Draft
Environmental Impact Report

Dutch Slough Tidal Marsh Restoration Project

SCH# 2006042009

November 2008

Prepared for the
California Department of Water Resources
and the California State Coastal Conservancy

DRAFT ENVIRONMENTAL IMPACT REPORT: DUTCH SLOUGH TIDAL MARSH RESTORATION PROJECT

November 2008

SCH # 2006042009

Prepared for:

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EXECUTIVE SUMMARY

OVERVIEW OF THE PROJECT AND DRAFT EIR

This Draft Environmental Impact Report (Draft EIR) addresses the potential environmental impacts of the Dutch Slough Tidal Marsh Restoration Project (hereinafter called Dutch Slough Restoration Project) near Oakley in Eastern Contra Costa County (See Figures 2-1 and 2-2). The proposed project entails wetland and upland restoration and public access to the 1,166-acre Dutch Slough property owned by the California Department of Water Resources (DWR). The property is comprised of three parcels separated by narrow man-made sloughs. Currently each parcel is leased for agricultural uses and grazing.

Tidal marsh restoration is seen by most Delta planning efforts (Delta Vision, Bay Delta Conservation Plan, CALFED Ecosystem Restoration Plan) as a critical component of improving the Delta ecosystem, and the primary goal of the Dutch Slough Tidal Marsh Restoration Project is to provide ecosystem benefits, including habitat for sensitive aquatic species. The project will be designed and implemented to maximize opportunities to assess the development of those habitats and measure ecosystem responses so that future Delta restoration projects will be more successful.

Two neighboring projects proposed by other agencies that are related to the Dutch Slough Restoration Project are also evaluated in concept in this Draft EIR (hereinafter called Related Projects). The City of Oakley is proposing a Community Park and Public Access Conceptual Master Plan (hereinafter referred to as 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 (See Figures 2-15 through 2-17). The City Community Park will provide parking and trailheads for the public access components of the Dutch Slough Restoration Project. The Ironhouse Sanitary District (ISD) is proposing the West Marsh Creek Delta Restoration Project (hereinafter called 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 ISD (See Figure 2-14). The Ironhouse Project could provide fill material for, and be linked to, the Dutch Slough Restoration lands.

This Draft EIR considers some of the environmental effects of the two Related Projects along with the effects of the Dutch Slough Restoration Project and its alternatives, and identifies overlapping and cumulative effects of the three projects. Although this Draft EIR provides some environmental analyses of the City Community Park and Ironhouse Project, subsequent California Environmental Quality Act (CEQA) review may be required for the Related Projects by their respective lead agencies (City of Oakley and ISD).

The proposed Dutch Slough Restoration Project is being planned by the Dutch Slough Management Team, which includes representatives from DWR, the California State Coastal Conservancy (SCC), the City of Oakley, and the California Bay-Delta Authority (CBDA). DWR is the landowner, having purchased the site in 2003 with funds from CBDA and the SCC, and is the CEQA lead agency for the restoration project. The SCC is assisting in the restoration planning with the Natural Heritage Institute (NHI). The City of Oakley is the lead agency for the City Community Park Project. The Ironhouse Sanitary District (ISD), along with NHI, is planning the restoration of the ISD parcel. The ISD is the CEQA lead agency for the Ironhouse Project.

PROJECT PURPOSE AND NEED

The Dutch Slough Restoration Project

The proposed 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; and,
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.

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

Related Projects

City of Oakley Community Park Project

The City of Oakley's proposed Community Park and Public Access Conceptual Master Plan is intended to provide shoreline access and educational and recreational opportunities for the community. Only the first phase of this Plan is evaluated in detail in this document. The City has the following goals for Plan implementation:

1. Provide and expand public access that is safe and consistent with the ecological and research goals of the project.
2. Create educational opportunities compatible with wildlife, habitat, and research goals.
3. Create recreational opportunities compatible with wildlife, habitat, and research goals.

Ironhouse Project

The Ironhouse Project would be 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.

The Ironhouse Project goals (developed by the 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 mile of channel);
3. Restore a large area of higher elevation tidal marsh (mean tide level, MTL) west of Marsh Creek that is comparable to tidal marsh treatments on the Dutch Slough property;
4. Provide up to 500,000 – 600,000 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.

DUTCH SLOUGH RESTORATION PROJECT ALTERNATIVES

This Draft EIR analyzes a range of restoration alternatives to meet the habitat restoration, research and recreation goals of the Dutch Slough Restoration Project, with consideration of economic feasibility and public safety. The restoration alternatives were developed to provide both sustainable ecosystem restoration benefits and adaptive management experiments. These alternatives apply only to the Dutch Slough Restoration Project and not the Related Projects.

The alternatives are:

- Alternative 1: Low marsh and open water emphasis with minimal grading (Minimum Fill Alternative)
- Alternative 2: Mix of mid marsh, low marsh, and open water with moderate fill (Moderate Fill Alternative)
- Alternative 3: Mid marsh and low marsh emphasis with imported fill (Maximum Fill Alternative)
- Alternative 4: No Project: This alternative addresses leaving the site in current uses, consistent with existing City of Oakley (Open Space) general plan and zoning designations.

Some of the Alternatives include implementation options, which are also addressed in this document. In Alternatives 2 and 3, Marsh Creek may (or may not) be diverted onto the project site (or Ironhouse Project site) to restore a natural delta at the mouth of the creek. In addition, under Alternatives 1, 2, and 3, several management options are considered for the proposed open water areas. Also considered is the option to retain the Burroughs parcel as upland habitat (the "No Burroughs" option). The three restoration alternatives are consistent with providing high quality public access and restoration opportunities, and provide for protection of existing infrastructure.

This Draft EIR identifies the potential impacts and mitigation measures for each of the Dutch Slough Restoration Project alternatives and options, along with some of the potential impacts of implementing the Related Projects (City's Community Park, and Ironhouse Project).

The project is designed to adapt to anticipated Global Climate Change, including sea level rise, and to mitigate for its own greenhouse gas emissions. Issues related to Global Climate Change are discussed in detail in a number of sections of this Draft EIR.

PURPOSE AND USE OF THIS DRAFT EIR

The Draft EIR was prepared in compliance with CEQA and the CEQA Guidelines, as amended. Because the document may be adapted, augmented, or otherwise used by the US Army Corps of Engineers, Natural Resources Conservation Service, US Fish and Wildlife Service, or other federal agencies, in support of their documentation in compliance with the National Environmental Policy Act (NEPA), it addresses alternatives at an equal level, as required under NEPA. This document does not, however, include NEPA-mandated environmental justice and socioeconomic analyses. DWR, as the lead agency under CEQA, has the responsibility for the scope, content, and legal adequacy of the document.

This document is a project-level Draft EIR for the Dutch Slough Restoration Project and, in addition, assesses the potential impacts of the City's Community Park and the Ironhouse Project at a conceptual level.

DWR will use this document to evaluate the Dutch Slough Restoration Project for approval. The City of Oakley may use it in the approval of the first phase of the City's Community Park project. In addition, the ISD may use this Draft EIR in the approval process of the Ironhouse Project. These two Related Projects may require additional project-level CEQA analysis, to be conducted by their respective lead agencies upon development of more detailed implementation plans.

PUBLIC INVOLVEMENT PROCESS

The Dutch Slough Restoration Committee held four public meetings beginning in 2003 and through 2006 to solicit input from concerned agencies, individuals, and interested partners, and provide/exchange information with these various parties in the development of the restoration plan. Similarly, during the fall and summer of 2005, the City of Oakley held a series of workshops and meetings to solicit public input on the park design. The Dutch Slough Management Team held a CEQA Scoping Meeting on April 5, 2006 to solicit input on the Draft EIR scope of work. That meeting was preceded by distribution of a CEQA Notice of Preparation (of the Draft EIR) on March 24, 2006.

ENVIRONMENTAL IMPACTS, AND MITIGATION MEASURES

The environmental impacts of the Dutch Slough Restoration Project alternatives are summarized on Table S-1 and are briefly described by topic below. Impacts that apply only to the Related Projects are addressed in the Draft EIR text but not shown in this summary table.

Hydrology and Geomorphology

Alternatives 1, 2, and 3, as well as the Related Projects, would have potential impacts of erosion in terminal sloughs due to increased tidal prisms, possible decreased flood flow conveyance of Marsh Creek, possible changes in groundwater levels due to groundwater seepage, potential levee overtopping into the Contra Costa Canal, and sedimentation issues. Alternatives 1-3 also could result in possible groundwater seepage into the Canal. Most geomorphic and hydrologic impacts would be less than significant or would be mitigated to less than significant levels by implementation of mitigation measures identified in this Draft EIR. The project would be designed such that planned levees and deposition of plant materials and sediments would partially reduce/offset the effects of anticipated sea level rise, however this impact may still be significant.

Water Quality

Alternatives 1, 2, and 3, as well as the Related Projects, would have potential short-term impacts of degradation of water quality due to potential release of contaminants and sediment from construction activities, degradation of water quality due to increased mercury and dissolved organic carbon in Delta waters (as would Alternative 4), increased erosion and turbidity, possible increased salinity in the Contra Costa Canal (if not encased), and possible degradation of water quality from other pollutant sources associated with fill materials and Marsh Creek flows. Water quality impacts would be mitigated to less than significant levels by implementation of mitigation measures identified in this Draft EIR. In addition, Alternatives 1, 2 and 3 would have long-term beneficial effects on water quality both within the project area and the surrounding water bodies.

Geology and Soils

Alternatives 1, 2, and 3, as well as the Related Projects, would have potential impacts of exposing people or structures to potential substantial adverse effects (including liquefaction and levee failure) resulting from strong seismic ground shaking, erosion of soil, seepage-induced levee failure, and, on the park parcel, construction hazards associated with expansive soils. Alternative 4 would continue to subject existing structures to seismic hazards, as well as potential levee failure from seepage or overtopping. All short-term geological and soils impacts would be less than significant or would be mitigated to less than significant levels by implementation of mitigation measures identified in this Draft EIR. In addition, through construction or reconstruction of levees surrounding the site to increase their resistance to seismic shaking and liquefaction, Alternatives 1, 2, and 3 would provide additional flood control benefits to the surrounding lands.

Biological Resources: Terrestrial and Wetlands

While the implementation of Alternatives 1, 2, and 3, as well as the Related Projects, would provide significant habitat benefits by creating tidal marsh and other habitats, they would also have potentially significant impacts to wildlife by disturbing or eliminating existing freshwater marsh and seasonal wetland habitats, plus terrestrial habitats including riparian woodland/scrub, alkali meadow, as well as short-term impacts to a number of individual sensitive species. Impacts to biological resources with the exception of the potential for significant unavoidable impacts to burrowing owls, would be less than significant or would be mitigated to less than significant levels by implementation of mitigation measures identified in this Draft EIR, as summarized in Table S-1, below. If the "no Burroughs" option were exercised, and the Burroughs parcel was not restored to tidal action, impacts to terrestrial and wetland habitats and their associated species would be decreased. Alternative 4 would eliminate the habitat loss associated with project construction, but as described in the Comparison of Alternatives below "no action" would eliminate the project's anticipated significant long-term benefits to fish and wildlife.

Biological Resources: Aquatic Resources

Alternatives 1, 2, and 3 would have long-term beneficial effects on aquatic resources both within the project site and in surrounding waters. However, Alternatives 1, 2, and 3, as well as the Ironhouse Project, could have impacts to fish resulting from decreased water quality, creation of habitat for non-native fishes, entrainment of fish, and levee repair activities. Alternative 4 also would have possible impacts to fish associated with entrainment and levee repair. Most project impacts would be less than significant or would be mitigated to less than significant levels by implementation of mitigation measures identified in this Draft EIR. There may be significant unavoidable impacts to aquatic resources related to the potential introduction of non-native fish, summarized in Table S-1, below.

Air Quality

Alternatives 1, 2, and 3, as well as the Related Projects, would have potential short-term impacts from construction emissions, which would be mitigated to less than significant levels by implementation of mitigation measures identified in this Draft EIR. Vehicular emissions of all alternatives would be less than significant. Alternative 4 would have no air quality impacts. In the long-term, the project would reduce dust emissions associated with agricultural uses of the site. Alternatives 1, 2, and 3, would emit greenhouse gases during construction, however, in the long term, the project is expected to sequester carbon, resulting in a net reduction in greenhouse gases from the site. Alternative 4 would not change greenhouse gas emissions from the site.

Noise

Alternatives 1, 2, and 3, as well as the Related Projects, would have potential short-term construction noise impacts that would be less than significant. In addition, potentially significant noise impacts from the proposed park and associated ball fields would occur, but this would be mitigable (mitigation would be developed in subsequent City CEQA analysis of the park). Alternative 4 would have no noise impacts.

Aesthetics

Alternatives 1, 2, and 3, as well as the Ironhouse Project, would not affect light and glare. The City's Community Park could adversely affect light and glare; these impacts would be mitigated to less than significant levels by implementation of mitigation measures identified in this Draft EIR. Other aesthetic issues would be less than significant or cause no impact. Alternative 4 would have no aesthetic impacts.

Land Use

Alternatives 1, 2, and 3, as well as the Related Projects, are not expected to conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project. Alternatives 1, 2 and 3 would not affect other land use issues, such as physically dividing an established community. Because the existing zoning is Open Space, Alternative 4 would not result in any near-term development of the site. However, if the site were not used for restoration/park purposes, it could eventually be subject to development pressures.

Agricultural Resources

Alternatives 1, 2, and 3, as well as the Related Projects, would not conflict with a Williamson Act (agricultural land preservation) contract. There would be a less-than significant conversion related to agricultural resources, based on compliance with agricultural policies contained in the City of Oakley General Plan. Alternative 4 would not result in the conversion of any agricultural lands, however, in the long term it is possible that the site would be subject to development pressures or inundation.

Recreation

Alternatives 1, 2, and 3, as well as the Related Projects, would have the potential to impact long-term changes in recreational opportunities and could generate conflicts between non-motorized watercraft and motorized watercraft. Recreational impacts would be less than significant or would be mitigated to less than significant levels by implementation of mitigation measures identified in this Draft EIR. Alternative 4 would not result in any possible recreation impacts, but would not provide the recreation benefits that would be afforded by the proposed access plan and city park.

Cultural Resources

Alternative 1, 2, and 3, together with the City Community Park Project, would result in significant unavoidable impacts related to loss of historic buildings and landscapes, as summarized in Table S-1, below. Alternatives 1, 2, and 3 also could impact unknown archaeological resources, which would be mitigated to less than significant levels by implementation of mitigation measures identified in this Draft EIR. Alternative 4 would not result in any direct impact to historic resources, however historic structures on the site may continue to deteriorate.

Transportation/Traffic

Alternatives 1, 2, and 3, as well as the Related Projects, would have the potential to generate construction-related, operational traffic, and other traffic issues, which would be less than significant. Alternative 4 would not result in any traffic generation or parking impacts.

Public Services, Utilities, and Service Systems

For Alternatives 1, 2, and 3, as well as the Related Projects, the potential impact to police protection, fire protection, water supply, wastewater, storm drainage, and electrical and gas transmission would be less than significant or mitigated to less than significant. Alternative 4 would not have any impacts to services or utilities.

Hazards and Hazardous Materials

For Alternatives 1, 2, and 3, as well as the Related Projects, the potential effects of soils contamination and building demolition would be mitigated to less than significant levels by implementation of mitigation measures identified in this Draft EIR. Alternative 4 would not result in any new hazardous materials on the site, nor would it eliminate any existing, hazardous materials.

Cumulative Impacts

The Dutch Slough Restoration Project, Related Projects, and other proposed or approved projects in the area, could result in short- or long-term cumulative impacts to hydrology and geomorphology, water quality, geology and soils, air quality, noise, aesthetics, land use, recreation, transportation/traffic, public services, utilities and service systems, and hazardous materials. However, all of these cumulative impacts would be less than significant or less than significant after mitigation.

The Dutch Slough Restoration Project, Related Projects, and other proposed or approved projects in the area would contribute to significant cumulative impacts on terrestrial and wetland biological resources, and on the Dutch Slough Rural Historic Landscape. Mitigation would reduce the project's contribution to these impacts, however they would still be significant. The projects also would result in cumulative benefits associated with provision of habitat for aquatic resources as well as recreation.

SIGNIFICANT UNAVOIDABLE IMPACTS

Significant unavoidable impacts under Alternatives 1, 2, or 3 include:

- Impacts to burrowing owls if they are present in the project area
- Creation of habitat that benefits non-native fish species
- Demolition of historic buildings/landscape features

COMPARISON OF ALTERNATIVES

CEQA Guidelines (Section 15126.6(a) and (e)(2)) require that a Draft EIR's analysis of alternatives identify the "environmentally superior alternative" among all of those considered. In addition, if the No Project Alternative is identified as environmentally superior, then the Draft EIR also must identify the environmentally superior alternative among the other alternatives. The primary adverse impacts of the Project are related to loss of agricultural lands, loss of historic landscapes, and degradation of hydrologic, water quality and biological resources. However, the Project also would provide substantial wetland/aquatic habitat and public access opportunities that would not be provided by Alternative 4 (No Project). Alternative 4 also would not provide enhanced flood protection nor would it protect the site from impacts of possible future development. Because

Alternative 4 would eliminate some of the potential adverse impacts associated with project development, it is considered the Environmentally Superior Alternative.

As required by CEQA, the other project alternatives were analyzed to determine which would be the Environmentally Superior Alternative. Alternative 1 could have somewhat less environmental impacts than Alternatives 2 and 3. Therefore this EIR considers the CEQA Environmentally Superior Alternative to be Alternative 1. It should be noted, however, that even this alternative and despite mitigation, would result in some significant adverse impacts, as with Alternatives 2 and 3. In addition, Alternative 1 would result in fewer long-term benefits of providing restored wetland habitat than Alternatives 2 or 3, and would not fully satisfy the restoration project's objectives.

Table S-1 Comparison of Impacts of Dutch Slough Restoration Project Alternatives

Impact Number	Impact	**Alternative 1:** Minimum Fill	**Alternative 2:** Moderate Fill/Preferred Alternative	**Alternative 3:** Maximum Fill Alternative	**Alternative 4:** No Project
Hydrology and Geomorphology					
3.1.1-1/2-1/3-1/4-1	Erosion in terminal sloughs due to increased tidal prisms	◑	◑	◑	○
3.1.1-5/2-7/3-7/4-2	Possible water quality degradation in Contra Costa Canal due to groundwater seepage	◑	◑	◑	○
3.1.1-6/2-8/3-8	Groundwater intrusion onto adjacent parcels	◑	◑	◑	○
3.1.1-7/2-9/3-9	Wind-wave driven levee overtopping of southern uplands into Contra Costa Canal	◑	◑	◑	○
3.1.1-8/2-10/3-10	Insufficient sedimentation in new wetland basin to keep up with Sea-level rise	?	?	?	○
3.1.1-9/2-11/3-11	Limited persistence of shallow tidal marsh channels	◑	◑	◑	○

KEY:

● = Significant and not mitigable impact ◑ = Significant and mitigable impact ⦶ = Less than significant impact ○ = No impact + = Beneficial impact

? = unknown/speculative

Note: Impact levels are the same for all Alternatives unless otherwise noted.

Table S-1 Comparison of Impacts of Dutch Slough Restoration Project Alternatives

Impact Number	Impact	**Alternative 1:** Minimum Fill	**Alternative 2:** Moderate Fill/Preferred Alternative	**Alternative 3:** Maximum Fill Alternative	**Alternative 4:** No Project
3.1.2-3/3-3	Point bar formation in Marsh Creek	○	◑	◑	○
3.1.2-4/3-4	Sedimentation in tidal portion of relocated Marsh Creek channel	○	◑	◑	○
3.1.5-1	Cumulative Impact - Groundwater seepage into the C. C. Canal	○	○	○	○
3.1.5-2	Cumulative Impact – Groundwater seepage into Cypress Grove and Dutch Slough properties	○	○	○	○
3.1.5-3	Cumulative Impact – Groundwater seepage and tidal flooding east into Hotchkiss Tract	⦶	⦶	⦶	○
3.1.5-4	Cumulative Impact – Tidal flooding south into Cypress Grove and Dutch Slough properties	◑	◑	◑	○
3.1.5-5	Cumulative Impact – Excess Scour in Emerson Slough	⦶	⦶	⦶	○

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Impact Number	Impact	**Alternative 1:** Minimum Fill	**Alternative 2:** Moderate Fill/Preferred Alternative	**Alternative 3:** Maximum Fill Alternative	**Alternative 4:** No Project
3.1.5-6	Cumulative Impact – Excess scour in Little Dutch Slough	⦶	⦶	⦶	○
Water Quality					
3.2.1-1/2-1/3-1/4-1	Degradation of water quality due to release of contaminants and sediment from construction activities	◑	◑	◑	⦶
3.2.1-2/2-2/3-2	Degradation of water quality due to increased dissolved organic carbon (DOC) in Delta waters	◑	◑	◑	◑
3.2.1-3/2-3/3-3	Degradation of water quality due to increased erosion and turbidity after construction	◑	◑	◑	○
3.2.1-4/2-4/3-4	Degradation of water quality due to increased mercury methylation	◑	◑	◑	○

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Impact Number	Impact	Alternative 1: Minimum Fill	Alternative 2: Moderate Fill/Preferred Alternative	Alternative 3: Maximum Fill Alternative	Alternative 4: No Project
3.2.1-5/2-5/3-5	Degradation of drinking water quality due to alteration of salinity levels in Delta waters	⦶	⦶	⦶	○
3.2.1-6/2-6/3-6	Degradation of water quality due to increased salinity concentrations in the Contra Costa Canal	◑	◑	◑	○
3.2.1-7/2-7/3-7	Degradation of water quality due to elevated metals, endocrine disrupting chemicals, or other pollutants	◑	◑	◑	○
3.2.1-8/2-8/3-8	Cumulative Impacts	◑	◑	◑	○
Geology and Soils					
3.3.1-1/2-1/3-1/4-1	Expose people or structures to potential substantial adverse effects (including levee failure) resulting from a surface rupture of a known earthquake fault	○	○	○	○

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3.3.1-2/2-2/3-2/4-2	Expose people or structures to potential substantial adverse effects (including levee failure) resulting from strong seismic ground shaking	◑	◑	◑	⦶
3.3.1-3/2-3/3-3/4-3	Expose people or structures to potential substantial adverse effects (including levee failure) resulting from ground failure, including liquefaction	◑	◑	◑	◑
3.3.1-4/2-4/3-4/4-4	Expose people or structures to potential substantial adverse effects resulting from landslides	○	○	○	○
3.3.1-5/2-5/3-5/4-5	Substantial soil erosion or loss of topsoil	◑	◑	◑	⦶
3.3.1-6/2-6/3-6/4-6	Landslide, lateral spreading, subsidence, liquefaction, or collapse resulting from construction on an unstable geological unit or unstable soils	◑	◑	◑	◑
3.3.1-7/2-7/3-7/4-7	Risk to life or property resulting from construction of structures on expansive soils	◑	◑	◑	◑
3.3.1-8/2-8/3-8/4-8	Levee failure resulting from erosion	◑	◑	◑	◑

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3.3.1-9/2-9/3-9/4-9	Levee failure resulting from seepage	◑	◑	◑	◑
Biological Resources: Terrestrial and Wetlands					
3.4.1-1.1/2-1.1/3-1.1	Potential impacts to wildlife in irrigated pasture and ruderal terrestrial habitats	◑	◑	◑	○
3.4.1-1.2/2-1.2/3-1.2	Potential wildlife disturbance (direct and indirect) on terrestrial habitats associated with recreation	◑	◑	◑	○
3.4.1-2.1/2-2.1/3-2.1	Potential impacts of dredging Little Dutch and Emerson sloughs	◑	◑	◑	○
3.4.1-2.2/2-2.2/3-2.2	Potential wildlife disturbance (direct and indirect) around the marsh edge associated with recreation	◑	◑	◑	○
3.4.1-2.3/2-2.3/3-2.3	Potential wildlife disturbance (direct and indirect) associated with maintenance of exterior levee	◑	◑	◑	○
3.4.1-3/2-3/3-3	Potential impacts to nontidal freshwater marsh and riparian woodland/scrub and associated wildlife species	◑	◑	◑	○
3.4.1-4/2-4/3-4	Potential impacts to alkali meadow and seasonal wetland flats and	◑	◑	◑	○

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	associated wildlife species				
3.4.1-5.1/2-5.1/3-5.1	Potential impacts to special-status plants	◑	◑	◑	○
3.4.1-5.2/2-5.2/3-5.2	Impacts to special-status tidal marsh plants of dredging Little Dutch and Emerson sloughs	◑	◑	◑	○
3.4.1-6/2-6/3-6	Potential loss of roosting sites for special-status bat species	◑	◑	◑	○
3.4.1-7/2-7/3-7	Potential impacts to Cooper's hawk	◑	◑	◑	○
3.4.1-8/2-8/3-8	Potential loss of Swainson's hawk foraging and nesting habitat	◑	◑	◑	○
3.4.1-9/2-9/3-9	Potential Impacts to burrowing owls	● (if present onsite)	● (if present onsite)	● (if present onsite)	○
3.4.1-10/2-10/3-10	Potential Impacts to white-tailed kite and northern harrier	◑	◑	◑	○
3.4.1-11/2-11/3-11	Potential impacts to nesting birds	◑	◑	◑	○

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3.4.1-12/2-12/3-12	Potential impacts to tricolored blackbirds	◑	◑	◑	○
3.4.1-13/2-13/3-13	Potential impacts to California horned larks	◑	◑	◑	○
3.4.1-14/2-14/3-14	Potential impacts to loggerhead shrikes	◑	◑	◑	○
3.4.1-15/2-15/3-15	Potential impacts to yellow-breasted chats and other marsh and riparian songbirds	◑	◑	◑	○
3.4.1-16/2-16/3-16	Potential impacts to special-status wading birds	◑	◑	◑	○
3.4.1-17/2-17/3-17	Potential impacts to California black rails	◑	◑	◑	○
3.4.1-18/2-18/3-18	Potential impacts to California tiger salamanders	◑	◑	◑	○
3.4.1-19/2-19/3-19	Potential impacts to California Red-legged frogs	◑	◑	◑	○
3.4.1-20/2-20/3-20	Potential impacts to northwestern pond turtles	◑	◑	◑	○
3.4.1-21/2-21/3-21	Potential impacts to giant garter snakes	◑	◑	◑	○
3.4.1-22/2-22/3-22	Potential impacts to silvery legless lizards	◑	◑	◑	○

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? = unknown/speculative

Note: Impact levels are the same for all Alternatives unless otherwise noted.

3.4.1-23/2-23/3-23	Potential impacts to vernal pool fairy shrimp and other special status vernal pool invertebrates	◑	◑	◑	○
3.4.1-24/2-24/3-24	Potential impacts to valley elderberry longhorn beetles	◑	◑	◑	○
3.4.1-25/2-25/3-25	Potential impacts to Heritage or other trees protected by local ordinance	◑	◑	◑	○
Biological Resources: Aquatic Resources					
3.5.1-1/2-1/3-1	Decreased water quality due to construction/dredging activities	◑	◑	◑	○
3.5.1-2/2-2/3-2	Release of low quality water from project area during pre-breach water management periods	◑	◑	◑	○
3.5.1-3/2-3/3-3/4-2	Entrainment of fish into areas disconnected from the Bay-Delta	◑	◑	◑	◑
3.5.1-4/2-4/3-4	Potential mercury methylation could cause bioaccumulation and toxicity to fish	◑	◑	◑	○
3.5.1-5/2-5/3-5	Disturbance of benthic habitats	⦶	⦶	⦶	○

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3.5.1-6/2-6/3-6	Creation of habitat that benefits non-native fish species	●	●	●	○
3.5.1-7/2-7/3-7	Endocrine disrupting chemicals and other contaminants entering the site from Marsh Creek or from fill soils could harm fish	◑	◑	◑	○
3.5.1-8/2-8/3-8	Cumulative Impacts	◑	◑	◑	○
3.5.4-1	Reduced water quality due to levee repair activities	○	○	○	◑
3.5.4-2	Entrainment of fish inside the project site through unintended levee breaches or overtopping	○	○	○	◑
Air Quality					
3.6.1-1/2-1/3-1	Vehicular emissions	⦶	⦶	⦶	○
3.6.1-2/2-2/3-2	Construction emissions	◑	◑	◑	○
3.6.1-3/2-3/3-3	Greenhouse gasses	⦶	⦶	⦶	○

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Noise					
3.7.1-1/2-1/3-1	Construction noise impacts	⦶	⦶	◑	○
Aesthetics					
3.8.1-1/2-1/3-1/4-1	Effect on a scenic vista	○	○	○	○
3.8.1-2/2-2/3-2/4-2	Effect on a scenic resource	○	○	○	○
3.8.1-3/2-3/3-3/4-3	Effect on visual quality of the site and its surroundings	⦶	⦶	⦶	○
Land Use					
3.9.1-1/2-1/3-1	Physically divide an established community	○	○	○	○
3.9.1-2/2-2/3-2	Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project.	○	○	○	○
3.9.1-3/2-3/3-3	Conflict with any applicable habitat conservation plan or natural community conservation plan	○	○	○	○

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Agricultural Resources

3.10.1-1/2-1/3-1	Conversion of Prime/Unique Farmland or Farmland of Statewide Importance	⦶	⦶	⦶	○
3.10.1-2/2-2/3-2	Conflict a Williamson Act contract	○	○	○	○
3.10.1.3/2.3/3.3	Involve other changes in the existing environment, which, due to their location or nature, could result in conversion of farmland to non-agricultural use	○	○	○	○

Recreation

3.11.1-1/2-1/3-1	Conflicts between non-motorized watercraft and motorized watercraft	◐	◐	◐	○
3.11.1-2/2-2/3-2	Temporary effects on recreational access during project construction	⦶	⦶	⦶	○
3.11.1-3/2-3/3-3	Long-term changes in recreational opportunities	+	+	+	○

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Cultural Resources					
3.12.1-1/2-1/3-1	Loss of unknown archaeological resources	◑	◑	◑	○
3.12.1-2/2-2/3-2	Cumulative effect of demolition of historic buildings and landscape features	●	●	●	⦶
Transportation/Traffic					
3.13.1-1/2-1/3-1	Trip distribution and roadway capacity	⦶	⦶	⦶	○
3.13.1-2/2-2/3-2	Parking	⦶	⦶	⦶	○
3.13.1-3/2-3/3-3	Cumulative traffic considerations	⦶	⦶	⦶	○
Public Services, Utilities and Service Systems					
3.14.1-1/2-1/3-1	Effect on police protection	⦶	⦶	⦶	○
3.14.1-2/2-2/3-2	Effect on fire protection	⦶	⦶	⦶	○
3.14.1-3/2-3/3-3	Effect on water supply	⦶	⦶	⦶	○

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3.8.1-4/2-4/3-4	Effect on wastewater	⦶	⦶	⦶	○
3.14.1-5/2-5/3-5	Effect on storm drainage	⦶	⦶	⦶	○
3.14.1-6/2-6/3-6	Effect on electrical and gas transmission	⦶	⦶	⦶	○
Hazards and Hazardous Materials					
3.15.1-1/2-1/3-1	Effects of Dutch Slough parcel soils contamination	◑	◑	◑	○
3.15.1-2/2-2/3-2/4-2	Health risks associated with demolition activities	◑	◑	◑	○
3.15.1-3/2-3/3-3/4-3	Health effects to workers from use of soils from Ironhouse parcel	⦶	⦶	⦶	○
3.15.1-4/2-4/3-4/4-4	Health effects from mosquitoes	◑	◑	◑	○
3.15.4-1	Effects of existing contaminated soils	○	○	○	⦶

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Note: Impact levels are the same for all Alternatives unless otherwise noted.

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1 Introduction

1. INTRODUCTION

1.1 OVERVIEW OF THE PROJECT

This project-level Draft Environmental Impact Report (EIR) addresses the potential environmental impacts of a Department of Water Resources tidal wetlands restoration project in the Dutch Slough area at the mouth of Marsh Creek in Eastern Contra Costa County, and two related projects under the jurisdiction of other agencies.

The Dutch Slough Tidal Marsh Restoration Project (Dutch Slough Restoration Project) entails wetland and upland restoration and public access to the 1,166-acre Dutch Slough property owned by the California Department of Water Resources (DWR). The Dutch Slough Restoration Project seeks to restore habitat for native fishes and other aquatic and wetland species, improve our understanding of restoration science in tidal marsh wetland ecosystems in the region, and provide public access to the restored area. The two neighboring projects (proposed by other agencies) that are closely related to the Dutch Slough Restoration Project are: 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, owned by the Ironhouse Sanitary District (ISD). Subsequent CEQA review may be required for these two projects by their respective Lead Agencies.

The Dutch Slough Tidal Marsh Restoration Project (also referred to herein as the Dutch Slough Restoration Project) is being planned by the Dutch Slough Management Team, which includes DWR, the California State Coastal Conservancy (SCC), the City of Oakley, and the California Bay-Delta Authority (CBDA). DWR is the landowner, having purchased the site in 2003 with funds from CBDA and the SCC, and is the CEQA Lead Agency for the Dutch Slough Restoration Project. The SCC is assisting in the restoration planning with the Natural Heritage Institute (NHI).

1.2 PROJECT BACKGROUND AND HISTORY

1.2.1 Dutch Slough Restoration Project

For over a hundred years, the Dutch Slough property was used for grazing and dairy operations. During the past twenty years, eastern Contra Costa County has undergone a rapid urbanization. Beginning in the 1990s, the former landowners began securing approvals for the eventual development of the property. In 1997, Contra Costa County approved a development agreement for this property that would have allowed for the construction of 4,500-6,100 housing units on the site. When the City of Oakley incorporated in 1999, this property was within the city limits, and the City was required to accept the County's development agreement.

In the fall of 2001 the NHI and DWR identified this site as an important restoration opportunity and began working cooperatively with the landowners to obtain grant funding to acquire and restore the property. During 2002, the project partners worked to build local support for the project. In the fall of 2002, the California Bay Delta Authority's (CBDA) Ecosystem Restoration Program and the SCC's San Francisco Bay Area Program awarded grants to fund the acquisition. In the fall of 2003, DWR completed the purchase of the 1,166-acre restoration site.

In 2003-4, the DWR, SCC, and CBDA began working with other project partners to develop a restoration plan that achieves the goals and objectives of the project. A Restoration Committee was established to obtain input from and provide information to stakeholders and the public. The Restoration Committee included representatives from key public agencies and stakeholders, and the meetings were open to the public. At the same time, the Dutch Slough Adaptive Management Working Group (AMWG), comprised of nine scientists, was convened to identify key scientific questions, provide technical review, and help develop the project's adaptive management plan (see Appendix D)[1]. The CALFED Ecosystem Restoration Program Science Board also provided input into the plan concepts.

In February 2004, NHI released the "*Dutch Slough Tidal Marsh Restoration Project Preliminary Opportunities and Constraints Report*", which described the restoration potential for the site as well as infrastructure, land use conflict, and ecological constraints.

In 2004, a consultant team, led by Philip Williams & Associates (PWA) began development of restoration alternatives and conducted a feasibility analysis of those alternatives. The PWA team coordinated closely with the project management team and AMWG to develop a restoration plan to accomplish the project's goals. The AMWG and PWA consultant team developed a conceptual model of wetland restoration as the basis for recommending high priority experiments to test in the Dutch Slough Restoration Project. The recommended experiments span various marsh scales. Marsh scale (i.e., size of the marsh drainage area) is considered important to test to guide the selection of future restoration sites. Small sites are generally more available for restoration than large sites, but may not offer the same benefits on a per-acre basis (e.g., tidal channel complexity). The small-scale experiments require only small areas (one or two acres) and can be readily accommodated within any given restoration alternative. The large-scale experiments require areas on the order of hundreds of acres. The project identified tidal marshplain elevation and marsh scale for large-scale testing. Marshplain elevation is considered important to test because lower vegetated marshes require less fill, but the habitat value is less well understood than for higher, natural marshes.

In May 2006, the PWA team completed the Dutch Slough Tidal Marsh Restoration Conceptual Plan and Feasibility Report that identified a range of restoration alternatives to meet the habitat restoration and adaptive management goals, with consideration of economic feasibility. The restoration alternatives were developed to meet the goals of the project. The project goals are described in Section 2.4 of this Draft EIR.

The alternatives are:

- **Alternative 1:** Low marsh and open water emphasis with minimal grading (Minimum Fill - see Figure 2-7)

[1] The goal of the Dutch Slough Adaptive Management Plan (DSAMP) is to generate scientific information that can be used to guide future tidal marsh restoration projects elsewhere in the delta. The DSAMP will guide one of the project's primary goals. It is not part of, nor should it be confused with, the project's mitigation monitoring and reporting plan (MMRP).

- **Alternative 2:** Mix of mid marsh, low marsh, and open water with moderate fill (Moderate Fill/Alternative [Preferred Alternative] - see Figures 2-8 and 2-9)
- **Alternative 3:** Mid marsh and low marsh emphasis with imported fill (Maximum Fill Alternative see Figure 2-8)
- **Alternative 4:** No Project Alternative: This alternative addresses leaving the site in current uses, consistent with existing City of Oakley (Open Space) general plan and zoning designations.

In Alternatives 1-3, there are two potential options: restore tidal action to all three parcels, or restore tidal action to only the Emerson and Gilbert parcels and retain existing terrestrial and wetland habitats on the Burroughs parcel ("No Burroughs" option).

In Alternatives 2 and 3, Marsh Creek may be diverted onto the project site at one of three locations to restore a natural delta at the mouth of the creek. In addition, a number of possible management options are considered for the open water areas under Alternatives 1, 2 and 3. All three restoration alternatives are consistent with providing high-quality public access and restoration opportunities and provide for protection of existing infrastructure. The three alternatives identified in the Feasibility Report represent different mixes of habitat, with different amounts of grading and imported fill to create these habitats. Additional restoration approaches and preliminary alternatives were considered and not recommended because they do not meet the project goals (see Section 2.4, in Project Description).

This Draft EIR addresses each of the "build" alternatives for the Dutch Slough Restoration Project in conjunction with the City Community Park Project and the Ironhouse Project, as well as a "No-Project" alternative. This Draft EIR also addresses several options with respect to open water management and the possible diversion of Marsh Creek onto the DWR and/or ISD properties. These are described in detail in Chapter 2, Project Description.

1.2.2 Related Projects

This Draft EIR discusses two related projects, the ISD's proposed Ironhouse Project, and the first phase of the City Community Park Project (Interim Improvements). Later phases of the City's park are not fully funded and are only generally addressed in this document. 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 for 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 facilities are required for the Dutch Slough Restoration Project to meet its recreational and public access goals. These related projects are summarized below.

City of Oakley's Community Park and Public Access Conceptual Master Plan (City Community Park Project)

Concurrent with the development of the restoration alternatives, the Conservancy and CBDA awarded funds to the City of Oakley to develop a public access master plan for the Dutch Slough Restoration Site and the adjacent community park site that is consistent with the restoration alternatives. The City worked with DWR and SCC to develop the Dutch Slough Community Park and Public Access Conceptual Master Plan. The purpose of the master plan is to present an overall vision for public access to the site and park use on the City's 55-acre parcel. 2M Associates was contracted by the City in March 2005 to develop the conceptual park and public access plan. Several public meetings were held by the City in which possible park plans were presented for public input. In February 2006, 2M Associates completed the draft Dutch Slough Community Park and Public Access Conceptual Master Plan for the City. An addendum to that Plan that refined and developed some facilities siting options and identified interim development plans for the park was submitted to the City in September 2006. The City Community Park Project is discussed at a conceptual level in this Draft EIR.

Ironhouse Restoration Project

In 2005, the project management team became aware of an opportunity to work with the Ironhouse Sanitary District (ISD) to restore a 100-acre parcel immediately west of the Dutch Slough Restoration Project site, on land owned by ISD. The PWA Feasibility Report was expanded to include a conceptual restoration plan option for that site. That conceptual restoration plan is shown in Figure 2-14 in Chapter 2, and is discussed at a conceptual level in this Draft EIR.

1.3 EIR APPROACH AND ASSUMPTIONS

The Draft EIR evaluates the potential impacts of the Dutch Slough Restoration Project in detail, and describes, at a conceptual level suitable for identifying cumulative effects, the impacts of the two related projects proposed by the City of Oakley and ISD. The Dutch Slough Restoration Project includes three "build' alternatives (i.e., restoration) and a "no project" alternative as well as a number of management options for the open-water portion of that project, four possible options for relocating the mouth of Marsh Creek on the Dutch Slough Restoration Project and/or Ironhouse Project sites, and a "no Burroughs" option to restore tidal action to only the Emerson and Gilbert parcels.

In order to facilitate the CEQA analysis and provide a framework for comparing project alternatives and options, this Draft EIR makes a number of assumptions regarding which options are considered a part of the project and which are possible options to that project. The impact assessments of each of the three restoration alternatives assessed in this Draft EIR assume the following scenarios:

- No relocation of Marsh Creek
- Shallow subtidal management of the Dutch Slough Restoration Project's open water areas

Brief discussions of the potential environmental impacts of each of the other open water management options and Marsh Creek outfall relocation options are included following the analysis of the primary scenario for each alternative. Tables are used to summarize and facilitate identification of the different impacts of each alternative and option. This approach allows the lead agencies to combine the basic alternatives with these different open-water management and Marsh Creek outfall relocation options in their ultimate project approval actions.

Further, because many of the impacts of the two "related projects" are similar to those of the Dutch Slough Restoration Project, the impact assessments of each of the Dutch Slough restoration Project Alternatives also consider the following:

- Implementation of the Ironhouse Project by the ISD
- Implementation of City Community Park Project by the City of Oakley.

Tables are provided to call out which specific impacts and mitigation measures would apply to the Dutch Slough Restoration Project, options to that project, and the two "related projects" addressed in this EIR. This is intended to facilitate the lead and responsible agencies in making their requisite CEQA findings for projects within their respective jurisdictions.

This Draft EIR also addresses the cumulative effects of other reasonably foreseeable planned development, including the adjacent Dutch Slough Properties residential project, the East Cypress Corridor residential projects, and the nearby eight-acre Dutch Slough Access Park proposed by the City of Oakley, among other projects.

1.4 PURPOSE AND USE OF THIS EIR

This Draft EIR has been prepared in compliance with the California Environmental Quality Act (CEQA) and the CEQA Guidelines, as amended. Because the document may be adapted or otherwise used by the US Army Corps of Engineers, Natural Resources Conservation Service, US Fish and Wildlife Service, or other federal agencies, in support of their documentation in compliance with the National Environmental Policy Act (NEPA), it will be formatted to address all alternatives at an equal level, as required under NEPA. The California Department of Water Resources (DWR) is the lead agency under CEQA. In accordance with CEQA, the lead agency has the responsibility for the scope, content, and legal adequacy of the document. Approval and permitting requirements for the various project components are described in detail in each technical section, and summarized at the end of the Project description chapter.

This document is a project-level Draft EIR for the Dutch Slough Restoration Project, and also addresses, at a conceptual level, the associated and overlapping effects of the related City Community Park Project and the Ironhouse Project. For example, some or all of the fill required to construct Alternatives 2 and 3 may come from the Ironhouse Parcel. Similarly, the City Park site would provide staging facilities and public access to the Dutch Slough parcels. The City also would maintain the levee trails on the Dutch Slough Restoration Project. To the extent that these components of the related projects would be developed as part of the Dutch Slough Restoration Project, they are considered at a project level in this EIR. Other effects of the related projects are considered at a conceptual level suitable for analysis of their contribution to cumulative impacts. As discussed below, the City and ISD may adopt the Final EIR for their projects and/or require additional CEQA review, at their discretion as CEQA Lead Agencies for those projects.

Provided the environmental impacts of future activities are adequately addressed in this document, additional CEQA documentation would not be required for the Dutch Slough Restoration Project. If additional environmental analysis is required for future activities and newly identified impacts, or to introduce new mitigation measures, subsequent environmental documents would be addressed in an Addendum or Supplement to the Final EIR for this project.

Under CEQA, a responsible agency is an agency other than the lead agency that has a legal responsibility for carrying out or approving a project or elements of a project (Public Resource Code [PRC] Section 21069). Responsible agencies are encouraged to actively participate in the CEQA process of the lead agency, review the CEQA documents of the lead agencies, and use the documents when making decisions on the project. Possible CEQA responsible agencies for components of this project include:

- California Air Resources Board
- California Department of Fish and Game, Bay-Delta Region
- Central Valley Regional Water Quality Control Board (Region 5)
- California Department of Toxic Substances Control
- CALFED Bay Delta Program
- State Water Resources Control Board
- State Historic Preservation Officer (SHPO)
- Bay Area Air Quality Management District
- City of Oakley
- Contra Costa County Flood Control District
- East Bay Regional Park District
- Reclamation Districts 799 and 2137
- State Lands Commission
- Delta Protection Commission

Specifically, the following State permits would be required:

- California Department of Fish and Game: Potential California Endangered Species Act consultation and issuance of Streambed Alteration Agreement (Fish and Game Code Section 1600).
- Central Valley Regional Water Quality Control Board (Region 5): National Pollutant Discharge Elimination System (NPDES) construction stormwater permit (Notice of Intent to proceed under General Construction Permit), and Section 401 Clean Water Act certification for waste discharge requirements.

In addition, local permits would be required for grading and levee encroachment/construction.

This EIR has been formatted to facilitate its incorporation into any NEPA documentation that may be required for the Project. Federal lead agencies and their permits for the project that may trigger NEPA review include:

- U.S. Army Corps of Engineers: Department of the Army Section 404 Clean Water Act permit would be required for discharge or fill of waters of the United States.
- National Marine Fisheries Service: Federal Endangered Species Act compliance would be required for anadromous fish species federally listed as threatened or endangered.
- U.S. Fish and Wildlife Service: Federal Endangered Species Act compliance would be required for resident fish and terrestrial species federally listed as threatened or endangered.
- California State Historic Preservation Office: Section 106 of the National Historic Preservation Act, as codified in 36 Code of Federal Regulations 800.4, requires federal

agencies to consult with the California State Historic Preservation Officer for resources that are eligible for listing as a historic resource.

- US Environmental Protection Agency: Oversight responsibility for federal Clean Water Act permits.

Other local, state and federal agencies that may have a non-permitting interest in the project include:

- National Resources Conservation Service
- Contra Costa Water District
- California Department of Conservation, Office of Agricultural Land Preservation

1.5 PUBLIC INVOLVEMENT PROCESS

The Dutch Slough Restoration Committee has held four public meetings from 2003 through 2006 to solicit input from concerned agencies, individuals, and interested partners, and provide/exchange information with these various parties in the development of the restoration project. Similarly, during the fall and summer of 2005, the City of Oakley held a series of workshops and meetings to solicit public input on the City Community Park design. A Notice of Preparation for this Draft EIR, accompanied by a Scoping Document summarizing issues to be assessed in the document, was distributed to the public and interested agencies on March 24, 2006 (See Appendix A). The Dutch Slough Management Team held a CEQA Scoping Meeting on April 5, 2006 to solicit input on the Draft EIR scope of work. That meeting was preceded by distribution of a CEQA Notice of Preparation (of the EIR), on March 24, 2006.

Comments presented at the Scoping Hearing included the following:

- Concerns over the possible effects of the project on Jersey Island levees. (Addressed in Section 3.1 of this EIR.)
- Issues associated with dogs and horses at the City Community Park. (Generally addressed in Section 3.11 of this EIR; to be addressed in detail in the City's subsequent project-level CEQA review of the park.)
- Issues associated with lighted ballfields at the City Community Park. (Generally addressed in this EIR; to be addressed in detail in the City's subsequent project-level CEQA review of the Community Park.)
- Issues associated with City's proposed boat ramp at Dutch Slough and Jersey Island Road bridge. (This separate 8-acre park is not part of the project; its impacts are generally addressed in Section 5.3, Cumulative Impacts, in this EIR.)
- Changes in flows/levels in Little Dutch Slough. (Addressed in this Section 3.1 of this EIR.)
- Changes in the potential for groundwater to enter the Contra Costa Canal. (Addressed in Section 3.1 of this EIR.)
- Request for integration of canal/restoration project interface. (Generally addressed in this Sections 3.1 and 3.4 of this EIR.)

- What will happen in Bureau of Reclamation's 300-foot right of way after Contra Costa Canal is encased? (This right of way is not part of this project – impacts are addressed in CCWD's April 2006 CEQA Initial Study on that project.)
- What shorebirds/waterfowl will benefit from this project? (Addressed in Section 3.4 of this EIR.)
- Concerns over project impacts to black rail and other sensitive bird species. (Addressed in Section 3.4 of this EIR.)
- What are the impacts of storm drains entering Dutch Slough? (Generally addressed in Section 3.2 in this EIR; see also EIRs on adjacent residential developments, which will be contributing most of the stormwater/contaminants to the Slough.)
- Phasing of the project. (Addressed in Chapter 2, Project Description.)
- Effects of flooding the Gilbert Parcel first on the Burroughs levee. (Not proposed in project assessed in the EIR.)
- Can open water areas be drained? (Only if the project has water control structures – see Project Description.)
- Concerns over loss of seasonal wetlands. Can seasonal wetlands be integrated into the project? (See Project Description and Section 3.4.)
- RD 799 requested that its levee at the northeast corner of the site be improved. (See Section 3.3.)
- Ironhouse Sanitary District requested analysis of project impacts to its recycled water line. (The line will be relocated as part of the project.)
- RD 830 concerned with potential for seepage to affect levees surrounding Jersey Island. (See Section 3.1.)

In addition to the above comments, comment letters in response to the Notice of Preparation were received from the following agencies, and are included in Appendix B of this EIR:

- US Bureau of Reclamation: Concerned with project impacts on Contra Costa Canal. (See Sections 3.1 and 3.2.)
- California Urban Water Agencies: Concerned with project's water quality impacts and consistency with ecosystem goals. (See Sections 3.2, 3.4, and 35)
- Contra Costa County Flood Control and Water Conservation District: Notes that the District owns Marsh Creek and that the project will require an encroachment permit from the District. Requests hydraulic assessment of project impacts on Marsh Creek Flood Control Channel upstream of project, as well as other flood control studies. Requests maintenance funding agreements for flood control channel. (See Section 3.1.)
- California Department of Transportation: Requests assessment of project impacts on State Highway system. (See Section 3.13.)

- Delta Protection Commission: Requests assessment of project compliance with Delta Protection Act policies. (See Section 3.9.)
- Department of Toxic Substances Control: Requests assessment of air, health, noise, and dust impacts. (See Sections 3.6, 3.7, and 3.15.)
- Reclamation District 799: Concerns with Jersey Island levees. (See Section 3.1.)
- Contra Costa Water District: Requests assumption of unlined CCWD canal (see Hydrology section); requests interim alternative with no assumption of full restoration until new pipeline is complete (See Hydrology section); requests avoidance of project impacts on canal or project funding of pipeline (see Hydrology section); states that Ironhouse Project assumes construction of wetlands on Bureau of Reclamation property and requests better integration of project and Contra Costa Canal piping project and assurance of continued maintenance access to the Canal. Since this comment was received CCWD has prepared an Initial Study, and the Bureau of Reclamation has prepared a Phase I Environmental Assessment (EA) for the District's proposal to encase the last 3.97 miles of the Contra Costa Canal from Rock Slough to Pumping Plant 1. Construction of the first Phase, consisting of approximately 2000 feet from Pumping Plant 1 to Marsh Creek, is anticipated to begin in 2008. (Information concerning the EA and Finding of No Significant Impact can be found at the Bureau of Reclamation, Department of Interior website :

  http://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=16721).
- Department of Fish and Game: Requests analyses of project impacts on watercourses and certain sensitive species. (See Sections 3.4 and 3.5.)
- Department of Conservation, Division of Land Resources Protection: Requests analysis of conversion of prime farmland. (See Section 3.10.).

Informal comments from the Contra Costa Water District, City of Oakley, Ironhouse Sanitary District, and the Department of Fish and Game were received on the Administrative Draft EIR, and incorporated where appropriate.

1.6 DOCUMENT ORGANIZATION

Chapter 1, **Introduction**. Describes the project background, and project purpose/need, EIR approach, and organization.

Chapter 2, Project Description and Alternatives. Describes the goals of the project and the process used to develop alternatives to the Dutch Slough Restoration Project, as well as descriptions of each alternative and option, and the alternatives and options that were not carried forward for further analysis in this document. It also describes the other projects assessed conceptually in the document: the City Community Park Project and the Ironhouse Project.

Chapter 3, Environmental Setting, Impacts, and Mitigation Measures. Includes descriptions of the environmental setting, and the impacts that may occur on each resource as a result of implementation of the projects. Mitigation measures for potentially significant impacts are identified, and residual impacts (following application of mitigation measures) are discussed.

Chapter 4, Evaluation of Project Alternatives. Provides a comparison of the impacts or effects of each alternative analyzed in the document, and identifies the CEQA "environmentally superior" alternative.

Chapter 5, CEQA Topical Analyses. Summarizes the project's growth inducement, unavoidable significant adverse impacts, cumulative impacts/mitigation, and irreversible/ irretrievable impacts.

Chapter 6, List of Preparers and Contributors. Identifies the preparers of this document.

Chapter 7, Definitions. Defines words used in the document.

Chapter 8, References. Lists references cited in the document.

Appendices. The appendices provide additional information on the environmental review process and technical information that was used in the EIR analyses. Pursuant to CEQA requirements, materials and literature referenced in the EIR, but not included in Appendices, are maintained at the DWR offices in Sacramento, California.

Appendix A Notice of Preparation

Appendix B Responses to NOP

Appendix C Distribution List

Appendix D Dutch Slough Adaptive Management Plan

Appendix E Construction Carbon Footprint Calculations

Insert tab titled

2 Project Description

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

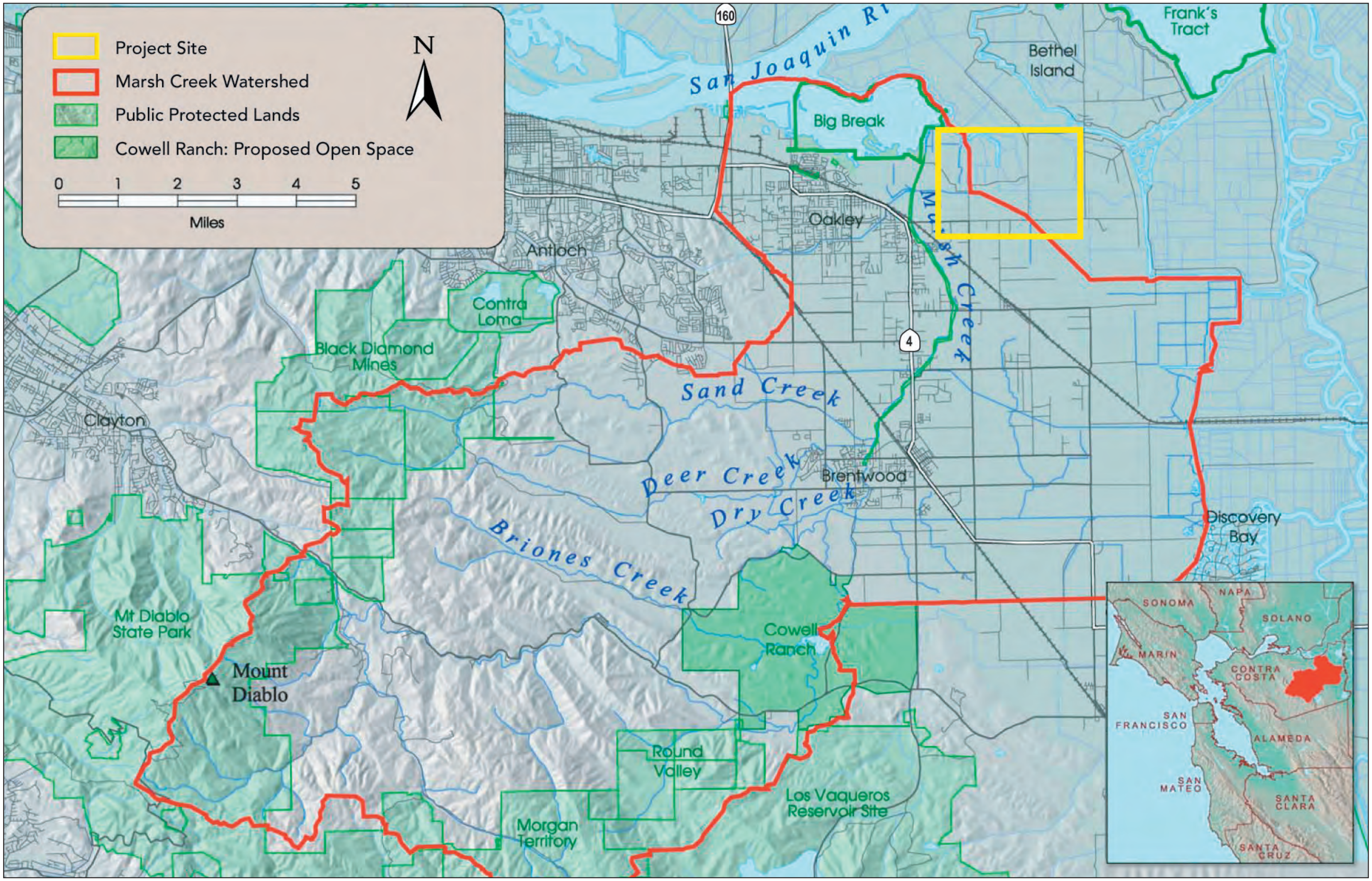


Figure 2-1

Regional Location

Sources: USGS, TIGER, EBRPD, GreenInfo Network

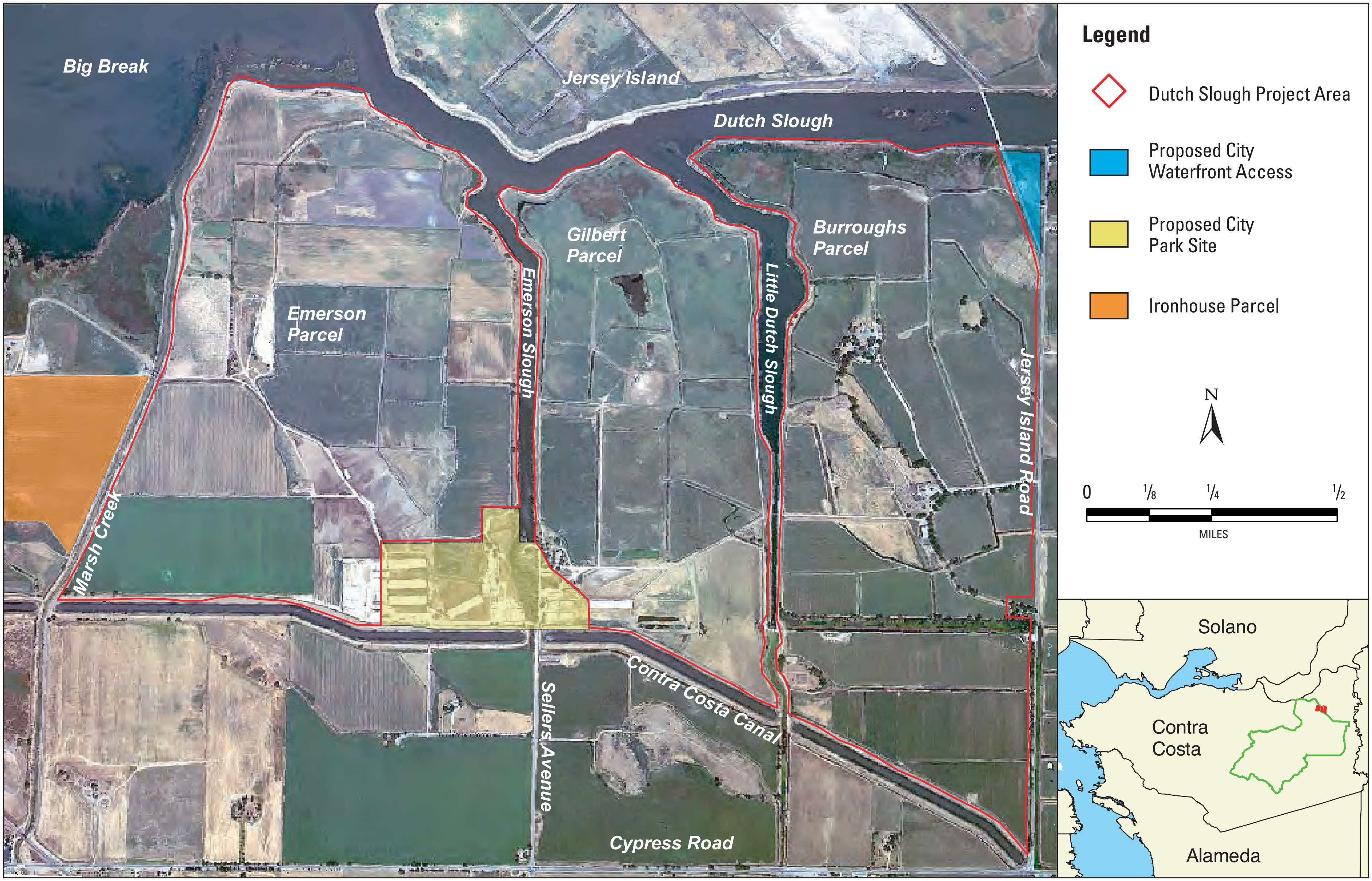


Figure 2-2

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

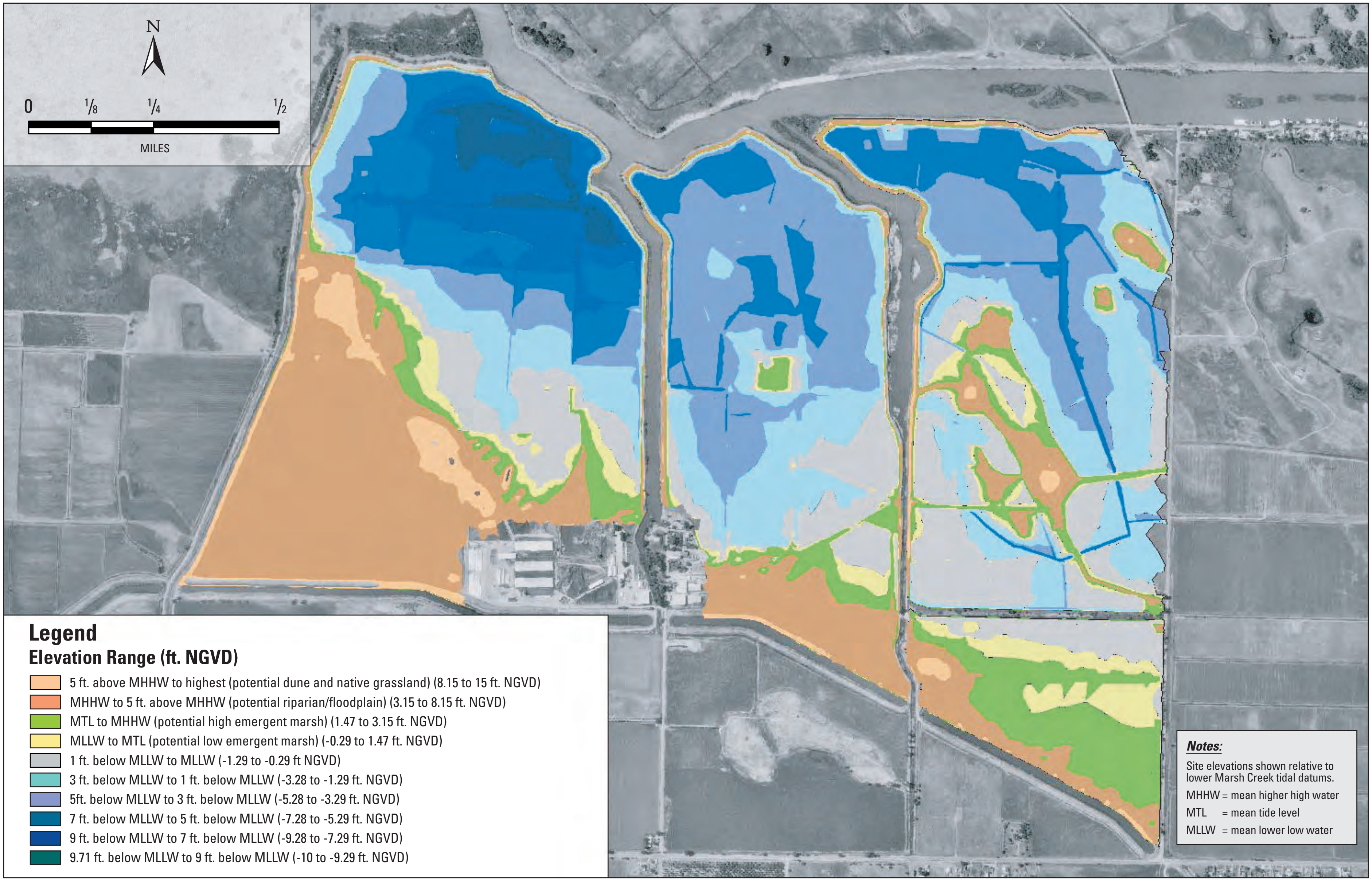


Figure 2-3

Dutch Slough Restoration Project Site Elevations

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

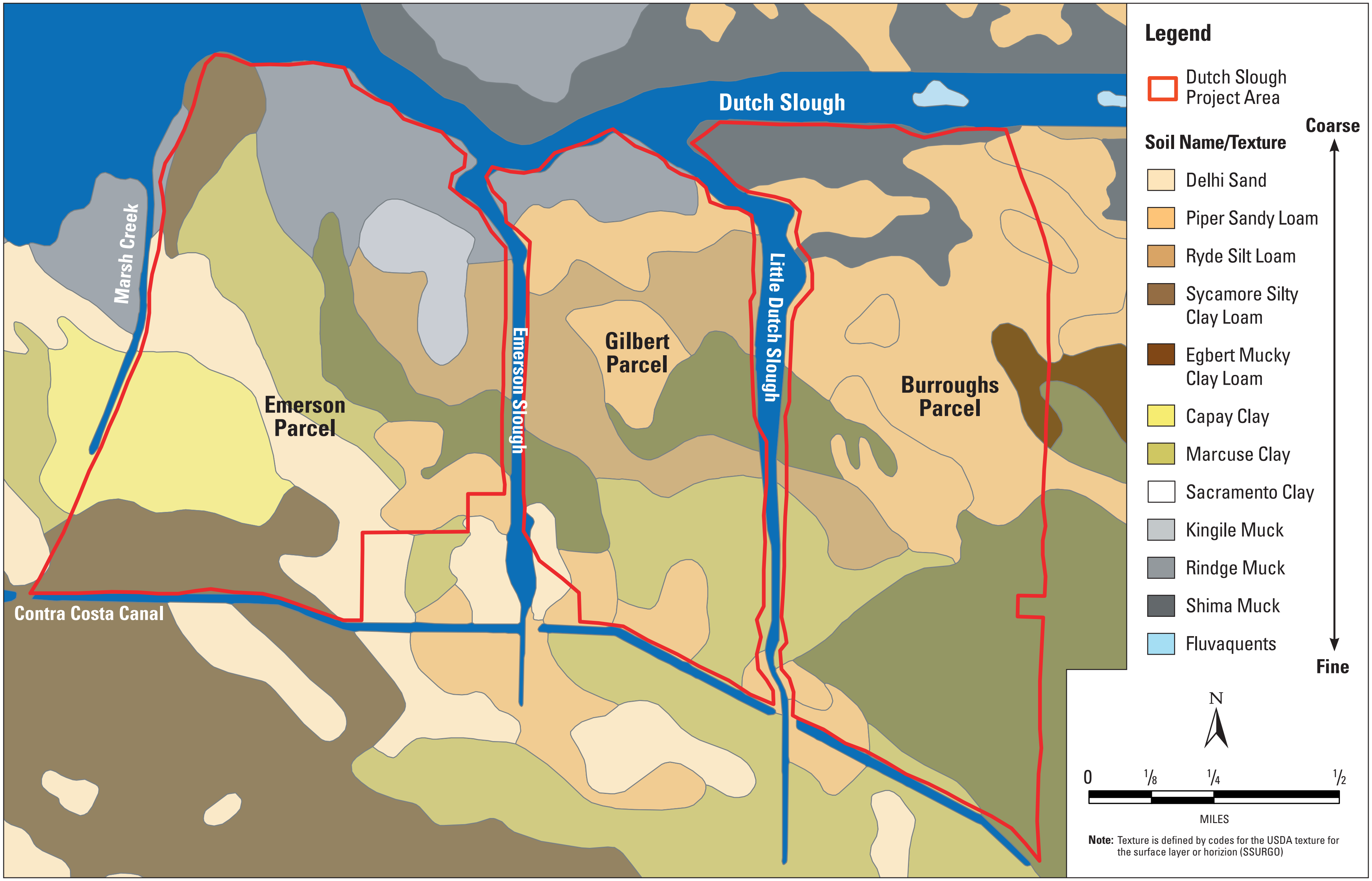


Figure 2-4

Dutch Slough Restoration Project Area - Soils Map

Source: NRCD

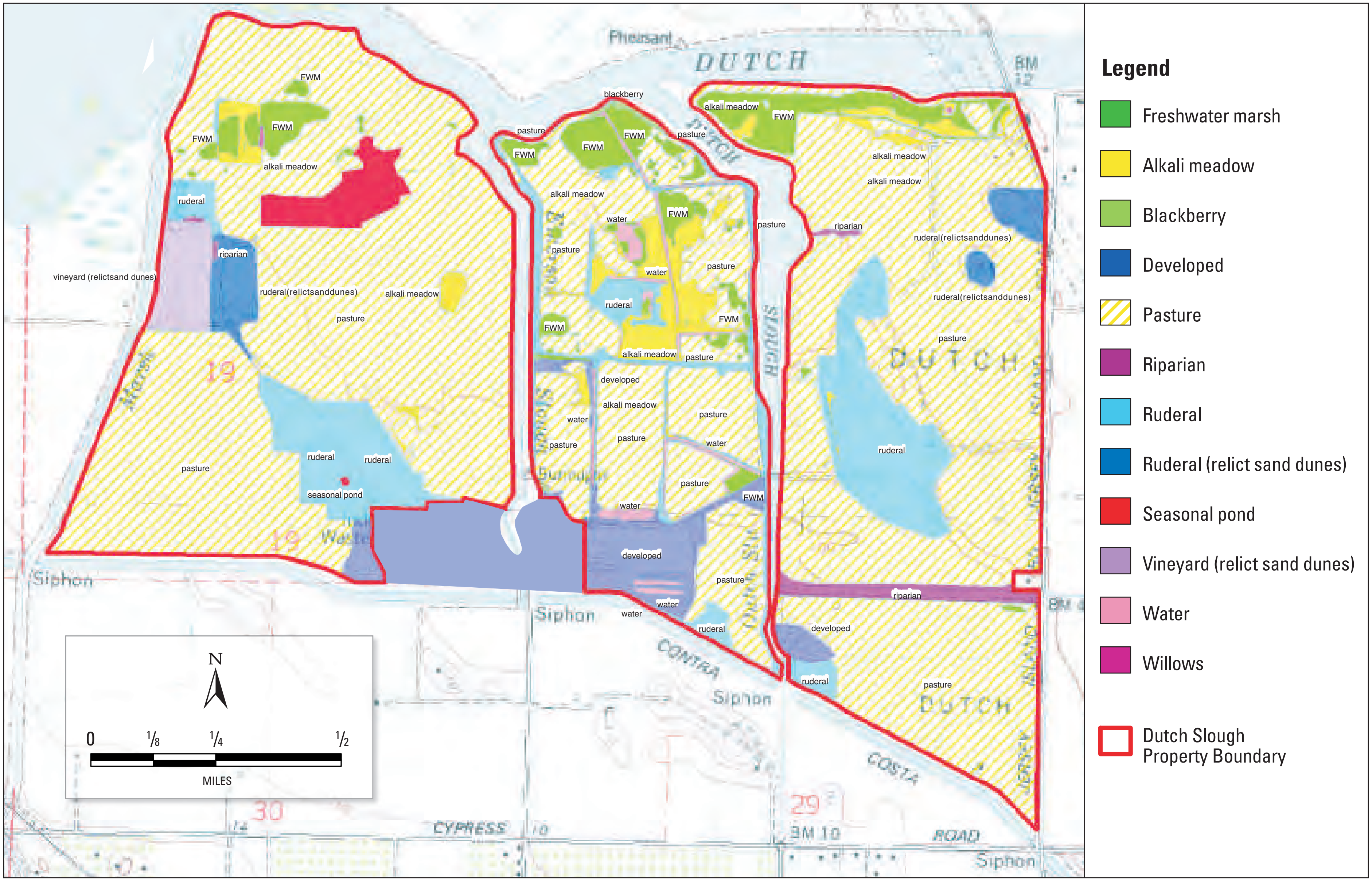


Figure 2-5

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

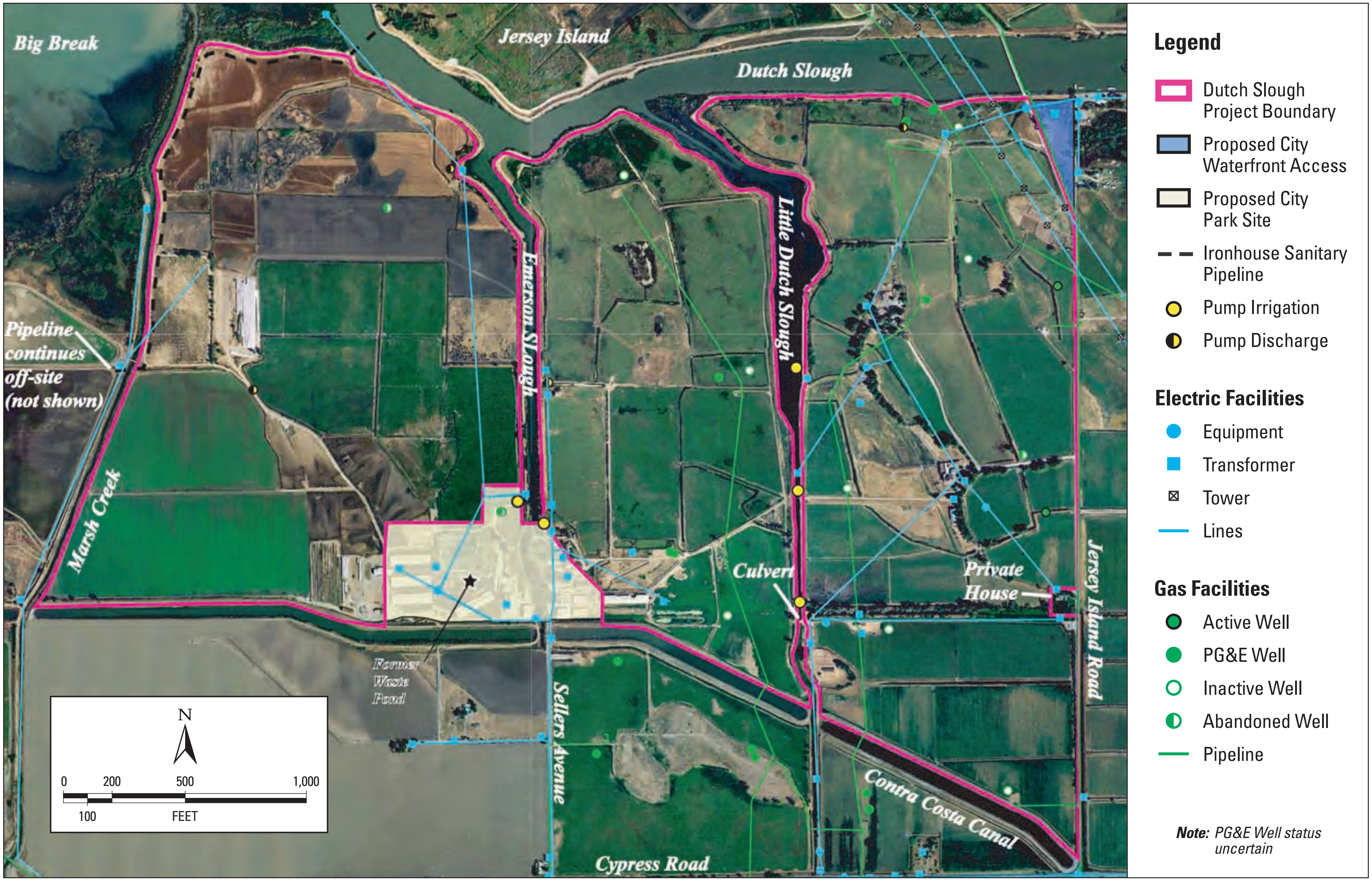


Figure 2-6

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.

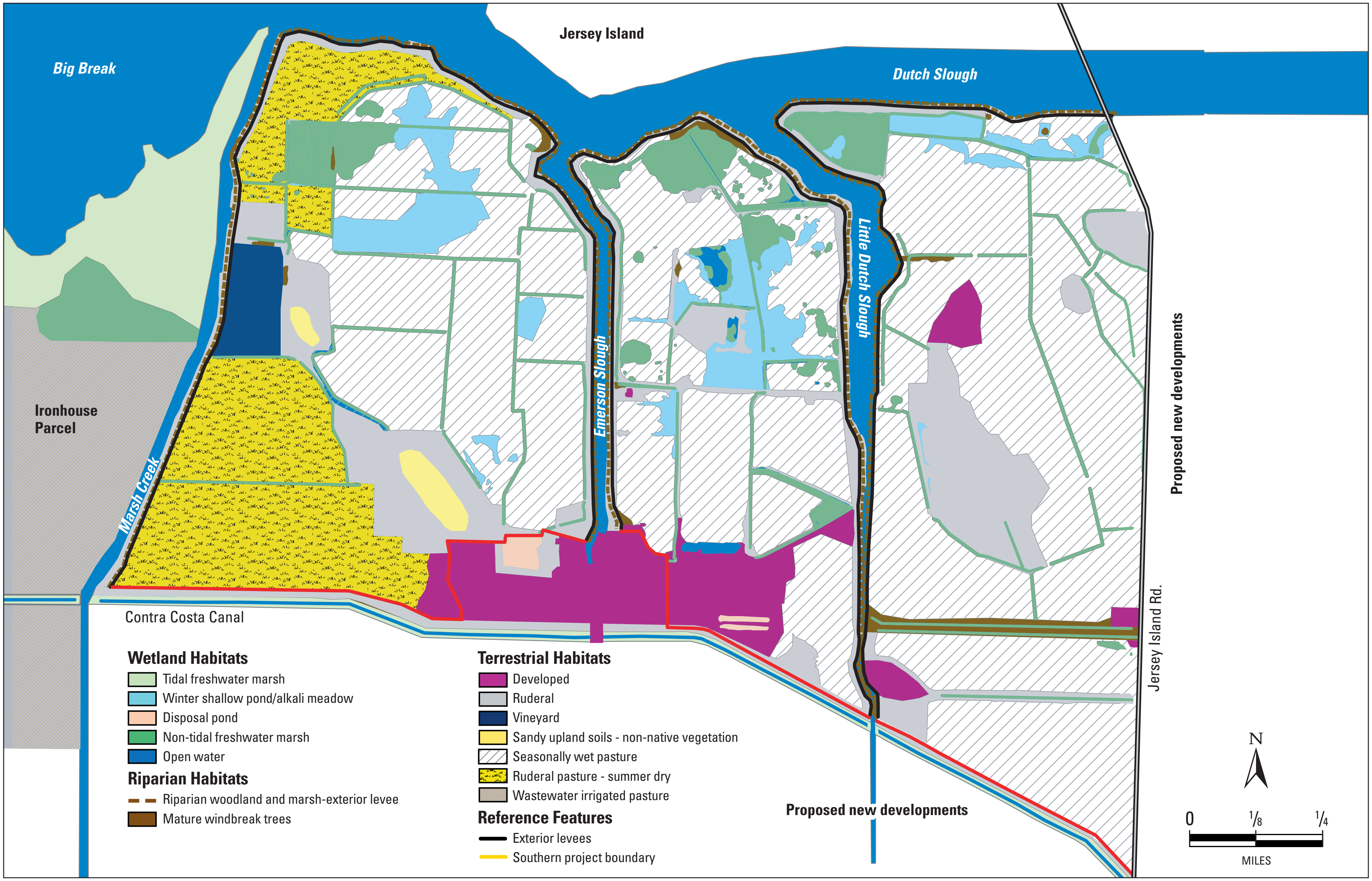
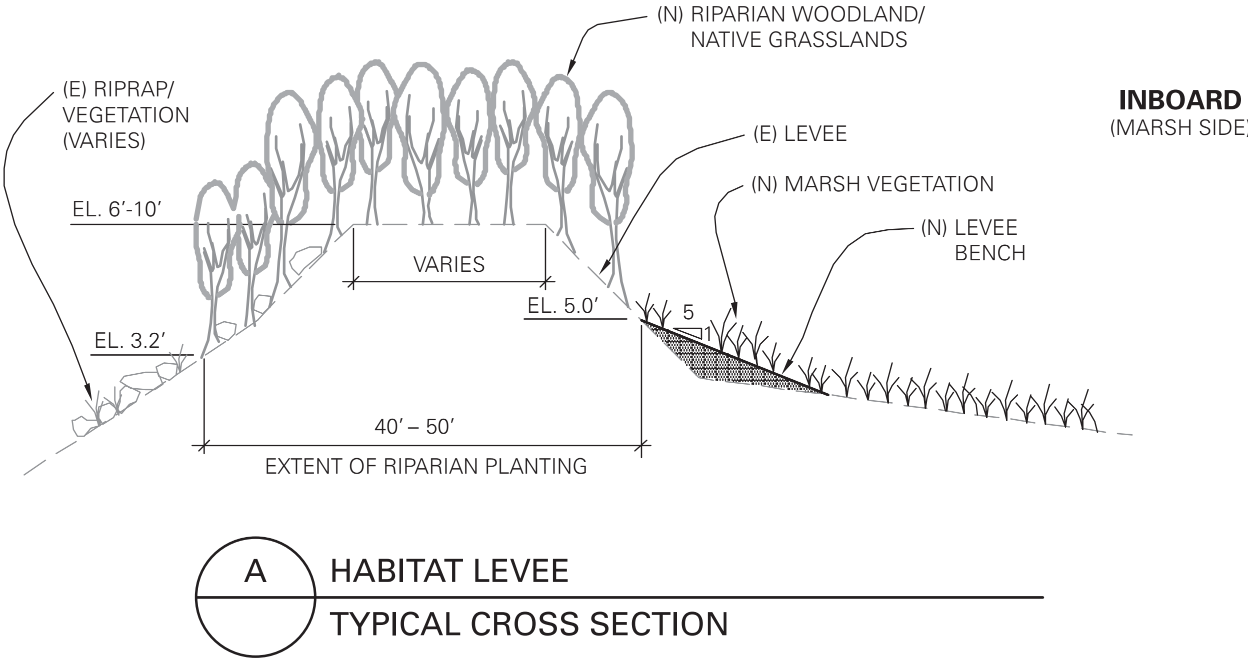


Figure 2-7

Dutch Slough Restoration Project Area - Existing Habitats

Source: PWA



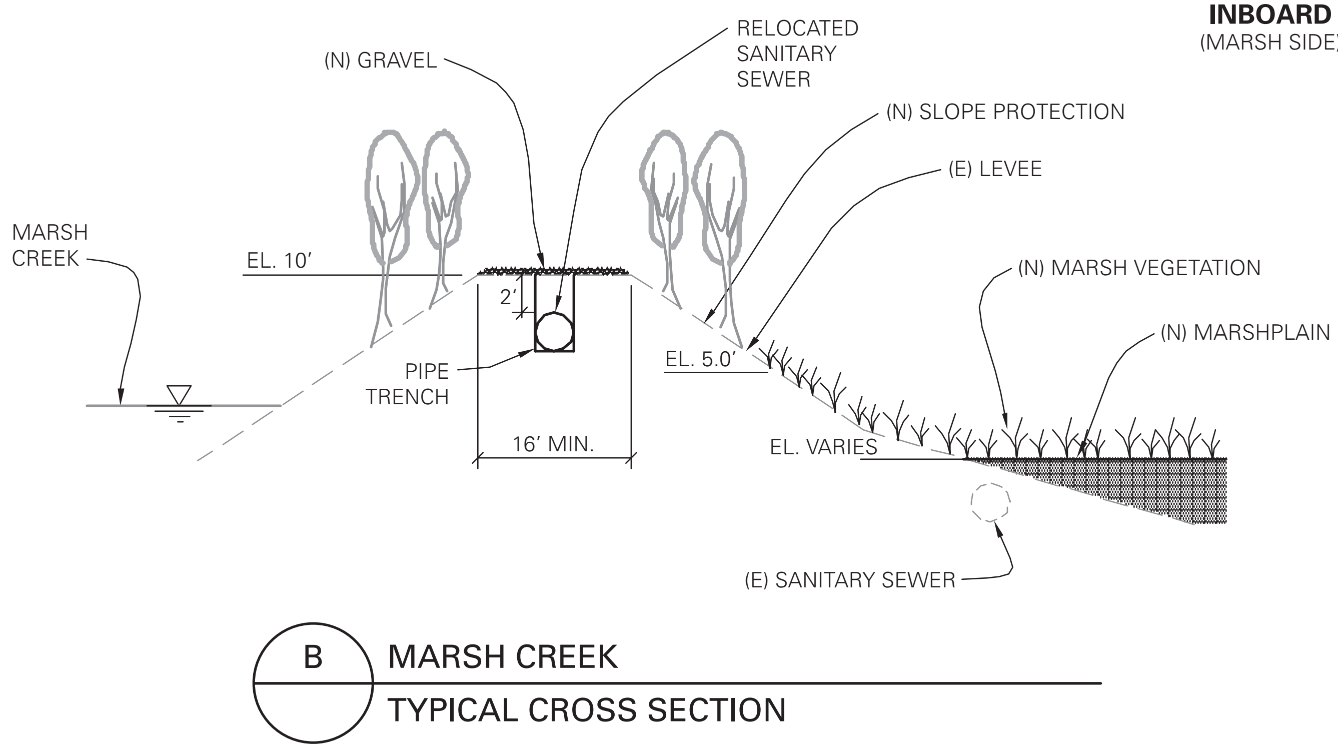


Figure 2-8

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

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[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.

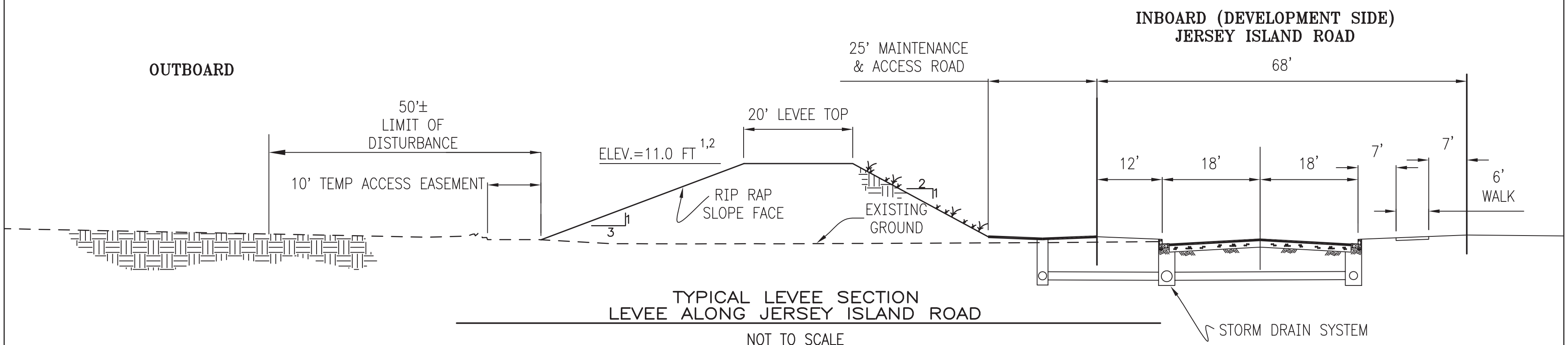
Contra Costa Canal Improvements

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



NOTES

1 PRELIMINARY ELEVATION; TO BE FINALIZED UPON COMPLETION OF WAVE RUN-UP CALCULATIONS.

2 ELEVATION BASED ON PROTECTION FROM 300-YEAR FLOOD EVENT (300 YEAR FLOOD PLAIN ELEVATION = 7.6, PLUS 3' FREEBOARD AND 0.1' SETTLEMENT = MINIMUM ELEVATION AT TRAIL SUBGRADE 10.7)

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 15th. 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.

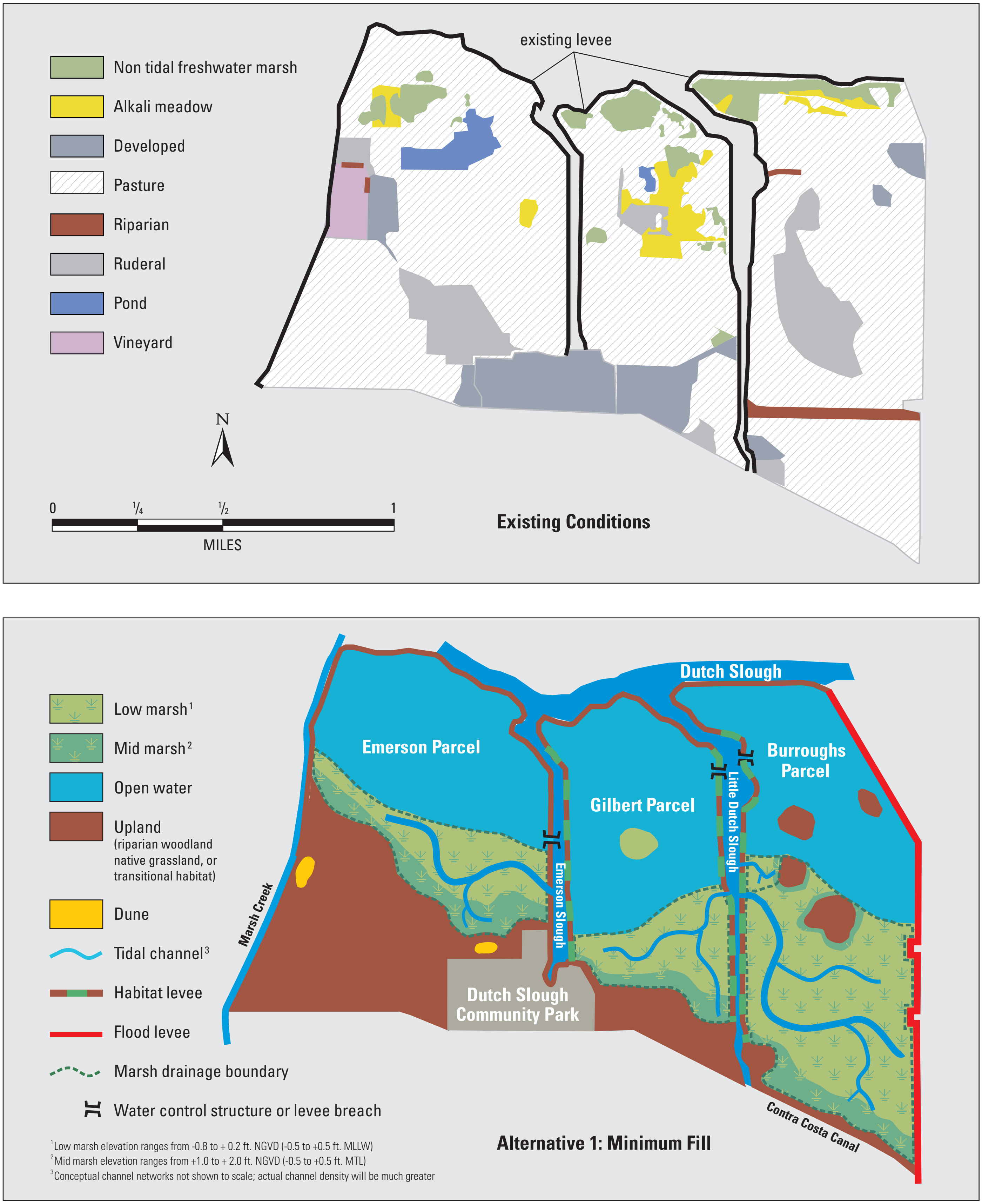


Figure 2-10

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.

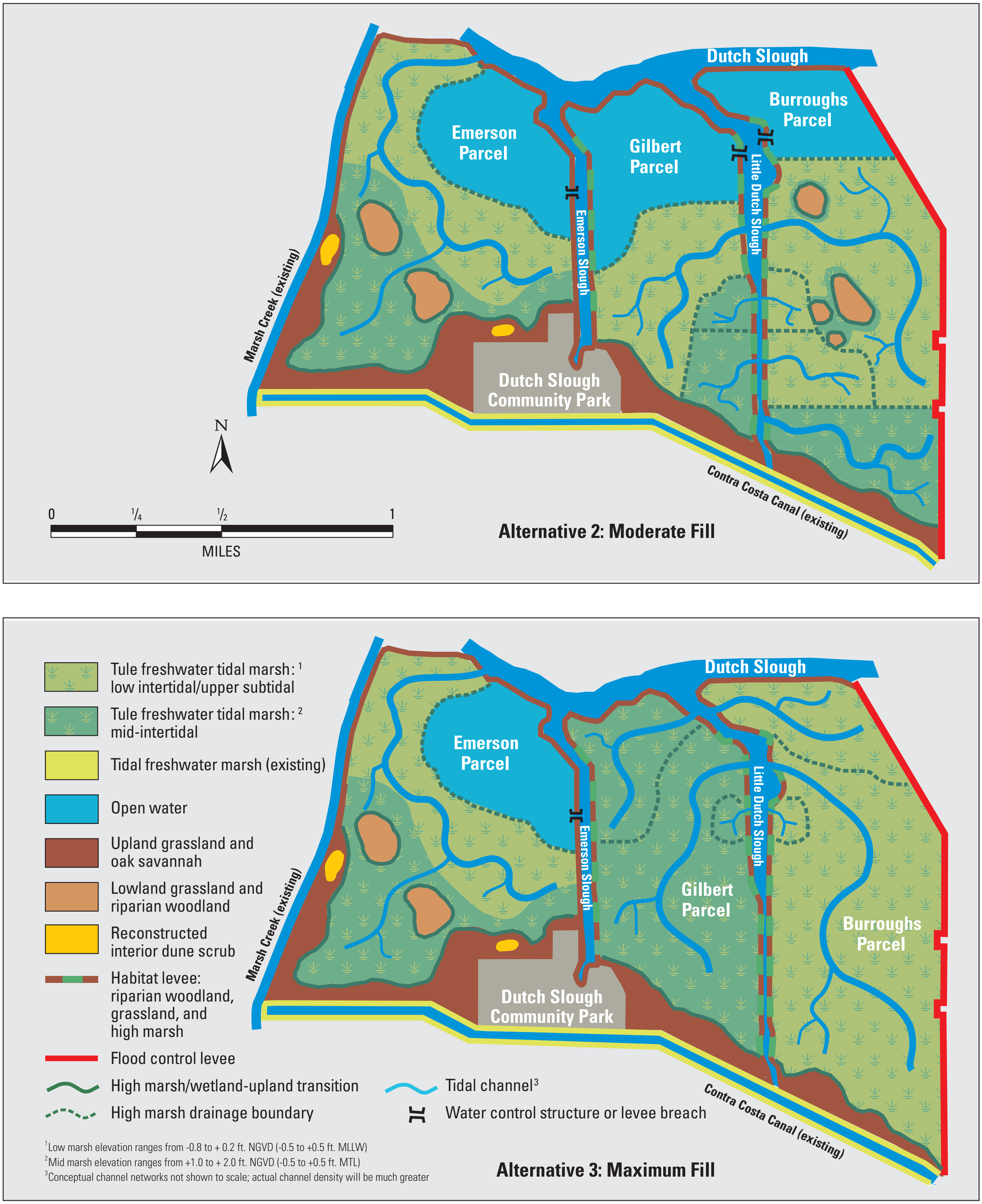


Figure 2-11

Dutch Slough Restoration Project - Alternative 2 and 3 Conceptual Plans

Source: PWA

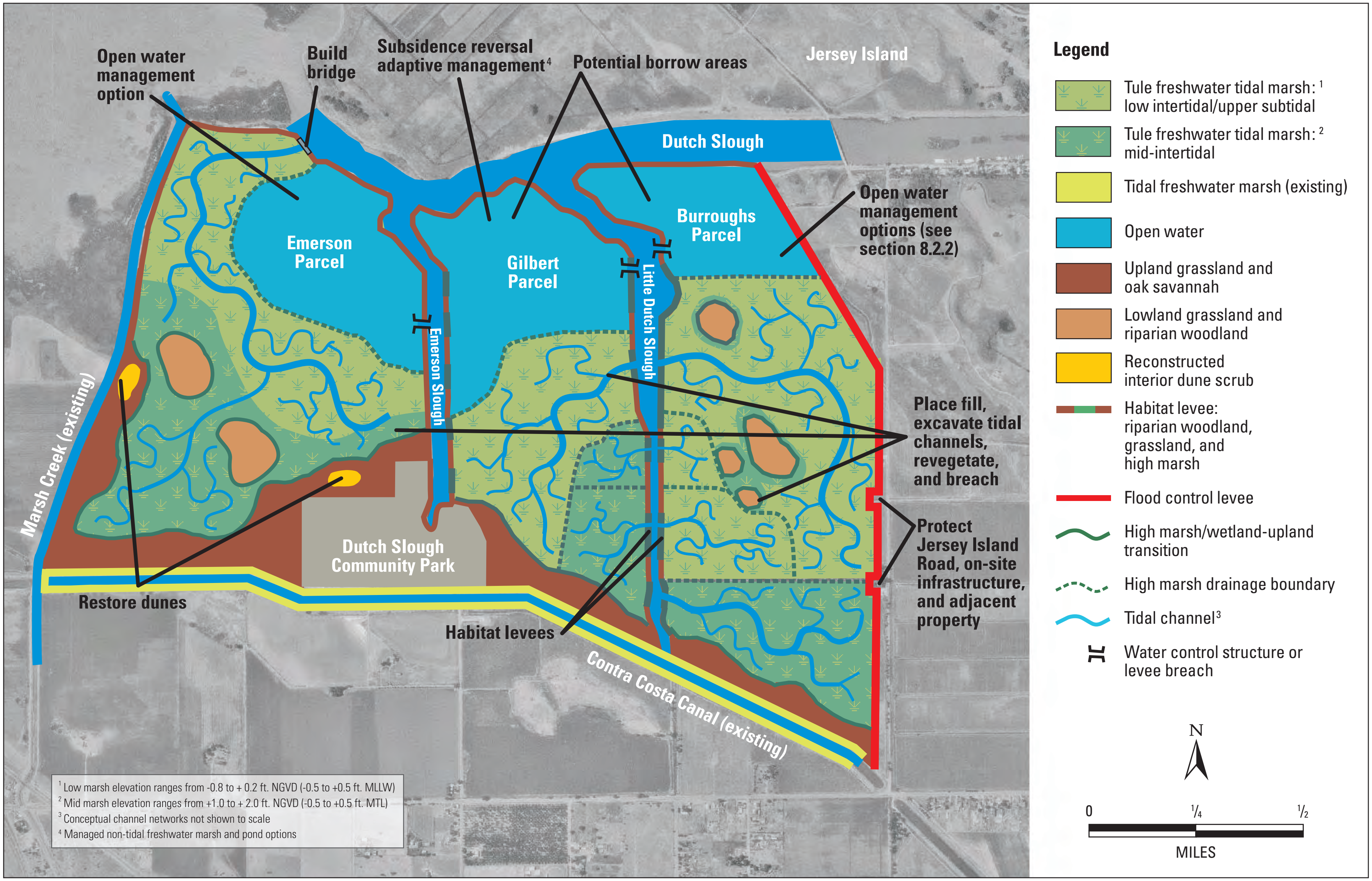


Figure 2-12

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

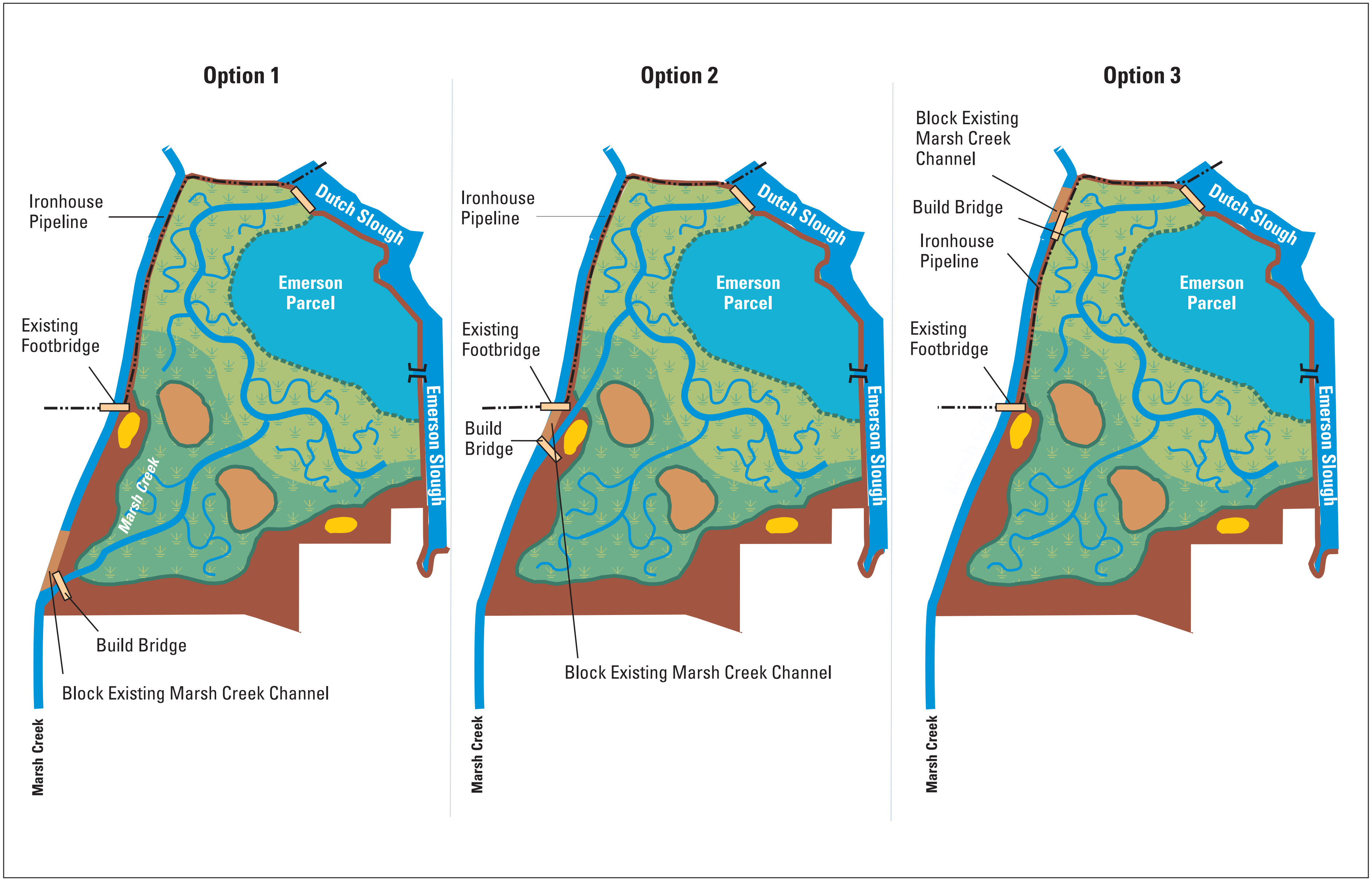


Figure 2-13

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.

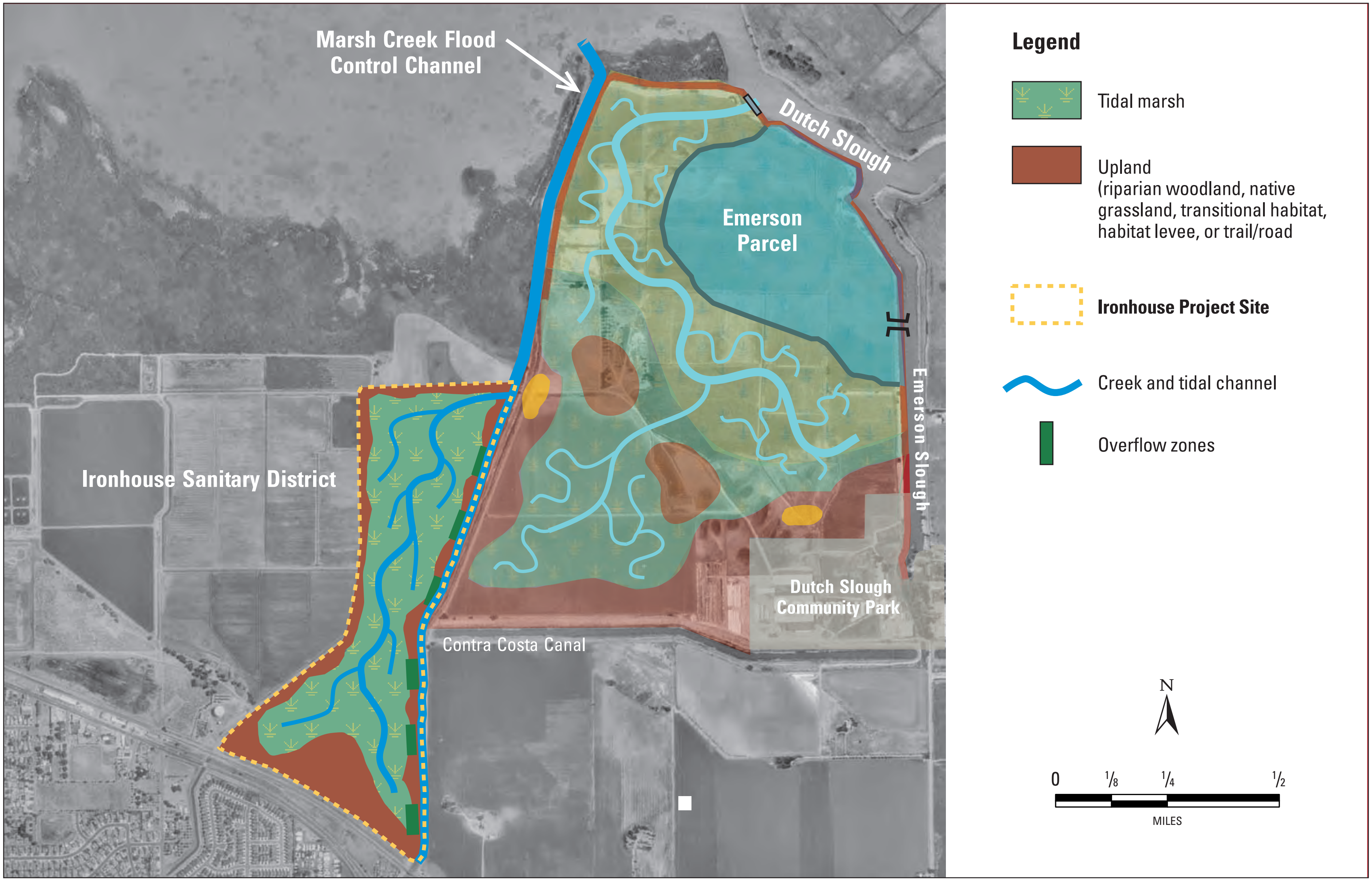


Figure 2-14

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

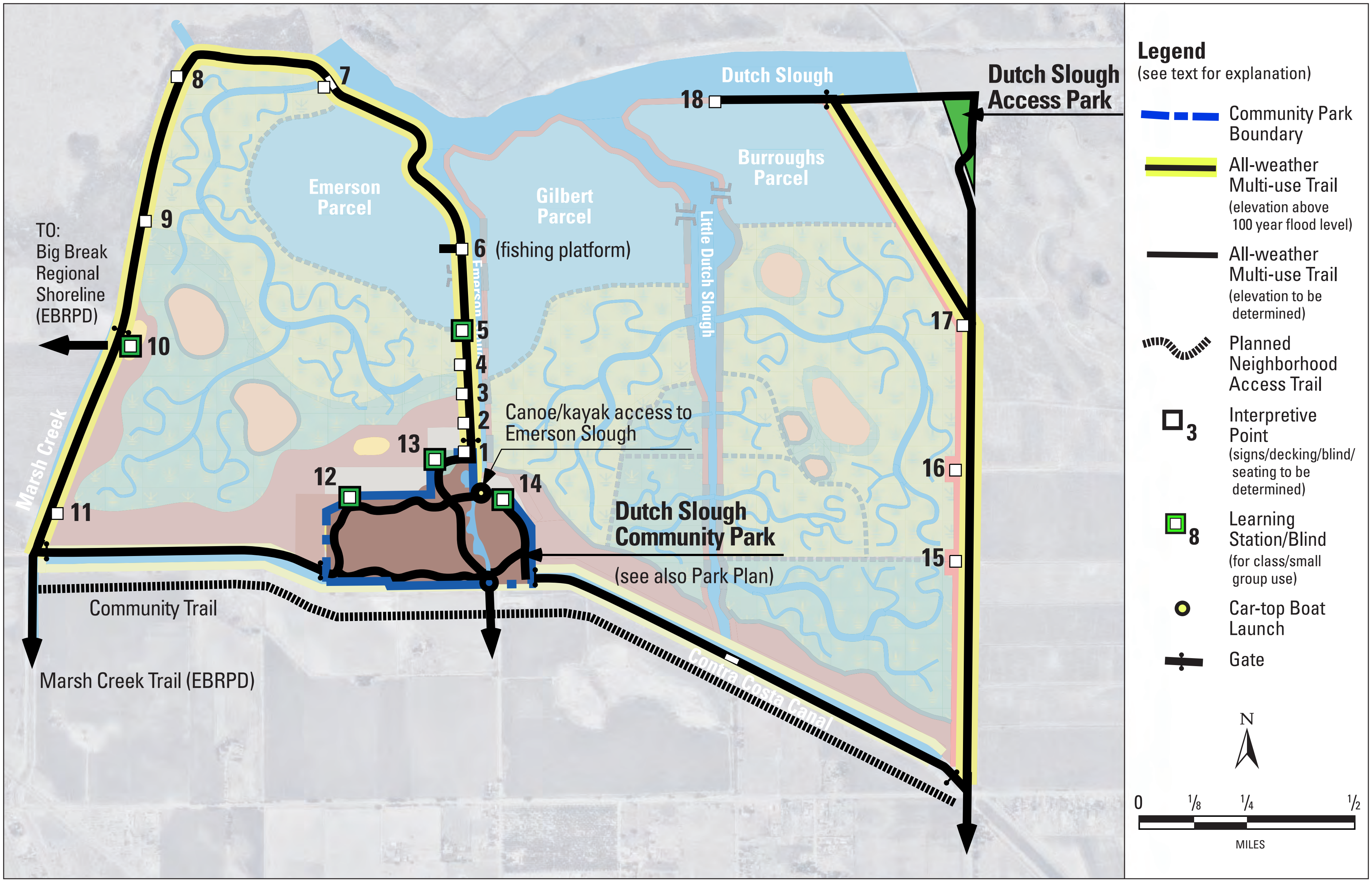


Figure 2-15

Public Access Plan

Source: 2M Associates

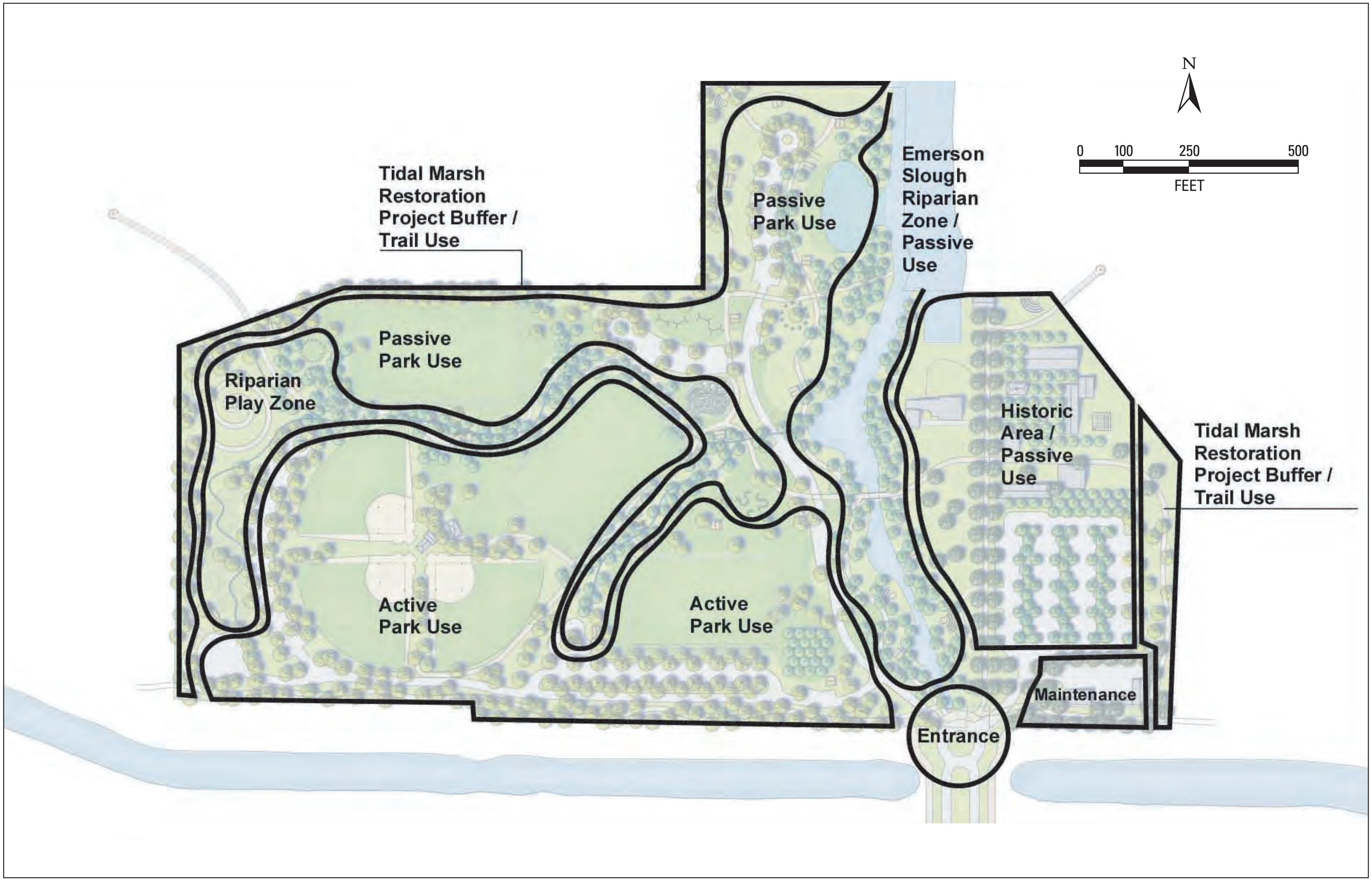


Figure 2-16

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.

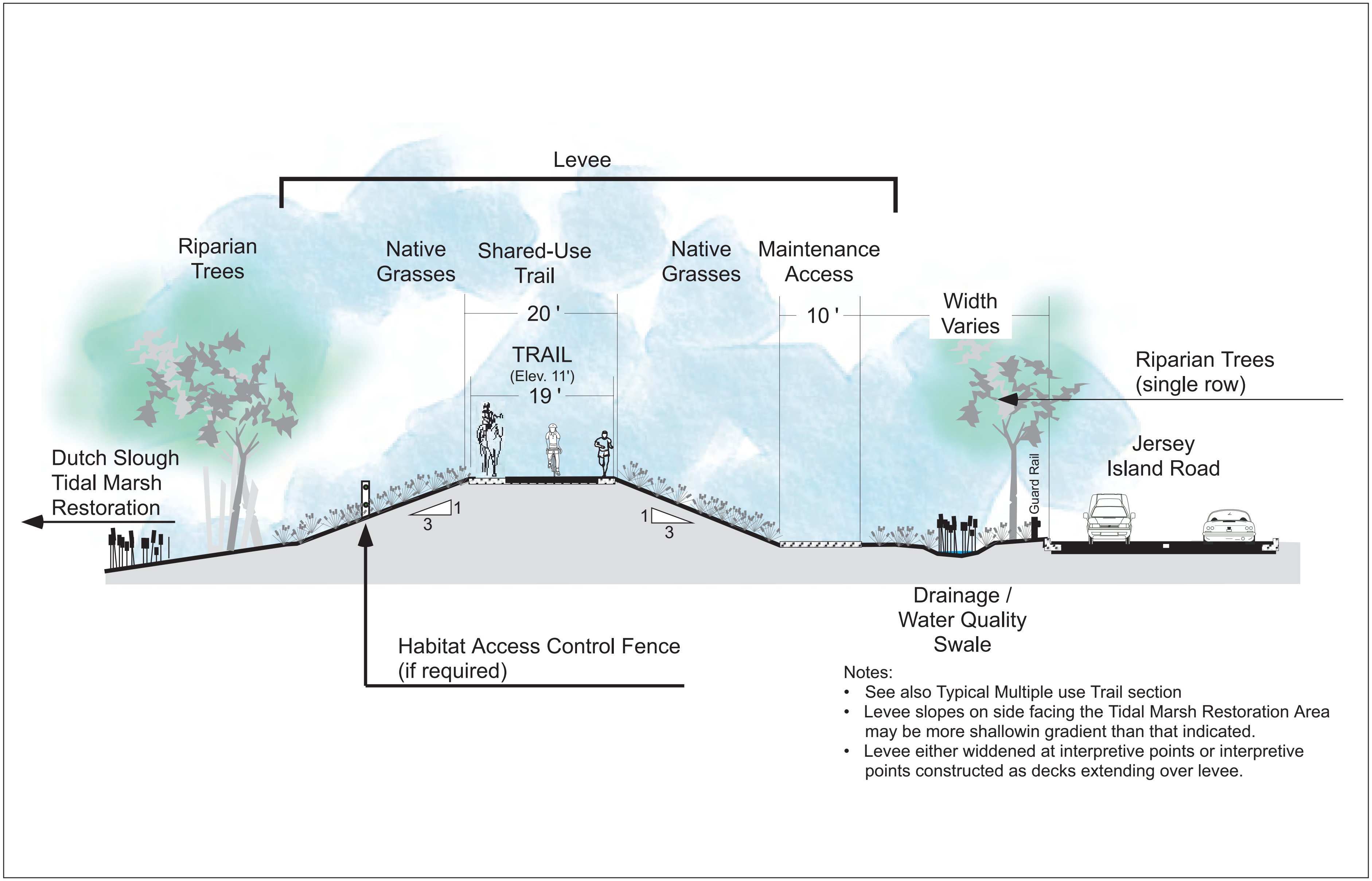
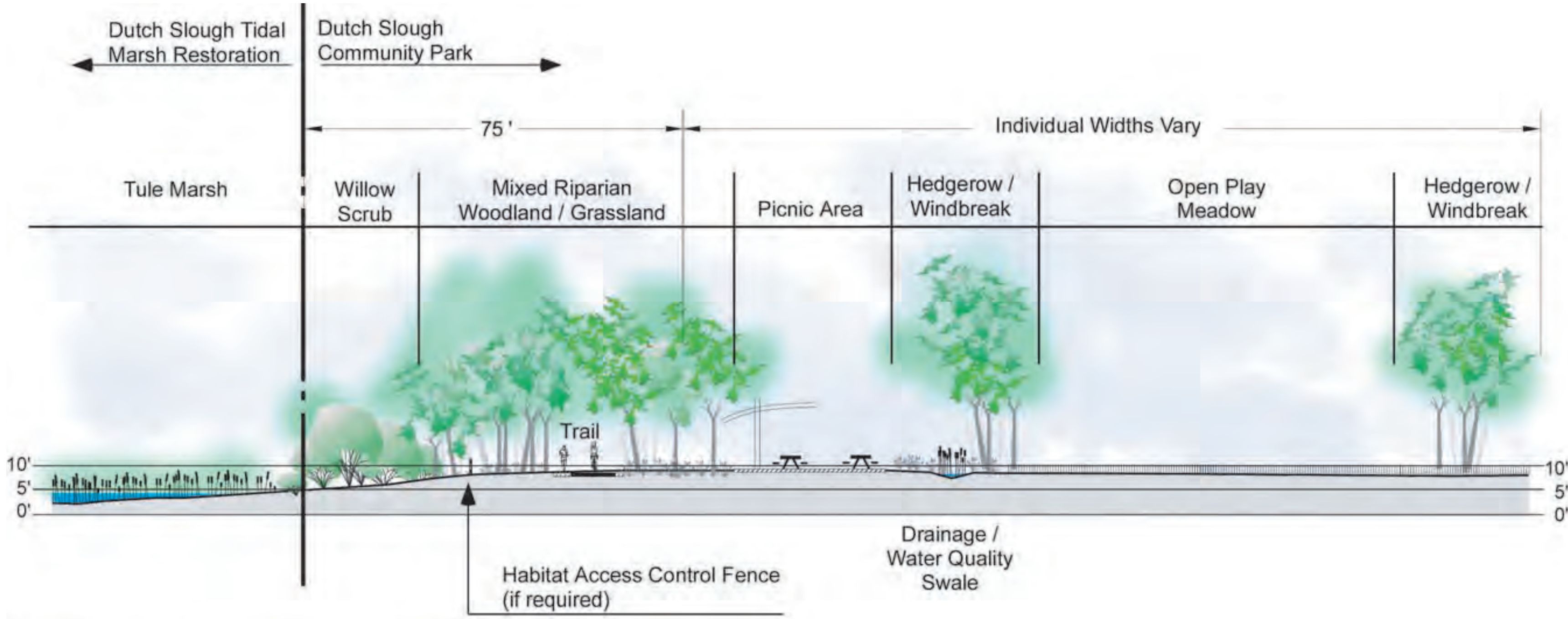


Figure 2-19

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

Insert tab titled
3 Environmental Setting

3.0 ENVIRONMENTAL SETTING, IMPACTS, AND MITIGATION MEASURES

This chapter describes the environmental setting, analyzes the potential impacts to environmental resources that would occur from the implementation of the project and alternatives described in Chapter 2, *Project Description and Alternatives*, and identifies feasible mitigation measures to reduce or eliminate impacts.

As described in Chapter 1, *Introduction*, this Draft EIR is intended to provide a project-level analysis of implementation of three potential Dutch Slough Restoration Project alternatives, and, at a conceptual level, the related Ironhouse Project and the City of Oakley's Community Park Project (referred to herein as the Related Projects). This document provides mitigation measures that can be applied to specific projects (to address impacts of the Dutch Slough Restoration Project, as well as the cumulative impacts of the Related Projects and the Dutch Slough Restoration Project). Additional CEQA assessments may be required as additional site-specific details of the Ironhouse Project and City Community Park Project are proposed.

With respect to the Dutch Slough Restoration Project alternatives, the impact assessments for Alternative 1 assume:

- The minimum fill restoration alternative on the Dutch Slough site;
- No relocation of the mouth of Marsh Creek; and,

Three open-water management options are considered. Alternative 2 differs from Alternative 1 in that it includes analysis of three relocation options for the mouth of Marsh Creek. Alternative 2 also has more fill and less open water than Alternative 1. Alternative 3 is similar to Alternative 2 except that it has greater fill and less open water. Also considered is the "No Burroughs" option, which would not restore tidal marsh to the parcel, but retain it as terrestrial and wetland habitats.

The impact assessment for the Alternatives 2 and 3 compares their impacts to those of Alternative 1 and focuses on the differences between those alternatives and Alternative 1. For Alternative 1, a statement of significance of the impact after mitigation is included under each impact. If there are no differences between an impact under Alternative 2 or 3 compared with Alternative 1, no new statement of impact significance is added.

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3.1 - Hydrology

3.1 HYDROLOGY AND GEOMORPHOLOGY

This section describes the hydrologic and geomorphic (land-form) conditions on and in the vicinity of the project site, including tidal action, surface water, runoff, flooding, groundwater flows and seepage, erosion, and sedimentation. Effects of the project and options on hydrologic and geomorphic resources are identified on the basis of studies conducted by Phillip Williams Associates (PWA, 2006), LSCE (2006), Hultgren-Tillis Engineers (2005), Natural Heritage Institute (2002, 2003, 2004), other reports including those for adjacent properties, and analysis of these reports by Wetlands and Water Resources (WWR), the chapter authors. Water quality is not addressed herein, but is described in detail in Section 3.2.

3.1.1 Affected Environment

Bay-Delta Estuary

The project is located in the Sacramento-San Joaquin Delta, within the upper reaches of the San Francisco Estuary. The Delta forms where the Sacramento and San Joaquin Rivers reach low-lying lands in the Central Valley, forming a maze of tributaries, sloughs, and islands that provide diverse habitats for plants and wildlife. From the rivers' confluence in the western Delta, they flow west through Suisun Bay and San Pablo Bay into central San Francisco Bay and through the Golden Gate into the Pacific Ocean. This entire system, from Delta to Golden Gate, comprises the San Francisco Estuary, the largest estuary on the West Coast of North and South America.

The Delta is a maze of river channels and diked islands covering roughly 1,150 square miles, including 78 square miles of water area (CVRWQCB 2004). The Delta receives runoff from about 40 percent of the land area of California, and about 50 percent of California's total streamflow (USGS 2000). It is the heart of a massive north-to-south delivery system, which transports billions of gallons per year of drinking water to more than 23 million people throughout the State (USGS 2000). The Sacramento and San Joaquin rivers collectively contribute roughly 95% of the total freshwater input to the estuary; the other 5% is provided by creeks and streams that drain directly into the Bay.

Hydrologic conditions in this area are affected predominantly by river flows, Marsh Creek watershed flows, diversions and other operations of the State Water Project and federal Central Valley Project, and tidal action. Agricultural diversions within the Delta may also contribute to local hydrology but at a minor scale.

Flows through the Delta vary greatly between seasons and from year to year. In a typical year, the Delta receives approximately 28 million acre feet (maf) of inflow from the watershed, with 75 percent of that coming from the Sacramento River, 15 percent from the San Joaquin River, and the rest coming from precipitation and the small eastern tributaries. About 25 percent of the Delta's inflow is pumped into the water supply system, predominantly to the State Water Project (only a very small fraction, 0.1 maf, to the Contra Costa Canal), and the rest flows into San Francisco Bay.

Flows within the Delta are extremely complex. The Delta consists of a network of branching, interconnected channels, which are strongly tidally affected. During periods of low surface water inflow, high tide events can effectively reverse the flow in some Delta channels. Dams in the upper watershed capture water and reduce flows during winter months and release water during summer months, increasing flows. A primary objective of the flow management regime is to reduce salinity intrusions from the Bay into the Delta by forcing the salt water out with freshwater flows (USGS 2000). Pumping water from the Delta into the State Water Project system in the south creates a southerly gradient within the channels of the southern portion of the Delta. Tidal effects in the vicinity of the Rock Slough and Old River intakes produce an oscillatory flow, which transports water back and forth in the channels, with a tidal elevation range of +/-3 feet at the Rock Slough intake (USGS 2000). In addition to tidal action and Delta inflows, the hydrologic conditions in the southern Delta channels are also influenced by municipal and agricultural water diversions and agricultural stormwater discharges.

Tides

OVERVIEW

San Francisco Bay Estuary is a "mixed-diurnal" tidal system, which generally exhibits two high tides and two low tides of unequal magnitude each day. During each tidal cycle (~24.5 hours) there is a higher high, high, low, and lower low tide. The heights of each high and low tide are different every day, reflecting the spring-neap tide cycle (~ 2 weeks tied to the moon's cycle) and seasonal controls. This tidal exchange is a fundamental determinant of water surface levels, direction, and volume of flow and salinity and thereby exerts a fundamental influence on the biological, chemical, and physical conditions of the Estuary.

Determining tidal datums at the site-specific scale involves collecting local water surface elevation data and comparing them to the NOS data for the closest continuous recording station. For Dutch Slough, the nearest NOS station is at Port Chicago located about 20 miles to the west. The calculated local tidal datum at Dutch Slough is presented in Table 3.1-1. This table includes Mean Higher High Water (MHHW), Mean High Water (MHW), Mean Low Water (MLW), and Mean Lower Low Water (MLLW) as these elevations inform restoration planning and design. PWA (2006) utilized two data sources to determine local tidal datums: work done in 2001 on Marsh Creek by Wetlands and Water Resources (WWR) for the Natural Heritage Institute and work done by the USGS between January 1, 1997 to February 28, 2003 in Dutch Slough. PWA calculated tidal datums using a one-year subset of the USGS data; they compared their results to those obtained by WWR and found similar results. The 100-year tide level included in Table 3.1-1 is based upon a FEMA estimate (1987).

TIDAL DATUMS AND SEA LEVEL RISE

Tidal datum refers to the local heights of the tides. Tidal datums vary spatially throughout the Estuary and Delta in response to complex processes of standing and progressive waves, interaction with local bathymetry, freshwater inflows, and atmospheric conditions. Tides decrease in amplitude and mean sea level increases from the Golden Gate into the Delta. Tide heights also increase over time with sea level rise. The National Oceanic and Atmospheric Administration's National Ocean Survey (NOS), the federal agency responsible for sea level monitoring and providing tidal data, periodically updates tidal datums to account for sea level rise; the most recent update occurred in 2003 for the five continuously measuring stations in the region and NOS continues to revise the numerous periodic stations around the region. That update showed a sea level rise of 0.2 ft at the Golden Gate between 1978 and 2003.

Tidal datums are projected to continue to rise as a result of global sea level rise. Global sea level rise can be a result of global warming through the expansion of sea water as the oceans warm and the melting of ice over land. Local sea level rise is affected by global sea level rise plus tectonic land movements and subsidence, which can be of the same order as global sea level rise. Atmospheric pressure, ocean currents and local ocean temperatures also affect local rates of sea level rise. The rate of global sea level rise is expected to continue along a global-warming-induced trajectory, possibly attaining an average rate of about 0.01 feet per year over the next 50 years (2000 to 2050), and rising to an average rate of about 0.015 feet per year over the following 50 years (2050 to 2100) (IPCC 2001). Although significant uncertainty exists regarding these rates, ongoing research regarding the primary factors affecting global sea level rise continues to narrow the uncertainties and refine future estimates.

For the purpose of this EIR, the Intergovernmental Panel on Climate Change (IPCC) mid-range estimate of 0.5 ft of future global sea level rise over the next 50 years was selected (IPCC 2001). The IPCC recently released an updated report (May 2007), which updates the 2001 global sea level rise estimates (IPCC 2007). The IPCC summary does not specify a 50-year mid-range estimate for direct comparison with the 2001 value. However, the midpoint of each of the 2007 climate change scenarios is within ten percent of the corresponding 2001 estimates (IPCC 2007).

The CALFED Independent Science Board (ISB) has evaluated the effects of sea level rise with respect to the Delta and concluded that current projections of sea level rise by the IPCC are likely very conservative as the models used to develop these projections under-estimate recent measured sea level rise (Jeffery Mount, ISB, memo to Mike Healy, CALFED, September 4, 2007). The ISB found that extrapolation from empirical models of sea level rise yields significantly higher estimates of sea level over the next few decades than the IPCC projections. The ISB suggests that the empirical projections are probably a better basis for short to mid term planning. The ISB further noted that neither approach to estimating future sea levels takes account of melting of ice in Greenland and Antarctica, which recent studies suggest is accelerating.

Based on their analysis, the ISB suggests that a mid range rise in sea level this century is likely to be at least 70-100 cm (27-39 inches), significantly greater (~200 cm/78 inches) if ice cap melting accelerates. Approximately one-third of the projected rise is expected in the next 50 years. While the absolute rise is alarming enough, even more alarming is the fact that only a few cm of sea level rise will greatly increase the frequency, intensity and duration of extreme water levels. It is these events that pose the greatest risk to Delta levees, infrastructure and private property.

Big Break

Big Break is located adjacent to the northwest boundary of the Emerson Parcel, across Marsh Creek. It is a former Delta tidal marsh diked in the late 1800s or early 1900s, farmed, and then subsequently breached by floods in the 1920s for which levee repairs were never made. The Big Break Regional Shoreline is managed by the East Bay Regional Park District. The site is predominantly open water, with perennial emergent freshwater marsh along its southern edges, and riparian species (*Salix* spp.) occurring near shore flats and low islands. Water from Dutch Slough and Marsh Creek passes through Big Break before entering the San Joaquin River.

Table 3.1-1. Dutch Slough Tidal Datums (from PWA 2006)

Tide Level	Dutch Slough Tidal Datums	
	Ft MLLW	Ft NGVD29
100-year tide level	6.8	6.5
Mean Higher High Water (MHHW)	3.44	3.15
Mean High Water (MHW)	2.99	2.7
Mean Sea Level (MSL)	1.77	1.48
Mean Tide Level (MTL)	1.76	1.47
Mean Low Water (MLW)	0.52	0.23
Mean Lower Low Water (MLLW)	0	-0.29

Sources: NOAA COOPS (2003), WWR (NHI, 2002) and FEMA (1987)

Dutch Slough

The principal surface waterway in the immediate Project vicinity is the east-west trending Dutch Slough, which connects Taylor Slough, Little Dutch Slough, Emerson Slough, and Marsh Creek. Dutch Slough separates Jersey Island to the north and the Project site to the south; it transports tidal flows between Franks Tract to the east and Big Break to the west. Dutch Slough receives water from the San Joaquin River and the myriad of rivers and channels in the southern portion of the Delta (see discussion of Sacramento-San Joaquin Delta, below), including Marsh Creek, Emerson Slough, Little Dutch Slough, Sand Mound Slough, Old River, and Middle River. Irrigation runoff from adjacent agricultural lands is also pumped over the levees and discharged into Dutch Slough. The direction of flow in Dutch Slough is controlled by the volume of flows from the Delta and tributaries, tidal cycles and, under some conditions, by pumping at the Rock Slough intake to the Contra Costa Canal (PWA 2006). A study by United States Geological Survey (Oltmann 1996) demonstrated the dynamic nature of tidal flows in the Delta, including Dutch Slough (Figure 3.1-1). As shown in the figure, flows at all stations changed direction with the tide, with the maximum flows in Dutch Slough reaching about 8,000 cubic feet per second (cfs) in either direction, about 16 times smaller than the San Joaquin River.

The direction of flow in Dutch Slough is determined primarily by tidal cycles. The direction and volume of flow also are influenced by pumping activities at the Rock Slough intake to the Contra Costa Canal. In addition to inflow from the Delta, pumps drain irrigation water from drainage ditches on adjacent properties into Dutch Slough. Dutch Slough also provides water via pumps for dry season irrigation and year round livestock use.

Little Dutch Slough and Emerson Slough

Little Dutch Slough and Emerson Slough are terminal sloughs that separate the Gilbert and Burroughs parcels and Emerson and Gilbert parcels, respectively. Little Dutch Slough receives a small amount of local watershed runoff and pumped agricultural drainage from diked lands south of the Contra Costa Canal.

The geomorphology of Little Dutch Slough, Emerson Slough, and their associated tributaries has been strongly influenced by human activities. When diking and agricultural activities in the area commenced in the late 1800s, the formerly sinuous tidal creeks were straightened and surrounded by earthen levees.

The Little Dutch Slough channel widens and deepens as it approaches Dutch Slough. The channel is approximately 100 feet wide in its southern reach near the Contra Costa Canal, widening to approximately 300 feet at the mouth of the slough. Channel invert (bottom) elevations slope downward from -2 ft NGVD[1]29 near the Contra Costa Canal to -7 ft NGVD29 at the mouth of the slough. Emerson Slough also shows widening and deepening from south to north, with southern and central cross sections being roughly 150 feet wide and 10 to 15 feet deep. To the north near its confluence with Dutch Slough, Emerson Slough widens to about 230 feet wide and 18 feet deep (NHI 2004).

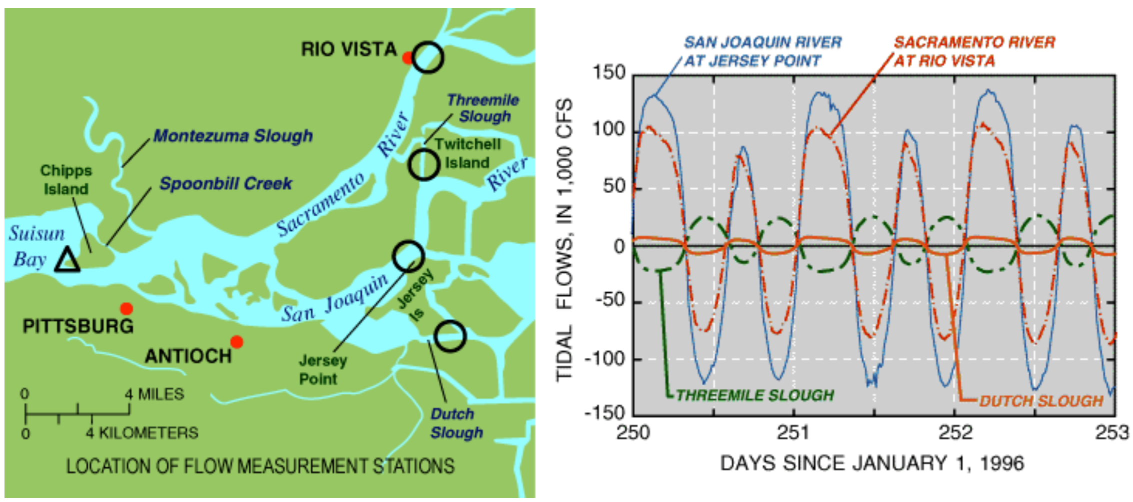

Figure 3.1-1. Flow directions and magnitudes at four stations in the Sacramento-San Joaquin Delta. Positive flow indicates seaward flows except for Threemile Slough, where positive flow indicates flow from the Sacramento River to the San Joaquin River. Source: Oltmann 1996; USGS

Marsh Creek Delta

Historically, Marsh Creek meandered across its lower reach, depositing mineral sediments and building natural levees until storm events forced it to leave its banks and establish a new channel. Through this process the creek gradually formed a delta at its mouth and the location of the creek's confluence with Dutch Slough varied over time. Confinement of the creek into its existing flood control channel took this ability away from the creek, and the location of its delta is now controlled by human flood control activities. Aerial photos taken in 1968 and 1978, indicate that at some point between those dates the mouth of the creek changed from flowing directly into Dutch Slough to flowing straight into Big Break.

Contributing Watersheds

Dutch Slough spans the boundaries of two watersheds. The western parcel (Emerson Parcel) is in the large Marsh Creek watershed while the middle and eastern parcels (Gilbert and Burroughs) are in

[1] NGVD29 29 = National Geodetic Vertical Datum of 1929. See http://www.ngs.noaa.gov/faq.shtml for more information.

the small East County Delta Drainages watershed (Jones and Stokes 2005). The Ironhouse Parcel is also part of the Marsh Creek watershed.

MARSH CREEK HYDROLOGY

Marsh Creek flows approximately 30 miles from its headwaters in the upper eastern portions of Mt. Diablo to its mouth at Big Break. The 128-square-mile watershed includes undeveloped and agricultural uplands in the upper watershed and urban lowlands in the vicinity of Brentwood and Oakley (Figure 2-1). Marsh Creek Reservoir, located in the upper portion of the watershed near Briones Valley, was constructed in 1938 and stores runoff from approximately 38% of the watershed (PWA 2006). The four major tributaries draining into Marsh Creek are Briones, Dry, Deer and Sand Creeks. The confluence of Briones and Marsh Creeks is at the Reservoir while Dry, Deer, and Sand Creeks flow into Marsh Creek in the lower portions of the watershed.

Rainfall in the watershed is comparatively light because of the rain shadow effect of Mt. Diablo. Average annual rainfall at Brentwood for the period 1907 to 2000 is 12 inches with variation between 4 and 30 inches (NHI 2003). Flow in Marsh Creek is highly seasonal, with peak flows associated with winter storm runoff, though it flows year round with summer flows sustained by discharges from the Brentwood Wastewater Treatment Plant. The 100-year flow is estimated to be 2,720 cubic feet per second (cfs) at its mouth at Big Break (CCC 2003). The lower reach of Marsh Creek, on the Project site, approximately north of its crossing the Contra Costa Canal, is tidal-influenced except during brief periods (generally less than one week annually) during the winters of wet years with high Delta outflow (PWA 2006). Bypasses and overbank spills upstream of the Contra Costa Canal are estimated to reduce peak flood discharges in lower Marsh Creek relative to locations further upstream (PWA 2006, FEMA 1987). Tidal height (stage) in Dutch Slough controls flood elevations in lower Marsh Creek below the Contra Costa Canal (PWA 2006). The lower reach of Marsh Creek in the project vicinity is owned by the Contra Costa County Flood Control and Water Conservation District, which maintains the channel for flood conveyance purposes.

MARSH CREEK GEOMORPHOLOGY

Before the Natural Resource Conservation Service (formerly the Soil Conservation Service) commenced flood control activities in eastern Contra Costa County in the 1950s and Reclamation District 799 began constructing levees in the area in the early 1900s, Marsh Creek meandered freely across the alluvial plain and into the diked lands adjacent to the project reach. However, these levee building and flood control activities had a major impact on Marsh Creek and its tributaries by straightening and confining the creeks as they moved through the developed lowlands. Marsh Creek was isolated from its floodplain and almost all natural features such as vegetation, point bars, riffles, and pools were removed. The channel was re-graded into an enlarged, homogenous, trapezoidal cross-section to expedite the movement of flood flows into Dutch Slough. The flood control channel separates the Dutch Slough site on its east from the Ironhouse parcel on its west, and is bordered on either side by levees that confine the entire flow of Marsh Creek. The elevation of the levees ranges from +12 to +14 feet NGVD29. The flood control district employs a chemical mowing program along the channel and levee banks to prevent colonization of riparian vegetation and maintain flood conveyance capacity. The levee on the west bank north of the EBRPD bridge, dividing Marsh Creek from Big Break, is not maintained.

East County Delta Drainages

The Gilbert and Burroughs parcels are linked to small portions of the East County Delta Drainages. These low-lying lands are dissected by numerous agricultural drainage ditches often terminating in pumps that discharge stormwater and groundwater into tidal sloughs. Flow in these areas is largely controlled by flood control infrastructure and irrigation canals which crisscross the landscape to supply water for agriculture (CCWD 2003).

Contra Costa Canal

Immediately south of the Dutch Slough site is the Contra Costa Canal, an artificial earth-lined waterway that supplies water from the Delta at Rock Slough to the Contra Costa Water District (CCWD) Pumping Plant No. 1 located a short distance southwest of the site. The canal from the pumping plant east to Rock Slough is approximately 4 miles in length, 10 feet deep at mean tide, and 50 to 100 feet wide (CCWD 2006). Top elevations of the levee on the north side of the Canal adjacent to the Project site range from +8.3 to +24.4 ft NGVD29. A trash rack and headworks structure are located at the Canal's confluence with Rock Slough. CCWD uses this water intake during winter months only as needed to supplement other water supply sources. CCWD maintains and operates the Contra Costa Canal for the U.S. Bureau of Reclamation, which owns the canal and adjacent right-of-way (ROW). Maintenance along the unlined canal ROW includes discing, mowing, and the use of herbicides and aquatic pesticides. CCWD expects that maintenance along the unlined canal would increase as more houses are built close to the canal (CCWD 2006).

CCWD is currently proposing to encase the canal in a pipeline from Rock Slough to Pumping Plant No. 1 (CCWD 2006). Phase I of the encasement, which encompasses the portion of the Canal between Pumping Plant No. 1 and the west side of Marsh Creek (approximately 2,000 feet), is scheduled to begin in April 2008. Encasement of the canal would eliminate its connectivity to surrounding surface and ground water, thereby eliminating concerns related to groundwater intrusion to the canal from the Dutch Slough Restoration Project. The Canal Encasement project has not received final permits.

Groundwater Connectivity to Surrounding Properties

Sand underlies the Dutch Slough site and adjacent properties in all directions with typical depths extending 30 to 50 feet below ground surface (Hultgren-Tillis 2005). While the regional groundwater gradient is from south to north toward the tidal waters of the western Delta, pumping and other land use activities on individual properties locally modify this gradient (Hultgren-Tillis 2005). Groundwater depths on the Dutch Slough site vary seasonally and between the parcels. During a recent study from September 2004 to April 2006, LSCE (2006) reported ranges of -0.7 to +5.7 ft NGVD29 on the Emerson Parcel, -1.5 to +3.2 ft NGVD29 on the Gilbert Parcel, and -2.7 to +1.5 ft NGVD29 on the Burroughs Parcel; LSCE reported all its data in feet NAVD88 which we have converted to NGVD29 to be consistent with the datum used in the Feasibility Report (PWA 2006)[2]. That conversion is approximately a 2.7ft difference locally. The Dutch Slough parcels are behind levees, subsided, and experience regular groundwater pumping, especially in the winter to maintain

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[2] NAVD 88 = North American Vertical Datum of 1988, which supersedes the National Geodetic Vertical Datum of 1929. The local difference between the two is estimated to be 2.7 ft per National Geodetic Survey online software at http://www.ngs.noaa.gov/TOOLS/Vertcon/vertcon.html. See http://www.ngs.noaa.gov/faq.shtml for more information.

accessible land (Hultgren-Tillis 2005). All the recent groundwater monitoring data demonstrate a daily tidal influence of roughly 0.1 to 0.2 feet (LSCE 2006).

CONNECTION TO THE CONTRA COSTA CANAL

DWR and CCWD recently released an evaluation of the relationship between shallow groundwater in the restoration area and the Contra Costa Canal *(Groundwater Investigation and Monitoring Program, Dutch Slough Restoration Area,* LSCE 2006). This study included (1) installing six monitoring wells 25 feet in depth (two on the Emerson Parcel, two on the Gilbert Parcel, one on the Burroughs Parcel, and one south of the Canal opposite the Gilbert Parcel) and monitoring their water level hourly from September 2004 to April 2006, (2), installing one stilling well in Emerson Slough and monitoring tide stage hourly from September 2004 to March 2005 and utilizing DWR monitoring data from Rock Slough after March 2005, and (3) sampling the monitoring wells and surface water in the Canal, Marsh Creek, Emerson Slough, and the Gilbert Pond and analyzing samples for a suite of mineral and nutrient water quality indicators.

The study indicated three general trends in the region. First, groundwater generally flows from south to north, i.e., from the low-lying alluvial plain of the lower watershed to the Delta. As noted above, management on individual parcels north and south of the canal, most notably winter pumping and summer irrigation, mediate these regional flow patterns at the site scale. Second, local soils generally exhibit relatively high permeability, facilitating groundwater exchange with surface water. This permeability is evident from the groundwater data at all six monitoring wells, as water levels exhibit a daily tidal signal (water levels rise and fall with the tides) on the order of 0.1 to 0.2 feet from adjacent tides in Marsh Creek, Dutch Slough, or the Contra Costa Canal.

For the Emerson and Gilbert Parcels, the study found that hydraulic conditions favor net flow from groundwater into the Canal during wet periods (termed “discharge”) and from the Canal into groundwater during dry periods (termed “recharge”). Periodically, summer irrigation activities raise groundwater levels on these parcels higher than water surface elevations within the Canal, creating the potential for temporary groundwater flow into the Canal. Otherwise, summer conditions favor outflows from the Canal (groundwater recharge). (LSCE 2006) At the Burroughs Parcel, the study found year-round flux from the Canal (recharge).

The LSCE study used a 5-hour averaged tide stage at Rock Slough as the tidal reference elevation. This approximation of mean sea level ranged from about 0.5 to 2.6 ft NGVD29, with the average value over the study period of about 1.3 ft NGVD29. Mean sea level at the Dutch Slough site is about 1.5 ft NGVD29; see Table 3.1-1.

For salt loading into the Canal, the study found results similar to prior investigations mentioned but not cited in the LSCE report, namely, that the Canal accumulates salts during low- and no-flow periods that originate from a broad source or sources of dissolved salts available in the vicinity of the unlined portions of the Canal. The report identifies these sources to include soils, seawater intrusion, wastewater application, and agricultural runoff. The study confirmed the Dutch Slough site groundwater to be generally brackish. The study also noted that two predominant soil types in the area, Marcuse Clay and Sycamore Silty Clay Loam, are characterized as poorly drained, saline, and alkali by the NRCS. The study did not attempt to identify the relative contributions of these different sources of salt but it did indicate the groundwater discharge from the south is expected to be greater than from the north (Dutch Slough site) side of the Canal, based on the regional groundwater gradients.

Previous investigations (mentioned but not cited in LSCE [2006]) of groundwater conditions at the Ironhouse parcel carried out by the Ironhouse Sanitary District have encountered groundwater elevations higher than water elevations in the Canal during certain periods. The District has also observed degraded water quality in the Canal during wet periods. Hultgren-Tillis (2005) reported groundwater levels were typically around local mean tide level and were controlled by irrigation from the Sanitary District and from groundwater connectivity to Marsh Creek.

CONNECTION TO LANDS SOUTH OF THE CONTRA COSTA CANAL

A stormwater management plan produced for the property immediately south of the Canal across from the Emerson parcel (Balance Hydrologics 2004) describes persistent groundwater elevations along the northern boundary of this property around +2.0 ft NGVD29, although no data are given to support this assertion. Data collected between September 2004 and April 2006 on the property south of the Gilbert Parcel (at a location approximately 400 ft south of the Canal) showed groundwater levels between about -0.7 to +3.3 ft NGVD29 with higher levels in the winter and lower levels in the summer (LSCE 2006).

CONNECTION TO LANDS EAST OF JERSEY ISLAND ROAD

ENGEO Inc (2005), which conducted a study for the adjacent Cypress Corridor Specific Plan Area (CCSPA) east of Jersey Island Road, concluded that that Emerson and Little Dutch Sloughs "do not currently contribute to significant groundwater recharge in [the CCSPA] because drainage tiles and lift pumps used to dewater the lands below sea level exist adjacent to these sloughs that provide a point of hydraulic control with zero net effect. In other words, the amount of water recharges from the sloughs equals, or is less than, the amount of water being removed by the drainage tiles and drainage lift pumps." The same study also concludes that the Contra Costa Canal recharges groundwater in the CCSPA because water surface elevations in the Canal are typically higher than groundwater elevations. ENGEO (2005) estimated the amount of this recharge to be approximately 335 acre-feet per year. Hultgren-Tillis (2005) indicated that recharge from Dutch Slough via porous underlying sandy soils contributes to groundwater in these lands.

CONNECTION TO LANDS WEST OF MARSH CREEK

Across Marsh Creek from the Dutch Slough site are ISD lands on which treated wastewater is used to irrigate fields and, as such, the land's available capacity for receiving water inputs is fully committed. Existing groundwater levels on these Ironhouse lands are around mean tide level. Marsh Creek is likely to be a drainage boundary between the Ironhouse lands and the Dutch Slough site (Hultgren-Tillis 2005).

Flooding

The three Dutch Slough parcels and the Ironhouse parcel are within FEMA's 100-year floodplain, which has a base flood elevation of +7 feet NGVD29 (PWA 2006; FEMA 1987). The agricultural levees around Dutch Slough and in the surrounding vicinity are not constructed to FEMA standards, and as such are presumed inadequate for providing 100-year flood protection. The berm separating the Contra Costa Canal from the Dutch Slough site has top elevations above the 100-year flood level and the FEMA study indicates it will provide protection to the lands south of Dutch Slough, even though it was not engineered for this purpose. However, PWA (2006) reports that site topographic surveys identify breaks in the embankments near Emerson and Little Dutch Sloughs that could result in flooding to the south. In addition, CCWD is planning to encase the entire canal by placing it an underground pipe. When this is done, the berm will be graded down to a lower elevation.

On site and surrounding infrastructure that may be susceptible to flood impacts include (PWA 2006):

- The Ironhouse Sanitary District Pipeline located along the northwest corner of the site
- The active gas wells located on the Burroughs property
- The Pacific Gas & Electric power lines located on the northeastern corner of the site
- The adjacent levees, including the Jersey Island levees north of Dutch Slough, could experience wave-induced erosion.
- The 1.36-acre residential inholding on the Burroughs parcel, adjacent to Jersey Island Road
- The proposed 55-acre City park site
- Areas south of the site that drain into Emerson Slough and Little Dutch Slough

Emerson, Gilbert, and Burroughs Parcels Hydrology

The Emerson, Gilbert, and Burroughs parcels collect direct precipitation and are seasonally managed during the rainy season, with surface water gathered in agricultural drainage ditches and pumped into the surrounding sloughs (PWA 2006). The existing groundwater elevation in the Dutch Slough site is estimated to be between +3 feet to -10 ft NGVD29 (PWA 2006). The existing levees around the Dutch Slough Restoration Project site have allowed the groundwater to be artificially lowered within the project site by evapo-transpiration in the summer and pumping in the winter. Many adjacent levee-protected properties also have lower groundwater levels than existed prior to reclamation. The aquifer beneath the site is being recharged in part from Dutch Slough, Little Dutch Slough, Emerson Slough, and the Contra Costa Canal. Groundwater levels around the site vary irregularly, most likely due to local groundwater withdrawal and/or infiltration. Regional topography and geology may cause a general pattern of groundwater flow in a northerly direction; however, local modifications to groundwater levels are likely to have a greater influence on the direction and magnitude of groundwater flow than regional patterns (PWA 2006).

Emerson, Gilbert and Burroughs Parcels Topography

PWA compiled previously existing site topographic data in the Dutch Slough Conceptual Plan & Feasibility Report (PWA 2006). Dutch Slough is more suitable for tidal marsh restoration than most other potential restoration sites in the Delta because it is not deeply subsided and sizeable portions of the site are at elevations conducive to sedimentation and colonization of emergent tidal marsh vegetation (PWA 2006). Table 3.1-2 presents the parcel acreages at the Dutch Slough parcels relative to the local tidal datum. These data are based upon previous site topographic surveys conducted by Carlson, Barbee & Gibson (CBG) and Green Mountain Engineering (GME) and the tidal datums reported in Table 3.1-1.

CBG conducted an aerial photogrammetric survey in 2000 to characterize site topography; this data set is reported relative to NGVD29. GME conducted subsequent ground surveys of the Emerson and Gilbert parcel levees in 2004. Characterizing site elevations relative to the tidal datums is important as it informs the restoration design, the location of design features and the overall feasibility of the restoration. These parcels slope downward from south to north (See Figure 2-3). Elevations at the site range from approximately -10 to +15 feet NGVD29 (-12 to +13 feet MSL) (PWA 2006). Most of the site (~68%) is below MLLW. Levee top elevations on the Gilbert, Burroughs and Emerson parcels range from ~ +8 to +12 feet NGVD29, though the southwestern portions of the Emerson parcel adjacent to Marsh Creek are substantially higher (+10 to +24 feet NGVD29) to provide greater flood protection along Marsh Creek.

Table 3.1-2. Parcel acreages relative to Dutch Slough tidal datums (from PWA 2006).

Elevation Range	Emerson (acres)	Gilbert (acres)	Burroughs (acres)
5 ft. above MHHW to Highest (Potential Dune Habitat and Upland)	32	1	3
MHHW to 5 ft above MHHW (Potential Riparian)	133	33	31
MTL to MHHW (Potential High Emergent Marsh)	22	17	37
MLLW to MTL (Potential Low Emergent Marsh)	12	6	27
6.25 ft. below MLLW to MLLW (Potential Low Emergent Marsh and Shallow Subtidal)	126	197	299
Lowest to 6 ft below MLLW (Potential Deep Subtidal)	111	21	21
Total	436	275	418

Note: Potential habitats based on colonization elevation data from Orr and others, 2003. Total acreages differ from the totals in NHI, 2004 due to small differences in the digitized boundaries.

Ironhouse Parcel Hydrology and Topography

The Ironhouse Parcel consists of 100 acres of irrigated pasture owned by the Ironhouse Sanitary District. The sanitary district irrigates the pasture with treated wastewater. The average elevation of the pasture is +6 feet NGVD29. The site is currently bisected by the Contra Costa Canal, which constrains the course of Marsh Creek where the two cross. As discussed above, groundwater elevations in the Ironhouse parcel can at times exceed surface water elevations in the Canal, creating conditions amenable to net flow from groundwater into the Canal. Hultgren-Tillis (2005) reported groundwater levels were typically around local mean tide level and were controlled by irrigation from the Sanitary District and from groundwater connectivity to Marsh Creek. The Contra Costa Water District is proposing to encase the canal below the lowest elevation of Marsh Creek and fill in the existing canal. The canal encasement and fill project would effectively eliminate any surface expression of the canal across the Ironhouse Parcel.

Regulatory Setting

Contra Costa County

The specific regulatory considerations related to hydrology and geomorphology are those arising from the Contra Costa County Flood Control and Water Conservation District (CCCFCWCD) and its obligations relative to maintaining flood conveyance capacity of Marsh Creek. Since the District owns Marsh Creek in fee title, any work proposed on the creek would require a flood control encroachment permit.

If Marsh Creek is diverted into the Dutch Slough site such that the original channel north of the diversion does not provide flood control services, CCCFCWCD has no interest in retaining the "orphaned" right-of-way along that segment of the channel. As a result, work on Marsh Creek may require real property transactions between CCCFCWCD and DWR.

At a minimum, CCCFCWCD would require that the project "design and construct a drainage system to adequately collect and convey stormwater runoff, entering or originating within the project to the nearest natural watercourse or adequate man-made drainage facility, without diversion of the watershed" (CCCFCWCD 2006). The design flow for the Marsh Creek flood control channel is the typical FEMA 100-year flow. The CCCFCWCD has requested that any Marsh Creek relocation efforts include as the design basis the flow of a 100-year storm based on ultimate watershed development (CCCFCWCD 2006).

Natural Resource Conservation Service

The Marsh Creek channel/levees were originally constructed by the Soil Conservation Service (SCS), now the Natural Resource Conservation Service (NRCS). Major modifications to the Marsh Creek channel/levees may need to be approved by NRCS. The NRCS also may need to release right-of-way transfers of portions of Marsh Creek to other agencies.

The State Reclamation Board cooperates with federal and State agencies and local governments in establishing, planning, constructing, operating, and maintaining flood control works. Reclamation District 799 is the agency responsible for flood protection and drainage on the Hotchkiss Tract immediately east of the Dutch Slough site. The Reclamation District issues permits for projects that:

A. Are within federal flood control project levees and within a Board easement, or

B. May have an effect on the flood control functions of project levees, or

C. Are within a Board designated floodway, or

D. Are within regulated Central Valley streams listed in Table 8.1 in Title 23 of the California Code of Regulations.

CALFED Delta Risk Management Strategy

A major need for the State is to determine how to make the Delta sustainable in the future. The 2000 CALFED Record of Decision presented its Preferred Program Alternative that described actions, studies, and conditional decisions to help fix the Delta. Included in the Preferred Program Alternative for Stage 1 implementation was the completion of a Delta Risk Management Strategy

(DRMS) that would look at sustainability of the Delta, and that would assess major risks to the Delta resources from floods, seepage, subsidence, and earthquakes. DRMS has also evaluated the consequences, and develop recommendations to manage the risk. To implement the Delta risk assessment, legislation was passed that requires DWR to evaluate the potential impacts on water supplies derived from the Delta based on 50-, 100-, and 200-year projections for each of the following possible impacts: subsidence, earthquakes, floods, climate change and sea level rise, or a combination of the above. The DRMS work will provide the majority of this required information. The report is due to the Legislature no later than January 1, 2009.

3.1.2 Impacts and Mitigations

Significance Criteria

Significance Criteria for the relevant hydrology and geomorphology portions of the project are based upon the CEQA guidelines and professional judgment. Potentially significant impact could occur if the project results in:

- Substantial modifications to existing hydrological conditions, including surface water inputs and outputs, drainage network, or channel alignment resulting in substantial erosion or siltation on or off-site
- Substantial modifications to existing infiltration rates and interference with groundwater recharge that would deplete groundwater supplies or lower the local groundwater table level
- Substantial alterations to existing drainage pattern of the project site or area that would increase surface runoff resulting in on-site or off-site flooding
- Runoff that would exceed stormwater drainage systems or act as source of polluted runoff
- Structures placed within a 100-yr flood hazard area that would impede or redirect flood flows
- Exposure of people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of levee failure

Alternative 1: Minimum Fill

IMPACT 3.1.1-1 EROSION IN TERMINAL SLOUGHS DUE TO INCREASED TIDAL PRISMS

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

Due to the presence of the site's perimeter levees, the tidal prisms (the tidal prism is the volume of water that flows past a given point, such as through a levee breach, during a tidal cycle) currently carried by Emerson and Little Dutch Sloughs are substantially smaller than they would be if the perimeter levees were breached. The channel geometry of these terminal sloughs is sized to carry these smaller tidal prisms. As a result, with the Project, it is expected that the sloughs would erode over time to accommodate the larger post-restoration tidal prisms (PWA 2006).

Erosion in and of itself would not be an undesirable impact of the Project; it would suspend a local sediment source in the tidal water column, making this sediment available for deposition on the restored marsh plain. However, erosion can result in negative impacts if (1) it does not happen within an expected period of time, resulting in a muted tidal signal which can potentially delay marsh plain evolution (PWA 2006), (2) it threatens the integrity of the upland areas surrounding the proposed City Community Park (Emerson Slough) or the berm adjacent to the Contra Costa Canal (Little Dutch Slough), or (3) it results in local water quality impairments.

Erosion Time Frame. The impact of erosion in Little Dutch Slough was modeled in 2006 by PWA, however, the modeling assumed the moderate site fill of Alternative 2, not the minimal fill of Alternative 1. The tidal prisms under Alternative 1 are larger than those of Alternative 2 due to lower total fill volumes to reverse subsidence. For the purposes of this analysis, it is assumed that the results of the Little Dutch Slough modeling apply to Emerson Slough as well. The modeling determined that velocities in the slough would be within the range of scouring (eroding) velocities, though the actual rates/amounts of scour could not be estimated due to a lack of information about critical shear stress values of the sediments in the slough. If modeled flow velocities were within scouring range under the smaller tidal prisms of Alternative 2, it follows that modeled velocities would be even higher for the larger tidal prisms of Alternative 1.

Since it is expected that erosion would occur, whether or not it happens within an "expected" time frame is dependent on the project performance measures established by project planners.

Upstream Erosion. Under Alternative 1, all breaches to the Dutch Slough Restoration Project site are downstream of the uplands south of Little Dutch Slough and the proposed City Community Park near Emerson Slough. Since the tidal prism upstream of these breaches would remain virtually unchanged, significant erosion in these areas is not anticipated.

OPEN WATER MANAGEMENT OPTIONS

The amount of erosion in the terminal sloughs is directly related to the size of the site's tidal prism. The larger the tidal prism, the greater erosion would be. Therefore, erosion would likely be greatest under the deep subtidal option, less so under the shallow subtidal option, and even less so under the skeletal channel network option. The PWA modeling indicates that if channel geometry in Little Dutch Slough remains unchanged, managing the open water areas as non-tidal would cause tidal damping to be slightly less than if the areas were fully tidal. Less tidal damping would likely result in increased erosion due to higher scouring velocities. Subsidence reversal is unlikely to result in the deposition of enough material to have a short-term significant effect on tidal prisms and scouring velocities in the terminal sloughs; this outcome may change in the long-term if plant material accretes to intertidal elevations.

"NO BURROUGHS" OPTION

Under this option, the levee breaches would occur on Emerson Slough rather than Little Dutch Slough. For the purposes of this analysis, it is assumed that the results of the Little Dutch Slough modeling apply to Emerson Slough as well. Therefore, the impacts of and proposed mitigations for the "no Burroughs" option with breaches on Emerson Slough are the same as for the tidal restoration of all three parcels with breaches on Little Dutch Slough

MITIGATION 3.1.1-1.1 EROSION/SEDIMENTATION DESIGN AND PERFORMANCE STANDARDS

The final design of the restoration projects shall include design periods, performance standards, and adaptive management contingencies for site evolution and development.

MITIGATION 3.1.1-1.2 EROSION MONITORING AND ADAPTIVE MANAGEMENT

Continual monitoring of erosion in the terminal sloughs shall be conducted by the Project for at least 10 years post-construction. This will not only provide useful scientific data, but also will allow for adaptive management of the Restoration Project site. If erosion is so great that it causes water quality impairments (see Section 3.2), improvements such as channel armoring shall be implemented to manage and reduce erosion.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.1.1-2 DECREASED FLOOD FLOW CONVEYANCE OF MARSH CREEK DUE TO INCREASED TAILWATER ELEVATIONS (IRONHOUSE PROJECT ONLY)

Flood flow conveyance in Marsh Creek is controlled by a number of factors: fluvial flows, tidal flows, channel geometry, bed roughness factors such as vegetation and shellfish, and flow attenuation via on- and off-line reservoirs and detention basins. Tidal influence on Marsh Creek is greatest near its mouth at Dutch Slough, then decreases heading upstream (NHI 2002). While the elevations of MLW and MLLW in the creek are controlled partially by bed elevations, MHHW in the creek near the Contra Costa Canal is only 0.2 ft lower than MHHW at the mouth of Marsh Creek. This small amount of tidal dampening is due to the larger dimensions of the channel north of the existing EBRPD bridge (NHI 2002). If the tidal prism upstream of the mouth of Marsh Creek is increased due to restoration of the Ironhouse parcel, tides may become muted and/or perched upstream in Marsh Creek. Given this increased tidal action further south towards and beyond the Contra Costa Canal, the project could be expected to increase tailwater height. WWR expects the existing 0.2 ft difference between MHHW at the Marsh Creek mouth and the Contra Costa Canal to shift south of the Canal and to propagate further upstream along Marsh Creek. While the effects of higher tailwater elevations on flood conveyance in Marsh Creek have not yet been evaluated, the effects are unlikely to be significant because the anticipated tailwater elevation increase (0.2 ft) is so small. Nevertheless, the risk of flooding around Marsh Creek makes modeling these effects prudent (see Mitigation Measures).

MITIGATION 3.1.1-2.1 DEVELOP DESIGN CRITERIA FOR INCREASED TIDAL PRISM ON MARSH CREEK

Prior to implementing restoration of the Ironhouse parcel a hydrodynamic analysis of the creek and/or the proposed Ironhouse restoration shall be performed, as applicable. This analysis shall investigate water surface elevations, flow rates/velocities, and groundwater impacts within lower Marsh Creek and its adjacent properties. On the basis of this analysis design criteria shall be developed that eliminate any potential for increased flooding from changes in tidal prism generated by restoration of the Ironhouse parcel (see Mitigation 3.1-2.2, below).

MITIGATION 3.1.1-2.2 DESIGN MARSH CREEK TO CONVEY 100-YEAR DESIGN FLOW

Any channels built to route Marsh Creek shall be designed and constructed to have adequate capacity convey the creek's 100-year design flow rate, as determined by the CCFCD.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.1.1-3 PEAK FLUVIAL-TIDAL DEPOSITION (IRONHOUSE PROJECT ONLY)

Due to increased tailwater elevations in Marsh Creek from restoration of the Ironhouse parcel (see Impact 3.1.1-2 above), the point of peak tidal-fluvial deposition in the creek would move south (upstream). However, insufficient information exists to determine the magnitude and location of these depositional changes. From a qualitative perspective, considering the anticipated small (0.2 ft) increase in MHHW throughout the lower reach of Marsh Creek, WWR expects the depositional changes to be less than significant. The Contra Costa County Flood Control District may have to shift the location, extent, and frequency of channel bed dredging as a consequence of this project, but it is not expected to result in a significant change to dredging needs.

IMPACT 3.1.1-4 POTENTIAL INCREASED FLOODING AT THE IRONHOUSE PARCEL (IRONHOUSE PROJECT ONLY)

Wetland restoration at the Ironhouse parcel would involve the breaching of a Marsh Creek levee (top elevation +12 to +14 ft NGVD29) and the excavation of lands at about +6 ft NGVD29 to about +1.5 ft NGVD29. Soil material excavated from the Ironhouse parcel will be used as fill in the greater Dutch Slough Restoration Project. Flood protection to compensate for breaching of the Marsh Creek levee would be provided by construction of a flood control levee around the upland edge of the parcel.

MITIGATION 3.1.1-4 CONSTRUCT FLOOD PROTECTION LEVEE AROUND IRONHOUSE PARCEL (APPLIES TO IRONHOUSE PROJECT ONLY)

To match the existing level of flood protection around Marsh Creek, a new flood control levee shall be built around the restored Ironhouse parcel. A flood protection analysis shall conducted in coordination with CCCFCD to determine the appropriate height for this levee.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.1.1-5 POSSIBLE WATER QUALITY DEGRADATION IN CONTRA COSTA CANAL DUE TO GROUNDWATER SEEPAGE

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

Studies have concluded that the permeable soils and geologic formations within and around the Dutch Slough Restoration Project site would allow for potentially significant subsurface hydraulic connectivity between the site and its surrounding properties (LSCE 2006). This connectivity would likely increase local groundwater elevations once the site is inundated by Delta waters, and create the potential for seepage into surrounding properties. The flattened gradient and elevated groundwater table on the Dutch Slough site following restoration suggests that there would be a greater magnitude and persistence of groundwater discharge into the Canal relative to existing conditions whenever groundwater elevations are greater than the Canal surface water elevation. As the tides within the Canal and on the Dutch Slough site are expected to be very close in magnitude but with a time lag in the Canal (LSCE 2006), the gradient would be expected to be quite small throughout much of the year leading to minimal net exchange. Winter rains, especially when combined with spring tides and large Delta outflow, may generate short-term increased gradients toward the Canal but the proposed tidal drainage versus current condition of storage with pump discharge is likely to remove rainfall via surface water more rapidly. Over the course of an annual cycle, the project would shift from a cycle of winter discharge into and summer recharge from the Canal at Emerson and Gilbert parcels, with the net direction being determined by tidal head (elevation) differences between Dutch Slough and Rock Slough (which the LSCE study states are negligible).

Therefore, any potential increase in salt loading into the Canal via groundwater discharge from Dutch Slough is likely to be small relative to current conditions. This impact, therefore, is likely to be less than significant. However, there is still some chance of an increase in salt loading occurring as a result of the Dutch Slough Restoration Project and thus mitigation measures are identified that would assure that this impact would be less than significant.

The planned encasement of the CCWD Canal, which is addressed further under Cumulative Impacts, would remove the risk of changes in groundwater levels on the project site affecting the water supply quality. That project also would protect the water supply from other potential sources of contamination such as agricultural runoff, municipal runoff, treated wastewater, and salt leaching from soils throughout the region. The CCWD project commenced implementation in 2008.

OPEN WATER MANAGEMENT OPTIONS

No change in impacts would occur with the various open water management options.

MITIGATION 3.1.1-5 GROUNDWATER INTRUSION STUDY AND REMEDIATION

If the Dutch Slough Restoration Project proceeds prior to the proposed CCWD Encasement Project, then the Dutch Slough Restoration Project shall participate in a study with CCWD to quantify the relative contributions of all possible sources of salt loading into the Canal, thereby quantifying the relative role of the Dutch Slough Restoration Project in local groundwater intrusion. The Dutch Slough Restoration Project shall be responsible for components related to the Dutch Slough site; CCWD shall be responsible for addressing all other sources.

STUDY DESIGN

The study to be completed by the Dutch Slough Restoration Project shall determine the absolute and relative contributions/loadings of salt from the restored Dutch Slough Restoration Project site to the Contra Costa Canal during time periods when the CCWD Pumping Plant #1 draws Canal water for public drinking water supply. While CCWD's cooperation in this study cannot be required under CEQA, it would increase greatly the likelihood of correctly identifying and quantifying other possible sources of salt loading to the Canal.

Salinity changes also could result from non-project activities including:

1. Groundwater pumping in the developed areas south of the Canal. Increased groundwater pumping would increase the gradient from the Canal to lands south of the Canal; that water demand could be met through increased inflows to the Canal at Rock Slough or it could cause a steeper groundwater gradient from the Project area than would otherwise exist, thereby increasing the potential for salt transport into the Canal from the Project area.

2. Changes in the salinity of inflow water at Rock Slough, a condition driven by more regional Delta salinity conditions.

Thus, in order to establish salinity effects from the Project area, the analysis will have to incorporate continuous salinity monitoring data from other nearby Delta locations or, if such monitoring locations are not already in place, such monitoring will have to be added into this study.

The study shall consist of an expanded version of that prepared by LSCE (2006). It shall reoccupy existing wells and install new wells to establish an adequate monitoring framework spatially and with depth, north and south of the Canal and explicitly capturing potential salt loading areas such as the Ironhouse Sanitary District lands. Monitoring shall include Canal surface water and Dutch Slough Restoration Project and other groundwater levels and conductivity utilizing automated sensors at tidal time-scale frequencies (12 or 15 minute intervals, depending on whether we track DWR or NOS monitoring). In addition, water quality grab samples shall be collected periodically (roughly biweekly) and analyzed for indicator trace minerals. If viable, the study shall also include use of added tracers for the purpose of establishing groundwater transport patterns. The monitoring shall occur for one year prior to opening the Dutch Slough Restoration Project to tidal action and continuing for one year afterwards. The study shall be operated under an approved Quality Assurance Project Plan (QAPP) to ensure collection of high-quality data upon which conclusions will be based.

Data analysis shall include using water levels to establish groundwater discharge-recharge conditions, conductivity to contribute to salt transport analyses, and trace mineral and potentially added tracers to establish salt loading sources and directions of transport. Analyses of other data sources shall also be included, such as soils maps to identify regions that could leach salts, and prior groundwater level and quality data to provide a broader perspective and to capture whether conditions during the study were reflective of or unique from prior conditions.

POST-STUDY ACTIONS

The data from this study shall be used to determine if groundwater intrusion from the Project area would result in an unacceptable increase in salinity in the Canal. The performance criteria for salinity are based on the guidelines set forth in the Bay-Delta Plan (SWRCB 2006). The Plan states that the maximum mean daily concentration of chloride (Cl^-) shall not exceed 250 mg/L during any "water year type" (defined by the Sacramento Valley 40-30-30 water year hydrologic classification index). In addition, the maximum mean daily concentration of 150 mg/L Cl shall be maintained for at least 240 days during a wet year, 190 days during an "above normal" year, 175 days during a "below normal" year, 165 days during a "dry" year, and 155 days during a "critical" year.

The project will be considered responsible for significant impacts to water quality only if, following restoration, (1) there is an increase in the groundwater gradient from the Project area into the Canal and (2) this change in gradient is accompanied by an unacceptable (as defined above) increase in salinity in the Canal water that is attributable to the increased groundwater gradient from the Project area.

If there is an increase in salinity in the Canal attributable to the Project and simple modifications to operations at the CCWD Water Treatment Plant to prevent violations of the salinity standards and maintain water supply to CCWD customers are determined to be infeasible by CCWD, one of the following mitigations shall be implemented:

1. Implementation of the Dutch Slough Restoration Project shall be delayed until the CCWD has encased the drinking water supply within the Canal in a pipeline.

or,

2. The technical and economic feasibility of constructing a groundwater cutoff wall (slurry wall), toe drain and pump, or other effective means of reducing infiltration into the Canal shall be evaluated, and such measures shall be implemented as appropriate. The groundwater intrusion study described above shall be continued after the implementation of the mitigation measures to determine the effects on groundwater infiltration and salinity in the Canal. The mitigation measures shall be deemed successful when salinity levels in the Canal are reduced below the threshold levels described above.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.1.1-6 GROUNDWATER INTRUSION ONTO ADJACENT PARCELS

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

Connectivity of the shallow aquifer suggests that permanently raised Dutch Slough Restoration site groundwater levels would have some influence on groundwater intrusion in all directions. These effects would be tempered to a great degree, however, because the tidal sloughs separating the restoration site from its adjacent parcels to the north, west, and south exert a far stronger hydraulic signal on groundwater (Hultgren-Tillis 2005). Groundwater pumping on these adjacent properties steepens the hydraulic gradient, causing greater flow from the Dutch Slough site. Adjacent parcels to the east and, if the Contra Costa Canal is encased, to the south, could therefore have increased pumping volumes, especially outside the wet season when other contributing sources to groundwater diminish relative to the possible Dutch Slough contribution.

North. Dutch Slough to the north is a wide, deep channel with a relatively large daily flow and direct hydraulic connection via sandy soils underlying the levees for Jersey Island to the north and the Dutch Slough site to the south (Hultgren-Tillis 2005). Groundwater effects of the Dutch Slough Restoration Project to Jersey Island are likely to be insignificant, therefore, and it is doubtful whether their signal could be detected amongst all the other controls on Jersey Island groundwater, i.e., the "noise" in the groundwater signal.

South. The Contra Costa Canal to the south has tides nearly identical to those at Emerson slough, and recent data demonstrate the tidal connectivity to groundwater on both sides of the Canal (LSCE 2006). Two external changes may take place in the near future, either before or after Dutch Slough implementation. First, a proposed residential development south of the Canal that is partially below sea level intends to install and permanently operate a groundwater management infrastructure system. Though groundwater on that property is currently pumped, the new system would be operated to maintain a lower and consistent groundwater level that will act to steepen the hydraulic gradient to its north, towards the Canal and Dutch Slough site. Under the current Canal configuration, increased groundwater levels at the Dutch Slough site would be dampened by the Canal such that the restoration site's groundwater signal to this property would be reduced to the level of insignificance.

Second, the Contra Costa Water District has proposed to fill the Canal, thereby eliminating the Canal's influence on groundwater levels south of the Dutch Slough site. Under this scenario, tidal action within the Dutch Slough Project would replace the Canal's influence to groundwater south of the Canal. Because of the greater horizontal distance between Dutch Slough and the property to the south and because backfill soils in the Canal reduce hydraulic conductivity relative to open water of the Canal, there would be lower hydraulic gradients relative to the existing condition and thus this impact would be less than significant.

West. Marsh Creek to the west is fully tidal to the EBRPD bridge with minor tidal dampening south to the Canal (NHI 2002). Ironhouse groundwater data (as reported in PWA 2006) also shows a strong tidal signal, with average levels (mean tide level) similar to those expected at the Dutch Slough Restoration Project site. During most of the year, no detectable changes in groundwater levels are expected to the west (Hultgren-Tillis 2005). During winter storm periods, prolonged average tide levels and higher peak high tides associated with storms may increase groundwater levels a small amount relative to existing conditions (Hultgren-Tillis 2005), thereby reducing by a small amount the absorption capacity of the field to the west currently irrigated with treated wastewater by the Ironhouse Sanitary District. The magnitude of this potential effect, however, is likely to be low since groundwater levels on remaining Ironhouse irrigated lands will be similar to the restored marsh and existing conditions primarily because Ironhouse does not pump its groundwater (i.e., a relatively small gradient). Due to projected increases in treatment demand associated with residential growth in the area, ISD is undertaking expansion plans that include terminating irrigation of these fields by 2010, before implementation of the Dutch Slough Restoration Project (Tom Williams, personal communication, July 3, 2008). Termination of irrigation would eliminate this impact west of the Dutch Slough Project site and no mitigation would be required.

East. To the east across Jersey Island Road are continued diked, subsided lands proposed for residential development; no tidal slough divides these properties. Dutch Slough Restoration Project site groundwater level increases are likely to increase groundwater flux to the east, requiring additional pumping to maintain existing water levels. This effect is likely to be significant. The Dutch Slough Restoration Project includes construction of a new levee on the west side of Jersey Island Road (PWA 2006). The proposed Hotchkiss development to the east intends to use groundwater as a resource to support water feature amenities and it includes a toe drain east of the new levee. If that project proceeds, then the impact is likely not to be significant. If Hotchkiss development does not proceed, then the impact would remain significant and require mitigation by the Dutch Slough Restoration Project, as identified in Mitigation 3.1.1-6-2, below.

OPEN WATER MANAGEMENT OPTIONS

The more open water area in the project, the greater influence the project would have on adjacent groundwater levels because open water transmits water level changes more rapidly and to a greater degree than do soils. If open water areas are managed as tidal systems, the groundwater fluctuations would be similar to those associated with tidal marsh components of the project, but with slightly greater changes in water levels and shorter durations of each of the water-level changes. The impacts to groundwater on adjacent parcels would be less than significant since none of the proposed open water areas would directly border the adjacent parcels (i.e. adjacent parcels are all bordered by either large stretches of land [that would buffer them from effects of open water management], or existing tidal sloughs).

If the open water areas are managed as a pond system, water surface elevations would be controlled by structures such as tide-gates and culverts. The effects of a managed pond regime on groundwater seepage onto adjacent parcels would depend on ultimate water surface elevations within the ponds, which could be managed lower or higher than tidal open water. The significance of the seepage impact would depend on the management regime (higher surface elevations would have a greater potential to result in groundwater intrusion on adjacent parcels).

"No Burroughs" Option

If this option were exercised, there would be no tidal marsh on the easternmost project parcel (Burroughs), so the risk of groundwater flux to the east would be negligible. This would eliminate a potentially significant impact, and Mitigation 3.1.1-6.2 would not be necessary.

Mitigation 3.1.1-6.1 Groundwater Intrusion Protection: West of Dutch Slough Restoration Project Site

ISD is implementing treatment alternatives that will eliminate use of the parcels adjacent to the Dutch Slough Restoration Project for treated wastewater irrigation. If the Dutch Slough Restoration Project proceeds before the Ironhouse Sanitary District (ISD) discontinues irrigation of its fields near its treatment plant (immediately west of the Ironhouse Project site) and if irrigation is expected to continue after Dutch Slough implementation, then the following mitigation measure shall be implemented:

Continued Groundwater Monitoring

The ISD currently monitors the groundwater levels in its irrigation fields manually once a month using a grid of 19 wells. The water level in the Contra Costa Canal adjacent to the Oakley treatment plant is also recorded at the time of the monthly monitoring by surveying the water surface elevation from a nearby benchmark. This monitoring program shall continue after the implementation of the Dutch Slough Restoration Project. In addition to the existing monitoring plan, the water level in Marsh Creek shall be surveyed during each monitoring event. Water level monitoring at Marsh Creek shall begin at least a year before restoration activities begin.

The Dutch Slough Restoration Project shall coordinate with the ISD to review pre- and post-restoration groundwater monitoring data to determine whether restoration activities at Dutch Slough are leading to increased groundwater levels and reduced groundwater storage capacity on the Ironhouse irrigation fields.

If there is an increase in groundwater levels at the Ironhouse irrigation fields that can be attributed to the Dutch Slough Restoration Project following the restoration activities and the increased groundwater levels cause a significant loss of groundwater storage capacity resulting in the loss of the use of the site for treated wastewater irrigation by ISD, the following additional mitigation measure shall be implemented.

Develop Compensatory Program with the ISD

The DWR shall coordinate with the ISD to determine the costs incurred to pump additional water to the District's Jersey Island lands as a result of restoration activities. One way in which this could be accomplished is by determining the volume of groundwater storage capacity that is lost following restoration and paying for the disposal of this volume of water. The exact formula for determining this volume, and the appropriate disposal costs shall be determined jointly by DWR and the ISD.

Mitigation 3.1.1-6.2 Groundwater Intrusion Protection– East of Site

The Dutch Slough project shall participate in a joint study with the adjacent landowners to the east to quantify the relative contributions of all possible sources of groundwater intrusion into the parcels east of the restoration site, thereby quantifying the relative role of the Dutch Slough restoration project in contributing to groundwater pumping needs. This study shall include field monitoring to measure actual flux into the eastern parcel. If this study determines a significant contribution from the project that would adversely affect hydrologic conditions east of the site that cannot be addressed with existing or planned groundwater management systems, then the technical and economic feasibility of constructing an effective means of reducing flux into the parcels shall be evaluated. Measures may include a groundwater cutoff wall, toe drain, or financial contribution to the operations and maintenance of groundwater collection systems currently in place or anticipated to be in place with new residential development, at levels commensurate with the documented percent contribution of the Dutch Slough project to increased groundwater levels and volumes to the south requiring abatement.

MITIGATION 3.1.1-6.3 DELAY DUTCH SLOUGH RESTORATION PROJECT UNTIL CESSATION OF IRRIGATION ON IRONHOUSE PARCELS AND CONSTRUCTION OF JERSEY ISLAND ROAD LEVEE

As an alternative to Mitigations 3.1.1-6.1 and 3.1.1-6.2 above, to prevent the loss of irrigation capacity at the Ironhouse parcels and the potential for groundwater intrusion onto the Hotchkiss Tract, to the east of the Dutch Slough Restoration Project site, implementation of the Dutch Slough Restoration Project shall be delayed until the ISD no longer uses lands west of the Dutch Slough site for wastewater irrigation and the Jersey Island Road levee/groundwater collection system is constructed.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.1.1-7 WIND-WAVE DRIVEN LEVEE OVERTOPPING INTO CONTRA COSTA CANAL

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

The levee along the north side of the Contra Costa Canal adjacent to the Project site has top elevations that range from +8.3 to over +24 ft NGVD29. Though the portion of this levee adjacent to the Emerson parcel has top elevations above +12 ft NGVD29, the portion of the levee adjacent to the Gilbert and Burroughs parcel is generally lower, with top elevations between +8.3 and +11.7 ft NGVD29. The low point (+8.3 ft NGVD29) in the levee south of the Gilbert parcel is only 1.8 ft above the 100-year tide level of +6.5 ft NGVD29.

There are two conditions when overtopping might occur. Both conditions are associated with extreme high tide events, which can occur in winter (Dec-Jan) and summer (Jun-Jul). In addition, Delta water levels can be much higher in the winter during major storm runoff events, a condition that does not occur in the summer. Significant wind events tend to come from the south during winter storms, away from the Canal, and from the west to northwest in the summer, somewhat aligned with the southern boundary. Were overtopping to occur in the winter, no significant impact is presumed to occur due to ambient salinity within the Dutch Slough site being very similar to that of the Canal water. Were overtopping to occur in the summer, a potentially significant effect on salinity in the Canal water could occur if the Canal were being used for water supply conveyance.

OPEN WATER MANAGEMENT OPTIONS

No change in impacts would occur with the various open water management options.

MITIGATION 3.1.1-7 LEVEE OVERTOPPING STUDY AND CONSTRUCT LEVEE IMPROVEMENTS OR DELAY DUTCH SLOUGH IMPLEMENTATION SCHEDULE IF OVERTOPPING A CONCERN

If the Dutch Slough Restoration Project proceeds prior to the proposed CCWD Encasement Project, then the Dutch Slough Restoration Project shall conduct a study to quantify the risk of upland/berm overtopping into the Contra Costa Canal and implement protective actions, as described below.

STUDY DESIGN

Factors in the study design are (1) existing elevations of land between the southern boundary of Dutch Slough and the Contra Costa Canal, (2) proposed land elevations of the encasement project, (3) 100-year tide heights, (4) wind fetch distance within Dutch Slough restoration site, (5) width of emergent vegetation between open water areas of restoration site and southern end of restoration site (emergent vegetation is a significant wave attenuator), and (6) projected wind-wave run-up heights in light of wind fetch distance and emergent vegetation wave attenuation effects.

DWR shall obtain detailed topographic data of the upland portions of the restoration parcels that border the Canal, as well as data along the northern Canal berm adjacent to the project area. Topographic data for the Project site already exists (PWA 2006); the CCWD should be able to supply topographic data for the Canal berms.

These topographic data shall be used to create a focused Digital Elevation Model (DEM) of the area bordering the Canal, which will be compared to the tidal datums calculated for the Project to determine if there are any areas along the Canal that may overtop under the anticipated typical range of tides and storms. Also, long term water level data shall be obtained from the nearby DWR Rock Slough monitoring station to look for past extreme high water events that, if replicated in the future, could potentially overtop the lands surrounding the Canal. Ten years of historic data shall be investigated. The most important events to look for are those that occur during low-flow (i.e. brackish) conditions in the Delta, since these brackish flows would have the greatest potential impact on water quality in the Canal.

If the study identifies events that could potentially overtop the levees surrounding the canal if replicated in the future, and these events are likely to be frequent (more than once per year), and likely to occur during periods of elevated Delta salinity, either of the following mitigation approaches shall be implemented:

A. CONSTRUCT ADDITIONAL LEVEE OR PERFORM LEVEE IMPROVEMENT IN POTENTIAL PROBLEM AREAS

If this study determines a significant likelihood of overtopping that would adversely affect water quality in the Canal, then levee structures/enhancements shall be constructed along the south boundary of the Dutch Slough Restoration Project as part of the Dutch Slough Project. The design of the structures/enhancements shall be based on the results of the study outlined above and shall include considerations for sea-level rise. Levee improvements must be approved by FEMA, Reclamation District 799 and the US Army Corps of Engineers. Should the overtopping only occur in isolated areas, levee construction or enhancement should be focused in those areas, rather than lining the entire southern boundary of the site.

B. Delay Dutch Slough Restoration Project Until CCWD Encasement Project Is Complete

If this study determines a significant likelihood of overtopping that would adversely affect water quality in the Canal, then the second option is to delay implementation of the Dutch Slough Restoration Project until the CCWD has encased the drinking water supply within the Canal in a pipeline.

C. Provide Flood Protection to Adjacent Properties after Canal Encasement

Once the Contra Costa Canal is encased, the height of the berm will be reduced. If this study determines a significant likelihood that the restoration project would cause flooding over the encased canal and onto properties to the south of the project, then the project design would be changed to incorporate a berm or levee sufficient to protect those areas from flooding.

Impact Significance After Mitigation

Less than significant with implementation of either of the above mitigation measures.

Impact 3.1.1-8 Insufficient Sedimentation in New Wetland Basin

Dutch Slough Restoration Project and Related Projects

Under Alternative 1, the Dutch Slough site would start at the lowest initial elevation, requiring the greatest amount of subsidence reversal to achieve intertidal marsh elevations. Accretion can occur through mineral deposition and biomass accumulation (plant matter). Mineral sedimentation rates are expected to be relatively low (PWA 2006), thereby leading to long time periods over which the restored marsh is expected to form. Plant biomass accumulation can be aided through management efforts, which is the general idea behind the open water management options described below. Because the site is expected to meet all its mitigation requirements with the as-built elevations, no adverse impact is expected from insufficient sedimentation. However, it will be critical that the project establish realistic sedimentation expectations based on sound scientific data from other San Francisco Bay-Delta area projects, in order to ensure that the evaluations of its outcome are judged against appropriate rather than unrealistic milestones.

It should be noted that even the highest rates of natural sedimentation processes may or may not be able to keep up with global/local sea level rise. A number of features that are likely to minimize the impact of sea-level rise on marsh restoration and its physical evolution have been incorporated into project design. These features include:

- Construction of a gradually sloping marsh surface (i.e., the terrestrial ecotone along grassland edges) that provides an elevation gradient over which elevation zones of tidal marsh may shift upslope as sea level rises;
- Early initiation of marsh vegetation ("pre-vegetation" of managed nontidal freshwater marsh, subsidence reversal, during construction) to maximize the duration of tule growth and establishment, marsh elevation gain, and biomass accumulation before excessive sea level rise acceleration may occur.

- The project's external levees will be designed to ensure that they can be adapted to anticipated Sea Level Rise. Current projections predict that SLR in this area will be between 6 and 13 inches over the next 50 years. Levee design (sizing and construction) will provide protection against this level of SLR; future levee work will ensure enhanced protection if projections are adjusted upward.

OPEN WATER MANAGEMENT OPTIONS

The intent of the open water management options is to test different approaches to facilitating plant biomass accumulation leading to intertidal elevations, to provide suitable fish habitats constrained by low initial starting elevations, and to provide some flexibility in how portions of the site are managed. Sediment supply should be greater with tidal versus managed options as there would be the greatest exchange with the source supply. Biomass accumulation depends on species present and the inundation regime (depth, frequency, duration) that exerts control over the many processes that affect production and decomposition. Tidal options may prove too deep in some areas and non-tidal is intended to provide some control to promote biomass accumulation. Actual differences would depend on many details about project operations not known at this time. The skeletal channel network option should act reasonably similar to the tidal option within the channel and similar to the non-tidal option outside the channel.

IMPACT SIGNIFICANCE

Impact significance would depend on the rate of sea level rise and accretion, the significance of this impact is uncertain and speculative at this time.

IMPACT 3.1.1-9 LIMITED PERSISTENCE OF SHALLOW TIDAL MARSH CHANNELS

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

Vegetation such as tules (*Schoenoplectus acutus* or *S. californicus*) would tend to dominate and fill in shallow tidal marsh channels (i.e., those channels with invert elevations around MLLW and higher) in many Delta wetlands. Vegetation infilling can but does not always lead to the channel disappearing as a geomorphic feature. However, it does reduce water exchange and it limits access to aquatic organisms into the channel and any marsh areas upstream of the vegetation. Such infilling, therefore, can detrimentally affect the ecological outcomes of the restoration effort.

OPEN WATER MANAGEMENT OPTIONS

No change in impacts to shallow tidal marsh channels would occur with the various open water management options.

MITIGATION 3.1.1-9 CHANNEL DESIGN

The invert elevation of any channels meant to persist as open-water habitat shall be designed to be at least 20 cm below MLLW. This depth would prevent emergent vegetation from filling in the channels. It should be noted that depths significantly greater may present adverse conditions for target fish species; see Chapter 3.5, *Aquatic Biology,* for information on appropriate maximum depths.

IMPACT SIGNIFICANCE

Less than significant with mitigation

Alternative 2: Moderate Fill

Impact 3.1.2-1 Erosion in Terminal Sloughs Due to Increased Tidal Prisms

Dutch Slough Restoration Project, Related Projects and All Options

Same as Impact 3.1.1-1 above, except that the larger amount of fill would result in smaller tidal prisms and therefore less erosion in the terminal sloughs. Erosion in the terminal sloughs would not be affected by the different Marsh Creek relocation options.

Mitigation 3.1.2-1 (.1 and .2)

Same as Alternative 1.

Impact Significance After Mitigation

Less than significant with mitigation

Impact 3.1.2-2 Decreased Flood Flow Conveyance of Marsh Creek Due To Increased Tailwater Elevations

Dutch Slough Restoration Project, Related Projects, and All Open Water Management Options

Same as Impact 3.1.1-2 above. If restoration of the Ironhouse parcel or relocation of the Marsh Creek delta do not occur, this impact would not apply. Flood flow conveyance in Marsh Creek would not be affected by the different open water management options.

Marsh Creek Delta Relocation

As detailed below, the various Marsh Creek delta relocation options (see Figure 2-13) would have different effects on flood flow conveyance in Marsh Creek by changing the degree to which the tidal signal moves upstream and by how fluvial sediment and debris are transported once reaching tidal waters (see further impacts below). As discussed above, there is currently little tidal dampening between the mouth of Marsh Creek and near where it crosses the Contra Costa Canal due to the large channel north of the EBRPD bridge. The projected impacts of the different relocation options described below assume that all Marsh Creek delta relocation options involve the construction of tidal channels that can handle at least the 100-year design flow rate for the ultimate watershed development, per CCCFCWCD.

Options 1 and 2. As with restoration of the Ironhouse parcel, diversion of Marsh Creek into the Dutch Slough Restoration Project site at the locations shown in the Conceptual Plan and Feasibility Report (PWA 2006) would propagate a 0.2 ft higher MHHW farther upstream south of the Contra Costa Canal crossing compared to current conditions. Again, although the effects of this tailwater increase are unlikely to be significant, modeling the effects is recommended (see Mitigation Measure 3.1.1-2.1).

Option 3. No change in Marsh Creek flood conveyance is anticipated because the diversion into Dutch Slough is expected to be far enough downstream and large enough such that changes in tailwater elevations are not expected (PWA 2006).

Mitigation 3.1.2-2.1 Develop Design Criteria for Increased Tidal Prism on Marsh Creek

Same as Mitigation 3.1.1-2.1 above except that the hydrodynamic modeling analysis shall include the Marsh Creek relocation options.

Mitigation 3.1.2-2.2 Design Marsh Creek to Convey 100-year Design Flow

Same as Mitigation 3.1.1-2.2 above.

Impact Significance After Mitigation

Less than significant with mitigation

Impact 3.1.2-3 Point Bar Formation in Marsh Creek

Dutch Slough Restoration Project and All Open Water Management Options

No impact.

Marsh Creek Delta Relocation

For each of the three Marsh Creek delta relocation options, the point of diversion would create an angular turn of flow which may in turn lead to point bar creation. Point bars would primarily accrete from sediment delivered by the watershed though reworking of restored marsh sediments could occur especially in the early years. Point bars could potentially grow large enough to reduce the flood flow conveyance of the channel.

Mitigation 3.1.2-3 Channel Design and Monitoring

The new Marsh Creek channel shall be designed to have excess width at the point of diversion into the Dutch Slough basin to reduce the likelihood of point bar formation negatively impacting flood conveyance in the channel. This channel shall be monitored by the Project for at least 10 years post-restoration to allow for possible dredging and other maintenance activities to maintain an adequate cross-section.

Impact Significance After Mitigation

Less than significant with mitigation.

Impact 3.1.2-4 Sedimentation in Tidal Portion of Relocated Marsh Creek Channel

Dutch Slough Restoration Project and All Open Water Management Options

No impact.

Marsh Creek Delta Relocation

Sedimentation within the new tidal marsh channel created by each of the three Marsh Creek delta relocation options may adversely affect the 100-year design flow conveyance of the channel.

MITIGATION 3.1.2-4.1 CHANNEL DESIGN AND MONITORING

The Marsh Creek channel downstream of the diversion into the Dutch Slough site shall be sized for at least the 100-year design flow of Marsh Creek. Compared to existing conditions, this design channel is likely to gain scour from the tidal prism of the adjacent marsh plain to maintain channel geometry, whereas the current channel north of the EBRPD bridge is confined by levees.

Monitoring of the tidal portion of the new Marsh Creek channel shall be performed at least yearly for five years minimum to ensure that sedimentation is not negatively affecting flood flow conveyance. This monitoring shall include regularly-spaced (maximum interval of 500 feet) cross-section surveys and a thalweg survey. Additionally, monitoring the original six channel cross-sections established by NHI in 1999 (NHI 2002) shall be conducted to allow for detection of sedimentation farther upstream from the new channel.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.1.2-5 PEAK FLUVIAL-TIDAL DEPOSITION

DUTCH SLOUGH RESTORATION PROJECT AND ALL OPEN WATER MANAGEMENT OPTIONS

Same as Alternative 1.

MARSH CREEK DELTA RELOCATION

As with the Dutch Slough Restoration Project, due to increased tailwater elevations in Marsh Creek from relocation of the Creek's delta (see Impact 3.1.1-2 above), the point of peak tidal-fluvial deposition in the creek would move south (upstream). From a qualitative perspective, considering the anticipated small (0.2 ft) increase in MHHW throughout the lower reach of Marsh Creek, WWR expects that the depositional changes would be less than significant. The CCC Flood Control District may have to shift the location, extent, and frequency of channel bed dredging as a consequence of this project, but it is not expected to result in a significant change to dredging needs.

IMPACT SIGNIFICANCE

Less than significant. No mitigation is required.

IMPACT 3.1.2-6 IN-KIND LEVEE REQUIREMENTS AT THE IRONHOUSE PROJECT PARCEL (IRONHOUSE PROJECT ONLY)

Same as Alternative 1.

MITIGATION 3.1.2-6. CONSTRUCT FLOOD PROTECTION LEVEE AROUND IRONHOUSE PARCEL (IRONHOUSE PROJECT ONLY)

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation

IMPACT 3.1.2-7 POSSIBLE WATER QUALITY DEGRADATION IN CONTRA COSTA CANAL DUE TO GROUNDWATER SEEPAGE

DUTCH SLOUGH RESTORATION PROJECT AND ALL OPTIONS

Same as Alternative 1.

MITIGATION 3.1.2-7 GROUNDWATER INTRUSION STUDY AND REMEDIATION

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.1.2-8 GROUNDWATER INTRUSION ONTO ADJACENT PARCELS

DUTCH SLOUGH RESTORATION PROJECT AND OPEN WATER MANAGEMENT OPTIONS

Same as Alternative 1, Impact 3.1.1-6.

MARSH CREEK DELTA RELOCATION

Relocating the Marsh Creek delta may lessen the effect of groundwater seepage at the northeast corner of the Ironhouse parcel, but not significantly.

MITIGATION 3.1.2-8

Same as Alternative 1, Mitigation 3.1.1-6.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.1.2-9 WIND-WAVE DRIVEN LEVEE OVERTOPPING OF SOUTHERN UPLANDS INTO CONTRA COSTA CANAL

DUTCH SLOUGH RESTORATION PROJECT AND ALL OPTIONS

Same as Alternative 1 (Impact 3.1.1-7), except that the maximum wind-wave height may be lower due to the higher tidal marsh elevations and greater distance of the Canal from open water resulting from the increased amounts of fill placed on the site. No change in impacts would occur with the various Marsh Creek delta relocation options.

MITIGATION 3.1.2-9

Same as Alternative 1, Mitigation 3.1.1-7.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

Impact 3.1.2-10 Insufficient Sedimentation in New Wetland Basin

Dutch Slough Restoration Project and All Open Water Management Options

Same as Alternative 1 (Impact 3.1.1-8), except that the increased amount of fill under Alternative 2 would require less sedimentation across the site.

Marsh Creek Delta Relocation

Insufficient sedimentation in the Emerson Parcel may delay the evolution of an intertidal channel network linked to a new, relocated Marsh Creek delta.

Impact Significance

Potentially significant and unmitigable, depending on rate of sea level rise.

Impact 3.1.2-11 Limited Persistence of Shallow Tidal Marsh Channels

Dutch Slough Restoration Project and all Options

Same as Alternative 1.

Mitigation 3.1.2-11 Channel Design Considerations

Same as Alternative 1.

Impact Significance After Mitigation

Less than significant with mitigation.

Alternative 3: Maximum Fill

Impact 3.1.3-1 Erosion in Terminal Sloughs Due to Increased Tidal Prisms

Dutch Slough Restoration Project

Similar to Impact 3.1.1-1 above, except that the maximum amount of fill would result in smaller tidal prisms and likely smaller quantities of erosion.

Open Water Management Options

Similar to Impact 3.1.1-1 above, except that the larger amount of fill would result in smaller tidal prisms and likely smaller quantities of erosion.

Marsh Creek Delta Relocation

Erosion in the terminal sloughs would not be affected by the different Marsh Creek relocation options.

Mitigation 3.1.3-1

Same as Alternative 1.

Impact Significance After Mitigation

Less than significant with mitigation.

Impact 3.1.3-2 Decreased Flood Flow Conveyance of Marsh Creek Due To Increased Tailwater Elevations

Dutch Slough Restoration Project and all Options

Same as Alternative 1.

Mitigation 3.1.3-2.1 Develop Design Criteria for Increased Tidal Prism on Marsh Creek

Same as Mitigation 3.1.1-2.1 above except that the hydrodynamic modeling analysis shall include the Marsh Creek relocation options.

Mitigation 3.1.3-2.2 Design Marsh Creek to Convey 100-year Design Flow

Same as Mitigation 3.1.1-2.2, above.

Impact Significance After Mitigation

Less than significant with mitigation.

Impact 3.1.3-3 Point Bar Formation in Marsh Creek

Dutch Slough Restoration Project and all Options

Same as Alternative 1.

Mitigation 3.1.3-3 Channel Design and Monitoring Considerations

Same as Alternative 1.

Impact Significance After Mitigation

Less than significant with mitigation.

Impact 3.1.3-4 Sedimentation in Tidal Portion of Relocated Marsh Creek Channel

Dutch Slough Restoration Project and all Options

Same as Alternative 1.

Mitigation 3.1.3-4 Channel Design and Monitoring

Same as Alternative 1.

Impact Significance After Mitigation

Less than significant with mitigation.

Impact 3.1.3-5 Peak Fluvial-Tidal Deposition

Dutch Slough Restoration Project and All Options

Same as Alternative 1.

Impact 3.1.3-6 Potential Increased Flood Hazards At the Ironhouse Parcel (Ironhouse Project Only)

Same as Alternative 1.

Mitigation 3.1.3-6 Construct Flood Protection Levee Around Ironhouse Parcel (Ironhouse Project Only)

Same as Alternative 1.

Impact 3.1.3-7 Possible Water Quality Degradation in Contra Costa Canal Due to Groundwater Seepage

Dutch Slough Restoration Project and all Options

Same as Alternative 1.

Mitigation 3.1.3-7 Groundwater Intrusion Study and Remediation

Same as Alternative 1.

Impact Significance after Mitigation

Less than significant with mitigation.

Impact 3.1.3-8 Groundwater Intrusion Onto Adjacent Parcels

Dutch Slough Restoration Project and all Options

Same as Alternative 1.

Mitigation 3.1.3-8

Same as Alternative 1.

Impact Significance After Mitigation

Less than significant with mitigation

Impact 3.1.3-9 Wind-wave Driven Levee Overtopping of Southern Uplands Into Contra Costa Canal

Dutch Slough Restoration Project and all Options

Similar to Alternative 1, except that the maximum wind-wave height would likely be minimized due to the presence of greater amounts of fill on the site, and the wind waves would have to propagate across a greater distance of higher elevation areas in the Gilbert and Burroughs parcels before reaching the canal. Thus, the level of impact would be less than Alternatives 1 or 2.

MITIGATION 3.1.3-9

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.1.3.-10 INSUFFICIENT SEDIMENTATION IN NEW WETLAND BASIN

DUTCH SLOUGH RESTORATION PROJECT

The presence of greater fill on the site under this alternative minimizes the need for sedimentation from external sources. The Emerson parcel design is the same as for Alternative 2 and would still have an open water area in need of sedimentation. The Gilbert and Burroughs parcels would have no open water areas and thus would not experience significant effects of insufficient sedimentation.

OPEN WATER MANAGEMENT OPTIONS

The presence of greater fill on the site under this alternative eliminates open water areas from the Gilbert and Burroughs parcels and retains the same open water for the Emerson Parcel as under Alternative 2. Thus effects of insufficient sedimentation would be reduced.

MARSH CREEK DELTA RELOCATION

As the current proposal for grading on the Ironhouse parcel proposes grading down to intertidal elevations, instead of relying on sediment accretion to raise substrate elevations, this project component would not affect wetland basin sedimentation.

IMPACT SIGNIFICANCE

Potentially significant depending on rate of sea level rise.

IMPACT 3.1.3-11 LIMITED PERSISTENCE OF SHALLOW TIDAL MARSH CHANNELS

DUTCH SLOUGH RESTORATION PROJECT AND ALL OPTIONS

Same as Alternative 1.

MITIGATION 3.1.3-11 CHANNEL DESIGN CONSIDERATIONS

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

Alternative 4: No Project

IMPACT 3.1.4-1 EROSION IN TERMINAL SLOUGHS

Under the No Project Alternative, tidal prisms at the site would not change. Therefore, erosion in the terminal sloughs would maintain its present equilibrium with sediment accretion in the sloughs.

IMPACT SIGNIFICANCE

No impact.

IMPACT 3.1.4-2 GROUNDWATER SEEPAGE INTO CONTRA COSTA CANAL

The 2006 study of groundwater characteristics within and around the Dutch Slough Restoration Project site by Luhdorff and Scalmanini Consulting Engineers discusses the fact that the Contra Costa Canal already experiences water quality degradation during periods of low flow (< 10 cfs), and hydraulic connectivity between the Canal and local groundwater is considered a primary source of degradation (LSCE 2006). The study concluded that groundwater flow into the Contra Costa Canal primarily happens on the Emerson and Gilbert parcels under the following conditions: (1) when groundwater levels exceed average tidal fluctuations, (2) during the wet season when groundwater is elevated above the level of surface water in the Canal, and (3) during the summer when irrigation of the site's existing fields causes groundwater to rise above the level of surface water in the Canal. Under the No Project Alternative, these conditions are expected to continue, so it follows that contamination of the drinking water supply in the Canal remains an impact of potential significance. However, as the Dutch Slough Restoration Project would not affect this continuation of existing conditions, no mitigation is required.

The encasement of the CCWD supply into a pipeline would remove the risk of groundwater contaminating the water supply. Such a pipeline would also protect the water supply from other potential sources of contamination such as agricultural and municipal runoff.

IMPACT SIGNIFICANCE

No impact.

Cumulative Impacts

The Dutch Slough Restoration Project site's location in a rapidly growing area of eastern Contra Costa County creates the potential for a number of impacts that, in conjunction with other nearby projects, could increase or decrease impacts. From a hydrologic and geomorphic perspective, the impacts of interest are those of flooding, groundwater seepage, and water quality.

IMPACT 3.1.5-1. GROUNDWATER SEEPAGE INTO THE CONTRA COSTA CANAL.

If CCWD proceeds with its water supply encasement project, then any groundwater seepage from the Dutch Slough Restoration Project into the canal and its associated introduction of brackish water would no longer affect drinking water quality. Consequently, the Project's potential impact to water supply would be eliminated by this cumulative project.

IMPACT 3.1.5-2. GROUNDWATER SEEPAGE INTO CYPRESS GROVE AND DUTCH SLOUGH PROPERTIES.

Cumulative projects include CCWD's plans to fill in and eliminate the Contra Costa Canal concurrent with encasing the water supply. This would result in groundwater flux to the south either remaining the same or decreasing for the reasons explained under Impact 3.1.1-6. Under current conditions, the Canal is a tidal water body that exerts a controlling factor on groundwater connectivity between lands to its north and south. The cumulative plus project conditions would result in a greater distance of tidal waters from these tracts than with the Canal. Therefore the project would not contribute to a significant cumulative impact to groundwater seepage on these parcels.

IMPACT 3.1.5-3 GROUNDWATER SEEPAGE AND TIDAL FLOODING EAST INTO HOTCHKISS TRACT

The potential for groundwater seepage and flooding onto the adjacent Hotchkiss Tract (Reclamation District 799) would be mitigated by the construction of a new Jersey Island Road levee and its associated toe drain. The new Jersey Island Road levee would have a toe/blanket drain on its landward side to remove any water that seeps through the levee from the Dutch Slough Restoration Project site (ENGEO 2005, Kleinfelder 2006). It would tie into an interior levee system needed on the Hotchkiss Tract to protect the new developments from flooding should the tract's unengineered exterior levees fail. Groundwater would also be pumped from the Hotchkiss Tract during the summer to provide "make-up" water for proposed stormwater retention/recreation ponds (ENGEO 2005). With this adjacent project, this impact is reduced to less than significant and no further mitigation is necessary.

IMPACT 3.1.5-4. TIDAL FLOODING SOUTH INTO CYPRESS GROVE AND DUTCH SLOUGH PROPERTIES

The CCWD's encasement project would lower the height of the existing canal barrier between the Dutch Slough site and properties to the south.

These adjacent properties to the south are either planning to build or are already constructing internal flood control levees similar to those on the Hotchkiss Tract should existing flood control levees around Dutch Slough and its tributaries fail. The Dutch Slough Properties Development site south of the Dutch Slough Restoration Project site plans to construct a 100-year internal flood control levee (City of Oakley 2005), and the Cypress Grove Development south of the Emerson restoration parcel has already constructed a 100-year internal flood control levee (PWA 2006). These planned new flood protection levees would reduce the potential for tidal flooding of the new residential areas from overtopping along the southern perimeter of the Dutch Slough Restoration Project to less than significant.

Undeveloped properties to the south of the encased canal could potentially be subject to flooding from wave-tide overtopping of the lowered encased canal berm. The likelihood and potential extent of this impact has not been calculated, however, any flooding of adjacent parcels by the Dutch Slough Restoration Project would be a potentially significant impact.

MITIGATION 3.1.5-4 CONDUCT FLOOD HAZARD STUDY AND CONSTRUCT FLOOD PROTECTION IMPROVEMENTS

As part of the levee overtopping study described in Mitigation 3.1.1-7, the Dutch Slough Restoration Project also shall evaluate the potential for flooding of unprotected lands south of the future encased canal. If that study indicates that there is the potential for the Project to increase flood hazards to those lands, then levee structures/enhancements shall be constructed along the south boundary of the Dutch Slough Restoration Project as part of the Dutch Slough Project. The design of the structures/enhancements shall be based on the results of the study outlined above and shall include considerations for sea-level rise. Should the overtopping only occur in isolated areas, levee construction or enhancement should be focused in those areas, rather than lining the entire southern boundary of the site.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.1.5-5. EXCESS SCOUR IN EMERSON SLOUGH

The Cypress Grove development to the south proposes to discharge its stormwater runoff, after cycling through a treatment wetland and/or lake system, into Emerson Slough, which bisects the Restoration Project site (Balance Hydrologics 2004). Stormwater outflows from the Cypress Grove development are not expected to be large enough to change flow velocities in the channel, so erosion in Emerson Slough due to these flows is not anticipated to be an impact (Balance Hydrologics 2004). The Dutch Slough Restoration Project has designed locations of its breaches into Emerson and Gilbert Parcels to minimize the potential for excess scour in Emerson Slough.

IMPACT 3.1.5-6. EXCESS SCOUR IN LITTLE DUTCH SLOUGH

Stormwater from the Dutch Slough Properties development south of the site would likely be pumped into Little Dutch Slough. It may be necessary for that development project to be responsible for levee setbacks at the southern, comparatively narrow end of Little Dutch Slough to accommodate those additional flows. Such a levee setback would reduce the acreage of marsh restoration on the Gilbert and/or Burroughs parcels but it may also increase design flexibility for locating breaches along Little Dutch Slough. This impact is not significant and thus no mitigation is required.

Table 3.1-3: Summary of Hydrologic and Geomorphic Impacts for Dutch Slough and Related Restoration Projects

	Impact No.	Impact	Dutch Slough Restoration Project	Related Projects	
				Ironhouse Project	City Community Park Project
Alternatives 1, 2, and 3	3.1.1-1	Erosion in Terminal Sloughs Due to Increased Tidal Prisms	X		
	3.1.1-2	Decreased Flood Flow Conveyance of Marsh Creek Due To Increased Tail-water Elevations	X	X	
	3.1.1-3	Peak Fluvial-Tidal Deposition	X	X	
	3.1.1-4	Potential Increased Flooding At the Ironhouse Parcel		X	
	3.1.1-5	Possible Water Quality Degradation in Contra Costa Canal Due to Groundwater Seep-age	X		
	3.1.1-6	Groundwater Intru-sion Onto Adjacent Parcels	X	X	
	3.1.1-7	Wind-wave Driven Levee Overtopping Into Contra Costa Canal	X		X
	3.1.1-8 (3.2.2-10)	Insufficient Sedi-mentation in New Wetland Basin	X (minimized in Alt 3)	X	
	3.1.1-9 (3.2.2-12)	Limited Persistence of Shallow Tidal Marsh Channels	X	X	
	3.1.5-4	Cumulative Impacts: Tidal Flooding South of Contra Costa Canal	X		
Alternatives 2 and 3 only	3.1.2-3	Point Bar Formation in Marsh Creek	X		
	3.1.2-4	Sedimentation in Tidal Portion of Re-located Marsh Creek Channel	X		

Table 3.1-4: Summary of Mitigation Applicability for Dutch Slough and Related Restoration Projects

	Impact/Mitigation	Dutch Slough Restoration Project	Related Projects	
			Ironhouse Project	City Community Park Project
Alternatives 1, 2, and 3	Mitigation 3.1.1-1.1 Erosion/Sedimentation Performance Measures	X		
	Mitigation 3.1.1-1.2 Erosion Monitoring and Adaptive Management	X		
	Mitigation 3.1.1.2-1 Develop design criteria for increased tidal prism on Marsh Creek		X	
	Mitigation 3.1.1-2.2 Design Marsh Creek to Convey 100-year Design Flow	X	X	
	Mitigation 3.1.4-1 Construct flood protection levee around Ironhouse parcel		X	
	Mitigation 3.1.1-5.1 Groundwater Intrusion Study and Remediation	X		
	Mitigation 3.1.1-6-1 Groundwater Intrusion Protection: West of Site	X	X	
	Mitigation 3.1.1-6.2 Groundwater Intrusion Protection: East of Site	X		
	Mitigation 3.1.1-6.3 Delay Dutch Slough Restoration Project Until Cessation of Irrigation on Ironhouse Parcels and Construction of Jersey Island Road Levee	X	X	
	Mitigation 3.1.1-7 Levee Overtopping Study and Improvements or Delay Dutch Slough Restoration Project Until CCWD Encasement Project is Complete	X		X
	Mitigation 3.1.1-9 Channel Design	X	X	
	Mitigation 3.1.5-4 Conduct Flood Hazard Study and Construct Flood Protection Improvements			
Alternatives 2 and 3 Only	Mitigation 3.1.2-3 Channel Design and Monitoring	X		
	Mitigation 3.1.2-4.1 Channel Design and Monitoring	X		

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3.2 - Water Quality

3.2 WATER QUALITY

This section describes existing water quality conditions and potential water quality impacts to the Sacramento/San Joaquin River Delta, Big Break, Dutch Slough, Marsh Creek, Emerson Slough, Little Dutch Slough, Contra Costa Canal (collectively referred to as "Surface Waters"), and groundwater for the proposed Dutch Slough Restoration Project and Related Projects. Processes and other factors affecting water quality conditions and existing water quality data are described to provide a baseline for environmental review. Contamination history of the Dutch Slough Restoration Project and Related Projects sites also is summarized. The regulatory framework provides an overview of federal, state and local regulations protecting water quality. Finally, known and potential impacts to water quality are described, as are mitigation measures to prevent and compensate for impacts.

3.2.1. Affected Environment

Water Quality Background

Water quality in the Project area is governed by both natural conditions and human land use. Local areas drain a mix of open space, rural and suburban landscapes to Marsh Creek, Emerson, Little Dutch and Dutch Sloughs, and the Sacramento/San Joaquin Delta. The net flow of water in the San Joaquin and Sacramento Rivers is downstream; however, incoming tides can transport water and its constituents into the project area as well as into the Contra Costa Canal. Chemical, physical, and biological water quality parameters are affected by land use and both human and natural processes.

The Marsh Creek watershed transports runoff from the undeveloped lands on the north-east side of Mt. Diablo as well as the rapidly urbanizing areas of Brentwood and Oakley. Contaminants from these areas are transported via the Marsh Creek flood control channel to the Delta at Big Break. Runoff from an abandon mercury mine site in the upper watershed is also a potential problem because it could lead to unhealthy concentrations of mercury in organisms in the Delta and at Dutch Slough and Marsh Creek. The Marsh Creek Dam forms the Marsh Creek Reservoir, located approximately 10.5 miles upstream of Big Break. The reservoir acts as a sediment sink, capturing runoff from much of the watershed including that from the historic mercury mine located well upstream of the reservoir.

Agricultural areas in the Marsh Creek watershed are being converted to suburban uses resulting in increased impervious surfaces and reduced infiltration of rainfall and runoff into the ground. As a result, natural filtration processes are decreased and pollutants are transported more directly to surface waters and increased erosion into these surface waters can occur, especially where vegetation has been degraded or removed. Increased erosion can, in turn, lead to increased turbidity and nutrients, while reduced shade from vegetation impacts can increase water temperature, lower pH, and increase biological oxygen demand. Remaining agricultural landscapes provide greater rainfall and runoff infiltration than developed areas but continue to be a source of fertilizers, pesticides, nutrients and other pollutants, including high concentrations of dissolved organic carbon that can contribute to the formation of chlorination by-products known as trihalomethanes.

Municipal wastewater discharges from the Brentwood Waste Water Treatment Plant into Marsh Creek are a potential source of pollutants, including endocrine disrupting chemicals that can have biological impacts that are not fully understood. The Ironhouse Sanitary District has discharged treated wastewater to Ironhouse Project lands and ISD lands adjacent to Marsh Creek and Dutch Slough for nearly 30 years, potentially increasing concentrations of endocrine disrupting chemicals, metals, and other pollutants to groundwater and surface waters in the Project site. In particular, treated wastewater has been used for irrigation on the Ironhouse parcel.

CONTAMINANT FLOWS OF POTENTIAL CONCERN IN THE MARSH CREEK WATERSHED

MERCURY

Mercury is a naturally occurring element that can be found throughout the Bay-Delta environment. Human activities such as mining, burning coal and using mercury to manufacture certain products and historical use in the 19th century Sierra Nevada gold mining industry, have increased the amount of mercury in many parts of the environment including the atmosphere, lakes, streams, rivers, and estuaries. The mining of mercury primarily in coastal mountain ranges and the use of mercury in gold mining in the Sierra Nevada have released large quantities of the metal to the environment of California since the mid 1800s (Alpers and Hunerlach 2000).

Concerns about mercury pollution stem largely from the potential adverse effects of dietary exposure to methylmercury (MeHg), a highly toxic form that readily accumulates in biota and can biomagnify to harmful concentrations in organisms atop aquatic food webs including larger fish and piscivorous birds (Mahaffey 2000, Clarkson 2002, Wiener et al. 2003). Nearly all of the mercury in fish is MeHg (Grieb et al. 1990, Bloom 1992), and consumption of fish is the primary modern pathway of MeHg exposure in humans (NRC Committee on the Toxicological Effects of MeHg 2000, Mahaffey 2000, Clarkson 2002, Schober et al. 2003). Concentrations of MeHg in food webs supporting production of fish and aquatic wildlife are strongly correlated with the supply of MeHg (Hecky et al. 1991, Kelly et al. 1997, Gilmour et al. 1998, Paterson et al. 1998, Heyes et al. 2000, Wiener et al. 2003).

Inorganic mercury is converted to MeHg by microbial activity, but the actual physical, chemical, and environmental factors controlling methylation (conversion to MeHg) and demethylation (conversion to inorganic mercury) are poorly understood. The restoration of wetlands, particularly in areas where the abundance of mercury in soils or sediments has been elevated by mining or other human activities, could accelerate the production of MeHg and increase the contamination of aquatic biota (Naimo et al. 2000, Wiener and Shields 2000). In addition, flooding of vegetated wetlands or uplands or fluctuating water levels during tidal cycles could stimulate microbial methylation of inorganic mercury, increasing concentrations of MeHg in water and biota (Hecky et al. 1991, Hall et al. 1997, Paterson et al. 1998, Bodaly and Fudge 1999, Hall et al. *in press*).

Due to the concern that wetland restoration could increase MeHg levels in the Delta, the CALFED Bay-Delta program initiated a multiyear research program to determine where MeHg levels are highest and identify when and how mercury is converted into MeHg in the Bay-Delta. Initial results of the research program were presented at the 2006 CALFED Science Conference and indicate that:

1. MeHg levels in fish are highest in San Francisco Bay and on the perimeter of the Delta where upstream rivers and flood bypasses enter the Delta. MeHg levels in fish are lowest in the central and western Delta near the Dutch Slough project.
2. Some wetland environments, particularly floodplains, appear to be a source of MeHg while other wetlands such as freshwater emergent tidal marsh appear to be a sink for MeHg.
3. MeHg fluxes onto and off of tidal wetlands appear to vary substantially over tide cycles and seasons. Export from tidal wetlands is probably greatest on extreme ebb tides when the wetland substantially drains.

4. Methylation rates vary between types of wetlands and in different parts of the Bay-Delta. They appear to be highest on floodplains and high salt-marsh plains that are episodically or periodically inundated and drained. Methylation rates are substantially lower in and along the edge of tidal sloughs, in open water, and freshwater emergent marsh where short-duration wetting-drying cycles are not found. Some of these latter environments may be locations of demethylation.

MERCURY IN THE MARSH CREEK WATERSHED

An abandoned mercury mine is located on Dunn Creek, a tributary to Marsh Creek in the upper watershed. This abandoned mine is a potential source of mercury to the Dutch Slough project area, but regional monitoring studies indicate that MeHg levels in the project area are among the lowest in the Bay-Delta region.

Runoff from the historic mercury mine tailings in the upper reaches of Marsh Creek has resulted in high concentrations of MeHg in the upper watershed (Slotton, 1998), but the Marsh Creek reservoir upstream of Brentwood appears to trap a significant amount of sediment, and presumably mercury, from the mine tailings site. It is unclear how much inorganic mercury is transported to lower Marsh Creek and Big Break, but several years of fish tissue sampling suggest that MeHg levels in Big Break are lower than other locations in the Delta and substantially lower than MeHg levels in San Francisco Bay as well as the northern and southern Delta. However, because rates of mercury methylation do not directly correspond to the concentrations of inorganic mercury, the amount of inorganic mercury transported to Marsh Creek and Big Break cannot be determined by the level of MEHg in fish. Inorganic mercury must be methylated before it can bioaccumulate in fish. Soil samples from Ironhouse lands on the western side of Marsh Creek indicate that inorganic mercury levels at that site are within natural ranges and do not reflect any anthropogenic influence despite decades of irrigation with Marsh Creek water.

Historic mercury mining in the upper watershed has resulted in elevated concentrations of mercury in the upper creek as mine tailings containing mercury continue to erode overtime and transport into the creek. Marsh Creek Dam and reservoir, located below the historic mining areas and many miles upstream of the Dutch Slough site, capture mercury-laden sediments from the historic mines. U.C. Davis researchers, Slotten and others (1998) found that mercury concentrations in stream invertebrates and resident fish were significantly higher close to the historic mine sites, and gradually decreased moving downstream closer to the Marsh Creek Reservoir. An earlier study by Slotton et al. (1996) measured total and dissolved mercury and total suspended solids (TSS) in various locations throughout Marsh Creek.[1] Results from this sampling event showed that total mercury concentrations were similar above Marsh Creek Reservoir to lower Marsh Creek at Delta Road in Oakley, ranging upstream to downstream from 37.67 to 43.7 nanograms per liter (ng/L) (approximately 0.04 parts per billion [ppb]). Dissolved mercury concentrations were also relatively consistent above and below the reservoir, measuring from 6.44 to 8.8 ng/L (app. 0.01 ppb). TSS measurements were found to increase from upstream to downstream while the amount of mercury adsorbed to solids decreased upstream to downstream from 1.25 ppm to 0.58 ppm.

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[1] The sampling event for this study took place following a significant storm event in 1995, and was designed to study rain-induced mobilization of mercury from the Diablo Mercury Mine. Therefore, results from this study are representative of a single higher discharge event during a relatively wet year.

Loads of total and dissolved mercury and TSS were estimated using the data from Slotton et al. (1996) and, like the concentrations, total and dissolved mercury loads did not show significant variability above the reservoir to the downstream sampling location. Total mercury loads ranged from 10.23 grams per day (g/d) to 10.27 g/d while dissolved mercury loads ranged from 2.39g/d to 1.75 g/d upstream to downstream. Similar to TSS concentrations, TSS loads increased substantially from upstream to downstream ranging from 6,273 kilograms per day (kg/d) to 14,610 kg/d. But in contrast to TSS mercury concentrations, TSS mercury loads increased from 7.84 g/d above the reservoir to 8.47 g/d at the downstream sampling location.

Bioavailable MeHg levels are also elevated in the upper watershed but appear to decline in the downstream direction. According to UC Davis researchers (Slotton et al., 1998), stream invertebrates and resident fish living directly downstream of the abandoned mine sites had significantly higher levels of MeHg in their tissues than invertebrates and fish upstream of the abandoned mine sites. Whole body MeHg concentrations in native stream fish such as California roach, hitch and three-spined stickleback, showed a 5- to 6-fold increase in specimens below the confluence with Dunn Creek as compared to specimens upstream of the confluence. Slotton et al. (1998) also found that 85% of fish sampled between the Dunn Creek inflow and the Marsh Creek Reservoir contained mercury concentrations above the California Department of Health consumption guideline levels. In addition, the research showed that mercury levels in fish and stream macro-invertebrates declined along a gradient moving downstream from Dunn Creek to the Marsh Creek Reservoir. Although mercury concentrations in the sampled biota declined along the downstream gradient, mercury laden sediments originating from the abandoned mine sites are accumulating behind the Marsh Creek Dam. Shallow wetland conditions in the reservoir provide an environment conducive for methylating the inorganic mercury, resulting in the contamination of the Reservoir's fishery (Slotton et al., 1998).

METHYLMERCURY IN DUTCH SLOUGH RESTORATION ZONE

Despite high levels of inorganic mercury and MeHg in the upper watershed, MeHg levels in Big Break, at the terminus of Marsh Creek, have consistently been a low spot in the entire Bay-Delta for silverside and clam mercury bioaccumulation over several years of fish sampling (Slotton *et al.* 2006). Silverside mercury was sampled in this area at the Big Break Index (33±3 ng/g) and at the base of Marsh Creek near the confluence with Big Break (28±2 ng/g) in 2006. Consistent with historic sampling, these areas had among the lowest silverside mercury in the entire study area. The fish from the base of Marsh Creek had the lowest mercury levels. The highest silverside mercury concentrations in the study area were found in the Yolo Bypass (169±10 ng/g) and Cosumnes River near the floodplain (180±24 ng/g). Other concentrations in the study area included: Montezuma Slough, east end (53±4 ng/g), Sherman Island (53+2 ng/g), and Montezuma Slough, west end (33+2 ng/g).

A third Dutch Slough-related site was Emerson Slough, which cuts deep into the proposed restoration area. At present, the habitat of this site is clear water, deep, rock-lined canal with submerged aquatic vegetation. Silversides were not present, but Slotton's team was able to take good samples of juvenile largemouth bass and bluegill for analysis. Samples were analyzed from all three of the sites and normalized for weight. Mercury concentrations in bass were lowest at the Marsh Creek site (55 ng/g), intermediate at the Big Break Index (66 ng/g), and somewhat higher in Emerson Slough (77 ng/g). The highest Largemouth Bass mercury concentrations in the study area were found in the Cosumnes River (232 ng/g). Other concentrations in the study area included: Dead Horse Cut (79 ng/g), Franks Tract (46 ng/g), and Prospect Slough (35 ng/g).

ENDOCRINE DISRUPTING CHEMICALS (EDCS)

Endocrine disrupting chemicals (EDCs), such as pesticides, pharmaceuticals and personal care products (PPCPs), are known to be components of incompletely treated wastewater. Concern about these contaminants has been developing in recent years. EDCs are compounds that can stop production or alter transmission of hormones in organisms and can be derived from natural and artificial sources. Examples of known effects in fish and amphibians resulting from continuous exposure to low-level concentrations include thyroid malfunction, sex alteration, reproductive failure, and growth reduction (NSTC 1996). Research on the fate of certain EDCs (nonylphenol) in effluent irrigated soils (Harms 1986) indicated that there is potential for uptake of EDCs in plants irrigated with sewage effluent. PPCPs are derived from pharmaceutical drugs, cosmetics, and food supplements, and while their impacts on organisms are not clearly understood, they are intended to have biological effects on humans and are assumed to have unintentional effects on organisms in the environment (Ying et al. 2004). PPCPs may be present in wastewater discharges and are not likely to be found in urban or agricultural runoff. The Central Valley Regional Water Quality Control Board (CVRWQCB) and USEPA have not established water quality objectives for most EDCs for protection of aquatic life (See *Regulatory Setting* section). Neither the BWWTP nor Ironhouse Sanitary District wastewater have been specifically tested for presence of endocrine disrupting chemicals (EDCs) or pharmaceuticals and personal care products (PPCPs).

AGRICULTURAL AND URBAN RUNOFF

Both agricultural and urban runoff have various well-known negative impacts to water quality. Years of agriculture, cattle grazing and dairy operations can result in lower concentrations of dissolved oxygen from increased concentrations of nitrogen and increased toxic pollutants from fertilizers, pesticides and herbicides that introduce synthetic toxins. Slotton et al. (1998) found that water quality from 1995 to 1997 was so degraded in the lower watershed that aquatic insects were essentially absent, and attributed these conditions to urban and agricultural discharges.

VEGETATION REMOVAL

Removal of riparian vegetation and elimination of adjacent floodplain areas has also resulted in impacts to water quality in Marsh Creek. The historic riparian corridor of Marsh Creek has been narrowed, eliminated, or degraded as adjacent floodplains have been converted for agriculture or development and as flood protection levees have been built to prevent flood damage. As a consequence, the filter effect of vegetation on sediment and pollutants draining across the landscape and settling on the floodplain has been reduced. Loss of riparian vegetation can also decrease pH (increase acidity), which increases solubility of chemical constituents making them biologically available to aquatic organisms. Shade also has been reduced resulting in elevated water temperatures and reduced dissolved oxygen.

Description of Water Quality by Project Sub-Area

EMERSON, GILBERT, AND BURROUGHS PROPERTIES

The Emerson, Gilbert, and Burroughs properties are former tidal marsh with relic dunes, historically surrounded by seasonal and riparian wetlands and the Marsh Creek delta. The site was diked and drained for agriculture as early as the 1850s (NHI 2004). All three parcels were originally used for dairy operations. The Gilbert and Burroughs parcels were converted to grazing in the mid-1970s, and the Emerson parcel remained a dairy until 2003. In 1990 and 1991, the Emerson parcel imported 500 acre-feet per year of secondary treated wastewater from the nearby Oakley-Bethel Island Wastewater Treatment Plant (now Ironhouse Sanitary District), for "leaching of peat soils" (James Montgomery 1991; see "Ironhouse parcel" section below for discussion of water quality). It is uncertain for how many years this irrigation took place, or at what time it was ceased. Since 2003, all three parcels have been used as irrigated pasture for cattle grazing, with some gas production from onsite wells. Phase 1 Environmental Site Assessments (Engeo 2003a, 2003b, Sequoia 2003) were carried out to identify land use and site conditions that have resulted or could result in soil, surface water, or groundwater contamination. These studies found conditions including stored chemicals; an above-ground fuel storage tank; previous existence of electrical transformers containing polychlorinated biphenyls (PCBs); fuel; solid waste and debris; livestock manure piles and dairy runoff; and active and inactive natural gas and groundwater supply wells. More information on these is included in Section 3.15, Hazardous Materials.

All known hazardous materials and conditions were removed or otherwise remediated under the supervision of the Department of Water Resources. Soils containing petroleum hydrocarbons, mercury, barium, or PCBs were removed or remediated to levels below USEPA residential and aquatic toxicity criteria (Tom Hall, DWR internal memo August 25, 2003). Groundwater concentrations of nitrogen (including total, nitrate, nitrite, and total Kjeldhal) were elevated, as would be expected from the dairy and manure contributions, but nitrate and nitrite concentrations after remediation were reportedly below drinking water criteria (i.e., USEPA Primary Maximum Contamination Levels (MCLs): nitrate = 10,000 parts per billion (ppb), nitrite = 1,000 ppb; DWR 2003). Residual concentrations of petroleum in groundwater were found to be above the water quality objectives for drinking water (i.e., 21 ppb for toxicity and 5 ppb for tastes and odors, per CVRWQCB memo 4/1/2004), however it was concluded that these levels would decrease naturally over time due to biodegradation and adsorption to organic material, and so no additional actions were taken (DWR 2003).

Natural gas wells exist on all three properties, and mineral rights have been reserved for continued operation of one gas well on each property. All inactive wells are to be abandoned and plugged by summer of 2008 as directed by the agreement of sale. Several groundwater wells exist on the properties, and one or more may continue to be used by the City Park. All unused wells are to be abandoned in accordance with County requirements.

Groundwater elevations vary, likely due to differences in local groundwater withdrawals and recharge rates. Groundwater naturally flows in a northerly direction towards the Delta due to local geology, but local groundwater pumping significantly alters flow direction at some times of the year. Groundwater elevations at the Project site are estimated to be between +3 and -10 feet with respect to mean sea level (PWA, 2006). The diked, tidally isolated nature of the site has resulted in lowering of groundwater from evapotranspiration and pumping to maintain dry lands. Dutch, Little Dutch, and Emerson sloughs contribute to recharge of the groundwater aquifer below the Project site.

All three parcels are substantially subsided, particularly in the northern portions nearest Dutch Slough, with a total of up to 750 acres lying below the elevation of Mean Lower Low Water (-0.29 ft NGVD; PWA 2006). Under current operation, the parcels may be irrigated with water from the Emerson and Dutch Sloughs during the dry summer months. However, during wet months, accumulated surface water is pumped off of the site into the adjacent sloughs. Although no data is available on the quality of the pumped water, based on past and current land uses, it can be assumed that it contains elevated concentrations of nutrients, organic carbon, and coliform bacteria.

MARSH CREEK

Marsh Creek borders the Emerson property on the west, and is proposed as an integral component of the Ironhouse Restoration and the Marsh Creek delta restoration options on the Emerson parcel. The quality and amount of water in Marsh Creek is strongly influenced by historic and present land uses in the watershed, including historic mercury mining in the upper watershed, discharges from the Brentwood Waste Water Treatment Plant (BWWTP) upstream from the Project site, agriculture, and urbanization.

The ISD collected monthly water quality data in lower Marsh Creek (referred to as the Oakley Ranch Supply) from 1986 to 1994. Average concentrations of Total Dissolved Solids (TDS), calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), chloride (Cl), sulfate (SO4), and alkalinity are summarized in **Table 3.2-1**.

Table 3.2-1. Marsh Creek Oakley Ranch Supply Average Concentrations (mg/L) (1986-1994)

TDS	*Ca*	*Mg*	*Na*	*K*	*Cl*	*SO4*	*Alkalinity*
785	55	27	184	8	197	140	260

The BWWTP, 3.5 miles upstream of the Project site, treats 4.5 million gallons per day (mgd) of municipal wastewater from the City of Brentwood and discharges a portion of that (0.25 mgd during low flows and 0.60 mgd during high flows) into Marsh Creek[2]. These discharges are regulated under the National Pollution Discharge Elimination System (NPDES) permit program administered by the Central Valley Regional Water Quality Control Board. A summary of water quality monitoring data from the BWWTP NPDES monitoring program for years 2000 to 2004 are shown in **Table 3.2-2**, and loads calculated for the same period are summarized in **Table 3.2-3**. Brown and Caldwell (2006) estimated that on average, 18% of wet weather and 61% of dry weather flows in Marsh Creek were treated wastewater discharged from the BWWTP.

Table 3.2-2. Brentwood Wastewater Treatment Plant Discharge Concentrations (2000-2004)

2000-2004	*Flow (MGD)*	*BOD (mg/L)*	*NH3 (mg/L)*	*NO3 (mg/L)*	*P (mg/L)*	*TDS (mg/L)*	*Total Coliform (MPN/100mL)*
Minimum	0.5	1.0	0.05	0.22	0.69	820	2
Maximum	3.0	12	1.90	13	3.40	1,400	1,600
Average	2.1	3.0	0.38	3.04	1.97	1,231	128

BOD = biological oxygen demand; NH3 = ammonia; NO3 = nitrate

Table 3.2-3. Brentwood Wastewater Treatment Plant Discharge Loads (2000-2004)

2000-2004	*BOD (kg/d)*	*NH3 (g/d)*	*NO3 (kg/d)*	*P (kg/d)*	*TDS (kg/d)*
Minimum	82,625	189	70,240	136,569	70,240
Maximum	490,374	5,429	429,374	401,019	429,374
Average	348,276	2,199	305,295	297,430	294,100

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[2] The treatment system consists of screening, grit removal, oxidation and nitrification (by extended aeration activated sludge), denitrification (by anoxic basins), coagulation, tertiary treatment filtration, chlorination and dechlorination. The new treatment plant went online in March 2003.

It should be noted that the BWWTP upgraded to a tertiary treatment system in mid-2003, and the above averaged monitoring data may not be representative of current water quality.

IRONHOUSE PARCEL

The 100-acre Ironhouse Project site is used by ISD for disposal (through irrigation) of treated wastewater from the communities of Oakley and Bethel Island. Prior to application to the site, the wastewater is treated in two-stage aerated treatment ponds (secondary treatment), and disinfected with sodium hypochlorite. The northern portion of the Ironhouse parcel, from approximately 500 feet north of the CCWD Canal north, has received reclaimed wastewater applications since 1982. The wastewater application was not uniform and some fields received more than others. Prior to that year, it was irrigated with water pumped from Marsh Creek. The southern portion of the property, from approximately 500 feet north of the CCWD Canal south (including south of the Contra Costa Canal), began receiving reclaimed wastewater in 1992 (HydroFocus 2003).

Water quality in the project site could be impacted by chemical condition of soils from the Ironhouse parcel which are to be used as fill on the Emerson, Gilbert and Burroughs properties under Alternatives 2 and 3. Soils from the Ironhouse parcel were analyzed by Stellar Environmental Solutions, Inc. (SES), at the request of Natural Heritage Institute, in August 2006. Samples were taken from above two feet above mean sea level to obtain information about the soil that is proposed for use as project fill. The locations for sampling included areas known by the ISD to have received proportionately more, or less, wastewater. As results were relatively similar (despite the different lithologies of the samples), it was concluded by SES that the samples were representative of the site in general and no more sampling was necessary. However soil samples from the wettest bore showed highest concentrations of the detected analytes. The water in these samples probably most closely represents groundwater rather than treated wastewater recently irrigated on the ground surface.

Samples were analyzed for California Title 22 (CAM 17) Metals (total metal concentrations only); semi-volatile organic compounds (SVOCs) and polynuclear aromatic hydrocarbons (PAHs) (full list) by EPA Method 8270; chlorinated herbicides by EPA method 8151; ammonia (as nitrogen) by EPA Method 350.3 and chloride by EPA Method 300.1; total petroleum hydrocarbons (motor oil range) by EPA Method 8015 (replaces test for "oil and grease").

No SVOCs, PAHs or herbicides were detected above the reporting limits (Table 3.2-4). Diesel and motor oil grade hydrocarbons were detected in several samples at concentrations between 1.2 and 88 mg/kg and were at higher concentrations in the shallower soil samples. The lighter, motor oil fraction was generally present at around twice the diesel concentration. SES concluded that the hydrocarbons most likely had some airborne source. None of the metals were detected at concentrations above guideline levels set by the San Francisco RWQCB for determining the general suitability for dredged material for beneficial reuse (wetland restoration) projects (SFRWQCB 2000). The range of metal concentrations in these soil samples is included in Table 3.2-4 (see also section on sediment screening criteria below). The SFRWQCB guidelines were used in this study because no such standards exist for wetland restoration in the Central Valley Region. It is anticipated that the CVRWQCB will default to the SFRWQCB standards for wetland restoration projects with potential modifications on a case-by-case basis.

Ammonia (as nitrogen) was detected in only one of 15 samples at 5.6 mg/kg, which is considered low. Chloride was detected at a range of 15-370 mg/kg. (There are no wetlands criteria for either ammonia or chloride).

Table 3.2-4. Concentrations of CA Title 22 (CAM 17) Metals in soil samples from Ironhouse Parcel and comparison to SFRWQCB 2000 screening criteria

Constituent	Range in Samples (mg/kg)	SFRWQCB 2000 Wetland Reuse Screening Criteria (mg/kg)	
		Wetland Surface Material	Wetland Foundation Material
Arsenic (As)	1.1 – 8.6	15.3	70
Chromium (Cr)	10 – 50	112	370
Lead (Pb)	1.5 – 8.9	43.2	218
Mercury (Hg)	0.021 – 0.099	0.43	0.7
Selenium (Se)	0.42 (1 sample)	0.64	NA

The Ironhouse Project site soil was not analyzed for coliform bacteria nor for EDCs (see discussion above). The treatment plant effluent that was irrigated on the Ironhouse parcel was analyzed directly in 1991 as part of a study for a potential constructed wastewater treatment wetland (James Montgomery 1991). The analysis showed non-detectable levels (at method detection limits) of priority pollutant pesticides, all PCBs, all regulated volatile organic carbons (VOCs), dioxin, phenol, hazardous substance compounds, most metals (including hexavalent chromium, arsenic, cadmium, mercury, selenium, silver, nickel, and lead), and most extractable priority pollutants. Copper and zinc were present at 0.019 and 0.073 mg/L, respectively, and bis (2-ethylhexyl) phthalate was present at 40 μg/L. A summary table of effluent data in the 1991 report indicated concentrations of metals may have been at the following levels: arsenic-5 μg/L, mercury-2 μg/L, cadmium-5 μg/L, chromium-10 μg/L, copper-20 μg/L, nickel-35 μg/L, lead-10 μg/L, zinc-73 μg/L, 10 μg/L, and selenium-5 μg/L (James Montgomery 1991, Figure 3-2), but these levels are below the method detection limits indicated on the laboratory reports.

The ISD has performed groundwater monitoring on the shallow aquifer beneath their irrigated pasture lands over the years for compliance with CVRWQCB requirements. Table 3.2.5 provides a summary of data collected between 2000 and 2005 from selected groundwater wells3. A 2003 study, designed to evaluate the impact of the wastewater irrigation on the beneficial uses of groundwater (HydroFocus 2003) attempted to develop indicators for determining the presence of wastewater in groundwater at the site (Table 3.2.5). The study concluded that TDS and chloride concentrations were consistent with estimated pre-existing conditions, and did not indicate a wastewater presence. Of the many parameters tested (not all of which are listed in Table 3.2-5), the study found that fluoride provided the best indicator of the presence of wastewater in groundwater.

[3] Most monitoring wells on the Ironhouse Sanitary District lands are placed in areas remote from the property being discussed herein, or are placed at interfaces between the property and other groundwater influences (e.g., Dutch Slough or Contra Costa Canal). The results shown in Table 3.2-5 are for a limited number of wells selected for the purposes of this report (mainland wells 15, 17, 18, 21, 26) as most representative of potential groundwater concentrations on the Ironhouse parcel itself.

BIG BREAK

Water quality at Big Break can be expected to be similar to Dutch Slough and the rest of the Sacramento-San Joaquin Delta (see discussions for each, below). The US Bureau of Reclamation and

Table 3.2-5. Groundwater Data for Selected Groundwater Wells on or Near the Ironhouse Parcel (Ironhouse 2005, HydroFocus 2003)

Parameter or Constituent	*Range of measurements at five representative wells*	
	Compiled 2000-2005 Data (Ironhouse 2005)	*2003 Study (HydroFocus 2003)*
pH	7.0-8.0	7.0-7.4
Electrical conductivity		1620-4190 µS/cm
Dissolved oxygen		0.0
Chloride (Cl)	80-660 mg/L	200-700 mg/L
Sulfate (SO4)	25-2300 mg/L	130-1400 mg/L
Hardness (HCO3)	310-880 mg/L	362-647 mg/L
Calcium (Ca)	61-520 mg/L	53-160 mg/L
Chromium (Cr)	0.003-0.07 mg/L	-not analyzed-
Copper (Cu)	0.003-0.4 mg/L	-not analyzed-
Lead (Pb)	0.002-0.02 mg/L	-not analyzed-
Magnesium (Mg)	41-300 mg/L	54-310 mg/L
Sodium (Na)	170-580 mg/L	230-650 mg/L
Total dissolved solids (TDS)	740-4000 mg/L	930-5300 mg/L
Bromide (Br)	0.5-8 mg/L	0.47-6 mg/L
Fluoride (F)	0.2-1 mg/L	0.4-0.5 mg/L
Phosphate as P (PO4-P)		0.1-0.82 mg/L
Nitrate (NO3)		14 mg/L
Nitrite (NO2)		0.4 mg/L
Total Kjeldhal Nitrogen (TKN)		0.1-0.3 mg/L
Total Coliform	8-1600 MPN/100ml	<2->1600 MPN/100ml
Total trihalomethanes (THMs)		<0.50 µg/L detection limit

Table 3.2-6 Big Break Water Quality (1980-1995)

Constituent/Parameter	*Unit*	*maximum*	*minimum*	*average*	*median*
pH		8.9	6.6	7.8	7.8
Temp	ºC	25	8	18.5	20
Dissolved Oxygen	mg/L	12.2	6.8	9.1	9.1
Dissolved Chloride	mg/L	994	8	185	73
Conductivity	µS/cm	4,920	115	851	506
Total Dissolved Solids	mg/L	2,100	75	439	233
Total Suspended Solids	mg/L	206	3	19.5	14
Nitrate + Nitrite	mg/L	1.2	0.01	0.33	0.31
Dissolved Ammonia - N	mg/L	0.8	0.01	0.05	0.03
Source: Bay Delta and Tributaries (BDAT) Project, http://baydelta.ca.gov. USBR-DWR Station D14.					

Department of Water Resources collected monthly water quality monitoring samples within Big Break (Station D14A) between 1968 and 1995. Selected water quality data from this station is summarized in Table 3.2-6. Total mercury concentrations in Big Break were measured twice annually from 1988-1993. During each sampling event, total mercury concentrations were 1 microgram per liter (υg/L) (BDAT).

The San Francisco Estuary Institute's Regional Monitoring Program collects and compiles water quality monitoring data on pollutants of concern for 31 monitoring stations within the Bay Estuary. The eastern-most station is located 4.3 miles west of Big Break, on the San Joaquin River. Flows at this location are dominated by the San Joaquin River, with some influence from the Sacramento River, but the water quality conditions can be expected to be similar to Big Break, and are instructive for the purposes of analysis. Summary data on selected constituents are provided in Table 3.2-7.

Table 3.2-7. San Joaquin Water Quality Data 4.3 Miles West of Big Break (1993-2003)

Constituent/Parameter	*Unit*	*maximum*	*minimum*	*average*	*median*
pH		8.10	6.30	7.59	7.70
Temp	ºC	23.7	9.5	17.2	17.4
Dissolved Oxygen	mg/L	11.24	7.35	8.87	8.68
Dissolved Organic Carbon	µg/L	6,528	1,606	2,951	2,329
Conductivity	µS/cm	3,610	110	665	223
Total Suspended Solids	mg/L	70	11	28	25
Nitrate	mg/L	0.74	0.17	0.36	0.28
Ammonia - N	mg/L	0.21	0.00	0.07	0.04
Dissolved Polyaromatic Hydrocarbons (PAHs)	pg/L	9,385	341	5,180	2,035
Total PAHs	pg/L	23,085	2,822	7,983	6,668
Dissolved Polychlorinated biphenyls (PCBs)	pg/L	289.10	15.90	95.55	90.20
Total PCBs	pg/L	704.40	66.10	195.12	162.91
Total Chlordanes	pg/L	253.50	25.76	125.67	113.90
Total DDTs	pg/L	1,049	175	429	365

Source: Regional Monitoring Program Status & Trends Monitoring Data. RMP Station BG-30 (longitude -21.806, lat 38.02). Approximately 20-25 samples collected 1993 - 2003 http://www.sfei.org/rmp/rmp_data_access.html.

EMERSON AND LITTLE DUTCH SLOUGHS

Emerson and Little Dutch Sloughs are artificial dead-end sloughs that divide the Dutch Slough Restoration Project site and would serve as the primary tidal water source for the Dutch Slough Restoration Project. Currently no water quality data are available for either slough; therefore Big Break water quality (above) is considered to be the best representation. Limited salinity data were collected from Little Dutch Slough for comparison to salinity in nearby irrigation ditches. Results indicated that salinity levels were similar, with a median conductance of 1,148 microsiemens per centimeter (μs/cm), which is generally in the range of drinking water (50-1,500 μs/cm; Balance Hydrologics, 2005)[4.]

DUTCH SLOUGH

The hydrology of Dutch Slough was described in Section 3.1. Water quality in the slough is influenced by Delta and Marsh Creek flows, and by surrounding land uses. Historical and current discharges of drainage from agricultural lands adjacent to Dutch Slough (including the Emerson, Gilbert, Burroughs, and Ironhouse Properties) contribute to degrading water quality in the slough by inputting excess nutrients, fertilizers, pesticides and emerging contaminants (see discussion of water quality in the Sacramento-San Joaquin Delta, below). Salinity levels in Dutch Slough fluctuate according to season and type of water year (wet, normal, dry). Salinity levels are discussed further in Section 3.1, Hydrology. The United States Bureau of Reclamation measured daily salinities in Dutch Slough using electric conductivity measurements from January 1, 1964 to December 31, 1998. Figure 3.2-1 summarizes those data as salinity concentrations (in parts per thousand, ppt) by type of water year. As shown in the figure, salinities in Dutch Slough did not rise above 1 ppt, even during years with historically low Delta outflow. There are currently no other water quality data available for Dutch Slough, but the data from Big Break are considered an appropriate surrogate.

SACRAMENTO-SAN JOAQUIN DELTA

The configuration and hydrology of the Sacramento-San Joaquin Delta was described in Section 3.1. The three closest water supply intakes (or "pump stations") are depicted in Figure 3.2-2. The Rock Slough and Old River intakes are 10 and 15 water-miles upstream, respectively, from the Dutch Slough site. Due to the presence of a permanent barrier in Sand Mound Slough (see Figure 3.2-2), water in Dutch Slough must travel upstream and around Holland Tract to reach the diversion points at Rock Slough and Old River. The two intakes collect water for the Contra Costa Canal (discussed further below), which provides water to approximately 500,000 users in Contra Costa County.

The Harvey O. Banks intake (20 water-miles upstream) is the northern most intake of the 444-mile California Aqueduct, the main artery of the State Water Project. Rock Slough and Old River intakes pump 0.1 million acre feet (maf) per year to the Contra Costa Canal, primarily in the winter months. The Harvey O. Banks intake pumps 5-7 maf per year to the State Water Project.

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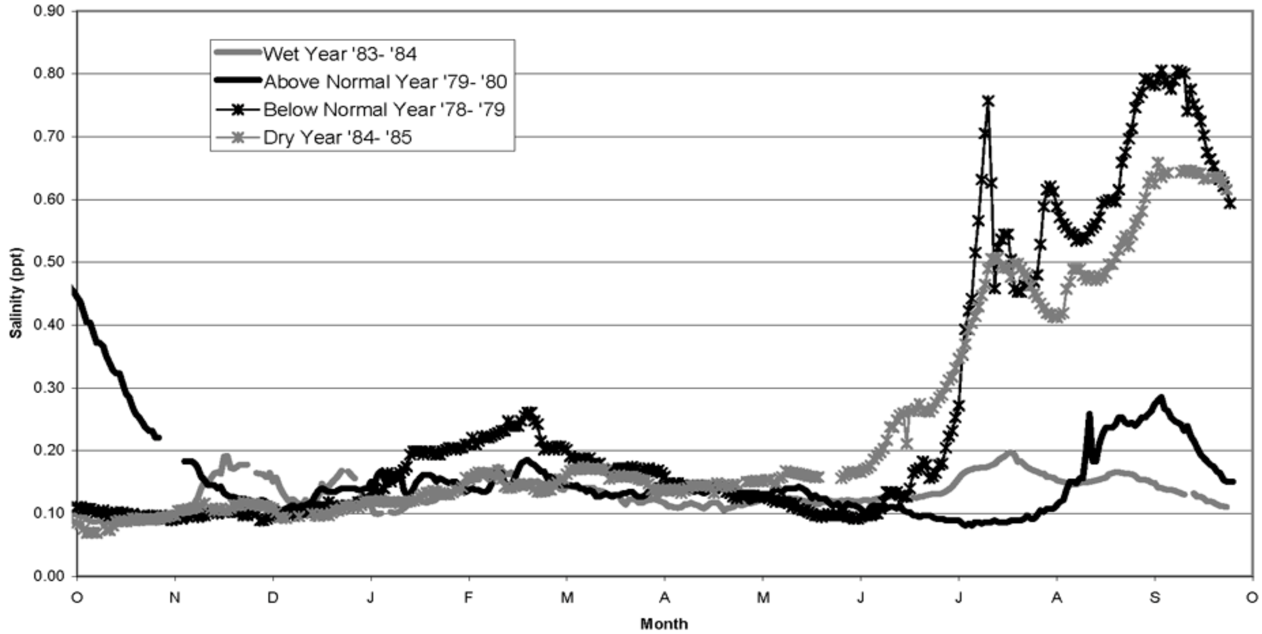
[4] Specific conductance is a widely used index of salinity. Conductance is a measure of the ability of water to transmit an electrical current, and it is proportional to the amount of dissolved solids in the water. Dissolved solids are, in turn, directly correlated to salinity; thus, the greater the conductance, the greater the salinity. Specific conductance is conductance standardized to 25º Celsius. When specific conductance was first defined in 1964, it was defined as "the reciprocal of the resistance in ohms", and the unit for reporting was defined as "micromhos per centimeter" ("mho" being the "reciprocal" of "ohm"). In recent years, the SI unit "microsiemens per centimeter" (μS/cm) has come into common use, and the two terms are interchangeable. In print, if the Greek symbol "μ" (mu) is not available, a small letter "u" is usually substituted, so the unit will be reported as uS/cm or umhos/cm.

The relationship of conductance to the concentration of salt ions in a water sample is specific to each water source. Typically, specific conductance in freshwater ranges from 0 to 1,300 μS/cm, brackish water ranges from 1,301 to 28,800 μS/cm, and salty water is greater than 28,800 μS/cm. Specific conductance has also been used to distinguish water of different origins. For instance, specific conductance of 30 to 50 μS/cm might indicate fresh rainwater, while 53,000 μS/cm would suggest a hypersaline lake. Groundwater typically has higher specific conductance than surface water because the water has moved through the soil column and acquired a higher concentration of dissolved solids or "salts." However, distinguishing between groundwater and brackish or saline surface water based on conductivity can be difficult without additional information.

Figure 3.2-1. Salinity Measurements in Dutch Slough (1978-1985)



Source: USBR, Central Valley Operations Office, in PWA 2996.

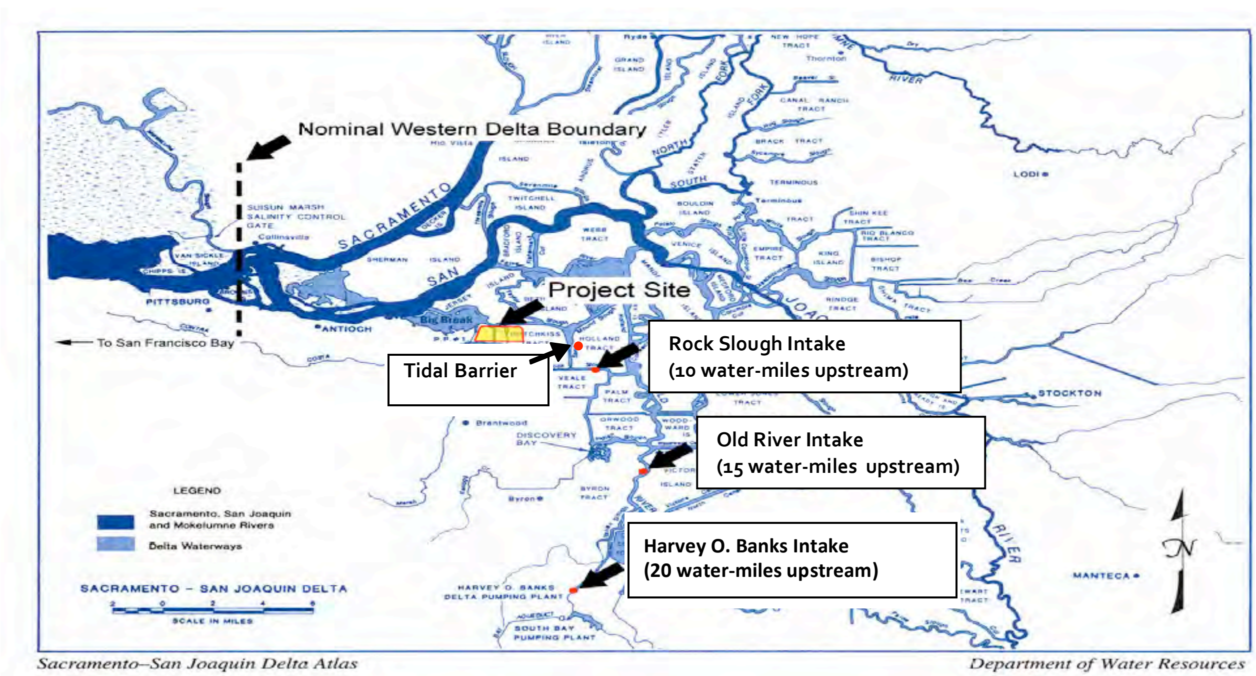


Figure 3.2-2. Location of Three Drinking Water Supply Intakes in the Vicinity of the Project.

WATER QUALITY IN THE DELTA

Water quality in the Delta is complex. Inflow from the Central Valley carries with it elevated concentrations of nutrients, salts, pesticides, and other agricultural byproducts, mercury and other metals, and other pollutants. Inflows also provide large volumes of organic carbon – the critical foundation for the aquatic food chain (Jassby 1992, Brown 2003, and others), but a serious water quality problem for water supply systems (Brown 2003, USEPA 2006). Some forms of organic carbon, particularly dissolved organic carbon (DOC), can combine with bromide during water purification and form carcinogenic trihalomethanes (THM). Tidal inflows can elevate salinity (including bromide), particularly during dry years (this effect was reduced by the construction and management of dams in the upper watersheds in the 1940s for salinity control) (USGS 2000). Organic carbon can be produced within a water system by phytoplankton, benthic microalgae, microalgae, seagrasses, or photosynthetic bacteria, or imported from river flows, stormwater runoff, atmospheric deposition, oil spills, or other external sources (Jassby 1992, Jassby et al. 1993). Total organic carbon import and export from the Delta was modeled by USEPA (USEPA 2006). During a typical wet year, total organic carbon (TOC) imports to the Delta from watershed sources were estimated at 155,000 tons. Within the Delta, dewatering from Delta islands and other agricultural sources contributed 24,000 tons, and tidal marsh export and primary ecological production together contributed 12,000 tons. Most of the TOC was estimated to be exported to the Bay, with approximately 28,000 tons being taken in by the water supply systems (Figure 3.2-3). During dry years, TOC contribution from the watershed was reduced to 54,200 tons, while contributions from within the Delta were estimated to remain the same.

Within the Delta, drainage water from Delta islands with peat soils is estimated to contribute from 20% to 50% of the dissolved organic carbon that leads to formation of THMs in water exported by the State Water Project (Amy et al. 1990). The western Delta is listed on the 2003 Clean Water Act Section 303(d) List of Impaired Waterways as impaired for chlorpyrifos, DDT, Diazinon, electrical conductivity, “group A” pesticides, mercury, and “unknown toxicity”. In addition, Old River is listed as impaired for dissolved oxygen. (USEPA 2003)

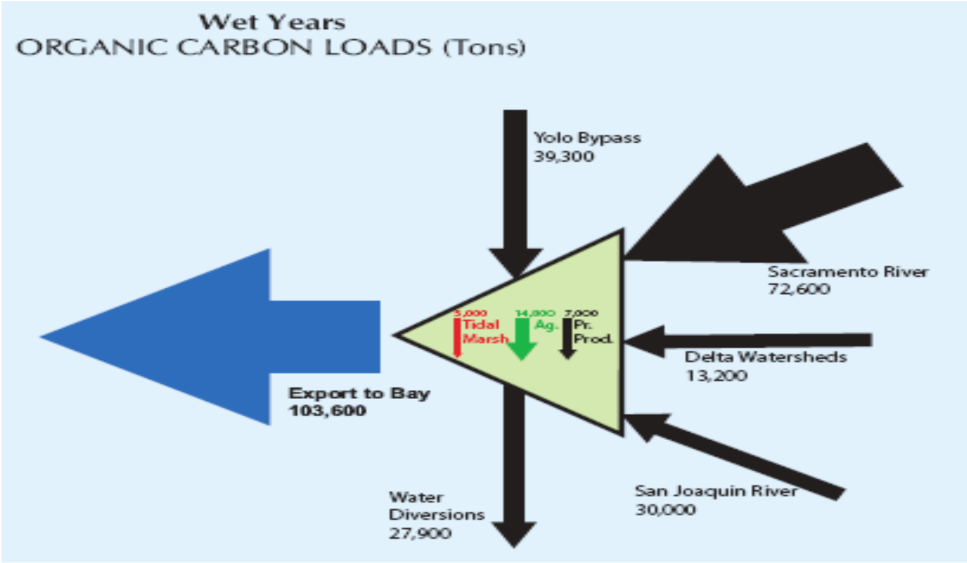


Figure 3.2-3. Total Organic Carbon Load to the Sacramento-San Joaquin Delta during a Typical Wet Year (USEPA 2006)

Because of the complexity of the Delta hydrology and water quality issues and its importance as a primary water supply for much of California, the State Department of Water Resources, State Water Resources Control Board, US Environmental Protection Agency, U.S. Geological Survey, and others, independently and through collaboration with the Calfed Bay-Delta Program, have undertaken extensive efforts to reduce uncertainty and develop a long term approach to restore the ecological health and improve water management of the system. Restoration of tidal wetlands in the Delta is seen as an important component of the effort (Brown 2003).

CONTRA COSTA CANAL

The Contra Costa Canal (Canal) is a 48-mile long artificial water supply canal servicing the Diablo Water District and Contra Costa Water District. The Canal is primarily concrete lined except for the first 3.97 miles and was originally constructed as part of the Central Valley Project between 1937 and 1940 to provide Delta water to the surrounding area. The Canal begins at Rock Slough (see Figure 3.2-2), which is connected to the Delta and located just to the east of the Project site. Rock Slough feeds Delta water to the Canal before it flows west forming the southern boundary of the Project. Most of the area surrounding the Canal is farmland and open space with significant conversion to residential development planned or underway. The Cypress Grove development (under construction) is located within the Eastern Cypress Corridor on the southern side of the Canal immediately across from the Dutch Slough Restoration Project and the planned City Community Park. The Canal is crossed by several roads and sloughs but has no direct hydrologic connection to other waterways. Contra Costa Water District has proposed the Contra Costa Canal Encasement Project to bury 3.97 miles of the Canal in a pipeline, including the reach between the Project and the Eastern Cypress Corridor. The primary purpose of the Encasement Project is to protect water quality in the earth lined portion of the Canal that can be degraded from interaction with local groundwater.

Water quality in the Contra Costa Canal is governed by the quality of water at its intake at Rock Slough, which varies depending on the volume of flows from the San Joaquin watershed, the amount of pumping at the Rock Slough and Old River intakes, the relative salinity import into the Delta from the Bay, and other factors (see the discussion of water quality in the Sacramento-San Joaquin Delta, above). Of particular concern for water supply purposes are salinity, total organic carbon, and bromide (see Delta discussion, above). Salinity measurements (measured in terms of electrical conductivity) at the Rock Slough intake for April 2003-April 2004 ranged from a low of 160-170 □S/cm during June and July 2003, to a high of 712 □S/cm during December 2006 (Figure 3.2-4). These levels are consistent with fresh- water of relatively high quality.

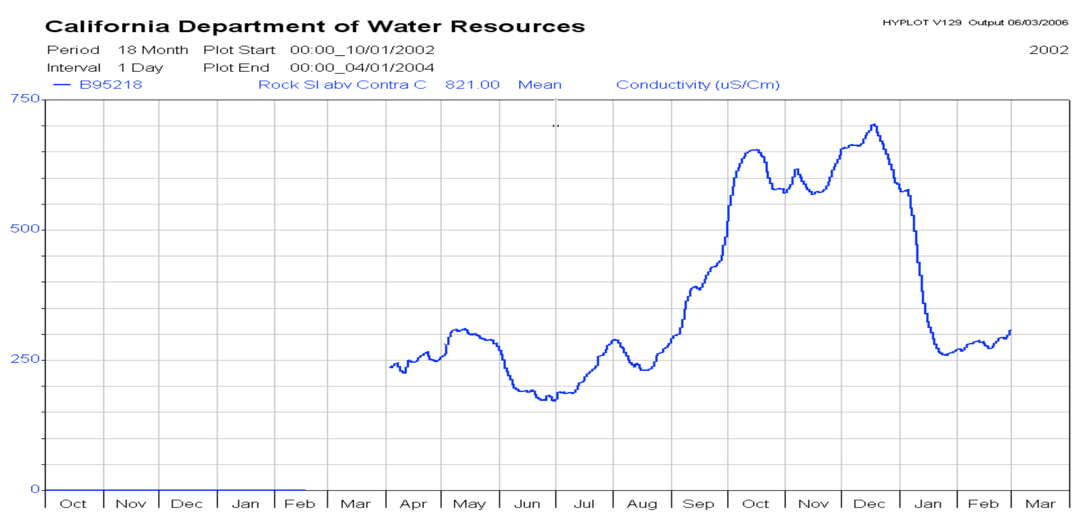


Figure 3.2-4. Plot of Conductivity of Water in Rock Slough at the Contra Costa Canal Water Supply Intake Between April 1, 2003 and April 1, 2004 (Source: DWR Water Data Library, continuous time series data for station B95218).

Dissolved organic carbon (DOC) concentrations measured at the Rock Slough monitoring station at Old River (immediately east of the Contra Costa Canal intake) over a 15 year period are shown in Figure 3.2-5. The Department of Water Resources estimated that between 30% and 50% of the DOC measured at this station was caused by agricultural drainage from Delta peat islands (DWR 2003).

Water and Sediment Quality Monitoring

The Dutch Slough Restoration Project would include a monitoring program to collect additional information for assessing potential water quality impacts and to verify compliance with regulatory requirements. An illustrative approach for the water quality monitoring program is described in Appendix C-2 of the PWA Feasibility Report. It includes establishment of five water quality sampling stations: two in Dutch Slough to the east and west of the project, and one each in Little Dutch Slough, Emerson Slough, and Marsh Creek.

In the suggested program, laboratory analyses for water samples would include some or all of the following: dissolved organic carbon (DOC), total organic carbon (TOC), UV 254, bromide, total mercury, dissolved mercury, MeHg (MeHg), nitrate, ammonia, total kjeldahl nitrogen (TKN), orthophosphate, total phosphorus, zinc, arsenic, copper, cadmium, chromium, lead, nickel, selenium, iron, aluminum, manganese, alkalinity, total dissolved solids (TDS), total coliform, fecal coliform, e. coli, and total suspended sediment (TSS).

Slough bed sediment samples would be analyzed for some or all of the following: MeHg, total mercury, dissolved mercury, total sulfide, iron, manganese, polychlorinated biphenols (PCBs), and organochloride pesticides. Marsh Creek sediment samples would be analyzed for total mercury.

Monthly average DOC with DOC in agriculture drainage (mg/L)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1976	2.19	2.42	2.98	3.17	3.16	3.12	3.18	3.28	3.11	2.80	2.55	2.40
1977	2.42	2.58	2.74	3.05	4.51	4.92	3.74	3.03	3.03	2.82	2.74	2.60
1978	2.58	2.64	3.05	5.66	7.71	6.60	5.01	4.87	3.70	2.94	2.49	2.32
1979	2.35	2.30	2.45	3.63	5.55	5.79	4.07	3.36	2.95	2.56	2.39	2.34
1980	2.27	2.26	2.73	5.62	5.70	5.03	4.39	3.20	3.04	2.72	2.43	2.31
1981	2.37	2.37	2.40	3.03	3.49	3.70	3.73	3.41	2.97	2.54	2.46	2.39
1982	2.28	2.72	5.03	6.46	5.83	5.25	4.59	4.52	3.40	2.65	2.40	2.21
1983	2.57	3.38	4.01	4.83	4.94	5.50	5.19	4.82	3.75	3.71	2.83	2.31
1984	2.67	3.14	3.75	4.38	4.72	3.31	2.77	2.81	2.62	2.50	2.42	2.28
1985	2.23	2.83	3.74	3.91	3.50	3.46	3.45	3.29	2.97	2.55	2.43	2.34
1986	2.28	2.32	3.00	4.74	8.04	6.77	5.37	4.48	3.18	2.95	2.54	2.23
1987	2.27	2.32	2.49	2.91	3.75	5.09	5.76	4.29	3.25	2.70	2.61	2.52
1988	2.45	2.46	2.85	5.07	5.74	5.34	4.20	3.63	3.17	3.06	3.04	2.83
1989	2.69	2.57	2.55	2.83	3.76	4.89	5.68	4.87	3.14	2.52	2.40	2.27
1990	2.17	2.34	2.61	3.55	4.62	4.31	3.92	4.23	3.67	3.44	3.22	2.92
1991	2.62	2.69	2.76	3.50	4.36	4.70	5.80	4.39	3.04	2.98	3.00	2.80
Avg	2.40	2.58	3.07	4.15	4.96	4.86	4.43	3.91	3.19	2.84	2.62	2.44

Figure 3.2-5. Monthly Average Concentrations of Dissolved Organic Carbon at Old River At Rock Slough (1976-1991) **Source: DWR 2003.**

Field parameters would be collected at all sites and may include GPS coordinates, flow, dissolved oxygen (DO), temperature, pH, conductivity, turbidity. As possible additions, oxidation reduction potential (ORP) and DO may be measured along the vertical profile of the sloughs.

Regulatory Setting

Actions that may affect surface and groundwater quality at the Dutch Slough Restoration Project site are subject to the requirements of the federal Clean Water Act (33 U.S.C. §§ 1251 et seq.; CWA) and associated regulations, the State Porter-Cologne Water Quality Control Act (Cal. Water Code §§ 13000 et seq.) and associated regulations, and to requirements established by the U.S. EPA, State Water Resources Control Board, the Regional Water Quality Control Board, Central Valley Region (CVRWQCB), County of Contra Costa and the City of Oakley.

The CVRWQCB is the lead agency for implementing all State regulations, and it has been designated by U.S. EPA as the State agency responsible for implementing the federal CWA Section 402 (National Pollutant Discharge Elimination System, "NPDES") and Section 401 (certification of Federal permits that might result in discharge to State waters/wetlands). The County of Contra Costa, the Contra Costa Flood Control District, and the City of Oakley are permittees under a regional NPDES permit to implement a stormwater management plan for Contra Costa County (the Contra Costa Clean Water Program). Under the permit, the agencies have responsibility for stormwater management and protection within their respective jurisdictions, and they may prohibit or set limits for discharges to meet water quality objectives set forth in the permit.

WATER QUALITY CONTROL PLANS

The CVRWQCB is the primary agency responsible for protecting water quality in natural waters ("waters of the State") within the Delta. The CVRWQCB's *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins* ("Basin Plan") (CVRWQCB 2006) designates existing and potential beneficial uses for each water body within its geographic region, and sets numeric and narrative water quality objectives to protect the beneficial uses. The surface water objectives include goals for a wide range of factors, including dissolved oxygen, pH, sediment, toxicity, and population and community ecology. The Basin Plan includes an implementation plan for achieving the water quality objectives that describes recommended actions for public and private entities, time schedules for actions, and strategies for compliance. The designated beneficial uses, combined with the narrative and numerical water quality objectives and the implementation plan constitute water quality standards for the Central Valley Region. Existing beneficial uses for the Delta surface water and groundwater are summarized in Table 3.2-8[5]. Beneficial uses are not designated specifically for Big Break, Dutch, Emerson, and Little Dutch Sloughs. Because these water bodies are tributary to and effectively part of the Delta, beneficial uses designated for the Delta are assumed to apply. Beneficial uses designated for Marsh Creek per State Board Resolution 90-28 include water contact recreation and non-contact water recreation, warm water spawning habitat, wildlife habitat, and rare, threatened, or endangered species habitat. All groundwater at and near the site is considered a potential source of drinking water.

In addition to the Basin Plan, the Delta is also protected under the *Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* (Bay/Delta Plan). The Bay/Delta Plan focuses

[5] Although the Basin Plan lists the beneficial uses for the Sacramento San Joaquin Delta as indicated, it also states (Table II-1, footnote 8) "beneficial uses vary throughout the Delta and will be evaluated on a case-by-case basis."

on the protection of the Estuary's beneficial uses that involve salinity (from salt water intrusion and agricultural drainage) and water project operations (reservoir releases and diversions) (SWRCB 2006). The State Board implements most of the objectives in the Bay/Delta Plan by assigning responsibilities to water rights holders, and particularly by requiring specific minimum Delta flows be maintained by dam/diversion operators (Bay/Delta Plan, pg. 23). The Bay/Delta Plan also recognizes a broad, multi-agency effort to provide better protection and support for biological resources, identifying among 14 priorities the following objective: "Implement actions needed to restore and preserve marsh, riparian, and upland habitat in and upstream of the Delta." The Bay/Delta Plan goes on to state that "State and federal agencies should require, to the extent of their authorities, habitat restoration in the Delta …as a condition of approving projects" (Bay/Delta Plan, pg. 40). Water quality objectives established in the Bay/Delta Plan are incorporated (by reference or adoption) into the Basin Plan.

The following policies are incorporated into the Basin Plan by reference and are relevant to the Dutch Slough Restoration and Ironhouse Projects:

The *Statement of Policy with Respect to Maintaining High Quality of Water in California* (State Board Resolution No. 68-60) and the associated *Antidegradation Implementation Policy* restrict the CVRWQCB and dischargers from reducing the water quality of surface or groundwater, even though such a reduction of water quality might still allow the protection of the beneficial uses associated with the water prior to the quality reduction. In application, the objective of the policy is to maintain existing high quality of waters "consistent with the maximum benefit to the people of the State."

The *Sources of Drinking Water Policy* (State Board Resolution No. 88-63) specifies that, except under specifically defined exceptions, all surface and groundwater of the state are to be protected as existing or potential sources of municipal and domestic supply. The specific exceptions include waters with existing high total dissolved solids (TDS) concentrations greater than 3000 mg/L (conductivity greater than 5,000 μS/cm; Basin Plan page II-3.00), low sustainable yield, or contamination that cannot be reasonably treated. The designation of drinking water supply can only be removed by the State Water Board through a formal Basin Plan amendment and public hearing.

The *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California* (State Board Resolution No. 2000-015), also known as the State Implementation Plan (SIP), establishes implementation provisions and certain monitoring requirements for the priority pollutant criteria promulgated by USEPA (May 2000) through the National Toxics Rule and California Toxics Rule (CTR), and for priority pollutant objectives established in the Basin Plan.

The *Nonpoint Source Management Plan* (State Board Resolution No. 88-123) establishes a three-tiered management approach for addressing nonpoint pollution source problems. These are 1) voluntary implementation of best management practices, 2) regulatory based encouragement of best management practices and3) adopted effluent limits. The policy states that the least stringent successful approach should be employed, with more stringent measures considered if timely improvements in beneficial use protection are not achieved.

The *Nonpoint Source Implementation and Enforcement Policy* (State Board Resolution No. 2004-0030) requires the State Board to regulate all nonpoint sources of pollution, using the administrative permitting authorities provided by the Porter-Cologne Act. The permitting authorities include, but are not limited to Basin Plan prohibitions, Waste Discharge Requirements, and waivers of Waste Discharge Requirements.

Table 3.2-8. Designated Beneficial Uses of the Sacramento San Joaquin Delta Surface Water and Groundwater as Defined by the Central Valley Regional Water Quality Control Board

Statewide Standard Basin Plan Beneficial Use Designations	*Sacramento San Joaquin Delta*	*Groundwater*
Municipal and Domestic Supply	Existing	Existing [6]
Agricultural Supply	Existing	Existing
Industrial Service Supply	Existing	Existing
Industrial Process Supply	Existing	Existing
Groundwater Recharge		
Freshwater Replenishment		
Navigation	Existing	
Hydropower Generation		
Water Contact Recreation	Existing	
Non-contact Water Recreation	Existing	
Aquaculture		
Warm Freshwater Habitat	Existing	
Cold Freshwater Habitat	Existing	
Estuarine Habitat		
Wildlife Habitat	Existing	
Special Significance Habitats		
Rare, Threatened or Endangered Species		
Migration of Aquatic Organisms	Existing *	
Spawning, Reproduction, and/or Early Development	Existing **	
Warm Water Spawning	Existing	

Source: Water Quality Control Plan for the Sacramento and the San Joaquin River Basins, 4th Edition

Key:

* Includes both cold water (salmon, steelhead) and warm water (striped bass, sturgeon, and shad) species

** Includes warm water species only

The *Irrigated Lands Regulatory Program* provides conditional waivers of waste discharge requirements for irrigated agricultural lands, which may include managed wetlands. The waivers will usually include the following conditions to protect water quality: 1) implement management practices to protect water, 2) comply with water quality standards, 3) conduct monitoring either individually or as part of a coalition, 4) prevent pollution of surface water, avoid nuisance conditions, such as odor, and 5) pay applicable fees..

[6] Although groundwater wells in the shallow aquifer of the Project Area typically show TDS concentrations or conductivity readings significantly greater than this standard (e.g., 800-50,000 □S/cm, Balance 2005; 650-8,000 mg/L TDS, Ironhouse 2005), the CVRWQCB regulates the shallow aquifer as a potential source of drinking water (Tom Williams, pers. comm.).

Applicable Water Quality Objectives for Surface Water

Although the Dutch Slough Restoration Project would not intentionally discharge pollutants to Waters of the State as a part of its purpose, there would be incidental discharges as a part of construction or operation, and there may be onsite conditions created that could result in the violation of some water quality objectives. It is not known at this time whether the CVRWQCB would choose to regulate all or part of the Dutch Slough Restoration Project activities under Waste Discharge Requirements, however, the following water quality objectives would generally apply:

- *Biostimulatory Substances*: Water shall not contain biostimulatory substances, which promote aquatic growths in concentrations that cause nuisance or adversely affect beneficial uses.
- *Chemical Constituents*: Waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses. At a minimum, water designated for use as domestic or municipal supply shall not contain concentrations of chemical constituents in excess of the maximum contaminant levels (MCLs) specified in Title 22 of the California Code of Regulations, which are incorporated into the Basin Plan by reference. Table 3.2-9 provides the relevant MCLs for inorganic chemicals. For some organic and inorganic chemicals, the California Toxics Rule applies more conservative limits for protection of freshwater aquatic life or human health.
- *Dissolved Oxygen*: Dissolved oxygen concentration within the Delta region occupied by this Project site shall not be reduced below 5.0 mg/l.

Table 3.2-9. Maximum Contaminant Levels for Inorganic Chemicals (Title 22 CCR Section 64431)

Chemical	*Maximum Contaminant Level, mg/L*
Aluminum	1.
Antimony	0.006
Arsenic	0.01*
Barium	0.1*
Beryllium	0.004
Cadmium	0.005
Chromium	0.05
Cyanide	0.01*
Mercury	0.002
Nickel	0.1
Nitrate (as NO3)	45.
Nitrate + Nitrite (sum as nitrogen)	10.
Nitrite (as nitrogen)	1.
Selenium	0.05
Thallium	0.002

*MCL from table III-1 in the Basin Plan. More stringent than Title 22 CCR level.

- *MeHg:* The Basin Plan (4th Edition) currently includes no specific requirements for MeHg in the Delta. However, the CVRWQCB is in the process of developing a TMDL for MeHg in the Delta. While the specifics of this TMDL are currently unknown, it is expected that the program will involve a three-phase strategy. The first phase would require studies to develop MeHg control strategies, the second phase requires implementing control measures identified in the first phase, and the third phase will be the full compliance phase with the TMDL objectives.
- *Oil and Grease:* Waters shall not contain oils, greases, waxes, or other materials in concentrations that cause nuisance, result in a visible film or coating on the surface of the water or on objects in the water, or otherwise adversely affect beneficial uses.
- *pH:* The pH shall not be depressed below 6.5 nor raised above 8.5. Changes in normal ambient pH levels shall not exceed 0.5 in fresh waters with designated COLD or WARM beneficial uses. In determining compliance with the water quality objective for pH, appropriate averaging periods may be applied provided that beneficial uses will be fully protected.
- *Salinity*: [7]To protect municipal and industrial beneficial uses, the maximum mean daily concentration of chloride (Cl) shall not exceed 250 mg/L during any "water year type" (defined by the Sacramento Valley 40-30-30 water year hydrologic classification index[8]). In addition, the maximum mean daily concentration of 150 mg/L Cl shall be maintained for at least 240 days during a wet year, 190 days during an "above normal" year, 175 days during a "below normal" year, 165 days during a "dry" year, and 155 days during a "critical" year.
- *Suspended Sediment*: The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.
- *Settleable Material*: Waters shall not contain substances in concentrations that result in the deposition of material that causes nuisance or adversely affects beneficial uses.
- *Suspended Material*: Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.
- *Temperature*: The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the CVRWQCB that such alteration in temperature does not adversely affect beneficial uses. At no time or place shall the temperature of COLD or WARM intrastate waters be increased more than 5°F above natural receiving water temperature.
- *Toxicity*: All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life. This objec-

[7] According to CVRWQCB staff, Betty Yee (8/9/06), salinity objectives stated for specific "compliance points" may not be interpolated to determine the salinity standard for another point. However, dischargers may interpolate the objectives in order to determine how their discharges might affect concentrations at the compliance points. The two nearest compliance points are Contra Costa Canal at Pumping Plant #1 (Station C5), and San Joaquin River at Antioch Shipping Canal (Station D12). Table 1 of the Bay/Delta Plan defines salinity limits in terms of chloride (Cl-) concentrations for protection of municipal and industrial beneficial uses. The salinity objectives for both nearby compliance points are the same, and so they are reported directly above.

[8] Note that the objective is defined in terms of the Sacramento Valley index rather than the San Joaquin Valley index.

tive applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances.

- *Turbidity*: Waters of the Delta shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Except for periods of storm runoff, the turbidity of Delta waters shall not exceed 50 NTUs in the waters of the Central Delta and 150 NTUs in other Delta waters. Exceptions to the Delta specific objectives will be considered when a dredging operation can cause an increase in turbidity. In this case, an allowable zone of dilution within which turbidity in excess of limits can be tolerated will be defined for the operation and prescribed in a discharge permit.

  In addition to these Delta-specific criteria, the general turbidity goals for the Sacramento and San Jaoquin River Basins also apply. These indicate that increases in turbidity attributable to controllable water quality factors shall not exceed the following limits:

  - Where natural turbidity is between 0 and 5 Nephelometric Turbidity Units (NTUs), increases shall not exceed 1 NTU.
  - Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent.
  - Where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs.
  - Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent.

Applicable Water Quality Objectives for Groundwater

None of the activities of the Dutch Slough Restoration Project would directly discharge pollutants into groundwater, but some activities may cause changes in groundwater characteristics as a result of changes in surface water hydrology or placement of soils where constituents could potentially be transported into the groundwater. Since the shallow groundwater aquifer underlying the Dutch Slough Restoration Project site is designated for municipal beneficial use, the following water quality objectives generally apply:

- *Bacteria:* The most probable number of coliform organisms over any seven-day period shall be less than 2.2/100 ml.
- *Chemical Constituent*: At a minimum, groundwaters shall not contain chemical constituents in concentrations that adversely affect beneficial uses. At a minimum, groundwaters shall not contain concentrations of chemical constituents in excess of the maximum contaminant levels (MCLs) specified in CCR Title 22 for inorganic chemicals, fluoride, organic chemicals, and they shall not contain lead in excess of 0.015 mg/l.
- *Taste and Odors*: Groundwaters shall not contain taste- or odor producing substances in concentrations that cause nuisance or adversely affect beneficial uses.
- *Toxicity*: Groundwaters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life associated with designated beneficial use(s). This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances

Sediment Screening Criteria

The Dutch Slough Restoration Project would excavate, relocate, and potentially import soils and sediments in areas that would subsequently be inundated by natural water as part of the restoration action. There currently are no Basin Plan objectives or other regulatory criteria for sediment to protect water quality; however, there are sediment quality guidelines that may be used as screening tools. The San Francisco Bay Regional Water Quality Control Board (SFRWQCB) developed sediment screening and testing guidelines for determining the general suitability of dredged material for beneficial reuse (wetland restoration) projects (SFRWQCB 2000; WQ Appendix I) [9]. The guidelines include sediment chemistry, acute toxicity, contaminant mobility, and elutriate chemistry and toxicity. Since the CVRWQCB has no such guidelines for sediment reuse in wetland restoration projects in the Central Valley, the SRFWQCB standards will be used as screening criteria in situations where sediment will be dredged or excavated, to evaluate the beneficial reuse options for the material and the potential adverse effects of these and other sediment disturbing activities. However, disposal of dredged or excavated material for beneficial reuse will be subject to site-specific testing requirements and acceptance requirements provided by the CVRWQCB as part of Waste Discharge Requirements for the project. The sediment screening criteria are as follows:

- *Chemistry*: The guidelines for sediment chemistry are shown in Table 3.2-10. The sediment chemistry guidelines are divided into two levels, one for material that will be placed at or near the wetland surface ("surface material") and one for material that will be placed at a minimum specified distance below the wetland surface ("foundation material").
- *Toxicity*: The recommended acute toxicity screening guideline for surface material is "no significant toxicity" for benthic bioassays. Benthic tests are to be interpreted following guidelines in SFBRWQCB Public Notice 93-3. For benthic bioassays, mortality in a test sediment that is statistically significant and 10 percentage points greater (20 percentage points for amphipods) than that in the reference is considered to be indicative of acute toxicity.
- *Contaminant Mobility*: There are no screening levels for contaminant mobility for wetland surface material because toxicity and chemistry screening for this material will result in concentrations for which mobility is not considered of concern. The screening levels for wetland foundation material are based on Water Quality Objectives found in the Basin Plan. While the foundation material is not expected to be in direct contact with biological receptors, levels of contaminants in effluent discharged during placement of material or in leachate produced after placement of material must be below levels of concern.
- *Elutriate Chemistry and Toxicity*: If dewatering will occur as part of material placement, discharge water must meet screening guidelines for both chemistry and toxicity. The screening guidelines for discharged water chemistry are the Basin Plan Water Quality Objectives listed above. The screening guideline for toxicity is "no significant toxicity". For the elutriate bioassay (the toxicity test on the water separated out from the sediment), this is met when the survival of organisms in effluent has a median value of not less than 90% and a 90th percentile value of not less than 70%.

[9] Use of these guidelines within the Central Valley Region is subject to approval by the CVRWQCB Staff. The Central Valley CVRWQCB may require different or additional criteria as part of CWA Section 401 review.

Table 3.2-10. Sediment Chemistry Screening Guidelines (from *Beneficial Reuse of Dredged Materials: Sediment Screening and Testing Guidelines* [SFBRWQCB 2000])

ANALYTE	Wetland Surface Material		Wetland Foundation Material	
	Concentration	Decision Basis	Concentration	Decision Basis
METALS (mg/kg)				
Arsenic	15.3	Ambient Values	70	ER-M
Cadmium	0.33	Ambient Values	9.6	ER-M
Chromium	112	Ambient Values	370	ER-M
Copper	68.1	Ambient Values	270	ER-M
Lead	43.2	Ambient Values	218	ER-M
Mercury	0.43	Ambient Values	0.7	ER-M
Nickel	112	Ambient Values	120	ER-M
Selenium	0.64	Ambient Values		
Silver	0.58	Ambient Values	3.7	ER-M
Zinc	158	Ambient Values	410	ER-M
ORGANOCHLORINE PESTICIDES/PCBS (mg/kg)				
DDTS, sum	7.0	Ambient Values	46.1	ER-M
Chlordanes, sum	2.3	TEL	4.8	PEL
Dieldrin	0.72	TEL	4.3	PEL
Hexachlorocyclohexane, sum	0.78	Ambient Values		
Hexachlorobenzene	0.485	Ambient Values		
PCBs, sum	22.7	ER-L	180	ER-M
POLYCYCLIC AROMATIC HYDROCARBONS (mg/kg)				
PAHs, total	3,390	Ambient Values	44,792	ER-M
Low molecular weight PAHs, sum	434	Ambient Values	3,160	ER-M
High molecular weight PAHs, sum	3,060	Ambient Values	9,600	ER-M
1-Methylnaphthalene	12.1	Ambient Values		
1-Methylphenanthrene	31.7	Ambient Values		
2,3,5-Trimethylnaphthalene	9.8	Ambient Values		
2,6-Dimethylnaphthalene	12.1	Ambient Values		
2-Methylnaphthalene	19.4	Ambient Values	670	ER-M
2-Methylphenanthrene		Ambient Values		
3-Methylphenanthrene		Ambient Values		
Acenaphthene	26.0	Ambient Values	500	ER-M
Acenaphthylene	88.0	Ambient Values	640	ER-M
Anthracene	88.0	Ambient Values	1,100	ER-M
Benz(a)anthracene	412	Ambient Values	1,600	ER-M
Benzo(a)pyrene	371	Ambient Values	1,600	ER-M
Benzo(e)pyrene	294	Ambient Values		
Benzo(b)fluoranthene	371	Ambient Values		
Benzo(g,h,i)perylene	310	Ambient Values		
Benzo(k)fluoranthene	258	Ambient Values		
Biphenyl	12.9	Ambient Values		
Chrysene	289	Ambient Values	2,800	ER-M
Dibenz(a,h)anthracene	32.7	Ambient Values	260	ER-M
Fluoranthene	514	Ambient Values	5,100	ER-M
Fluorene	25.3	Ambient Values	540	ER-M
Indeno(1,2,3-c,d)pyrene	382	Ambient Values		
Naphthalene	55.8	Ambient Values	2,100	ER-M
Perylene	145	Ambient Values		
Phenanthrene	237	Ambient Values	1,500	ER-M
Pyrene	665	Ambient Values	2,600	ER-M

Ambient Values – Ambient or "background" concentration statistically derived by the SFBRWQCB from data collected by the Regional Monitoring Program for Trace Substances (SFEI 1999) and the Bay Protection and Toxic Substances Cleanup Program Reference Study (SWRCB 1998)

TEL, PEL – Threshold Effects Level and Probable Effects Level - Sediment chemistry values developed by the Florida Department of Environmental Protection (FDEP 1994) as those below which biological effects are unlikely (TEL), and above which biological effects are likely (PEL).

ER-L, ER-M – Effects Range-Low and Effects Range-Median – Sediment chemistry values developed by Long et al. (1995) using the sediment chemistry and toxicity database of the National Oceanographic and Atmospheric Administration as those below which biological effects are unlikely (ER-L) and above which biological effects are likely (ER-M).

Dredged materials that meet the screening guidelines described above for wetland surface reuse are likely to be found suitable for this use, as well as for all the other uses described in this paper, subject, of course, to any project-specific limitations.

Dredged materials with statistically significant toxicity in one or more bioassays may be found suitable for Wetland Foundation Reuse if the material passes the screens for sediment chemistry and contaminant mobility. Reuse of such materials would be limited (by reuse site permitting) to locations that are designed to eliminate the threat of exposure. A wetland restoration design should include at least three feet of material suitable for Wetland Surface Reuse (or equivalent safeguards) and placement of the material in a location that is not threatened by erosion.

3.2.2. Project Impacts and Mitigations

Significance Criteria

In the evaluation of project alternatives that follows, a potential impact to water quality was considered significant if the construction or foreseeable post-construction conditions would cause any of the following:

- Violation of any water quality standard indicated in the Regulatory Framework section, above, or any Waste Discharge Requirement or NPDES permit condition;
- Discharge of any toxic substances into the water in concentrations that are lethal to or that produce significant alterations in population or community ecology or receiving water biota;
- Degradation of the existing high quality of water in any waters of the State, in violation of the Anti-degradation Policy; or
- Any change of water quality that would adversely affect designated beneficial uses.

Evaluation of Alternatives

This section considers each of the four Dutch Slough Restoration Project alternatives to determine whether any component of the alternative may result in significant impacts to water quality during or after project construction. If potential impacts are identified, mitigation measures are described that would reduce the impact, ideally to less than significant levels. In some cases, water quality impacts could potentially occur that would also involve impacts to fish or wildlife. In these cases, the water quality impact and mitigation will be addressed herein, and reference is made to other appropriate sections (e.g., Section 3.5, *Aquatic Resources*) for additional evaluation.

An important aspect of the Dutch Slough Restoration Project is that it has been designed with the specific intent of creating an environmentally beneficial project that would have minimal adverse affects; therefore many "mitigations" for potential water quality impacts have already been incorporated into the Dutch Slough Restoration Project design. This evaluation considers any mitigation that is already a part of the design to be a part of the project being assessed unless the implementation of the measure may be optional or discretionary.

Under Alternatives 2 and 3 material would be transported from the Ironhouse parcel and used as fill for the main project site. Under Alternative 1 restoration activities on the Ironhouse parcel may affect water quality in Marsh Creek.

Alternative 1: Minimum Fill

IMPACT 3.2.1-1: DEGRADATION OF WATER QUALITY DUE TO RELEASE OF CONTAMINANTS AND SEDIMENT FROM CONSTRUCTION ACTIVITIES (DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS)

Construction activities such as site clearing, grading, excavation, tide gate installation, demolition, reconstruction of existing facilities, or levee breaching, lowering, or building, could leave soils exposed to rain or surface water runoff[10] that may carry soil contaminants (e.g., nutrients, metals, hydrocarbons, or other pollutants) into waterways adjacent to the site, degrade water quality, and potentially violate water quality standards for specific chemicals, dissolved oxygen, oil and grease, suspended sediment, or toxicity. Alternative 1 would entail the least amount of surface disturbance for excavation of the Ironhouse parcel (which would be only slightly graded because it would not have to supply fill material to the Dutch Slough Restoration Project) and for grading or channel construction on all parcels, and so it would pose the lowest level of risk of this kind of impact. However, demolition and construction for the City Community Park, trails, and marsh areas would still be substantial, and overall potential impact to water quality could still be significant.

OPEN WATER MANAGEMENT OPTIONS

The deep subtidal option would entail more excavation and moving of soils on the site, increasing the risk of contaminated runoff by (1) potentially digging up additional areas of contaminated soils that would otherwise remain buried, and (2) increasing the area of disturbed soil subject to runoff. The skeletal channel option would require import and placement of large amounts of additional fill, increasing the risk of contaminated runoff by (1) increasing the area of disturbed soil subject to runoff, and (2) bringing in imported soils that could contain additional contaminants. The managed pond option would entail the same level of impact as the shallow subtidal open water option, but it potentially would have slightly reduced risk because flows could be regulated via the tide gate to allow remediation of contaminated soils or water prior to discharge. The subsidence reversal option would be similar to the managed pond in impact and risk, but it could potentially provide additional water quality benefit by serving as a stormwater "treatment wetland" for runoff for other parts of the project site.

MITIGATION 3.2.1-1.1: STORM WATER POLLUTION PREVENTION PLAN

A Stormwater Pollution Prevention Plan (SWPPP) shall be prepared prior to any construction on any portion of the Project, and implemented during construction. Individual SWPPPs may be prepared for various construction components or phases (e.g., demolition of existing site structures, grading of one parcel, etc.). The SWPPP(s) shall be prepared according to requirements of the State's Construction Activities Storm Water Permit (Construction Permit; State Board Order No. 99-08-DWQ, NPDES Permit CAS000002), following guidance contained in Section A of that permit, and it shall include all appropriate best management practices (BMPs) for minimizing stormwater runoff and the potential pollution it may cause. Coverage shall be obtained under the Construction Permit by filing a Notice of Intent and fee prior to construction of any project component.

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[10] By its very nature, the Project would intentionally bring surface water in contact with exposed soils, as the site is inundated as part of the restoration plan.

MITIGATION 3.2.1-1.2: DEWATERING RESTRICTION

Ponded storm or groundwater in construction areas shall not be dewatered directly into adjacent surface waters or to areas where they may flow to surface waters unless authorized by a permit from the CVRWQCB. In the absence of a discharge permit, ponded water (or other water removed for construction purposes), shall be pumped into baker tanks or other receptacles, characterized by water quality analysis, and remediated and/or disposed of appropriately based on results of analysis. If determined to be of suitable quality, some of this water may be used on-site for dust control purposes.

MITIGATION 3.2.1-1.3: CONTRACTOR TRAINING FOR PROTECTION OF WATER QUALITY

All contractors that will be performing demolition, construction, grading, road building, or other work that could cause increased water pollution conditions at the site (e.g., dispersal of contaminated soils, oiling of access roads) will receive training regarding the environmental sensitivity of the site and need to minimize impacts. Contractors will also be trained in implementation of stormwater BMPs for protection of water quality.

MITIGATION 3.2.1-1.4: MINIMIZE POTENTIAL POLLUTION CAUSED BY INUNDATION OF SITE

Sites shall not be inundated (connected to tidal water sources) until surface soil conditions have been stabilized, all construction debris removed, and all surface soils containing chemicals in excess of the Sediment Screening Criteria for "surface material" have been remediated or removed from the site.

SIGNIFICANCE AFTER MITIGATIONS

Less than significant with mitigation

IMPACT 3.2.1-2: DEGRADATION OF WATER QUALITY DUE TO INCREASED DISSOLVED ORGANIC CARBON (DOC) IN DELTA WATERS (DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS)

Alternative 1 would create approximately 440 acres of tidal marsh and 480 acres of shallow subtidal habitat, which is expected to result in production and export of organic carbon as part of natural, and typically desirable, wetland processes. While organic carbon is considered a critical foundation for the aquatic food chain (see discussion of San Joaquin-Sacramento Delta Water Quality, above), the dissolved fraction of organic carbon (DOC) can adversely impact drinking water sources by increasing production of trihalomethanes and other by-products during water disinfection. The Dutch Slough Restoration Project is located approximately ten water-miles from the Rock Slough intake to the Contra Costa Canal (see Figure 3.2-2), and so the potential export of organic carbon was raised as a concern by the Contra Costa Water District. Source water from Rock Slough is an important untreated water supply source during wet months, when salinity levels in the Delta are low. Supplies diverted through the canal also are used to blend with Los Vaqueros Reservoir water during dry months and droughts, when salinity levels are higher in the Delta.

There are currently no water quality objectives for DOC or total organic carbon (TOC) for the western Delta. However, the State Water Board suggests a goal of average total organic carbon (TOC) concentrations of 3.0 mg/L at drinking water intakes in the southern and central Delta (SWRCB 2006). The CVRWQCB is in the process of developing a new policy to protect sources of drinking water and appropriate levels of DOC are one of the chief concerns that will be addressed. It is unlikely that the CVRWQCB would choose to view export of organic carbon from a restored wetland system as a violation of the Antidegradation Policy, since organic carbon for the food chain is one of the primary objectives of wetland restoration and it supports a key beneficial use of Delta waters. However, if there were substantial reason to believe that carbon export from the Project could adversely affect water quality at the Contra Costa Canal intake, the CVRWQCB could choose to address it via Waste Discharge Requirements that specified site specific objectives or mandated specific management actions. Also, it would be considered a significant impact under this evaluation if the condition were to result in a "change of water quality that would adversely affect designated beneficial uses" (Section 3.2.2.1, above), whether or not a water quality objective were actually violated.

Whether the organic carbon produced by the restored marshes on the Dutch Slough Project site could adversely affect the drinking water source at the Rock Slough intake would depend on the character of the organic carbon (e.g., the percent in dissolved or otherwise reactive form) and whether it could reach the Rock Slough intake in sufficient concentration to be discernable from "background" levels. According to USGS, the best estimate for export of [total] organic carbon from tidal wetlands is 150 grams carbon per square meter per year (Brown 2003, citing Jassby and Cloern 2000). However, the percentage of this carbon that may be reactive and form disinfection byproducts (such as trihalomethanes) is dependent on many factors, including type of soil, amount of vegetation, wetland construction method, and age of the wetland (Brown 2003, Orr et al. 2003). A study of carbon production on flooded Delta islands found that the initial rate of flux of DOC into the water column was very high (0.6 g DOC/m^2/day) accounting for 84-98% of the total carbon. This rate of flux decreased markedly over two years to 0.15 g DOC/m^2/day, as did the relative fraction of carbon in the dissolved state (Reddy 2005).

Using the TOC and DOC export estimates of Jassby and Cloern (2000) and Reddy (2005), respectively, the following rough estimates can be made for carbon export from the 440 acres of marsh and 480 acres of shallow subtidal habitat created in Alternative 1: (1) the "steady state" export of TOC from the marsh may be about 1.7 tons TOC/day; (2) the export of DOC from the site may be as high as 2.5 tons DOC/day initially, and may decrease to 0.6 tons DOC/day after two years. Depending on the DOC concentrations with respect to CCWD's water intake, this may be a significant impact to water quality.

The total area of the Ironhouse parcel that would be inundated and thus become an exporter of organic carbon is not specified in the plan. For evaluation purposes, it was estimated that 75% of the 100-acre property, or 75 acres, would be inundated. Applying the TOC and DOC export estimates of Jassby and Cloern (2000) and Reddy (2005), respectively, the following rough estimates can be made for carbon export from the 75 acres if tidal marsh habitat created by the Ironhouse Project: (1) the "steady state" export of TOC from the marsh may be about 0.1 tons TOC/day; (2) the export of DOC from the site may be as high as 0.2 tons DOC/day initially, and may decrease to 0.05 tons DOC/day after two years.

Total and dissolved organic carbon exported from the park site would be consistent with typical urban runoff, and would not be expected to be significantly higher than under current conditions (current agricultural uses generate similar levels of organic carbon).

Finally, in order for DOC generated at the Dutch Slough Restoration Project to reach the water supply intakes at Rock Slough, it would have to be transport ten miles upstream through tidal channels – first north into Dutch Slough, eastward six miles into Old River, and southward another five miles, then more than a mile westward into the Rock Slough Intake. A permanent tide gate on San Mound Slough prevents Dutch Slough Water from reaching Rock Slough more directly via Sand

Mound Slough. Although it is possible for DOC to move upstream in a tidal environment, the quantity of DOC reaching the Rock Slough intake when the canal is operating is likely to be small. Furthermore, the extent of mixing across this transport distance would substantially dilute DOC concentrations from Dutch Slough given the very small tidal prism of the restoration project compared to the very large volume of water into which restoration site waters would mix. The likely transport and dilution of DOC from Dutch Slough to Rock Slough, however, has not been calculated.

OPEN WATER MANAGEMENT OPTIONS

The deep subtidal option would presumably produce a similar loading of TOC, but may have a slightly higher fraction of DOC. The skeletal channel option would have reduced area functioning to produce TOC, and the carbon produced would perhaps tend to have a lower fraction of DOC. The managed pond option would have little or no export of organic carbon. The subsidence reversal option would delay export of organic carbon for the period of time that the site was operated as a non-tidal system. When the site was ultimately opened for tidal inundation, export of organic carbon would initiate. The type and quality of the carbon would be determined by the type of substrate that had developed over time, with peat soils causing the highest fraction of reactive dissolved organic carbon.

"NO BURROUGHS" OPTION

The "no Burroughs" option would decrease acreage of tidal marsh from approximately 390 acres to approximately 180 acres. A relative decrease in TOC and DOC would be expected and may reduce this impact to less than significant.

MITIGATION 3.2.1-2.1: REFINE MODEL FOR EXPORT AND TRANSPORT OF TOC AND DOC PRIOR TO INITIATING TIDAL FLOW.

More precise estimates of marsh and open water areas and tidal flow volumes and transport to the Rock Slough intakes would be developed as the project design proceeds. These improved values shall be used to better estimate the potential TOC and DOC export from the site (using the Jassby and Cloern and Reddy models or others). During this time the monitoring program will also get underway, and TOC and DOC concentrations in the sloughs adjacent to the site, at the entrance to Rock Slough, and at the CCWD intakes will be measured. The refined export estimates shall be compared to the measured TOC and DOC values at the monitored points and these loads can be converted to concentrations by considering diurnal tide, with flushing from tidal marsh channels to Dutch Slough. If the predicted concentrations are at or below levels observed at the CCC intake, it can be stated that no significant impact from DOC is expected. If concentrations are at or above levels observed at the CCC intake, then hydrodynamic modeling would be employed to evaluate transport from the site to the CCC intake to determine dilution between project and intake.

MITIGATION 3.2.1-2.2: PHASE RESTORATION OF PARCELS

If the estimates from mitigation 3.2.1-2.1, above, show a potential significant impact, restoration of tidal flows to parcels shall be phased over several years to reduce the amount of DOC exported from the project to a level that will not adversely impact water quality at the Rock Slough intake.

SIGNIFICANCE AFTER MITIGATIONS

Less than significant with mitigation

IMPACT 3.2.1-3: OPERATIONAL DEGRADATION OF WATER QUALITY DUE TO INCREASED EROSION AND TURBIDITY (DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS AND OPEN WATER MANAGEMENT OPTIONS)

Increased erosion that could occur from operation of the Dutch Slough and Ironhouse restoration projects are described in Section 3.1, Hydrology and Geomorphology. As described in that section, project elements that could result in post-construction erosion and increased turbidity include levee breaches and skeletal marsh channels. Erosion and increased turbidity also could occur in Dutch, Emerson and Little Dutch Slough (especially southern Little Dutch Slough if not enlarged), and Marsh Creek; this impact is addressed in Impact 3.1.1-1 in Section 3.1, Hydrology and Geomorphology. Secondary water quality impacts due to elevated turbidity could include increased temperature and lower DO. In addition, the Project could result in temporary impacts to water quality parameters (turbidity, temperature, pH, DO) if increased erosion occurs as design elements adjust to restoration hydrology and revegetation. Increased turbidity may have benefits to Delta Smelt (see Chapter 3.5, Aquatic Resources).

"NO BURROUGHS" OPTION

In the "no Burroughs" option, tidal breaches would occur on Emerson Slough rather than Little Dutch Slough. Turbidity impacts are likely to be similar, though there is the potential for less erosion in Emerson Slough because it is a wider slough at its southern end. The potential need for dredging Emerson Slough has not been assessed.

MITIGATION 3.2.1-3: DREDGE LITTLE DUTCH SLOUGH

As described in Section 3.1, any channel erosion is expected to occur over time and should not greatly increase turbidity. Dredging to enlarge southern Little Dutch Slough could reduce sediment input from scour that would occur otherwise. Mitigation measures for Impact 3.1-1.1 also would apply to this impact.

SIGNIFICANCE AFTER MITIGATIONS

Less than significant with mitigation

IMPACT 3.2.1-4: POTENTIAL DEGRADATION OF WATER QUALITY DUE TO INCREASED MERCURY METHYLATION (DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS)

As discussed above, mercury methylation is a concern for wetland restoration projects in the Bay-Delta because certain types of wetland habitats are known to support the bio-geochemical processes that transform mercury into MeHg. Total mercury should not change as a result of the Dutch Slough Restoration Project, however, there could be increase in MeHg loads to water in Dutch Slough or Big Break, as well as localized increased concentrations of MeHg in sediment.

The mercury that could potentially be converted into MeHg can be attributed to two sources at the Dutch Slough site. The first source is "ambient" mercury in the waters of the Delta, which may come from any number of sources that are combined and mixed together. The second source is the more direct input of mercury from upstream sources, particularly the abandoned mercury mine, in the Marsh Creek watershed. Preliminary data indicate that there is currently little transport of mercury below the Marsh Creek reservoir. However it is possible that high flow events or a failure of the dam could move mercury contaminated sediments out of the reservoir to the lower reaches. While there are no actions associated with the Dutch Slough Restoration Project that can address ambient mercury levels including possible Marsh Creek Reservoir dam failure, certain measures may be taken to reduce the potential impacts of mercury supplied from Marsh Creek. If Marsh Creek were routed onto the Dutch Slough site, it could increase the load of mercury, potentially increasing MeHg leaving the site. This would be a potentially significant impact.

In terms of the Ironhouse restoration parcel, the connection to Marsh Creek has been designed in a manner to minimize the potential for mercury from Marsh Creek to enter the site, thereby reducing the potential for mercury to be introduced via water or sediment sources. The connection to Marsh Creek is positioned as far downstream as possible and in such a position that water most easily enters the parcel during a flood tide, when Marsh Creek water is most diluted.

Certain aquatic habitats are more likely than others to transform mercury into MeHg. Irregularly inundated areas such as tidal high marsh zones and floodplains seem to have the highest rates of MeHg export while more regularly inundated tidal marshes and open water habitats appear to have the lowest rates of flux. Since the amount of high marsh habitat being created is minimal, the amount of MeHg exported from the Dutch Slough Restoration Project may be negligible. The width of the 5:1 slope levees and natural transitions to uplands by about 1 ft vertical range of restored marsh by about 5 miles of edge at most equates to about 3 acres total of high marsh out of 440 to 830 acres of restored marsh depending on alternative. While all of the restored marsh area has some probability fo methylating mercury, creation of landscapes anticipated to have the highest probability of methylating mercury amounts to roughly 0.7% of the restored marsh area at most. Natural evolution of the low and mid marsh to high marsh is anticipated to be a fairly slow process due to the low sediment supply in the surrounding surface waters, so formation of greater area of high marsh is anticipated to be quite slow. For these reasons, this impact is considered not significant.

OPEN WATER MANAGEMENT OPTIONS

Since many of these options are "experimental" it is hard to predict how they will impact MeHg production. The environmental factors that promote the production of MeHg (high organic matter content, low DO, high temperature, irregular inundation) would be more enhanced in the skeletal channel network option than in the deep subtidal option. In the non-tidal management options, subsidence reversal would be more likely to promote mercury methylation than managed pond since it would produce high organic matter, low DO, and high temperature conditions. These areas, however, are expected to remain submerged for extended periods with little if any periods of dry, thereby providing conditions that are apparently less likely to produce and export MeHg.

MONITORING PROGRAM

CALFED and the project partners have funded several years of baseline monitoring studies to determine the existing levels of methyilmercury in bio-sentinel organisms (fish). DWR's water quality monitoring program, discussed in the Setting section, above, will continue bio-sentinel monitoring along with measurements of MeHg levels in water and sediments in the Dutch Slough vicinity both before and after restoration activities take place. This monitoring would provide baseline conditions at the site and would allow for comparisons between pre and post restoration MeHg levels. The information would aid in determining potential site management changes in the future, as well as advance the general body of knowledge on the subject of MeHg creation and export in restored tidal marshes. It is likely that these monitoring activities will be coordinated with the creation of the Delta Mercury TMDL.

The water quality monitoring plan also will include monitoring for mercury and MeHg levels in Marsh Creek.

MITIGATION 3.2.1-4: POTENTIAL PROHIBITION OF DIVERSION OF MARSH CREEK ONTO IRONHOUSE PARCEL

Should the monitoring program study find that mercury levels are outside the acceptable range, diverting Marsh Creek onto the Ironhouse Parcel may be prohibited.

SIGNIFICANCE AFTER MITIGATIONS

Less than significant with mitigation.

IMPACT 3.2.1-5: DEGRADATION OF DRINKING WATER QUALITY DUE TO ALTERATION TO SALINITY LEVELS IN DELTA WATERS

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

As described in Impact 3.1.1-1, larger open water areas in Alternative 1 may result in greater tidal prism and more inputs of Bay water. This could potentially cause small increases in salinity in the Delta by increasing tidal flows from the Bay. Increased Delta salinities could negatively impact drinking water and irrigation water quality. However, given the distance from the project site to drinking water intakes, this impact is expected to be less than significant. In addition, mitigations for Impact 3.5.1-2, Aquatic resources, would further reduce this potential impact.

OPEN WATER MANAGEMENT OPTIONS

It is possible that the deep subtidal alternative could increase tidal prism but probably insignificantly compared to other open water management options.

"NO BURROUGHS" OPTION

The "no Burroughs" option, which would decrease the acreage of tidal marsh by approximately half, would decrease the tidal prism and reduce the risk of increased salinity in the Delta.

SIGNIFICANCE AFTER MITIGATIONS

Less than significant with or without mitigation.

IMPACT 3.2.1-6: DEGRADATION OF WATER QUALITY DUE TO INCREASED SALINITY CONCENTRATIONS IN THE CONTRA COSTA CANAL (FROM ELEVATED GROUNDWATER)

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS AND OPEN WATER MANAGEMENT OPTIONS

See discussion of Impact 3.1.1-5, Possible Water Quality Degradation in Contra Costa Canal due to Groundwater Seepage.

MITIGATION

See mitigation for Impact 3.1.1-5, Groundwater Intrusion Study and Remediation.

SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

Impact 3.2.1-7: Degradation of Water Quality due to Elevated Metals, Endocrine Disrupting Chemicals, or Other Pollutants

Dutch Slough Restoration Project and Related Projects and Open Water Management Options

Wastewater that may contain endocrine disrupting chemicals (EDCs) reaches the project area from two sources: the Brentwood Wastewater Treatment Plant (BWWTP) tertiary treated wastewater that is discharged into Marsh Creek and the Ironhouse Sanitary District wastewater that is sprayed onto the Ironhouse parcel.

Development of the Ironhouse Project would disturb soil on that parcel and may liberate contaminants (including potential EDCs) into the restored Marsh Creek Delta. This would be a temporary effect that might release a small amount of contaminants and is not considered significant.

Metals and other contaminants at levels exceeding regulatory criteria were not found in investigations of the Ironhouse parcel soil; therefore, no impact would occur from excavation and replacement of that material on the Ironhouse parcel (Stellar Environmental Solutions, 2006). The results of the soil investigation also indicate that the spatial variation in contaminants is low enough that no further sampling is necessary before soils are excavated and reused.

While tertiary treated wastewater is usually free from harmful levels of most common pollutants, many EDCs are not effectively removed. The Dutch Slough site would receive some input of these pollutants from the BWWTP via Marsh Creek even without it being routed directly onto the property since the mouth of the creek is adjacent to the site. The Ironhouse parcel however would be directly exposed to these substances since Marsh Creek would be routed directly onto it. As described the Setting, water samples have not been analyzed for EDCs and no regulatory criteria have been established for many of the potential contaminants. Therefore, a definitive assessment of the significance of these impacts is not possible at this time and, as a reasonable worst-case assumption, the impact is considered potentially significant.

Mitigation 3.2.1-7: Marsh Creek Water Quality Testing and Evaluate Feasibility of Marsh Creek Relocation Based On Water Quality Considerations

If and when the RWQCB establishes criteria for EDCs of concern, the Marsh Creek water-quality testing program described in Mitigation 3.2.1-4 shall be expanded to include these compounds. Marsh Creek shall not be relocated if EDC levels exceed acceptable criteria.

Impact Significance After Mitigation

Less than significant with mitigation.

Impact 3.2.1-8: Cumulative Impacts

The Dutch Slough restoration project would take place in an area that is experiencing rapid urbanization. Several housing developments immediately adjacent to the site are either currently under construction or are scheduled to begin construction soon. The Ironhouse Sanitary District (ISD) is planning to expand its sewage treatment capacity from 2.6 million gallons/day (MGD) to 4.3 MGD (phase 1) and 8.6 MGD (phase 2) to accommodate the new housing developments. The ISD also plans to eliminate its land-based wastewater irrigation on the mainland and construct a surface water discharge with tertiary treatment downstream of Jersey Point (on Jersey Island). The CVRWQCB adopted an NPDES permit (Order No. R5-2008-0057) on 25 April 2008 authorizing a surface water discharge from the wastewater treatment plant.

These proposed developments could have potential impacts on water quality in the Dutch Slough site and the greater project vicinity. The new housing developments could impact water quality in several ways. During construction of these developments, there could be increased pollution as described in impact 3.2.1-1. Due to a greater amount of impervious surfaces, these new housing developments will cause more stormwater runoff laden with the contaminants common in urban/suburban areas (i.e., pesticides, lawn fertilizers, hydrocarbons). The increased volume of municipal sewage from the new developments would introduce more pollutants to the waters, which could exacerbate Impact 3.2.1-7 above. The method in which the treated wastewater is discharged would determine the severity of the impact to water quality. More pollutants will be introduced if the effluent is discharged to surface waters as opposed to being used for irrigation on Jersey Island.

The implementation of the Dutch Slough Restoration Project could affect these new housing developments through the impacts to drinking water quality listed above. However, the mitigations offered should reduce the impacts to less than significant levels. There is also a plan to encase up to almost four miles of the Contra Costa Canal, which would eliminate impact 3.2.1-6 by severing the hydraulic connection between the Contra Costa Canal and the Dutch Slough site.

Maintenance of the City's Community Park would involve the use of herbicides and pesticides that may be washed into the wetland restoration area. Similarly, oil, grease and heavy metals may be washed into the wetlands and sloughs from the proposed Community Park parking lots and roadways. This could result in a significant impact to receiving water quality.

The impacts to water quality due to potential sea level rise must also be considered. A variety of estimates quantify the range of potential sea level rise, report observed trends and offer predictions of global warming and the potential impacts (IPCC 2001, CCCC 2006). The Intergovernmental Panel on Climate Change reports that over the last 100 years the eustatic (globally averaged) sea level rise was 1 to 2 mm/year (0.3 to 0.6 ft/century). The IPCC projects rates of sea level rise to increase over the next century, with projected increases ranging from 0.4 - 2.9 ft by 2100 (IPCC 2001). More recent estimates by the California Climate Change Center report sea level rise in California over the past century to be approximately 7 inches (0.6 ft), and projects increases of 22 to 35 inches (1.8 to 2.9 ft) by 2100 (CCCC 2006). Increases in sea level would affect water quality primarily by raising the water table and by the intrusion of more saline water from the Bay. This phenomenon would exacerbate impacts 3.2.1-5 and 3.2.1-6.

MITIGATION 3.2.1-8

Mitigations identified for Impacts 3.2.1-1 to 7, above as well as those identified in the Hydrology (Sea Level Rise) sections would reduce the Dutch Slough Restoration project's contributions to cumulative impacts to less than significant levels.

Alternative 2: Moderate Fill Alternative

Alternative 2 has two main differences with Alternative 1. First, it includes placement of fill within the restoration parcels in order to bring site elevations closer to suitable intertidal elevations for tidal marsh restoration. Second, it includes options to relocate Marsh Creek into the Emerson Parcel.

Impact 3.2.2-1: Degradation of Water Quality Due to Release of Contaminants and Sediment from Construction Activities

Dutch Slough Restoration Project and Related Projects and Open water Management Options

Impacts would be similar to those described for Alternative 1, but with the potential for greater impact due to increased imported fill and grading.

Marsh Creek Delta Relocation

Impact and mitigation for Marsh Creek Delta Relocation would be the same as for the rest of the project as described in Alternative 1.

Mitigations

Mitigations 3.2.1-1.1, 2, 3, and 4 also would apply to this Alternative.

Significance after Mitigations

Less than significant with mitigation

Impact 3.2.2-2: Degradation of Water Quality Due to Increased Dissolved Organic Carbon (DOC) in Delta Waters

Dutch Slough Restoration Project and Related Projects

Alternative 2 would create approximately 660 acres of tidal marsh and 210 acres of shallow subtidal habitat, which would result in production and export of organic carbon as part of natural, and typically desirable, wetland processes.

Using the TOC and DOC export estimates of Jassby and Cloern (2000) and Reddy (2005), respectively, the following rough estimates can be made for carbon export from the 660 acres of marsh and 210 acres of shallow subtidal habitat created in Alternative 2: (1) the "steady state" export of TOC from the marsh may be about 1.6 tons TOC/day; (2) the export of DOC from the site may be as high as 2.3 tons DOC/day initially, and may decrease to 0.58 tons DOC/day after two years. These quantities are slightly greater than those projected to be generated by Alternative 1.

Impacts for the Related Projects would be the same as Alternative 1.

Open Water Management Options

Same as Alternative 1

Marsh Creek Delta Relocation Options

There would be no significant change in TOC from the Marsh Creek Delta relocation options.

Mitigations

Mitigations 3.2.1-2.1, 2, and 3 also would apply to this alternative.

Significance after Mitigations

Less than significant with mitigation

Impact 3.2.2-3: Degradation of Water Quality Due to Increased Erosion and Turbidity After Construction

Dutch Slough Restoration Project and Related Projects and Open Water Management Options

Impacts would be similar to those described for Alternative 1, but with the potential for more erosion and sediment due to increased channel network, fill, and grading.

Marsh Creek Delta Relocation Options

Restoration on Emerson Parcel will be designed as a delta so localized deposition should occur from upstream sediment inputs but any increase in turbidity in other water bodies should be less than significant.

Mitigations

Same as Alternative 1

Significance After Mitigation

Less than significant with mitigation

Impact 3.2.2-4: Potential Degradation of Water Quality Due to Increased Mercury Methylation

Dutch Slough Restoration Project and Related Projects

Impacts would be similar to those described for Alternative 1.

Open Water Management Options

Same as Alternative 1

Marsh Creek Delta Relocation Options

Diverting Marsh Creek to the project area could cause mercury deposition in marsh and open water areas, especially in Ironhouse or Emerson parcels (depending on design), to the extent that mercury is present in waters and suspended sediments in Marsh Creek. Loads of total mercury to marsh areas could increase MeHg production.

Mercury and MeHg levels in Marsh Creek will be monitored both pre- and post-project. Should the study find that mercury levels are outside the acceptable range, diverting Marsh Creek onto the Emerson Parcel may be prohibited.

Impact 3.2.2-5: Degradation of Drinking Water Quality Due to Alteration to Salinity Levels in Delta Waters

All Options

Impacts would be similar to with Alternative 1 however the smaller open water areas of Alternative 2 could result in reduced tidal prism and less input of Bay Water. However, given the distance from the Dutch Slough area to drinking water intakes, this impact is expected to be less than significant. In addition, mitigations for Impact 3.5.1-2, Aquatic resources, would further reduce this potential impact.

SIGNIFICANCE AFTER MITIGATIONS

Less than significant with mitigation

IMPACT 3.2.2-6: DEGRADATION OF WATER QUALITY DUE TO INCREASED SALINITY CONCENTRATIONS IN THE CONTRA COSTA CANAL

ALL OPTIONS

See discussion of Impact 3.1.2-5

MITIGATIONS

See mitigations for Impact 3.1.2-5

SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation

IMPACT 3.2.2-7: DEGRADATION OF WATER QUALITY DUE TO ELEVATED METALS, ENDOCRINE DISRUPTING CHEMICALS, OR OTHER POLLUTANTS ON IRONHOUSE PARCEL.

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS AND OPEN WATER MANAGEMENT OPTIONS

This is the same as Impact 3.2.1-7 except that Alternative 2 proposes that the soil from the Ironhouse parcel be used as fill on the Dutch Slough parcels, therefore potential for contamination on the Dutch Slough site would exist. However, metals and other contaminants at levels exceeding regulatory criteria were not found in investigations of the Ironhouse parcel soil therefore no significant impact is anticipated from excavation and replacement of that material on the Dutch Slough site. Marsh Creek Relocation Options

MARSH CREEK RELOCATION OPTIONS

If Marsh Creek were relocated onto the Dutch Slough site, contaminants could reach the restored Dutch Slough site directly rather than the potential for these contaminants to enter Dutch Slough first then be transported by the tides into the Dutch Slough site.

MITIGATION

Same as Alternative 1. If Marsh Creek water quality is found to be below acceptable standards, relocating Marsh Creek onto the Dutch Slough Site may not be an option.

SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation

IMPACT 3.2.2-8: CUMULATIVE IMPACTS

Same as Alternative 1

Alternative 3: Maximum Fill Alternative

This alternative proposes the most fill placement within the restoration parcels and thus the smallest tidal prism. Marsh Creek delta relocation options are part of this alternative, as they are for Alternative 2.

IMPACT 3.2.3-1: DEGRADATION OF WATER QUALITY DUE TO RELEASE OF CONTAMINANTS AND SEDIMENT FROM CONSTRUCTION ACTIVITIES

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS AND OPEN WATER MANAGEMENT OPTIONS

Impacts would be similar to those described for Alternatives 1 and 2, but with the potential for greater impact due to increased imported fill and grading.

MARSH CREEK DELTA RELOCATION

Impact and mitigations for Marsh Creek Delta Relocation would be the same as described for Alternative 2.

MITIGATION

Mitigations 3.2.1-1.1, 2, 3, and 4 also would apply to this Alternative.

SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation

IMPACT 3.2.3-2: DEGRADATION OF WATER QUALITY DUE TO INCREASED DISSOLVED ORGANIC CARBON (DOC) IN DELTA WATERS

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

Alternative 3 would create approximately 830 acres of tidal marsh and 110 acres of shallow subtidal habitat. Using the TOC and DOC export estimates of Jassby and Cloern (2000) and Reddy (2005), respectively, the following rough estimates can be made for carbon export for Alternative 3: (1) the "steady state" export of TOC from the marsh may be about 1.7 tons TOC/day; (2) the export of DOC from the site may be as high as 2.5 tons DOC/day initially, and may decrease to 0.62 tons DOC/day after two years. These quantities are slightly greater than those projected to be generated by Alternatives 1 and 2.

The impacts for the Related Projects would be the same as Alternative 1.

OPEN WATER MANAGEMENT OPTIONS

Same as Alternative 1

MARSH CREEK DELTA RELOCATION OPTIONS

There would be no significant change in TOC from the Marsh Creek Delta relocation options.

MITIGATIONS

Mitigations 3.2.1-2.1, 2, and 3 also would apply to this alternative.

SIGNIFICANCE AFTER MITIGATIONS

Less than significant with mitigation.

IMPACT 3.2.3-3: DEGRADATION OF WATER QUALITY DUE TO INCREASED EROSION AND TURBIDITY AFTER CONSTRUCTION

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS AND OPEN WATER MANAGEMENT OPTIONS

Impacts would be similar to those described for Alternatives 1 and 2, but with the potential for more erosion and sediment due to increased channel network, fill, and grading.

MARSH CREEK DELTA RELOCATION OPTIONS

Same as Alternative 2

MITIGATIONS

Same as Alternative

SIGNIFICANCE AFTER MITIGATIONS

Less than significant with mitigation

IMPACT 3.2.3-4: POTENTIAL DEGRADATION OF WATER QUALITY DUE TO INCREASED MERCURY METHYLATION

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

Impacts would be similar to those described for Alternative 1.

OPEN WATER MANAGEMENT OPTIONS

Same as Alternatives 1 and 2

MARSH CREEK DELTA RELOCATION OPTIONS

Same as Alternative 2

IMPACT 3.2.3-5: DEGRADATION OF DRINKING WATER QUALITY DUE TO ALTERATION TO SALINITY LEVELS IN DELTA WATERS

ALL OPTIONS

Same as Alternative 1

MITIGATION

Same as Alternative 1

SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation

IMPACT 3.2.3-6: DEGRADATION OF WATER QUALITY DUE TO INCREASED SALINITY CONCENTRATIONS IN THE CONTRA COSTA CANAL (FROM ELEVATED GROUNDWATER)

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS AND ALL OPTIONS

See discussion of Impact 3.1.2-5

MITIGATION

See mitigations for Impact 3.1.2-5

Significance after Mitigation

Less than significant with mitigation

Impact 3.2.3-7: Degradation of Water Quality due to Elevated Metals, Endocrine Disrupting Chemicals, or Other Pollutants on Ironhouse Parcel.

Dutch Slough Restoration Project and Related Projects and All Options

This impact would be the same as 3.2.2-7

Mitigation

Same as Alternative 1

Impact Significance After Mitigation

Less than significant with mitigation

Impact 3.2.3-8: Cumulative Impacts

Same as Alternative 1

Alternative 4: No Project Alternative

Impact 3.2.4-1: Degradation of Water Quality Due to Release of Contaminants and Sediment from Construction Activities

Minor erosion and sedimentation would occur with ongoing agricultural activities. This impact would not be significant and not require any mitigation.

Impact 3.2.4-2: Degradation of Water Quality Due to Increased Dissolved Organic Carbon (DOC) in Delta Waters

The site would continue to have excess irrigation and storm water pumped off site into Emerson, Little Dutch, and Dutch Sloughs. Such agricultural drainage has been identified as the predominant source of trihalomethanes forming DOC in the Delta. This is not considered a significant impact because it is no change from existing conditions.

Table 3.2-11: Summary of Potential Water Quality Impacts for Dutch Slough Restoration Project and Related Projects

	Impact Description	Dutch Slough Restoration Project	Related Projects	
			Ironhouse Project	City Community Park Project
Alternatives 1, 2, 3	Impact 3.2.1-1: Degradation of water quality due to release of contaminants and sediment from construction activities	X	X	X
	Impact 3.2.1-2: Degradation of water quality due to increased dissolved organic carbon (DOC) in Delta waters	X	X	X
	Impact 3.2.1-3: Operational degradation of water quality due to increased erosion and turbidity	X	X	
	Impact 3.2.1-4: Potential degradation of water quality due to increased mercury methylation	X	X	
	Impact 3.2.1-5: Degradation of water quality due to alteration to salinity levels in Delta waters	X	X	
	Impact 3.2.1-6: Degradation of water quality due to increased salinity concentrations in the Contra Costa Canal (from elevated groundwater)	X	X	
	Impact 3.2.1-7: Degradation of water quality due to elevated metals, endocrine disrupting chemicals, or other pollutants	X	X (Alt 2, 3)	
	Impact 3.2.4-1: Degradation of water quality due to release of contaminants and sediment from construction activities	X	X	X
Alternative 4	Impact 3.2.4-2: Degradation of water quality due to increased dissolved organic carbon (DOC) in Delta waters	X	X	X

Table 3.2-12: Summary of Water Quality Mitigation Applicability for Dutch Slough and Related Restoration Projects

	Mitigation	Dutch Slough Restoration Project	Related Projects	
			Ironhouse Project	City Community Park Project
Alternatives 1, 2, 3	Mitigation 3.2.1-1.1: Storm water pollution prevention plan	X	X	X
	Mitigation 3.2.1-1.2: Dewatering restriction	X	X	X
	Mitigation 3.2.1-1.3: Contractor training for protection of water quality	X	X	X
	Mitigation 3.2.1-1.4: Minimize potential pollution caused by inundation of site	X	X	
	Mitigation 3.2.1-2.1: Refine model for export and transport of TOC and DOC prior to initiating tidal flow.	X	X	
	Mitigation 3.2.1-2.2: Phase restoration of parcels	X	X	
	Mitigation 3.2.1-3: Dredge Little Dutch Slough	X	X	X
	Mitigation 3.2.1-4: Potential prohibition of diversion of Marsh Creek onto Ironhouse or Emerson parcel	X	X	
	Mitigation 3.2.1-7 Marsh Creek water quality testing and evaluate feasibility of Marsh Creek relocation based on water quality considerations	X	X	

Insert tab titled

3.3 - Geology

3.3 GEOLOGY AND SOILS

This section describes soils and geologic conditions on and affecting the project site, and assesses the geologic and soils impacts, constraints, and hazards on the Emerson, Burroughs, and Gilbert parcels, as well as the Ironhouse parcel. Geologic and soils issues addressed herein include seismic (earthquake) hazards, slope stability, soil expansion, settlement, and erosion. This analysis is based on a review of soils and geologic studies and maps prepared by private consultants and resource agencies for the region, project site, and adjacent development projects.

3.3.1. Affected Environment

Regional Geology

The Dutch Slough Restoration Project and Related Project sites are located in the Great Valley Geomorphic province, near the eastern boundary of the Coastal Range province. These two provinces display different topography, geology, climate, and faulting. The Great Valley is an alluvial plain approximately 50 miles wide, extending 400 miles through the middle of California. Approximately 3 – 6 miles of sedimentary deposits underlying the valley accumulated in the former marine setting over the past 160 million years (Atwater 1982). The confluence of California's two principal rivers, the Sacramento and San Joaquin, is immediately west of the Site. Glacial outwash and weathered material from the Sierra Nevada mountain range is the source of historic sediments and parent material transported from the numerous major drainages of the Sierra into the Sacramento and San Joaquin rivers. Several hundred feet of unconsolidated to weakly consolidated material accumulated in the Dutch Slough site vicinity over the thousands of years of fluctuating sediment deposition and erosion. Hydraulic mining debris generated during the gold rush in the mid-1850s significantly altered natural deposition processes in the Delta as hundreds of thousands of tons of silt washed down from the Sierra Nevada altering stream channels and sloughs and raising natural levees. The adjacent San Francisco Bay, located in the Coastal Range geomorphic province, is a subsided basin marked with active north-west trending fault lines. This seismically active region includes numerous faults. Proximate faults include the Greenville, the Concord-Green Valley, and the Mt. Diablo Thrust, as well as major regional faults including the Hayward, San Andreas, Concord, and Calaveras.

The regional geomorphology is dominated by the confluence of the Sacramento and San Joaquin rivers and an interconnected assemblage of sloughs and islands. Artificial levees ring the perimeter of these islands, which are largely below sea level exhibiting varying extents of subsidence.

Project Area Geologic Units

The USGS Geologic Map and Map Database of Northeastern San Francisco Bay Region identify the following major geologic units at the Dutch Slough Site or in the immediate vicinity (Graymer, Jones, and Brabb 2002). For reference, the time periods for the geologic epochs identified include the Holocene (8,000 years ago - Present) and the Pleistocene (1.8 million - 8,000 years ago).

> **Qhb:** Basin deposits (Holocene) – Very fine silty clay to clay deposits occupying flat-floored basins and flat areas. Basin deposits bury older eroded sand dunes.

Qds: Dune sands (early Holocene and latest Pleistocene) – Very well sorted fine- to medium-grained eolian (wind-blown earth material) sand. These sands were historically deposited during periods of lower sea levels, prior to present day levels.

Qhdm: Delta mud deposits (Holocene) – Predominantly mud and peat with lesser silt and sand deposited near seal level in the Sacramento-San Joaquin Delta. Much of this unit was diked, dried and farmed and is currently compacted and deflated.

Ac: Artificial channel deposits (Historic) – Common to modified stream channels, such as Marsh Creek, realigned and concrete lined or barriered for flood control.

Alf: Artificial levee fill (Historic) – Various materials used to create levees in the Delta over the past 150 years. Materials, ages, and integrity vary, most constructed prior to 1965 are simply uncompacted, dumped materials.

Site Soils

The Dutch Slough vicinity is underlain by the Upper Modesto Formation consisting of alluvial sand deposited over thousands of years. Initially derived from the Sierra Nevada mountain range, these outwash deposits sands were locally redistributed by winds to form dunes. Previous geologic investigations in the vicinity indicate these unconsolidated eolian (wind- deposited) deposits of sand are ~10,000 to 40,000 years old (Kleinfelder 2006; PWA 2006). Delta peat and organic soils formed as sea level rise began at the end of the last ice age roughly 11,000 years before present. The sand layer extends to depths of 50 ft below mean sea level (NGVD), with irregular layers of alluvial silt and clays and sands extending deeper. Sand surface elevations ranging from -16 to +2 ft NGVD (PWA 2006).

Natural Resources Conservation Service (NRCS) Soil Survey map indicates 11 soil series present at the site (SCS 1977). These soils include Delhi Sand, Piper Sandy Loam, Ryde Silt Loam, Sycamore Silty Clay Loam, Egbert Mucky Clay Loam, Capay Clay, Marcuse Clay, Sacramento Clay, Kingile Muck, Rindege Muck, and Shima Muck (SCS 1977). These soils reflect different sources including local parent material, alluvial deposits, and imported soils and therefore represent a rather wide range of textures and properties.

Typically a site's parent material affects soil composition and thus exhibits influence over the plant community structure and distribution. This in not the case at Dutch Slough because disturbance and previous land uses including agriculture and sand mining altered the landscape. The soil and vegetation at Dutch Slough were removed, amended, and generally modified over time with changing land uses (PWA 2006). Prior to levee construction and land reclamation around the turn of the century, ground surface elevations are estimated to be 2 ft NGVD. However, as groundwater levels were lowered for farming and ranching, oxidation of the surface peat material and subsequent subsidence lowered ground surface elevations.

The northern portions of the site are principally fine grained muck soils, which reflect the historically very poorly drained organic soils that formed from the decomposition of reeds and tules and the accumulation of alluvial deposits over thousands of years. A patchwork of silty loams and clays extend across the majority of the four parcels, with a notable band of sand on the Emerson Parcel and a smaller patch on the Gilbert Parcel. The sand (Dehli) is characteristic of the historic Antioch dunes complex (PWA 2006). The Ironhouse parcel contains similar soils as the Emerson Parcel, which includes Marcuse clay, Capay clay, Dehli sand, and Sycamore silty clay loam (SCS 1977).

Local and Regional Seismicity

The seismically active San Francisco Bay region includes the San Andreas and other significant regional faults including the Hayward, Concord, and Calaveras. Additionally, Dutch Slough is in the vicinity of the Greenville, the Concord-Green Valley, and the Mt. Diablo faults. The San Andreas is the major fault system. This right-lateral strike slip fault indicates the tectonic boundary between the Pacific Plate to the west and the North American plate to the east. Over the last 160 years, it has produced numerous small-magnitude and a dozen moderate- to large-magnitude earthquakes (magnitude >6) in the Bay Area, including the 1906 San Francisco (M8+), the 1838 and 1865 San Francisco quakes (M7), and the 1989 Loma Prieta (1989). Recent activity on nearby faults includes the Calaveras faults' 1861 San Ramon Valley (M5.7) earthquake, the Greenville faults' Livermore (M5.4), the 1889 Antioch (M6.3), the 1955 Concord (M5.4), and the 1868 Hayward (M6.8) quake.

A 2003 report by the U.S. Geological Survey (USGS) indicates that there is a 62% probability of at least one magnitude 6.7 or greater quake in the greater San Francisco Bay area between 2003-2032 (USGS 2003). An earthquake of this magnitude is likely to result in widespread damage in portions of the greater Bay Area. The Earthquake Probability Map indicates the probability for each major fault (USGS 2003). The report concludes the probabilities of a >6.7M earthquake on the faults proximate to Dutch Slough are lower (Greenville 3%, the Concord-Green Valley 4%, and the Mt. Diablo Thrust 3%) than other major regional faults. The Coast Range-Central Valley (CRCV) or Great Valley fault geomorphic block is a blind thrust fault (below ground surface) known to have caused earthquakes at depth but has not caused surface ruptures in the recent geologic history. This indicates the site is potentially subject to significant ground shaking resulting from a quake occurring along any of the major regional faults. Due to the site's proximity to the Greenville Fault, located approximately 9 miles away, the site is identified by the CBC as located in Seismic Zone 4 and therefore subject to more stringent earthquake-resistant design standards.

Several previous studies of seismicity have been conducted for projects in close proximity to the Dutch Slough site. A May 2006 study by Kleinfelder included a seismic source characterization of the East Cypress Corridor (Kleinfelder 2006). The study discusses alternative models of source characterization and presents a summary of seismic parameters based upon the California Geological Survey (CGS 1996) Coast Range-Central Valley (CRCV) model. Table 3.3-1 identifies the seismic source parameters for significant regional faults as presented in the Jersey Island Road Levee Evaluation (Kleinfelder 2006).

Surface Fault Rupture

Typically, surface ruptures are confined to a narrow linear band typically located within feet (typically < 10 – 20 feet) of the fault line but potentially occurring short-distances (< 250 feet) of the fault line. The California Geological Survey (CGS) does not identify any Fault Hazard Zones or known active faults on the Dutch Slough site or in the immediate vicinity (CA Department of Conservation, Division of Mines and Geology 1999).

Ground Shaking

Significant ground shaking is likely to occur at the Dutch Slough site in a major earthquake. There is a 3% probability that one or more earthquakes with a moment magnitude > 6.7 will occur along the Greenville fault prior to 2031 (Working Group on California Earthquake Probabilities 2003). The

Table 3.3-1. Seismic source parameters for significant regional faults as presented in the Jersey Island Road Levee Evaluation (Kleinfelder 2006)

Fault Name	Fault Length (mi)	Closest Distance to Site (mi)	Magnitude of Maximum Earthquake**	Slip Rate (mm/yr)	Values of*	
					a	b
CRCV (Segment 6)	28	4	6.7	1.5	4.41	1.20
Clayton-Marsh Creek-Greenville	35	13	6.9	2	3.27	0.80
Concord-Green Valley	16	21	6.9	6	3.45	0.80
Calaveras (northern)	32	23	6.8	6	3.95	0.90
Calaveras (southern)	62	33	6.2	15	3.2	0.70
Hayward	50	33	7.1	9	3.49	0.90
West Napa	19	36	6.8	1	2.55	0.70
Rodgers Creek	37	45	7.0	9	3.96	0.90
San Andreas (1906 event)	292	51	7.9	24	1.37	0.70

* Parameters based on data presented by Real et al. (1978), Toppozada et al. (1978), Hart et al. (1984), Wesneousky (1986), Wong et al. (1988), Working Group of California Earthquake probabilities (1990), Wagner (1990), Schwartz (1994), Jennings (1994), Mualchin (1995), Frankel et al. (1996), and Petersen et al. (1996).

** Moment magnitude

severity of shaking is dependent upon many factors including the magnitude of the earthquake, distance from epicenter, duration of earthquake, and soil and geology. Unconsolidated sediments are prone to strong shaking and known to amplify and prolong ground shaking. Ground shaking is classified by the modified Mercalli intensity (MMI) which ranges from I (not felt) to XII (damage total, results in widespread devastation). Previous studies indicate a generalized MMI of VII (defined as strong) for Dutch Slough in a large magnitude earthquake (ABAG 2006; USGS 2006). MMI relates ground shaking to potential damage. MMI VII is described as resulting in negligible damage in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures, capable of generating waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks, and damaging concrete irrigation ditches (ABAG 2006; USGS 2006).

Liquefaction

Soil liquefaction is the sudden loss of soil strength due to strong ground shaking typically associated with earthquakes. Liquefaction occurs when granular material is transformed into a fluid-like state due to increased pore-water pressure displacing granular soils and groundwater. Soil properties (soil type, grain size distribution), magnitude and duration of earthquake, and depth to groundwater are factors determining susceptibility to liquefaction. Sand and peat soils are more prone to liquefaction, whereas clay and silt are typically more stable soils. Unconsolidated materials have a high propensity for liquefaction. According to ABAG's Regional Liquefaction Map, the Dutch Slough parcels are identified as having moderate to high liquefaction potential (ABAG 2006).

Ground Lurching

Ground lurching occurs during earthquakes as a result of the rolling motion transferred to the ground surface leading to the formation of cracks in the surface. The potential for the formation of cracks is greatest between layers of material with different properties. The hazard of ground lurching at the Dutch Slough site is characterized as typical of other project locations in and around the San Joaquin Valley.

Landslides

The potential for landslide hazards at the Dutch Slough site is low because the site is relatively flat and not adjacent to any steep slopes. Existing levees have not experienced substantial landslides.

Lateral Spreading

Lateral spreading refers to the sliding or downward shifting of a top or overlying layer of soil generally due to liquefaction of the underlying soil layer. Typical zones of lateral spreading occur on slope faces or areas of incision. Previous studies indicate that the potential for lateral spreading in the vicinity is low and with maximum lateral movement likely to be less than one foot (Kleinfelder 2004). The greatest potential for lateral spreading is likely to be on unimproved levees proximate to sloughs and the existing canal (Kleinfelder 2004).

Levee Seepage

Levees are prone to through-seepage and under-seepage, which can lead to levee failure (DWR 2005). Through-seepage occurs in levees containing portions of relatively porous material that when subjected to prolonged periods of inundation (e.g., high water flood events) provide pathways conducive to flow through levees. Under-seepage occurs beneath levees underlain by porous soils, such as sand, allowing flow underneath a levee to the surface on the landward side. If left uncontained, such flow may result pressure in on the landward side of levees leading to ruptures in the surface soils commonly referred to as boils, as the typically circular shaped failures are reminiscent of the bubbling effect of boiling water. These conduits of flow result in levee slumping and eventual overtopping and failure. Under-seepage of site levees is reasonably probable as the local levees are underlain by sandy soils (Hultgren-Tillis 2006).

Regulatory Framework

State and local regulations that guide building and construction activities include several acts specifically regulating these activities in geologic hazard areas. In the seismically active San Francisco-Bay Delta estuary, these regulations are particularly relevant and applicable. The following section provides an overview of the principal regulations.

CALFED Delta Risk Management Strategy

A major need for the State is to determine how to make the Delta sustainable in the future. The 2000 CALFED Record of Decision presented its Preferred Program Alternative that described actions, studies, and conditional decisions to help fix the Delta. Included in the Preferred Program Alternative for Stage 1 implementation was the completion of a Delta Risk Management Strategy (DRMS) that would look at sustainability of the Delta, and that would assess major risks to the Delta resources from floods, seepage, subsidence, and earthquakes. DRMS would also evaluate the consequences, and develop recommendations to manage the risk. To implement the Delta risk assessment, legislation requires DWR to evaluate the potential impacts on water supplies derived from the Delta based on 50-, 100-, and 200-year projections for each of the following possible impacts: subsidence, earthquakes, floods, climate change & sea level rise, or a combination of the above. The DRMS work will provide the majority of this required information. The report is due to the Legislature no later than January 1, 2008.

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act intends to minimize the hazards posed to people and property during and immediately following earthquakes. First enacted in 1972 (subsequently amended), the Act prohibits the location of developments and structures for human occupancy across the trace of active faults and regulates construction activities in the corridors of earthquake faults zones. The Act prohibits and restricts construction activities and zoning classifications based upon fault activity and fault definition, providing legal definitions for active, sufficiently active, and well-defined and establishes a process for reviewing construction proposals in the vicinity of earthquake fault zones. Trained geologists conduct site-specific investigations to determine the appropriate zoning classification. Regulations are more stringent for areas of greater hazard potential. The Act identifies Earthquake Special Study Zones. Dutch Slough site is not located in a Special Study Zone.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act also intends to provide for a statewide seismic hazard mapping and technical advisory program to assist cities and counties in protecting the public health and safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failure and other seismic hazards caused by earthquakes. Under the Act, the State is responsible for identifying and mapping seismic hazard zones. Cities and counties are required to utilize these hazard maps in issuing building permits, which provides a mechanism to regulate construction and development accordingly in these zones to ensure that building standards provide for safe development. Prior to issuing permits, the Act requires site-specific geotechnical investigations be conducted and development plans incorporate measures to mitigate potential damage in most developments designed for human occupancy within the Zones of Required Investigation.

Local Permitting and Site-Specific Geotechnical Investigations

Construction and development is also subject to local permitting requirements and site-specific geotechnical investigations. This permitting process may differ somewhat by jurisdiction, but generally involves a multi-stage permit review process. Site-specific geotechnical investigations examine geology, soils, land use history, and relevant factors to ensure building standards provide for safe development.

The State Reclamation Board cooperates with federal and State agencies and local governments in establishing, planning, constructing, operating, and maintaining flood control works. Reclamation District 799 is the agency responsible for flood protection and drainage on the Hotchkiss Tract immediately east of the Dutch Slough site. The Reclamation District issues permits for projects that:

- Are within federal flood control project levees and within a Board easement, or
- May have an effect on the flood control functions of project levees, or
- Are within a Board designated floodway, or
- Are within regulated Central Valley streams listed in Table 8.1 in Title 23 of the California Code of Regulations.

3.3.2 Impacts and Mitigation Measures

Significance Criteria

Criteria for determining significant impacts are based upon the CEQA Guidelines (Appendix G) and professional judgment. These guidelines state that the project would have a significant impact on geology, soils, and seismicity if it would:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

  - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault

  - Strong seismic ground shaking

  - Seismic-related ground failure, including liquefaction

  - Landslides

- Result in substantial soil erosion or the loss of topsoil
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse
- Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property

Additional criteria not explicit to CEQA guidelines but evaluated in this section include:

- Levee failure resulting from erosion
- Levee failure resulting from seepage.

Alternative 1: Minimum Fill

IMPACT 3.3.1-1: EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS (INCLUDING LEVEE FAILURE) RESULTING FROM A SURFACE RUPTURE OF A KNOWN EARTHQUAKE FAULT

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

Surface ground ruptures are generally confined to a narrow linear zone adjacent to faults. Fault ground rupture is unlikely at Dutch Slough as there are no active faults mapped across the site by the California Geological Survey. The site is not located in a Fault Hazard Zone (Alquist-Priolo Earthquake Special Study Zone). Therefore no impact would occur and no mitigation is required.

OPEN WATER MANAGEMENT OPTIONS

No change in fault rupture impacts would occur with the various open water management options.

SIGNIFICANCE

No Impact; no mitigation required.

IMPACT 3.3.1-2: EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS (INCLUDING LEVEE FAILURE) RESULTING FROM STRONG SEISMIC GROUND SHAKING

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

As previously stated, strong seismic ground shaking is likely to occur in the Dutch Slough area from a major earthquake in the Bay Area within the next 30 years (USGS 1999). The potential shaking is categorized by the modified Mercalli intensity level VII (defined as Strong). The severity of shaking is dependent upon many factors including the magnitude of the earthquake, distance from epicenter, duration of earthquake, and soil and geology.

Peak ground accelerations (PGA) is a measure of the intensity of ground shaking during an earthquake. The California Geological Society (CGS), USGS, and CALFED Bay-Delta Program have developed probabilistic contour maps of PGA for the region. Several prior technical studies conducted for projects in the immediate vicinity have calculated estimates of PGA (Kleinfelder 2003, 2004, 2006, ENGEO 2004). The Probabilistic Seismic Hazard Assessment for the State of California (Petersen et al. 1996) and subsequent calculations by DCM Engineering (2005) indicate a 10% probability that peak horizontal acceleration from 0.35g to 0.40g ("g" = acceleration of gravity) in 50 years. This corresponds with the CALFED Bay-Delta Program estimates for the Western Delta of 0.35g (1998). A probabilistic analysis conducted by Kleinfelder (2006) for the Jersey Island Road Levee Evaluation for the Cypress Corridor shows similar results with PGA of 0.32, based upon a 475 year return period (10% in 50 years) with an annual probability of exceedence of 0.0021.

The Dutch Slough Restoration Project site is approximately 9 miles from the Greenville Fault. Due to this proximity, the site is identified by the CBC (1998 edition) as located in Seismic Zone 4. The California Probabilistic Seismic Hazard Maps, which identify fault parameters and classifications, classify the Greenville as a Class B fault (Cao et al. 2003). The USGS identifies it as Class A fault (2005). The CBC design guidelines are more stringent for projects located adjacent to a Class A or B fault and require earthquake-resistant design standards based upon a minimum horizontal acceleration of 0.4g. Any structures built as part of the Dutch Slough Project and Related Projects, such as the proposed levee access footbridges and the City Community Park buildings, must meet these standards that are intended to prevent significant structural damage from seismic ground acceleration.

The site consists of unconsolidated soils prone to amplify and prolong strong shaking during earthquakes. Existing levees are constructed on native and imported soils. Levee failure could occur in a major earthquake; this would introduce water from the Bay-Delta onto the site and potentially, depending upon location of failure, into the surrounding vicinity. Repairs and upgrades to existing structures and levees incorporating earthquake-resistant design and construction measures to reduce liquefaction, settlement, and lateral spread would reduce the potential impacts. New levees and structures would be engineered to withstand seismic events to the extent practicable.

Seismic shaking also could damage structures including the City Community Park buildings, infrastructure, and bridges and viewing structures. Conformance to building codes and applicable regulations does not render structures or levees infallible or provide any guarantee that significant structural damage would not result from large magnitude seismic events; however, it does provide reasonable assurance that appropriately designed and constructed structures would be better suited to withstand these events without collapse or loss of life.

OPEN WATER MANAGEMENT OPTIONS

The open-water management option would not influence the likelihood of structural or levee failure due to strong seismic shaking. If the eastern perimeter levee (Jersey Island Road levee) failure occurred, there would be no difference amongst tidal open-water options. Greater potential flood hazard under tidal open water option compared to managed water level because there is greater tidal exchange and potential for inflow. Proper levee design based upon site-specific geotechnical investigations and remediation will reduce potential for impact to less than significant.

MITIGATION MEASURE 3.3.1-2.

Conduct site specific geotechnical investigations to identify and implement appropriate remediation actions (e.g., subgrade densification).

Site-specific geotechnical investigations shall be conducted to determine most appropriate remediation actions for new levees and structures and upgrades or repairs to existing levees and structures. Potential mitigation measures include dynamic deep compaction to densify subgrade soils to reduce impact to less than significant.

SIGNIFICANCE OF IMPACT AFTER MITIGATION

Mitigation Measure 3.3.1-2 would not be infallible against strong seismic activity but would result in levees better suited to withstand seismic events and to the extent practicable and would reduce impacts to less than significant.

IMPACT 3.3.1-3: EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS (INCLUDING LEVEE FAILURE) RESULTING FROM SEISMIC-RELATED GROUND FAILURE, INCLUDING LIQUEFACTION.

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

As stated above, levees and structures constructed on the property are potentially subject to these hazards resulting from strong seismic events. Design and construction would need to be engineered to withstand seismic activity to the extent practicable and future construction at the site must provide adequate level of protection per USACE and Reclamation District 799 guidelines. All new or relocated historic structures on the restoration site and on the City Community Park must conform to applicable State building codes. Improper design could result in greater susceptibility to damage to structures and levees from liquefaction.

Previous studies including cone penetration tests in the project vicinity (East Cypress Corridor) indicate potential for liquefaction within interbedded sand layers (typically 2 to 5 feet thick) located in the upper 15 to 25 feet of soil (Kleinfelder 2004). Empirical based estimates indicate seismically induced settlement of liquefiable sand layers range from less than 0.5 inch to approximately 3 inches (Kleinfelder 2004). The Geotechnical Consultation of Seepage and Levees at Dutch Slough prepared by Hultgren-Tillis Engineers in August 2005 states that portions of the sand subgrade may be at risk for liquefying in a large earthquake and states that densification treatment (e.g., deep dynamic compaction) may be necessary for FEMA Urban Levee design (Hultgren-Tillis 2005). Liquefaction could potentially damage or destroy project structures, infrastructure, and levees.

MITIGATION MEASURE 3.3.1-3

Conduct site-specific geotechnical investigations to identify and implement appropriate remediation actions (e.g., subgrade densification).

Site-specific geotechnical investigations shall be conducted at Dutch Slough to characterization site conditions. Pre-design and design-level geotechnical field investigations (soil borings, Cone Penetration Tests), laboratory analyses, groundwater analyses would better enable assessing site conditions and constructability of proposed levees and structures on the Dutch Slough Restoration Project site and the City Community Park. These investigations would provide a basis for appropriate Site design for any new and/or improvements to exiting levees and structures on the Dutch Slough Restoration Project site and the City Community Park. Potential methods include treatment such as deep dynamic compaction to densify subgrade soils. These investigations shall supplement recent work presented in Kleinfelder (2006).

SIGNIFICANCE OF IMPACT AFTER MITIGATION

Implementing appropriate design, remediation, and construction measures would engineer levees and structures to withstand seismic events to the extent practicable. These measures would mitigate potential impacts of ground failure to less than significant.

OPEN WATER MANAGEMENT OPTIONS

No change in structural or levee failure impacts would occur with the various open water management options.

IMPACT 3.3.1-4: EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS RESULTING FROM LANDSLIDES

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

Site topographic surveys indicate relatively flat terrain and geologic maps and aerial photos do not indicate the presence of any landslide hazards. Therefore, there would be no associated impact.

OPEN WATER MANAGEMENT OPTIONS

The open water management option would not affect landslide hazard.

IMPACT 3.3.1-5: SUBSTANTIAL SOIL EROSION OR LOSS OF TOPSOIL

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

Following the proposed breach in the levees, the Dutch Slough Restoration Project site is expected to be depositional. Shallow sub-tidal to intertidal vegetation and emergent marsh species are anticipated to enhance sediment accretion on the site. Erosion from within the site is not anticipated to be problematic. Levee design and embankment buffering and marsh plain vegetation is anticipate to moderate wind and water erosion.

Construction activities and earth moving from both restoration activities and park development have the potential to increase wind and water erosion on a temporary basis. The site is located in a region of high winds and may be subject to wind erosion particularly during construction as soils are excavated, transported and stockpiled on site. Temporary erosion control measures would implemented during construction to minimize erosion in line with construction Best Management Practices (BMPs) and the Stormwater Pollution Prevention Plan (SWPPP).

OPEN WATER MANAGEMENT OPTIONS

The open water management option would not affect topsoil erosion potential. Post-breach the site is anticipated to accrete sediment. Open water management options may influence levee erosion due to differences in potential wind-wave fetch, see discussion under impact 3.3.1.8.

MITIGATION MEASURE 3.3.1-5: IMPLEMENTING EROSION CONTROL BMPS DURING CONSTRUCTION.

Temporary erosion control measures (e.g., silt fences, straw bales, detention basins, check dams, sandbag dikes, geo-fabric, and ground cover) shall be implemented during construction per required BMPs and SWPPP.

SIGNIFICANCE OF IMPACT AFTER MITIGATION

Implementing BMPs and SWPPP during construction will mitigate impacts for erosion and sedimentation to less than significant.

IMPACT 3.3.1-6: LANDSLIDE, LATERAL SPREADING, SUBSIDENCE, LIQUEFACTION, OR COLLAPSE RESULTING FROM CONSTRUCTION ON AN UNSTABLE GEOLOGICAL UNIT OR UNSTABLE SOILS

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

Levees and structures constructed on the Dutch Slough Restoration Project site, as well as the Related Projects sites, are potentially subject to lateral spreading, subsidence, liquefaction hazards resulting from strong seismic events. Landslides are not considered a hazard due to site topography. Improper design and construction could result in liquefaction or subsidence. Design and construction needs to be engineered to withstand earthquakes to the extent practicable and future construction on the restoration site, the community park and levee access pathways must provide adequate level of protection per CBC standards and county, reclamation district, USACE, and State regulations.

Existing levees are constructed of unconsolidated material, but have been in place for decades and to date have not experienced significant landslides, lateral spreading, subsidence, liquefaction or collapse. This does not ensure future stability. Ongoing repair and maintenance of existing levees would be conducted. Fill placement and construction activities along levees and the resulting increasing in loading could increase substrate sheer stress with the potential to result in subsidence and differential settling.

The report, *Geotechnical Consultation Seepage and Levees Dutch Slough Tidal Marsh Restoration* (Hultgren-Tillis Engineers, 2005), indicates that the new proposed levee along the eastern boundary of the Burroughs parcel would be constructed of lean clay. Where necessary, areas of peat would need to be excavated from beneath the proposed levee to expose underlying sand or stiff clay soils. The report recommends incorporation of a wide berm to maintain stability and aid in controlling levee settlement induced by lateral creep. The report also indicates potential for differential settlement at the junction of the new levee and the existing Dutch Slough levee and recommends a core be installed into this segment to minimize risk of piping (internal seepage) due to cracks in the levee resulting from differential settling (Hultgren-Tillis 2005).

OPEN WATER MANAGEMENT OPTIONS

The open water management option would not affect Impact 3.3.1-6.

MITIGATION MEASURE 3.3.1-6

Pre-design and design-level geotechnical field investigations (soil borings, Cone Penetration Tests) and laboratory analyses shall be conducted to determine soil characteristic and strength to enable an assessment of site conditions and constructability. Field investigations and laboratory results shall be included in geotechnical reports and form the basis for appropriate site design. Potential methods to address liquefaction include deep dynamic compaction to densify subgrade soils. A geotechnical engineer shall monitor and provide oversight of field construction activities including excavation, fill placement, and materials removed from and deposited at the site.

As recommended in the Hultgren-Tillis (2005) Levee and Seepage report, the new proposed levee along the eastern boundary of the Burroughs parcel shall be constructed of lean clay. Where necessary, areas of peat would need to be excavated from beneath the proposed levee to expose underlying sand or stiff clay soils. Levee design shall include a wide berm to maintain stability and aid in controlling levee settlement induced by lateral creep. To minimize potential for differential settlement and risk of internal piping (seepage) a core should installed into levees segments as needed.

If Marsh Creek is relocated, site-specific soils investigations shall be conducted at the selected diversion point, and any improvements identified implemented as necessary.

SIGNIFICANCE OF IMPACT AFTER MITIGATION.

Implementing appropriate design, remediation, and construction measures would mitigate impact to less than significant.

IMPACT 3.3.1-7: RISK TO LIFE OR PROPERTY RESULTING FROM CONSTRUCTION OF STRUCTURES ON EXPANSIVE SOILS

Soil surveys indicate significant portions of the Dutch Slough Restoration Project and Related Project sites include Sacramento and Marcus clay soils characterized as expansive with high potential to shrink-swell (SCS 1977). Portions of the City Community Park also overlie expansive clay soils that are prone to shrink-swell with moisture. Volume changes may occur resulting from changes in water table levels and placement of fill material. These changes can damage foundations, roadways, pipes, and other infrastructure. Potential significant impacts can be mitigated to less than significant or avoided by implementing the mitigation measures identified below.

OPEN WATER MANAGEMENT OPTIONS

The choice of open water management option would not affect this impact.

MITIGATION MEASURE 3.3.1-7: REMOVE AND/OR REMEDIATE UNSTABLE OR EXPANSIVE SOILS

Design level geotechnical investigations shall be conducted to assess presence of expansive soils and identify most appropriate remediation measures for the restoration site and the proposed community park. In the event that unstable or expansive geologic units or soils are encountered during the geotechnical investigations and are deemed unsuitable for construction, remedial measures shall be implemented, including removing soils and backfill with engineered fill or imported offsite material, re-grading with non-expansive soils, soil lime treatment, or otherwise treating soils to decrease shrink/swell potential and otherwise satisfy the required specifications for compaction and shear strength. All structures shall adhere to building codes; this would reduce risk to life or property and reduce impacts to less than significant levels.

SIGNIFICANCE OF IMPACT AFTER MITIGATION

Implementation of the mitigation measure identified above would reduce these impacts to less than significant.

IMPACT 3.3.1-8: LEVEE FAILURE RESULTING FROM EROSION

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

Wind and water are principal causes of erosion that may result in weathering and transport of soils from the site. The site is currently subject to wind erosion and outboard levees subject to water erosion from channel flow and tidal action. Alternative 1 includes breaching the existing levees which would result in an increase in the tidal prism (water volume and velocity) entering and exiting the parcels. Breaching the levees has the potential to increase erosion adjacent to the breaches and along interior levees by subjecting levees to daily fluctuations in water levels, daily wetting/drying cycles, and wind-driven erosion. Breaching existing perimeter levees would increase the potential for greater wind-wave fetch and relatively larger wave run-up for all perimeter levees adjacent to open water and marsh areas. Wind-wave action may scour, erode and weaken levees. Some erosion may be acceptable within the restoration design objectives. However, unintended breaches along sloughs would increase tidal exchange and potentially result in channel erosion and increase exchange to the extent that other portions of levees are subject to increased likelihood of erosion and potential failure. Unintended breaches along Dutch Slough and the accompanying increase in localized flow velocities could potentially increase erosion scour of the Jersey Island levees.

DWR, the City of Oakley, RD799, and developers of adjacent nearby parcels are evaluating the feasibility of cost-sharing for the construction of a levee along jersey Island Road that will provide 300-year flood protection, as well as protect the areas from possible seepage associated with the Dutch Slough Restoration Project. This increased protection would be far greater than the less than 100-year flood protection provided by the existing levees.

OPEN WATER MANAGEMENT OPTIONS

Potential for levee erosion differs between open water management options because of differences in the size and depth of open water areas and resulting differences in wind-wave fetch. The deep-water tidal option has relatively greater potential for eroding levees than the other two tidal options. Of the non-tidal managed alternatives, the pond option has greater potential for erosion than the subsidence reversal due to greater water depths and thus increased wind-wave fetch potential. Regardless of option, the impact is considered less than significant because the perimeter levee designs are to include levee buffering, flat slopes, and vegetation cover that collectively act to dissipate wave energy and minimize erosion potential.

MITIGATION MEASURE 3.3.1-8. LEVEE MAINTENANCE

3.3.1-8.1 Levee design and maintenance. Levees shall include vegetation cover and biotechnical and/or physical buffering and feature gently graded slopes. Levees planted with marsh and riparian vegetation in and feature flatter slopes provide a wave-damping wetland bench will dissipate wave energy and minimize erosion as well as support habitat objectives. Periodic levee inspections and maintenance shall be specified as part of the project design. Anticipated levee maintenance activities include levee inspections and patrolling, grading, engineering, vegetation and rodent control, debris removal, drainage cleaning, seepage control, underwater surveys, and slope protection.

3.3.1-8.2 Repair unintended levee breaches. To prevent channel erosion and potential damage to the levee systems, unintended levee breaches at Dutch Slough that are not consistent with the restoration option shall be repaired by the project sponsors.

3.3.1-8.3 Maintain levee along Dutch Slough. Levees along Dutch Slough shall be maintained to prevent increase in wind-wave fetch that could lead to greater erosion and scour of Jersey Island levees.

3.3.1-8.4 Jersey Island Road levee shall account for increased wave run up. Due to greater fetch and potential wave run-up due to greater surface water area post-breach, the design height of the new Jersey Island Road levee shall be adequate to prevent account for increased water heights due to wave run-up.

SIGNIFICANCE OF IMPACT AFTER MITIGATION.

Less than significant

IMPACT 3.3.1-9: LEVEE FAILURE RESULTING FROM SEEPAGE

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

Seepage is recognized as a key mechanism leading to levee failure (DWR 2005). Through-seepage occurs in levees containing portions of relatively porous material, that when subjected to prolonged inundation (e.g., high water flood events) provide flow pathways through levees. Under-seepage has the potential to occur in levees underlain by porous soils, such as sand, that allow flow beneath a levee to the surface on the landward side. If left uncontained, this flow may result in pressure on the landward side of levees causing ruptures in the surface soils resulting in visible boils. These conduits of flow result in levee slumping and eventual overtopping and failure.

Levee failure is principally a concern along the perimeter of the site due to potential flooding damage to infrastructure in surrounding parcels. The PWA Feasibility Report states a new levee along the eastern boundary of the project will provide "in-kind" replacement of the existing levee currently around the Burroughs parcel along Dutch Slough and Little Dutch Slough (PWA 2006). In-kind replacement will not increase existing levee of flood protection, which offers less than 100-year flood protection.

Hultgren-Tillis Engineers (2005) developed a conceptual criterion for the in-kind levee replacement, an upgrade from in-kind to FEMA urban levee, and a FEMA urban levee. The FEMA urban levee offers increased flood protection. The Feasibility Study states upgrading from the in-kind levee replacement is not the responsibility of the Dutch Slough Restoration Project, though the potential for upgrade may exist through a cost-sharing partnership with responsible parties. The details of the cost-sharing partnership and the levee design specifications of the Jersey Island Road levee are currently under negotiation between the Department of Water Resources, Reclamation District 799, and the residential developer building on the Hotchkiss Tract (personal communication with Tom Hall, July 27, 2006).

The Hultgren-Tillis report indicates that the new proposed levee along the eastern boundary of the Burroughs parcel should be constructed of lean clay. The report also indicates potential for differential settlement at the junction of the new levee and the existing Dutch Slough levee and recommends a core be installed into this segment to minimize risk of piping (internal seepage) due to cracks in the levee resulting from differential settling (Hultgren-Tillis 2005). The report indicates that were the new levee intended to be a FEMA Urban Levee, the inclusion of an internal drain as a seepage control measure would reduce the risk in through-seepage (piping). The report recommends the inclusion of seepage ditches on the outside toes of new and existing levees around Dutch Slough that would act to pull the water level down beneath the levee toe to reduce the risk of seepage from the face of the levee. The Jersey Island Levee Road Levee evaluation by Kleinfelder proposes use of a pervious 25-foot blanket drain below the toe of the levee in conjunction with an internal perforated drainage pipe to incept potential internal seepage (Kleinfelder 2006). Inclusion of a chimney drain at the interior end of the blanket drain would provide an additional safety factor against seepage potentially by-passing the blanket drain due to soil layering or stratification (Kleinfelder 2006).

DWR, the City of Oakley, RD799, and developers of adjacent nearby parcels are evaluating the feasibility of cost-sharing for the construction of a levee along jersey Island Road that will provide 300-year flood protection, as well as protect the areas from possible seepage associated with the Dutch Slough Restoration Project. This increased protection would be far greater than the less than 100-year flood protection provided by the existing levees.

The potential impact of levee failure resulting from seepage is significant; however the proposed levee design would reduce this impact to less than significant.

OPEN WATER MANAGEMENT OPTIONS

There may be a slight difference in levee seepage potential between open water management options insofar as the options result in different water heights within the managed area and thus different gradients between surface water on either side of levees adjacent to the open water management areas. These differences are not expected to be great enough to affect the significance level of this impact after mitigation.

MITIGATION 3.3.1-9 APPROPRIATE LEVEE DESIGN, CONSTRUCTION, MONITORING AND MAINTENANCE

The project design shall comply with HTA and Kleinfelder design criteria and geotechnical investigations and shall incorporate consultation with the USACE, Reclamation District 799 and Reclamation District 830, and appropriate design and construction. The seepage potential of the selected Open Water Management option shall be evaluated as part of geotechnical investigations and consultations.

SIGNIFICANCE OF IMPACT AFTER MITIGATION

The mitigation identified above would reduce impacts to less than significant.

Alternative 2: Moderate Fill Alternative

IMPACT 3.3.2-1: EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS (INCLUDING LEVEE FAILURE) RESULTING FROM A SURFACE RUPTURE OF A KNOWN EARTHQUAKE FAULT

Impacts and mitigations are the same as Alternative 1 (for all options).

IMPACT 3.3.2-2: EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS (INCLUDING LEVEE FAILURE) RESULTING FROM STRONG SEISMIC GROUND SHAKING

Impacts and mitigations are the same as Alternative 1 (for all options).

IMPACT 3.3.2-3: EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS (INCLUDING LEVEE FAILURE) RESULTING FROM SEISMIC-RELATED GROUND FAILURE, INCLUDING LIQUEFACTION.

Impacts and mitigations are the same as Alternative 1 (for all options).

IMPACT 3.3.2-4: EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS RESULTING FROM LANDSLIDES

Impacts and mitigations are the same as Alternative 1 (for all options).

IMPACT 3.3.2-5: SUBSTANTIAL SOIL EROSION OR LOSS OF TOPSOIL

Impacts and mitigations are the same as Alternative 1 for the Dutch Slough Restoration Project and Related Projects and Open Water Management options.

MARSH CREEK DELTA RELOCATION OPTIONS

Relocating Marsh Creek from its current channel into the Emerson Parcel has the potential to introduce scouring flows during major storm events into the restoration site. These flows could cause erosion of existing soils or of fill soils placed for wetland restoration purposes. Scoured soils may be relocated elsewhere within the Emerson Parcel or transported into Dutch Slough. The extent of potential scour and transport depends on which Marsh Creek Delta Relocation Option (see Figure 2-13) is considered. There is a greater potential to occur the further south the diversion into Emerson Parcel is situated. This issue is described further, and mitigation identified as a component of the Marsh Creek Delta Relocation hydrologic evaluation described in Chapter 3.1.

IMPACT 3.3.2-6: LANDSLIDE, LATERAL SPREADING, SUBSIDENCE, LIQUEFACTION, OR COLLAPSE RESULTING FROM CONSTRUCTION ON AN UNSTABLE GEOLOGICAL UNIT OR UNSTABLE SOILS

Impacts and mitigations are the same as Alternative 1 (for all options).

IMPACT 3.3.2-7: RISK TO LIFE OR PROPERTY RESULTING FROM CONSTRUCTION OF STRUCTURES ON EXPANSIVE SOILS

Impacts and mitigations are the same as Alternative 1 (for all options).

IMPACT 3.3.2-8: LEVEE FAILURE RESULTING FROM EROSION

Impacts and mitigations are the same as Alternative 1 (for all options).

IMPACT 3.3.2-9: LEVEE FAILURE RESULTING FROM SEEPAGE

Impacts and mitigations are the same as Alternative 1 (for all options).

Alternative 3: Maximum Fill

IMPACT 3.3.3-1: EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS (INCLUDING LEVEE FAILURE) RESULTING FROM A SURFACE RUPTURE OF A KNOWN EARTHQUAKE FAULT

Impacts and mitigations are the same as Alternatives 1 and 2 (for all options).

IMPACT 3.3.3-2: EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS (INCLUDING LEVEE FAILURE) RESULTING FROM STRONG SEISMIC GROUND SHAKING

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

As discussed for Alternative 1, strong seismic ground shaking is likely to occur at the Dutch Slough site in a major earthquake. The potential for structural and levee damage is previously discussed under Alternative 1.

The potential flood hazard is comparatively less for Alternative 3 than for Alternatives 1 and 2 because the Alternative 3 design has less open water on the Gilbert and Burroughs parcel. The design indicates channels present on the Burroughs parcel, but no open water along the eastern perimeter

(Jones Island Road levee), which reduces the threat of flooding along this boundary due to levee failure.

Incorporating earthquake-resistant levee design and construction measures to reduce liquefaction, settlement, and lateral spread may reduce the potential impacts. Conformance to building codes and applicable regulations would not render structures or levees infallible or provide any guarantee that significant structural damage will not result from large magnitude seismic events; however, it would provide reasonable assurance that appropriately designed and constructed structures would be better suited to withstand these events without collapse or loss of life.

MITIGATION MEASURE 3.3.3-2

Conduct site-specific geotechnical investigations to identify and implement appropriate remediation actions (e.g., subgrade densification).

Mitigation is the same as Alternatives 1 and 2.

SIGNIFICANCE OF IMPACT AFTER MITIGATION

Mitigation Measure 3.3.3-2 is not infallible against strong seismic activity but would result in levees better suited to withstand seismic events to the extent practicable and therefore reduce impacts to less than significant.

OPEN WATER MANAGEMENT OPTIONS

The open water management option would not influence the likelihood of structural or levee failure due to strong seismic shaking. The potential impacts do not differ amongst tidal open water options. Impacts would be mitigated to less than significant with Mitigation Measure 3.3.3-2.

MARSH CREEK DELTA RELOCATION

Marsh Creek Delta Relocation options would not influence the likelihood of structural or levee failure due to strong seismic shaking or potential impacts.

IMPACT 3.3.3-3: EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS (INCLUDING LEVEE FAILURE) RESULTING FROM SEISMIC-RELATED GROUND FAILURE, INCLUDING LIQUEFACTION.

As stated previously, levees and structures constructed on the property are potentially subject to these hazards resulting from strong seismic events. Design and construction needs to be engineered to withstand seismic activity to the extent practicable and per local, state and federal guidelines.

The potential flood hazard is comparatively less for Alternative 3 than for Alternatives 1 and 2 because the Alternative 3 design has less open water on the Gilbert and Burroughs parcel. The design indicates channels present on the Burroughs parcel, but no open water along the eastern perimeter (Jersey Island Road levee), which would reduce the threat of flooding along this boundary due to levee failure.

OPEN WATER MANAGEMENT OPTIONS

The open water management option would not influence the likelihood of levee failure due to seismic-related ground failure or effect potential impacts.

MARSH CREEK DELTA RELOCATION OPTIONS

Marsh Creek Delta Relocation would not affect the likelihood of levee failure due to seismic-related ground failure or affect potential impacts.

MITIGATION MEASURE 3.3.3-3.

Conduct site-specific geotechnical investigations to identify and implement appropriate remediation actions (e.g., subgrade densification).

Mitigation is the same as for Alternatives 1 and 2.

SIGNIFICANCE OF IMPACT AFTER MITIGATION

Less than significant

IMPACT 3.3.3-4: EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS RESULTING FROM LANDSLIDES

Impacts and mitigations are the same as Alternatives 1 and 2.

IMPACT 3.3.3-5: SUBSTANTIAL SOIL EROSION OR LOSS OF TOPSOIL

Impacts and mitigations are the same as Alternatives 1 and 2.

IMPACT 3.3.3-6: LANDSLIDE, LATERAL SPREADING, SUBSIDENCE, LIQUEFACTION, OR COLLAPSE RESULTING FROM CONSTRUCTION ON AN UNSTABLE GEOLOGICAL UNIT OR UNSTABLE SOILS

Impacts and mitigations are the same as Alternatives 1 and 2.

IMPACT 3.3.3-7: RISK TO LIFE OR PROPERTY RESULTING FROM CONSTRUCTION OF STRUCTURES ON EXPANSIVE SOILS

Impacts and mitigations are the same as Alternatives 1 and 2.

IMPACT 3.3.3-8: LEVEE FAILURE RESULTING FROM EROSION

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

As with Alternatives 1 and 2, there would be the potential for outboard levee erosion on all parcels and on levees of open water area of Emerson parcels. However, due to lack of open water on the Gilbert and Burroughs parcels, the likelihood of erosion and scour on inboard levees is comparatively less for Alternative 3. Potential flood hazard along Jersey Island Road levee is least for Alternative 3 since it does not feature open water in Burroughs parcel.

OPEN WATER MANAGEMENT OPTIONS

Potential for levee erosion differs between open water management options because of differences in the size and depth of open water areas and resulting differences in wind-wave fetch. The deep-water tidal option has relatively greater potential for eroding levees than the other two tidal options. Of the non-tidal managed alternatives, the pond option has greater potential for erosion than the subsidence reversal due to likelihood for greater potential for wind-wave fetch. Regardless of option, the impact is considered less than significant because levee design is to include levee buffering, flat slopes, and vegetation cover which collectively act to dissipate wave energy and minimize erosion potential.

MARSH CREEK DELTA RELOCATION OPTIONS

Marsh Creek Delta Relocation options do not differ in their potential to result in levee erosion.

MITIGATION MEASURE 3.3.3-8 LEVEE MAINTENANCE

Mitigation is the same as for Alternatives 1 and 2.

SIGNIFICANCE OF IMPACT AFTER MITIGATION

Less than significant

IMPACT 3.3.3-9: LEVEE FAILURE RESULTING FROM SEEPAGE

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

As discussed in Alternative 1, through-seepage and under-seepage are mechanisms leading to levee failure. Levee failure is principally a concern along the perimeter of the site due to potential flooding damage to infrastructure in surrounding parcels.

The lack of open water on the Gilbert and Burroughs parcels would reduce the likelihood of seepage under Alternative 3 compared to Alternatives 1 and 2.

OPEN WATER MANAGEMENT OPTIONS

Potential for levee failure resulting from seepage does not differ amongst open water management options.

MARSH CREEK DELTA RELOCATION OPTIONS

Potential for levee failure resulting from seepage does not differ amongst marsh creek relocation options.

MITIGATION 3.3.3-9 APPROPRIATE LEVEE DESIGN, CONSTRUCTION, MONITORING AND MAINTENANCE.

Mitigations are the same as Alternatives 1 and 2.

SIGNIFICANCE OF IMPACT AFTER MITIGATION.

Less than significant

Alternative 4: No Project

IMPACT 3.3.4-1: EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS (INCLUDING LEVEE FAILURE) RESULTING FROM A SURFACE RUPTURE OF A KNOWN EARTHQUAKE FAULT

Surface ground ruptures are generally confined to a narrow linear zone adjacent to faults. Fault ground rupture is unlikely at Dutch Slough as there are no active faults mapped across the site by the California Geological Survey. As with Alternatives 1-3, the site is not located in a Fault Hazard Zone (Alquist-Priolo Earthquake Special Study Zone). Therefore, this impact is considered less than significant and no mitigation is required.

IMPACT 3.3.4-2: EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS (INCLUDING LEVEE FAILURE) RESULTING FROM STRONG SEISMIC GROUND SHAKING

As discussed for Alternative 1, strong seismic ground shaking is likely to occur at the Dutch Slough site in a major earthquake. Existing levees and structures are likely to be subject to potential damage. Aerial photos indicate minimal presence of structures within the Dutch Slough Restoration Project boundaries (PWA 2006). Levee failure would introduce water from the Bay-Delta onto the site and potentially, depending upon location of failure, into the surrounding vicinity. Under the No Project Alternative option, existing levees around the Dutch Slough parcels will not be rebuilt but will be maintained. DWR, the City of Oakley, RD799, and developers of adjacent nearby parcels are evaluating the feasibility of cost-sharing for the construction of a levee along jersey Island Road that will provide 300-year flood protection, as well as protect the areas from possible seepage associated with the Dutch Slough Restoration Project. This increased protection would be far greater than the less than 100-year flood protection provided by the existing levees.

. Under this No-Project Alternative, this new levee would be the sole responsibility of the Hotchkiss Tract development. Impacts of flooding adjacent parcels or the Contra Costa canal to the south are significant

MITIGATION 3.3.4-2: LEVEE MONITORING AND MAINTENANCE

Ongoing repair and maintenance of existing levees shall be conducted by RD 799 and RD 2137.

SIGNIFICANCE OF IMPACT AFTER MITIGATION

Less than significant

IMPACT 3.3.4-3: EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS (INCLUDING LEVEE FAILURE) RESULTING FROM SEISMIC-RELATED GROUND FAILURE, INCLUDING LIQUEFACTION.

As stated above, levees and structures constructed on the property are potentially subject to these hazards resulting from strong seismic events. Levee failure is a significant impact as it would introduce water from the Bay-Delta onto the site and potentially, depending upon location of failure, onto the adjacent parcels and the Contra Costa Canal. This impact is considered significant.

MITIGATION 3.3.4-3: LEVEE MONITORING AND MAINTENANCE

As stated, the existing levees are constructed of unconsolidated material, but have been in place for decades and to date have not experienced significant landslides, lateral spreading, subsidence, liquefaction, seepage or collapse. This does not ensure future stability.

Potential mitigations are identified in Alternatives 1 and 2. Ongoing levee maintenance is required.

SIGNIFICANCE OF IMPACT AFTER MITIGATION.

Less than significant

IMPACT 3.3.4-4: EXPOSE PEOPLE OR STRUCTURES TO POTENTIAL SUBSTANTIAL ADVERSE EFFECTS RESULTING FROM LANDSLIDES

Site topographic surveys indicate relatively flat terrain and geologic maps and aerial photos do not indicate the presence of any landslide hazards. Potential for levee sloughing/sliding is mitigated through proper levee design, construction and maintenance as previously identified in Alternatives 1 and 2. There is no associated impact.

IMPACT 3.3.4-5: SUBSTANTIAL SOIL EROSION OR LOSS OF TOPSOIL

The project site is currently subject to wind erosion and wind-wave erosion along outboard levees. Currently, Reclamation Districts 799 and 2137 maintain the Dutch Slough levees and will continue to maintain them. The site is located in an area of high winds and is subject to potential wind erosion. The predominant land use is agriculture and grazing. Under this land management regime, the potential for wind erosion varies with seasonality, crop cover, mowing, disking, and related grazing density and rotation activities. The impacts from these ongoing actions are less than significant. No mitigation is required.

IMPACT 3.3.4-6: RISK TO LIFE OR PROPERTY RESULTING FROM CONSTRUCTION OF STRUCTURES ON EXPANSIVE SOILS

Soil surveys indicate significant portions of the Dutch Slough site include soils with high potential to shrink-swell (SCS 1977). As proposed, the No Project alternative proposes to maintain the Site as open space under current agricultural land uses in which case the potential impacts are less than significant. However, pending extent and nature of potential future structural development the mitigation measures outlined in Alternative 1 are available to reduce potential impacts to less than significant.

IMPACT 3.3.4-7: LEVEE FAILURE RESULTING FROM EROSION

The site is currently subject to wind erosion and outboard levees are subject to water erosion from channel flow and tidal action. Wind-wave action may scour and erode and weaken levees at the Dutch Slough Restoration Project site. As discussed, levee failure poses flood hazard potential for adjacent properties. Potential impacts from levee erosion are significant. As currently done, routine inspection, maintenance, and repair would continue to be necessary.

Development proposed on the Hotchkiss Tract to the east of Jersey Island Road would be subject to effects of levee failure on the Burroughs Tract unless that development provides an independently constructed flood control levee. Under this no-action alternative, the negotiations currently 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 would provide 300-year flood protection, as well as protect adjacent areas from possible seepage associated with the restoration project, are not applicable.

Under the No Project alternative, Bethel Island and Jersey Island levees would continue to be subject to wind-wave scour and erosion. These levees would continue to require routine inspection, maintenance, and repair. The No-Project alternative would not alter existing conditions and would not improve the Bethel Island and Jersey Island levees, thus would not increase or decrease their likelihood of failure resulting from erosion.

MITIGATION MEASURE 3.3.4-7: LEVEE MONITORING AND MAINTENANCE

Ongoing levee maintenance activities such as levee inspections and patrolling, grading, engineering, vegetation and rodent control, debris removal, drainage cleaning, seepage control, underwater surveys, and slope protection can reduce the likelihood of failure. These activities will continue to be the responsibility of Reclamation District 799 and 2137.

SIGNIFICANCE OF IMPACT AFTER MITIGATION

Less than significant

IMPACT 3.3.4-8: LEVEE FAILURE RESULTING FROM SEEPAGE

As previously discussed, seepage poses a threat to the stability of levees and has the potential to result in failure. The existing levees are constructed of unconsolidated material, but have been in place for decades and to date have not experienced significant landslides, lateral spreading, subsidence, liquefaction, seepage or collapse. This does not ensure future stability. Ongoing repair and maintenance of existing levees is necessary, as levees throughout the Delta are subject failure from seepage. Levee failure poses flood hazard potential for adjacent properties.

MITIGATION 3.3.4-8 LEVEE MONITORING AND MAINTENANCE

Ongoing levee maintenance activities such as levee inspections and patrolling, grading, engineering, vegetation and rodent control, debris removal, drainage cleaning, seepage control, underwater surveys, and slope protection can reduce the likelihood of failure. However, given the age of the levees, the lack of specificity regarding material used to construct them, it is likely the levees do not provide the level of protection new, properly designed and constructed levees provide.

SIGNIFICANCE OF IMPACT AFTER MITIGATION

Less than significant

Cumulative Impacts

The Dutch Slough Restoration site is located in an area that is undergoing rapid development, with multiple residential developments in the area proposed, approved, or already under construction. Implementing the Dutch Slough Restoration would not result in cumulative impacts upon geology and soils as proper design and construction of levees and structures and adherence to building code regulations would reduce impacts to less than significant. These mitigated impacts are not additive in nature and do not produce cumulative impacts. Impacts of soil erosion are minor or temporary and can be effectively mitigated by using Best Management Practices at time of construction, as previously discussed. The potential flood hazard due to levee failure impacting residential and commercial developments located on subsided lands in historical floodplain is a concern throughout the Delta. The increase in residential development around Dutch Slough increases overall flood hazard potential in the event of levee failure. DWR, the City of Oakley, RD799, and developers of adjacent nearby parcels are evaluating the feasibility of cost-sharing for the construction of a levee along jersey Island Road that would provide 300-year flood protection, as well as protect the areas from possible seepage associated with the Dutch Slough Restoration Project. This increased protection would be far greater than the less than 100-year flood protection provided by the existing levees.

The existing levees on the Emerson and Gilbert parcels would continue to be maintained by the Reclamation Districts and therefore implementation of the Dutch Slough restoration would not increase likelihood of levee failure and would not add to cumulative impacts.

An additional factor that requires consideration for prudent planning and consideration of restoration outcomes are projected increases in sea level rise as this relates to levee design height and flood hazard potential. Sea level rise projections are discussed in Section 3..1, Hydrology. A variety of estimates quantify the range of potential sea level rise, report observed trends and offer predictions of global warming and the potential impacts (IPCC 2001, CCCC 2006). The Intergovernmental Panel on Climate Change reports that over the last 100 years the eustatic (globally averaged) sea level rise was 1 – 2 mm/year (0.3 – 0.6 ft/century). The IPCC projects rates of sea level rise to increase over the next century, with projected increases ranging from 0.4 - 2.9 ft by 2100 (IPCC 2001). More recent estimates by the California Climate Change Center[1] report sea level rise in California over the past century to be approximately 7 inches (0.6 ft), and projects increases of 22 to 35 inches (1.8 to 2.9 ft) by 2100 (CCCC 2006).

The CALFED Independent Science Board (ISB) has evaluated the effects of sea level rise with respect to the Delta and concluded that current projections of sea level rise by the IPCC are likely very conservative as the models used to develop these projections under-estimate recent measured sea level rise (Jeffery Mount, ISB, memo to Mike Healy, CALFED, September 4, 2007). The ISB found that extrapolation from empirical models of sea level rise yields significantly higher estimates of sea level over the next few decades than the IPCC projections. The ISB suggests that the empirical projections are probably a better basis for short to mid term planning. The ISB further noted that neither approach to estimating future sea levels takes account of melting of ice in Greenland and Antarctica, which recent studies suggest is accelerating.

Based on their analysis, the ISB suggests that a mid range rise in sea level this century is likely to be at least 70-100 cm (27-39 inches), significantly greater (~200 cm/78 inches) if ice cap melting accelerates. While the absolute rise is alarming enough, even more alarming is the fact that only a few cm of sea level rise will greatly increase the frequency, intensity and duration of extreme water levels. It is these events that pose the greatest risk to Delta levees, infrastructure and private property.

The projected increase in sea-level will alter historical storm frequency predictions by decreasing reoccurrence intervals and increasing vulnerability of coastal regions to flooding (CCCC 2006). To provide context with a generalized scenario, an increase in sea-level of 1 foot means that storm-surge induced flood events that formerly occurred as 100-year events would more likely occur at a 10-year interval (CCCC 2006). Local sea level rise depends upon a number of physical factors including local land vertical movement (uplift/subsidence) and hydrodynamic responses. In the ab-

[1] The California Climate Change Center report is a multi-institution collaboration among the California Air Resources Board, California Department of Water Resources, California Energy Commission, CalEPA, and the Union of Concerned Scientists.

sence of site-specific data, levee design height should account for predicted increases in sea level rise to the extent practicable.

Table 3.3-2: Summary of Geological and Soils Impacts for Dutch Slough and Related Restoration Projects					
	Impact No.	Impact Description	Dutch Slough Restoration Project	Related Projects	
				Ironhouse Project	City Community Park Project
Alternatives 1, 2, and 3	3.3.1-1; 3.3.2-1; 3.3.3-1	Expose people or structures to potential substantial adverse effects (including levee failure) resulting from a surface rupture of a known earthquake fault			
	3.3.1-2; 3.3.2-2; 3.3.3-2	Expose people or structures to potential substantial adverse effects (including levee failure) resulting from strong seismic ground shaking	X	X	X
	3.3.1-3 3.3.2-3 3.3.3-3	Expose people or structures to potential substantial adverse effects (including levee failure) resulting from ground failure, including liquefaction	X	X	X
	3.3.1-4 3.3.2-4 3.3.3-4	Expose people or structures to potential substantial adverse effects resulting from landslides			
	3.3.1-5 3.3.2-5 3.3.3-5	Substantial soil erosion or loss of topsoil	X	X	X
	3.3.1-6 3.3.2-6 3.3.3-6	Landslide, lateral spreading, subsidence, liquefaction, or collapse resulting from construction on an unstable geological unit or unstable soils	X	X	X
	3.3.1-7 3.3.2-7 3.3.3-7	Risk to life or property resulting from construction of structures on expansive soils	X	X	X
	3.3.1-8 3.3.2-8 3.3.3-8	Levee failure resulting from erosion	X	X	X
	3.3.1-9 3.3.2-9 3.3.3-9	Levee failure resulting from seepage	X	X	X

Table 3.3-3: Summary of Geological and Soils Mitigation Applicability for Dutch Slough and Related Restoration Projects

	Mitigation	Dutch Slough Restoration Project	Related Projects	
			Ironhouse Project	City Community Park Project
Alternative 1, 2, 3	Mitigation Measure 3.3.1-2 Conduct site specific geotechnical investigations	X	X	
	Mitigation Measure 3.3.1-3 Site specific geotechnical investigations to characterization conditions	X	X	
	Mitigation Measure 3.3.1-5 Temporary construction BMPs will be implemented during construction to minimize erosion.	X	X	X
	Mitigation Measure 3.3.1-6 Implement appropriate remediation measures per results of site-specific geotechnical field investigations.	X	X	X
	Mitigation Measure 3.3.1-7 Remove and/or remediate unstable or expansive soils.	X	X	
	Mitigation Measure 3.3.1-8.1 Levee design and maintenance.	X	X	X
	Mitigation Measure 3.3.1.-8.2 Repair unintended levee breaches.	X	X	X
	Mitigation Measure 3.3.1-.8.3 Maintain levee along Dutch Slough.	X		
	Mitigation Measure 3.3.1-8.4 Design height of new Jersey Island Road levee to account for increase in fetch resulting wave run-up potential.	X		
	Mitigation 3.3.1-9 Appropriate levee design, construction, monitoring and maintenance.	X		

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3.4 - Terrestrial Biology

3.4 TERRESTRIAL AND WETLAND BIOLOGICAL RESOURCES

This section identifies the existing terrestrial and wetland biological resources potentially impacted by the Dutch Slough Restoration Project. Also included are some impacts of the related Ironhouse and City Park projects (Related Projects) that may affect or contribute to the cumulative effects of the Dutch Slough Project. Information in this section is based on a literature review, site reconnaissance including plant and bird surveys, a number of technical reports prepared by DWR and others for the project parcels, and reports on proposed developments on adjacent parcels. These reports are listed in the references section.

3.4.1. Affected Environment

Landscape Setting and Habitat Trends

LOCAL AND REGIONAL HABITAT TRENDS

The biological resources within the Dutch Slough area are affected by, and are part of, populations, communities, and habitat types that occur within the Antioch and Oakley area and adjacent portions of the Sacramento-San Joaquin Delta. These terrestrial and wetland features are undergoing substantial changes that cumulatively affect the status of biological resources within the project area.

Adjacent agricultural lands similar to those of the project area (originating as diked, reclaimed marshland, converted to lowland pasture and hay crops; managed grassland) are undergoing rapid conversion to residential and urban development. A large block of reclaimed marsh between Marsh Creek, Dutch Slough, and Sand Mound Slough to the east until recently supported a suite of habitat types typical of these lowland managed grasslands – ditches with freshwater marsh, extensive pastures and hayfields, ruderal (weedy) habitats, seasonal wetlands, patches of riparian woodland – in an extensive, unbroken, relatively homogeneous landscape unit including the three Dutch Slough Restoration Project site parcels, as well as the Related Project parcels. This landscape pattern provided continuity for dispersal of plant and wildlife populations across them. The stability and resilience (viability) of plant and animal populations, particularly rare species and those with limited dispersal ability, are likely to be affected by this landscape-level change.

Currently, the Dutch Slough Restoration Project and Related Project sites are mostly isolated by residential subdivisions to the south and east that were until recently managed lowland grassland (Dal Porto North, Biggs parcel, Lesher parcel; “East Cypress Corridor” area). Consequently, many of the Dutch Slough resident terrestrial species’ populations are no longer exchanging individuals with a larger, continuous populations distributed across larger habitat patches. This landscape-level change in continuity of habitats and populations is significant in particular for species with limited dispersal ability, species that require extensive blocks of habitat, and species that depend on large-scale population turnover (local extinction and colonization over wide areas). The Dutch Slough area wetlands and terrestrial habitats are now relatively more isolated and island-like in some respects, compared with recent past conditions.

HABITAT FRAGMENTATION AND HABITAT ISLANDS

Populations of wetlands species of the Dutch Slough Restoration Project parcels are still connected to locally extensive wetlands of Marsh Creek and Big Break through the Emerson Parcel and sloughs. The blocks of reclaimed historic marshlands south of Dutch Slough between Big Break and Sand Mound Slough (Dutch Slough wetland/terrestrial habitat complex) are separated by minor internal barriers to dispersal of wetland and terrestrial species (narrow irrigation ditches, small sloughs with terrestrial connections at their southern ends). In contrast, reclaimed wetlands north of Dutch Slough are separated from this connected complex by wide sloughs and open water. Exchange of terrestrial and wetlands species may occur across these wider, often turbulent open water "barriers", but long-distance dispersal across them would probably be relatively infrequent compared with contiguous parcels within the Dutch Slough habitat complex. Big Break and Marsh Creek are likely to exchange individuals (including potential colonizers, or "founder populations" of restored habitats) at the Dutch Slough and Ironhouse parcels. The Contra Costa Canal, which borders the site at the south, is also likely to act as a local population source and dispersal corridor for wetland and terrestrial species (Swaim 2005). Many highly mobile and widely dispersed wetland species are likely to reach the Dutch Slough and Ironhouse parcels through tidal exchange in Delta waters, connecting large delta wetland areas nearest Dutch Slough, such as Lower Sherman Island, by long-distance dispersal across open tidal water.

The Antioch Dunes National Wildlife Refuge, located along the south shore of the San Joaquin River two miles east of Marsh Creek (western edge of the project site), is only remotely related to terrestrial habitats of the project site, but it is significant because it is literally a disjunct, isolated refuge for rare species that require distinctive interior dune (disturbed sand) habitats (see description below). The project site also includes small remnant "sand mound" topographic-soil units that are derived from the same ancient river floodplain dune sheet that included the sand quarry that became Antioch Dunes. The Refuge is actively managed to maintain viable populations of its rare and endangered species.

Project Site and Adjacent Habitats

VEGETATION AND PLANT SPECIES

VEGETATION OVERVIEW. The vegetation at the Dutch Slough Restoration Project and Related Project sites can be broadly classified into several types of terrestrial and wetland vegetation that characterize major habitats. Many of the broad vegetation and habitat types are relatively well-defined terrestrial (upland) and wetland features, but the prevalent vegetation type, pasture, is a complex of transitional terrestrial and wetland habitats (which may or may not coincide with legal "wetland" determinations). While some vegetation patches can be relatively stable, the boundaries of vegetation types in areas transitional between wetland and terrestrial vegetation, represented in vegetation maps, can be naturally imprecise, and often vary among years. These boundaries in intermediate wetland/terrestrial vegetation are modified by variations in climate, hydrology, disturbance history, and ecological processes such as population spread or competition. The interpretation of transitional vegetation types may also differ among observers and scientific (or regulatory) classification criteria used. A useful "snapshot" representation of the 2004 boundaries of broadly distinct vegetation-habitat types (cover types) of the project site is presented in Figure 2-5 (DWR 2004a). A version of this map is modified to show the approximate distribution of relatively arid, ungrazed "pasture" or hayfields of the Emerson Parcel (see Figure 2-10).

The tidal wetland vegetation bordering Marsh Creek, Dutch Slough, Emerson Slough, and Little Dutch Slough includes freshwater marsh, submerged aquatic vegetation beds (mostly non-native invasive species), floating aquatic vegetation mats (mostly non-native species), and riparian woodland. The upper boundaries of freshwater tidal marsh vegetation are relatively stable, established by periodic tides. A large patch of mature freshwater tidal marsh occurs at Big Break at former positions of Marsh Creek delta, next to the west side of Emerson Parcel. Other tidal wetland vegetation around the project site occurs as narrow fringes along levees, or old side-cast spoils from former channel dredging

The types of non-tidal wetlands within the diked historic Delta marshlands include variable assemblages of perennial freshwater marsh vegetation, "alkali-meadow" (a type of seasonal wetland with brackish to alkaline soil, intermediate between grassland and marsh), and seasonal to perennial ponds. Large patches of perennial emergent freshwater marsh (soil moist, saturated or flooded in late summer/fall, flooded winter/spring and part of summer) occur in undrained deep depressions (strongly subsided areas) at the north ends of the Gilbert and Burroughs Parcels, and a cluster of freshwater marsh patches occur also at the north-central part of the Emerson Parcel. Alkali meadows occur in shallower depressions, generally nearby the perennial freshwater marshes.

TRANSITIONAL TERRESTRIAL AND WETLAND VEGETATION: IRRIGATED PASTURE. The prevalent existing vegetation and habitat type at the Dutch Slough Restoration Project and Related Project sites is irrigated cattle pasture, an altered form of grassland vegetation. Both terrestrial and wetland vegetation types occur on natural as well as constructed gradients on the site, and areas transitional between wetland and terrestrial vegetation may not maintain clearly distinct boundaries over time or geographic areas. The distinction between wetland and terrestrial vegetation is also made somewhat ambiguous because of the general mapping convention of the most abundant general habitat/vegetation type, "seasonal farmed wetlands" (estimated on the Dutch Slough Restoration Project site at 748 acres by DWR), which may occur in wetland and terrestrial phases.

The pastures of the site are mostly managed by flood irrigation (ditch flooding and drainage, control of indirect groundwater elevation relative to the ground surface pumping; see Section 3.1, Hydrology and Geomorphology), and are intensively grazed or hay-farmed. Areas mapped as "seasonal farmed wetlands" contain mostly non-native grasses, as well as seasonal wetland vegetation types on clayey or peaty soils (saturated or flooded for prolonged periods in winter or spring, and potentially during summer irrigation in some areas. Because technical, legal criteria for federal jurisdictional wetlands (specific to fill permits under the Clean Water Act) are expressly not habitat or vegetation classifications, "wetlands" described in this discussion of biological resources should be understood to be vegetation or biological habitat types based on ecological, rather than legal, characteristics. The U.S. Fish and Wildlife Service's Cowardin classification system of wetlands corresponds with this usage.

On the project site, grazed "pasture" areas with transitional wetlands or intermittently wet meadows include freshwater seasonal and perennial marsh plants, as well as grasses tolerant of wet soils, including rabbit's-foot grass (*Polypogon monspeliensis*), Bermuda grass (*Cynodon dactylon*), native and non-native barley species (*Hordeum* spp.) nutsedge (*Cyperus eragrostis*), wire rush (*Juncus balticus*, syn. *J. arcticus*), toad rush (*Juncus bufonius*), watergrass (*Echinochloa crus-galli*), non-native dock species (*Rumex* spp.), and spikerush (*Eleocharis macrostachya*). Introduced non-native forage grasses and forbs are also widespread in irrigated pastures, including canary grass (*Phalaris arundinacea*), meadow fescue (*Festuca arundinacea*), non-native plantains (*Plantago* spp.) non-native clovers (*Trifolium* spp.), and dallisgrass (*Paspalum dilatatum*), ryegrass (*Lolium multiflorum*) and bird's-foot trefoil (*Lotus corniculatus*). Native grasses are a relatively rare component of the pasture, but traces of saltgrass (*Distichlis spicata*), resembling Bermuda grass, and creeping wildrye (*Leymus triticoides*), and meadow barley (*Hordeum brachyantherum*) have been detected. These native grasses (rather than native bunchgrasses) were historically typical of lowlands near the edge of the delta where groundwater is within reach of perennial grass roots in spring and early summer, particularly where soil alkali or salt content influences vegetation. Most native vegetation within pasture occurs as rushes and spikerushes. Intensive grazing on the site can mask the expression of terrestrial and wetland phases of pasture vegetation, and obscure the identity of some grasses and rushes. Relatively well-drained pastures lacking persistent periods of soil saturation tend to lack the associated marsh species of rushes and wetland grass species (Figure 3.4-1).

WETLAND VEGETATION AND HABITATS

EXISTING WETLAND LANDSCAPE. The site's wetlands are mostly non-tidal seasonal and perennial wetlands formed within agriculturally reclaimed historic freshwater marshes of the western Sacramento-San Joaquin delta.

Remnants of freshwater tidal marshes are distributed in narrow fringes along the outer margins of the levees. A large patch of mature tidal freshwater marsh habitat does exist, however, at the eastern end of Big Break at the historic mouth (delta) of Marsh Creek, adjacent to the west side of the Emerson Parcel. This mature freshwater tidal marsh is a local sample of possible future conditions of the restored marsh vegetation at the Dutch Slough site. Marsh Creek's banks also support continuous fringes of freshwater tidal marsh, but these are periodically disturbed by maintenance of flood conveyance capacity (dredging). The Contra Costa Canal is another feature supporting a fringe of freshwater marsh. The edges of this manmade tidal channel are periodically disturbed (by maintenance: desilting, devegetation) freshwater marsh habitats. The canal corridor borders the southern end of the project site.

The salinity range of the Dutch Slough tidal marshes (from Big Break eastward) is also generally very low, usually within the limits of physiological tolerance of most freshwater marsh species. They are effectively freshwater marshes with traces of soil salts (oligohaline marsh). Most of these effectively freshwater tidal marshes contrast with the brackish tidal marshes of Suisun Marsh, which usually become sufficiently saline in summer to inhibit the growth of salt-intolerant species or increase their mortality.

Nontidal freshwater wetlands, in contrast with the continuous fringes of tidal marsh, are distributed in large and small patches within diked reclaimed agricultural lands. Old marsh peat soils within reclaimed agricultural lands on the project site have subsided in large depressions well below sea level, making drainage difficult. Winter runoff from pastures floods these depressions, and they are also influenced by near-surface groundwater recharged from adjacent tidal sloughs during the growing season. The nontidal freshwater marshes correspond with these topographic depressions in subsided, porous, decomposed poorly drained peaty soils. They are generally saturated or flooded for most of the summer growing season. Their freshwater marsh vegetation also indicates that their soil salinity is a negligible factor for plant growth.

Flood-irrigated pastures of operational dairy ranch, Gilbert Parcel. Pasture includes variable transitions between wetland meadow and relatively well-drained terrestrial grassland. Vegetation is composed of nonnative forage grasses and weedy broadleaf plants, and some native rushes (dark green in photo), grasses, sedges, and spikerushes. In summer, pastures may alternate between wetter and drier phases of irrigation and grazing. Pastures are generally wet in the rainy season.

Figure 3.4-1

Flood Irrigated Pastures

Source: Grassetti Environmental

One exception to the prevalent low-salinity wetlands occurs in nontidal evaporation basins that support important seasonal wetlands of the project site. Flooded shallow pools and flats develop in winter on relatively impermeable clayey soils, often in patchy areas surrounding freshwater marsh. These seasonal wetlands act as evaporation basins, and expose relatively dry soil in spring and summer. These evaporation basins may concentrate soil salts ("alkali") and select for salt-tolerant vegetation. Their distinctive vegetation contains elements of brackish marsh, playa, and alkali grasslands with vernal pools. They are informally called "alkali meadow" (see description below).

The distribution pattern of distinct wetland vegetation types and habitats within the Dutch Slough Restoration Project site, as interpreted and mapped based on 2004 conditions, are shown in Figure 2-10. These occupy extensive patches concentrated in topographic depressions at the north end of parcels, but also in artificial ditches throughout the irrigated pastures. The upper boundaries of some wetland types, such as non-tidal freshwater marsh and riparian woodland, are relatively clear. The boundaries of other wetland types, particularly seasonal wetlands such as seasonal ponds and "alkali meadow" (saline to alkaline seasonal wetlands dominated by grasses and forbs), like "irrigated pasture" are subject to variability in distribution between years. Acreages identified below should be interpreted as dynamic approximations, varying with the depth and duration of flooding.

FRESHWATER MARSH. Freshwater marsh refers to wetlands with emergent, rooted perennial vegetation in non-saline soils that are either flooded or saturated for most the growing season. The most familiar types of freshwater marshes in the Delta region are tule, cattail, or bulrush marshes, vegetation types with tall, linear stems or leaves. Broad-leaved plants may also be abundant in freshwater marshes. Freshwater marshes formerly dominated vast areas of the Sacramento-San Joaquin delta ecosystem, but are now reduced to habitat fragments, often narrow fringes of marsh bordering levees. Both tidal and non-tidal phases of freshwater marshes occur at the project site and vicinity, differing somewhat in composition, function, and habitat value. Both are predominantly tule vegetation. Freshwater tidal marsh constitutes the primary target vegetation and habitat for the project.

FRESHWATER NONTIDAL MARSH. (Figure 3.4-2) Freshwater nontidal marshes occur on the project site in undrained, subsided depressions where soils are submerged during the rainy winter season and during most or all of the summer growing season. Shallow (water less than 3 feet deep) emergent freshwater marshes are dominated by thick, tall, highly productive stands of tules (*Schoenoplectus acutus, S. californicus;* formerly *Scirpus*), and also cattails (*Typha* spp.). Disturbed freshwater marsh in ditches supports a higher proportion of cattails than stable freshwater marshes. Broad, deeply flooded areas that support open water most of the year, and develop emergent mud beds (drawdown) late in the growing season effectively alternate between seasonal ponds and freshwater marshes. Other locally abundant grass-like freshwater marsh species includes common spikerush (*Eleocharis macrostachya*), rabbit's-foot grass (*Polypogon monspeliensis*) and dallisgrass (*Paspalum dilatatum*). Many marsh forbs occur in freshwater marsh, but tules or cattails usually dominate the vegetation. Characteristic forbs in nontidal freshwater marsh include cocklebur (*Xanthium strumarium*, a coarse annual), curly dock (*Rumex crispus*, nonnative perennial), and many marsh knotweed species (*Polygonum* spp., widespread native and nonnative broadleaf annuals and perennials). The upper ends of freshwater marsh gradients may be abrupt, steep edges of terrestrial vegetation, or they may grade into transitional vegetation of alkali meadow, riparian woodland, pasture, or blackberry thickets. Vegetation mapping completed by DWR, based on 2004 field conditions, estimated that 54 acres of nontidal freshwater marsh occur within the Dutch Slough Parcels. (DWR 2004a)

Freshwater nontidal marshes form in undrained topographic low areas, in muck or peaty soils. Above: extensive freshwater marsh bordered by mature California black walnut trees (riparian woodland) on levee of northwest Burroughs parcel in July 2005. Vegetation is variable and patchy, including tules, cattail, spikerush, marsh forbs. Below: Relatively isolated freshwater marsh within matrix of arid ruderal (weedy) vegetation, Emerson parcel. Vegetation is mostly tules, bordered by patches of willow, blackberry. (Vineyard and windbreak walnut trees in background).

Figure 3.4-2

Freshwater Nontidal Marshes

Source: Grassetti Environmental

Freshwater tidal marsh. Freshwater tidal marshes occur around the edges of the project site and adjacent Big Break shoreline. Vegetation and habitat types occurring there also represent habitat restoration objectives of the project. (a) low intertidal marsh zone, tule and mud bed (Big Break); (b) middle intertidal marsh zone, diverse assemblage of broadleaf flowering marsh plants, bulrush, spikerush, rush, and tule (Big Break).

Figure 3.4-3a

Freshwater Tidal Marshes

Source: Grassetti Environmental

Freshwater tidal marsh (continued). (c) High intertidal freshwater marsh grades into middle and low marsh patches below, and lowland grassland above, at Big Break. High marsh gradient here includes (a) baltic rush, saltgrass, creeping wildrye, heliotrope, and Yerba Mansa. (d) Complete tidal wetland complex including gradients between low, middle, high tidal freshwater marsh and riparian woodland along Marsh Creek at Big Break.

Figure 3.4-3b

Freshwater Tidal Marshes

Source: Grassetti Environmental

FRESHWATER TIDAL MARSH. (Figures 3.4-3a and b) Freshwater tidal marsh refers to regularly flooded tidal marshlands with very low levels of soil salinity, tolerable by most freshwater species. The low intertidal marsh zone has soils flooded by daily tides, and is generally dominated by tall tules (*Schoenoplectus acutus, S. californicus*; formerly *Scirpus*), and occasionally several species of cattails (*Typha* spp.). Low marshes are highly productive, but support few species other than tules that tolerate deep, prolonged tidal flooding. The outer sides of levees around the Dutch Slough parcels support narrow fringes of low intertidal freshwater marsh. Low marsh vegetation may extend to shallow subtidal depths in some conditions, where it may compete (or out-compete) non-native submerged aquatic vegetation and displace invasive floating aquatic vegetation. Relatively few emergent plant species can tolerate the long flooding periods and depths of the low marsh zone, and competition from tules there. Tule marshes are generally not subject to invasion by non-native wetland weeds because they tend to overwhelm other species with their tall, dense shoot masses, belowground network of stems and roots, and superior flood tolerance. Though native, they may even be considered "invasive" in some land use contexts (DiTomaso and Healy 2003).

Portions of the freshwater tidal marshes that are regularly flooded most of the month, but are emergent (soil above water level) for many hours each day, compose the middle intertidal marsh zone. The middle marsh zone is considerably more diverse in plant species, even though this zone also may be dominated by tules. This zone is rarer and less abundant than low marsh, since it often represents a more mature marsh condition, requiring long periods of peat accumulation or sediment deposition. The Dutch Slough, Ironhouse and City of Oakley Park parcels support very little of this tidal freshwater marsh type, but substantial patches do occur along Marsh Creek and some areas that are free from both rip-rap and woody riparian vegetation. Invasive non-native plants can also invade this species-rich freshwater tidal marsh zone, including yellow flag (*Iris pseudoacorus*), purple loosestrife (*Lythrum salicaria*), but these do not currently appear to be significant components of the middle marsh zone along Marsh Creek.

The middle marsh zone grades into the uppermost end of tidal freshwater marsh (high intertidal marsh zone) that is only occasionally flooded by tides or flood events, but it includes depressions that remain flooded after tides recede. Very little of this zone occurs sporadically in a very narrow area of the outer levee toe of Dutch Slough Parcels. It is well-developed locally along the Big Break shoreline (a natural and very local reference site), and is an important part of the project restoration design. The high marsh zone at Big Break is dominated by wire rush (*Juncus balticus*, syn. *J. arcticus*), creeping wildrye (*Leymus triticoides*), and include large patches of Yerba Mansa (*Anemopsis californica*), saltgrass (*Distichlis spicata*), and wild heliotrope (*Heliotropium curassavicum*). Rare plants of this zone include Suisun aster (*Aster lentus*) and rose-mallow (*Hibiscus lasiocarpus*). The endangered Suisun Marsh plants, Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*) and soft bird's-beak (*Cordylanthus mollis* ssp. *mollis*) do not occur in freshwater tidal marshes of the Delta, and there is no evidence that they every occurred there historically. Large thickets of non-native Himalayan blackberry (*Rubus discolor*) also invade high marsh, converting them to riparian scrub thickets. High freshwater marsh may naturally grade into lowland grasslands (dense, closed stands of saltgrass, creeping wildrye, heliotrope) or seasonal wetland transition zones, or it may end abruptly at the edges of steep levees or river banks eroded in terrestrial sediments.

The acreage of tidal freshwater marsh bordering the Dutch Slough Restoration Project parcel levees has not been quantified. No tidal marsh occurs within the project levees.

FLOATING AQUATIC VEGETATION (FAV). (Figure 3.4-4) Some vegetation extends over the open water surface, either as free-floating plants, or colonies extending from plants rooted in banks. Some floating aquatic vegetation is native (water-primrose; most *Ludwigia* species and subspecies), but most FAV consists of highly invasive non-native plants like water-hyacinth (*Eichornia crassipes*) that choke irrigation ditches of the project site where tules have been removed, or where canals are too deep to support tules. FAV also occurs along quiet sloughs, especially at the blind ends of sloughs. Whether native or non-native, abundant FAV is treated as a nuisance to boating. Even native FAV species may become overabundant and invasive in nutrient-rich waters of urban and agricultural watersheds with diminished tidal and freshwater outflows. FAV borders marshes along large sloughs and small tidal channels of the Dutch Slough area, and may accumulate as large wracks that disturb marsh vegetation by smothering it with decomposing masses of debris. It also is abundant to dominant in irrigation ditches. Because FAV mats are seasonal and unstable in terms of area and distribution, their total acreage has not been estimated; acreage estimates would be an annual variable.

SUBMERGED AQUATIC VEGETATION (SAV). (Figure 3.4-5) Submerged aquatic vegetation is treated as wetland vegetation in some broad wetland classifications, such as the U.S. Fish and Wildlife classification of wetlands (Cowardin 1979). Submerged aquatic plants have leaves and stems that are fully submersed for all or nearly all of their life-cycle, and often have root systems reduced to minimal anchorage structures in pond or river beds. There are many native SAV species, including pondweeds (*Potamogeton* species, and sago pondweed, *Stuckenia pectinatus*) and stoneworts (*Chara* spp., green algae structurally similar to vascular plants) that are highly valuable food plants for waterfowl, and nursery habitat for aquatic invertebrates and fish. SAV may form patches or beds of extensive bottom "canopy" habitat.

In the delta, non-native invasive SAV species overwhelmingly dominate and replace native SAV and naturally bare open-water slough beds. Brazilian waterweed, *Egeria densa*, is extremely competitive against native SAV, invasive, and capable of surviving at great water depths. It has structural characteristics that create exaggerated cover and shelter in tidal slough beds, favoring predatory non-native fish. For this reason, SAV as a whole in the Delta may be viewed unfavorably in aquatic restoration and management because of *Egeria*, which rapidly establishes in shallow or deep subtidal habitats, including restoration sites.

Shallow SAV (visible from some aerial photography) has not been estimated within the immediate vicinity of Dutch Slough, Emerson Slough and Little Dutch Slough, however *Egeria* is widespread and abundant there, particularly in vegetated shallow water of Big Break.

Floating aquatic vegetation (FAV), composed of mostly non-native invasive plants, covers otherwise open water at blind ends of tidal sloughs (Emerson Slough, above), and non-tidal ditches and ponds (Burroughs Parcel, below).

Figure 3.4-4

Floating Aquatic Vegetation

Source: Grassetti Environmental

Submerged Aquatic Vegetation (SAV) at the project site is predominantly highly invasive, non-native Brazilian waterweed, Egeria densa, which spreads as massive beds in deep quiet tidal sloughs and bays.

Figure 3.4-5

Submerged Aquatic Vegetation

Source: Grassetti Environmental

Alkali Meadow. Seasonal wetlands dominated by low-growing, salt-tolerant plants are described as "alkali meadow", including plants associated with alkali vernal pools, grasslands, and brackish marshes. They occur in undrained flats that flood in winter and dry in summer, often in areas surrounding nontidal freshwater marsh. (Emerson parcel example shown at left)

Figure 3.4-6

Alkali Meadow

Source: Grassetti Environmental

"ALKALI MEADOW" AND SHALLOW SEASONAL PONDS, FLATS. (Figure 3.4-6) "Alkali meadow" is an informal habitat description describing variable types of seasonal wetland flats that concentrate salts ("alkali" refers to non-marine salts with different chemical properties) in surface soils after shallow water evaporates early in the growing season (spring or early summer). On the project site, alkali meadow may include relatively barren flats with sparse vegetation, annual grassland (Mediterranean barley, *Hordeum marinum*, often dominant), annual forb-dominated vegetation (brass-buttons, *Cotula coronopifolias*), or even perennial vegetation with brackish marsh plants (saltgrass, heliotrope, *Heliotropium curassavicum*). The composition of alkali meadow wetlands can be highly variable from site to site, and they may include species typically associated with alkali grassland, alkali sink, chenopod scrub, brackish marsh, and alkaline vernal pools. Species richness of seasonal wetlands associated with alkali meadow habitats can be high or low.

RIPARIAN WOODLAND AND SCRUB. (Figure 3.4-7) Within freshwater marshes like Big Break, and along levees, woody shrubs form dense thickets with canopies well above the marsh surface. Riparian scrub thickets are usually associated with higher, sloping, better-drained marsh edges or topographic high areas, such as levee remnants, or locally elevated flood deposits. They may occur along shorelines of ponds, or banks of channels, in tidal or non-tidal freshwater habitats. Willow thickets, and dead branches or trees (snags) within riparian woodland provide very important habitat for a wide range of wildlife species. During extreme floods, dense and tall riparian willow thicket canopies may partially remain above water levels, and trap debris, sediment, and act as baffles (permeable barriers) to wave energy propagated across open water.

Wild California black walnut trees (*Juglans californica* ssp. *hindsii*) of mature size are widespread along the outer levees of the Dutch Slough Restoration Project parcels, and are particularly abundant along Emerson Slough and Little Dutch Slough. This species was a component of historic riparian forests of the Delta, formed on well-drained flood sediments of wide natural river levees. "Old growth" stands of riparian forest are effectively extinct as a functional part of the Delta ecosystem, but naturally recruited "second-growth" woodlands composed of walnuts even when limited to narrow levees, provide some important riparian woodland habitat. Most mature native walnuts along the Emerson and Little Dutch Slough levees are rooted close to the high tide line, probably originating as floating seeds. Other than willows and walnuts, other woody native species of Delta riparian woodlands are relatively scarce at the project site. Non-native Himalayan blackberry thickets are common in the riparian zone of levees and throughout the pastures within the levees. Planted windbreak walnut trees along the edges of the Emerson Parcel vineyard (terrestrial setting) are not equivalent to riparian (shoreline) woodland.

DWR mapped 11.4 acres of riparian scrub and woodland vegetation in shoreline wetland settings (DWR 2004a). This estimate segregates patches of Himalayan blackberry (nonnative shrub thickets often in riparian vegetation) that may also occur in terrestrial habitats; some separately mapped blackberry thickets adjoining wetlands are presumably riparian vegetation as well. Blackberry thickets are distinguished as a vegetation type primarily because they are easy to identify and map from aerial photographs, and because they are difficult to assign exclusively to riparian or terrestrial vegetation except by interpretation in local landscape context.

TERRESTRIAL VEGETATION AND HABITATS.

CROPLAND, LANDSCAPED, AND DEVELOPED AREAS. The intensively developed areas on the project site include vineyards (European wine grapes) planted on ancient dune soils, former dairy industrial buildings and operational areas, miscellaneous farm buildings, or residences with ornamental landscaping or derelict landscaping including old windbreak trees. The Burroughs parcel supports extensive linear and isolated windbreak tree plantings, composed of mature, large, old native and non-native trees. These historic windbreak plantings are similar to those of former ranches in the project vicinity (Dal Porto North, Dal Porto South, Lesher, Biggs parcels). They include mature cottonwood (*Populus fremontii*, native), blue gum (*Eucalyptus globulus*, nonnative), fig (*Ficus carica*; non-native, apparently not spreading from plantings), elms (*Ulmus pumila*, *Ulmus* sp.; nonnative), black locust (*Robinia pseudoacacia*, nonnative, spreading), and California black walnut (*Juglans californica* ssp. *hindsii*; native).

Mature date palms (*Phoenix canariensis*, non-native), silver maple (*Acer saccharinum*, non-native) and sycamore (*Platanus occidentalis*, native) are also documented on the project site (DWR 2004a). The Emerson and Gilbert parcels have relatively few windbreak/landscape trees in the open pasture areas; most are clustered near old ranch and dairy buildings at the south end. Large, old trees are not natural components of native vegetation, but they have important effects on wildlife habitat (particularly broken-top, dead, dying standing trees with cavities), as discussed below.

RUDERAL (WEEDY) TERRESTRIAL VEGETATION. (Figure 3.4-8) Ruderal terrestrial vegetation occurs sporadically, and is most frequently associated with sandy well-drained soils, roadsides, dry levee slopes, and areas that were formerly used intensively in dairy operations or equipment/storage areas. Fields with recent history of discing also tend to support rank weedy vegetation. Mapping of ruderal vegetation on site corresponds well with the distribution of disturbed "sand mound" (ancient dune) deposits, but many disturbed soils on site support weedy vegetation.

Ruderal vegetation of the site has variable composition, including noxious invasive weeds such as mallow (*Malva neglecta*), bull thistle (*Cirsium vulgare*), bindweed (*Convolvulus arvensis*), poison hemlock (*Conium maculatum*), wild lettuce (*Lactuca serriola*), tumbleweed (*Salsola tragus*), many non-native annual grasses (including oats, *Avena sativa*; ripgut brome, *Bromus diandrus*; hare barley, *Hordeum murinum*). Some native annuals such as spikeweed (*Centromadia pungens*) and willowherb (*Epilobium brachycarpum, E.* spp.) are also common in ruderal vegetation. Levees that are periodically disturbed by maintenance activities surround all Dutch Slough parcels with persistent seed sources of terrestrial weeds.

REMNANT ANCIENT INTERIOR DUNE HABITATS. (Figure 3.4-9) Though mapped as ruderal vegetation and vineyards, the low-lying sands of the project site have substantial, distinctive biological resource attributes relevant to restoration (project objectives) and also potential for some sensitive species. The Emerson and Burroughs parcels contain substantial remnants of low-lying ancient stabilized dunes, related to the same formation that includes Antioch Dunes and many of the sandy soils of the project vicinity (See Section 3.3, Geology and Soils). The early historic vegetation of these largely stabilized, ancient, interior dunes was perennial grassland, oak woodland, and local "blowout" areas (naturally disturbed, unstable wind-erosion and depositional sites, or river-cut sand cliffs, within stabilized dunes) that supported the distinctive dune species surviving at the Antioch Dunes National Wildlife Refuge. Similar elevated mounds of ancient dune remnants occurred within former pastures of nearby East Cypress corridor subdivisions. These dune remnants are not formed or sustained by modern river sand sources.

Riparian woodland and scrub at the project site occur along the borders of tidal and nontidal freshwater marshes, Marsh Creek (shown above), and levees along Dutch Slough, Emerson Slough, and Little Dutch Slough. Live and dead trees (snags) both provide important habitat (shown below). Willows are most abundant along marsh edges, and California walnuts mixed with willows (see Figure 3.6-2, nontidal freshwater marsh) are most abundant along levee edges in existing local riparian woodland.

Figure 3.4-7

Riparian Woodland

Source: Grassetti Environmental

Ruderal (weedy, disturbed) terrestrial habitats of the project site are variable, and occur in derelict arid agricultural land, derelict industrial dairy operation areas, levees, roadsides, and similar disturbed areas that grade into areas mapped as pasture. Tumble-weeds, spikeweeds, and annual grasses are abundant, particularly in sandy soils at higher elevations.

Figure 3.4-8

Ruderal

Source: Grassetti Environmental

Ancient Dune Habitats. "Sand mound" (sandy soils of ancient dunes) vegetation at the project site, support an old vineyard and weedy nonnative plants. The disturbed artificial sandy road embankment at the vineyard (yellow arrow) locally supports small populations of several native sandy soil and dune plants.

Figure 3.4-9

Ancient Dune Habitats

Source: Grassetti Environmental

The dune remnants at the Emerson Parcel are partly converted to vineyard, and the rest are dominated by non-native weedy vegetation and trees, rather than the characteristic native vegetation of disturbed blowouts in ancient interior dune remnants at Antioch dunes, or upland dune soil "sand mounds" of former grazed lands in the project vicinity. Past cattle grazing and long-term growth of nitrogen-fixing, non-native trees such as black locust (*Robinia pseudoacacia*) appear to have altered the soil properties of the upper soil horizons of the ancient dune soil remnants at the Emerson Parcel, enriching them with organic matter and nutrients. Native dune species are lacking or extremely scarce on the existing remnant dune soils of the Emerson Parcel.

Elevated soil organic matter and nutrients of the relict dune soils in historic pasture at Emerson Parcel have apparently promoted persistent dominance by invasive non-native vegetation. The subsoil of the relict dune areas, however, are likely to support relatively intact mineral dune sand that could potentially support native dune vegetation if exposed, and thus has some biological resource value as potential restorable habitat for a suite of sensitive species and uncommon plant communities (see Special-status plants, Special-status wildlife, below). This potential is indicated by incidental recent creation of a localized strip of artificial dune habitat caused by road maintenance on sandy soils of the Emerson Parcel vineyard: the roadside berm formed by side-cast sandy subsoil that was scraped from the road bed was spontaneously colonized by two native local dune species: native Chamisso's bush lupine (*Lupinus chamissonis*, a characteristic dune shrub) and a perennial dune evening primrose (*Oenothera deltoides* ssp. *dentata*) related and somewhat similar to the endangered Antioch Dunes evening-primrose (*O. d* ssp. *howellii*). Small, persistent populations of both native dune plants are present in existing conditions along the vineyard roadside, indicating the ability to regenerate native dune vegetation locally.

Recent surveys of similar "sand mound" ancient dune remnants at adjacent, similar parcels (now eliminated in residential subdivisions) have revealed remnants of the local dune flora, and suggest the potential or historic vegetation of large exposures of ancient dune soils at the Emerson Parcel. The sand mound vegetation on similar parcels east of the project site supports a sand-associated local native flora similar but not identical with that of Antioch Dunes. The original vegetation of the Emerson Parcel sand mounds (Delhi soils) may have been intermediate in composition between Antioch Dunes and sand mounds to the east, which support widespread species such as California croton (*Croton californica*), telegraph weed (*Heterotheca grandiflora*), Kellogg's spikeweed (*Deinandra kelloggii*), slender buckwheat (*Eriogonum gracile*), small-flowered evening primrose (*Camissonia micrantha*), and common lessingia (*Lessingia glandulifera*).

The Antioch Dunes flora includes other species such as Chamisso's and silvery bush lupine (*Lupinus chamissonis, L. albifrons*), nude buckwheat (*Eriogonum nudum*), and deerweed (*Lotus scoparius*). It is unknown whether the rare, endangered plants of Antioch Dunes naturally occurred in the low-lying ancient dune remnants of the project site in early historic, pre-agricultural times; there are no records of these species by the time they were distinguished taxonomically, long after agriculture modified the vegetation.

TERRESTRIAL AND WETLAND WILDLIFE

WILDLIFE OF PASTURES AND RUDERAL TERRESTRIAL HABITATS. The Dutch Slough Restoration Project and Related Project sites support extensive cattle-grazed or hay-farmed pastures and weedy habitats with abundant wildlife, primarily birds. Similar open grassland habitats occur on agricultural lands east of the Burroughs parcel. Mammalian species common in these habitats include rodents (ground squirrels, *Spermophilus beecheyi*; pocket gophers, *Thomomys bottae*; and mice, *Mus musculus,* *Peromyscus* sp., *Microtus californicus, Reithrodontomys megalotis*); coyote (*Canis latrans)*; black-tailed jackrabbit,(*Lepus californicus),* red fox (*Vulpes vulpes)*, opossum (*Didelphis virginiana*), and raccoon (*Procyon lotor).*

Small mammals and insects are prey for numerous raptor species (hawks and owls) that actively forage over the extensive grassland habitat, especially well-drained or arid areas. Barn owls (*Tyto alba*), great horned owls (*Bubo virginianus*), red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*Buteo lineatus*), American kestrel (*Falco sparverius*), northern harrier (*Circus cyaneus*), white-tailed kite (*Elanus caeruleus*), and Swainson's hawk (*Buteo swansoni*) have been reported from the project site in surveys conducted by DWR (DWR 2004b). They also have been consistently reported in surveys of adjacent ranchlands (Sycamore Associates 2005), and are evidently established in the project vicinity. Burrowing owl (*Athene cunicularia*) populations, while not documented on the project site in 2005, occur in the project vicinity and utilize the same types of habitats present for foraging and nesting. Many perching birds, including tricolored blackbird (*Agelaius tricolor*), Brewers blackbird (*Euphagus cyanocephalus*), western meadowlark (*Sturnella neglecta*), golden-crowned and white-crowned sparrows (*Zonotrichia atricapilla, Z. leucophrys*), forage in pastures on the site. California quail (*Callipepla californica*) and (non-native) ring-necked pheasant (*Phasianus colchicus*) are abundant in ruderal areas with more vegetation cover and seed production. Western fence lizards (*Sceloporus occidentalis*) are common in dry ruderal habitats. The moist or wet irrigated pastures of the Gilbert parcel, surrounded by permanently wet ditches, support large populations of Pacific treefrogs (*Pseudacris regilla*). Long-billed curlew (*Numenius americanus*), great egrets (*Casmerodius albus*), snowy egrets (*Egretta thula*), and great blue herons (*Ardea herodias*) forage in the irrigated pastures as well as freshwater marshes on the site.

WILDLIFE OF NONTIDAL FRESHWATER MARSHES. Nontidal freshwater marshes (including shallow to deep water areas seasonally present within them) support locally common to abundant wading birds (great egret, snowy egret, great blue heron), waterfowl (mallard, *Anas playrhynchos*; common moorhen, *Gallinula chloropus*; cinnamon teal, *Anas cyanoptera*) and shorebirds (dunlin, *Calidris alpina*; greater yellowlegs, *Tringa melanoleuca*), and wetland perching birds (marsh wren, *Cistothorus palustris*; red-winged blackbird, *Agelaius phoeniceus*). Suitable habitat for a large number of additional waterbird species exists on the estimated 54 acres of nontidal freshwater marsh on site. The freshwater marshes and ponds within the project site support northwestern pond turtles (*Emys marmorata*; see special-status wildlife species) that serve as an indicator of habitat quality for other native amphibians and reptiles inhabiting freshwater marshes. A juvenile pond turtle was detected on the site, suggesting a local breeding population (DWR, Laura Patterson, pers. comm. 2005) suggesting that some refuges from non-native bullfrog (*Rana castebeiana*) likely exist within at least some freshwater marsh habitat locations on site. This indicates relatively high potential for other wetland-dependent wildlife (reptiles, amphibians) to establish breeding populations in the isolated "islands" of freshwater marshes within the project site. The irrigation ditches of the project site, however, support abundant populations of predatory bullfrogs. The ditch network is likely to act as bullfrog dispersal corridors, enabling them to access larger blocks of freshwater marsh.

WILDLIFE OF TIDAL FRESHWATER MARSH. The tidal freshwater marshes that fringe the levees of the project site support river otter (*Lontra canadensis*), muskrat (*Ondatra zibethicus*), northwestern pond turtles, and snakes (gopher snake, *Pituophis melanoleocus*; garter snakes, *Thamnophis* sp.; racers*, Masticophis lateralis*). These species have been reported (trapped or observed) from lower Marsh Creek, and are likely to occur throughout the tidal marsh fringes of the project site. In addition, wading birds and wetland perching birds typical of the nontidal freshwater marshes of the site occur in fringing tidal marshes. Double-crested cormorants (*Phalacrocorax auritus*) and diving and dabbling ducks occur in the adjacent sloughs. Virginia rail (*Rallus limicola*), sora (*Porzana carolina*), and California black rail (*Laterallus jamaicensis coturniculus*; see special-status species, below) are known to occur in tidal marshes around the project site. Beaver (*Castor canadensis*) and mink (*Mustela vison*) have been reported from the lower San Joaquin river marshes, and may occur at least intermittently at the project site boundaries. Surveys of the tidal Contra Costa Canal, bordering the southern end of the site, also reported the presence of northwestern pond turtles, racers, gopher snakes, garter snakes and bullfrogs. The resident wildlife populations of fringing tidal marshes are likely to serve as local founder population sources for marsh restoration.

WILDLIFE OF ALKALI MEADOW AND SEASONAL WETLAND FLATS. The shallow seasonally flooded alkali meadow and related seasonal wetland flats and shallow seasonal ponds of the site provide local habitat for dabbling ducks and shorebirds. The invertebrate fauna of the local alkali meadow and flats is not known. The seasonal pools and alkali meadows of adjacent ranches were surveyed for special-status branchiopods (fairy shrimp, tadpole shrimp) and diving beetles because they were considered to be suitable habitat, but only wide-ranging aquatic invertebrates, important for food webs (midge larvae, copepods, cladocerans, corixids, etc.) were found (Arnold 2005, Dexter 2004). No special-status branchiopods (specialized vernal pool invertebrates, many of which are special-status species) have been detected in surveys of adjacent ranchlands, but habitats are potentially suitable. Surveys of similar alkali meadows and shallow seasonal wetland flats on adjacent parcels indicated abundant production of Pacific tree frogs (important prey item for snakes, wading birds). The alkali meadows and shallow seasonal ponds are unlikely to support bullfrogs because of the variable seasonal drainage or desiccation of this habitat in summer. The on-site status of other amphibians species adapted to seasonal wetlands, such as California tiger salamander (*Ambystoma californiense*, see special status species, below) is unknown. Dabbling ducks are likely to utilize rich seasonal production of small aquatic invertebrates for foraging in shallow pools. Tricolored blackbirds may also utilize seasonally flooded alkali meadow habitats adjacent to pastures.

WILDLIFE OF RIPARIAN SCRUB AND WOODLAND. Many bird species use existing riparian habitats. Generalist perching birds that seek shrub or tree canopies use riparian areas, and birds that favor riparian habitats have also been observed frequently in existing riparian woodland and scrub thickets of the site, including many sparrow and warbler species (DWR 2005). Great egrets roost in riparian thickets, favor mature, decadent stands with large branches, dead-top trees and snags (for example, see Figure 3.4-7). Raptors that forage over water or marsh, such as osprey (*Pandion haliaetus*), white-tail kite, and northern harrier (see species of concern, below) are likely to use mature riparian woodland similarly. A number of raptors use this on-site habitat for nesting, including Swainson's hawk, red-shouldered hawk, red-tailed hawk, and great horned owl.

WILDLIFE OF LANDSCAPED AREAS AND BUILDINGS. Barn owls inhabit the developed areas at the south end of the Emerson and Burroughs parcels, where derelict dairy buildings; large, old, and decadent windbreak tree groves; and ruderal vegetation occur together. Bats and swallows (DWR 2004b) have been observed near old dairy buildings, but their local distribution and abundance have not been determined. Swift species may utilize crevices in old buildings as well; DWR bird surveys did report white-throated swifts (*Aeronauts saxatalis*) from the project site (DWR 2004b). Raccoon sign is also evident near old dairy buildings. Commonly, feral domestic cats (*Felis catus*) occur in developed areas, and Norway rats (*Rattus norvegicus*) have been reported (Sycamore Associates 1999). Small mammals (mice, voles) are also likely to occur in old dairy areas. Many habitat-generalist perching birds, including brown-headed cowbirds (*Molothrus ater*), European starlings (*Sturnus vulgaris*), sparrows, American crows (*Corvus brachyrhynchos*), scrub jays (*Aphelocoma coerulescens*), and northern mockingbirds (*Mimus polyglottus*), are common throughout the area and have been observed at the site by multiple observers.

SPECIAL-STATUS TERRESTRIAL AND WETLANDS SPECIES

"Special-status" species is a general term that refers to any species or population segment with substantial, legal, policy, or scientifically valid concern for conservation. A "population segment" refers to geographically or genetically distinguished portion of species, subspecies, or variety. Special status species generally include: federally listed or state-listed endangered, threatened, and candidate species; state-listed "rare" species; species identified as "species of concern" in federal endangered species recovery plans; species ranked as "species of special concern" by the California Department of Fish and Game; species listed as "fully protected" by the California Department of Fish and Game; species ranked as rare, threatened, endangered, or "watch list" in scientifically peer-reviewed non-governmental conservation organizations; and species for which substantial evidence ("fair argument") exists to justify conservation significance at a local, regional, or statewide scale, such as evidence of rarity from published scientific surveys, floras, or research. The species list below (Table 3.4.1) was generated from these sources as well as DFG's California Natural Diversity Database and Special Animals and Special Plants lists, and lists generated from the USFWS website. The project site is located in the southeast corner of the Jersey Island and the northeast corner of the Brentwood USGS quad maps. The government lists were generated for these two quads as well as the two quads to the east, Bouldin Island, and Woodward Island.

Table 3.4.1: Species List for Dutch Slough Area

Species	Status (State/ Federal/ Other*)	Distribution	Habitat	Likelihood of occurrence in project area	Evaluated in EIR?
PLANTS					
Astragalus tener var tener Alkali milk-vetch	/ / CNPS 1B	CA endemic. The historical distribution includes the S. Sacramento Valley, N. San Joaquin Valley, and the E. San Francisco Bay Area.	Associated with clay soils of alkaline flats and meadows, valley and foothill grasslands, and alkaline vernal pools. The blooming period is March through June.	Very low. Presumed extirpated from Contra Costa County. Surveys in 2004 did not find it on the project site.	Yes
Atriplex cordulata Heartscale	/ / CNPS 1B	Historical distribution was valley and foothill grasslands throughout the Sacramento and San Joaquin Valleys and the San Francisco Estuary.	Saline or alkali areas in chenopod scrub, or sandy valley and foothill grasslands. Also alkali soils within and adjacent to seasonal marsh.	Unlikely. Not known from project area.	No
Atriplex coronata var coronata Crownscale	/ / CNPS 4	Central Valley and southern Coast Ranges	Chenopod scrub, alkali areas, valley and foothill grassland; vernal pools. Blooms Mar-Oct.	Low, though known to occur near the project site, in similar habitats. Surveys in 2004 did not find it on the project site.	Yes
Atriplex depressa Brittlescale	/ / CNPS 1B	Endemic to the lower Sacramento and upper San Joaquin valleys and greater San Francisco Bay-Delta.	Chenopod scrub, valley and foothill grassland, meadows, alkaline playas, and vernal pools; occurs in relatively barren alkaline areas which are drier than vernal pools	Unlikely. Not known from project area.	No
Atriplex joaquiniana San Joaquin saltbush	/ / CNPS 1B	W side of the Central Valley from Glenn to Merced counties and in small valleys of the inner Coast Ranges.	Clay, often highly saline, soils in alkaline grasslands and alkali meadows or on the margins of alkali scrub.	Low, though known to occur in Contra Costa County. Surveys in 2004 did not find it on the project site.	Yes

Species	Status (State/ Federal/ Other*)	Distribution	Habitat	Likelihood of occurrence in project area	Evaluated in EIR?
Blepharizzonia plumose var plumose Big tarplant	/ / CNPS 1B	CA endemic. The historical distribution extended from the NW San Joaquin Valley to the E SF Bay region.	Occurs on dry hills and grassy plains. Flowers from July through October	Low, though known to occur in Contra Costa County. Surveys in 2004 did not find it on the project site.	Yes
Carex comosa Bristly sedge	/ / CNPS 2	Widespread through US and Canada.	Invades gaps in marshes, lake shores, and wet meadows, freshwater tidal marshes; often in shallow water or on emergent stumps, floating logs, and floating mats of vegetation.	Low, though there is one CNDDB occurrence in quad adjacent to project area.	No
Centromadia parryi ssp. congdonii Congdon's tarplant	/ / CNPS 1B	Originally distributed through the central and southern portions of western California.	Alkaline grasslands. Blooms June through November.	Unlikely. Not known from project area.	No
Cordylanthus mollis ssp. mollis soft bird's-beak	/E/	Historically found in high tidal marshes along the Petaluma and Napa rivers through the Carquinez Strait to Suisun Bay and the San Joaquin-Sacramento River Delta.	Soft bird's-beak is found predominantly in the upper reaches of salt grass/pickleweed marshes at or near the limits of tidal action. Blooms July-September.	None. No appropriate habitat in the project area. Surveys in 2004 did not find it on the project site.	No
Erodium macrophyllum Round-leaved filaree	/ / CNPS 2	Central Valley, central and south coast and southern Coast Ranges.	Typically grows in valley and foothill grasslands in open habitat on friable clay soils.	Unlikely. No suitable habitat (soils) on site. Surveys in 2004 did not find it on the project site.	No
Eschscholzia rhombipetala Diamond-petaled California poppy	/ / CNPS 1B	Known historically from the inner Coast Ranges and eastern SF Bay region.	Found on nearly barren areas of clay soils.	Highly unlikely. Only known populations are from Livermore National Laboratory and the Carrizo Plain. Surveys in 2004 did not find it on the project site.	No
Hibiscus lasiocarpus Rose-mallow	/ / CNPS 2	Sacramento, San Joaquin Delta.	Well-developed freshwater marsh areas, moist gradual sloping riverbanks, and on low peat islands of the Delta Blooms in August and September.	Unlikely. One historic occurrence at Dutch Slough site, though not currently present. Project unlikely to impact the species. Surveys in 2004 did not find it on the project site.	No.
Isocoma arguta Carquinez goldenbush	/ / CNPS 1B	Endemic to California; known only from Solano, Contra Costa and San Luis Obispo counties.	Valley Grassland, usually occurs in alkaline soils, flats, lower hills	Unlikely. Only Contra Costa County occurrences were along Carquinez Straits. Surveys in 2004 did not find it on the project site.	No
Lasthenia conjugens Contra Costa goldfields (E)	/E/ CNPS 1B	Historically, central CA coast, southern SF Bay, base of Mt. Diablo, inner Coast Range around San Pablo and Suisun bays, and the western Delta.	Vernal pools within open grassy areas in woodlands and valley grasslands from sea level to 1,500 feet.	Unlikely. Very little suitable habitat and not known from near project area.	No

Species	Status (State/ Federal/ Other*)	Distribution	Habitat	Likelihood of occurrence in project area	Evaluated in EIR?
Lathyrus jepsonii var. jepsonii Delta tule pea	/ / CNPS 1B	Occurs on the Delta islands of the lower Sacramento and San Joaquin Rivers and westward through Suisun Bay, Suisun Marsh, Napa River marshes, and the wetlands around south San Francisco Bay.	Occurs along sloughs, riverbanks, and levees affected by tidal fluctuations. Usually near the water's edge on the outboard side of tidal slough levees, but also occupies creek and slough banks in tidal marshes.	Unlikely. Plant is conspicuous and it was not found during plant surveys in 2004. Surveys in 2004 did not find it on the project site.	No
Lilaeopsis masonii Mason's lilaeopsis	Rare/ / CNPS 1B	The intertidal zone of freshwater and brackish marshes of the Delta, Suisun Bay, Suisun Marsh, Mare Island, Carquinez Straits, and the Napa River.	Restricted to the littoral zone of freshwater and brackish marshes. It is most common on actively eroding slough banks, wave cut beaches, or earthen levees with a clay substrate.	Possible. Not found during surveys, but populations fluctuate with bank conditions. Surveys will be conducted again before project construction. Surveys in 2004 did not find it on the project site.	Yes
Limosella subulata Delta mudwort	/ / CNPS 2	Intertidal zone of Suisun Marsh and the Delta.	Grows along eroding banks inundated by the tide, especially along edges of channel islands where competition is limited. Blooms from May - August	Possible. Not found during surveys, but surveys will be conducted again before project construction. Surveys in 2004 did not find it on the project site.	Yes
Oenothera deltoides ssp. howellii Antioch Dunes evening-primrose	T/E/ CNPS 1B	Endemic to the Antioch Dunes, south of the confluence of the Sacramento and San Joaquin Rivers. Not known from any other locations.	Occurs in loose sand and semistabilized dunes and requires freshly disturbed sand for the establishment and survival of seedlings. Blooms March-May and in September.	Not present. The primrose on site is *O. d. cognata*, which has no status as a rare plant.	No
Potamogeton zosteriformis Eel-grass pondweed	/ / CNPS 2	Occurs throughout Canada and N half of US, including scattered areas of CA.	Marshes and swamps. water from shallow to >12' deep; in soft sediment soil	Unlikely. Local CNDDB records are from >50 years ago. Surveys in 2004 did not find it on the project site. Surveys in 2004 did not find it on the project site.	No
Scutellaria galericulata Marsh skullcap	/ / CNPS 2	Throughout US and Canada.. In CA, most occurrences are in NE part of state.	Wet meadows and thickets, shores. Blooms June to September.	Unlikely. Appropriate habitat does not occur on site. Local CNDDB records are from Middle River and channel islands in large Delta channels.	No
Scuttellaria lateriflora Blue skullcap	/ / CNPS 2	Throughout US and Canada.	Wet meadows and thickets, shores.	Unlikely. Local CNDDB record is from >100 years ago. Surveys in 2004 did not find it on the project site.	No
Symphiotrichum lentum (Aster lentus) Suisun aster	/ / CNPS 1B	Sacramento – San Joaquin Delta, Suisun Bay, Suisun Marsh, and the marshes associated with the Napa River north of San Pablo Bay. Populations have been documented in Sacramento, San Joaquin, Solano, Contra Costa, and Napa counties.	Occurs along brackish sloughs and riverbanks affected by tidal fluctuations, and within tidal wetlands.	Present. Known from project site.	Yes

INVERTEBRATES

Species	Status (State/ Federal/ Other*)	Distribution	Habitat	Likelihood of occurrence in project area	Evaluated in EIR?
Apodemia mormo langei Lange's metalmark butterfly	/E	Currently known only from Antioch Dunes.	Always near larval host plant, naked-stem buckwheat (*Eriogonum nudum auriculatum*) which requires dunes.	Unlikely. Remaining sandy areas are not suitable for host plant.	No
Branchinecta conservatio Conservancy fairy shrimp	/E	Currently, scattered populations from Butte to Ventura counties.	Large, deep, cool-water vernal pools in annual grasslands.	Unlikely. No known occurrences in Contra Costa County. Pools on site are not appropriate habitat.	No
Branchinecta longiantenna longhorn fairy shrimp	/E	Eastern margin of central Coast Ranges from Contra Costa to San Luis Obispo counties.	Small, clear pools in sandstone rock outcrops or clear to moderately turbid pools with clay or grass bottoms.	Unlikely. Pools on site are not appropriate habitat.	No
Branchinecta lynchi vernal pool fairy shrimp	/T	Oregon and Central Valley and areas of southern CA	Variety of vernal pool habitats from smaller, clear, sandstone pools to large, turbid, alkaline valley grassland pools,	Low. Alkaline pools may be potential habitat.	Yes
Branchinecta mesovallensis Midvalley fairy shrimp	None	Central California.	shallow vernal pools, vernal swales and various artificial ephemeral wetlands	Possible. Species is fairly common and widespread, so project is not a threat to the species	No
Desmocerus californicus dimorphus valley elderberry longhorn beetle	/T	Streamside habitats below 3,000 feet throughout the Central Valley.	Riparian and oak savanna habitats with elderberry shrubs; elderberry is the host plant.	Possible. At least two elderberries (Sambucus racemosa) on project site.	Yes
Elaphrus viridis Delta green ground beetle and Critical habitat for Delta green ground beetle	/T	Currently known only from the greater Jepson Prairie area of Solano County.	Grassland-playa pool matrix; edges of pools, trails, roads, ditches, and surrounding grasslands.	Unlikely. Not known from project area.	No
Hygrotus curvipes Curve-footed hygrotus diving beetle	None	Known only from Contra Costa, Alameda, and northwest San Joaquin counties.	Occur primarily in temporary, still, alkaline ponds from late winter, to early summer	Possible. Only occurrence in CNDDB is the type locality (unknown year) from Oakley.	Yes
Lepidurus packardi vernal pool tadpole shrimp	/E	Central Valley of California from Shasta County to Tulare County.	Vernal pools and swales containing clear to highly turbid waters. These pools are most commonly located in grass bottomed swales of unplowed grasslands in old alluvial soils underlain by hardpan, or in mud-bottomed pools containing highly turbid water.	Unlikely. No true vernal pools on site.	No
Linderiella occidentalis California linderiella	None	Central Valley of California.	Prefer large, fairly clear vernal pools and lakes. However, they can survive in clear to turbid water with pH from 6.1 to 8.5, and they have been found in very small pools.	Possible. Species is fairly common and widespread, so project is not a threat to the species.	No

Species	Status (State/ Federal/ Other*)	Distribution	Habitat	Likelihood of occurrence in project area	Evaluated in EIR?
Lytta molesta Molestan blister beetle	None	Central California.	Vernal pools	Unlikely. No true vernal pools on site.	No
Perdita scitula antiochensis Antioch andrenid bee	None	Antioch Dunes.	Dune habitats. Collect pollen from just a few species.	Unlikely. Pollen plants are not found on project site. Species may be extinct.	No
AMPHIBIANS AND REPTILES					
Ambystoma californiense California tiger salamander	SC/T	From Sonoma County and the Colusa-Yolo County line, south to Tulare County. In the Coast Range, it occurs from Santa Cruz County south to Santa Barbara County, California.	Primary habitat is annual grasslands, and oak woodlands, but vernal pools and stock ponds in the vicinity are crucial to breeding.	Possible. Known throughout Contra Costa County.	Yes
Rana aurora draytonii California red-legged frog	SC/T	Historically from Redding to NW Baja California; in the Central Valley, the SF Bay area, and along the coast. Today found primarily in drainages of the central Coast Ranges.	Relatively shallow, slow moving water in streams, ponds, ditches.	Unlikely. Closest known populations are south of Antioch in Diablo foothills.	Yes
Anniella pulchra pulchra Silvery legless lizard	SC/	Interior ranges from Contra Costa to San Diego counties.	Found primarily in areas with sandy or loose organic soils or where there is plenty of leaf litter.	Low. Potential habitat on Emerson parcel.	Yes
Emys (=Clemmys) marmorata western pond turtle	SC/	Common in waterways throughout lower elevations of California. Northwestern and southwestern subspecies overlap throughout the Delta and Central Valley.	Ponds, marshes, rivers, streams, irrigation canals with muddy or rocky bottoms in woodlands, grasslands, and open forests.	Present. Species is known to occur, and breed, in the project area.	Yes
Masticophis lateralis euryxanthus Alameda whipsnake	T/T	Restricted to Alameda and Contra Costa counties; fragmented into 5 disjunct populations throughout its range.	Valleys, foothills, and low mountains associated with northern coastal scrub or chaparral habitat; requires rock outcrops for cover and foraging.	Low. No scrub or rocky habitat in project area.	No
Thamnophis gigas giant garter snake	E, FP/E	Central Valley from Fresno to Butte counties.	Sloughs, canals, low gradient streams and freshwater marsh habitats, irrigation ditches, and rice fields where there is a prey base of small fish and amphibians. Requires grassy banks and emergent vegetation for basking, and areas of high ground protected from winter flooding.	Unlikely. Potential habitat in project area, but extensive surveys for the species in areas around the project area have not been successful.	Yes

BIRDS					
Species	**Status (State/ Federal/ Other*)**	**Distribution**	**Habitat**	**Likelihood of occurrence in project area**	**Evaluated in EIR?**
Accipiter cooperi Cooper's hawk	SC/	Occurs throughout CA except in high altitudes. Winters in Central Valley.	Nests in riparian woodlands, gray pine-oak woodlands, mixed conifer forests.	Present. Observed using project site, and known to nest nearby.	Yes
Accipiter striatus Sharp-shinned hawk	SC/	Throughout CA except in highest altitudes. Only winters in the Central Valley.	Forages in woodland openings, brushy pastures, shorelines where bird prey are found.	Possible. Not observed using project site, but it is likely that they do. Known to nest nearby.	No
Agelaius tricolor Tricolored blackbird	SC/	Permanent resident in Central Valley from Butte to Kern county.	Colonial nester near fresh water, in emergent wetland plants but also thickets of willow, blackberry, and wild rose. Feeds in grassland and cropland habitats.	Present. Use project site for foraging; not known to nest on site.	Yes
Ardea herodias Great blue heron	SC/	Common throughout lower elevations of California.	Shallow estuaries, fresh and saline wetlands, ponds and other slow moving waterways. Nests in colonies in large snags or trees.	Present. Forage and roost on project site. No known nesting, although appropriate trees exist on site. Project not expected to negatively impact foraging.	No
Asio flammeus Short-eared owl	SC/	Resident in isolated populations throughout lower elevations of CA. Widespread winter migrant primarily in Central Valley.	Usually found in open areas with few trees such as grasslands, prairies, dunes, meadows, irrigated lands, and wetlands. Needs dense tules or tall grass for nesting.	Present. Observed intermittently during winter; not known to nest in project area, and unlikely that they do despite on site habitat.	No
Athene cunicularia Burrowing owl	SC/BCC	Lowlands throughout CA, including Central Valley.	Level, open, dry, heavily grazed or low stature grassland or desert vegetation with available rodent burrows.	Present. Have been observed on project site, though not during 2005 surveys. Appropriate habitat with ground squirrel burrows is present on project site.	Yes
Buteo regalis Ferruginous hawk	SC/BCC	Does not nest in CA; winters in CA at lower elevations and open grasslands in the Central Valley and Coast Ranges.	Open grasslands, scrub, low foothills surrounding valleys.	Low. Primary concern for the species is loss of nesting sites, but the species does not nest in California.	No
Buteo swainsoni Swainson's hawk	T/BCC	Once found throughout lowland CA, now restricted to portions of the Central Valley and Great Basin regions.	Agricultural areas, (particularly alfalfa fields), juniper-sage flats, riparian areas, and oak savannas.	Present. Nest and forage on and near project site.	Yes
Casmerodius albus Great egret	SC/	Resident throughout CA except for high mountains and deserts.	Fresh and saline emergent wetlands; along the margins of estuaries, lakes, slow moving streams and ditches; and in irrigated croplands and pastures. Nests and roosts in large trees.	Present. Forage and roost on project site. No known nesting, although appropriate trees exist on site. Project not expected to negatively impact foraging.	No

Species	Status (State/ Federal/ Other*)	Distribution	Habitat	Likelihood of occurrence in project area	Evaluated in EIR?
Charadrius montanus Mountain plover	SC/	Does not nest in CA. Winters in Central Valley south of Yuba County and along the central and southern coast.	Occupies open plains or rolling hills with short grasses or sparse vegetation, including agricultural fields.	Low. Not observed at project site, although habitat is suitable. Winter usage likely to be minor and intermittent.	No.
Circus cyaneus Northern harrier	SC/	Occurs throughout lowland CA.	Grasslands, meadows, marshes, and seasonal wetlands and agricultural lands.	Present. Nest and forage on and near project site. May benefit from the project.	Yes
Egretta thula Snowy egret	SC/	Occurs in the Central Valley, coastal lowlands, NE plateau and Imperial Valley.	Shallow estuaries and fresh and saline wetlands, ponds and slow moving waterways. Nests in colonies in large snags or trees.	Present. Forage and roost on project site. No known nesting, although appropriate trees exist on site. Project not expected to negatively impact foraging.	No
Elanus caeruleus White-tailed kite	FPS/	Resident in low elevation areas west of Sierras throughout CA; rarely found away from agricultural areas.	Forages in open grasslands, meadows, farmlands and emergent wetlands. Nests in dense oak, willow, or other tree stands.	Present. Nest and forage on and near project site.	Yes
Eremophila alpestris actia California horned lark	SC/	Found throughout California	Occupies a variety of open habitats, usually where large trees and shrubs are absent.	Present. Observed on site in winter but not in summer. Not known to nest on site, though there is appropriate habitat and the species nests nearby.	Yes
Falco peregrinus anatum American peregrine falcon	E/BCC, (delisted)	Found throughout California. Permanent resident of Coast Ranges. Winters in the Central Valley.	Nests and roosts on protected ledges in high cliffs, usually adjacent to water bodies.	Present. Known to forage on site during the winter; unlikely to nest on or near project site. May benefit from project.	No
Geothlypis trichas sinuosa Saltmarsh common yellowthroat	SC/BCC	Found only in SF Bay Area.	Freshwater marshes in summer and salt or brackish marshes in fall and winter; requires tall grasses, tules, and willow thickets for nesting and cover.	Unlikely. Yellowthroats occur on site throughout the year, but are unlikely to be the subspecies of concern, which is not known from Contra Costa County.	No
Grus canadensis tabida Greater sandhill crane	T, FPS/	In CA, breeds in NE CA, winters in Central Valley.	Winter habitats include annual and perennial grasslands, moist croplands with rice or corn stubble, and open, emergent wetlands.	Possible. Not observed on site in the winter, but known to occur in east Contra Costa County. Does not nest in project area.	No
Icteria virens Yellow-breasted chat	SC/	Throughout North America. Formerly bred throughout CA except in higher mountains and coastal islands. Now, an uncommon summer resident and migrant in coastal CA and in Sierra Nevada foothills.	Uses several habitats, especially riparian thickets and brush.	Present. Species observed and expected to nest on site.	Yes

Species	**Status (State/ Federal/ Other*)**	**Distribution**	**Habitat**	**Likelihood of occurrence in project area**	**Evaluated in EIR?**
Lanius ludovicianus Loggerhead shrike	SC/	Resident and winter visitor in lowlands and foothills of California.	Prefers open habitats with scattered shrubs, trees, fences, posts, utility lines, or other perches.	Present. Occur on project site in winter and summer, and nest on site.	Yes
Larus californicus California gull	SC/	Western US and Canada. In CA primarily in winter where it frequents coastal areas and interior lowlands.	Inland, frequents lacustrine, riverine, and cropland habitats, landfill dumps, and open lawns in cities. Often abundant in CA in winter.	Possible. Not observed on site, but likely to forage there at times. Does not nest in project area. May benefit from project.	No
Laterallus jamaicensis californicus California black rail	T, FPS/ BCC	Permanent resident in the SF Bay/Delta region and in isolated areas of the Sierra foothills and S CA. Winter resident in central and southern coastal areas.	Fresh, brackish or tidal marshes with emergent vegetation.	Possible. Has been observed or heard on site.	Yes
Melospiza melodia maxillaries Suisun song sparrow	SC/BCC	Restricted to western edge of Delta between the cities of Vallejo and Pittsburg near Suisun Bay.	Brackish and tidal marshes with tall emergent plants.	Unlikely. Song sparrows occur on site throughout the year, but are unlikely to be the subspecies of concern. Not known to occur in project area.	No
Numenius americanus Long-billed curlew	SC/BCC (breeding)	Nests in NE CA. Winters along the coast and interior valleys west of the Sierras.	In winter frequents coastal beaches and mudflats and interior grasslands and ag fields.	Known to forage on site in winter. Does not nest in project area.	No
Pandion haliaetus Osprey	SC/	Worldwide distribution. In CA, breeds near lakes from Cascades to Lake Tahoe and along the coast S to Marin County. Winters along coast and slightly inland south from Sonoma County.	Associated strictly with large, fish-bearing waters, primarily in mixed conifer habitats.	Possible. Observed flying over and perched on site, but not known to forage or nest on or near the project site.	No
Pelecanus erythrorhynchos American white pelican	SC/	Present in much of W and Central N America. Throughout SF Bay Area and Delta after breeding.	Coastal areas, large lakes and other water bodies.	Possible. Are known to fly over the project site, but no current use due to limited open water habitat.	No
Phalacrocorax auritus Double-crested cormorant	SC/	Coastal areas of North America, and inland breeding. In Ca, primarily coastal areas, NE part of state, and Central Valley.	Inland lakes, in fresh, salt, and estuarine waters.	Present. Roost in large riparian trees and snags on site, and forage in adjacent sloughs. No known nesting on project site.	No
Plegadis chihi White-faced ibis	SC/	Uncommon summer resident in sections of S CA, rare visitor in the Central Valley, and more common and widespread during winter migration.	Prefers freshwater marshes with emergent vegetation. Commonly forages in winter in flooded ag fields such as rice.	Possible. Have been observed on site. Primary concern is loss of nesting sites, but it is not known to nest in or near project site.	No
Rallus longirostris obsoletus CA clapper rail	E, FPS/E	Salt and brackish marshes of SF Bay to Suisun.	Restricted to salt marshes and tidal sloughs.	Unlikely. No habitat at or near project site.	No

Species	Status (State/ Federal/ Other*)	Distribution	Habitat	Likelihood of occurrence in project area	Evaluated in EIR?
Riparia riparia Bank swallow	T/	Primarily occurs along Sacramento River from Tehama Co. to Sacramento Co., Feather and lower American rivers.	Nests in bluffs or banks, usually adjacent to water, where the soil is sand or sandy loam.	Low. Not observed on site, but may use it in transit between nesting and wintering areas. No nesting habitat on or near site.	No
Sterna antillarum browni California lest tern	E, FPS/E	Nests on beaches along SF Bay and along S CA coast.	Nests on beaches, mudflats; forages on adjacent surf line, estuaries, or the open ocean.	Low. Do not occur in area in significant numbers; not observed on site. May benefit from project.	No
Sterna caspia Caspian tern	/BCC	Breeds in scattered locations across North America, and winters along the Pacific Coast from southern California southward to Guatemala, and along the Atlantic and Gulf coasts.	Breeds in wide variety of habitats along water, During migration and winter found along coastlines, large rivers and lakes. Roosts on islands and isolated spits.	Low. Observed flying over site, but not using open water. Do not nest in project area. May benefit from project.	No
MAMMALS					
Antrozous pallidus Pallid bat	SC/	Arid and semi-arid regions throughout N Mexico and the W US. Occurs throughout CA except in Sierras and the NW part of the state, most abundantly in deserts.	Most common in open, dry habitats with rocky areas for roosting. Roost in rock crevices, trees, buildings, and bridges in arid regions.	Possible. CNDDB has records of the species near Antioch, there is potential habitat for the species at the project site.	Yes
Corynorhinus townsendii townsendii Townsend's western big-eared bat,	SC/	Common in W US. Throughout CA in numerous habitats except subalpine and alpine areas.	Most abundant in moist habitats. Roosts primarily in mines and caves, but also in buildings and other human structures.	Possible. East Contra Costa HCP reports no published records of the species in Contra Costa County.	Yes
Lasiurus blossevillii Western red bat	SC/	Locally common from Shasta County to Mexican border, west of Sierra crest and deserts. Winter range includes western lowlands and coastal regions south of SF Bay.	Roosts in trees or shrubs in forests and woodlands from sea level up through mixed conifer forests. Common in riparian areas. Feeds over grasslands, shrublands, open woodlands and forests, and croplands.	Possible. Known to occur in general area. (CNDDB records from Brannan Island and Antioch).	Yes
Lasiurus cinereus Hoary bat	SC/	Throughout North America. In CA, throughout the state.	May be found in any location in CA. Roosts in trees	Possible. Known to occur in general area. (CNDDB records from Brannan Island).	Yes
Reithrodontomys raviventris salt marsh harvest mouse	E, FPS/E	Marshes around San Francisco, San Pablo, and Suisun bays.	Saline and brackish marshes with thick cover of halophytic plants with layered structure.	None. No suitable habitat.	No
Vulpes macrotis mutica San Joaquin kit fox	T/E	Mainly in San Joaquin Valley, but also in interior valleys, plus areas of Contra Costa County	Favors grasslands and scrub habitats with fine textured soils.	Unlikely. Little suitable habitat in the project area.	No

*E=Endangered under state or federal Endangered Species Act

T=Threatened under state or federal Endangered Species Act

SC=California Special Concern species

FPS=California Fully Protected Species

BCC=USFWS Bird of Conservation Concern

CNPS = California Native Plant Society rare plant lists

1A. Presumed extinct in California

1B. Rare or endangered in California and elsewhere

2. Rare or endangered in California, more common elsewhere

3. More information needed

4. Plants of limited distribution

SPECIAL-STATUS PLANT SPECIES. A large number of special-status plant species have some potential to occur on the project site, in areas that may be affected by the project alternatives, or in the project vicinity. Only a small number of special-status plant species, however, are likely to occur, and only one sensitive species was found in botanical surveys conducted by DWR in 2004. The sensitive plant species listed in Table 3.4.1 are based on regional lists, the CNDDB, USFWS lists, and databases based on U.S. Geological Survey quadrangles. The results of database searches and field surveys performed for similar, adjacent parcels of the East Cypress Corridor project sites (Lesher, Biggs, Dal Porto parcels) and Big Break Regional Shoreline were considered in evaluating sensitive species and likelihood of occurrence.

Plant surveys of the areas inside project site levees, along Marsh Creek bordering the project site, and along all the exterior levees were performed by DWR staff in 2004 (DWR 2004a). These surveys occurred throughout the spring and summer and specifically targeted several sensitive plant species. Targeted rare plant species were based on a CNDDB search of the Jersey Island and Brentwood USGS quads. (The lists generated for this EIR included Jersey Island and Brentwood, plus the two adjacent quads, Bouldin Island and Woodward Island.) Many special-status plant species require focused surveys by expert botanists (following survey guidelines for rare plants by California Department of Fish and Game or the California Native Plant Society) for detection. This DEIR considers all available information, including DWR plant surveys, wetland delineations, and botanical surveys of neighboring sites with similar soils, topography, and vegetation, to assess the likelihood of occurrence for special-status plant species.

Criteria for recognizing the special status of plants are varied. Plants listed as threatened or endangered under State and Federal Endangered Species Acts have the strongest legal protection, and are often, but not always, the rarest or most at risk of extinction. The California Native Diversity Database ranks plant species according to legal protected status as well as other classes of rarity or threat. The California Native Plant Society (CNPS) maintains a scientifically peer-reviewed and updated list (Inventory) of plants with various ranks for rarity or threat, as well as provisional "watch" status for species about which limited information is available about current distribution and abundance. CNPS also has published a broader set of conservation criteria including limits of species' ranges, regional rarity, isolated remote populations, or other biogeographic considerations for native plants of Alameda and Contra Costa County (Lake 2004). The U.S. Fish and Wildlife Service also treats plant "species of concern" in recovery plans – species at foreseeable risk of decline or future threat – as the focus of conservation planning efforts. Only federal and state-listed species have special legal protected status, but EIRs may evaluate the special status any species with a "fair argument" (valid scientific or conservation policy reason) for significant impacts.

Special-status plant species that are known to occur, or have an appreciable risk of occurring on the project site, or are likely to be otherwise affected substantially by project alternatives, are discussed in detail below.

ALKALI MILK-VETCH, ASTRAGALUS TENER VAR. TENER. (CNPS list 1B)

Alkali milkvetch is a low-growing annual herb in the pea family, related to desert locoweeds. It occurs rarely in alkaline to subsaline seasonal wetlands (alkaline vernal pools and flats, playa, and similar habitats with sparse cover and seasonally flooded and dry flats). Suitable artificial habitat occurs on the project site (alkali meadow, seasonal pond edges), but the species has been presumed extirpated in Contra Costa County. It has, however, been rediscovered at other localities within its historic range after being presumed extirpated, and in former agricultural lands that reverted to alkali-subsaline seasonal wetlands after farming was ceased. As an annual seasonal wetland species, it may necessarily emerge in unfavorable years (hydrology, competition may inhibit it), or it may emerge and reproduce erratically and intermittently. It may persist as long-dormant soil seed banks, or it may be dispersed long distances very rarely. Because the 2004 surveys did not target this plant, and because the plants in the alkali habitats are likely to differ from year to year, more intensive, surveys would be required for detection.

SAN JOAQUIN SALTBUSH, ATRIPLEX JOACHINIANA (CNPS list 1B,) and other rare Atriplex species: Crownscale, *Atriplex coronata* var. *coronata* (CNPS list 4); Brittlescale, *Atriplex depressa* (CNPS list 1B); and Heartscale, *Atriplex cordulata* (CNPS list 1B).

A suite of annual, low, spreading forbs in the amaranth family (traditionally chenopod or goosefoot family) in the genus *Atriplex* are native to alkaline to subsaline seasonal wetland habitats (alkali meadow or grassland, alkali scrub, playa, vernal pools), and occur in the Sacramento-San Joaquin Valley. They may occur in suitable subsaline to alkaline artificial seasonal wetland habitats at the project site, but none have been detected in general plant surveys. Many *Atriplex* species are structurally similar in aspect, and resemble common, abundant species such as spearscale, *A. triangularis* (syn. *A. prostrata*), which may obscure detection of rarer species. They generally have light buoyant fruits with small seeds that can be dispersed by water or waterfowl, and may spontaneously colonize unoccupied habitats. One of these uncommon to rare species, crownscale (*A. coronata* var. *coronata*) was unexpectedly discovered in small patches of alkali meadow at the nearby Dal Porto South parcel during focused surveys in 2004, in habitat substantially similar to seasonal wetlands that occur at the Dutch Slough project site. This indicates that alkali meadow and alkaline-subsaline seasonal wetlands supporting *Atriplex* species at Dutch Slough parcels are likely suitable habitat for crownscale and related native rare *Atriplex* species. It also suggests that there is a small chance that crownscale and other special-status *Atriplex* species could establish in Dutch Slough alkali meadow/seasonal wetland patches, or may occur there now undetected.

BIG TARWEED, *BLEPHARIZONIA PLUMOSA VAR. PLUMOSA*. (CNPS List 1B).

Big tarweed is a glandular, strongly scented coarse gray-green annual forb of arid grasslands. It occurs in the northwestern San Joaquin Valley, including portions of Contra Costa County. It could potentially occur on the project site, and may be difficult to detect in surveys because of abundant yellow-flowered, summer-blooming annual aster family species. It was not observed on the site in general plant surveys in 2004 (DWR 2004a). No populations are known from the project vicinity, and it is considered unlikely to occur.

MASON'S LILAEOPSIS, *LILAEOPSIS MASONII*. (CNPS List 1B).

Mason's lilaeopsis is a highly inconspicuous, creeping forb in the carrot family. This rare species occurs mostly in low, turfy, sparsely vegetated, or otherwise bare tidal marsh substrates of eroding marsh banks, but it also sometimes colonizes patches of mud on rock slope protection. It is geographically restricted to northern San Pablo Bay east through the Delta. The status of Mason's lilaeopsis in the tidal marsh banks bordering Dutch Slough, Little Dutch Slough, and Emerson Slough is uncertain because no survey information is available. . Some potentially suitable habitat likely exists along the outer edges of fringing tidal marsh bordering the project site. The water-side levees around the Dutch Slough parcels were surveyed from the water during 2004, and Mason's lilaeopsis was not found. Further surveys will be conducted prior to any water-side levee disturbance.

DELTA MUDWORT, *LIMOSELLA SUBULATA*. (CNPS List 2). Delta mudwort is a tiny and highly inconspicuous annual plant. It occurs in wet mud or sand banks and flats within freshwater tidal marshes of the Delta. It also occurs in Europe, but California populations are presumed to be native. Potential habitat for Delta mudwort may occur along the fringing tidal marsh banks of Emerson Slough, Little Dutch Slough, and Dutch Slough. The water-side levees around the Dutch Slough parcels were surveyed from the water during 2004, and Delta mudwort was not found. Further surveys will be conducted prior to any water-side levee disturbance.

SUISUN ASTER, *SYMPHYOTRICHUM LENTUM* *(syn. Aster lentus,* CNPS List 1B)

Suisun aster is a tall, erect, perennial forb with creeping below-ground stems that forms colonies near the upper edges of brackish or alkaline perennial marshes, particularly tidal marshes of the Suisun Marsh area and the western Delta. Suisun aster closely resembles, and sometimes intergrades with, the more common aster, *Aster chilense*. It also can establish in non-tidal freshwater or slightly brackish, alkaline marshes. Local populations often occur as multiple clonal colonies near each other. Isolated colonies composed of single clones (genetic individuals) are unlikely to reproduce successfully by seed.

DWR detected nine colonies of Suisun aster along the fringing tidal marshes of the outer levees of Emerson Slough and Marsh Creek, bordering the Emerson Parcel (DWR 2004a). No colonies of this species were detected in non-tidal freshwater marshes on the site. Essentially similar suitable habitat occurs along the fringing marshes of other parcels of the Dutch Slough project site as well. Ditch edges and some non-tidal freshwater marshes could potentially support Suisun aster, but environmental factors severely restrict the likelihood of viable perennial populations there (frequent disturbances from ditch maintenance, extreme fluctuation in water levels of freshwater non-tidal marshes, and high competition from tules, willows, and blackberry along narrow, steep marsh edges).

The Marsh Creek populations of Suisun aster along the western Emerson Parcel levee may have been disturbed or extirpated along reaches of Marsh Creek that were subjected to channel maintenance (vegetation clearing, dredging for flood conveyance) in 2005. A few additional populations of Suisun aster are known to occur in the project vicinity (Antioch Dunes National Wildlife

Refuge shoreline, Big Break, to Sand Mound Slough. Natural long-distance dispersal of Suisun aster and successful colonization is probably very infrequent. Suisun aster and other perennial asters with creeping below-ground stems are easily propagated by seed or vegetative clonal division. The likelihood of artificially establishing propagated populations in natural or restored marshes, however, is uncertain. Established perennial colonies are likely to persist for long periods of time unless disturbed.

SPECIAL-STATUS WILDLIFE SPECIES. A number of special-status wildlife species have some potential to occur on the project site or within the project vicinity, in areas that may be affected by the project alternatives. Only a small number of special-status wildlife species, however, are likely to occur in existing Project-site habitats. The assessment of wildlife species impacts is based primarily on the following sources of information: (1) on-site general bird surveys by DWR staff biologists (DWR 2005b), and Natural Heritage Institute (NHI 2004); (2) reports and surveys of special-status wildlife species at Marsh Creek, Contra Costa Canal, and adjacent ranches with similar habitats (Arnold 2005, Dexter 2005, Sycamore Associates 2004, 2005; Swaim 2004, 2005).

Criteria for recognizing the special status of wildlife species are varied. Species listed as threatened or endangered under State and Federal Endangered Species Acts, or the California Fish and Game Code (fully protected species section) have the strongest legal protection, and are often, but not always, the rarest or most at risk of extinction. The California Natural Diversity Database ranks wildlife species according to legal protected status as well as other classes of rarity or threat.

SPECIAL-STATUS BAT SPECIES.

The abandoned agricultural buildings on the site, particularly at the Emerson parcel, provide potential roosting and nursery habitat for some special-status (species of concern or special concern) bat species, such as western red bat (*Lasiurus blossevillii)*and hoary bat (*Lasiurus cinereus*). Other possible species, though less likely to occur because of their range or habitat needs are Townsend's western big-eared bat (*Corynorhinus townsendii townsendii*), western mastiff bat (*Eumops perotis californicus*), small-footed myotis (*Myotis ciliolabrum*), long-legged myotis (*Myotis volans*), and Yuma myotis (*Myotis yumanensis*). Bats are site-faithful, and are likely to return to successful breeding or roosting sites, which aids in their detection. The adjacent open pastures and ruderal lands interspersed with wetlands provide ample potential foraging habitat for bats. Large old trees and snags (dead standing trees) associated with windbreak and ornamental plantings of the historic ranches may also provide cavity habitat suitable for bats. Bats are likely to occur in some or most of the suitable habitats provided by old trees and abandoned buildings on site. Neither an inventory of bat habitat nor surveys for populations have been done to determine their presence or absence.

PALLID BAT, *ANTROZOUS PALLIDUS*. (California species of special concern)

The pallid bat occupies a wide variety of habitats including grasslands, shrublands, woodlands, and forests from sea level up through mixed conifer forests. It is most common in open, dry habitats with rocky areas for roosting. It is a yearlong resident in most areas of California. Pallid bats feed on a wide variety of insects and arachnids, taking them primarily from foliage or off the ground.

Daytime roosts are in caves, crevices, mines, and occasionally in hollow trees or buildings. Few hibernation sites are known, but the species probably uses rock crevices. Maternity colonies form in early April and commonly have fewer than 100 individuals. Mating occurs from October to February with delayed fertilization, and young are born from April through July.

The species is very sensitive to disturbance of roost sites, which are essential for metabolic economy, juvenile growth, and as night roosts to consume prey.

TOWNSEND'S WESTERN BIG-EARED BAT, *CORYNORHINUS TOWNSENDII TONSENDII*. (California species of special concern)

Townsend's western big-eared bats require caves, mines, tunnels, buildings or other human-made structures for roosting. Small moths are the primary food, and they are caught in flight using echolocation, or are gleaned from foliage. Small groups, usually less than 100 individuals, form a maternity roost in relatively warm caves, tunnels, or buildings. The species is relatively sedentary, moving only short distances to hibernation sites. Hibernation occurs from October through April. Mating occurs prior to hibernation, fertilization is delayed, and birth of a single young occurs during May or June.

The species is extremely sensitive to disturbance of roost sites, and abandonment of nursery roosts may have led to its sharp decline in California.

***WESTERN RED BAT, LASIURUS BLOSSEVILLII*.** (California species of special concern)

Western red bats typically roost singly in the foliage of broad-leafed trees such as sycamores, cottonwoods, walnuts, and fruit trees. Roosts are shaded from above and on the sides, generally three to many feet off the ground, and open below, thus allowing these bats to drop into flight. They forage on moths, beetles, flying ants, and occasionally on ground-dwelling crickets, and are known to forage near streetlamps. Individuals usually remain within about 1,000 yards of their roosts. Most young are born between mid-May and June. In late fall, western red bats are thought to migrate to and hibernate in the southern part of their range. Threats to the species include loss of riparian forests and use of pesticides in agricultural areas. The CNDDB has recent records from Brannan Island State Park.

HOARY BAT, *LASIURUS CINEREUS*. (California species of special concern)

This bat is migratory and moves northward in spring and southward in winter. Like its relative the red bat, with which it frequently associates, the hoary bat is more or less solitary and frequents wooded areas where it roosts in the open by hanging from a branch or twig. Hoary bats are thought to prefer trees at the edge of clearings, but have been found in trees in heavy forests, open wooded glades, and shade trees along urban streets and in city parks. The chief food is moths, although they are known to also eat beetles, flies, grasshoppers, termites, dragonflies, and wasps. One to four young are born from mid-May into early July. From August through October, hundreds of hoary bats may travel together during fall migration. In the United States, most apparently overwinter in coastal areas, along the West Coast from San Francisco south. The CNDDB has recent records from Brannan Island State Park.

SPECIAL-STATUS BIRDS

SPECIAL-STATUS RAPTORS. Numerous special-status raptor species are known to occur at the project site or in its vicinity, and most may be affected by project construction activities and long-term habitat conversion. Species that are likely to be affected are discussed below.

COOPER'S HAWK, ***ACCIPITER COOPERI*****.** (California species of special concern).

Cooper's hawks occur throughout the US and Mexico, but numbers are declining in most areas. Suitable habitat areas include deciduous, evergreen, and mixed forests; open woodland habitats; and urban and suburban areas. They are usually found in areas with dense tree cover, and near open water. Nests are placed high in trees, and they will nest in close proximity to human activity. Cooper's hawks primarily eat birds, but will also take small mammals.

Breeding begins in March, and most chicks are fledged by July. In California the species is resident, with little migratory or seasonal movements.

Population declines have been attributed to the use of DDT, and habitat loss, mainly loss of lowland riparian areas.

Cooper's hawks have been observed at the project site and are reported to nest nearby. The project site's riparian woodlands, thickets, and tree plantings (windrows, residential ranch ornamental trees) provide suitable nesting habitat.

BURROWING OWL, ***ATHENE CUNICULARIA HYPUGEA*****.** (California species of special concern)

Burrowing owls in California historically ranged throughout the Central Valley, in suitable habitat in coastal areas from Marin County to the Mexican border, and in lower numbers in desert areas of the northeastern and southeastern portions of the state. Throughout the vast majority of the burrowing owl's range in California, breeding owls now persist in only small, declining populations of birds that are highly susceptible to extirpation.

Burrowing owls are found in open, dry grasslands, agricultural and range lands, and desert habitats; they are usually associated with burrowing animals such as ground squirrels. Burrowing owls tend to be opportunistic feeders, with large arthropods, mainly beetles and grasshoppers, comprising a large portion of their diet. The species is primarily crepuscular (active at dusk and dawn), but will hunt throughout a 24-hour period.

Burrowing owls may use a site for breeding, wintering, foraging, and/or migration stopovers. Breeding occurs from March through August, with the peak activity in April and May. In addition to natural and artificial burrows, the owls may use artificial structures such as culverts, piles of concrete, large rock, and man-made and natural woodpiles as refugia.

The species has been reported to occur on the site (though they were not observed during 2005 surveys by DWR wildlife biologists), and they are known to forage and breed in similar habitats in adjacent sites (now under residential development; Sycamore Associates 2004, 2005, 2005d). They have also been observed nesting on the banks of the Contra Costa Canal adjacent and south of the project site (Swaim 2004). Extensive foraging and nesting habitat occurs on the project site, which supports extensive ground squirrel burrows, short grazed vegetation, disturbed ditch banks, and large populations of small mammal and insect prey. Most pasture and ruderal habitat that is not seasonally flooded is likely to provide potential suitable habitat for burrowing owls.

SWAINSON'S HAWK, ***BUTEO SWAINSONI*****.** (federal bird of conservation concern, state listed as threatened).

Swainson's hawks were once found throughout lowland California but today are restricted to portions of the Central Valley and Great Basin regions where suitable nesting and foraging habitat is still available. Suitable foraging areas include native grasslands or lightly grazed pastures, alfalfa and other hay crops, and certain grain and row croplands. Unsuitable foraging habitat includes crops such as vineyards, orchards, certain row crops, rice, corn and cotton crops. Suitable nest sites may be found in mature riparian forest, lone trees or groves of oaks, other trees in agricultural fields, and mature roadside trees. In the summer months, Swainson's hawks primarily eat insects, birds, and small mammals. During migration and in the winter, the hawk's diet consists almost entirely of insects.

Within California, Swainson's hawks begin nesting in late March and the young usually leave the nest (fledge) by July. Nests are constructed in trees, shrubs, or on utility poles at heights of 4 to 100 ft. above the ground. Migratory flocks begin to form in late August and September and most birds are on the wintering grounds in Mexico by November. In the spring, they begin returning north to California in March.

The populations of Swainson's hawks have declined by 90% since the 1940's due to the loss of nesting habitat. In the 1980's there was an estimated 375 pairs within California, but not all pairs nested.

Swainson’s hawks have been observed nesting and foraging on the project site in multiple years, and Swainson’s hawks have been documented nesting and foraging in the project vicinity (DWR 2004b, Sycamore Associates 2004, 2005; Sycamore Associates 2005c). Suitable habitat with ample prey base for Swainson’s hawk occurs at the project site, but has declined substantially in the project vicinity because of land use conversion from agriculture to residential/urban development. A 2005 Analysis of cumulative impacts to habitat availability indicate that recent development adjacent to the project site removed over 2500 acres of suitable habitat, but over 15,000 acres will remain available for the foreseeable future (25 years), assuming stable rates of land use conversion.

WHITE-TAILED KITE, *ELANUS LEUCURUS*. (California fully protected species).

California contains the largest number of white-tailed kites in North America. The species is found in virtually all lowlands of California west of the Sierra Nevada range and the southeast deserts. It is a common resident of the Central Valley and along the entire CA coast. White-tailed kites occur in lowland grasslands, agriculture, wetlands, oak-woodland and savannah habitats, and riparian areas associated with open areas.

Kites feed almost exclusively on mice, and occurrence of kites is tied to prey abundance. Habitats with larger prey populations are more suitable; ungrazed lands support higher prey populations than grazed lands. Summer habitat preferences to include riparian zones, dry pastures, alfalfa, orchards, and rice stubble fields. Plowed field were avoided in both winter and summer.

Kites nest in shrubs and trees of various species; they will nest in single isolated trees or trees within large stands. Nest-building occurs January through August; peak fledging probably occurs in May and June with most fledging complete by October.

Kites have been observed foraging at the project site, and suitable potential foraging habitat with ample prey base is widespread there (DWR 2004b). Suitable breeding habitat also occurs on site (small tree groves, windbreak tree plantings, riparian woodland patches), and the species was observed nesting on the site during bird surveys in 2005.

NORTHERN HARRIER, *CIRCUS CYANEUS*. (California species of special concern)

Northern harriers, formerly called marsh hawks, occur in open fields, grasslands, prairies, and marshes from Alaska, northern Canada, and Maritime Provinces south to southern California, Arizona, Kansas and Virginia for breeding. In California, some birds are year-round residents, while others migrate into the state in the winter.

This species breeds primarily in open wetland areas, foraging widely in wet pastures, dry uplands and desert shrub habitat. Densest populations are typically associated with large tracts of undisturbed habitats dominated by thick, low vegetation. Harriers feed on mice, rats, snakes, frogs, and other small animals by sound as well as sight. Adult males migrate later in fall, earlier in spring, than females and immatures.

Breeding occurs April to September. Northern Harriers nest on the ground in open, treeless areas such as marshes, wet meadows, and dry grasslands. Nests are typically placed in patches of dense vegetation such as cattails, usually close to water or on mats of vegetation raised above water level. Harriers are nomadic, and both breeding and nonbreeding densities may vary in response to local changes in prey availability and habitat condition.

Loss of wetland habitat poses an ongoing threat to breeding and wintering populations. Conversion of native grassland to irrigated agriculture has contributed to local population declines, and remains a threat in some areas. Prey availability may be reduced by widespread use of insecticides and rodenticides, as well as by overgrazing of pastures. They have been observed foraging and nesting on the project site, and are likely to forage also over adjacent tidal marshlands at Big Break (DWR 2004b).

SPECIAL-STATUS PERCHING BIRDS

TRICOLOR BLACKBIRD, *AGELAIUS TRICOLOR*. (California species of special concern).

The tricolored blackbird is a California endemic. Most breeding occurs in California's Central Valley from April through July. A large portion of the population is believed to overwinter in the Sacramento - San Joaquin Delta.

Tricolored blackbirds are colonial nesters. Traditional nesting habitat consists of inundated dense cattail or tule marshes, but nesting also occurs in upland habitats such as agricultural grain fields, thickets of blackberry, or patches of thistle or stinging nettle. Foraging mostly occurs in upland habitats, especially in dry grassland and pastures; heavily grazed fields are usually not suitable foraging habitat. Winter roosting habitat consists mostly of dense deepwater marshes and nearby trees.

During the nonbreeding season, tricolored blackbirds forage on insects, grains and seeds. When provisioning offspring, however, adults forage almost entirely on insects, so breeding habitat selection is most likely primarily a function of insect densities. Colonies, therefore, may occur regularly in some locations but sporadically in others. Breeding tends to be highly synchronized within colonies where active nest densities may reach 3 or more per square meter. Colonies range in size from less than one hundred to tens of thousands of breeding adults.

Because tricolored blackbirds are colonial, they require concentrated food resources within a manageable commuting distance from the colony. The size of the foraging arena, therefore, varies with colony size and insect abundance. Foraging arenas of successful colonies may range in size from a radius of 2-3 miles to as many as 8 miles.

Declines in numbers of tricolored blackbirds are primarily due to loss of both breeding and foraging habitat.

Extensive suitable foraging and breeding habitat for tricolor blackbirds occurs in the complexes of irrigated dairy pasture and interspersed seasonal wetlands with nontidal freshwater marsh at the project site. Tricolor blackbirds are highly colonial, and tend to occur in large numbers in occupied habitat. During bird surveys in 2005, the species was intermittently abundant on the site in the winter, but there was no breeding.

CALIFORNIA HORNED LARK, *EREMOPHILA ALPESTRIS ACTIA.* (California species of special concern)

The California horned lark is a yearlong resident in California and can be found in a variety of open habitats, from grasslands on the coast to alpine dwarf-shrub habitat above treeline. They occur in short-grass prairie, bald hills, mountain meadows, open coastal plains, fallow grain fields, and alkali flats. The species forages primarily on insects and other invertebrates during breeding, and adds seeds and other plant matter to its diet in other seasons.

Breeding occurs from March through July, with peak activity in May. Nests are built on the ground in the open. Territories are maintained only during the breeding season, after which large flocks forage and roost together.

Continuing threats to the species include habitat destruction and fragmentation. Pesticides have been shown to poison and kill horned larks, and nests are lost to mowing, plowing and other agricultural practices.

Horned larks have been observed on site in winter but were not observed there in summer (DWR 2004b). They are known to nest in the project vicinity, but no nests are known to occur at the project site, which does support suitable nesting and foraging habitat.

LOGGERHEAD SHRIKE, *LANIUS LUDOVICIANUS* (California species of special concern)

A common resident and winter visitor in lowlands and foothills throughout California. Prefers open habitats, including agricultural areas, with scattered shrubs, trees, posts, utility lines or other perches from which to search for prey. Feeds primarily on large insects, but also takes small vertebrates.

Lays eggs from March into May; young become independent in July or August. Well-concealed nests are built in dense shrubs or trees.

Throughout its range in North America, populations are declining due to loss of habitat. However, numbers in California are fairly stable.

Loggerhead shrikes forage on areas of the project site where abundant, productive terrestrial foraging habitat (ruderal, pasture, riparian woodland) exists. They also nest on site. No estimates of local loggerhead shrike population size are available, but relatively few have been observed (DWR 2004b).

YELLOW-BREASTED CHAT, *ICTERIA VIRENS*. (California species of special concern)

The yellow-breasted chat is a summer resident and migrant of the northwestern state, coastal areas, scattered desert areas, and in the foothills of the Sierra Nevada. In California, chats require dense riparian thickets of willows, vine tangles, and dense brush associated with streams, swampy ground and the borders of small ponds (Small 1994). Some taller trees (i.e., cottonwoods and alders) are required for song perches. Chats feed on both berries and insects. They arrive in California between March and May. Breeding occurs from early May into early August, and they depart the breeding grounds in August and September; some stragglers remain into October. Occurrence of the species is poorly documented due to the species' secretive nature; it goes largely undetected once singing ceases in mid-July.

Yellow-breasted chat (a large warbler) is known to occur in riparian habitats on the project site (DWR 2004b).

CALIFORNIA BLACK RAIL, *LATERALLUS JAMAICENSIS COTURNICULUS*. (listed as threatened and fully protected species).

California black rails are year-round residents in the Bay-Delta region, and generally inhabit brackish to freshwater tidal marshes with ample high marsh that remains emergent most of the monthly spring-neap tidal cycle, and has ample high tide cover near tidal channel banks. Tidal channels usually correspond closely with patterns of territory and nesting. Occupied marshes are those with vegetation that provides dense cover from predators, but are fairly open at ground level to provide rails opportunities for foraging and nesting. They forage primarily on invertebrates (insects, mollusks, amphipods) and some seeds.

Breeding occurs from February through July. Nest location is determined by the size of the wetland, cover density, wetland plant species composition, water levels and food availability. The nest is concealed in dense vegetation at ground level or a few inches above.

California black rails are reported to occur in fringing tidal marshes adjacent to the project site, and they are known to occur in tidal marshes in the project vicinity. No black rails were detected on the project site by DWR biologists during surveys (DWR 2004b), but they have previously been reported from tidal marshes in the project vicinity (NHI 2004). Virginia rails and sora, which inhabit similar habitats, have been reported previously from the Emerson and Burroughs parcels (Sycamore Associates 1999). Black rail populations near the site are of critical importance as founder source populations for colonizing restored habitat of the project.

SPECIAL-STATUS AMPHIBIANS

CALIFORNIA TIGER SALAMANDER, *AMBYSTOMA CALIFORNIENSE*. (federally listed as threatened; California species of special concern)

California tiger salamanders are rare amphibians of grasslands and oak savannahs, with patchy geographic distribution from Sonoma County to the Central Valley, and south to Santa Barbara. They inhabit shallow seasonal ponds or pools (including alkali meadows, playa, and vernal pools) during larval stages and breeding periods, and move to mammal burrows in grasslands during the dry season. Their population viability depends on ponds of sufficient duration for breeding and larval development, but with summer desiccation to restrict predatory fish and bullfrogs. They are probably excluded from freshwater marshes with stable local predator populations. Long-distance dispersal across non-habitat is probably exceedingly rare. Most extant populations are probably fragmented remnants of former widespread local populations.

The nearest known population to the project site occurs at the Sand Creek and Cowell Ranch State Park areas, miles from the project site, and separated by urban barriers to dispersal. It is unknown whether old, relict populations occur within seasonal wetland complexes (alkali meadow, seasonal pools, flats) on the site, independent of (unlikely) dispersal from offsite populations. Similar seasonal wetland pools and alkali meadows occurred on similar irrigated pastures of neighboring ranches, where periods of inundation ranged up to 120 days (Dexter 2005), probably sufficient for California tiger salamander breeding. Burrows of ground squirrels are also abundant in the vicinity of seasonal wetland pools on the project site. No California tiger salamanders have been detected in general amphibian surveys of neighboring ranches with similar habitat, but no focused surveys were conducted on the Dutch Slough Restoration Project site or the related project sites.

CALIFORNIA RED-LEGGED FROG, *RANA AURORA DRAYTONII*. (federally listed as threatened, California species of special concern)

The California red-legged frog is a federally listed threatened amphibian species (species of concern for California). It typically inhabits shallow ponds, emergent freshwater marsh, and fresh-brackish marsh with water throughout summer most years. It also may occur in relatively still marshy channel pools in streams, and has adapted to artificial ponds (stock ponds, ditches). One of the principal threats and constraints on habitat suitability for this species is intensive predation by bullfrogs). Otherwise suitable marsh habitats of California red-legged frogs may be rendered unsuitable when substantial populations of bullfrogs establish. California red-legged frog populations may remain viable in marshes isolated from bullfrog populations, or in marshes with environmental fluctuations (hydroperiods, salinity) that are tolerated by red-legged frog adults, but not bullfrog adults or tadpoles.

The closest reported occurrences of the red-legged frog are upstream in Marsh Creek, approximately seven miles south of the project; there are no CNDDB occurrences for the closer reaches of Marsh Creek.

California red-legged frogs have not been detected in either nontidal or tidal freshwater marshes at Dutch Slough parcels. The irrigation ditches of Dutch Slough parcels support very large bullfrog populations, and these are a possible cause of local extinction of red-legged frog populations that could otherwise occur in suitable habitat. There are some freshwater marshes with seasonal water fluctuations (September-October drawdown, emergence) and moderately low salinities (several parts per thousand salinity/alkalinity) that could potentially act as refuges from large bullfrog populations. General wildlife surveys by DWR staff biologists failed to detect California red-legged frogs (T. Hall. DWR, pers. comm. 2005.) No California red-legged frog populations were detected in adjacent ranchland parcels (Lesher, Biggs, Dal Porto South) with essentially similar habitat during recent intensive reptile surveys (Swaim 2005). No California red-legged frogs are known to occur within likely dispersal distances through suitable habitat corridors; the nearest known source population is at Cowell Ranch State Park (Marsh Creek watershed), over seven miles upstream, across abundant bullfrog (predator) habitat. Most potential freshwater marsh habitat connectivity among parcels also occurs through ditches that support highly abundant bullfrogs, and are likely predation "sinks". Thus, there is a very low probability of California red-legged frog occurrence or natural dispersal to the project site, where existing bullfrog-dominated habitats select against them. Some potentially suitable isolated seasonally emergent freshwater marsh, however, does exist at the project site, particularly where evidence of western pond turtle breeding occurs.

SPECIAL-STATUS REPTILES

Several special-status reptile species may potentially occur on the project site, but only one is known to occur on site (northwest pond turtle). The risk of undetected giant garter snake occurrence in suitable habitats on site is considered sufficient to warrant evaluation of project impact to this species.

SILVERY LEGLESS LIZARD, ***ANNIELLA PULCHRA PULCHRA*****.** (California species of special concern)

The silvery legless lizard is found from Antioch south to Baja California. This fossorial reptile constructs burrows in sandy or loose soils. Its distribution is restricted to areas with undisturbed sandy or loose loamy soils, particularly under sparse vegetation of beaches, dunes, chaparral, or pine-oak woodlands; or near sycamores, cottonwoods, or oaks on stream terraces. Sandy loam soils on stabilized dunes seem to be especially favorable habitat.

The species is insectivorous, feeding largely on larval moths and beetles, adult beetles, termites, and spiders. Breeding occurs between early spring and July. One to four live young are born between September and November. Sexual maturity is reached in 2 or 3 years.

The silvery legless lizard is in decline primarily due to habitat loss and disturbance of the loose soils that are necessary for its survival.

The subspecies is known to occur near the project area. There are several CNDDB occurrences from Contra Costa County, and an East Bay Regional Park District Legless Lizard Preserve is located about 1 mile west of the SW corner of the Dutch Slough Project boundary.

NORTHWESTERN POND TURTLE, ***EMYS MARMORATA MARMORATA*****.** (California species of special concern).

The northwestern pond turtle (northern subspecies of western pond turtle; Stebbins 2003) inhabits permanent fresh to brackish ponds, sloughs, and streams with still or slow-flowing channel pools, where marsh or riparian woodland vegetation cover and basking sites (large woody debris, mud or bedrock outcrop banks) are present. Nesting sites are in terrestrial or seasonal wetland grasslands or similar terrestrial vegetation up to 400 meters from aquatic habitats. Individual turtles may be long-lived (decades).

Northwestern pond turtles have been detected in freshwater nontidal marshes within the project site, in Marsh Creek, and in the Contra Costa Canal. Although focused surveys for WPT were not conducted on the project site, several of various sizes were observed during habitat evaluations in 2005. Western pond turtles were observed basking on the banks, as well as on debris, and mats of downed vegetation in ditches and ponds. Perhaps the greatest densities of pond turtles were seen in the large east-west irrigation ditch on the Burroughs parcel and in the disposal ponds on the Gilbert parcel. The only observation of a WPT on the Emerson parcel was a juvenile which was found in one of the overgrown irrigation ditches with just a small puddle of water present. One of the Stage 1 Expectations for western pond turtles in the CALFED Ecosystem Restoration Program Plan is that "populations of turtles that appear to still have successful reproduction will have been located and protected, in conjunction with other habitat protection measures" (CALFED, 2000). This sighting confirms that successful reproduction is occurring on the project site, and protection or enhancement of nesting areas and microhabitats for hatchlings and small juveniles should be priorities for this project.

GIANT GARTER SNAKE, *THAMNOPHIS GIGAS*. (federal and state-listed as threatened)

While giant garter snakes historically inhabited natural wetlands of the Central Valley, they now occupy a variety of agricultural, managed, and natural wetlands, as well as uplands adjacent to these areas. Giant garter snakes consume predominantly aquatic prey such as fish and amphibians. They are typically active from early spring through late-fall and inactive during the winter during which time they require upland hibernacula in the form of cracks and burrows in areas high enough to provide refuge from winter flood waters.

The following essential habitat components are recognized as necessary to support healthy populations of the species: (1) adequate water during the snake's active season to maintain dense populations of prey species; (2) emergent, herbaceous wetland vegetation for escape cover and foraging habitat; (3) grassy banks and openings in waterside vegetation for basking; and (4) higher elevation upland habitat for cover and refuge from flood waters during the snake's inactive season.

Within the project area, the potential habitat consists of irrigation ditches, disposal ponds, and borrow ponds. Water rarely persists in the irrigation ditches, so despite the growth of emergent vegetation such as cattails and bulrushes, the ditches are not ideal habitat. However, some toe drains and larger, deeper ditches appear to possess water throughout the active season. In addition to the irrigation ditches, there are ponds in the Gilbert parcel which remain wet throughout the active season and support emergent vegetation and prey. Most of the uplands are located on the levees; however, some interior land remained fallow with relatively little disturbance and was also included in the upland area calculation.

The project area is within the historic range of GGS and is hydrologically connected to historical and/or recent GGS occurrence records and therefore could potentially support this species; however, the project vicinity has recently been surveyed specifically for giant garter snake (Contra Costa Canal, Marsh Creek, adjacent ranches with habitat type and quality similar to the project site), in coordination with the U.S. Fish and Wildlife Service, and surveys were negative. Habitat on the project site was evaluated in 2005 by a species expert Laura Patterson, DWR); no giant garter snakes were observed during those evaluations. Ms Patterson concluded that the likelihood that the project area supports GGS was slim based on the land use, available habitat, and absence of a nearby population.

SPECIAL-STATUS INVERTEBRATES

VALLEY ELDERBERRY LONGHORN BEETLE, *DESMOCERUS CALIFORNICUS DIMORPHUS* (federally listed as threatened)

All stages of the beetle's life cycle are closely associated with elderberry shrubs and trees (*Sambucus* spp.) in a variety of habitats. In the spring adult beetles lay eggs on the plants, primarily on stems greater than one inch in diameter. When the eggs hatch the larvae bore into the stems and feed for up to two years on the soft core of the stems. After pupation, new adults emerge and use elderberry for resting, foraging, and reproduction. Numbers of the beetle have declined due to widespread loss of streamside woodlands that support elderberry.

There are at least two *Sambucus racemosa* shrubs on the Dutch Slough site, both with multiple stems greater than one inch in diameter. The shrubs have not been searched for exit holes, but it will be assumed that they provide habitat for the beetle.

SPECIAL-STATUS INVERTEBRATE SPECIES.

The remaining invertebrates on the species list are known only from the Antioch Dunes or from vernal pool habitats, and are summarized below.

ANTIOCH DUNES INSECT FAUNA. Several special status invertebrate species occur on the Antioch Dunes National Wildlife Refuge, located approximately six miles west of the project site. Although some relict, ancient dune sand deposits ("sand mounds") occur at the project site, there is little potential for endemic or rare insects associated with the Antioch Dunes community to occur on the project site because the Dutch Slough sand deposits are highly disturbed and vegetated with vineyard plantings, non-native grasses and weeds, and nitrogen-fixing non-native trees. They also lack key native host plants for some insects, such as buckwheat (*Eriogonum* species), minimizing their habitat suitability. Similar sand mounds on adjacent ranches (adjacent and east of the Dutch Slough project site), which did support some native sandy-soil/dune indicator plants, were assessed for the presence of rare native dune insect fauna, and were surveyed specifically for five special-status beetle taxa (Arnold 2005). The assessment covered the following insects, and concluded they were unlikely to occur on the severely degraded sand mound habitats of the Dutch Slough project site:

Lange's metalmark butterfly, ***Apodemio mormo langei*** (federal and state listed as endangered). This species is associated with native buckwheat (*Eriogonum*) host plants; the species was determined to be absent from adjacent ranches south of Dutch Slough. The essential host plant is lacking at Dutch Slough.

San Joaquin dune beetle, ***Coelus gracilis*****.** The species is presumed extinct; it was not detected on adjacent ranches south of Dutch Slough.

Ciervo Aegialian scarab beetle, ***Aegialia concinna***. It is unlikely the species is present in degraded habitat, but surveys may be warranted; surveys detected none on adjacent ranches south of Dutch Slough.

Antioch and Sacramento anthicid beetles, ***Anthiscus antiochiensis, A. sacramento***. There is suitable loose sand habitat on the project site, but these ground-dwelling beetles were not detected in surveys of similar habitats of adjacent ranches south of Dutch Slough. They are unlikely to occur.

Antioch mutillid wasp, ***Myrmosula pacifica***. This ground-nesting, sand-loving wasp (which may be a synonym of a widespread species) was not detected on adjacent ranches south of Dutch Slough, but some potential habitat occurs in degraded sand mounds of the project site.

Molestan blister beetle, *Lytta molesta*. This beetle parasitizes sand-loving, ground-nesting bees. The species was not detected on adjacent ranches south of Dutch Slough, but some potential habitat occurs in degraded sand mounds of the project site.

Yellow-banded and Antioch andrenid bees, *Perdita scitula antiochiensis*, *P. hirtoceps luteocincta*. Loose sand habitat is present for these ground-nesting bees, but none were detected none on adjacent ranches south of Dutch Slough. Their preferred nectar plant assemblages do not occur at the project site.

Antioch Cophuran, Efferian, and Hurd's Metapogon robberflies, *Cophura hurdi, Eferia antiochi,* and *Metapogon hurdi*. These endemic Antioch Dunes robberflies are presumed extinct. They were not detected on adjacent ranches south of Dutch Slough, east of the project site.

Antioch and redheaded sphecid wasps, *Philanthus nasalis* and *Eucerceris ruficeps*. These ground-dwelling sand-substrate wasps have some potential to occur in sand mounds, but cattle or vehicle disturbance may reduce habitat quality. They were not detected none on adjacent ranches south of Dutch Slough.

VERNAL POOL INVERTEBRATE FAUNA.

Most of the vernal pool invertebrates are also unlikely to occur at the Dutch Slough project site because there are few ponded areas in the project site that hold water for more than a few days (Brent Gilbert, pers. comm., March 2008). In most cases, clay soil is necessary to hold water in vernal pools, and there is little clay at the project site. Seasonal wetlands at the project site are due more to local runoff and high water tables than from the characteristics of the underlying soil. However, seasonally wet areas have some potential to be occupied by some sensitive invertebrates.

CURVE-FOOTED HYGROTUS DIVING BEETLE, *HYGROTUS CURVIPES*. This species inhabits alkali vernal pools and other seasonal wetlands or slow moving streams with pools and fringed with alkali vegetation. Adults are about an eighth of an inch long, with males being slightly larger than females. This species is known only from Contra Costa, Alameda, and northwest San Joaquin counties, at the western edge of the Central Valley. This aquatic beetle may occur in suitable habitats at the project site, but it was not detected in surveys in highly similar habitats at adjacent ranches south of Dutch Slough, east of the project site (Arnold 2005).

VERNAL POOL FAIRY SHRIMP, *BRANCHINECTA LYNCHI*. (Federally listed as threatened) A small (11-25mm) crustacean found in vernal pools. The majority of known populations inhabit vernal pools with clear to tea-colored water, most commonly in grass or mud bottomed swales or basalt flow depression pools in unplowed grasslands. One population is known from an alkaline vernal pool. The species has been found from early December through early May, and is only rarely found with other fairy shrimp species. (USFWS 1994--Determination of Endangered Status for the Conservancy Fairy Shrimp, Longhorn FS, and Vernal Pool Tadpole Shrimp; and Threatened Status for the VP Fairy Shrimp. Federal Register Vol 59, No. 180 9/19/94.) This species is known from Contra Costa County and there may be habitat for it in the alkaline wetlands on the Dutch Slough Project site.

Similar species that are less likely to occur on the project site include California linderiellia, *Linderiellia occidentalis*; Longhorn fairy shrimp, *Branchinecta longiantenna*, (federally listed as endangered); midvalley fairy shrimp, *Branchinecta mesovallensis;* and the vernal pool tadpole shrimp, *Lepidurus packardi*, (federally listed as endangered). Wet-season branchiopod surveys conforming to methods and protocols accepted by the U.S. Fish and Wildlife Service were performed in apparently suitable seasonal wetland habitats of adjacent ranches, but no branchiopods were detected (Dexter 2005).

Regulatory Setting

Assessment of impacts to biological resources at the Dutch Slough Restoration Project and Related Project sites is subject to many public policies, regulations, and laws affecting biological resources. These are described briefly below in the context of the proposed project.

FEDERAL LAWS, REGULATIONS, POLICIES

CLEAN WATER ACT (33 U.S.C 1252 *ET SEQ*.)

The Clean Water Act is a federal law aimed overall at restoring and maintaining the chemical, physical and biological integrity of United States waters, by reducing or eliminating discharges of pollutants that degrade aquatic resources. The pertinent section of the Clean Water Act in the context of fill placement in wetlands and wetland restoration is Section 404. The regulations for Section 404 prepared by the Environmental Protection Agency (EPA) implement specific policies for discharges of earthen fill materials in wetlands: these are known as the "404(b)(1) Guidelines" (40 C.F.R. Part 230). In addition, the preamble to the Guidelines published in the Federal Register articulates EPA policies specific to discharges of fill for the purpose of habitat construction, such as wetland restoration (Federal Register Vo. 45, No. 249, December 24, 1980, p. 85344, "Habitat Development and Restoration of Water Bodies"). These specific policies as well as the Guidelines are pertinent to the Dutch Slough project.

The 404(b)(1) Guidelines describe exceptions for a general rule that fill should not be discharged in waters of the United State if there is a practicable alternative that would overall have less adverse impact on aquatic resources. They presume that for special aquatic sites like wetlands, practicable alternatives to fill discharges in wetlands are available unless otherwise demonstrated. The Guidelines also prohibit discharges of fill that may cause or contribute to "significant degradation" of U.S. waters, or discharges that may jeopardize a federally listed endangered or threatened species. Finally, for approved fill discharges in U.S. Waters, the Guidelines require that practical steps must be taken to minimize impacts (mitigation; Subpart H). The Guidelines require detailed factual determinations (40 C.F.R. Section 230.11, Subparts C-F) to support permit decisions that must comply with the Guidelines, including physical, chemical, and biological impacts, impacts to special aquatic sites (wetlands, mudflats, refuges, mudflats, vegetated shallows, etc.), and impacts to human uses. These factual determinations identify the specific functions and values of aquatic habitats that must be evaluated for impacts of proposed fill. Permits for fill discharges subject to Section 404 are issued by the U.S. Army Corps of Engineers, with some programmatic oversight from EPA. The Army Corps is authorized to issue a Section 404 Permit for the discharge of dredged or fill material into waters of the U.S., provided that such discharges are found to be in compliance with the Sections 401 and 404(b)(1) guidelines published by the U.S. Environmental Protection Agency

The Dutch Slough Restoration Project restoration alternatives all propose variable amounts of fill in existing non-tidal wetlands, all of which have been determined to be within Federal jurisdiction; the U.S. Army Corps of Engineers verified the DWR wetland delineation (2006) that took federal jurisdiction over non-tidal wetlands on site (pasture). The overall purpose of the Dutch Slough project is to restore tidal wetlands, increase the net extent and quality (ecological function) of U.S. Waters in the long term. This is consistent with the "Habitat Development and Restoration" policies of EPA discussed in the preamble of the Guidelines. These policies also advise against substituting one viable aquatic habitat for another, and recommend selection of "obviously degraded or significantly less productive habitats" for restoration. In addition, the EPA recommends experimental approaches analogous with "adaptive management" principles that were integral to the development of the Dutch Slough design process and scientific peer review.

NATIONAL ENVIRONMENTAL POLICY ACT OF 1969 (42 U.S.C. §§ 4321 *ET SEQ*.)

The National Environmental Policy Act's (NEPA) basic purpose is to ensure that the quality of the human environment is considered in federal decisions, and to promote enjoyable harmony between humans and their environment. In practice, NEPA works as a formal procedure for federal agency decision-making and documentation. Federal agencies develop and implement their own specific NEPA regulations regarding procedures for evaluating and documenting environmental impacts. NEPA requires that agencies consider alternative actions that minimize conflicts between project objectives and environmental quality, and promotes selection of environmentally preferable alternatives. NEPA establishes methods for mitigation based on avoiding, minimizing, and correcting environmental impacts. It emphasizes significant environmental issues and impacts over details and paperwork, and promotes plain language, and public involvement in the public environmental review process. The EPA provides oversight for NEPA compliance of individual federal agencies.

NEPA encourages integration between state and federal environmental review procedures, such as joint EIR/EIS documents when both state and federal lead agencies determine that significant impacts may occur, and require preparation of EIR/EIS documents. This EIR was prepared prior to formal determination of the federal lead agency status for permitting, but, as described in Chapter 1, Introduction, is formatted to facilitate its use as an EIS. It anticipates the perspective of NEPA, but is not prepared under the guidelines of a federal lead agency or Environmental Protection Agency.

NEPA does not have specific, substantive policies for federal decisions about particular biological resources, such as those of the Endangered Species Act and Clean Water Act. It does, however, specifically identify positive or negative impacts to Endangered Species as an important factor for determining whether an impact is significant (40 C.F.R. Section 1508.27).

RIVERS AND HARBORS ACT OF 1899 (33 U.S.C. 403, SECTION 10)

The Rivers and Harbors Act of 1899 is principally concerned with regulation of any work or structures navigable waters and impacts to navigation, but "navigable waters" in law is broadly defined to include all tidal waters. Permits authorizing work or structures under this law are issued by the U.S. Army Corps of Engineers, whose permit process also includes Clean Water Act Section 404 authorization and a consolidated public interest review of factors affecting both laws. Rivers and Harbors Act jurisdiction may in some cases expand the overall federal jurisdiction of the Corps, and may trigger other federal environmental laws.

In the Dutch Slough Restoration Project design, the breaching of levees and restoration of tidal flows would be subject to regulation under the Rivers and Harbors Act.

ENDANGERED SPECIES ACT (16 U.S.C. 1531 *ET SEQ*.)

The Endangered Species Act of 1973, as amended (ESA) establishes a national program for conservation (survival and recovery) of species listed as threatened or endangered, and the ecosystems on which they depend. The sections of ESA that apply to the proposed project are Section 4, Section 7, and Section 9. The U.S. Fish and Wildlife Service (Department of Interior) and the National Oceanic and Atmospheric Administration - Fisheries (NOAA Fisheries) are responsible for implementing the Endangered Species Act. Listed plants, wildlife, and non-anadromous fish species are regulated by the U.S. Fish and Wildlife Service, and listed anadromous fish species and marine mammals are regulated by NOAA.

Section 4 of the ESA requires that listed species have federal plans for their recovery, including practical steps for implementation. By policy, recovery plans also include ecosystem restoration objectives and objectives for conserving species of concern that may become threatened or endangered. Federal agencies have an affirmative obligation to use their discretion to further the recovery of listed species by cooperating with the implementation of recovery plans recommendations.

Section 7 of the ESA requires that federal agencies must consult with the Service or NOAA if their actions may affect a federally listed species. Section 7 also prohibits any federal agency from taking actions that are likely to jeopardize the survival and recovery of listed species. Issuance of a federal permit is one type of action that may trigger the requirement to initiate Section 7 consultation. The Service or NOAA conclude formal Section 7 consultation with the issuance of a biological opinion. The biological opinion may also include an “incidental take statement”. The incidental take statement provides authorization for incidental “take” (indirect killing, harm, harassment, injury) of listed fish or wildlife species that is otherwise prohibited by Section 9 of the ESA.

The proposed Dutch Slough Restoration Project includes actions recommended by recovery plans. Construction of the tidal wetland restoration project may have long-term beneficial effects on the recovery of some federally listed endangered species, and also some short-term adverse effects.

MIGRATORY BIRD TREATY ACT (16 U.S.C. 703 *ET SEQ*.)

The Migratory Bird Treaty Act governs the “taking” of migratory birds, their eggs, parts, and nests. Actions that harm or kill migratory birds (including their essential feeding, roosting, nesting behaviors) are regulated by the Migratory Bird Treaty Act. Construction activities associated with engineering of wetland restoration may affect migratory birds.

EXECUTIVE ORDER 13112, INVASIVE SPECIES

This Executive Order inaugurated the National Invasive Species Management Plan and National Invasive Species Council (Council) in 1997. It provides policy direction to promote coordinated efforts of federal, state, and local agencies in monitoring, detecting, preventing, evaluating, managing, and controlling the spread of invasive species and increasing the effectiveness of scientific research and public outreach affecting the spread and impacts of invasive non-native species.

The Dutch Slough Restoration Project has objectives to minimize the spread of invasive species, but also carries some unavoidable risks of increasing the spread of some invasive species.

EXECUTIVE ORDER 11988, FLOODPLAIN MANAGEMENT

This Executive Order directs federal agencies to avoid long-term and short-term adverse impacts of development in floodplains, to the extent practical. The purpose of this policy is to minimize the risk of flood losses, risk to human safety, health, and welfare. An inherent consequence of this policy is to promote retention of undeveloped floodplains in conditions suitable for wetlands. As described in Section 3.1, the proposed project occupies a portion of the Delta landscape that is subject to extensive floodplain development.

STATE OF CALIFORNIA LAWS, REGULATIONS, AND POLICIES

CALIFORNIA ENDANGERED SPECIES ACT (FISH AND GAME CODE SECTION 2050 *ET SEQ*.)

The state equivalent of the federal Endangered Species Act, CESA has similar, but distinct requirements and goals. CESA requires State agencies to coordinate with the California Department of Fish and Game to ensure that state-authorized or state-funded actions do not jeopardize a state-listed species. The state list of species classified as rare, threatened, or endangered does not correspond with the federal list of threatened and endangered species. CESA prohibits unauthorized "take" of a state-listed species.

The Fish and Game Code also includes a less familiar special legal status for some species as "fully protected", a category developed before CESA was authorized. Most "fully protected" species have been placed on the state list of rare, threatened, or endangered species, but some have not. Prohibitions against take of older "fully protected" species are more stringent and inflexible than those of CESA, generally prohibiting nearly all "take", and providing no instrument to authorize "take" except for recovery and research actions. Fully protected species regulations in the Fish and Game Code are found at §3511 for birds, mammals at §4700, reptiles and amphibians at §5050, and fish at §5515 and California Code of Regulations, Title 14, Division 1, Subdivision 1, Chapter 2, Article 4,§5.93. The category of Protected Amphibians and Reptiles in Title 14 has been repealed.

CALIFORNIA NATIVE PLANT PROTECTION ACT (FISH AND GAME CODE SECTION 1900 *ET SEQ*.)

In addition to the California Endangered Species Act, the Native Plant Protection Act (NPPA) protects endangered and "rare" species, subspecies, and varieties of native California plants. The species listed under this law, which preceded CESA, now overlap with those of CESA. NPPA contains many exemptions for agriculture and forestry, and many exceptions, but it otherwise generally prohibits unauthorized "take" of listed plants. NPPA contains "notice and salvage" provisions that require landowners to notify CDFG to "salvage" (rescue by transplanting – a technique no longer generally scientifically supported) listed plants in the path of land-clearing or development activities.

PORTER-COLOGNE WATER QUALITY CONTROL ACT (CALIFORNIA WATER CODE SECTION 13000 ET SEQ.; C.C.R. TITLE 23, CHAPTER 3, CHAPTER 15)

The Porter-Cologne Water Quality Act provides the state with broad jurisdiction over water quality and waste discharge, and also provides the state the authority to prepare regional Basin Plans that identify "beneficial uses" of state waters that expressly include biological resources such as wetlands, fish, and wildlife conservation. Biological "beneficial uses" of state waters are subject to regulation through various means, including mandatory conditions attached to state water quality certification of federal Clean Water Act (Sections 401, 404) authorizations. The Regional Water Quality Control Boards frequently provide Porter Cologne compliance with wetland beneficial use policies by attaching mandatory conditions to Section 401 certification for U.S. Army Corps of Engineers permits for fill discharges in federal jurisdictional wetlands.

EXECUTIVE ORDER W-59-93, CALIFORNIA WETLANDS CONSERVATION POLICY

This state policy established by the Governor of California in 1993 provides substantive environmental goals to ensure no overall net loss of wetlands, to achieve a long-term net gain in the quantity, quality, and permanence of wetlands in California, with due concern for private property and stewardship. The basic purpose of the Dutch Slough Restoration Project implies a significant long-term net gain in the quantity, quality and permanence (dynamic stability) of wetlands, consistent with this policy

FISH AND GAME CODE SECTION 1600 *ET SEQ*. (STREAMBED ALTERATION AGREEMENTS)

The California Legislature repealed and re-enacted with modification this section of the Fish and Game Code in 2003. It has as its primary purpose the protection of the state's fish and wildlife resources from harmful impacts of activities that occur near any rivers, streams, lakes and other water bodies in the state, regardless of the amount or duration of flow. "Fish" are broadly defined in the Fish and Game Code (Section 45) as aquatic organisms, including mollusks, crustaceans, invertebrates, or amphibians. Prior to undertaking stream-altering activities that may adversely affect fish or wildlife, applicants must notify the Department of Fish and Game, pay fees, and enter into an agreement with the Department for authorization. The Department may authorize (for up to 5 years) alteration of streams with scientifically sound, reasonable conditions to avoid or minimize harm (substantial adverse effects) and protect fish and wildlife resources. The Department has discretionary authority to modify the conditions of a Section 1600 Stream Alteration Agreement.

LOCAL LAWS, REGULATIONS, AND POLICIES

CITY OF OAKLEY HERITAGE TREE PRESERVATION

The City of Oakley Municipal Code sections 9.1.1112-1114 address the protection and preservation of heritage and protected trees, and outline the actions necessary to obtaining permits for removal of protected trees.

3.4.2 IMPACTS AND MITIGATION

Significance Criteria

The significance of biological impacts to terrestrial and wetland biological resources depends partly on the regulatory setting (policy, regulation, statute; see Regulatory Setting), and partly on the context of the scientific literature on ecology, conservation biology, and related environmental sciences. The following criteria are proposed as thresholds of significance for adverse environmental impacts in the context of CEQA:

- Extirpation (local extinction) of a population of a rare, threatened, or endangered species, or substantial contribution to the reduction of its natural geographic range (contraction of its distribution, or elimination of disjunct [outlier] populations) population viability, or population size.
- Degradation of habitat occupied by a rare, threatened, or endangered species, to the point at which its population declines or becomes unstable.
- Artificial introduction or range extension of a rare, threatened, or endangered species to plant communities or floristic provinces in which it did not occur historically.
- Substantial reduction in distribution or abundance of a species of concern, relative to its regional and local distribution.
- Loss or substantial reduction in area or distribution of a unique or rare plant or animal community.
- Major incremental loss of a widespread plant or animal community that is undergoing very rapid decline at a regional or subregional scale.
- Substantial loss of composition or structure in a plant or animal community that is very old or mature, and very slow or uncertain to regenerate over many human generations.
- Major increase in the distribution, rate of spread, abundance, or impact of an invasive non-native species.
- Major, long-term change in biogeochemical processes or productivity.
- Major, long-term reduction in diversity of native species and communities

Significance criteria for impacts to special-status species consider potential impacts to existing populations (direct and indirect impacts), impacts to suitable but unoccupied habitat of special-status species with narrow habitat requirements or very limited distribution, and impacts to high-priority recovery areas or critical habitat (cumulative impacts). Impacts to special status plant species that are certain or likely to cause local population extinction, or major long-term declines in local population size or stability, are considered significant.

Significance determinations for impacts to special-status plants consider potential impacts to existing populations (direct and indirect impacts), impacts to suitable but unoccupied habitat of special-status species with narrow habitat requirements or very limited distribution, and impacts to high-priority recovery areas or critical habitat (cumulative impacts). Impacts to special status plant species that are certain or likely to cause local population extinction, or major long-term declines in local population size or stability, are considered significant.

Background and Considerations in Impact Assessment

The Dutch Slough and related Ironhouse projects propose to reverse former diking and reclamation of historic tidal marshes by breaching dikes and restoring tidal flows over artificial non-tidal habitats. Artificial non-tidal habitats may include wetlands or terrestrial habitats with important ecological functions, including significant wildlife habitats for waterfowl, shorebirds, mammals, plants, amphibians, reptiles, and invertebrates. Some ecological functions and species supported by diked, reclaimed habitats partially emulate those of pre-reclamation wetland ecosystems. Some special-status species may establish populations or important refuge habitats in diked, reclaimed historic tidelands. The impacts of large-scale habitat conversions associated with tidal restoration depend on the landscape context in which they occur – relative abundance and trends of other habitats in the region surrounding the tidal restoration project.

While the general outcome of tidal conversion is predictable, ecological understanding essential to forecasting specific habitat or species changes (impacts, benefits) has practical limits, and unavoidable uncertainty. The "adaptive management" policies of CALFED agencies are aimed at addressing the inherent ecological and practical uncertainties of habitat restoration projects, using scientific experimental approaches. This approach is somewhat different from the forecasting and straightforward prediction required by CEQA analysis of impacts and mitigation.

Tidal restoration, though a gradual process of ecological succession (growth and development of ecological communities over time), is implemented via abrupt, disruptive disturbances of construction and tidal flooding. Many years or decades are required for restored tidal marshes to regenerate the ecological functions of long-established artificial non-tidal habitats they replace. This lag effect on biological resource losses due to tidal conversion, and their replacement by habitats and populations that later regenerate is considered in the impact assessment. In general, terrestrial habitat functions of reclaimed tidelands, such as those of artificial grasslands and pastures, are eliminated or significantly reduced with certainty. Some ecological functions, however, are replaced or improved rapidly by tidal restoration, but with less certainty about where, how much, and when. The "self-mitigating" aspect of tidal wetland restoration (substitution of ecological "services" provided by non-tidal wetland with those of tidal wetlands) depends on ecological succession rates, patterns and trends that are only approximately predictable in absolute time, and difficult to control experimentally at a large geographic scale. The same is true for restoration of many terrestrial habitats, such as native grasslands and dunes.

Independent variables with overwhelming ecological influence, such as climate change, species invasions, and acceleration of sea-level rise, contribute to the inherent uncertainty of ecological forecasting for specific large-scale restoration projects. The Dutch Slough Restoration Project is the largest freshwater tidal marsh restoration in California, and the first to be studied with scientific rigor. The lack of studies of other similar, local habitats constrains the EIR's ability to forecast ecological outcomes of restoration.

Most scientific and management experience with tidal marsh restoration in the Bay-Delta region comes from San Francisco Bay salt marshes with abundant local sources of suspended fine mineral sediment, and tidal ranges (daily vertical water elevation change) well over 3 feet. (The "Bay-Delta Region" here refers to tidal San Francisco Estuary and the Sacramento-San Joaquin River delta, including reaches with little or no tidal signal). Understanding of tidal marsh restoration impacts and ecological benefits in the Bay-Delta is based on several decades of experiences mostly from the "lower estuary" (San Francisco Bay, San Pablo Bay), where extensive mudflats serve as large reservoirs of mobile fine mineral sediment. Typical consequences of breaching levees of subsided, diked, reclaimed lands of the lower estuary includes: relatively rapid mineral (bay mud) sediment deposition over relatively shallow (slightly below sea level) subsided ground elevations, and rapid establishment of "pioneer" native marsh vegetation. Submerged aquatic vegetation in salt marshes of the lower estuary is very limited (restricted to pools), and consists mostly of benign native species.

In contrast, Delta tidal wetlands (predominantly freshwater tidal marshes east of Antioch) have negligible rates of fine mineral sediment deposition to rebuild tidal marshes, and have significantly lower tidal energy than wetlands of the lower estuary. Marsh-building processes in the Delta depend mostly on biomass production of tules (growth and accumulation of organic substrates like peat). Dominant wetland vegetation in the Delta includes rapid invasion by non-native submerged aquatic vegetation with adverse effects on aquatic habitat quality. Marsh zonation (segregation of different dominant vegetation types along environmental gradients, such as elevation) in the Delta, where low vertical tidal range and negligible local salinity gradients prevail, is less pronounced than in the lower estuary. These contrasts make even rough prediction of marsh habitat development more difficult for the Delta than in San Francisco and San Pablo Bay because it is more influenced by biological processes than physical ones.

The impact assessment of biological resources for this project is based on experience of tidal marsh restoration in the Bay-Delta region, the best available scientific data and literature, and unpublished local biological survey information, expert opinion, and professional judgment.

Alternative 1: Minimum Fill

IMPACT 3.4.1-1.1: POTENTIAL IMPACTS TO WILDLIFE IN IRRIGATED PASTURE AND RUDERAL-TERRESTRIAL HABITATS (DUTCH SLOUGH AND ALL OPEN-WATER OPTIONS, CITY PARK, AND IRONHOUSE PROJECTS)

Irrigated pasture makes up approximately 750 acres of the Dutch Slough project site, and there is approximately 250 acres of miscellaneous upland habitats. Alternative 1 would convert most of these terrestrial habitats on the three parcels (including jurisdictional seasonal wetlands in irrigated pastures) to freshwater marsh or open water habitats. These terrestrial habitats support common wildlife such as rodents, black-tailed jackrabbits, coyotes, and raccoons, as well as almost all the sensitive species (plant, invertebrate, and wildlife) that occupy the project sites. Several bird species, both common and sensitive, are ground-nesters on site. All these species would experience short-term habitat loss; the loss would be permanent for many of them. Permanent loss would be a significant impact.

For the sensitive species supported by terrestrial habitats, large-scale habitat conversion to marsh would be a significant impact. A few of these species, such as white-tail kites and northern harriers (Impacts 3.4.1-10), may be able to utilize some or most freshwater marsh as foraging habitat, which may offset some of the impact of the loss of terrestrial habitats. In addition, some species, such as tricolored blackbird, yellow-breasted chat, and California black rail, may realize significant habitat improvements after tidal restoration when wetland vegetation becomes established.

There would be a significant loss of terrestrial acreage in all three project "build" alternatives, but Alternative 1 would retain the largest acreage of terrestrial habitat, and maintain it in a consolidated block in the southern Emerson Parcel. This would probably act as a refuge for terrestrial wildlife species in the long term. However, the amount of remaining on-site terrestrial habitat in Alternative 1 would be insufficient to fully compensate for the loss of terrestrial habitats.

"NO BURROUGHS" OPTION

In this option, the Burroughs parcel would remain as terrestrial and wetland habitats. This would reduce the loss of irrigated pasture and terrestrial habitats by approximately 350 acres.

MITIGATION 3.4.1-1.1: AVOID AND MINIMIZE EFFECTS OF LOSS OF IRRIGATED PASTURE AND RUDERAL HABITATS THROUGH PROJECT TIMING AND PHASING

Although mitigation for loss of irrigated pasture and ruderal habitats is not required, per se, this loss does impact Swainson's hawk and other special status species. Off site mitigation is proposed for those species in Mitigation 3.4.1-8.1.

Effects on resident wildlife shall be minimized through project timing and phasing.

- Earthmoving shall be minimized during the breeding season (March through August). If earthmoving must be done during this time, those areas shall be de-vegetated prior to the breeding season to discourage nesting and denning.
- The project shall be phased so that impacts to terrestrial habitats do not occur throughout the project area all in the same year.

IMPACT SIGNIFICANCE AFTER MITIGATION

If sufficient quality and quantity of off-site compensatory mitigation habitats are acquired in appropriate geographic settings, impact would be less than significant.

IMPACT 3.4.1-1.2: WILDLIFE DISTURBANCE (DIRECT AND INDIRECT) ON TERRESTRIAL HABITATS ASSOCIATED WITH RECREATION (DUTCH SLOUGH AND CITY PARK PROJECTS)

Wildlife within retained terrestrial habitats within the Dutch Slough, Ironhouse, and City Park sites would be affected by the public access trails and new City Park. The public access trail encircling the Emerson Parcel would distribute human disturbances along the edge of relatively narrow terrestrial habitat patches, reducing the extent of undisturbed, contiguous blocks of habitat, which may disturb any wildlife inhabiting these areas. Such disturbance can disrupt foraging, feeding, sheltering, and all aspects of reproduction.

Increased park uses and food waste associated with increased visitor use to parks would probably increase local populations of ravens (*Corvus corax*), crows, gulls, raccoons, rats (*Rattus* spp.), and *skunks (Mephitis mephitis*). These artificially inflated predator populations may concentrate their impacts on resident wildlife of the remaining, reduced terrestrial habitats compressed near trails and park areas. This would be a significant cumulative impact: despite restoration with native vegetation, the reduced terrestrial habitats may have disproportionately reduced wildlife value.

MITIGATION 3.4.1-1.2: HABITAT ENHANCEMENT TO OFFSET HABITAT LOSS AND DISTURBANCE ON TERRESTRIAL HABITATS ASSOCIATED WITH RECREATION

Alternative 1 includes terrestrial habitat that would be retained and restored as terrestrial grassland. In addition, the project would restore riparian woodland habitats and low upland islands within restored freshwater tidal marshes. These internal terrestrial habitat restoration features would offset some, but not most, of the wildlife impact of terrestrial-marsh habitat conversion. Because groundwater elevations of terrestrial habitats are expected to adjust to sea level after tidal restoration, the character of terrestrial grassland in much of the area may be alluvial grassland with dense perennial vegetation. This may further reduce the availability of relatively arid, sparse grassland and ruderal wildlife habitat.

As part of the final Dutch Slough Restoration Project restoration plans, a terrestrial wildlife habitat enhancement and phasing plan shall be prepared and implemented by DWR according to the following criteria for on-site actions to offset the impacts to wildlife dependent on irrigated pastures (including seasonal wetlands) and ruderal terrestrial habitat:

DWR shall modify the terrestrial habitat restoration component of the phased proposed Dutch Slough project by incorporating the following habitat enhancement elements to emulate and sustain equivalent habitat functions of moist pasture and ruderal vegetation:

(i) distribute enhanced natural or naturalistic cover features (brush piles, coarse and fine woody debris) in scattered patches throughout most terrestrial habitat;

(ii) retain the maximum number of native on-site native riparian (levee) and upland trees, and retain some snags of killed trees scheduled for eradication;

(iii) salvage and relocate large snags and logs removed from wetland restoration parcels to install within restored or enhanced terrestrial habitats; and

(iv) restore or manage terrestrial grasslands to include diverse grassland types, including perennial sod-forming stands (such as creeping wildrye/saltgrass grassland near wetland edges), regionally native forb-dominated stands (such as annual tarweed, spikeweed, lupine, goosefoot family annual forbs, etc.) and regionally native scrub and forb vegetation adapted to sandy soils.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.1-1.3: WILDLIFE DISTURBANCE FROM LIGHTING AND NOISE (CITY PARK)

Park lighting and noise could adversely affect certain wildlife species that are sensitive to human intrusion. Lighting interferes with movements of insects and migratory birds; attracts insects, increasing their vulnerability to predation; disrupts hunting of other predators; and interferes with circadian rhythms of wildlife. Noise can disrupt foraging, feeding, sheltering, and reproduction. These could be potentially significant impacts.

MITIGATION 3.4.1-1.3: REDUCE EFFECTS OF CITY PARK LIGHTING AND NOISE

Mitigation for this issue is provided in Sections 3.7, Noise and 3.8, Aesthetics. In addition, these issues would be studied further in the project-level CEQA assessment for the City Park.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.1-2.1: IMPACTS OF DREDGING LITTLE DUTCH AND EMERSON SLOUGHS (DUTCH SLOUGH PROJECT WITH ALL OPEN WATER MANAGEMENT OPTIONS AND IRONHOUSE PROJECT)

Dredging is proposed as a contingency (option) to increase the tidal prism of Little Dutch Slough, and possibly Emerson Slough (in the No Burroughs" option), to minimize tidal damping in restored marshes. The desired increase in tidal prism in these channels could be accomplished by deepening or widening the sloughs, or both. Dredging may cause increased rates of fringing tidal marsh erosion along sloughs or their direct removal. This would reduce the total area of tidal marsh habitat and increase habitat fragmentation. Widening the channel by narrowing the fringing marsh width would increase exposure of ground-nesting wildlife (such as California black rails) to adverse effects of boat wakes. Reduction of fringing marsh habitat area and quality may reduce the size and the viability of wildlife populations. This may in turn reduce the capacity of resident tidal marsh wildlife with limited dispersal ability to serve as a founder population for colonizing newly restored marsh. This is a potentially significant impact.

OPEN WATER MANAGEMENT OPTIONS

Subsidence reversal and skeletal marsh/creek options would provide the most valuable freshwater marsh habitats that contribute to habitat support for tidal marsh wildlife. Deep water would potentially increase populations of predatory fish (see Section 3.5, Aquatic Habitats) that could adversely impact viability of native marsh reptile and amphibian populations.

MITIGATION 3.4.1-2.1A: INCREASE ACREAGE OF TIDAL FRESHWATER MARSH.

In the long-term, the project is expected to "self-mitigate" many short-term significant impacts to existing tidal freshwater marsh wildlife on site, and avoid long-term significant impacts. This would occur through increases in acreage of tidal freshwater marsh, with a significant net increase in the extent of freshwater marsh habitat overall to support an increased diversity of wetland wildlife species. The extent to which this occurs would depend on many final design options of the restoration, and their consequences for wildlife.

MITIGATION 3.4.1-2.1B: AVOID CHANNEL WIDENING AND DREDGE NON-NATIVE SAV BEDS.

If existing tidal source sloughs are dredged to increase tidal flows into restored marsh, dredging plans shall avoid widening channels (direct excavation of marsh), or over-steepening banks so that significantly increased rates of marsh bank slumping occur. If dredging of existing invasive non-native SAV beds is feasible and consistent with dredging needs, non-native SAV beds shall be dredged and deepened.

In addition, implementation of Mitigation measures 3.4.1-1a would minimize impacts to wildlife in tidal freshwater marsh habitats. Effects on resident wildlife shall be minimized through project timing: all efforts shall be made to minimize dredging during the breeding season (March through August).

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.1-2.2: WILDLIFE DISTURBANCE (DIRECT AND INDIRECT) AROUND THE MARSH EDGE ASSOCIATED WITH RECREATION (DUTCH SLOUGH AND CITY PARK PROJECTS)

The construction of a permanent public access trail around the perimeter of Emerson Parcel, and the addition of a public park at the head of Emerson Slough, would likely have significant indirect effects on tidal wetland wildlife. Amenities at the park would likely provide an attractive nuisance for crows, gulls, ravens, raccoons, rats, and skunks because of food resources (garbage). These species are likely to increase in population size and increase predation pressure on nesting tidal marsh birds, particularly ground-nesting species such as rails. Increased visitor access along trails would increase exposure of wildlife to human disturbance. Trail use would likely reduce the likelihood of establishment for egret or heron rookeries in riparian/tidal marsh edges. These are potentially significant impacts.

MITIGATION 3.4.1-2.2: HABITAT ENHANCEMENT TO OFFSET HABITAT LOSS AND DISTURBANCE AROUND THE MARSH EDGE ASSOCIATED WITH RECREATION

The final Dutch Slough and related Ironhouse Project restoration plans shall include the following specifications for implementation:

- Final designs for constructed tidal marsh shall include selective placement of large woody debris in constructed tidal sloughs and marsh ponds to provide wildlife cover, basking sites, and roosting sites for wildlife dependent on freshwater marsh bordering shallow open water habitats. Final designs for large woody debris placement shall be reviewed and approved by the DFG and USFWS.
- To protect the integrity of tidal marsh-riparian woodland edge habitat functions, placement of rock slope protection shall be minimized on outer levee slopes. If rock placement is unavoidable to prevent erosion that jeopardizes levee stability, rock-armored levee segments shall be capped with soil and revegetated with native marsh and riparian woodland vegetation. Soil-filled gaps in rock arrangement shall be included in rock-armored levee segments to provide rooting continuity with underlying levee or marsh soils and to maximize feasibility of native riparian tree and shrub planting.
- Revegetated native riparian shrub cover (primarily California blackberry and willow thicket) along existing or restored tidal marsh edges shall be made as continuous as possible along public levee trails to screen tidal marsh wildlife from visual exposure to passing human visitors.
- Timing of dredging shall avoid nesting season (March-August) to reduce impacts on breeding birds.

The following measures shall be incorporated as part of the public access components of both the Dutch Slough Restoration Project and the City Park:

- To minimize artificial attraction of predators along public access trails bordering tidal marsh wildlife habitats, food and garbage shall be prohibited on marsh levee trails. Sanitation shall be rigorously maintained in the county park to minimize attraction of scavenger/predator wildlife species.
- If rookeries or other tidal marsh bird nest sites are detected along levee trails, seasonal trail closures shall be evaluated and implemented upon consultation with USFWS and DFG.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.1-2.3: WILDLIFE DISTURBANCE (DIRECT AND INDIRECT) ASSOCIATED WITH MAINTENANCE OF EXTERIOR LEVEE (DUTCH SLOUGH PROJECT)

Levee stabilization and maintenance is proposed for some segments of levee, particularly for permanent public access trails with vehicle access. This may include placement of additional rock slope protection. Rock slopes placed on the levee and marsh surface are likely to displace high tidal marsh wildlife habitat and associated riparian woodlands. This is a potentially significant impact.

MITIGATION 3.4.1-2.3: MINIMIZE DISTURBANCE (DIRECT AND INDIRECT) ASSOCIATED WITH MAINTENANCE OF EXTERIOR LEVEE.

In planning the project, rock placement on portions of levee with high habitat value shall be minimized. When rock placement in such areas is necessary, work will occur in the smallest possible area and construction shall be timed to avoid nesting periods of sensitive species.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant.

IMPACT 3.4.1-3: POTENTIAL IMPACTS TO NONTIDAL FRESHWATER MARSH AND RIPARIAN WOODLAND/SCRUB AND ASSOCIATED WILDLIFE SPECIES (DUTCH SLOUGH AND IRONHOUSE RESTORATION PROJECTS)

The Dutch Slough project site includes approximately 70 acres of freshwater marsh vegetation and 13 acres of riparian woodland and scrub vegetation. Impacts to wildlife of existing non-tidal freshwater marsh and riparian woodland/scrub habitats on site are likely to depend on the location of those habitats in relation to final design of project construction features. Wildlife such as egrets, herons, and reptiles are likely to depend on the cover types, substrates, and habitat structure provided by linked complexes of freshwater marsh, seasonal ponds, and riparian woodland/scrub habitat patches. Segregating impacts by individual habitat categories would understate impacts to wetland-dependent wildlife that utilize integrated marsh, riparian, and shallow open water habitats. These impacts may be significant.

Several interacting Dutch Slough project activities may impact freshwater marshes, including the following:

- Marshes located within areas to be used as on-site borrow areas for fill (not yet determined) would be destroyed along with less motile wildlife (such as reptiles and amphibians) in them, by earthmoving activities. This would be a significant short-term impact.
- If non-tidal marshes were included within proposed managed tule marsh ("pre-vegetation", and peat-building, subsidence reversal experiments), outside the areas proposed for earthmoving, they would instead become assimilated within dynamic, expanded areas of non-tidal freshwater marshes. The original (pre-project) locations of non-tidal freshwater marshes would be "drowned" because they lie in the lowest topographic areas. The close interspersion of marsh, open water, and riparian woodland/thickets, and the specific habitat functions provided by this habitat edge, may take many years to regenerate in restored tidal marsh/upland transition zones. They may also not be replicated in "subsidence reversal" nontidal tule marshes managed for maximum productivity/peat production (see Open Water Management Options, below). If existing marsh/riparian complexes are protected during project construction and gradually flooded during restoration, they may also serve as a source population for resident wildlife colonizing managed marshes.

- When non-tidal marshes are eliminated or drained during project construction, or rapidly flooded during restoration, their ability to serve as a founder population for resident marsh wildlife in the restored marsh would be severely reduced or eliminated. This impact would necessarily occur if the most subsided locations are selected as borrow sites for project fill. These are potential significant short-term or long-term impacts.
- Amphibians and reptiles are likely to suffer significant net losses of high-value marsh habitat if restoration design is not resilient to rising sea level and fill subsidence. Marsh wildlife dependent on access to emergent marsh substrate (mammals, wading birds) may also experience significant net losses of habitat if tule cover or density is inadequate, and marsh substrate is excessively submerged for most of the tidal cycle.

In the long-term, the project is expected to "self-mitigate" many short-term significant impacts to existing non-tidal freshwater marsh wildlife on site, and avoid long-term significant impacts. This would occur through habitat replacement by tidal freshwater marsh, with a significant net increase in the extent of freshwater marsh habitat overall to support an increased diversity of wetland wildlife species. The extent to which this occurs would depend on many final design options of the restoration, and their consequences for wildlife. These final design options are probably more important influences on marsh habitat quality and wildlife than differences among project alternatives. Some critically important final design features include:

- **Texture of imported borrow sediments used as fill.** The source and type of fill for wetland restoration has not been determined. Both on-site and imported fill sources are considered. Peat and muck soils, rich in organic matter, used to construct the marsh surface are likely to result in high productivity of freshwater tidal marsh and growth of tall, dense vegetation cover. Sandy dredge spoils, however, are the most abundant and available source of fill material for wetland restoration in the Delta. Sandy sediments have less capacity to retain nutrients, and are likely to support shorter, less productive marsh vegetation with less cover. Sandy sediments are also less likely to maintain stability of channel bank habitats or ponds within marsh plains.
- **Initial marsh elevations.** Sea level rise is expected to accelerate in the period of initial marsh restoration (about 50 years). Low intertidal marsh is designed at the lower limits of tule growth at contemporary sea level. Pre-establishing tules in nontidal marshes before tidal restoration may increase their initial density at their lower limits of tidal submergence, but this density may not be sustainable with rising sea level. Similarly, middle intertidal marsh zones are subject to submergence by rapidly rising sea levels in coming decades. The ability of loose, organic freshwater marsh surfaces to adjust to sea level by producing and accumulating peat is limited, and may be outpaced by rising sea level, subsidence of engineered fill, or both. Gradual marsh submergence may reduce the ability of restored marsh habitats to functionally replace and mitigate many of the lost wildlife functions of stable emergent non-tidal marshes, regardless of net increases in marsh acreage.
- **Interim marsh protection/borrow site location.** The location of internal, on-site borrow sites for fill will directly control the impacts to resident wetland-dependent wildlife and their contribution to founder populations of the restored tidal or non-tidal wetlands.

OPEN WATER MANAGEMENT OPTIONS

Subsidence reversal option would contribute the most compensation for impacts to nontidal freshwater marsh/riparian habitat complexes. The degree to which it would compensate would depend on (a) the number of parcels on which it applied (total acreage of open water treated; and (b) the degree to which habitat diversity of managed marsh is integrated into the primary objective of primary productivity and peat accumulation/subsidence reversal. This has not been designed or evaluated.

"NO BURROUGHS" OPTION

In this option, all nontidal freshwater marsh (approximately 20 acres) and riparian woodland (approximately 7 acres) on Burroughs parcel would be preserved, and potentially enhanced.

MITIGATION 3.4.1-3: DESIGN RESTORATION PLANS TO MINIMIZE IMPACTS TO NONTIDAL FRESHWATER MARSH AND RIPARIAN WOODLAND/SCRUB AND ASSOCIATED WILDLIFE SPECIES

The final restoration plans for the Dutch Slough Restoration and related Ironhouse projects shall include the following specifications for implementation:

- On-site borrow sources of fill shall be located outside of existing freshwater non-tidal marshes on site, so that existing freshwater marsh habitats and their wetland-dependent wildlife persist as long as feasible and may disperse into restored or constructed marsh habitats during project phasing. Management for "pre-vegetation" in areas of existing nontidal freshwater marsh shall be implemented by flooding the areas gradually rather than abruptly.
- Sand or other imported fill materials that may excessively restrict primary production of freshwater marsh vegetation shall be avoided as a foundation for the upper 30 cm of constructed tidal marsh substrate. If sand is used as a foundation for marsh within 30 cm of the surface, it shall be mitigated by either (a) mixing with sufficient proportions of slurried clay and fine silt or organic muck, and deposited hydraulically so that clay-silt concentrates in surface layers; or (b) capping the surface and channel banks with clay or clay-peat substrates with earthmoving equipment or a subsequent deposit of slurried clay-silt.
- Design elevations for low intertidal marsh and middle intertidal marsh zones shall anticipate sea level rise within at least a 20-year period. Design elevations shall be established on sloping surfaces rather than flat plains at uniform elevations, so that marsh transgression results in a gradual and well-buffered distribution of marsh zones for wildlife habitats as sea level rises. Wide, gradual gradients between middle and high intertidal freshwater marsh zones are particularly important for many resident marsh wildlife species requiring access to emergent nesting habitat or flood escape habitat.
- Impacts associated with short-term loss of resident wetland-dependent wildlife and their habitats shall be reduced by replacing and enhancing habitat with high levels of structural habitat diversity (large woody debris, high channel bank construction) within constructed tidal marsh channels and ponds. Naturalistic large woody debris (snags, basking logs, debris jams, flood escape habitat, roosts for wildlife) shall be embedded within constructed marsh channel banks at selected locations in the restored marsh and tidal channel complex, as in mitigation measure 3.4.1-2. Large woody debris sources that exist on-site as

mature windbreak tree plantings (subject to mortality due to tidal flooding in marsh restoration) shall be salvaged and redistributed selectively within marsh, pond, and channel habitats, as large woody debris. The final plans for salvage and placement of large woody debris shall be coordinated with the DFG and the USFWS.

- During project construction, existing nontidal freshwater marsh/riparian edge vegetation and their hydrology shall be protected to the greatest extent feasible to retain viability of established wetland-dependent wildlife populations. If protection of existing freshwater marsh/riparian edges is not feasible, restoration designs for subsidence reversal shall be modified to enhance edge habitat of riparian scrub/woodland, shallow open water, and freshwater marsh, and diversify marsh habitat structure.
- High quality marsh edge (ecotone) edge habitat shall be maintained along the new flood control levee at the east shore of Burroughs parcel by including long (total length at least 1:1 minimum (linear) replacement ratio for existing freshwater marsh/riparian or marsh/upland perimeter) segments of "habitat levee" design features (wide, gently sloping marsh bench and riparian woodland plantings) in flood control levee design.

In addition, implementation of Mitigation measures 3.4.1-1a and 3.4.1-2a, above would minimize impacts to wildlife in freshwater marsh habitats.

IMPACT SIGNIFICANCE AFTER MITIGATION:

Less than significant with mitigation.

IMPACT 3.4.1-4: POTENTIAL IMPACTS TO ALKALI MEADOW AND SEASONAL WETLAND FLATS AND ASSOCIATED WILDLIFE SPECIES (DUTCH SLOUGH RESTORATION PROJECT WITH ALL OPEN WATER MANAGEMENT OPTIONS AND IRONHOUSE PROJECT)

The Dutch Slough project site includes approximately 55 acres of alkali meadow vegetation, and 22 acres of seasonal ponds. Populations of native invertebrates and amphibians typically associated with alkali meadow and seasonal wetlands, including uncommon or sensitive species, may be eliminated by project construction and tidal restoration. In addition to sensitive invertebrates, these habitats may be used by dabbling ducks, shorebirds, reptiles, and amphibians. These areas have not been surveyed to determine if uncommon to rare species of aquatic invertebrates, such as branchiopod species [see impact 3.4.1-22], are present on site. If these species are present, loss of these habitats would be a significant impact.

"NO BURROUGHS" OPTION

In this option, all alkali meadow (approximately 6 acres) and seasonal wetland (varies annually) on Burroughs parcel would be preserved, and potentially enhanced.

MITIGATION 3.4.1-4: RECREATE HABITAT FEATURES TO REDUCE POTENTIAL IMPACTS TO WILDLIFE OF ALKALI MEADOW AND SEASONAL WETLAND FLATS

The Dutch Slough project can compensate for wildlife impacts caused by conversion of shallow seasonal wetland habitat by incorporating surrogate habitat in the restoration design, following criteria and technical specifications, subject to review and approval by DFG and USFWS. Both existing and constructed seasonal wetlands shall consist of artificial depressions in artificially managed soils in the gently sloping marsh-terrestrial vegetation transition zones at the south end of the site. Alkali meadow and seasonal wetland flats shall be lined with sub-saline clay soil salvaged from on-site borrow pits, and shall be compacted when wet to minimize permeability. Surface soil and inoculum (cysts, eggs, seeds, other dormant resistant structures or propagules, etc.) shall be scraped from existing alkali meadow and seasonal wetland surfaces, and shall be salvaged, stockpiled, and covered when dry. Inoculum shall be spread over constructed seasonal wetland pools, as in vernal pool restoration techniques.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.1-5.1: POTENTIAL IMPACTS TO SPECIAL-STATUS PLANTS (DUTCH SLOUGH RESTORATION PROJECT WITH ALL OPEN WATER MANAGEMENT OPTIONS AND BOTH RELATED PROJECTS)

Plant surveys conducted in 2004 throughout the project site found only Suisun aster However, throughout the project areas there is potential habitat for a number of special status species. All three projects will remove the majority of existing vegetation, and if special status plant species were present, there is a potential for a significant impact.

"NO BURROUGHS" OPTION

In this option, all existing plant populations on the Burroughs parcel would be preserved. Although no sensitive plant species have been located on the Burroughs parcel, it could serve as a potential transplantation site for sensitive plants that need to be moved from the other parcels.

MITIGATION 3.4.1-5.1: MINIMIZE, AVOID, AND COMPENSATE FOR IMPACTS COMMON TO ALL SENSITIVE PLANTS

Mitigation for special status plant species is addressed collectively for all species, with modifications noted for individual species.

Significant impacts to special-status plant species present or likely to be present onsite shall be minimized, avoided, and contingently compensated by complying with the following:

- Pre-construction surveys: Potential habitat for special-status plant species shall be surveyed in appropriate seasons for optimal species-specific detection prior to project excavation/dredging, fill, drainage, or flooding activities associated with project construction. Survey methods shall comply with CNPS/CDFG rare plant survey protocols, and shall be performed by qualified field botanists. Surveys shall be modified to include detection of juvenile (pre-flowering) colonies of perennial species when necessary. Any populations of special status plant species that are detected shall be mapped.
- If special-status plant populations are detected where construction would have unavoidable impacts, a compensatory mitigation plan shall be prepared and implemented in coordination with USFWS or DFG. Such plans may include salvage, propagation, on-site reintroduction in restored habitats, and monitoring.

- If USFWS or DFG require propagation or transplantation, scientifically sound genetic management guidelines and protocols for rare plants shall be applied to propagation and transplant plans, possibly including the following:
  - maintain some reserve clonal stock of perennial special-status plant populations during the monitoring period to offset the risk of failure in establishing populations in the wild,
  - set aside surplus reserve seed of annual special-status plants from impacted populations
  - conduct long-term monitoring to determine the fate of managed special-status plant populations.

No special-status plant species shall be introduced to the site beyond their known historic geographic range unless such introduction is recommended in a final recovery plan or conservation plan prepared and adopted by the USFWS or the CDFG, in formal consultation with the USFWS.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.1-5.2: IMPACTS TO SPECIAL-STATUS TIDAL MARSH PLANTS OF DREDGING LITTLE DUTCH SLOUGH (DUTCH SLOUGH PROJECT)

The dredging component of Alternative 1 has the potential to significantly impact special-status plant species in tidal marsh fringing the project site.

Suisun Aster. Suisun aster colonies have been detected at the tidal edges of the Emerson parcel. Their persistence at the time of project implementation is uncertain because they are subject to extirpation and recolonization following flood control channel maintenance activities along Marsh Creek. Final design of levee improvements for the public trail system would control the potential impacts to Suisun aster, rather than project alternatives.

Direct potential impacts that eliminate existing colonies of Suisun aster at the time of construction, such as slough widening by dredging, would be adverse and significant. Indirect impacts that permanently and adversely modify suitable unoccupied existing habitat (e.g. levee armoring with rip-rap) would also be a significant impact. These potential impacts would depend on specific final project designs features that are not yet developed, and so cannot be predicted precisely.

In the long term, the proposed project has major potential for major cumulative beneficial effects on the local Suisun aster population, depending on the final design of levees and high tidal marsh edges (slopes, soils, and vegetation of restored high marsh edges of terrestrial habitats). The project proposes to revegetate portions of restored high tidal marsh with propagated Suisun aster. Natural colonization or artificial propagation and transplanting of Suisun aster to suitable constructed habitats could cause major increases in the number and persistence of local Suisun aster populations. This positive outcome would require that they be transplanted into relatively stable, compatible assemblages of native high marsh plants. This action may provide a major contribution to the conservation of the species, and possibly establish a new core population.

Depending on final design of levees retained and upgraded for public access, modification of outboard (tidal) slopes (stabilization, rock slope armor, revegetation, planting of woody riparian shrubs and trees) may also adversely affect established colonies of Suisun aster. Adverse modification of levee slopes or fringing marsh edges may preclude colonization of previously suitable habitat (reducing population viability, potential local range of the species).

Revegetation with rare plants such as Suisun aster may also have some potential adverse effects related to genetic management and propagation of rare plants. Some rare plant populations have depleted genetic variability. If propagation of founder stock of rare Suisun aster populations is not well managed genetically by careful genetic sampling and propagation of plants with known genetic identify (source population or colony, parent plants, siblings), adverse artificial genetic patterns may become permanent features in clonal perennial colonies. Hybridization of parent stock with related Chilean aster is also a genetic risk for founder populations.

Mason's Lilaeopsis. Impacts to Mason's lilaeopsis may occur within fringing tidal marshes that may be affected by restoration engineering actions, such as channel dredging to increase tidal prism of Little Dutch Slough. Additional impacts could occur from tidal breaching of levees, levee stabilization by placement of rock slope protection, and realignment of the mouth of Marsh Creek. Any Mason's lilaeopsis occurring within these areas of impact would likely be extirpated. This would be a significant impact. Gradual, natural erosion of tidal marsh channels by increased tidal prism due to tidal restoration would probably have a beneficial effect on populations, depending on the rate of marsh bank slumping. Gradual bank slumping provides opportunities for Mason's lilaeopsis' clonal (vegetative) colonization and escape from competition by tall, robust freshwater emergent marsh vegetation.

Mason's lilaeopsis is also proposed for reintroduction to the restored habitats of the Dutch Slough Restoration Project site. Suitable habitat is unlikely to be available during early project stages (early succession tidal freshwater marsh). Translocation failure risk is likely to be high if Mason's lilaeopsis is transplanted among vigorous, tall, dense tidal marsh vegetation rather than cohesive, slumping peaty marsh banks. Design options that increase the scope of rock slope placement in channels affected by boat wakes (total length of levee treated in high scour potential environments) would probably increase impacts to this species.

Delta Mudwort. Undetected populations of Delta mudwort may occur within fringing tidal marshes that may be affected by restoration engineering actions, such as channel dredging to increase tidal prism of Little Dutch Slough. Additional impacts could occur from tidal breaching of levees, levee stabilization by placement of rock slope protection, and realignment of the mouth of Marsh Creek. Any Delta mudwort occurring within these areas of impact would likely be extirpated. This would be a significant impact. Gradual, natural erosion of tidal marsh channels by increased tidal prism due to tidal restoration would probably have a beneficial effect on populations, depending on the rate of marsh bank slumping. Gradual bank slumping provides opportunities for seedling colonization of Delta mudwort in bare, slowly eroding mud or peat banks where they may escape competition from dense, tall emergent freshwater marsh vegetation.

Delta mudwort is also proposed for reintroduction to the restored habitats of the Dutch Slough Restoration Project site. Stable suitable habitat is unlikely to be available during early project stages (early succession tidal freshwater marsh). Translocation failure risk is likely to be high if Delta mudwort is transplanted into level gaps within vigorous tidal marsh vegetation early in primary marsh succession. Failure of transplanted plants may result in net negative population growth because of seed removal from source populations. This would be a significant adverse impact. Design options that increase the scope of rock slope placement (total length of levee treated) would probably increase impacts.

"No Burroughs" Option

In this option, tidal breaches would occur on Emerson Slough rather than Little Dutch Slough, therefore no dredging of Little Dutch Slough would occur. Additional analyses are needed to determine if dredging of Emerson Slough would be necessary. Until those analyses are completed, it is assumed that this option would require similar mitigation measures.

Mitigation 3.4.1-5.2: Minimize, avoid, and compensate for impacts to sensitive species of tidal marsh plants

Impacts to tidal marsh plants (Suisun aster, Mason's lilaeopsis, delta mudwort) in existing tidal habitat shall be avoided to the greatest extent feasible. If avoidance is infeasible, a compensatory mitigation plan for salvage, propagation, on-site reintroduction in restored habitats, and monitoring shall be prepared and implemented in coordination with USFWS and DFG, and subject to their approval, as for special-status plants in diked, nontidal habitats.

Also implement Mitigation 3.4.1-5.1, minimize, avoid, and compensate for impacts common to all sensitive plants.

Impact Significance after Mitigation

Less than significant with mitigation

Impact 3.4.1-5.3: Impacts of Loss of Terrestrial and Wetland Habitats to Special-Status Plants (Dutch Slough Restoration Project with all open water options and related projects)

Alkali Milkvetch. Although alkali milkvetch was not detected during rare plant surveys, Dutch Slough, Ironhouse, and City Park sites do contain potentially suitable habitat in alkali meadow, seasonal subsaline to alkaline shallow ponds, and seasonal wetlands that currently exists at the project site. Avoidance of impacts to any populations discovered in seasonal wetlands on the site would be infeasible, because they would occur far below sea level, and would be flooded under any tidal restoration or open water management alternative. If previously undetected populations of alkali milkvetch in alkali/subsaline seasonal wetlands exist on the project site, they would therefore be extirpated. The probability of this occurring is low, but this species has been found in former farmed seasonal wetlands on alkali-subsaline soils after farming ceased, so it may occur at Dutch Slough parcels with suitable habitat. Loss of alkali milkvetch, if present on the site, would be a significant adverse impact.

Special-Status Atriplex Species. Project construction and restoration would eliminate all suitable habitat (alkali meadow, seasonal subsaline to alkaline shallow ponds, seasonal wetlands) for these species that currently exists at the site. If previously undetected populations occur mixed with more common, abundant *Atriplex* species like spearscale, they would be extirpated. The probability of this is low, but of the special-status *Atriplex* species, *A. coronata* is known to have established in a small population in similar habitat at the nearby Dal Porto South parcel in recent years, and is therefore presumed to have appreciable potential to occur at the Dutch Slough Parcel. If implementation of any of the projects caused local extirpation of a population of special-status *Atriplex* species, this would be a potentially significant adverse impact.

Big Tarweed, Congdon's Tarplant. Undetected populations of big tarweed and Congdon's tarplant are unlikely to occur in suitable habitat at the Dutch Slough, Ironhouse, and City Park sites, but possible impacts would be significant if they do occur. Most existing suitable habitat at the project site occurs in arid disturbed grasslands on sandy soils above sea level. These would be difficult to protect in the course of project construction, and require extensive modification and disturbance for restoration of terrestrial grasslands.

Rose-mallow. No project impacts to wild populations of rose-mallow are likely to occur because no levee breaches or levee reconstruction/upgrade work is proposed adjacent to Dutch Slough's fringing tidal marsh, and because it is highly unlikely that rose-mallow populations persist at this location. Therefore, impacts are not expected.

If possible, rose-mallow would be re-introduced to the Dutch Slough site. There are several constraining factors to such a re-introduction, however. Because one historic locality is known from the edge of the Burroughs parcel, there is a very small chance that a population may persist; if it did, it could affect the selection of source populations for propagation and reintroduction. Sampling of rare source populations (seed, clonal divisions of rhizomes) could adversely impact populations off-site or on-site. This impact would be significant if it caused local small populations to decline or become extirpated, and this impact would be amplified if reintroduced populations were unstable and failed at the Dutch Slough Restoration Project. Improper genetic sampling of rose-mallow could cause impaired genetic viability of the reintroduced population.

Contra Costa Goldfields. No populations of Contra Costa Goldfields have been detected in plant surveys at the project site, but it is possible, though unlikely, that persistent seed banks of undetected small populations occur in alkali meadows, playa-like flats and similar seasonal wetlands. If undetected populations of Contra Costa goldfields exist on the site, construction of the Dutch Slough Restoration Project and related projects would likely eliminate them. This would be a significant impact, but it is unlikely to occur.

Delta Tule Pea. Delta tule pea is proposed for reintroduction to the restored freshwater marsh habitats of the project, but no known populations occur at the site. Perennial offsite source populations are unlikely to be impacted by seed collection for the project. Establishment of introduced delta tule pea populations to suitably restored high freshwater tidal marsh and riparian habitats at the site (within its geographic range) are likely to succeed. The Dutch Slough and related Ironhouse projects are likely to have a cumulatively beneficial effect on the conservation of delta tule pea if appropriate genetic sampling protocols for rare plants are followed in management of reintroduced populations. No mitigation is indicated for potential beneficial impacts to delta tule pea.

"No Burroughs" Option

In this option, all existing plant populations on the Burroughs parcel would be preserved. Although no sensitive plant species have been located on the Burroughs parcel, it could serve as a potential transplantation for sensitive plants that need to be moved from the other project parcels.

Mitigation 3.4.1-5.1: Minimize, avoid, and compensate for impacts common to all sensitive plants

Implement mitigation 3.4.1-5.1, above.

Impact Significance After Mitigation

Less than significant with mitigation.

Impact 3.4.1-6: Potential Loss of roosting sites for Special-status Bat Species (Dutch Slough Restoration Project with all Open Water Management Options and City Park)

Existing buildings and mature trees and snags within the project area provide potential roosting habitat for several special status bat species. If bats occupy abandoned buildings, cavity trees, or other structures associated with former dairy ranch occupancy, they would be disturbed, displaced, and their local habitats diminished or destroyed. If no alternative habitats are available, displacement of bat colonies may cause increased mortality of local populations. If special status bat species are present, these would be significant impacts.

"No Burroughs" Option

Most of the buildings and large trees found on the Dutch Slough project site are located on the Burroughs parcel. Therefore, it is likely that bats roosting on the project site would be found on the Burroughs parcel. If the "no Burroughs" option were exercised, all trees will be preserved, and the potential exists to preserve bat-occupied buildings as well, which would significantly reduce impacts to bats.

Mitigation 3.4.1-6: Minimization and compensation for Potential Impacts to Special-status Bat Species

Pre-construction (or pre-building-demolition) surveys for roosting bats shall be conducted by a qualified biologist within 30 days prior to any removal of trees or buildings. If active roosts are not found, no further action would be warranted. If bats are detected, project plans shall specify that some derelict buildings shall be retained as long as possible, and replaced with functionally equivalent or superior artificial bat roost or nursery structures that are more compatible with adjacent park and human visitors. Monitor surrogate artificial habitats to determine their effectiveness as alternative bat habitats for all species impacted.

If an active maternity roost is located, in a building or tree that cannot be preserved, demolition or removal can only take place before maternity colonies form (prior to March 1) or after young have left the colony (after July 31). If a hibernaculum is found, demolition or removal can only take place after hibernation has terminated (typically between April and September). Disturbance-free buffer zones as determined by a qualified biologist in consultation with DFG will be observed during the maternity season (March 1 to July 31) or hibernation season (October 1 to April 30). Bats may be evicted from other roost sites, under the direction of a qualified biologist, by opening the roost to introduce airflow, or by installing one-way structures to allow the bats to leave the roost but not to re-enter it. Removal or demolition of trees or structures will occur only after it is established by a qualified biologist that bats are no longer present.

Impact Significance After Mitigation

Less than significant with mitigation.

IMPACT 3.4.1-7: POTENTIAL IMPACTS TO COOPER'S HAWK (DUTCH SLOUGH RESTORATION PROJECT WITH ALL OPEN WATER MANAGEMENT OPTIONS AND CITY PARK PROJECTS)

Cooper's hawks are known from the project area, though on-site nesting was not observed during bird surveys in 2005 and 2008. Dutch Slough Restoration Project and City Park construction would eliminate many large, mature windbreak trees and old ornamental planted trees that provide potential nesting habitat for Cooper's hawk. This would be a potentially significant short-term and long-term impact. The intensity of impact would depend on the population size and level of habitat use at the time of construction.

"NO BURROUGHS" OPTION

The majority of the large trees suitable for raptor nesting within the project area are located on the Burroughs parcel. Thus, exercising this option would result in a significant reduction in impacts to nesting Cooper's hawks.

MITIGATION 3.4.1-7: MINIMIZATION, AVOIDANCE, AND TREE REPLACEMENT FOR POTENTIAL IMPACTS TO COOPER'S HAWK.

Nesting trees are the most important habitat component for Cooper's hawks in the project area. Focused annual surveys shall be conducted, beginning in 2008, to estimate the level of use and local population size of Cooper's hawks (and other nesting birds) prior to commencement of any construction activity that would affect nesting Cooper's hawks. Focused surveys shall be used to prioritize the sequence of habitat retention and disturbance during project construction phasing.

If nesting Cooper's hawks are observed on site during the pre-construction surveys, DFG will be consulted regarding appropriate avoidance and mitigation measures to meet the specific needs of the nesting birds. Measures may include establishing a buffer zone around occupied trees, adapting restoration plans or timing to preserve nesting trees, or delay of construction disturbance until after young have fledged.

Short-term impacts cannot be mitigated because existing tree habitats lie mostly below sea level. Long-term impacts shall be mitigated by riparian woodland restoration and enhancement design of the restoration project. Native coast live oak woodland groves, and individual oaks shall be included in terrestrial habitat restoration to enhance efficacy of mitigation for raptor habitat. Mature existing trees shall be retained in the community park, including decadent trees and non-invasive non-native ornamental/shade/windbreak trees.

No trees will be removed during the nesting season. In addition, implementation of Mitigation measures 3.4.1-1 and 3.4.1-11 would minimize impacts to Cooper's hawks.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation

IMPACT 3.4.1-8: LOSS OF SWAINSON'S HAWK FORAGING AND NESTING HABITAT (DUTCH SLOUGH WITH ALL OPEN WATER OPTIONS AND BOTH RELATED PROJECTS)

General habitat types were assessed during the 2005 wetland delineation, and these data, along with visual assessments, were used to quantify Swainson's hawk habitat at Dutch Slough. Two delineated habitats are used by Swainson's hawks for foraging: 'seasonal farmed wetland' and 'alkali meadow wetland', which make up 803 acres at Dutch Slough. In practice, both of these habitats are irrigated pasture, which is moderate to poor quality foraging habitat (Estep, 1989). Alfalfa and hay crops provide higher quality foraging (Estep, 1989), but these crops are only grown at Dutch Slough occasionally and in minimal acreage. Since the delineation in 2005, there has been an increase in acreage of some bunch grass species (primarily *Lolium* sp.), and this vegetative structure does not provide good foraging opportunities. This indicates that the foraging quality at the site may be decreasing. There are a number of trees suitable for Swainson's hawk nesting at Dutch Slough, though not all of them are found within the 7 delineated acres of riparian forest.

Avian surveys were conducted in 2005 and 2008. During both surveys, Swainson's hawks were seen foraging in all three parcels, though always few in number (usually just one or two at a time). During the 2005 survey, there were two pairs of Swainson's hawks nesting on the property: one on the north end of the Emerson parcel and one in the southeast of the Gilbert parcel. During the 2008 survey, a single pair nested near the house at the center of the Burroughs parcel.

Swainson's hawks use the project sites for both nesting and foraging. Therefore, development of the Dutch Slough Restoration Project, and the related City Park and Ironhouse Restoration Project would abruptly eliminate most of the open foraging habitat present in pastures and ruderal vegetation of the project sites. This would be a direct significant impact because alternative habitat is declining around the project site because of extensive residential development, causing resident birds to expend more energy and time searching for and traveling to alternative foraging areas. The cumulative decline of productive lowland pasture habitat for Swainson's hawk in the project vicinity is significant: all lowland pastures between Big Break and Sand Mound Sloughs have been converted to other land uses with low or no foraging potential for this species.

Alternative 1 would retain the largest acreage of terrestrial habitat, and maintain it in a consolidated block in the southern Emerson Parcel. This would probably act as a substantial refuge for Swainson's hawk in the long term, but there would still be a loss of about 700 acres of suitable foraging habitat. The availability of nearby offsite wildlife refuge habitat is constrained by cumulative impacts of residential development surrounding most of the project site.

Many of the large trees on the Dutch Slough site occur in areas that would be inundated by tidal waters. Once dead, these trees would no longer provide nesting habitat for Swainson's hawks. This is a potentially significant impact.

"No Burroughs" Option

The Burroughs parcel contains the majority of the large trees suitable for raptor nesting within the project area. In 2008, the only Swainson's hawk nest within the project site was located on the Burroughs parcel. In addition, approximately 300 acres on this parcel are managed as irrigated pasture, which provides foraging habitat for Swainson's hawks. Thus, exercising this option would result in a significant reduction in impacts to both foraging and nesting Swainson's hawks.

Mitigation 3.4.1-8.1: mitigation for loss of Swainson's Hawk foraging and nesting habitat.

DWR shall acquire and protect off-site mitigation lands through one (or more) of the following methods:

- acquire and permanently protect lands

- purchase conservation easements to permanently protect lands
- participation in an in-lieu fee program
- purchase of the required acreage in an approved mitigation bank
- participation in an approved Habitat Conservation Plan.

Such mitigation lands should be near the project site and contain stands of mature trees with irrigated pasture, ruderal seasonal wetland, or alfalfa hay crop cover. For maximum benefit to Swainson's hawks, the first priority would be for alfalfa or irrigated and mowed pasture.

The acreage of protected habitat shall be established in consultation with DFG and based on the following:

- number of Swainson's hawks using the project site for nesting and foraging as determined by annual bird surveys to be begun in 2008,
- ecological assessment of the acreage of habitats used by Swainson's hawk and the quality of those habitats for Swainson's hawk, and
- use of Swainson's hawk as an "umbrella" species for other sensitive species occupying terrestrial pasture/ruderal wildlife habitat at Dutch Slough.

To the extent feasible, the conservation easement or other acquisition of habitat shall be implemented before commencement of grading in irrigated pasture on the project site.

If habitat is acquired and preserved, a Mitigation and Monitoring Plan describing the mitigation and monitoring requirements and performance standards shall be prepared and submitted to DFG for approval within six months of acquisition.

In addition, implementation of mitigation measures 3.4.1-1.1, 3.4.1-1.2, and 3.4.1-11 would minimize impacts to Swainson's hawks. To the extent feasible, the levee breaches will be constructed after local Swainson's hawks have fledged their young, and possibly after birds have migrated south for the winter. This would prevent abrupt disruptions to local resident birds.

If final project designs preserve sufficient upland habitat on the project site, these lands, to the extent compatible with the restoration, will be managed as Swainson's hawk foraging habitat.

MITIGATION 3.4.1-8.2: AVOID AND MINIMIZE LOSS OF SWAINSON'S HAWK NESTING TREES.

Annual surveys shall be conducted starting in 2008 to identify trees on the Dutch Slough site that are used by Swainson's hawks. To the extent feasible, regularly used nesting trees will be protected from long- and short-term project impacts. In addition, implement Mitigation Measure 3.4.1-7.

IMPACT SIGNIFICANCE AFTER MITIGATION

If sufficient quality and quantity of off-site compensatory mitigation habitats are acquired in appropriate geographic settings, impacts would be less than significant.

IMPACT 3.4.1-9: POTENTIAL IMPACTS TO BURROWING OWLS (DUTCH SLOUGH RESTORATION PROJECT WITH ALL OPEN WATER MANAGEMENT OPTIONS AND BOTH RELATED PROJECTS)

Avian surveys conducted by DWR in 2005 and 2008 did not detect burrowing owls on site, though there is suitable habitat, and the species had been previously reported from the site. Suitable habitat for burrowing owls in pasture, levee, and ruderal vegetation with ground squirrel burrows would be inundated by tidal restoration. This habitat loss would add cumulatively to the losses of occupied burrowing owl habitat in adjacent former ranch parcels converted to residential developments. These would be significant direct and cumulative impacts to burrowing owl habitat if these owls were to occur on the site.

Recent surveys of adjacent ranches with similar pasture habitat indicated that they are often present in low numbers (several per ranch parcel), but may be concentrated in sandy soils with high densities of mammal burrows. Restored lowland grassland (closed perennial vegetation cover) may be less suitable grassland habitat for burrowing owls than disturbed, semi-open arid ruderal pasture and devegetated ditch banks of the existing cattle pastures.

"NO BURROUGHS" OPTION

Although recent surveys have not found burrowing owls on the Burroughs parcel, suitable habitat does exist there. Exercising the "no Burroughs" option, preserving it as upland habitat, would preserve potential habitat for the owls. If owls were found on the other Dutch Slough parcels, and moving the owls was deemed appropriate by USFWS and DFG, artificial burrows could be created for them on the Burroughs parcel.

MITIGATION 3.4.1-9 MINIMIZE AND COMPENSATE FOR POTENTIAL IMPACTS TO BURROWING OWLS

Annual surveys will be conducted starting in 2008 to determine foraging and nesting status, and population size. Surveys shall comply with standard protocol survey methods approved by DFG. In addition, surveys will be conducted within 30 days of commencement of earth-moving activities, or other construction activities, such as placement of fill. Pre-construction surveys must be repeated if more than 30 days pass between survey dates and construction activities.

Presence or sign of burrowing owl and all potentially occupied burrows will be recorded and monitored according to DFG guidelines. If burrowing owls are not detected by sign or direct observation, construction may proceed. If burrowing owls are present during surveys conducted between February 1 and August 31, grading will not be allowed within 250 feet of any burrow, unless approved by DFG.

A compensatory mitigation plan shall be prepared and implemented if burrowing owls are confirmed to occur on site. Compensatory mitigation shall comply with guidelines accepted by DFG. Mitigation may include placement of exclusion doors on occupied burrows (passive relocation), establishment of artificial burrows on or near the project site, or monitoring of burrows.

If burrowing owls are detected on the project site, foraging habitat with natural or artificial burrows will be acquired and permanently protected to compensate for the habitat loss. The protected lands shall be occupied burrowing owl habitat, or created habitat, in an area acceptable to DFG. First priority would be to preserve habitat on the project site; second priority would be to off-site locations near (within approximately a 5 mile radius of) the project site; third priority would be to off-site location further from the project site that is acceptable to DFG. Habitat will be acquired, permanently protected, and enhanced through management, for the benefit of the burrowing owl. If lands are purchased and managed, a Mitigation and Monitoring Plan describing the mitigation and monitoring requirements and performance standards will be prepared. Alternatively, the required mitigation can be met by purchase of credits in an accepted mitigation bank, in-lieu fee program, or approved Habitat Conservation Plan

If acceptable to DFG, Mitigation 3.4.1-8.1 (purchase of off-site mitigation area primarily for Swainson's hawk) may also be applied to this impact to compensate for significant loss of suitable habitat because the degree to which restored grasslands on the project site (which, under the influence of higher groundwater elevations adjacent to restored tidal marsh, may naturally develop lowland grassland characteristics less suited to burrowing owl) compensate for habitat losses is doubtful.

IMPACT SIGNIFICANCE AFTER MITIGATION

If burrowing owls are found on the project site, potentially significant impacts may persist after mitigation, because the feasibility of mitigation is unknown (particularly the availability of off-site compensatory habitat).

IMPACT 3.4.1-10: POTENTIAL IMPACTS TO WHITE-TAILED KITE AND NORTHERN HARRIER (DUTCH SLOUGH RESTORATION PROJECT WITH ALL OPEN WATER MANAGEMENT OPTIONS AND BOTH RELATED PROJECTS)

Construction and habitat conversion would abruptly eliminate existing available foraging habitat and impact nesting habitat on site. These would be significant impacts. The three Dutch Slough Restoration Project "build" alternatives would not differ substantially in their significant short-term impacts to these species. Alternative 1 would include more suitable terrestrial foraging habitat and nesting habitat in the long term, but less wetland foraging habitat. All project "build" alternatives would significantly reduce potential nesting sites for white-tailed kites in mature trees. The open water management option for subsidence reversal (nontidal tule marsh) would reduce net loss of high-value foraging habitat for white-tail kites and northern harriers compared with deepwater or skeletal marsh/channel options.

"NO BURROUGHS" OPTION

The Burroughs parcel contains the majority of the large trees suitable for white-tailed kite nesting within the project area. In addition, the majority of the terrestrial and wetland habitat (approximately 350 acres) on the Burroughs parcel provides foraging habitat for white-tailed kites and foraging or nesting habitats for northern harriers. Thus, exercising this option would result in a significant reduction in impacts to both foraging and nesting habitats for these species.

MITIGATION 3.4.1-10: MITIGATION FOR POTENTIAL IMPACTS TO WHITE-TAILED KITE AND NORTHERN HARRIER

Implementation of Mitigation 3.4.1-1.1, 3.4.1-1.2, and 3.4.1-11 would minimize impacts to these raptor species. If off site mitigation lands are acquired as per Mitigation 3.4.1-8.1, these lands would also mitigate for impacts to white-tailed kites and northern harriers.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation, because white-tailed kites and northern harriers can utilize marsh as well as grassland habitat for foraging.

IMPACT 3.4.1-11: POTENTIAL IMPACTS TO NESTING BIRDS (DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS AND ALL OPEN WATER MANAGEMENT OPTIONS)

Several special status and common bird species have the potential to nest throughout the project area. Annual bird surveys will be conducted, beginning in 2008, which will document nesting by special status species. All areas except open water are potential nest sites including all vegetation types and structures. Removal of buildings or trees, grading or earth moving, and introduction of tidal action have the potential to result in nest abandonment, nest failure, or premature fledging of young. Destruction or disturbance of active nests would be a violation of the Migratory Bird Treaty Act and DFG Code, and would be considered a potentially significant or significant impact, depending on the level of disturbance and the species disturbed.

"NO BURROUGHS" OPTION

Exercising the "no Burroughs" option would protect all the existing bird nesting sites on that parcel. The parcel contains a number of suitable nesting sites including large trees, buildings, riparian woodland, terrestrial pasture and ruderal habitat, and freshwater marsh.

MITIGATION 3.4.1-11: MITIGATION FOR POTENTIAL IMPACTS TO NESTING BIRDS

Earth moving activities and removal of buildings or trees shall occur from September 1 through February 28, outside the normal nesting season. If earth moving must occur during the nesting season, vegetation shall be removed from September 1 to February 28, to discourage nesting in the construction area. If removal of structures, trees or other vegetation, or construction begins between March 1 and August 31, a nesting bird survey shall be performed by a qualified biologist within 14 days prior to the disturbance. The biologist shall inspect for nests in all potential habitats (trees, shrubs, structures, grasslands, pastures, emergent wetland vegetation, etc.) in and immediately adjacent to the impact area, as well as watch for adult birds displaying reproductive behaviors such as carrying nest materials or food items.

If active nests are found, appropriate non-disturbance buffer zones shall be established around the nest site. The size of the buffer zone will be determined by a qualified biologist in consultation with DFG, and will depend upon the species involved, site conditions, and type of work to be conducted in the area.

Active nests shall be monitored by a qualified biologist to determine when young have fledged and are no longer using the nest site. The biologist and DFG shall determine when construction activities may resume in the buffer zone.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

Impact 3.4.1-12 Potential Impacts to Tricolored Blackbirds (Dutch Slough Restoration Project with all Open Water Management Options and both Related Projects)

Dutch Slough Restoration Project construction activities and tidal habitat conversion would eliminate suitable foraging habitat of tricolored blackbird, primarily in seasonal wetland within grazed irrigated pastures. Although the restored tidal marsh may provide nesting habitat for the species, long-term restoration of tidal marsh and terrestrial grassland would not compensate for loss. This would be a potentially significant short-term and long-term impact. This impact would be cumulatively significant because of widespread conversion of similar extensive habitat to residential development in all adjacent ranches. Annual bird surveys will be conducted, beginning in 2008, which will assess use of the site by tricolored blackbirds.

"No Burroughs" Option

Exercising the "no Burroughs" option would protect approximately 350 acres of potential foraging habitat for the tricolored blackbirds, decreasing impacts to the species.

Mitigation 3.4.1-12: Mitigation for Potential Impacts to Tricolor Blackbirds

If off-site mitigation lands are acquired as per Mitigation 3.4.1-8.1, they would mitigate for loss of foraging habitat for tricolored blackbirds. If final project designs maintain significant acreage of terrestrial habitat, this would reduce impacts to tricolored blackbirds. Increases in acreage of tidal marsh may provide nesting habitat for the species in the long term.

Impact Significance After Mitigation

If sufficient quality and quantity of off-site compensatory mitigation habitats are acquired in appropriate geographic settings, impacts would be less than significant.

Impact 3.4.1-13: Potential Impacts to California Horned Larks (Dutch Slough Restoration Project with Open Water Management Options and both Related Projects)

Construction and tidal restoration activities would destroy most suitable habitat for California horned larks (irrigated and arid pastures) in the short-term. This would be a potentially significant impact. Annual bird surveys will be conducted, beginning in 2008, which will assess use of the site by horned larks.

"No Burroughs" Option

Exercising the "no Burroughs" option would protect approximately 350 acres of potential foraging and nesting habitat for horned larks, decreasing impacts to the species.

Mitigation 3.4.1-13: Mitigation for Potential Impacts to California Horned Larks

If off-site mitigation lands are acquired as per Mitigation 3.4.1-8.1 this impact would be mitigated. If final project designs maintain significant acreage of terrestrial habitat, this would reduce impacts to horned larks. In addition, implementation of Mitigation Measures 3.4.1-1.1, 3.4.1-1.2, and 3.4.1-11 would minimize impacts to horned larks.

IMPACT SIGNIFICANCE AFTER MITIGATION

Provision of adequate off-site or on-site mitigation acreage including interspersion of seasonal wetlands in irrigated pasture would reduce this impact to less than significant. The Dutch Slough and Ironhouse restorations themselves would not compensate for the seasonal wetland habitat/grassland mosaic in irrigated pastures.

IMPACT 3.4.1-14: POTENTIAL IMPACTS TO LOGGERHEAD SHRIKES (DUTCH SLOUGH RESTORATION PROJECT WITH OPEN WATER MANAGEMENT OPTIONS AND BOTH RELATED PROJECTS)

Construction and tidal restoration activities would eliminate most suitable foraging habitat for loggerhead shrikes (irrigated and arid pastures, scrub) in the short- and long-term. This would be a potentially significant impact. Annual bird surveys will be conducted, beginning in 2008, which will assess use of the site by loggerhead shrikes and quantify the level of impact.

"NO BURROUGHS" OPTION

Exercising the "no Burroughs" option would protect approximately 350 acres of potential foraging habitat for loggerhead shrikes, decreasing impacts to the species.

MITIGATION 3.4.1-14: POTENTIAL IMPACTS TO LOGGERHEAD SHRIKES

If off-site mitigation lands are acquired as per Mitigation 3.4.1-8.1 this impact would be mitigated. If final project designs maintain significant acreage of terrestrial habitat, this would reduce impacts to loggerhead shrikes.

IMPACT SIGNIFICANCE AFTER MITIGATION

Provision of adequate off-site or on-site mitigation acreage including interspersion of seasonal wetlands in irrigated pasture would reduce this impact to less than significant. The Dutch Slough and Ironhouse restorations themselves would not compensate for the seasonal wetland habitat/grassland mosaic in irrigated pastures.

IMPACT 3.4.1-15: POTENTIAL IMPACTS TO YELLOW-BREASTED CHATS AND OTHER MARSH AND RIPARIAN SONGBIRDS (DUTCH SLOUGH RESTORATION PROJECT WITH ALL OPEN WATER MANAGEMENT OPTIONS)

Yellow-breasted chats may be exposed to short-term adverse impacts of habitat destruction during project construction. Short-term losses of existing freshwater marsh/riparian habitat edges on site would reduce or eliminate habitat for the species. This could be a significant short-term impact. In the long-term, the project would increase habitat for the species.

"NO BURROUGHS" OPTION

Exercising the "no Burroughs" option would protect existing freshwater marsh and riparian habitat for chats and other songbirds, decreasing the short-term impacts to these species.

MITIGATION 3.4.1-15: MITIGATION FOR POTENTIAL IMPACTS TO YELLOW-BREASTED CHATS AND OTHER SONGBIRDS

Mitigation 3.4.1-3 applies to this impact. Annual bird surveys will be conducted, beginning in 2008, which will assess use of the site by yellow-breasted chats and other special status marsh songbirds. If those surveys have documented nesting by any special status marsh songbirds prior to construction, applicants shall conduct additional surveys for yellow-breasted chats and avoid disturbance of high-use habitats during the nesting season. This would reduce impacts to chats and other riparian songbirds to less than significant levels.

In addition, implementation of Mitigation measure 3.4.1-1.1 would minimize impacts to yellow-breasted chats.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.1-16: POTENTIAL IMPACTS TO SPECIAL-STATUS WADING BIRDS (DUTCH SLOUGH RESTORATION PROJECT)

Because snowy egrets and white-faced ibis would be able to forage in recently flooded, disturbed wetlands with shallow water and fish, their foraging habitat use would not be adversely affected by project construction activities or interim nontidal water management. However, there would be short-term habitat loss in the period between site grading and inundation. In addition, some potential roosting habitat for egrets would be lost due to elimination of existing nontidal riparian woodland (especially decadent old stands) near foraging habitats. Because there is no evidence of site-faithful or location-specific egret roosts, this would not be a significant impact. Egrets would probably benefit from long-term tidal marsh restoration with adjacent riparian woodland, mostly in channel edges. No mitigation is indicated for foraging habitat.

OPEN WATER MANAGEMENT OPTIONS

Managed marsh (subsidence reversal) during early phases of succession is likely to provide the greatest benefits of all options. Skeletal marsh/channel could also provide substantial benefits, depending on steepness of marsh berms.

MITIGATION 3.4.1-16: MITIGATION FOR SPECIAL-STATUS WADING BIRDS

Because the restoration would increase marsh habitats, wading birds are expected to benefit from the project (mitigation 3.4.1-2.1). Mitigation 3.4.1-1.2 includes large woody debris that will provide riparian roosting habitat in the interim before restored riparian woodland develops mature or decadent roosting or nesting structures, also applies to this impact.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.1-17: POTENTIAL IMPACTS TO CALIFORNIA BLACK RAIL (DUTCH SLOUGH RESTORATION PROJECT WITH OPEN WATER MANAGEMENT OPTIONS AND IRONHOUSE PROJECTS)

Dredging of fringing tidal marshes along Little Dutch Slough to increase tidal prism/flow conveyance could disturb California black rails, destroy potential nests, and destroy suitable habitat. The project as a whole would likely have long-term beneficial effects on the region's California black rail population.

"NO BURROUGHS" OPTION

If the "no Burroughs" option were exercised, dredging of Little Dutch Slough would not occur, so there would be no associated impacts to black rails or their habitat.

MITIGATION 3.4.1-17: MITIGATION FOR POTENTIAL IMPACTS TO CALIFORNIA BLACK RAIL

Annual bird surveys will be conducted, beginning in 2008, which will assess use of the site by black rails. If those surveys have documented presence of black rails, DWR shall conduct pre-construction surveys for rails in potential dredging or construction sites in or adjacent to fringing tidal marshes. If California black rails are detected within 500 feet of proposed dredging or construction sites, DWR shall consult with DFG to modify construction timing and location to minimize or avoid impacts.

In addition, Mitigations 3.4.1-2.1, 3.4.1-2.2, and 3.4.1-2.3 also would apply to this impact.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.1-18: POTENTIAL IMPACTS TO CALIFORNIA TIGER SALAMANDERS (DUTCH SLOUGH RESTORATION PROJECT WITH OPEN WATER MANAGEMENT OPTIONS AND BOTH RELATED PROJECTS)

If undetected relict populations of California tiger salamander occur within suitable habitat (alkali meadow, seasonal pools near ground squirrel burrows in terrestrial habitat) at the project site, they would be eliminated by Dutch Slough Restoration Project construction and tidal restoration. This would be a significant impact. The probability of this impact is very unlikely, but unknown because of a lack of survey information.

"NO BURROUGHS" OPTION

Exercising the "no Burroughs" option would protect approximately 350 acres of potential habitat for tiger salamanders, decreasing potential impacts to the species.

MITIGATION 3.4.1-18: MITIGATION FOR POTENTIAL IMPACTS TO CALIFORNIA TIGER SALAMANDERS

DWR, through the federal lead permit agency, shall conduct early informal consultation with the USFWS to determine whether or how surveys for the California tiger salamander shall be performed in suitable pools at the Dutch Slough project site. Avoidance of impacts to local populations and habitats would be infeasible because of the subsided (below sea level) position of existing potential habitats. If California tiger salamanders are detected on site, DWR shall consult with USFWS and DFG. Three possible mitigation strategies may be applicable: (a) construction of suitable alternative seasonal wetland habitat within the overall wetland restoration project, followed by translocation of captured tiger salamander adults to receptive, suitable habitat; (b) off-site protection and enhancement of existing, established tiger salamander populations; or (c) a combination of (b) and (c). Otherwise, impacts would be significant and unmitigated in the unlikely event that populations do occur on site. Any plans to construct surrogate habitat and translocate California tiger salamanders shall be coordinated and approved by USFWS and DFG.

IMPACT SIGNIFICANCE AFTER MITIGATION

It is unlikely that the species is present on the project site, so there is very low probability of any impact. However, if the species were present on the site, off-site mitigation would be required to reduce impacts to less than significant.

IMPACT 3.4.1-19 POTENTIAL IMPACTS TO CALIFORNIA RED-LEGGED FROGS (DUTCH SLOUGH RESTORATION PROJECT AND ALL OPEN WATER MANAGEMENT OPTIONS)

Dutch Slough Restoration Project construction, water management, and tidal restoration would eliminate suitable, relatively isolated patches of freshwater marsh habitats that are potentially suitable for the California red-legged frog. Surveys of nearby areas have not found any red-legged frogs, and dispersal corridors from remote off-site populations to the site's isolated patches of suitable habitat are densely populated with bullfrogs (heavy predation "sink"), so the on-site habitat patches are unlikely to be occupied by California red-legged frogs. If, however, small (low probability of detection), isolated, remnant populations of California red-legged persist on the site, they would probably suffer local extirpation as a result of project construction. No California red-legged frogs have been detected on the Dutch Slough Restoration Project site in general amphibian and reptile surveys, so this potential significant impact is unlikely to occur.

"NO BURROUGHS" OPTION

Exercising the "no Burroughs" option would protect ditches and freshwater marsh on the parcel which could serve as potential habitat for red-legged frogs, decreasing impacts to the species.

MITIGATION 3.4.1-19: MITIGATION FOR POTENTIAL IMPACTS TO CALIFORNIA RED-LEGGED FROGS

DWR, through the federal lead permit agency, shall conduct early informal consultation with USFWS to determine whether or how surveys for the California red-legged frog shall be performed at the Dutch Slough project site. If this species is detected, develop and incorporate habitat restoration and relocation plans for any populations detected at the Dutch Slough project site, in context of formal consultation with the USFWS. Suitable restored habitats to mitigate losses of occupied on-site habitats may include relatively isolated depressional freshwater marshes and ponds near the landward edge of the restored tidal marsh. These shall be in areas where seasonal evaporation (drawdown, concentration of brackish salinity (2-3 ppt) to moist soil in late summer may restrict the life-cycle of predatory non-native bullfrogs (tadpoles normally requiring maturation in continuously flooded nonsaline habitats 2 years), and facilitate maintenance of relatively viable, persistent local California red-legged frog populations.

Impact Significance After Mitigation

Less than significant with mitigation.

Impact 3.4.1-20: Potential Impacts to Northwestern Pond Turtles (Dutch Slough Restoration Project with Open Water Management Options and Related Projects)

Occupied on-site habitats and populations of northwestern pond turtles would be directly impacted by earth moving and tidal marsh restoration. Existing habitats below sea level would be submerged by restored tides, which would increase aquatic habitat but would probably reduce basking and nesting habitats. If fill or borrow sites are selected in occupied habitats, individuals may be destroyed directly by earthmoving activities.

The Dutch Slough and related Ironhouse restoration projects may, in the long-term, provide a net gain of suitable habitat in restored tidal freshwater marshes. However, this potential benefit would depend on the availability of specific, essential sub-habitats, including well-distributed basking sites, nesting habitat, flood escape habitat, and backwater ponds relatively free from predatory fish and bullfrogs. These specialized structural features of tidal marsh are not currently included in project designs, and they are unlikely to develop spontaneously in immature, early-succession freshwater tidal marsh during periods of accelerated sea level rise.

The presence of a small (<2 year old) pond turtle in 2005 established that there is successful pond turtle breeding on or near the project site. Because the actual nesting area is unknown, nesting habitat on the Dutch Slough or Ironhouse sites could be lost when the area is restored to tidal action. If there is nesting habitat on the City Park site, it will also be negatively affected by development of the park. Loss of nesting habitat would be a significant impact.

"No Burroughs" Option

Pond turtles are regularly seen in water bodies on the Burroughs parcel. These habitats would remain undisturbed if the Burroughs parcel were not restored to tidal action; this would significantly reduce impacts to the species.

Mitigation 3.4.1-20: Mitigation for Potential Impacts to Northwestern Pond Turtles

Apply Mitigation measures 3.4.1-2.1-3. A detailed habitat assessment of the Dutch Slough and City Park project sites shall be done by a qualified biologist to determine locations of potential nesting habitat, and how tidal action may affect those areas. USFWS and DFG will be consulted to determine optimal timing of the levee breaches to minimize the potential inundation of turtle nests (also considering effects on other special-status species). In addition, earth-moving activities of the project shall be phased to protect existing western pond turtle habitats and populations at least until suitable replacement freshwater marsh and shallow open water habitats have been restored on-site. DWR shall consult with the USFWS and DFG to determine the need for active translocation of northwestern pond turtles from existing marsh/pond habitats to constructed suitable pond turtle habitats. The amount, type, and location of large woody debris suitable as cover and basking habitat for northwestern pond turtle shall be modified to enhance habitat value for northwestern pond turtles along constructed tidal sloughs. In consultation with DFG and USFWS, nesting habitat features may be incorporated into the final Dutch Slough project design.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.1-21: POTENTIAL IMPACTS TO GIANT GARTER SNAKES (DUTCH SLOUGH RESTORATION PROJECT AND BOTH RELATED PROJECTS)

A detailed habitat assessment of the Dutch Slough project site was completed in 2005. The assessment concluded that although there was potential habitat, it was unlikely to be occupied by giant garter snakes based on the land use, quality and quantity of habitat, and absence of a nearby population. In addition, based on recent, rigorous, area-wide focused surveys including Marsh Creek and the Contra Costa Canal, it is highly unlikely that the Dutch Slough, Ironhouse, or City Park sites are occupied by giant garter snakes. Therefore, the projects are not expected to impact the species. If undetected populations of giant garter snakes were present in suitable existing habitats on site (particularly Emerson Parcel), however, construction and restoration impacts of tidal conversion would probably cause mortality of individual garter snakes, or extirpation of the local population. Existing suitable giant garter snake habitat would be eliminated. The long-term freshwater tidal marsh restoration of the project site is likely to increase habitat availability and quality, but realization of this habitat area and volume would depend on potential colonization from nearby source populations, rare long-distance dispersal events, or recovery-related translocation actions approved by the USFWS.

OPEN WATER MANAGEMENT OPTIONS

Skeletal marsh/creek designs may provide additional habitat for Giant Garter Snake if channel banks include topographic high areas supporting high marsh, riparian thickets, and large woody debris. Subsidence reversal option may also provide marginal additional habitat.

"NO BURROUGHS" OPTION

Exercising the "no Burroughs" option would protect ditches, freshwater marsh, and potential basking habitats on the parcel, decreasing potential impacts to giant garter snakes.

MITIGATION 3.4.1-21: MITIGATION FOR POTENTIAL IMPACTS TO GIANT GARTER SNAKES

On-site mitigation measures for impacts to northwestern pond turtles (Mitigation 3.4.1-20) as well as Mitigation 3.4.1-2.1-3 would substantially mitigate significant impacts to any extant on-site giant garter snake population, if it exists. In addition, DWR shall:

- Conduct early informal consultation with the USFWS to determine whether or how surveys for the giant garter snake shall be performed in suitable, relatively isolated freshwater marsh habitat patches at the Dutch Slough project site.
- Perform pre-construction surveys for giant garter snakes if required by USFWS.
- If this species is detected, develop and incorporate habitat restoration and relocation plans for any populations detected, in context of formal consultation with the USFWS.

IMPACT SIGNIFICANCE AFTER MITIGATION.

Less than significant with mitigation.

IMPACT 3.4.1-22: POTENTIAL IMPACTS TO SILVERY LEGLESS LIZARD (DUTCH SLOUGH RESTORATION PROJECT WITH ALL OPEN WATER MANAGEMENT OPTIONS AND CITY PARK)

Silvery legless lizards have the potential to inhabit areas of sandy soils which are present on all three parcels of the Dutch Slough project, and the City Park property. All these areas are moderately to heavily disturbed by development and human activities (City Park Property), agriculture (vineyard on Emerson parcel), or grazing (all other areas of the Dutch Slough project) which make it unlikely that legless lizards occupy the project site. Some of the sandy soil areas on the Emerson and Gilbert parcel are likely to remain uninundated by the tidal restoration.

MITIGATION 3.4.1-22: MITIGATION FOR POTENTIAL IMPACTS TO SILVERY LEGLESS LIZARD

Because potential habitat on the Dutch Slough site is highly disturbed and therefore unlikely to be occupied by the silvery legless lizard, and because the species is difficult to detect, surveys for the species are not proposed. To mitigate for potential impacts, the restoration plan will include habitat improvements to the sandy areas that will remain uninundated after tidal restoration to benefit silvery legless lizard, as well as other special-status dune species. Species experts, USFWS, and DFG will be consulted on details for habitat improvements.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.1-23: POTENTIAL IMPACTS TO VERNAL POOL FAIRY SHRIMP AND OTHER SPECIAL STATUS VERNAL POOL INVERTEBRATES (DUTCH SLOUGH RESTORATION PROJECT AND OPEN WATER MANAGEMENT OPTIONS)

Habitat assessments and surveys for vernal pool fairy shrimp and branchiopods at adjacent ranches south of Dutch Slough and east of the project site have had generally negative survey results; most of these areas have had low to moderate potential suitable habitat for insects, and some suitable habitat for branchiopods. These conditions are similar at Dutch Slough; given the disturbance from grazing and agriculture, and the preponderance of nonnative annual grasses, there is little habitat for special status invertebrates.

DWR conducted a habitat assessment for vernal pool branchiopods on March 18, 2008. A number of areas were found that were considered to be potential habitat, though the likelihood of branchiopod presence was considered low due to the lack of standing water during the assessment, the preponderance of non-clay soils at the site, and information from long-time resident Brent Gilbert who reported that there are few areas that hold water longer than a week or two during the winter. Because most potentially suitable habitats are likely to be degraded by irrigation, cattle, and dominance of nonnative species, populations would probably be low in conservation importance if they did occur. If undetected populations of vernal pool invertebrate species occurred on-site, however, they would be eliminated by construction and restoration activities. This would be a potentially significant impact.

“No Burroughs” Option

Exercising the “no Burroughs” option would protect any existing ponds, ditches, or seasonal wetlands on the Burroughs parcel that may provide habitat to vernal pool invertebrates. This would decrease potential impacts to these species.

Mitigation 3.4.1-23: Mitigation for Potential Impacts to Vernal Pool Fairy Shrimp and other Special-Status Vernal Pool Invertebrates

A qualified biologist shall conduct wet season surveys on the Dutch Slough project site for vernal pool invertebrates for one winter survey period according to USFWS protocol. If special-status species are not found during the wet season survey and it is deemed necessary by the qualified biologist to continue surveys, one additional wet season survey will be conducted. If special-status species are not detected after completion of the second survey, no further mitigation will be required.

If any special-status branchiopod is detected, suitable replacement habitat (with proper hydroperiod and depth) should be constructed at a 2:1 ratio on appropriate soils on-site. The habitat shall be permanently protected, enhanced, and managed for the benefit of the species. Original areas occupied by special-status vernal pool species shall be excavated in such a way to preserve the uppermost layer of soil, which may contain cysts of special-status species and seeds of native plants. This soil shall be placed in newly-created habitat as inoculum. A Mitigation and Monitoring plan describing the habitat replacement/translocation plan, mitigation and monitoring requirements, and performance standards shall be prepared if habitat is developed for special status vernal pool species. This Plan will be reviewed for approval by the UFWS and DFG.

If it is deemed infeasible to create habitat on-site, habitat will be replaced, created, or preserved at a location approved by USFWS. The habitat in the amount specified by USFWS shall be acquired, permanently protected, and enhanced for the benefit of the species. Alternatively, DWR may provide the required acreage in an approved mitigation bank or Habitat Conservation Plan.

Impact Significance After Mitigation

Less than significant with mitigation.

Impact 3.4.1-24: Potential Impacts to Valley Elderberry Longhorn Beetle (Dutch Slough Restoration Project and City Park)

At least two elderberry shrubs are present on the project sites. One of these is near the boundary of the Dutch Slough project and the City Park, but its exact location relative to the line between the properties has not yet been established. However, it is likely that both shrubs will be impacted by the projects, leading to potential impacts to the beetle.

Mitigation 3.4.1-24: Mitigation for Potential Impacts to Valley Elderberry Longhorn Beetle

A stem count and measurement of the two elderberry shrubs will be conducted 60 days prior to construction activity that would disturb the plants. Based on number and size of stems, USFWS guidelines for replacement and mitigation will be followed. If feasible, the shrubs will be salvaged and planted elsewhere on the Dutch Slough project site. Additional elderberry shrubs, as determined by USFWS guidelines will also be planted on-site, or possibly at an off-site mitigation area or bank approved by USFWS.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.1-25: POTENTIAL IMPACTS TO HERITAGE OR OTHER TREES PROTECTED BY LOCAL ORDINANCE (DUTCH SLOUGH RESTORATION PROJECT AND CITY PARK)

A number of trees within the project areas for the Dutch Slough project and the City Park would be removed directly or killed by tidal inundation. Some of these may qualify as Heritage or Protected Trees under the City of Oakley Tree Ordinance.

"NO BURROUGHS" OPTION

The majority of the large trees on the project site are located on the Burroughs parcel. Thus, exercising this option would result in a significant reduction in impacts to protected trees.

MITIGATION 3.4.1-25: MITIGATION FOR POTENTIAL IMPACTS TO PROTECTED TREES

Once design plans for the Dutch Slough Restoration and the City Park are finalized, an assessment will be made to determine which trees will be removed or killed by the projects. A certified arborist will be hired to examine the trees and determine whether they are protected by the tree ordinance. All protected trees will be mitigated for as outlined in the ordinance.

DWR WILL CONSULT WITH THE CITY OF OAKLEY WHEN DETERMINING THE NUMBER AND SPECIES OF TREES TO BE PLANTED ON THE DUTCH SLOUGH PROJECT SITE.IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

CUMULATIVE IMPACTS

CUMULATIVE IMPACTS TO TERRESTRIAL AND WETLAND BIOLOGICAL RESOURCES

The alternatives' contributions to potential significant cumulative impacts to wetland and terrestrial biological resources are summarized below. They are evaluated in detail above under the Alternative 1 impact analysis.

- Cumulative reduction in the amount and quality of foraging habitat (open grassland-like habitats) utilized by special status birds, including Swainson's hawk, burrowing owls, California horned lark, and loggerhead shrike.
- Cumulative reductions to the population size and viability of special-status birds dependent on pasture and ruderal habitat (open grassland-like habitats) utilized by special status birds, including Swainson's hawk, burrowing owls, California horned lark, and loggerhead shrike.
- Cumulative reductions of the amount of seasonal wetland habitat associated with alkali meadow and similar habitats similar to playa, alkali grassland, or alkali vernal pools.

- Cumulative loss of steep peat banks fringing tidal marshes, generally caused by boat wakes, but also by channel dredging and rock slope armor.
- Cumulative loss of successful western pond turtle breeding habitat.
- Cumulative reductions in the stability and persistence of established clonal populations of Suisun aster.

IMPACT SIGNIFICANCE AFTER MITIGATION

Cumulative impacts to wildlife dependent on terrestrial biological resources are due in part to recent and planned residential development throughout these habitats between Marsh Creek and Sand Mound Slough, leaving the last large block of this habitat mix at the project site. This cumulative wildlife habitat loss affects Swainson's hawk, burrowing owls, California horned lark, and loggerhead shrike. If onsite mitigation for cumulative impacts to special-status and sensitive species is inadequate, the project's impacts to wildlife would be mitigated by providing compensating offsite mitigation. This would reduce the project's contribution to cumulative impacts to these species to a less than significant level.

Other cumulative impacts are likely to be fully mitigated by a combination of on-site mitigation measures to minimize, avoid, or rectify individual project impacts, and limited off-site mitigation. Burrowing owl impacts may also fall in this category, depending on the offsite mitigation approach applied (extensive grassland protection versus Contra Costa Canal bank enhancement). Construction and management of specific, local seasonal wetlands types at adjacent Iron-house parcels may mitigate cumulative impacts to species dependent on this habitat type, but the availability of these lands is also uncertain.

ECOLOGICAL CONSEQUENCES OF ACCELERATED SEA LEVEL RISE

The ecological consequences of accelerated sea level rise are a concern for all tidal marsh restoration projects. At low rates of sea level rise, such as those that have prevailed in the last 3,000 years, freshwater tidal marshes generally kept pace with rising sea level by compensatory increases in marsh primary production (organic peat accumulation), or both. Modern freshwater tidal marsh succession may proceed from low intertidal marsh to high intertidal marsh through the same processes. In contrast, when sea level rises at rates that exceed the ability of tule marshes to keep pace with marsh peat accretion, marshes gradually "drown" – upper tidal marsh zones may submerge and convert to low marsh, and lower marsh zones may be converted to shallow open water or SAV (submerged aquatic vegetation) beds. Tidal marsh drowning has already occurred in the United States in some coastal regions with locally accelerated sea level rise due to subsidence, and it is expected to occur in the future (Reed and Cahoon 1992; Reed 1995; Morris et al. 2002; Overpeck et al. 2006).

The ecological expression of accelerated sea level rise in approaching decades at the Dutch Slough Restoration Project may include: (a) more gradual than expected colonization of low marsh at the lower intertidal zone; with prolonged persistence of mudflats; (b) "drowning" or submergence of lower tule marsh, and conversion to SAV or channel habitat; (c) delayed or arrested emergence of upper intertidal freshwater marsh with high species diversity; (d) compression of tidal marsh zonation along steeper slopes of levees. Some of these effects of sea level rise may be subject to adaptive management actions, such as artificial construction of localized high marsh on artificial fill. Other impacts related to systemic sediment deficits or submergence due to sea level rise may be less readily compensated.

Alternative 2: Moderate Fill

Impact 3.4.2-1.1: Potential Impacts to Irrigated Pastures (Including Jurisdictional Seasonal Wetlands) and Ruderal Terrestrial Habitats and Associated Wildlife Species (all options)

Alternative 2 retains substantially less terrestrial habitat within the project site than Alternative 1. Alternative 2 also distributes terrestrial habitat in narrower borders, like buffer zones, and in low islands within the restored tidal marsh. These terrestrial edge habitats are likely to provide more habitat value for resident marsh wildlife, but would provide relatively lower habitat value (per acre) for principally terrestrial wildlife associated with large, continuous blocks of terrestrial habitat, especially foraging raptors. Alternative 2 would have stronger significant impacts to terrestrial wildlife compared with Alternatives 1 and 4 (No Project). It would not differ significantly from Alternative 3 in this respect.

Mitigation 3.4.2-1.1: Avoid and minimize effects of loss of irrigated pasture and ruderal habitats through Project timing and phasing.

Same as Alternative 1, but greater impacts would result from Alternative 2 because less terrestrial habitat would be retained and restored. The quality of retained and restored terrestrial habitat would probably differ from existing conditions and Alternative 1 because a higher proportion of terrestrial habitats would occur at the edge of tidal marsh, and would be affected by high groundwater. This would promote more closed, perennial grassland and scrub vegetation. Therefore, more off-site mitigation would be required.

Impact Significance after Mitigation

If sufficient quality and quantity of off-site compensatory mitigation habitats are acquired in appropriate geographic settings, impact would be less than significant.

Mitigation 3.4.2-1.2 & 3.4.2-1.3: Mitigate for and minimize effects of (.2) Recreation, and (.3) Effects of city park lighting.

Both Mitigation Measures will be the same as for Alternative 1.

Impact Significance After Mitigation

Less than significant.

Impact 3.4.2-2.1: Potential Impacts to Tidal Freshwater Marsh Habitats and Associated Wildlife Species (Dutch Slough Restoration Project and Related Projects)

The impacts to wildlife in existing freshwater tidal marsh habitats are the same as Alternative 1, but the degree to which the restoration projects "self-mitigate" by providing an increase in habitat acreage may differ in Alternative 2. Alternative 2 would provide a more favorable balance of low to middle tidal freshwater marsh to buffer risks of marsh submergence due to sea-level rise, or poor restored habitat quality, compared with Alternatives 1 and 3. It distributes fill such that high and low marsh form gradients in each parcel, and develop transition zones with riparian woodland/scrub or terrestrial grassland throughout. It performs better at "self-mitigation" for loss of complex gradients and mosaics of freshwater marsh habitats on the Dutch Slough site than other alternatives.

Open Water Management Options

Subsidence reversal (managed nontidal marsh) would generate the greatest amount of nontidal freshwater marsh with similar wildlife habitat value as tidal freshwater marsh for most affected wildlife species, and would contribute most to "self-mitigation" for the loss of existing freshwater tidal marsh in terms of raw freshwater marsh acreage. Maximizing productivity of tules for subsidence reversal, however, may not maximize all wildlife habitat or wildlife populations that require a mix of shallow open water interspersed with variable vegetation and a range of food plants and cover types; wildlife diversity/habitat diversity and marsh productivity are not likely to be positively correlated. Managed pond and deepwater options would also generate at least a fringe of freshwater marsh habitat. Skeletal marsh management would provide some linear freshwater marsh along intertidal berms within open water areas, and edges of open water would also support a freshwater marsh fringe. Managed pond, deepwater, and skeletal marsh/tidal channels would generate less marsh area, but potentially more marsh/shallow water edge habitat favorable for marsh wildlife diversity. All open water management options would provide some mitigation for impacts to nontidal freshwater marsh, and subsidence reversal (managed tule marsh) would likely produce the most "self-mitigation", followed by skeletal marsh/tidal channels.

Marsh Creek Delta Relocation Options

Marsh Creek Delta relocation options would be likely to increase overall structural diversity of tidal marsh habitats (increasing complexity of habitat patterns, gradients, and diversity of microhabitats).

"No Burroughs" Option

If the "no Burroughs" option were exercised, the project would ultimately result in significantly fewer acres of tidal marsh habitat. This may significantly reduce the benefits of the project by decreasing habitat acreage for fishes and other aquatic organisms as well as ecosystem benefits such as primary productivity.

Mitigation 3.4.2-2.1: Mitigation for Potential Impacts to Wildlife in Tidal Freshwater Marsh

All three Mitigation Measures are the same as for Alternative 1.

Impact Significance After Mitigation

Less than significant with mitigation.

Impact 3.4.2-3 Potential Impacts to Nontidal Freshwater Marsh and Riparian Woodland/Scrub and Associated Wildlife Species (Dutch Slough Restoration Project and Related Projects)

The impacts to wildlife in existing nontidal freshwater tidal marsh habitats are the same as Alternative 1, but the degree to which the Dutch Slough project supplies its own mitigation by compensatory mitigation ("self-mitigation") may differ in Alternative 2. Many wildlife habitat functions supplied by nontidal freshwater marsh may in the long term be replaced by mature tidal freshwater marsh. Isolation of marsh ponds from nonnative predatory fish and bullfrogs, however, may not be replaced by tidal marsh. Alternative 2 would provide a more favorable balance of low to middle tidal freshwater marsh to buffer risks of marsh submergence due to sea-level rise, or poor restored habitat quality, compared with Alternatives 1 and 3. It distributes fill such that high and low marsh form gradients in each parcel, and develop transition zones with riparian woodland/scrub or terrestrial grassland throughout. It performs better at "self-mitigation" for loss of complex gradients and mosaics of freshwater marsh habitats on the Dutch Slough project site than other alternatives. In this respect, it is similar or somewhat better compared with Alternative 3, which has more total marsh area, but less well integrated sub-habitat structure (marsh gradients, interspersion of upland, high marsh, middle marsh, low marsh and riparian woodland/thicket).

OPEN WATER MANAGEMENT OPTIONS

Subsidence reversal (managed nontidal marsh) would generate the greatest amount of nontidal freshwater marsh, and would contribute most to "self-mitigation" for the loss of existing freshwater tidal marsh in terms of raw acreage. Maximizing productivity of tules for subsidence reversal, however, may not maximize all wildlife habitat or wildlife populations that require a mix of shallow open water interspersed with variable vegetation and a range of food plants and cover types; wildlife diversity and marsh productivity are not likely to be positively correlated. Managed pond and deepwater options would also generate at least a fringe of freshwater marsh habitat. Skeletal marsh management would provide some linear freshwater marsh along intertidal berms within open water areas, and edges of open water would also support a freshwater marsh fringe. Managed pond, deepwater, and skeletal marsh/tidal channels would generate less marsh area, but potentially more marsh/shallow water edge habitat favorable for marsh wildlife diversity. All open water management options would provide some mitigation for impacts to nontidal freshwater marsh, and subsidence reversal (managed tule marsh) would likely produce the most "self-mitigation", followed by skeletal marsh/tidal channels.

MARSH CREEK DELTA RELOCATION OPTIONS

Each of the Marsh Creek diversion options would be likely to increase the interspersion of riparian, marsh, and channel/open water habitats, and may contribute substantially to compensating for losses to equivalent existing habitats. The individual options cannot be predicted to differ significantly in this mitigative aspect of marsh/riparian/open water interspersion or edge habitat.

Flood sediment deposition from Marsh Creek in the restored marsh, however, may cause either beneficial marsh habitat or adverse impacts, depending on final design. Peak flood transport of coarse sediment (sands, silts) in Marsh Creek may potentially deliver potentially valuable or disruptive delta-like sediment fans to the Emerson Parcel, depending on the location and interaction with restored marsh. If large, coarse, immobile sediment deposits form in areas of low-energy tidal channels, they may obstruct marsh and channel drainage, form large undrained channel pools, cause significant mosquito production, and provide deepwater stagnant pond habitats favorable for non-native bullfrogs. These would be significant indirect impacts of specific final Marsh Creek design in relation to restored tidal marsh and channels. If sediment fans or deltas form in open water (forming prograding marsh) or over low marsh plains lacking channels (forming natural high marsh gradients), they would instead contribute valuable dynamic freshwater marsh habitat. These potential benefits or impacts would be controlled by design options for the point of diversion and the structure of receiving waters or marsh. Similar potential benefits or impacts could occur for Ironhouse overflow channel design options. These potentially significant adverse impacts could occur in each of the Marsh Creek Delta restoration options because all of them would direct coarse bedload of flood flows into channelized tidal marsh. Option 3 has the greatest potential to dam or choke tidal flows to the greatest length of channel and marsh.

MITIGATION 3.4.2-3: DESIGN RESTORATION PLANS TO MINIMIZE IMPACTS TO NONTIDAL FRESHWATER MARSH AND RIPARIAN WOODLAND/SCRUB AND ASSOCIATED WILDLIFE SPECIES

Same as Alternative 1, with the following addition for Marsh Creek diversion impacts on freshwater marsh habitat quality:

> "In final design, locate Marsh Creek mouth diversion points over low marsh or channels where its flood deposits are unlikely to obstruct terminal slough channels."

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.2-4: POTENTIAL IMPACTS TO ALKALI MEADOW AND SEASONAL WETLAND FLATS AND ASSOCIATED WILDLIFE SPECIES (ALL OPTIONS)

Same as Alternative 1.

MITIGATION 3.4.2-4: RECREATE HABITAT FEATURES TO REDUCE POTENTIAL IMPACTS TO WILDLIFE OF ALKALI MEADOW AND SEASONAL WETLAND FLATS

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.2-5: POTENTIAL IMPACTS TO SPECIAL-STATUS PLANTS

Basically the same as Alternative 1, except for the following contrasts related to Marsh Creek diversion impacts and the extent and quality of terrestrial habitat. Each option of Marsh Creek Delta restoration designs may directly impact or destroy existing colonies of special-status tidal marsh plants, or additional colonies that may establish near them by the time of construction. Alternative 2 includes substantially less potential terrestrial grassland area that could serve as remaining habitat for terrestrial special-status plants (Congdon's tarplant, big tarweed), and more of this habitat would likely be unsuitable because a higher proportion would be at the edge of tidal marsh, likely to be dominated by sod-forming perennial grasses incompatible with regeneration of this annual species.

MITIGATION 3.4.2-5: MITIGATION FOR POTENTIAL IMPACTS TO SPECIAL-STATUS PLANTS (ALL OPTIONS)

Both Mitigation Measures are the same as for Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.2-6: POTENTIAL IMPACTS TO SPECIAL-STATUS BAT SPECIES (ALL OPTIONS)

Same as Alternative 1.

MITIGATION 3.4.2-6: MINIMIZATION AND COMPENSATION FOR POTENTIAL IMPACTS TO SPECIAL-STATUS BAT SPECIES

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.2-7: POTENTIAL IMPACTS TO COOPER'S HAWK (ALL OPTIONS)

Similar to Alternative 1. Because significantly less terrestrial habitat will be retained in Alternative 2 compared with Alternative 1, and more of it will consist of narrow strips of lowland edge habitat, there are greater impacts than in Alternative 1, that require additional tree planting or protection of off-site groves of mature trees.

MITIGATION 3.4.2-7: MITIGATION FOR POTENTIAL IMPACTS TO COOPER'S HAWK

Short-term impacts cannot be mitigated because existing tree habitats lie mostly below sea level. Long-term impacts may be mitigated by riparian woodland restoration and enhancement design of the Dutch Slough Restoration Project. Addition of some native coast live oak woodland groves, and individual oaks, to terrestrial habitat restoration should be included because they would substantially contribute to efficacy of mitigation. Retain mature trees in the new park, including decadent trees.

IMPACT SIGNIFICANCE AFTER MITIGATION

If sufficient quality and quantity of off-site compensatory mitigation habitats are acquired in appropriate geographic settings, impacts would be less than significant.

IMPACT 3.4.2-8: IMPACTS TO SWAINSON'S HAWK (ALL OPTIONS)

Alternative 2 would retain significantly less acreage of terrestrial habitat suitable as foraging habitat for Swainson's hawk compared with Alternative 1, and would maintain it as a narrow strip at the southern end of all Dutch Slough Restoration Project parcels. This would not act as a substantial refuge for Swainson's hawk in the long term, and would be even less adequate at minimizing the loss of over 800 acres of suitable foraging habitat than Alternative 1. This Alternative would therefore require more acreage as off-site mitigation. However, the availability of offsite wildlife refuge habitat is constrained by cumulative impacts of residential development surrounding the Dutch Slough area.

There would also be more nesting trees lost in Alternative 2, due to the larger acreage of created wetlands.

MITIGATION 3.4.2-8: MITIGATION FOR IMPACTS TO SWAINSON'S HAWK

Both Mitigation measures would be the same as in Alternative 1, but more acreage and more trees would be needed to compensate for the larger losses.

IMPACT SIGNIFICANCE AFTER MITIGATION

If sufficient quality and quantity of off-site compensatory mitigation habitats are acquired in appropriate geographic settings, impacts would be less than significant.

Impact 3.4.2-9: Potential Impacts to Burrowing Owls (all options)

Direct, indirect, and cumulative impacts would be the same as Alternative 1, but Alternative 2 would potentially impact more acreage. The quality of retained terrestrial habitat for burrowing owls would be reduced because it would occur as a narrow strip at the southern end of all Dutch Slough Restoration Project parcels with a high proportion of it near the tidal marsh edge. This would favor dominance by sod-forming perennial grasses that would reduce or eliminate nesting habitat. The availability of offsite wildlife refuge habitat is constrained by cumulative impacts of residential development surrounding most of the Dutch Slough site.

Mitigation 3.4.2-9: Mitigation for Potential Impacts to Burrowing Owls

Same as Alternative 1.

Impact Significance After Mitigation

Potentially significant impacts after mitigation.

Impact 3.4.2-10: Potential Impacts to White-tail Kite and Northern Harrier (all options)

Same as Alternative 1.

Mitigation 3.4.2-10: Mitigation for Potential Impacts to White-tail Kite and Northern Harrier

Same as Alternative 1.

Impact Significance After Mitigation

Less than significant with mitigation.

Impact 3.4.2-11: Potential Impacts to Nesting Birds (all options)

Same as Alternative 1.

Mitigation 3.4.2-11: Mitigation for Potential Impacts to Nesting Birds

Same as Alternative 1.

Impact Significance After Mitigation

Less than significant with mitigation.

Impact 3.4.2-12: Potential Impacts to Tricolor Blackbirds (all options)

Same as Alternative 1.

Mitigation 3.4.2-12: Mitigation for Potential Impacts to Tricolor Blackbirds

Same as Alternative 1.

Impact Significance After Mitigation

If sufficient quality and quantity of off-site compensatory mitigation habitats are acquired in appropriate geographic settings, impacts would be less than significant.

IMPACT 3.4.2-13: POTENTIAL IMPACTS TO CALIFORNIA HORNED LARKS (ALL OPTIONS)

Same as Alternative 1.

MITIGATION 3.4.2-13: MITIGATION FOR POTENTIAL IMPACTS TO CALIFORNIA HORNED LARKS

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

If sufficient quality and quantity of off-site compensatory mitigation habitats are acquired in appropriate geographic settings, impacts would be less than significant.

IMPACT 3.4.2-14: POTENTIAL IMPACTS TO LOGGERHEAD SHRIKES (ALL OPTIONS)

Same as Alternative 1.

MITIGATION 3.4.2-14: MITIGATION FOR POTENTIAL IMPACTS TO LOGGERHEAD SHRIKES

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

If sufficient quality and quantity of off-site compensatory mitigation habitats are acquired in appropriate geographic settings, impacts would be less than significant.

IMPACT 3.4.2-15: POTENTIAL IMPACTS TO YELLOW-BREASTED CHATS AND OTHER SONGBIRDS OF MARSH AND RIPARIAN HABITATS (ALL OPTIONS)

Same as Alternative 1.

MITIGATION 3.4.1-15: MITIGATION FOR POTENTIAL IMPACTS TO YELLOW-BREASTED CHATS AND OTHER SONGBIRDS OF MARSH AND RIPARIAN HABITATS

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.2-16: POTENTIAL IMPACTS TO SPECIAL-STATUS WADING BIRDS (ALL OPTIONS)

Same as Alternative 1.

MITIGATION 3.4.2-16: MITIGATION FOR POTENTIAL IMPACTS TO SPECIAL STATUS WADING BIRDS

Same as Alternative 1.

Impact Significance After Mitigation

Less than significant with mitigation.

Impact 3.4.2-17: Potential Impacts to California Black Rail (all options)

Same as Alternative 1.

Mitigation 3.4.2-17: Mitigation for Potential Impacts to California Black Rail

Same as Alternative 1.

Impact Significance After Mitigation

Less than significant with mitigation.

Impact 3.4.2-18: Potential Impacts to California Tiger Salamanders (all options)

Same as Alternative 1.

Mitigation 3.4.2-18: Mitigation for Potential Impacts to California Tiger Salamanders

Consultation with USFWS and possible survey components of mitigation are the same as Alternative 1, but compensatory components of mitigation (b, c) would probably be infeasible with Alternative 2 because there is insufficient space within terrestrial habitats to construct viable seasonal wetland habitat in suitable locations, and with sufficient defensible buffering against bullfrog dispersal. Offsite mitigation would be necessary if California tiger salamanders are detected on site, but this is highly unlikely.

Impact Significance After Mitigation

It is unlikely that the species is present on the project site, so there is very low probability of any impact. However, if the species were present on the site, off-site mitigation would be required to reduce impacts to less than significant.

Impact 3.4.2-19: Potential Impacts to California Red-legged Frogs (all options)

Same as Alternative 1.

Mitigation 3.4.2-19: Mitigation for Potential Impacts to California Red-legged Frogs

Same as Alternative 1.

Impact Significance After Mitigation

Less than significant with mitigation.

IMPACT 3.4.2-20: POTENTIAL IMPACTS TO NORTHWESTERN POND TURTLES (ALL OPTIONS)

Similar to Alternative 1 except for Marsh Creek realignment effects, below.

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS AND OPEN WATER MANAGEMENT OPTIONS

Managed marsh (subsidence reversal) during early phases of succession is likely to provide the greatest benefits of all options. Skeletal marsh/channel could also provide substantial benefits, depending on steepness of marsh berms.

MARSH CREEK DELTA RELOCATION OPTIONS

Marsh Creek mouth realignment would cause construction impacts that would be likely to disturb resident turtle populations and temporarily remove suitable or occupied habitat. This would be a significant impact. Specific options may differ from one another with respect to this impact, depending on the specific location of turtle basking sites that cannot be foreseen (because channel maintenance may alter their local distribution by the time impacts occur). Conversely, if Marsh Creek flood sediments choked or cut off pre-existing tidal sloughs, converting some to elongate relict channel ponds, Marsh Creek realignment may increase potential turtle habitat.

MITIGATION 3.4.2-20: MITIGATION FOR POTENTIAL IMPACTS TO NORTHWEST POND TURTLES

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.2-21: POTENTIAL IMPACTS TO GIANT GARTER SNAKES (ALL OPTIONS)

Same as Alternative 1.

MITIGATION 3.4.2-21: MITIGATION FOR POTENTIAL IMPACTS TO GIANT GARTER SNAKES

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.2-22: POTENTIAL IMPACTS TO SILVERY LEGLESS LIZARD (DUTCH SLOUGH RESTORATION PROJECT AND OPEN WATER MANAGEMENT OPTIONS)

Same as Alternative 1.

MITIGATION 3.4.2-22: MITIGATION FOR POTENTIAL IMPACTS TO SILVERY LEGLESS LIZARD

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.2-23: POTENTIAL IMPACTS TO VERNAL POOL INVERTEBRATES (ALL OPTIONS)

Same as Alternative 1.

MITIGATION 3.4.2-23: MITIGATION FOR POTENTIAL IMPACTS TO VERNAL POOL INVERTEBRATES

Consultation with USFWS and possible survey components of mitigation are the same as Alternative 1, but compensatory components of mitigation (b, c) for special-status branchiopods in seasonal wetland pools may be constrained in Alternative 2, because there probably is insufficient space within terrestrial habitats to construct viable shallow seasonal wetland habitat in suitable locations. Offsite mitigation may be necessary if special-status branchiopods are detected on site, which is highly unlikely. Habitat restoration for special-status insects native to sandy, arid, loose substrates would probably be highly feasible, but feasibility of translocation or temporary refuge methods may be uncertain.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.2-24: POTENTIAL IMPACTS TO VALLEY ELDERBERRY LONGHORN BEETLE

Same as Alternative 1.

MITIGATION 3.4.2-24: MITIGATION FOR POTENTIAL IMPACTS TO VALLEY ELDERBERRY LONGHORN BEETLE

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.2-25: POTENTIAL IMPACTS TO HERITAGE OR OTHER TREES PROTECTED BY LOCAL ORDINANCE (DUTCH SLOUGH RESTORATION PROJECT AND CITY PARK)

Same as Alternative 1.

MITIGATION 3.4.2-25: MITIGATION FOR POTENTIAL IMPACTS TO PROTECTED TREES

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

Alternative 3: Maximum Fill

IMPACT 3.4.3-1.1: IMPACTS TO WILDLIFE FROM LOSS OF IRRIGATED PASTURE AND RUDERAL HABITATS AS A RESULT OF DUTCH SLOUGH, CITY PARK, AND IRONHOUSE PROJECTS

Alternative 3 retains substantially less terrestrial habitat within the Dutch Slough Restoration Project site than Alternative 1. Alternative 3 also distributes terrestrial habitat in narrower borders, like buffer zones, and in low islands within the restored tidal marsh. These terrestrial edge habitats are likely to provide more habitat value for resident marsh wildlife, but would provide relatively lower habitat value (per acre) for principally terrestrial wildlife associated with large, continuous blocks of terrestrial habitat, especially foraging raptors. Alternative 3 would have stronger significant impacts to terrestrial wildlife compared with Alternatives 1 and 4. It would not differ significantly from Alternative 2 in this respect.

MITIGATION 3.4.3-1.1: AVOID AND MINIMIZE EFFECTS OF LOSS OF IRRIGATED PASTURE AND RUDERAL HABITATS THROUGH PROJECT TIMING AND PHASING

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

If sufficient quality and quantity of off-site compensatory mitigation habitats are acquired in appropriate geographic settings, impacts would be less than significant.

IMPACT 3.4.3-1.2: WILDLIFE DISTURBANCE (DIRECT AND INDIRECT) ON TERRESTRIAL HABITATS ASSOCIATED WITH RECREATION AS A RESULT OF DUTCH SLOUGH AND CITY PARK PROJECTS

MITIGATION 3.4.1-1.2: HABITAT ENHANCEMENT TO OFFSET HABITAT LOSS AND DISTURBANCE ON TERRESTRIAL HABITATS ASSOCIATED WITH RECREATION

Same as proposed project. It should be noted that under this alternative, less on-site upland acreage would be available for restoration, and off-site mitigation proposed under Mitigation 3.4.3-1.1 also may be required to mitigate this impact.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.3-2.1: POTENTIAL IMPACTS TO TIDAL FRESHWATER MARSH HABITATS AND ASSOCIATED WILDLIFE SPECIES (DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS)

The impacts to wildlife in existing freshwater tidal marsh habitats would be the same as Alternative 1 and 2, but the degree to which Alternative 3 alternative is self-mitigating may differ. Alternative 3 would provide a less favorable balance of low to middle tidal freshwater marsh to buffer risks of marsh submergence due to sea-level rise, or poor restored habitat quality, compared with Alternatives 2. It distributes fill such that high and low marsh are segregated in Gilbert and Burroughs parcels, rather than joined in natural gradients. The entire low marsh in Burroughs would be at greater risk of complete submergence by accelerated sea level rise, and conversion to excessive or predominant open water habitat.

Open Water Management Options

Subsidence reversal in Emerson parcel, the only open water management in Alternative 3, would make the entire Dutch Slough Restoration Project's wetland component freshwater marsh and riparian habitat, and would most completely mitigate impacts to tidal marsh in the long-term.

Marsh Creek Delta Relocation Options

Same as Alternative 2.

Mitigation 3.4.3-2.1: Mitigation for Potential Impacts to Tidal Freshwater Marsh Habitats and Associated Wildlife Species

Same as Alternative 2.

Impact Significance After Mitigation

Less than significant with mitigation.

Impact 3.4.3-2.2: Wildlife disturbance (direct and indirect) around the marsh edge associated with recreation as a result of Dutch Slough and City Park projects

Mitigation 3.4.3-2.2: Habitat enhancement to offset habitat loss and disturbance around the marsh edge associated with recreation.

- Same as Alternative 2.

Impact Significance after Mitigation

Less than significant with mitigation.

Impact 3.4.3-3 Potential Impacts to Freshwater Marsh Habitats and Associated Wildlife Species (Dutch Slough Restoration Project and Related Projects)

Alternative 3 proposes greater wetland foundation fill that could potentially support marsh gradients well-buffered against excessive sea level rise or subsidence. Alternative 3 distributes fill very unevenly, however, between Burroughs and Gilbert parcels, rather than establish balanced marsh gradients (high marsh to low) over each parcel. This design favors experimental objectives segregating "treatments" of different marsh plain elevations, with priority over freshwater marsh habitat structure and value for all wildlife in all restored parcels. It reduces the extent of consolidated blocks of marsh gradients that would promote persistent favorable wildlife habitat structure during potential accelerated sea level rise. This alternative, therefore, has less ecological resilience than Alternative 2, and less favorable wildlife habitat structure for all restored parcels. The nontidal freshwater wetlands on the site, in contrast, include interspersed, well-distributed adjacent zones of riparian woodland/scrub, freshwater marsh, and open water. The degree to which Alternative 3 "self-mitigates" impacts to wetland-dependent wildlife that rely on integration structure of multiple freshwater wetland habitats is less than Alternative 2.

Other impacts to nontidal marsh would be the same as Alternatives 1 and 2.

OPEN WATER MANAGEMENT OPTION

In Alternative 3, open water management applies only to the Emerson Parcel; the other parcels would be entirely channelized tidal marsh. Subsidence reversal (managed nontidal marsh) would generate the greatest amount of nontidal freshwater marsh, and would contribute most to "self-mitigation" for the loss of existing freshwater tidal marsh in terms of raw acreage. Maximizing productivity of tules for subsidence reversal, however, may not maximize all wildlife habitat or wildlife populations that require a mix of shallow open water interspersed with variable vegetation and a range of food plants and cover types; wildlife diversity and marsh productivity are not likely to be positively correlated. Managed pond and deepwater options would also generate at least a fringe of freshwater marsh habitat. Skeletal marsh management would provide some linear freshwater marsh along intertidal berms within open water areas, and edges of open water would also support a freshwater marsh fringe. Managed pond, deepwater, and skeletal marsh/tidal channels would generate less marsh area, but potentially more marsh/shallow water edge habitat favorable for marsh wildlife diversity. All open water management options would provide some mitigation for impacts to nontidal freshwater marsh, and subsidence reversal would likely produce the most "self-mitigation", followed by skeletal marsh/tidal channels.

MARSH CREEK DELTA RELOCATION OPTIONS

Marsh Creek Delta relocation options would probably not differ in their contribution to "self-mitigation" for impacts to nontidal freshwater marsh in Alternative 3.

MITIGATION 3.4.3-3: MITIGATION FOR POTENTIAL IMPACTS TO NONTIDAL FRESHWATER MARSH HABITATS AND ASSOCIATED WILDLIFE SPECIES

Same as Alternative 2.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.3-4: POTENTIAL IMPACTS TO ALKALI MEADOW AND SEASONAL WETLAND FLATS (ALL OPTIONS) AND ASSOCIATED WILDLIFE SPECIES

Same as Alternatives 1 and 2.

MITIGATION 3.4.3-4: MITIGATION FOR POTENTIAL IMPACTS TO ALKALI MEADOW AND SEASONAL WETLAND FLATS AND ASSOCIATED WILDLIFE SPECIES

Same as Alternatives 1 and 2.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.3-5: POTENTIAL IMPACTS TO SPECIAL-STATUS PLANTS (ALL OPTIONS)

Same as Alternatives 2.

MITIGATION 3.4-3.5: MITIGATION FOR POTENTIAL IMPACTS TO SPECIAL-STATUS PLANTS

Same as Alternative 2

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.3-6: POTENTIAL IMPACTS TO SPECIAL-STATUS BAT SPECIES (ALL OPTIONS)

Same as Alternatives 1 and 2.

MITIGATION 3.4.3-6: MITIGATION FOR POTENTIAL IMPACTS TO SPECIAL-STATUS BAT SPECIES

Same as Alternatives 1 and 2.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.3-7: POTENTIAL IMPACTS TO COOPER'S HAWK (ALL OPTIONS)

Same as Alternative 2.

MITIGATION 3.4.3-7: MITIGATION FOR POTENTIAL IMPACTS TO COOPER'S HAWK

Same as Alternative 2.

IMPACT 3.4.3-8: IMPACTS TO SWAINSON'S HAWK

Same as Alternative 2.

MITIGATION 3.4.3-8: MITIGATION FOR IMPACTS TO SWAINSON'S HAWK (ALL OPTIONS)

Both Mitigation measures would be the same as in Alternative 2, but more acreage and more trees would be needed to compensate for the larger losses.

IMPACT SIGNIFICANCE AFTER MITIGATION

If sufficient quality and quantity of off-site compensatory mitigation habitats are acquired in appropriate geographic settings, impacts would be less than significant.

IMPACT 3.4.3-9: POTENTIAL IMPACTS TO BURROWING OWLS (ALL OPTIONS)

Same as Alternative 2.

MITIGATION 3.4.3-9: MITIGATION FOR POTENTIAL IMPACTS TO BURROWING OWLS

Same as Alternative 2.

IMPACT SIGNIFICANCE AFTER MITIGATION

Potentially significant impacts after mitigation.

IMPACT 3.4-3.10: POTENTIAL IMPACTS TO WHITE-TAIL KITE AND NORTHERN HARRIER (ALL OPTIONS)

Same as Alternative 2 for white tailed kite.

Similar to Alternatives 1 and 2 for northern harrier. However, Alternative 3 would probably be superior in compensating for long-term conversion impacts to northern harriers because it would provide for the largest marsh foraging area and the highest marsh (most suitable for foraging).

MITIGATION 3.4.3-10: MITIGATION FOR POTENTIAL IMPACTS TO WHITE-TAIL KITE AND NORTHERN HARRIER

Same as Alternative 2 for white tailed kite and same as Alternatives 1 and 2 for northern harrier.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.3-11: POTENTIAL IMPACTS TO NESTING BIRDS (ALL OPTIONS)

MITIGATION 3.4.3-11: MITIGATION FOR POTENTIAL IMPACTS TO NESTING BIRDS

Same as Alternatives 1 and 2.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation, because northern harrier can utilize marsh as well as grassland habitat for foraging.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.3-12: POTENTIAL IMPACTS TO TRICOLOR BLACKBIRDS (ALL OPTIONS)

Same as Alternatives 1 and 2.

MITIGATION 3.4.3-12: MITIGATION FOR POTENTIAL IMPACTS TO TRICOLOR BLACKBIRDS

Same as Alternatives 1 and 2.

IMPACT SIGNIFICANCE AFTER MITIGATION

If sufficient quality and quantity of off-site compensatory mitigation habitats are acquired in appropriate geographic settings, impacts would be less than significant.

IMPACT 3.4.3-13: POTENTIAL IMPACTS TO CALIFORNIA HORNED LARKS (ALL OPTIONS)

Same as Alternatives 1 and 2.

MITIGATION 3.4.3-13: MITIGATION FOR POTENTIAL IMPACTS TO CALIFORNIA HORNED LARKS

Same as Alternatives 1 and 2.

IMPACT SIGNIFICANCE AFTER MITIGATION

If sufficient quality and quantity of off-site compensatory mitigation habitats are acquired in appropriate geographic settings, impacts would be less than significant.

IMPACT 3.4.3-14: POTENTIAL IMPACTS TO LOGGERHEAD SHRIKES (ALL OPTIONS)

Same as Alternatives 1 and 2.

MITIGATION 3.4.3-14: MITIGATION FOR POTENTIAL IMPACTS TO LOGGERHEAD SHRIKES

Same as Alternatives 1 and 2.

IMPACT SIGNIFICANCE AFTER MITIGATION

If sufficient quality and quantity of off-site compensatory mitigation habitats are acquired in appropriate geographic settings, impacts would be less than significant.

IMPACT 3.4.3-15: POTENTIAL IMPACTS TO YELLOW-BREASTED CHATS AND OTHER SONGBIRDS OF MARSH AND RIPARIAN HABITATS (ALL OPTIONS)

Same as Alternatives 1 and 2.

MITIGATION 3.4.3-15: MITIGATION FOR POTENTIAL IMPACTS TO YELLOW-BREASTED CHATS AND OTHER SONGBIRDS OF MARSH AND RIPARIAN HABITATS

Same as Alternatives 1 and 2.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.3-16: POTENTIAL IMPACTS TO SPECIAL-STATUS WADING BIRDS (ALL OPTIONS)

Same as Alternatives 1 and 2.

MITIGATION 3.4.3-16: MITIGATION FOR POTENTIAL IMPACTS TO SPECIAL STATUS WADING BIRDS

Same as Alternatives 1 and 2.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

Impact 3.4.3-17: Potential Impacts to California Black Rail (all options)

Same as Alternative 2, but Alternative 3 could establish more potential habitat for California black rail, depending on whether constructed channel banks include high to middle marsh habitat. Otherwise, Alternative 2, though providing less overall high/middle marsh, provides more interspersion of high marsh, terrestrial edge habitat near channels, where black rails are most likely to establish home ranges.

Mitigation 3.4.3-17: Mitigation for Potential Impacts to California Black Rail

Same as Alternative 2. Alternative 3 has potential for more "self-mitigation" than Alternative 2 because it includes larger areas of high/middle marsh zones.

Impact Significance After Mitigation

Less than significant with mitigation.

Impact 3.4.3-18 Potential Impacts to California Tiger Salamanders (all options)

Same as Alternatives 1 and 2.

Mitigation 3.4.3-18: Mitigation for Potential Impacts to California Tiger Salamanders

Same as Alternative 2.

Impact Significance After Mitigation

It is unlikely that the species is present on the project site, so there is very low probability of any impact. However, if the species were present on the site, off-site mitigation would be required to reduce impacts to less than significant.

Impact 3.4.3-19: Potential Impacts to California Red-legged Frogs (all options)

Same as Alternatives 1 and 2.

Mitigation 3.4.3-19: Mitigation for Potential Impacts to California Red-legged Frogs

Same as Alternatives 1 and 2.

Impact Significance After Mitigation

Less than significant with mitigation.

Impact 3.4.3-20: Potential Impacts to Northwest Pond Turtles (all options)

Same as Alternative 1.

MITIGATION 3.4.3-20: MITIGATION FOR POTENTIAL IMPACTS TO NORTHWEST POND TURTLES

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.3-21: POTENTIAL IMPACTS TO GIANT GARTER SNAKES (ALL OPTIONS)

Same as Alternative 2.

MITIGATION 3.4.3-21: MITIGATION FOR POTENTIAL IMPACTS TO GIANT GARTER SNAKES

Same as Alternative 2.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.3-22: POTENTIAL IMPACTS TO SILVERY LEGLESS LIZARD (ALL OPTIONS)

Same as Alternative 2.

MITIGATION 3.4.3-22: MITIGATION FOR POTENTIAL IMPACTS TO SILVERY LEGLESS LIZARD

Same as Alternative 2.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.3-23: POTENTIAL IMPACTS TO VERNAL POOL INVERTEBRATES (ALL OPTIONS)

Same as Alternatives 1 and 2.

MITIGATION 3.4.3-23: MITIGATION FOR POTENTIAL IMPACTS TO VERNAL POOL INVERTEBRATES

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.3-24: POTENTIAL IMPACTS TO VALLEY ELDERBERRY LONGHORN BEETLE

Same as Alternative 1.

MITIGATION 3.4.3-24: MITIGATION FOR POTENTIAL IMPACTS TO VALLEY ELDERBERRY LONGHORN BEETLE

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.4.3-25: POTENTIAL IMPACTS TO HERITAGE OR OTHER TREES PROTECTED BY LOCAL ORDINANCE (DUTCH SLOUGH RESTORATION PROJECT AND CITY PARK)

Same as Alternative 1.

MITIGATION 3.4.3-25: MITIGATION FOR POTENTIAL IMPACTS TO PROTECTED TREES

Same as Alternative 1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

Alternative 4: No Project

IMPACT 3.4.4-1: LONG-TERM EFFECTS ON EXISTING TERRESTRIAL AND WETLAND WILDLIFE HABITATS

The existing conditions that are used as an environmental baseline for assessment of biological impacts are a static "snapshot" of dynamic, long-term ecological conditions of the Dutch Slough area. The "no project" alternative, by definition, causes no immediate impacts in relation to itself. However, it should be noted that long-term degradation of the habitat on the site may occur absent any restoration activities

Catastrophic levee breaching or flooding from overtopping would remain an infrequent but high impact, and an inherent risk for existing non-tidal diked wetland habitats of the Dutch Slough site. Levee breaching or flooding from overtopping would largely eliminate resident terrestrial wildlife populations (burrowing mammals, terrestrial predators, lizards, terrestrial invertebrates), and cause significant declines (mass mortality) in amphibians and semi-aquatic reptiles (turtles, snakes, frogs). The intensity of severe flooding would depend on the season, duration and depth of flooding. As surrounding areas suffer declines in terrestrial and wetland habitats due to urbanization, the ability of the site's wildlife populations to regenerate after flood disturbance by long-distance dispersal of immigrants from offsite would be likely to decline, particularly for infrequent or rare species, and species with limited dispersal ability. Thus, decreasing habitats and fragmentation of the areas surrounding Dutch Slough would likely cause a decline in the stability of existing habitats, even with "no action". As sea level rises in the 21st century, the risk of catastrophic levee failure is likely to increase.

Gradual, long-term, non-catastrophic changes in the Dutch Slough Restoration Project site's wetland habitats are likely to occur even with no project, because of the existing soil conditions and their responses to drainage and flood irrigation. Most of the soils on the site (other than relict ancient dune sands) are high in organic matter deposited in historic tidal marshes. When organic soils are drained and aerated, they decompose and subside (lose volume) under the influence of aerobic soil bacteria and fungi. As the shallow basins in the diked pastures subside farther below sea level, they become more difficult to drain. When seasonal wetland vegetation is flooded (by rainfall or subirrigation) and soils are saturated (lacking oxygen) soil bacteria generate sulfides, and soluble salts dissolve in ponded waters. When soils drain, soluble salts concentrate by evaporation in poorly drained flats (seasonal ponds, alkali meadows), and sulfides are converted to sulfates (acidic and somewhat toxic to some plants, depending on concentration). Thus, the Dutch Slough Restoration Project site in the "no project" alternative would likely fall farther below sea level as sea level rises, soils subside, and soil quality declines. This is a general regional trend of agricultural lands reclaimed by diking tidal marshes in the 19th and early 20th century.

Over time, increased, ongoing subsidence in the "No Project" alternative would tend to increase the extent and depth of seasonal ponds, and their duration of flooding. Freshwater marsh and ponds would probably encroach on alkali meadow and other shallow seasonal wetlands. Within freshwater marsh, larger areas may convert to seasonal or perennial pond habitat, with more annual marsh plant cover and less tule or cattail marsh. Following levee overtopping events (with increasing frequency expected as sea level rises and storm frequency and intensity increases), depth and duration of ponding may expand nontidal pond habitats, and possibly expand the area of deep water suitable for diving birds and predatory nonnative fish. Increases in predatory fish within perennial ponds could reduce viability of native amphibian and reptile populations within nontidal freshwater marshes bordering ponds.

This impact is not considered significant because it is the result of changing background conditions and not related to any change in existing activities on the site.

Table 3.4-2: Summary of Terrestrial Biological Resource Impacts for Dutch Slough and Related Projects.

	Impact No.	Impact Description	Dutch Slough Restoration Project	Related Projects	
				Ironhouse Project	City Community Park Project
Alternatives 1, 2, and 3	3.4.1-1.1	Potential Impacts to Wildlife in Irrigated Pasture and Ruderal-Terrestrial Habitats.	X	X	X
	3.4.1-1.2	Wildlife Disturbance (Direct and Indirect) Associated with Recreation on Terrestrial Habitats.	X		X
	3.4.1-1.3	Wildlife Disturbance from Lighting and Noise.			X
	3.4.1-2.1	Potential Impacts to Wildlife in Tidal Freshwater Marsh Habitats from Dredging Little Dutch Slough.	X		
	3.4.1-2.2	Wildlife Disturbance (Direct and Indirect) Associated with Recreation around the marsh edge.	X		X
	3.4.1-2.3	Wildlife Disturbance (Direct and Indirect) Associated with Maintenance of Exterior Levee.	X		
	3.4.1-3.	Potential Impacts to Nontidal Freshwater Marsh and Riparian Woodland/Scrub and associated wildlife species—Loss of Habitat	X	X	
	3.4.1-4.	Potential Impacts to Alkali Meadow And Seasonal Wetland Flats and associated wildlife species—Loss of Habitat.	X	X	
	3.4.1-5.1	Potential Impacts to Special-status Plants.	X	X	X
	3.4.1-5.2	Impacts to Special Status tidal marsh plants of dredging Little Dutch Slough.	X		
	3.4.1-5.3	Impacts of Loss of Terrestrial and Wetland Habitats to Special-Status Plants.	X	X	X

	3.4.1-6.	**Potential Impacts to Special-status Bat Species—loss of roosting sites**	**X**		**X**
	3.4.1-7.	**3.4.1-7. Potential Impacts to Cooper's Hawk—loss of nesting trees**	**X**		**X**
	3.4.1-8.1 a, b.	**3.4.1-8. Potential Impacts to Swainson's Hawk** 3.4.1-8a. Loss of foraging habitat 3.4.1-8b. Loss of nesting trees	**X** **X**	**X**	**X** **X**
	3.4.1-9.	**Potential Impacts to Burrowing Owls—loss of habitat**	**X**	**X**	**X**
	3.4.1-10.	**Potential Impacts to White-tail Kite and Northern Harrier—loss of foraging and nesting trees**	**X**	**X**	**X**
	3.4.1-11.	**Potential Impacts to Nesting Birds—loss nesting habitat**	**X**		**X**
	3.4.1-12.	**Potential Impacts to Tricolor Blackbirds—loss of foraging habitat**	**X**	**X**	**X**
	3.4.1-13.	**Potential Impacts to California Horned Larks—loss of habitat**	**X**	**X**	**X**
	3.4.1-14.	**Potential Impacts to Loggerhead Shrikes—loss of foraging habitat**	**X**	**X**	**X**
	3.4.1-15.	**Potential Impacts to Yellow-breasted Chat and other Songbirds of Marsh and Riparian Habitats**	**X**		
	3.4.1-16.	**Potential Impacts to Special-status Wading Birds**	**X**		
	3.4.1-17.	**Potential Impacts to California Black Rail**	**X**	**X**	
	3.4.1-18.	**Potential Impacts to California Tiger Salamander**	**X**	**X**	**X**
	3.4.1-19.	**Potential Impacts to California Red-legged Frogs**	**X**		
	3.4.1-20.	**Potential Impacts to Northwest Pond Turtles**	**X**	**X**	**X**
	3.4.1-21.	**Potential Impacts to Giant Garter Snakes**	**X**	**X**	**X**
	3.4.1-22.	**Potential Impacts to Silvery Legless Lizard**	**X**		

	3.4.1-23.	**Potential Impacts to Vernal Pool Fairy Shrimp and Other Special-status Vernal Pool Invertebrates**	**X**		
	3.4.1-24	**Potential Impacts to Valley Elder-berry Longhorn Beetle**	**X**		**X**
	3.4.1-25	**Potential Impacts to Heritage or other trees protected by local ordi-nance.**	**X**		**X**
		Cumulative Impacts to Terrestrial and Wetland Biological Resources	**X**	**X**	**X**

Table 3.4-3: Summary of Terrestrial Biological Resource Mitigation Measures for Dutch Slough and Related Projects.

Mitigation No.	Mitigation Measure	Dutch Slough Restoration Project	Related Projects	
			Ironhouse Project	City Community Park Project
3.4.1-1.1	Avoid and minimize effects of loss of irrigated pasture and ruderal habitats through project timing and phasing.	X	X	X
3.4.1-1.2	Habitat enhancement to offset effects of habitat loss and disturbance on terrestrial habitats associated with recreation.	X		X
3.4.1-1.3	Reduce effects of City Park lighting and noise.			X
3.4.1-2.1a-b	1a: Increase acreage of tidal freshwater marsh. 1b: Avoid channel widening and dredge non-native SAV beds.	X X	X	
3.4.1-2.2	Habitat enhancement to offset habitat loss and disturbance around the marsh edge associated with recreation	X	X	X
3.4.1-2.3	Minimize disturbance (direct and indirect) associated with maintenance of exterior levee	X		X
3.4.1-3	Design restoration plans to minimize impacts to nontidal freshwater marsh and riparian woodland/scrub and associated wildlife species. .	X	X	

	3.4.1-4	**Recreate habitat features to reduce potential impacts to wildlife of alkali meadow and seasonal wetland flats.**	**X**	**X**	
	3.4.1-5.1	**Minimize, avoid, and compensate for impacts common to all sensitive plants.**	**X**	**X**	**X**
	3.4.1-5.2	**Minimize, avoid, and compensate for impacts to sensitive species of tidal marsh plants**	**X**	**X**	
	3.4.1-6	**Minimization and compensation for Potential Impacts to Special-status Bat Species**	**X**		**X**
	3.4.1-7	**Minimization, avoidance, and tree replacement for impacts to Cooper's Hawk**	**X**		**X**
	3.4.1-8.1	**Off-site mitigation for loss of Swainson's Hawk foraging habitat.**	**X**	**X**	**X**
	3.4.1-8.2	**Avoid and minimize loss of Swainson's Hawk nesting trees.**	**X**		**X**
	3.4.1-9	**Minimize and compensate for potential impacts to Burrowing Owls.**	**X**	**X**	**X**
	3.4.1-10	**Off-site mitigation for loss of White-Tail Kite and Northern Harrier habitat.**	**X**	**X**	**X**
	3.4.1-11	**Mitigation for potential impacts to nesting birds.**	**X**		**X**
	3.4.1-12	**Mitigation for potential impacts to Tricolor Blackbirds.**	**X**	**X**	**X**
	3.4.1-13	**Off-site mitigation for potential impacts to California Horned Larks.**	**X**	**X**	**X**
	3.4.1-14	**Off-site mitigation for potential impacts to Loggerhead Shrikes.**	**X**	**X**	**X**
	3.4.1-15	**Mitigation for potential impacts to Yellow-Breasted Chats and other Marsh and Riparian Songbirds.**	**X**		

	3.4.1-16	**Mitigation for Special-Status Wading Birds.**	**X**		
	3.4.1-17	**Mitigation for potential impacts to California Black Rail.**	**X**	**X**	
	3.4.1-18	**Mitigation for potential impacts to California Tiger Salamander.**	**X**	**X**	**X**
	3.4.1-19	**Mitigation for potential impacts to California Red-legged Frogs.**	**X**		
	3.4.1-20	**Mitigation for potential impacts to Northwestern Pond Turtles.**	**X**	**X**	**X**
	3.4.1-21	**Mitigation for potential impacts to Giant Garter Snakes.**	**X**	**X**	**X**
	3.4.1-22	**Mitigation for potential impacts to Silvery Legless Lizard.**	**X**		
	3.4.1-23	**Mitigation for potential impacts to Vernal Pool Fairy Shrimp and other Special-status vernal pool invertebrates.**	**X**		
	3.4.1-24	**Mitigation for potential impacts to Valley Elderberry Longhorn Beetle.**	**X**		
	3.4.1-25	**Mitigation for potential impacts to protected trees.**	**X**		**X**

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3.5 - Aquatic Biology

3.5 BIOLOGICAL RESOURCES – AQUATIC RESOURCES

This section describes the fish and invertebrates associated with the aquatic environment that may be affected by the Dutch Slough Restoration Project and Related Projects. Analysis will focus both on impacts to the aquatic habitats and how fish and prey utilization of those habitats would be affected, both directly and indirectly. Specific habitats will include all shallow water habitats, including open water, subtidal, and intertidal, associated with the restoration and park projects sites and vicinity.

3.5.1 Affected Environment

The San Francisco Estuary (Estuary) can be divided into five separate regions: The Sacramento-San Joaquin Delta (the Delta), Suisun Bay, North (San Pablo) Bay, Central Bay, and South Bay, each of which exhibits somewhat different hydrological conditions determined by its position relative to marine and freshwater sources (Conomos 1979). The Dutch Slough Restoration Project lies within the legal boundary of the Delta, close to its western edge, which extends to the Sacramento River to the north, and the San Joaquin River to the south. The Delta is a vast expanse of various wetland and shallow water habitats with western limits several miles upstream of the main river confluence near Suisun Bay. The triangular-shaped landscape is incised by a network of channels and sloughs, often circumnavigating diked islands used for agricultural purposes. Tidal effects are significant throughout the delta, creating a maze of interconnected freshwater tidal marshes which historically dominated landscape habitat, comprising nearly 90 percent of the total land space; however, this habitat is now reduced to several hundred acres in size with little connectivity. The salinity associated with the Estuary tides rarely penetrates into the Delta except during times of low flow (i.e. summer and early fall).

The combined discharge of both rivers is high, receiving runoff from two interior watersheds totaling 63,000 square miles which accounts for 90 percent of the total freshwater entering the San Francisco Bay. Each river, however, has a unique hydrographic signature in terms of flow and sediment load, reflecting in part human alterations and use (i.e., dams and water diversions). As a result of these and other human induced changes, pelagic fish species in the delta, including longfin smelt (*Spirinchus thaleichthys)*, threadfin shad (*Dorosoma petenense*), striped bass (*Morone saxatilis*), and delta smelt (*Hypomesus transpacificus*) are currently in decline. One species, the delta smelt, is listed as threatened under both the Federal and the California Endangered Species Acts.

The serious decline in certain fish species, including the threatened delta smelt, and their associated food organisms, is commonly referred to as Pelagic Organism Decline (POD). As part of continuing POD studies, scientists have recently documented a serious and unexpected decline (approximately 90%) in young delta smelt produced this season. The location of the young fish is an even greater concern; they were found in the channels that are within the sphere of influence of the South Delta Diversions, including the State and Federal Water Projects' pumping plants. Areas of toxic waters also have been observed in the nursery areas of young smelt. Some of the other declining species, including striped bass, are exotic species that have historically occurred at very high density in the estuary.

Dutch Slough Area Setting

Dutch Slough is located in the western delta, an area of low salinity and historically high biological productivity. Several conspicuous features of the western delta include the confluence of the Sacramento and San Joaquin River and the Low Salinity Zone, an interface between the freshwater source flows and the furthest reach of the tidal influence where dense patches of zooplankton and larval fish are naturally entrained in the water column. This west delta area is documented to be an important rearing area for many of the Delta's estuarine-dependent fish, which utilize the increased turbidity in this area to avoid visual predators (Dege and Brown 2004, Kimmerer 2002, Nobriga et al. 2005).

The large embayment called Big Break lies just west of Dutch Slough. Big Break is a former asparagus farm where levees breached in 1928 due to excessive rainfall, resulted in flooding of the diked lands with flows from the San Joaquin River, Dutch Slough, and a remnant waterway connecting from the east. Big Break now consists of mostly open-water habitat, lined by the leveed agricultural land of Jersey Island to the north and East Bay Regional Park District public shoreline access to the south. A small patch of high quality tidal marsh exists along the southern edge of Big Break; however, non-natural hydrological conditions have helped fuel the growth of the invasive Brazilian waterweed (*Egeria densa*), which is often too dense to pass through by boat.

The terminus of Marsh Creek runs parallel to the western border of the Emerson Parcel. Totaling 30 miles in length, Marsh Creek is a significant source of freshwater to the local system of Big Break and vicinity draining 128 square miles of agricultural and urban land of Contra Costa County foothills. Marsh Creek has been significantly impacted by human activity: it features a dam and reservoir in its upper reaches, while its lower reach has been highly channelized for flood control purposes. Development of the Marsh Creek watershed has led to reduced natural flows and compromised water quality due to urban and agricultural runoff, wastewater treatment plant discharges, and historic mercury mining activities (Cain and Robins 2003).

FISH

The distribution and abundance of estuarine organisms are often affected by both physical and biological processes. Inland fish species common in the western delta are often classified by their tolerances to salinity and temperature and how their life history strategies have evolved to utilize the delta's various habitats (i.e. timing in estuary, feeding type - benthic (bottom) or pelagic (open water)). A high percentage of the fish community assemblage in the Delta consists of non-native species that compete with native species for resources. Restoration of natural processes has the potential to lessen the establishment of non-native species and subsequently assist native populations (Marchetti et al. 2004).

In the tidal freshwater system of the Delta, temperature and freshwater flows are important nonbiotic factors that influence fish distribution and composition, and are often cited as the critical component for the life history strategies of many of the native species (Feyrer and Healy 2003). For example, Grimaldo et al. (2004) and Simenstad et al. (2000) reported peak abundances for native fish species in February and March (i.e. period of high river flow and lower temperatures), with a later second peak in summer for non-native fish species reflective of warm-water and low flow conditions.

FRESHWATER TIDAL MARSH HABITAT

A tidal freshwater marsh often consists of a mosaic of different shallow water habitats, populated by a heterogeneous composition of plants spatially distributed relative to tidal hydrology. It has been widely documented that tidal marsh systems provide essential habitats for an array of aquatic animals, supporting particularly high abundances of fish and aquatic invertebrates. Tidal marsh systems include extensive networks of small vegetated channels and sloughs dispersed through the marsh plain which provide access to critical foraging grounds. In the Delta, channel and slough networks within tidal freshwater marshes can range from limited to more extensive, and generally channels with inverted elevations around MLLW (mean lower low water) tend to become full of tule (*Schoenoplectus acutus)* vegetation. The very small extent of remaining tidal marsh in the Delta, especially large marshes, makes it difficult to generalize their characteristics. Channel habitat characteristics, including width, maximum water depth, sediment composition and profiles all have an effect on species composition and utilization patterns (Williams and Zedler 1999). For example, fish abundance has been positively correlated with marsh channel edge, suggesting larger channel systems could provide more complexity and heterogeneity of habitats. Fish growth can be used as a measure of marsh function as it incorporates multivariate environmental factors often too complex to separate. Madon et al. (2001) found that killifish could double their daily food intake if access to the marsh plain was available; high densities of larval insect prey forms in shallow, emergent marsh habitat suggest a benefit for fish growth as well (see Grimaldo et al. 2004, Kneib 2003).

Nursery value of the tidal marsh is high for fish, providing suitable substrate, hydrologic conditions, and critical geomorphic features that enhance refuge for breeding and spawning adults and young (Minello et al. 2003). Many fish species use the inland channel tributaries to lay eggs and rear young before emigrating back to open waters. Marsh-plain habitats have been documented to be critical to the successful recruitment of fish species as refuge from predators and as forage grounds. These shallow-water habitats are only available when the water surface rises higher than the channel sides, such as when flooded during high river discharge or during high spring tides.

FOOD WEB STRUCTURE

The nutritional complexity of freshwater tidal marshes is supported by a robust food-web structure consisting of terrestrial insects, planktonic invertebrates, benthic macroinvertebrates, and detritus; all of which form the base of available prey for larval and juvenile fish. Aquatic invertebrates associated with habitats found in tidal marsh systems are often more diverse in composition, and are susceptible to the same hydrologic forcing mechanisms that affect their distribution and abundance.

Benthic invertebrates that reside on or near the bottom of channels contribute significantly to the production of fish and macroinvertebrates. Simenstad et al. (2000) found the larvae and benthic pupae of chironomids, a terrestrial insect that completes its juvenile life cycle in water, to be abundant in the diet of fishes utilizing tidal marshes. Crustacean zooplankton such as copepods associated with water column and shallow water habitats were also dominant prey taxa. Other significant sources of prey include fall-out insects associated with the water surface, which are often consumed by Chinook salmon juveniles. Aquatic invertebrates produced within tidal marshes also have indirect benefits at a regional scale, acting as important vectors for the transfer of energy from these nearshore environments to deeper waters and beyond.

FISH COMPOSITION AND ABUNDANCE

The Delta has a well documented history of abundant biological resources rich in aquatic animal species, both within the larger delta channels and tidal sloughs and marsh systems supporting large numbers of migrating salmon and steelhead returning to spawn in the tributaries of the upper Sacramento and San Joaquin rivers. The recent literature and long term monitoring programs have identified almost 100 fish species that use the Estuary either seasonally as rearing grounds to forage on prey taxa, or as year round residents, completing their entire life history within the Estuary (Marchetti et al. 2004 and Moyle 2002).

Long term monitoring collections of fish and macroinvertebrates of the Estuary have been conducted by several state and federal regulatory and governmental agencies primarily as part of the Interagency Ecological Program (IEP), with broad objectives to describe the general trends in the distribution, abundance, and community composition of both native and alien species. These agencies include California Department of Fish and Game (CDFG), U.S. Fish and Wildlife Service (USFWS), Department of Water Resources (DWR), and U.S. Bureau of Reclamation. Other studies on this topic include Orsi (1999), Matern et al. (2002), and Wang (1986). These field efforts often employ trawl methods that bias results towards specimens vulnerable to those gear types and, more importantly, towards species inhabiting the larger deeper channel habitats often associated with higher flows and open water. Abundance and composition data are publicly available (see http://www.iep.ca.gov).

More recently, investigators have relocated their efforts to address questions seeking to understand how fish utilize shallow water and near-shore habitats of tidally affected fresh and saltwater marshes (see Grimaldo 2004, Nobriga et al. 2005, IRWM [www.irwm.org], Simenstad et al. 2000).

A diversity of fish species are expected to penetrate into marshes and mudflats via the tidal channels, and occupy the system at low tides and water within channels (Kneib and Wagner 1994). Fish assemblages can also be stratified by water depth, with juveniles of many species maintaining their position in relatively shallow water, including smaller, shallow channels within the marsh system, and adults and larger juveniles found only in larger, deeper channels. Common bottom-dwelling species such as gobies and sculpins may be found throughout the tidal channel systems. Open water species such as inland silverside (*Menidia beryllina*), splittail (*Pogonichthys macrolepidotus*) and juvenile Chinook salmon (*Oncorhynchus tshawytscha*) will move dynamically in and out of the channels, although specific patterns of movement with tide stage is generally unknown. Evidence from other regions suggests that juvenile Chinook salmon may penetrate into lower order channels in marshes as long as the channels are unvegetated. Epibenthic species such as tule perch (*Hysterocarpus traskii*) and bluegill (*Lepomis macrochirus*) will also occupy the channels, but perhaps in greater densities concentrated among emergent submerged aquatic vegetation (SAV) and floating aquatic vegetation (FAV). Larger, more active predators, such as the non-indigenous juvenile striped bass and largemouth bass (*Micropterus salmoides*), will likely move in and out of the larger channels with tidal fluctuation. It is thought by many that tidal wetlands may increase the survival of juvenile fish by offering rearing and refuge habitat, thus leading to increased production of adults (Brown 2003).

CURRENT FISH HABITAT

The existing on-site fish habitat is limited to non-tidal freshwater marsh habitat that occurs in perennially flooded or ponded, shallow (less than three feet deep) depressions and channels throughout the interior of the diked areas of the Dutch Slough Restoration Project site. Tidal freshwater marsh habitat occurs along the exterior edge of the diked areas, predominantly located along unarmored (i.e., no riprap) levees, decrepit levees, narrow marsh or creek areas, and on in-channel islands in Dutch Slough. An extensive and high quality stand of tidal marsh exists in the abandoned channel of the former mouth of Marsh Creek along the north edge of the Emerson parcel. Some tidal marsh also occurs along Big Break's southeastern corner, directly across Marsh Creek from the Emerson Parcel.

SPECIES OF CONCERN TO THE DUTCH SLOUGH RESTORATION PROJECT

Table 3.5-1 lists the most common species captured from local fish population studies and reflects the possible pool of species that could utilize the Dutch Slough Restoration Project area. The table describes the general habitat needs of the species and which habitat features of the Dutch Slough Restoration Project (open water, low marsh, mid marsh, and high marsh) the species is likely to utilize.

Table 3.5-1: Sacramento – San Joaquin Estuary Fishes that Could Utilize the Dutch Slough Restoration Project Area

Species	General Habitat	Project Microhabitat			Status I = Introduced N = Native
		Open water	Low to Mid Marsh	Mid to High Marsh	
Inland silverside, *Menidia beryllina*	Shallow fresh waters in the Delta and tributaries. Transient planktivores that feed on zooplankton and utilize marsh opportunistically. Common with salmon and splittail.	Yes	Yes	Yes	I
Threadfin shad, *Dorosoma petenense*	Well lighted surface waters. Open, warm water.	Yes	Yes	In channels	I
Striped bass, *Morone saxatilis*	Suisun and San Pablo Bay - water column oriented. Will enter marsh to forage. Larvae associated with warm water temperatures and lower outflow.	Yes	Yes	In channels	I
Yellowfin goby, *Acanthogobius flavimanus*	Shallow, soft bottom areas. Partially catadromous.	Yes	Yes	In channels	I
Splittail, *Pogonichthys macrolepidotus*	Nursery resident and will occupy marsh for long durations feeding on marsh prey. High temps will limit splittail recruitment. Age-0 fish favor low velocity shallow-water habitats.	Yes	Yes	Yes	N
Redear sunfish, *Lepomis microlophus*	Deep (>2M), warm, quiet ponds, lakes and sloughs with substantial SAV.	Yes	Yes	In channels	I

Species	General Habitat	Project Microhabitat			Status I = Introduced N = Native
		Open water	Low to Mid Marsh	Mid to High Marsh	
Bluegill, *Lepomis macrochirus*	Reservoirs, warm shallow lakes, sloughs; favor aquatic plants. Opportunistic feeders, wide range of prey types. Larvae were found in shallow water as well as the open estuary; lower reaches of the Delta and Suisun Bay.	Yes	Yes	In channels	I
Threespine stickleback, *Gasterosteus aculeatus*	Shallow, weedy pools, emergent plants and over gravel, sand and mud. Pelagic, SAV associated. Prefer zooplankton prey.	No	Yes	Yes	N
Rainwater killifish, *Lucania parva*	Shallow inshore water with dense vegetation. Migrate to freshwater to breed. Abundant when flows are high and temps low.	No	Yes	Yes	I
Largemouth bass, *Micropterus salmoides*	Throughout sloughs and tributaries of the Delta. Densities and life stage dependent on SAV density. Prefers lower temperatures.	Yes	Yes	In channels	I
American shad, *Alosa sapidissima*	Anadromous adults breed in freshwater, beginning their immigration in March to May.	Yes	Yes	In channels	I
Longfin smelt, *Spirinchus thaleichthys*	Most common in the open waters of upper SFE, preferring more saline waters but capable of tolerating freshwater necessary for spawning.	Yes	Yes	No	N
Chinook Salmon, *Oncorhynchus tshawytscha* Spring Run: Federal - Threatened State - Threatened Winter Run: Federal - Endangered State - Endangered	Found along the margins of channels and shallow water habitats. Winter and spring runs. Favor open water areas and unvegetated habitats.	Yes	Yes	In channels	N
Central valley steelhead, *Oncorhynchus*	Central Valley main river systems. Spawn in small, freshwater tributaries. Juveniles remain in freshwater for several years before returning to the ocean. Main rearing habitat	Yes	Yes	In channels	N

Species	General Habitat	Project Microhabitat			Status I = Introduced N = Native
		Open water	Low to Mid Marsh	Mid to High Marsh	
mykiss irideus Federal - Threatened	is in stream/river systems.				
Tule perch, *Hysterocarpus traski*	Associated with vegetated habitats, backwaters with complex banks; epibenthic. Only resident, freshwater, native.	Yes	Yes	In channels	N
Delta smelt, *Hypomesus transpacificus* Federal - Threatened State - Threatened	Lower reaches of the SR, SJR and the Delta; preference for low salinity areas with tidal influence. Spring/Early summer individuals scattered throughout Suisun; brackish water rearing habitat.	Yes	Yes	In channels	N
Green sturgeon, *Acipsenser medirostris* Federal - Threatened	Sacramento River is the southern boundary of their range with anecdotal evidence of a San Joaquin population. Enter freshwater only to spawn. Migrate during periods of high flow and cold water. Prefer large, fast flowing channels	Rare	No	No	N
Sacramento pikeminnow, *Ptychocheleius grandis*[n]	Smaller streams and freshwater tributaries. Native piscivore related more to north delta; juveniles and adults common in the western Delta in turbid in tidal freshwater habitats.	Yes	No	No	N
Sacramento blackfish, *Orthodon microlepidotus*	Small turbid streams and sloughs with a preference for turbid, warm waters; common also in lakes and reservoirs. Spawnings occurs in shallow water within aquatic vegetation.	Yes	Yes	Yes	N
Golden shiner, *Notemigonus crysoleucas*	Warm, shallow sloughs. Beds of aquatic vegetation.	Yes	Yes	In channels	I
Bigscale logperch, *Percina macrolepida*	Slow moving, warm, clear streams. Bury in sand and gravel, but very opportunistic feeders.	Yes	Yes	In channels	I
Prickly sculpin, *Cottus asper*	Common in the Sacramento and San Joaquin rivers and estuary.	Yes	Yes	In channels	N

Species	General Habitat	Project Microhabitat			Status I = Introduced N = Native
		Open water	Low to Mid Marsh	Mid to High Marsh	
Hitch, *Lavinia exilicauda*[n]	Warm, low-elevation lakes, sloughs, and slow-moving stretches of river. Spawning in nontidal creeks. Juveniles in shallow weedy areas of nontidal creeks. Present in Marsh Creek.	Rare	Rare	Rare	N
Sacramento sucker, *Catostomus occidentalis*	Found in the open waters of the Delta and Suisun Bay. Juveniles remain in freshwater.	Rare	Rare	Rare	N
White catfish, *Ameiurus catus*	Shallow waters throughout the Delta. Stagnant or slow current habitats, including the oligohaline portion of San Pablo Bay.	Yes	Channels	In channels	I
Western mosquitofish, *Gambusia affinis*	Shallow, stagnant ponds. Prefers water with cover.	Yes	Yes	Yes	I

Delta smelt, *Hypomesus transpacificus*, is listed as threatened under both federal and state Endangered Species Acts (ESA). The delta smelt is the only smelt endemic to California and is described as the only true native estuarine species found in the Sacramento-San Joaquin Delta (Moyle and others, 1989, Wang 1986). Although historically distributed broadly from Suisun Bay through the central Delta and upstream in both the Sacramento and San Joaquin Rivers, (Moyle and others, 1989), that range is now more restricted depending upon life history stage and river discharge rates. Extensive congregations were previously documented in upper Suisun Bay and Montezuma Slough (Federal Register, 58: March 5, 1993). Due to flow manipulation, the distribution of delta smelt has more recently shifted to the Sacramento River channel (Moyle and others, 1992). Although concentrated along the northern margins of the western and central Delta, schools of delta smelt have been observed on the intake screens of the Pittsburg and Contra Costa power plants (Wang, 1986). Delta smelt spawn in shallow, fresh or slightly brackish water upstream of the mixing zone, typically in tidal portions of backwater, sloughs and channel edge-waters in the western Delta (Wang, 1986, Moyle and others, 1992). Big Break is noted as a likely rearing region for delta smelt, where appropriately brackish, shallow, protected, food-rich environments are maintained. While the Dutch Slough Restoration Project may provide benefits to delta smelt by increasing prey items, it is not likely to provide a significant increase in habitat.

Splittail, *Pogonicheilus macrolepidotus*, is listed as a species of concern under the federal ESA. Native populations are concentrated in the central and western Delta, Suisun Bay, and several of the San Pablo tributaries, particularly the Napa River, and Petaluma River (Moyle, 1976). They are most abundant in the north and west portions of the Delta, although other areas are considered to be suitable for spawning (CDFG, 1995). Because splittail spawn on flooded terrestrial vegetation in the lower reaches of rivers and the Delta, the decrease in riparian marshlands and floodable areas in recent decades has likely been a major contributor to their decline (Federal Register, 64: February 8, 1999).

Juvenile chinook salmon, *Oncorhynchus tshawytscha*, migrate and rear in the western and central Delta. The Sacramento River winter run is listed as endangered under both federal and state ESAs. The spring run is listed as threatened under both federal and state ESAs. Fall and late-fall runs are not listed but are a species of concern to both State and federal authorities. Juvenile Chinook are typically found along the margins of channels and shallow water habitats, where they feed on zooplankton (*Daphnia* spp.), epibenthic crustaceans (amphipods) and aquatic (*Chironomidae*) and surface insects (Simenstad and others, 2000). Based on the IEP survey results, the western Delta region could constitute a significant rearing area for these "ocean-type" Chinook when Delta outflows are high enough to depress the salinity regime to oligohaline conditions.

Central Valley steelhead, *Oncorhynchus mykiss irideus* are found throughout the Central Valley main river systems (Sacramento River and to a lesser extent San-Joaquin River) however densities have been critically reduced by dam construction within the major tributaries and headwaters, and currently only a winter run persists. In March of 1998, Central Valley steelhead were listed as a threatened species, reaffirmed in January of 2006.

Central valley steelhead spawn in the smaller freshwater tributaries to the main rivers during January through March when flows are high and temperatures are cool. Juveniles remain in freshwater for several years before emigrating back to the ocean for adult growth. Dam obstruction prevents adult steelhead from reaching the preferred spawning and rearing areas. Adult steelhead immigrating to spawning locales upstream will benefit indirectly from restoration efforts in the west Delta as will juveniles returning back to the ocean.

Green sturgeon, *Acipsenser medirostris* have a general southern distribution boundary in the Sacramento River with the highest densities in the Colombia River in Washington, and Klamath River, with local recordings in the Feather River and near Red Bluff. There is anecdotal support for a San Joaquin population, however the counts are markedly low and are considered uncommon. Green sturgeon enter freshwater only to spawn, between February and July during periods of high flow and cold water. In the west Delta, adults will be confined to the larger, fast flowing channels. In the San Francisco tributaries juveniles migrate back to the ocean within a year or two, spending at least 3 years at sea before returning to spawn. Adults do eat fish, but a preponderance of their diet is derived from the benthos, including crustaceans, amphipods, and mysid shrimp. The green sturgeon is listed as federally threatened.

Sacramento perch, *Archoplites interruptus,* are unique as the only native centrachid species in the Estuary. There were once broad historic distributions throughout the Central Valley common in sloughs and slow moving rivers, with additional catches in smaller creeks. Today the population is severely limited in number and individuals are captured mainly in manmade lakes and reservoirs in part due to increased competition from non-native centrarchids. Spawning occurs primarily from March to August correlated with rising water temperatures, where males actively defend nests on various bottom substrates. No Sacramento perch have been recorded in local fish monitoring efforts in the western Delta recently, however efforts by California Department of Fish and Game to reintroduce individuals have occurred in Suisun Marsh and Sherman Lake.

NONNATIVE PREDATORS OF CONCERN

Striped bass, *Morone saxitalis*, a non-native species, are abundant in this region of the Delta and are known predators of delta smelt and juvenile Chinook salmon. In addition to these predators, non-indigenous fish such as the wagasaki, or Japanese smelt (*Hypomesus nipponensis*), and inland silverside may constitute competitors with Delta smelt (Bennett et al. 1995).

Largemouth bass, *Micropterus salmoides* were introduced early in California's history as a recreational game fish where they quickly established as an aggressive predator throughout waterways in the state. Largemouth bass are abundant in warm, shallow ponds and reservoirs and prefer bed of dense aquatic vegetation. . They are voracious predators capable of feeding on a variety of prey types and sizes, but subsist mainly on fish. Individuals are capable of withstanding a wide range of temperature and can persist within local highs. Largemouth bass prefer freshwater habitats and are rarely found in salinities above 5 o/oo.Spawning events can occur as early as March and continue through June, where eggs are deposited in nests made of sand or gravel depressions constructed defended by the males species. The salinity, hydrologic conditions, and prey availability will favor success of largemouth bass in the west Delta.

Introduced sunfishes, *Lepomis* spp. (e.g., bluegill and red ear Sunfish) represent an abundant and diverse group of deep bodied, freshwater fishes, which have adapted to a varied range of habitats in the Sacramento-San Joaquin Delta. They are most common in warm, reservoirs, lakes, and ponds, but also inhabit streams and rivers where pools exist, and are highly correlated with aquatic vegetation and cover; which are a common habitat in the west Delta. Researches also identified the dominance of introduced sunfishes in Big Break, and area often choked with floating and submerged aquatic vegetation. Feeding behaviors are equally flexible, capable of preying on food items throughout the water column. Spawning generally occurs from spring to late summer, where males construct nests in the gravel beds and sand and continue to defend vigorously.

Yellowfin goby, *Acanthogobius flavimonus* are native to the shallow coastal waters Japan, Korea, and China. They were believed to have been introduced to the Estuary in 1963 via vessel ballast water and are now common throughout the waterways of California. In the Estuary yellowfin gobies are found in shallow, soft-bottomed areas within a large range of salinities, including freshwater, which adults require for breeding. Adult females spawn in fall and winter primarily in San Pablo Bay, but are regularly captured in Suisun Bay during the spring and summer. These species will be common in the project area, particulary during the spawning season. Yellowfin gobies exploit a broad array of prey items including fish, but feed heavily on amphipods and mysids.

3.5.2 Impacts and Mitigations

Significance Criteria

Criteria for determining significant impacts to aquatic organisms were based on the State CEQA Guidelines (Appendix G) and on professional judgment. The Guidelines state that the project would have a significant impact on aquatic resources if it:

A. Has a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service

B. Interferes substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impedes the use of native wildlife nursery sites.

The CEQA Guidelines do not define the term *substantial* since what is considered substantial will depend on the species in question and the circumstances of individual projects. It is therefore up to the organization preparing the EIR to determine standards for the threshold of significance.

Impacts to the fish assemblage in the vicinity of project were assessed by evaluating all potential direct, indirect, temporary, and permanent impacts. The Dutch Slough Restoration Project is intended to produce tidal wetland habitat in an area that is currently diked and managed for agriculture, and thus has the potential to be a net benefit to fish. However, implementation of the Dutch Slough Restoration Project could negatively impact fish through the following mechanisms:

- Changes in water quality (See Section 3.2, Water Quality for analyses of this issue)
- Entrainment of fish in areas disconnected from the Bay-Delta
- Disturbance of substrate
- Creation of habitat that will benefit non-native invasive species at the expense of natives

Alternative 1: Minimum Fill

IMPACT 3.5.1-1: DECREASED WATER QUALITY DUE TO CONSTRUCTION/DREDGING ACTIVITIES (DUTCH SLOUGH RESTORATION PROJECT AND OPEN WATER MANAGEMENT OPTIONS)

Potential water quality changes due to the Dutch Slough Restoration and Ironhouse projects that could impact fish and macroinvertebrates include changes in suspended sediments, dissolved oxygen (DO), temperature, and various contaminants. The significance of these water quality impacts is based on compliance with standards set forth by the RWQCB Central Valley Region Water Quality Control Plan (Basin Plan) (2004) and other supporting documents. For further information on these standards and how the Dutch Slough Restoration and Related Projects may affect water quality, see Section 3.2.

Periods of high suspended sediment concentrations can reduce respiratory efficiency in fish due to clogging and abrasion of gill filaments, thus leading to increased stress levels (Waters 1995, Kemp 1949). Increased turbidity due to suspended sediments can lead to reduced feeding efficiency for visual predators like salmon (Madej 2004). Sediment can also smother eggs, causing increased mortality thus affecting future fish stocks (Hobbs 1937). The Basin Plan states that suspended sediment concentrations should not reach levels that impair beneficial uses (such as supporting fisheries). A threshold level of 50 NTUs (units of turbidity) should not be exceeded in waters of the central Delta.

Contaminants such as petroleum products (fuels, oil, grease) used in conjunction with construction activities can be accidentally introduced into the water. These substances are known to be toxic to fish and prolonged exposure can cause morphological, behavioral, physiological, and biochemical abnormalities (Sindermann et al. 1982). The Basin Plan states that water should not contain oils, greases, waxes or other materials in concentrations that cause a nuisance, or result in a visible coating/film on the water surface or on objects in the water.

Implementation of this alternative would require re-grading, lowering, and potentially disking the existing levees surrounding the Dutch Slough Restoration Project site. Unintentional levee breaches surrounding open water management areas would have to be repaired. Also, creating the final levee breaches to allow full tidal exchange between the Dutch Slough Restoration Project area and the Bay-Delta would require excavation adjacent to and inside the waters of the Delta. The construction activities have the potential to increase suspended sediments and introduce contaminants (fuel oils, grease) in the vicinity. This impact would apply to all portions of the Dutch Slough Restoration Project. It also would apply to the Ironhouse Project because it involves grading and lowering levees adjacent to Marsh Creek. Since this disturbance could be continuous throughout the levee construction/maintenance period, and could therefore impact special status species in the immediate vicinity, the impact is considered potentially significant.

It is possible that the upstream reach of Little Dutch Slough may need to be dredged to allow full tidal drainage to adjacent marshes. This action would cause a short-term increase in suspended sediments since it involves direct disturbance of the substrate. This impact is considered to be potentially significant.

MITIGATION 3.5.1-1.1: DEVELOP A STORM WATER POLLUTION PREVENTION PLAN (SWPPP) THROUGH THE RWQCB

Prior to construction of the Dutch Slough, City of Oakley Community Park, or Ironhouse Project, the respective applicant shall obtain authorization from the RWQCB. As part of this application process, the applicant shall develop a SWPPP and identify Best Management Practices (BMPs) for controlling soil erosion and the discharge of construction-related contaminants. BMPs shall be monitored as specified in the SWPP for successful implementation. This mitigation measure shall apply to all portions of the Dutch Slough Restoration and Related Projects that involve construction activities.

MITIGATION 3.5.1-1.2: LIMIT CONSTRUCTION TO THE DRY WEATHER SEASON (JUNE – NOVEMBER)

Construction activities involving earth-moving on any of the sites in an area where material may enter or be transferred to a slough shall be limited to the April 15-October 15 dry season. This will reduce the amount of sediment and contaminants washed into the Delta from the Dutch Slough Restoration and Related Projects site by rains.

MITIGATION 3.5.1-1.3: INSTALL COFFER DAMS

Prior to levee breaching, coffer dams shall be installed around areas where the levees are to be breached to allow construction equipment to operate on both sides of the levee while greatly reducing the amount of sediments and construction contaminants reaching the Delta.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.5.1-2: RELEASE OF LOW QUALITY WATER FROM PROJECT AREA DURING PRE-BREACH WATER MANAGEMENT PERIODS (DUTCH SLOUGH RESTORATION PROJECT AND IRONHOUSE PROJECT)

Low DO concentrations can be common in shallow, isolated bodies of water experiencing limited hydraulic exchange with surrounding areas. Temporary reductions in DO concentrations below an organism's tolerance level can cause undue stress, impede movement, and lead to death if conditions persist long enough. The Basin Plan states that DO concentrations in waters of the Delta should be above 5.0 mg/l.

These shallow, isolated water bodies can also experience elevated temperatures. As with DO, temporary periods of water temperatures outside an organism's tolerance range can cause undue stress, can impede movement, and can lead to death if conditions persist long enough. The Basin Plan states that the temperature of intrastate waters such as the Delta shall not be increased more than 5°F above their ambient temperature by outside input.

Most fish are capable of leaving areas where detectable water quality conditions become adverse. However, less mobile organisms such as macroinvertebrates may not be able to avoid such conditions. A decrease in macroinvertebrates could indirectly but significantly affect fish by reducing prey availability.

The Dutch Slough Restoration Project includes some pre-breach water management periods during which revegetation will be encouraged or open water maintained. Areas graded to tidal marsh plain elevations (low and mid marsh) are expected to have a relatively short water management period. Areas graded to open water are expected to have far longer water management periods, with duration dependent on open water options (discussed below).

During pre-breach water management periods, water will periodically be released from the Dutch Slough Restoration Project area during drawdown. The release of stagnant water with low DO and high temperature compared to the surrounding waters could be harmful to sensitive aquatic species residing in the Dutch Slough Restoration Project vicinity. Responses will vary depending on life stage, organism mobility, and hydrologic conditions during the event (e.g. tidal phase, current velocity, etc.). Native species, including tule perch and prickly sculpin, could be entrained in release waters as they are regular inhabitants of the current project area, associated with the dense submerged aquatic vegetation of Big Break, and are sensitive to increases in temperature. Emigrating salmon smolts would also be adversely affected by warm waters which have been documented to increase mortality to individuals that remain in high temperature waters (Brown 2003). This impact applies to both the Dutch Slough Restoration Project site and the Ironhouse parcel. Since this impact could potentially occur during salmon migrations, thus affecting endangered species, it is considered significant.

OPEN WATER MANAGEMENT OPTIONS

This impact applies to all of the tidal open water management options. Under the two non-tidal management options impacts would occur over a longer time period. These two options do not involve breaching the site to full tidal action at any time in the foreseeable future and thus would require water level management for the lifetime of the Dutch Slough Restoration Project. The impacts for all the above scenarios would be significant.

MITIGATION 3.5.1-2.1: RELEASE ON-SITE WATER GRADUALLY

Water from the Dutch Slough Restoration Project area shall be released gradually to reduce the impact of low DO and high temperature water on the surrounding water body. This would allow the plume of degraded water to dissipate without harmful affects to aquatic life.

MITIGATION 3.5.1-2.2: LIMIT OPERATION DURING MIGRATION PERIODS OF SENSITIVE SPECIES

Water level management activities shall be limited during migration periods for sensitive species such as salmon to reduce the potential impacts upon these species.

MITIGATION 3.5.1-2.3: MAINTAIN SHORT RESIDENCE TIME

Residence time of water shall be limited to reduce the opportunity for adverse water quality conditions to develop. Residence time is controlled by the rate at which water is exchanged between the managed area and its adjacent tidal source. The Dutch Slough Restoration Project shall utilize appropriate water control structures that allow flexibility in management to provide adaptive management capacity.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation

IMPACT 3.5.1-3: ENTRAINMENT OF FISH INTO AREAS DISCONNECTED FROM THE BAY-DELTA (DUTCH SLOUGH RESTORATION PROJECT AND IRONHOUSE PROJECT)

Entrainment involves the diversion of fish from a water body into habitats that may be unsuitable, or from which they are unable to escape. If fish are diverted into an area isolated from the surrounding water body they may be subject to stressors such as poor water quality (i.e., increased water temperature and low dissolved oxygen) and increased predation pressure from other fish, birds and mammals. Entrainment can also prevent fish from completing important life history events such as spawning and rearing migrations. The significance of entrainment is assessed based on the potential to impede the movement of special status species during critical life history events, or to cause excessive mortality.

Alternative 1 calls for lowering some sections of the surrounding levees to high marsh elevation prior to breaching the site for full tidal exchange. High tides would occasionally overtop these areas, potentially entraining fish inside the site. Water would also be drawn into the site during the revegetation period potentially entraining fish through the intake structures. This impact would apply to the Dutch Slough and Ironhouse projects. Since the Dutch Slough Restoration Project site levees are not expected to be breached until three years after the initial levee construction phase of the Dutch Slough Restoration Project, this impact is considered potentially significant.

OPEN WATER MANAGEMENT OPTIONS

This impact applies to all of the Dutch Slough Restoration Project open water management options. The tidal management options would have short-term periods prior to levee breaching when fish could be entrained. The duration of this impact is relatively short, but as described above it could be three years to breaching. The non-tidal management options would have entrainment impacts over a longer time period. These two options do not involve breaching the site to full tidal action and thus, by design, create possibilities for fish entrainment through intake structures as well as crossing the drainage divides from the restored tidal marsh. Since both the tidal and non-tidal management options would create entrainment hazards for at least three years, the impacts are considered potentially significant.

MITIGATION 3.5.1-3: DEVELOP MEASURES TO MINIMIZE ENTRAINMENT UNDER INCIDENTAL TAKE PERMIT

Implementation of the Dutch Slough Restoration Project may require an incidental take authorization from the USFWS/NOAA Fisheries and the California DFG. This will require monitoring for entrainment during periods of potential presence of listed species. The mitigation plan shall require the identification of measures to avoid and minimize the take of listed species. Potential measures shall include the installation of fish screens on water intake structures based on the criteria of NMFS, USFWS, and DFG, or restricting the operation of such structures during migration periods of listed species.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation

IMPACT 3.5.1-4: MERCURY METHYLATION COULD CAUSE BIOACCUMULATION AND TOXICITY TO FISH (DUTCH SLOUGH RESTORATION PROJECT AND IRONHOUSE PROJECT)

As discussed in Chapter 3.2, Impact 3.2.1-4 mercury methylation, is a concern for wetland restoration projects in the Bay-Delta because certain types of wetland habitats are known to support the biological processes that transform mercury into methylmercury (MeHg). Total mercury should not change as a result of the Dutch Slough Restoration Project and Ironhouse Projects (the City's Community Park Project would not affect mercury), however, there could be an increase in MeHg loads to water in Dutch Slough or Big Break, as well as localized increased concentrations of mercury in sediment. A localized increase in MeHg in the immediate vicinity of the Dutch Slough Restoration Project could be a hazard to aquatic organisms regularly inhabiting the area. Since MeHg biomagnifies up the trophic structure, increased amounts of MeHg in the environment could have adverse effects on top predators such as salmonids, striped bass, and largemouth bass in the Dutch Slough vicinity. High levels of MeHg can cause damage to the nervous, reproductive and immune systems.

Certain aquatic habitats are more likely to serve as sources of MeHg than others. Mudflats and irregularly inundated areas such as high marsh zones and flooded bypasses seem to have the highest rates of MeHg export while emergent tidal marshes and open water habitats appear to have the lowest rates of flux, and can even serve as MeHg sinks. More shallow open water and less vegetation means Alternative 1 is likely to yield lower MeHg concentrations than Alternatives 2 and 3. Since the amount of high marsh and mudflat habitat being created would be minimal, the amount of MeHg exported from the Dutch Slough Restoration Project site may be negligible. The width of the 5:1 slope levees and natural transitions to uplands by about 1 ft. vertical range of restored marsh by about 5 miles of edge at most equates to about 3 acres total of high marsh out of 440 to 830 acres of restored marsh depending on alternative. While all of the restored marsh area has some probability of methylating mercury, roughly 0.7% of the restored marsh area is considered high marsh zone, which is the type of marsh anticipated to have the highest MeHg export. For these reasons, this impact is considered less than significant.

The Dutch Slough Project includes monitoring for mercury and MeHg levels in water and sediments in the Dutch Slough vicinity both before and after restoration activities take place. This monitoring will provide baseline conditions at the site and will allow for comparisons between pre and post restoration MeHg levels. The information will aid in determining potential site management changes in the future, as well as advance the general body of knowledge on the subject of MeHg creation and export in restored tidal marshes. It is likely that these monitoring activities will be coordinated with the creation of the Delta Mercury TMDL.

The water-quality monitoring plan also includes monitoring for mercury and MeHg levels in Marsh Creek. Should the study find that mercury levels are outside the acceptable range, diverting Marsh Creek onto the Ironhouse Parcel as part of that project may not occur.

OPEN WATER MANAGEMENT OPTIONS

Since many of these options are "experimental" it is hard to predict how they will impact MeHg production. The environmental factors that promote the production of MeHg (high organic matter content, low DO, high temperature) would be more enhanced in the skeletal channel network option than in the deep subtidal option. In the non-tidal management options, subsidence reversal would be more likely to promote mercury methylation than managed pond since it would produce high organic matter, low DO, and high temperature conditions. These areas, however, are expected to remain submerged for extended periods with little if any periods of dry, thereby providing conditions that are apparently less likely to produce and export MeHg. Given the existing knowledge base regarding the biogeochemical processes of MeHg and the extremely small areas that would be established that appear more likely to methylate mercury, this impact is considered not significant.

IMPACT SIGNIFICANCE

Less than significant. No mitigation required.

IMPACT 3.5.1-5: DISTURBANCE OF BENTHIC HABITATS

DUTCH SLOUGH RESTORATION PROJECT AND ALL OPEN WATER MANAGEMENT OPTIONS

As previously mentioned, it is possible that the upstream reach of Little Dutch Slough may need to be dredged to allow full tidal drainage in marshes adjacent to it. This action would disrupt the substrate, thus removing the benthic habitat and associated macroinvertebrate community. This action would occur over a short time period, and therefore the impacts should be only temporary. The substrate that would be disturbed should be rapidly recolonized by benthic macroinvertebrates and fish. Therefore, this impact is not expected to be significant.

IMPACT 3.5.1-6: CREATION OF HABITAT THAT BENEFITS NON-NATIVE FISH SPECIES

DUTCH SLOUGH RESTORATION PROJECT

While the goals of the Dutch Slough Restoration Project and Ironhouse Project are to create tidal and freshwater wetland habitats for the benefit of native fishes, there is a chance that the habitats created could favor non-native species (Brown 2003) that prey on native species, thus causing a further decline of some special status species. The fish assemblages found in tidal freshwater wetlands in the Delta are dominated by alien species (Brown 2003). The fish assemblage found in a restored wetland often depends on the type of habitat that is created. Native species are associated more with shallow, intertidal habitats, while deep, subtidal areas tend to support more invasives (Simenstad et al. 2000). Several studies have also investigated the link between invasive submerged aquatic vegetation (SAV) and invasive fish species. The vegetation species of greatest concern is *Egeria densa*, a Brazilian waterweed that forms dense monocultures in shallow waters (Grimaldo and Hymanson 1999). Water hyacinth (*Eichhornia crassipes)* is another highly invasive floating plant in the Sacramento San Joaquin delta. Invasive centrarchid predators (bass and bluegill) are often found in high numbers in *Egeria* beds, as are the native tule perch. The decline in tule perch coupled with the increase in centrarchids in the Delta suggest that there may be interspecific interaction between these species (Nobriga and Chotkowski 2000).

There is a growing body of evidence that shallow habitats dominated by submerged macrophytes are generally unsuitable for the Delta's remnant native fish fauna (Grimaldo et al. 2004; Nobriga and Feyrer 2007; Brown and Michniuk 2007, as cited in Nobriga and Feyrer 2007; Brown 2003; Nobriga et al. 2005). Grimaldo et al. (2004) found very few native fish larvae in macrophyte-dominated habitats, suggesting they are either rarely used as spawning habitats or native fish larvae suffer high mortality when they use submerged macrophytes for spawning. Grimaldo et al. (2004) also found a link between the amount of tidal exchange and exotic fish: in their study, a restored site with minimal tidal exchange and greater lower-trophic productivity supported the highest densities of alien fish. They conclude that the best native fish restoration strategy may be restoring wetlands that offer only winter and spring inundation periods, which may provide maximum benefits to natives while limiting access by many exotic fishes (Grimaldo et al. 2004). Nobriga and Feyrer (2007) state: "We strongly suggest that restoration projects in the Delta need to discourage submerged macrophyte domination".

A recently completed 5-year fish monitoring program at the newly created Decker Island Tidal Marsh restoration site in the Sacramento- San Joaquin estuary (Rockriver 2007) supports the observations that non-native aquatic vegetation enhances non-native fish predator populations. This restoration site, in the Sacramento River near Rio Vista, is composed of several subtidal channels in a dendritic configuration with a single outlet to the Sacramento River. In the 5-years since the project was created, the channels have become invaded by beds of *Egeria* and water hyacinth, and introduced centrachids dominate the restored habitat. Also, large numbers of young-of-the year centrachids indicate that the restoration site is utilized for spawning and rearing. While the vegetation/upland habitat of the project was highly successful, the project has not met 4 out of the 5 aquatic success criteria that were developed to determine habitat value for native fish in the restoration site (Rockriver 2007). The monitoring report concludes by stating that "eliminating or greatly decreasing the amount of SAV and floating vegetation from the restoration site may increase native fish use of the restoration site in the spring. More importantly, it may reduce the number of centrarchids residing in the channel habitats."

Egeria may offer increased foraging resources for some native species through the associated macroinvertebrate community (Brown 2003), but it is unlikely that this benefit outweighs the increased predation pressure from non-native centrarchids and striped bass. The significance of this impact depends on whether the creation of such habitats could lead to more predation upon special status species than currently occurs.

This impact applies mainly to the open-water and subtidal portions of the Dutch Slough Restoration Project. This document assumes that the Dutch Slough Restoration Project's open-water management option would be shallow subtidal with native SAV planting. This option calls for the pre-establishment of native plants and management for invasives. If this is performed effectively then the habitat created should be beneficial for native fish species. However, if invasive plants are allowed to colonize the open water areas, they may create feeding opportunities for invasive fish species at the expense of natives, including target special status species. Because the final outcome of the created aquatic habitat cannot be determined and because of the outcome of the aquatic habitat on Decker Island, the significance of this impact cannot be pre-determined and it will be considered potentially significant.

OPEN WATER MANAGEMENT OPTIONS

The skeletal channel network options for open water management also call for the pre-establishment of native SAV and would therefore have the same impacts and significance as the shallow subtidal option; it may, however, lend itself better for control measures to reduce invasive SAV and floating aquatic vegetation (FAV). Additionally, the skeletal channel network would act to separate native fish species from open water habitat colonized by invasive SAV, and also provide superior channel edge habitat thus potentially exceeding the potential impacts of subtidal open water areas compromised by SAV. The deep open water management option would be too deep for the establishment of FAV/SAV. This option would prevent invasive SAV from establishing and taking over the site. However, as noted above, deep open water areas in breached wetland habitats are often dominated by alien fish species

The two non-tidal open water management options for the Dutch Slough Restoration Project, managed pond and subsidence reversal, are not designed for the benefit of fish and the assemblages that develop in the ponds would do so mainly through entrainment. Therefore, these options are not considered to produce any benefit for fish, be they native or alien, and the impacts would not be significant.

Adaptive management techniques would be applied as they become available and information warrants topromote native fish success in open water areas. One avenue that will be investigated, in the event that non-native vegetation and fish predators become dominant in the Dutch Slough Restoration site, is the construction of additional levee breaches to enhance tidal exchange.

MITIGATION 3.5.1-6: ENHANCE TIDAL EXCHANGE.

In the event that non-native vegetation and fish predators become dominant in the Dutch Slough Restoration site, constructing additional levee breaches and other measures to facilitate a greater tidal exchange in the open water areas and subtidal channels to promote habitat favorable to the establishment of native SAV and native fish will be investigated and implemented accordingly.

IMPACT SIGNIFICANCE AFTER MITIGATION:

Potentially significant. The problems caused by non-native fishes are ubiquitous throughout the Delta and the subsequent invasion of the site by these species may be an unavoidable consequence of habitat restoration.

IMPACT 3.5.1-7: ENDOCRINE DISRUPTING CHEMICALS AND OTHER CONTAMINANTS ENTERING THE SITE FROM MARSH CREEK OR FROM FILL SOILS COULD HARM FISH

DUTCH SLOUGH RESTORATION PROJECT AND OPEN WATER MANAGEMENT OPTIONS

As described in Section 3.2, Impact 3.2.1-7, endocrine-disrupting chemicals and heavy metals could enter Dutch Slough and Ironhouse restoration project waters via Marsh Creek and fill soils, particularly imported soils from the Ironhouse parcel formerly subjected to spray of treated wastewater, which may have contained these compounds and metals. Some endocrine disruptors that are of particular concern to fish are heavy metals, polyaromatic compounds and steroid estrogens. Metals are known to have a suite of physiological and behavioral effects on fish including organ damage (Baker 1969), delaying or preventing sexual maturation (Edwards and Brown 1967), and inhibiting feeding behavior. Exposure to polyaromatic compounds has been linked to increases in cancerous lesions and tumors and deformities in fish (Vogelbein and Unger 2006, Yang 2005). Steroid estrogens (e.g. estrone (E1), 17-estradiol (E2), 17-ethinylestradiol (EE2)) are responsible for a phenomenon known as "feminization", in which males experience morphological changes in sex organs, or complete sex reversals (Matthiessen and Sumpter 1998, Gomez and Lester 2003).

Recent soil toxicity tests on the Ironhouse parcel indicate no likely adverse effects on water quality if borrow sediment is used. No elevated concentrations were recorded for a suite of potential harmful contaminants (Stellar Environmental Solutions 2006). The results of the soil investigation also indicated that the spatial variation in contaminants was low enough that no further sampling is necessary before soils are excavated and reused.

The EPA has established target concentrations for heavy metals and many polyaromatic hydrocarbons that are not to be exceeded in freshwater environments. These standards can be located through the Water Quality Standards Database (http://www.epa.gov/wqsdatabase/reports_inter.html). There are, however, no established limits for concentrations of estrogenic compounds or many other PPCPs.

There are also other water quality constituents that could be found in Marsh Creek that could be harmful to aquatic life either directly or indirectly. These include hydrocarbons, excessive nutrients from agriculture operations and lawn fertilizers, and pathogens from agricultural operations and municipal wastewater. These pollutants could cause harm to fish and macroinvertebrates if they are found in high enough concentrations.

This impact would apply mainly to the Ironhouse restoration parcel under the Dutch Slough Restoration Project scenario. Diverting Marsh Creek onto the Dutch Slough Restoration Project site could cause adverse effects by introducing the above listed contaminants directly. The Dutch Slough Restoration Project site would still receive some input of these substances from Marsh Creek even without it being routed directly onto the property since the mouth of the creek is adjacent to the site. These pollutants could cause harm to fish and macroinvertebrates if they are found in high enough concentrations. There are currently not enough data on the water quality in Marsh Creek to determine with certainty if diversion could lead to significant harm to aquatic resources. The impact is considered potentially significant.

MITIGATION 3.5.1-7.1: MARSH CREEK WATER QUALITY TESTING AND EVALUATE FEASIBILITY OF MARSH CREEK RELOCATION BASED ON WATER QUALITY CONSIDERATIONS

This mitigation will be the same as water quality mitigation 3.2.1-7.1.

MITIGATION 3.2.1-7.2: TIMING OF RELOCATION OF MARSH CREEK

This mitigation will be the same as water quality mitigation 3.2.1-7.2

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation

IMPACT 3.5.1-8 CUMULATIVE IMPACTS

The Dutch Slough Restoration Project, Ironhouse Project, and City Community Park would be developed in an area that is experiencing rapid urbanization. Several housing developments immediately adjacent to the site are either currently under construction or are scheduled to begin soon. The Ironhouse Sanitary District is planning to expand its sewage treatment capacity from 3.6 million gallons/day (MGD) to 8.0 MGD to accommodate the new housing developments. The ISD also plans to eliminate its land-based wastewater irrigation on the mainland and construct a surface water discharge with tertiary treatment at Jersey Point (on Jersey Island). This is the preferred alternative, although the ISD is also evaluating the possibility of expanding its wastewater irrigation operations on Jersey Island.

These proposed developments could have potential impacts on fishery resources in the Dutch Slough and Ironhouse sites and the greater project vicinity. The new housing developments would increase the human population in the area, leading to more recreation pressure at the site. Specific impacts to fisheries could include increased angling and littering. The increased volume of municipal sewage from the new developments would introduce more pollutants to the waters, which could exacerbate Impact 3.5.1.7 above. The method in which the treated wastewater is discharged would determine the severity of the impact to aquatic organisms. More pollutants could potentially be introduced to the site if the effluent is discharged to surface waters as opposed to being used for irrigation on Jersey Island. However, the point of surface water discharge is planned to be located at Jersey Point on the San Joaquin River, which is on the opposite side of Jersey Island from the Dutch Slough Restoration Project site. This will allow pollutants to be diluted and dispersed before they reach the site, thus reducing their potential impact on aquatic life. The aquatic resources in Gallagher Slough (across the San Joaquin River from Jersey Point) and potentially Big Break and Franks Tract would be more severely impacted.

There is also a proposal to encase nearly four miles of the Contra Costa Canal including a section of the Canal in the vicinity of Dutch Slough. The encasement of this waterway would eliminate any fishery resources currently in the canal. However, that project calls for fish relocation efforts prior to construction, which should mitigate that impact.

The impacts to aquatic resources due to potential sea level rise also must be considered. A variety of estimates quantify the range of potential sea level rise, report observed trends and offer predictions of global warming and the potential impacts (IPCC 2001, CCCC 2006). The Intergovernmental Panel on Climate Change reports that over the last 100 years the eustatic (globally averaged) sea level rise was 1to 2 mm/year (0.3 to 0.6 ft/century). The IPCC projects rates of sea level rise to increase over the next century, with projected increases ranging from 0.4 - 2.9 ft by 2100 (IPCC 2001). More recent estimates by the California Climate Change Center[1] report sea level rise in California over the past century to be approximately 7 inches (0.6 ft), and projects increases of 22 to 35 inches (1.8 to 2.9 ft) by 2100 (CCCC 2006). As described in Chapter 3.1, Hydrology, CALFED scientists have projected possible greater sea level rises, ranging from 29-78 inches this century.

Rise in sea level would affect fish primarily by changing the availability of habitat. In the Dutch Slough Restoration Project site, a rise in sea level would cause marsh areas to become shallow open water habitat, and open water areas to become even deeper. This could effectively eliminate the marsh habitat being created by the restoration project unless natural sediment accretion is able to keep up with the rate of sea level rise.

Alternative 2: Moderate Fill Alternative

IMPACT 3.5.2-1: DECREASED WATER QUALITY DUE TO CONSTRUCTION/DREDGING ACTIVITIES

DUTCH SLOUGH RESTORATION PROJECT AND OPEN WATER MANAGEMENT OPTIONS

The impact would be the same as Impact 3.5.1-1.

MARSH CREEK RELOCATION OPTIONS

All options for relocating Marsh Creek would require the construction of an earthen blockage in the existing channel to route the creek onto the Emerson parcel. The creation of this structure could lead to an increased sediment and construction contaminant load to the creek and the adjoining Bay-Delta. This impact is considered to be potentially significant.

MITIGATIONS

Mitigations will be the same as for Impact 3.5.1-1. Along with installing coffer dams around levee breach locations (Mitigation 3.5.1-1.3), these structures shall be installed around the area where the Marsh Creek channel blockage is to be constructed to reduce sediment and contaminant loading to the Bay-Delta.

SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation

IMPACT 3.5.2-2: RELEASE OF LOW QUALITY WATER FROM PROJECT AREA DURING REVEGETATION PERIOD

DUTCH SLOUGH RESTORATION PROJECT

The impact would be the same as Impact 3.5.1-.2, except that there is less open water area in this alternative, resulting in a lower volume of water to be managed.

OPEN WATER MANAGEMENT OPTIONS

The impact would be the same as 3.5.1-2 except that the volume of water would be less.

MARSH CREEK RELOCATION OPTIONS

Not applicable

MITIGATIONS

Mitigations would be the same as for Impact 3.5.1-2.

Impact Significance After Mitigation

Less than significant with mitigations.

Impact 3.5.2-3: Entrainment of Fish into Areas Disconnected from the Bay-Delta

Impacts and mitigations would be the same as for Impact 3.5.1-3 (all options).

Impact 3.5.2-4: Mercury Methylation Could Cause Bioaccumulation and Toxicity to Fish

Dutch Slough Restoration Project

The impact would be the same as for Impact 3.5.1-4.

Open Water Management Options

The impact would be the same as for Impact 3.5.1-4.

Marsh Creek Relocation Options

Diverting Marsh Creek to the project area could cause mercury deposition in marsh and open water areas, especially in Ironhouse or Emerson parcels (depending on design), to the extent that mercury is present in waters and suspended sediments in Marsh Creek. Loads of total mercury to marsh areas could slightly increase MeHg production.

The Dutch Slough Project includes monitoring for mercury and MeHg levels in Marsh Creek. Should the study find that mercury levels are outside the acceptable range, diverting Marsh Creek onto the Emerson Parcel may not occur.

Impact Significance

Less than significant.

Impact 3.5.2-5: Destruction of Benthic Habitats

Dutch Slough Restoration Project

The impact will be the same as Impact 3.5.1-5.

Open Water Management Options

The impact will be the same as Impact 3.5.1-5.

Marsh Creek Relocation Options

All three options for Marsh Creek relocation involve the creation of a channel block which would eliminate benthic habitat within the block's footprint. However, the creek would be routed into the Dutch Slough Restoration Project site via a newly dredged channel, which would ultimately create more habitat for these organisms. As long as the construction and dredging activities for Marsh Creek are performed outside of migration and or spawning periods for special status species, the impact would not be significant and would require no mitigation.

IMPACT SIGNIFICANCE

Less than significant.

IMPACT 3.5.2-6: CREATION OF HABITAT THAT BENEFITS NON-NATIVE FISH SPECIES

DUTCH SLOUGH RESTORATION PROJECT

The impact would be the same as for Impact 3.5.1-6. The total area of open water in Alternative 2 would be less than that in Alternative 1, which would result in less area that must be managed for invasive FAV/SAV.

OPEN WATER MANAGEMENT OPTIONS

The impact would be the same as Impact 3.5.1-6, except that the total area of open water would be less in this alternative. Less area would need to be managed for invasive FAV/SAV under the skeletal network option. Under the deep subtidal management option there would be less open water habitat for alien fish species to colonize. The non-tidal management options also would be the same as in Alternative 1, only with a smaller area for alien fish species to colonize.

MARSH CREEK RELOCATION OPTIONS

Not applicable

MITIGATIONS

Mitigations would be the same as for Impact 3.5.1-6.

IMPACT SIGNIFICANCE AFTER MITIGATION

Potentially significant and unmitigable. However, the problems caused by non-native fishes are ubiquitous throughout the Delta and the subsequent invasion of the site by these species is an unavoidable consequence of habitat restoration.

IMPACT 3.5.2-7: ENDOCRINE DISRUPTING CHEMICALS AND OTHER CONTAMINANTS ENTERING THE SITE FROM MARSH CREEK OR FROM FILL SOILS COULD HARM FISH

DUTCH SLOUGH RESTORATION PROJECT

The impact would be the same as 3.5.1-7, except in this alternative, soils from the Ironhouse Parcel would be used as fill material on the Dutch Slough Site.

OPEN WATER MANAGEMENT OPTIONS

Not applicable

MARSH CREEK RELOCATION OPTIONS

Diverting Marsh Creek onto the Dutch Slough Restoration Project site could cause adverse effects by introducing the above-listed contaminants from urban runoff, agricultural operations, and wastewater treatment effluent. These pollutants could cause harm to fish and macroinvertebrates if they are found in high enough concentrations. There are currently not enough data on the water quality in Marsh Creek to make a decision if diversion could lead to harm to aquatic resources. The Dutch Slough Restoration Project intends to collect more data on this topic. Until that time it is not possible to determine the potential significance of this impact and, for the purposes of this EIR, it is considered potentially significant.

MITIGATIONS

Mitigations would be the same as for Impact 3.5.1-7. If water quality is found to be below allowable standards, the routing of Marsh Creek onto the Dutch Slough Site would be eliminated.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.5.2-8 CUMULATIVE IMPACTS

Same as Alternative 1.

Alternative 3: Maximum Fill

IMPACT 3.5.3-1: DECREASED WATER QUALITY DUE TO CONSTRUCTION/DREDGING ACTIVITIES

DUTCH SLOUGH RESTORATION PROJECT

The impact would be similar to Impact 3.5.1-1 but reduced because there would be no need to dredge Little Dutch Slough.

OPEN WATER MANAGEMENT OPTIONS

Not applicable

MARSH CREEK RELOCATION OPTIONS

The impact would be the same as Impact 3.5.2-1.

MITIGATION

Mitigations would be the same as for Impact 3.5.2-1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation

IMPACT 3.5.3-2: RELEASE OF LOW QUALITY WATER FROM PROJECT AREA DURING REVEGETATION PERIOD

DUTCH SLOUGH RESTORATION PROJECT

The impact would be the same as Impact 3.5.1-2 except that only the Emerson parcel would have an open water area, resulting in the smallest volume of water of all three alternatives.

Open Water Management Options

The impact would be the same as Impact 3.5.1-2 except only the Emerson parcel would have an open water area.

Marsh Creek Relocation Options

Not applicable

Mitigations

Mitigations would be the same as for Impact 3.5.1-2.

Impact Significance After Mitigation

Less than significant with mitigation

Impact 3.5.3-3: Entrainment of Fish Into Areas Disconnected From the Bay-Delta

Dutch Slough Restoration Project

The impact would be the same as Impact 3.5.1-3; however the impacts would be less intense because the Emerson parcel is the only parcel that is designed to have open water areas.

Open Water Management Options

The impact would be the same as Impact 3.5.1-3, however the impacts would be less intense because the Emerson parcel is the only parcel that is designed to have open water areas.

Marsh Creek Relocation Options

Not applicable

Mitigation

This would be the same as Mitigation 3.5.1-3

Impact Significance After Mitigation

Not significant with mitigation

Impact 3.5.3-4: Mercury Methylation Could Cause Bioaccumulation and Toxicity to Fish

Dutch Slough Restoration Project and Open Water Management Options

Impacts would be the same as for Impact 3.5.2-4 (all options).

Marsh Creek Delta Relocation Options

Same as Impact 3.5.2-4

Impact 3.5.3-5: Destruction of Benthic Habitats

Dutch Slough Restoration Project

Alternative 3 would not include dredging Little Dutch Slough, which would eliminate the destruction of the benthos in this area.

Open Water Management Options

Not applicable

Marsh Creek Relocation Options

The impact would be the same as Impact 3.5.2-5

Impact Significance

Not significant

Impact 3.5.3-6: Creation of Habitat That Benefits Non-Native Fish Species

Dutch Slough Restoration Project

The impact would be similar to Impact 3.5.1-6. However, since this alternative calls for the creation of the least amount of open water habitat (on the Emerson parcel only), the potential negative impacts on native fishes should be the least of the three alternatives.

Open Water Management Options

The impact would be similar to Impact 3.5.1-6. However, this alternative would involve the least amount of area that must be managed for invasive FAV/SAV under the skeletal network options. Under the deep subtidal management option there would be less open water habitat for alien fish species to colonize.

Marsh Creek Relocation Options

Not applicable

Mitigations

Mitigations would be the same as for Impact 3.5.1-6

Impact Significance After Mitigation

Potentially significant. However, the problems caused by non-native fishes are ubiquitous throughout the Delta and the subsequent invasion of the site by these species is an unavoidable consequence of habitat restoration.

Impact 3.5.3-7: Endocrine Disrupting Chemicals and other Contaminants Entering the Site from Marsh Creek or from fill soils Could Harm Fish

Impacts and mitigations would be the same as for Impact 3.5.2-7 (all options).

Impact Significance After Mitigation

Less than significant with mitigation

Impact 3.5.3-8 Cumulative Impacts

Same as Alternative 1.

Alternative 4: No Project

Under the no-project alternative there are several possible scenarios of future land use, including management for non-tidal wetland habitat, conversion to a recreational park, or residential and commercial development. In all of these situations the levees will continue to be maintained.

Impact 3.5.4-1: Reduced Water Quality Due to Levee Repair Activities

Without the Dutch Slough Restoration Project, the levees surrounding the Dutch Slough Restoration Project site would continue to be subject to wind-wave erosion, resulting in occasional levee failures/breaches. Repairing these breaches would result in construction activities that could cause temporary localized increases in suspended sediments and the possible introduction of contaminants (fuel oils, grease, etc) from construction equipment.

Mitigation 3.5.4-1: Follow SWPPP and BMPs During Levee Maintenance and Repair

Levee maintenance activities shall follow accepted practices for levee maintenance and repair according to existing and future permits held by the Reclamation District from the U.S. Army Corps of Engineers and Regional Water Quality Control Board.

Impact Significance After Mitigation

Less than significant

Impact 3.5.4-2: Entrainment of Fish Inside the Dutch Slough Restoration Project Site Through Unintended Levee Breaches or Overtopping

Should levee breaches or overtopping occur, it is possible that fish from the surrounding Bay-Delta could be diverted onto the Dutch Slough Restoration Project site and into subsided areas that they are unable to escape from.

Mitigation 3.5.4-2: Maintain Levees to Minimize Potential for Overtopping and Breaching

Continue active maintenance and repair of levees so as to minimize the potential that levee overtopping or unintended breaches could occur. Follow all regulatory requirements (see Impact 3.5.4-1).

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant.

Table 3.5-2: Summary of Aquatic Resources Impacts for Dutch Slough Restoration Project and Related Projects

	Impact No.	Impact	Dutch Slough Restoration Project	Related Projects	
				Ironhouse Project	City Community Park Project
Alternatives 1, 2, and 3	3.5.1-1	Decreased water quality due to construction/dredging activities	X	X	X
	3.5.1-2	Release of low quality water from project area during pre-breach water management periods	X	X	
	3.5.1-3	Entrainment of fish into areas disconnected from the Bay-Delta	X	X	
	3.5.1-4	Mercury Methylation could cause bioaccumulation and toxicity to fish	X	X	
	3.5.1-5	Destruction of Benthic Habitats	X		
	3.5.1-6	Creation of habitat that benefits non-native fish species	X		
	3.5.1-7	Endocrine disrupting chemicals and other contaminants entering the site from Marsh Creek or from fill soils could harm fish	X	X	
	3.5.4-1	Reduced water quality due to levee repair activities	X	X	
Alternative 4 (No Project Alternative)	3.5.4-2	Entrainment of fish inside the Dutch Slough Restoration Project site through unintended levee breaches or overtopping	X		

Table 3.5-3: Summary of Mitigation Applicability for Dutch Slough Restoration Project and Related Projects

	Mitigation	Dutch Slough Restoration Project	Related Projects	
			Ironhouse Project	City Community Park Project
Alternatives 1, 2 and 3	Mitigation 3.5.1-1.1: Develop A SWPPP through the RWQCB	X	X	X
	Mitigation 3.5.1-1.2: Limit construction to the dry weather season	X	X	X
	Mitigation 3.5.1-1.3: Install coffer dams	X	X	
	Mitigation 3.5.1-2.1: Release on-site water gradually	X	X	
	Mitigation 3.5.1-2.2: Limit operation during migration periods of sensitive species	X	X	
	Mitigation 3.5.1-2.3: Maintain short residence time	X	X	
	Mitigation 3.5.1-3: Develop measures to minimize entrainment under incidental take permit	X	X	
	Mitigation 3.5.1-4: Monitor mercury and methylmercury concentrations in the project area and implement identified reduction strategies	X	X	
	Mitigation 3.5.1-6: Enhance tidal exchange	X	X	
	Mitigation 3.5.1-7-2: Timing of relocation of Marsh Creek	X	X	
Alt. 4 No Project	Mitigation 3.5.4-1: Follow SWPPP and BMPs during levee maintenance and repair	X	X	
	Mitigation 3.5.4.-2: Maintain levees to minimize potential for overtopping and breaching	X	X	

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3.6 - Air Quality

3.6 AIR QUALITY

This section describes local meteorological and air quality conditions and trends. Effects of the Dutch Slough Restoration Project and Related Projects on air pollutant generation and concentrations are calculated. If significant effects may occur, mitigation measures are identified consistent with Bay Area Air Quality Management Agency CEQA implementation guidelines.

3.6.1 AFFECTED ENVIRONMENT

Meteorology

The project sites are located in the City of Oakley, in eastern Contra Costa County, which lies at the eastern edge of the San Francisco Bay Area Air Basin (BAAB). Oakley is located on the south side of the San Joaquin River delta. Its location between the greater Bay Area and the Central Valley has great influence on the climate and air quality of the area.

Temperatures in Oakley average 62°F annually, ranging on the average from the low-40s on winter mornings to the low-90s in late summer afternoons. Daily and seasonal fluctuations in temperature are reduced because of the moderating effects of the nearby ocean. There is, however, a very dramatic difference in summer maximum temperatures in San Francisco (low-70s) versus Brentwood (low-90s).

In contrast to the slowly fluctuating temperature regime, rainfall is highly variable and confined almost exclusively to the "rainy" period from early November to mid-April. Oakley averages 14 inches of precipitation annually, about 4 inches less than communities closer to San Francisco Bay. Because much of the area's rainfall is derived from the fringes of mid-latitude storms, a shift in the annual storm track of a few hundred miles can mean the difference between a very wet year and near-drought conditions.

Oakley has a relatively low potential for air pollution given the persistent and strong winds typical of the area. Wind records from the closest wind-measuring sites show a strong predominance of westerly winds. Daytime wind speeds average 7 – 9 miles per hour. Average wind speed is relatively high and the frequency of calm winds is quite low. These winds dilute pollutants and transport them away from the area so that emissions released in the area have more influence of air quality in the Sacramento and San Joaquin valleys than they do locally. There are, however, several major stationary sources in upwind cities that can influence local air quality and the area's location downwind of the greater Bay Area also means that pollutants from other areas are transported to the Oakley area.

Ambient Air Quality Standards

The Federal Clean Air Act Amendments of 1970 established national ambient air quality standards, and individual states retained the option to adopt more stringent standards and to include other pollution sources. California had already established its own air quality standards when federal standards were established. Because of the unique meteorological problems in the State, there is considerable diversity between State (SAAQS) and national (NAAQS) standards currently in effect in California, as shown in Table 3.6-1.

Table 3.6.1: Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards		Federal Standards		
		Concentration	Method	Primary	Secondary	Method
Ozone (O_3)	1 Hour	0.09 ppm (180 µg/m³)	Ultraviolet Photometry	0.12 ppm (235 µg/m³)	Same as Primary Standard	Ultraviolet Photometry
	8 Hour	0.07 ppm (140 µg/m³)		0.08 ppm (157 µg/m³)		
Respirable Particulate Matter (PM_{10})	24 Hour	50 µg/m³	Gravimetric or Beta Attenuation	150 µg/m³	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	20 µg/m³		50 µg/m³		
Fine Particulate Matter ($PM_{2.5}$)	24 Hour	No Separate State Standard		65 µg/m³	Same as Primary Standard	Inertial Separation and Gravimetic Analysis
	Annual Arithmetic Mean	12 µg/m³	Gravimetric or Beta Attenuation	15 µg/m³		
Carbon Monoxide (CO)	8 Hour	9.0 ppm (10 mg/m³)	Non-Dispersive Infrared Photometry (NDIR)	9 ppm (10 mg/m³)	None	Non-Dispersive Infrared Photometry (NDIR)
	1 Hour	20 ppm (23 mg/m³)		35 ppm (40 mg/m³)		
	8 Hour (Lake Tahoe)	6 ppm (7 mg/m³)		–	–	–
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	(new standard pending)	Gas Phase Chemiluminescence	0.053 ppm (100 µg/m³)	Same as Primary Standard	Gas Phase Chemiluminescence
	1 Hour	0.25 ppm (470 µg/m³)		–		
Lead	30-Day average	1.5 µg/m³	Atomic Absorption	–	–	–
	Calendar Quarter	–		1.5 µg/m³	Same as Primary Standard	High Volume Sampler and Atomic Absorption
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	–	Ultraviolet Fluorescence	0.030 ppm (80 µg/m³)	–	Spectrophotometry (Pararosaniline Method)
	24 Hour	0.04 ppm (105 µg/m³)		0.14 ppm (365 µg/m³)	–	
	3 Hour	–		–	0.5 ppm (1,300 µg/m³)	
	1 Hour	0.25 ppm (655 µg/m³)		–	–	
Visibility Reducing Particles	8 Hour	Extinction coefficient of 0.23 per kilometer–visibility of 10 miles or more (0.07–30 miles or more for Lake Tahoe) due to particles when relative humidity is less than 70 percent. Method: Beta Attenuation and Transmittance through Filter Tape.		No Federal Standards		
Sulfates	24 Hour	25 µg/m³	Ion Chromatography			
Hydrogen Sulfide	1 Hour	0.03 ppm (42 µg/m³)	Ultraviolet Fluorescence			
Vinyl Chloride	24 Hour	0.01 ppm (26 µg/m³)	Gas Chromatography			

The ambient air quality standards are intended to protect the public health and welfare, and they incorporate an adequate margin of safety. They are designed to protect those segments of the public most susceptible to respiratory distress, known as "sensitive receptors," including asthmatics, the very young, the elderly, people weak from other illness or disease, or persons engaged in strenuous work or exercise. Healthy adults can tolerate occasional exposure to air pollution levels somewhat above the ambient air quality standards before adverse health effects are observed.

Air quality is classified according to whether an air-shed meets the applicable standards ("attainment"), does not meet the standard ("non-attainment"), or there is insufficient data to classify the region ("unclassified"). The BAAB is classified with respect to state and/or federal air quality standards as follows:

Table 3.6-2: State and Federal Ambient Air Quality Standards – Attainment Status

Pollutant	Average Time	State AAQS	National AAQS
Ozone	1-hour	Non-attainment	Non-attainment
	8-hour	Unclassified*	Non-attainment**
Carbon Monoxide	1-hour	Attainment	Attainment
	8-hour	Attainment	Attainment
Nitrogen Dioxide	1-hour	Attainment	No Standard
	Annual	Attainment[a]	Attainment
PM-10	24-hour	Non-attainment	Unclassified
	Annual	Non-attainment	Attainment
PM-2.5	24-hour	No Standard	Unclassified
	Annual	Non-attainment	Unclassified

Source: BAAQMD

* recently adopted standard, anticipated to be "non-attainment"

** "marginal" non-attainment classification by EPA

a new standard adopted in 2006

Ambient Air Quality

The Bay Area Air Quality Management District (BAAQMD) operates a regional monitoring network which measures the ambient concentrations of criteria air pollutants: Ozone (O_3), carbon monoxide (CO), inhalable particulate matter (PM-10 and PM-2.5), and nitrogen dioxide (NO2). Existing and probable future levels of air quality in the project area can be best inferred from ambient air quality measurements conducted by the BAAQMD at its Bethel Island Road air monitoring station. Since PM-2.5 is not monitored at either this station or the nearby Pittsburgh station, PM-2.5 data was not included. Table3.6-3 is a five-year summary of monitoring data (2000-2004) from the BAAQMD station.

OZONE (O3)

O_3 is not emitted directly into the atmosphere but is a secondary air pollutant produced in the atmosphere through a complex series of photochemical reactions involving hydrocarbons (HC) and nitrogen oxides (NOx). O_3 is a regional air pollutant because its precursors are transported and diffused by wind concurrently with O_3 production by the photochemical reaction process. O_3 causes eye and respiratory irritation, reduces resistance to lung infection, and may aggravate pulmonary conditions in persons with lung disease. Table 3.6-3 shows that any exceedance of the state standard has occurred on average two times a year for the past six years. The less stringent federal standard of 0.12 ppm for one hour, has only been exceeded once in the past five years and the federal 8-hour ozone standard have not been violated in the last two years near the project site.

Table 3.6-3: Project Area Ambient Air Quality Monitoring Summary
(Days standard were exceeded and maximum observed concentrations)

Pollutant/Standard	2000	2001	2002	2003	2004
Ozone					
1-Hour > 0.09 ppm (S)	1	3	5	0	1
1-Hour > 0.12 ppm (F)	0	1	0	0	0
8- Hour > 0.08 ppm (F)	1	2	3	0	0
Max. 1-Hour Conc. (ppm)	0.12	0.13	0.11	0.09	0.10
Carbon Monoxide					
1-Hour > 20 ppm (S)	0	0	0	0	0
8- Hour > 9 ppm (S, F)	0	0	0	0	0
Max. 1-Hour Conc. (ppm)	2.3	2.5	1.7	1.6	1.2
Max. 8-Hour Conc. (ppm)	1.5	1.5	1.3	0.9	0.9
Nitrogen Dioxide					
1-Hour > 0.25 ppm (S)	0	0	0	0	0
Max. 1-Hour Conc. (ppm)	0.04	0.04	0.04	0.05	0.03
Inhalable Particulates (PM-10)					
24-Hour > 50 µg/m3 (S)	2/61	4/61	3/61	1/61	0/61
24-Hour > 150 µg/m3 (F)	0/61	0/61	0/61	0/61	0/61
Max. 24-Hour Conc. (□ g/m3)	65	92	61	51	42

Source: Bay Area AQMD – Bethel Island Road Air Monitoring Station.

CARBON MONOXIDE (CO)

CO is an odorless, invisible gas usually formed as the result of incomplete combustion of organic substances. Approximately 80 percent of the CO emitted in the Bay Area comes from on-road motor vehicles (BAAQMD). High levels of CO can impair the transport of oxygen in the bloodstream and thereby aggravate cardiovascular disease and cause fatigue, headaches, and dizziness. Table 3.6-3 shows that no exceedances of state CO standards were recorded between 1996 and 2001. Measurements of carbon monoxide (CO) show low baseline levels with the hourly and 8-hour maximum never exceeding the allowable state or federal standards for the past five years. The maximum 1-hour and 8-hour concentrations seem to be declining.

RESPIRABLE PARTICULATE MATTER (PM-10)

PM-10 consists of inhalable particulates that can cause adverse health effects. PM-10 can include certain substances, such as sulfates and nitrates, that can cause lung damage directly, or can contain absorbed gases (e.g., chlorides or ammonium) that may be injurious to health. Table 3.6-3 shows that exceedances of the state PM-10 standard occur relatively infrequently in the project vicinity. State PM-10 standards were exceeded about 3 percent of the time and Federal PM-10 standards have never been exceeded at the Bethel Island air monitoring station.

In July 1997, the U. S. Environmental Protection Agency adopted an 8-hour ozone standard, and a new standard for PM-2.5, which represents the fine fraction of inhalable particulate matter. California has adopted an annual average state standard for PM-2.5 that is more stringent than the federal annual average standard. The SAAQS for PM-2.5 went into effect in July 2003.

These new standards were challenged in federal court as a "states rights" issue. A stay on implementation of the standards was issued. The U.S. Supreme Court heard the appeal filed by the Dept. of Justice on behalf of EPA. In a unanimous decision, the Supreme Court ruled in February, 2001, that the EPA did indeed have the proper authority to adopt national clean air standards, and that a cost versus benefit analysis need not accompany such new rules. However, the court ruled that attainment schedules for new standards were inconsistent with those from "older" standards, and that new schedules must be prepared. EPA signed a consent decree to revise the ozone attainment classification of a number of air basins based upon the 8-hour standard, and to begin an attainment planning process for the federal PM-2.5 standard. The Bay Area Air Basin is designated a "marginal" non-attainment area for the 8-hour ozone standard. Although there are no air monitoring stations in the project area which measure PM-2.5, the project area likely has few violations of the standard. Although some parts of the basin have air quality that is not as good as in the Oakley area, few federal clean air standards have been exceeded in the project area in almost a decade.

GREENHOUSE GASES

Gases that trap heat in the atmosphere are often called greenhouse gases (GHG). Common GHG include water vapor, carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, ozone , and aerosols. GHG are emitted by both natural processes and anthropogenic (human-caused) sources. The accumulation of GHG in the atmosphere increases the earth's temperature over time (global warming). GHG emissions from human activities, such as fossil fuel combustion for electricity generation and vehicle use, have elevated the concentration of these gases in the atmosphere, thus contributing significantly to global warming (California Association of Environmental Professionals [AEP] 2007).

Listed below are the principal greenhouse gases that enter the atmosphere from human activities, and their primary anthropogenic and natural sources. Also included are the percent contributions of each to total U.S. anthropogenic GHG emissions (EPA 2008 http://www.epa.gov/climatechange/emissions/usinventoryreport.html).

- Carbon dioxide, CO2. Natural sources include volcanic eruptions, diffusion from oceans, fires, and respiration by and decay of biological organisms. The primary anthropogenic source of CO2 is combustion of fossil fuels (oil, natural gas, and coal); it accounts for approximately 94% of CO2 emissions. In 2006, CO2 accounted for 85% of all US anthropogenic GHG emissions. CO_2 is removed from the atmosphere (or sequestered) when it is used by plants during photosynthesis or absorbed by seawater.

- Methane, CH_4. Anthropogenic sources include fossil fuel production, animal husbandry (digestion of feed by livestock, manure management), and solid waste and wastewater management. In 2006, CH_4 accounted for 8% of all US anthropogenic GHG emissions. Natural sources of methane include wetlands (such as tidal marshes), oceans and fresh water bodies, non-wetland soils, wildfires, and other sources.
- Nitrous oxide, N_2O. The primary natural sources are biological processes in soil and water. It is also emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste. A significant local source of N_2O is the drying and disking of Delta peat soils. In 2006, N_2O accounted for 5% of all US anthropogenic GHG emissions.
- Fluorinated gases: Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes. Fluorinated gases are often used as substitutes for ozone-depleting substances (i.e., chlorofluorocarbons, hydrofluorocarbons, and halons). These gases typically are emitted in smaller quantities (2% of all 2006 US anthropogenic GHG emissions), but because they are potent greenhouse gases, they are sometimes referred to as High Global Warming Potential gases ("High GWP gases") (USEPA 2006).

The greenhouse gas of most concern is CO_2 because it is the most common, can last in the atmosphere for centuries, and "forces" more climate change than any other greenhouse gas. CO_2 is the standard for GHG, and the effect of all other GHG gases are transformed into 'CO_2 equivalents', which is a common measure used to report total GHG emissions.

In 2004 (and most years), CO_2 accounted for 85% of the greenhouse gas emissions produced in the United States. Approximately 6.65 billion short tons[1] of CO_2 were emitted in the United States in 2004 from all sources. The California Energy Commission (CEC) has estimated that in 2004, the state emitted 542 million short tons of CO_2 equivalent GHG emissions (CEC 2006 Report), which is about 8% of the national total.

Regulatory Framework

FEDERAL STANDARDS

The 1977 Clean Air Act required that regional planning and air pollution control agencies prepare a regional Air Quality Plan to outline the measures by which both stationary and mobile sources of pollutants can be controlled in order to achieve all standards within the deadlines specified in the Clean Air Act. For the Bay Area Air Basin (BAAB), the Association of Bay Area Governments (ABAG), the Metropolitan Transportation Commission (MTC), and the BAAQMD jointly prepared a Bay Area Air Quality Plan in 1982, which predicted attainment of all federal clean air standards within the basin by 1987. This forecast was somewhat optimistic in that attainment of federal clean air standards did not occur throughout the entire air basin until 1991.

In 1995, after several years of minimal violations of the federal one-hour ozone standard, the U.S. Environmental Protection Agency (EPA) revised the designation of the BAAB from "non-

[1] A short ton is 2,000 pounds, as opposed to the metric ton which is 2,204 pounds.

attainment" to "attainment" for this standard. However, with less favorable meteorology in subsequent years, violations of the national ozone standard were again observed in the basin. Effective August 1998, the EPA downgraded the Bay Area's classification for this standard from a "maintenance" area to an "unclassified non-attainment" area. Because the federal ozone standard was not met by 2001 as required under interim designations, a new federal attainment plan was imposed upon the air basin. With redesignation of the basin as “marginal non-attainment” for the 8-hour ozone standard, the planning process for federal standards will convert from the one-hour to the 8-hour standard with little difference in the actual attainment strategy. In 1998, after many years without violations of any carbon monoxide (CO) standards, the attainment status for CO was upgraded to "attainment."

STATE STANDARDS

In 1988, California passed the California Clean Air Act (AB-2595) which, like its federal counterpart, called for designations of areas as attainment or non-attainment, based on state Ambient Air Quality Standards rather than federal or national standards.

The 1988 California Clean Air Act (CCAA) also required development of air quality plans and strategies to meet state air quality standards in the Bay Area. The Bay Area 1991 Clean Air Plan (1991 CAP) included a comprehensive strategy to reduce air pollutant emissions and focused on control measures to be implemented during the 1991 to 1994 period. It also included control measures to be implemented from 1995 through 2000 and beyond. The Bay Area 1994 Clean Air Plan (1994 CAP) included changes in the organization and scheduling of some 1991 CAP measures and also included eight new stationary and mobile source control measures. The 1994 CAP covered the period from December 1994 to 1997. Based on revisions to the 1994 CAP, the 1997 CAP was updated and adopted December 17, 1997. The 1997 CAP contains every control measure deemed feasible for implementation as required by state law. Even with all reasonable and feasible measures, the 1997 CAP did not predict near-term attainment of the state ozone standard.

For state air quality planning purposes, the Bay Area is classified by the CCAA as a serious non-attainment area for ozone. The serious classification triggers various plan submittal requirements and transportation performance standards. One such requirement is that the Bay Area update the CAP every three years to reflect progress in meeting the air quality standards and to incorporate new information regarding the feasibility of control measures and new emission inventory data. The most recent update of the attainment plan for meeting the state ozone standard was completed in 2005, and adopted by the Governing Board of the BAAB in January, 2006. This plan includes various elements such as climatic change/global warming, fine particulate matter, and the Community Air Risk Evaluation (CARE) program. The 2005 plan includes land use strategies that promote smart growth and enhance public transit opportunities. Because the proposed project generates minimal new traffic, the project is believed to be consistent with clean air planning objectives.

The California Air Resources Board (ARB) is the state agency responsible for regulating air quality. ARB responsibilities include establishing State Ambient Air Quality Standards, emissions standards and regulations for mobile emissions sources (e.g., autos, trucks, etc.), and overseeing the efforts of county-wide and multi-county air pollution control districts, which have primary responsibility over stationary sources. The Bay Area Air Quality Management District (BAAQMD) is the regional agency responsible for air quality regulation within the San Francisco BAAB. The BAAQMD regulates air quality through its permit authority over most types of stationary emission sources and through its planning and review activities. The BAAQMD. AMBAG and the MTC are co-lead agencies in developing regional air quality attainment plans to meet state and federal air quality improvement mandates.

GREENHOUSE GASES

The California Legislature has determined that global warming poses a serious threat to the economic well-being, public health, natural resources, and the environment of California (Health and Safety Code Section 38501). The Global Warming Solutions Act of 2006 (AB 32) codifies California's goal of reducing statewide emissions of greenhouse gases (GHG) to 1990 levels by 2020. This reduction will be accomplished through an enforceable statewide cap on global warming emissions that will be phased-in starting in 2012 to achieve maximum technologically feasible and cost-effective GHG emission reductions. In order to effectively implement the cap, AB 32 directs the California Air Resources Board (CARB) to develop appropriate regulations and establish a mandatory reporting system to track and monitor global warming emissions levels. As part of AB 32, CARB is currently proposing to adopt a number of Early Actions. One Early Action would reduce emissions from diesel trucks, which are responsible for 7.5% of California's global warming pollution. The proposed "Heavy-Duty Vehicle Greenhouse Gas Emission Reduction Measure" would require trucks to reduce emissions through retrofits or upgrades to newer trucks.

In 2007, the California legislature passed legislation (Senate Bill 97) amending CEQA to specifically establish that GHG emissions and their impacts are appropriate subjects for CEQA analysis. SB 97 requires the Governor's Office of Planning and Research (OPR) to prepare guidelines for the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions by July 2009 and that these guidelines be certified and adopted by the Resources Agency by January 2010. On June 19, 2008, OPR issued a Technical Advisory entitled "CEQA and Climate Change: Addressing Climate Change Through California Environmental Quality Act (CEQA) Review." That technical advisory recognizes the lack of statewide thresholds of significance for GHG emissions and states that OPR has asked the CARB to recommend a method for setting thresholds that will encourage consistency in CEQA analyses. Until uniform guidelines are in place, OPR recommends that each CEQA lead agency establish its own approach to analyzing climate change from projects that generate GHG emissions. Three steps – quantifying emissions, assessing the significance of the impact on climate change, and identifying alternatives or mitigation measures – are recommended by OPR.

3.6.2 IMPACTS AND MITIGATIONS

Criteria of Significance

The California Environmental Quality Act (CEQA) Appendix G Guidelines includes a number of tests of potential air quality impact significance. Although CEQA does not allow the Lead Agency to defer its decision and findings to another agency, it does encourage the use of significance criteria established by a responsible or commenting agency with expertise in air quality.

In the BAAB, the BAAQMD has developed numerical significance criteria, or has provided technical guidance for significance evaluation, in its "BAAQMD CEQA Guidelines" (1996, revised December 1999). These thresholds of significance are recommended for use in assessing impacts associated with construction, project operations, odors, toxic air contaminants, accidental releases, cumulative impacts and regional planning projects/programs associated with project implementation.

The Air District guidelines are designed to identify those impacts that would create new violations of ambient air quality standards, substantially worsen existing violations, or create impacts for which no safe exposure levels exist. Because many air quality impacts require additional photochemical transformation after atmospheric release, individual project impacts are diluted to an immeasurably small increment. The BAAQMD has therefore adopted emission levels that are considered as contributing to a substantial increase even if the ambient air quality increment itself is undetectable. Emissions based significance criteria for operational emissions are as shown on Table 3.6-4.

Table 3.6-4: Emissions Based Significance Criteria For Operational Emissions

Pollutant	Ton/Year	Lb/Day
ROG	15	80
NOx	15	80
PM-10	15	80

If daily CO emissions exceed 550 lb/day, or project vicinity intersections operate at Levels of Service of D, E or F (see Traffic section for local intersection operation levels), or the project adds more than 100 vehicles per hour and increases volumes by 10 percent at any intersection or roadway segment, a micro-scale impact analysis is recommended to assess CO "hot spot" potential.

Temporary construction activity may impact air quality, but such impacts are highly variable from day-to-day or project-to-project. They are difficult to quantify accurately. The primary focus of any construction activity impact assessment is from particulate matter (PM-10). Exhaust emissions from heavy equipment may also be generated during construction. The BAAQMD CEQA Guidelines suggest that equipment exhaust emissions have been integrated into the regional are quality plan as part of overall growth and are mainly a regional air quality issue.

No state or federal agency has yet established significance criteria (thresholds of significance) for GHG or other impacts to global climate change. Neither has DWR established its own protocols for analyzing project-generated GHG emissions or set thresholds of significance. Policies have not been set, in part, because the science required to do so has not been fully developed. Although estimates have been made at the national and state levels for types of emissions and their sources, we do not yet know how to accurately measure GHG emissions for small projects. Although we can identify most of the factors contributing project emissions, we cannot yet reliably quantify them. However, given the current state of the science, it is believed that habitat restoration projects such as the Dutch Slough or Ironhouse projects, which result in a change in current practice from grazing or agriculture to tidal marsh, contribute very little, if any, GHG emissions. As addressed herein, the primary GHG contributions from the Dutch Slough Tidal Marsh Restoration project are short term and temporary, resulting from the construction of the project.

We did not attempt to measure a baseline for GHG emissions from the current land use of the project site, but assume that there is a net emission of GHG. The following are current GHG sources for the project site:

- CH4 from beef cattle and their manure
- N2O from drained peat soils

- CO_2 from combustion of fossil fuels (vehicles, heavy equipment, pumps)
- CO_2 and N_2O from disking and ground disturbance

There are approximately 70 acres of permanent freshwater wetlands on the project site. USGS research has indicated that such wetlands are net carbon sinks (Robin Miller pers comm. 2008). However because we cannot quantify the GHG sources, it is not known if the wetland sequestration is sufficient to offset GHG emissions from the site.

Alternative 1: Minimum Fill

IMPACT 3.6.1-1: VEHICULAR EMISSIONS (ALL OPTIONS)

Restoration of the Dutch Slough and Ironhouse parcels, and development of the City Community Park would generate a limited amount of additional traffic. The three projects would generate an additional 125 daily trips for educational, recreational and passive visitor traffic; most of these trips would be associated with the park uses, with lesser traffic generated by the two restoration projects. Emissions generated from such a small volume of traffic are negligible compared to the BAAQMD thresholds seen as shown in Table 3.6-5. As can be seen in that table, regional air quality impacts are shown above to be negligible. No mitigation is required.

Table 3.6-5: Emissions Based Significance Criteria For Vehicular Emissions

Pollutant	Project Emissions (lbs/day)	BAAQMD Threshold (lbs/day)
Reactive Organic Gases	1.0	80
Nitrogen Oxides	1.4	80
Carbon Monoxide	17.8	n/a
Particulate Matter	0.1	80

Source: EMFAC2002 Computer Model, Year = 2008

IMPACT 3.6.1-2: CONSTRUCTION EMISSIONS (ALL OPTIONS)

Any impact potential would derive from short-term demolition and construction emissions, particularly from fugitive dust (PM-10). Because of the difficulty in quantifying daily construction dust emissions, the air district guidelines are more oriented toward effective mitigation of PM-10 rather than precise quantification. The BAAQMD has therefore developed a menu of mitigation measures that, if fully implemented, are presumed to achieve a less-than-significant air quality impact. The range of mitigation measures includes a set of “Basic Control Measures,” and a set of "Enhanced Control Measures" if the project construction area exceeds 4.0 acres. Potential emissions of hazardous materials from demolition of buildings are addressed in Section 3.15, Hazards and Hazardous Materials.

Equipment exhaust is not considered a significant regional emissions source at any individual construction project (BAAQMD CEQA Guidelines, 1996). However, the diesel-powered equipment would release carcinogenic particulate emissions for which there is no safe exposure level. Risk assessments for a variety of construction projects have demonstrated, however, that the combined effects of limited construction duration, very good daytime ventilation in the Oakley area and the absence of many existing neighbors during daytime construction hours all serve to not measurably increase lifetime individual cancer risk beyond *de minimis* levels. Therefore this impact would be less than significant.

MITIGATION 3.6.1-2: ENHANCED DUST-CONTROL PROGRAM (ALL OPTIONS)

Because the proposed project is more than 4.0 acres, implementation of an enhanced dust control program during construction is recommended to achieve a less-than-significant dust nuisance impact. The list of suggested PM-10 mitigation measures is included in Table 3.6-6.

Table 3.6-6: Control Measures for Construction Emissions of PM-10

Basic Control Measures (Required)

The following controls will be implemented:

- Water all active construction areas at least twice daily.
- Cover all trucks hauling soil, sand, and other loose materials or require all truck to maintain at least 2 feet of freeboard.

Pave, apply water three times daily, or apply (non-toxic) soil stabilizers on all unpaved access roads, parking areas and staging areas at construction sites.

- Sweep streets daily (with water sweepers) if visible soil material is carried onto adjacent public streets.

Enhanced Control Measures (Recommended because large scale of grading)

The following additional measures are recommended to be implemented at this construction site:

- Enclose, cover, water twice daily or apply (non-toxic) soil binders to exposed stockpiles (dirt, sand, etc.).
- Limit traffic speeds on unpaved surfaces to 15 mph.
- Install sandbags or other erosion control measures to prevent silt runoff to public roadways.
- Replant vegetation in disturbed areas as quickly as possible.

Significance after Mitigation: Less than Significant

IMPACT 3.6.1-3: GREENHOUSE GAS EMISSIONS (ALL OPTIONS)

The Dutch Slough Restoration Project and Related Projects would contribute to GHG primarily through the use of diesel-powered construction equipment. There would be no net long-term emissions (permanent sources) of GHG from the Dutch Slough or Ironhouse Project. The combustion of diesel fuel in off-road construction equipment and on-road vehicles (trucks, etc.) would emit greenhouse gases consisting mainly of carbon dioxide (CO2), along with small amounts of methane (CH4) and nitrous oxide (N2O).

DWR staff estimated the emissions-based carbon footprint for the construction of the Dutch Slough Restoration Project using:

- estimated number of anticipated workers needed for construction, their average commute distance, and associated fuel consumption;

- estimated construction equipment needed, their fuel consumption, and total hours of operation;
- estimated number of days for construction;
- estimated volumes of imported fill and on-site grading and cut-and-fill.

Using this methodology, the estimate for construction-related emissions for Alternative 1 is 245 metric tons of CO2-equivalent. Methods used for this estimate can be found in Appendix E. It is estimated that it would take approximately ten acres of mature tule marsh to sequester this much carbon in one year (see below).

While emissions will be created through the operation of construction and earth moving machinery, wetland restoration projects such as the Dutch Slough Restoration Project are expected to become long-term carbon sinks, eventually offsetting emissions from all associated vehicular traffic and short term operation of construction equipment. Further, the cessation of agricultural activities would eliminate current GHG sources such as vehicle traffic, cattle grazing, and pump operation.

Vegetation in wetlands can capture carbon by taking in atmospheric CO2, converting it to plant mass through photosynthesis, and then sequestering the carbon in the inundated soils that form as plant matter decomposes. Pilot studies being undertaken in mature tule marshes on Twitchell Island have found a very high primary productivity (carbon fixation) and sequestration of below-ground carbon (C-immobilization, or long term "storage") that would remain stable. On the other hand, wetlands can release greenhouse gases, including methane, under certain conditions. To address these uncertainties, DWR and USGS have initiated research on the processes that affect the carbon cycle in re-establishing wetlands. This research, being conducted on a farm-scale wetland on Twitchell Island, will attempt to more accurately quantify biogeochemical processes and net GHG. In addition, the California Climate Action Registry is underwriting the development of research to help quantify the GHG balance in tidally-influenced wetland systems.

Recent research has indicated that in mature tule marshes as much as 25 metric tons of carbon per acre per year may be sequestered, and that as much as 0.5 metric tons of carbon per acre per year may be produced as methane (Robin Miller pers comm.). These results are widely variable depending upon many factors such as temperature, inundation regime, and plant species.

For the Dutch Slough Restoration Project, there will be open water, intertidal vegetated wetlands, channels, riparian areas, and uplands. Acreage of intertidal wetlands vary between the alternatives and options (see Table 2-1), but range between approximately 200 and 800 acres for Alternative 1, and approximately half of that area is expected to develop into tule marsh capable of sequestering significant amounts of carbon. All the open water and wetland areas are expected to release methane, though at varying rates depending upon plant type and cover. There will be roughly 500-800 acres of these habitats. Rates of sequestration and emission depend upon many factors, including plant species, depth and duration of inundation, and the age of the wetlands. There are too many variables to accurately estimate the amount of carbon the mature wetlands will sequester, but based on the Department’s most current understanding of these systems, the restored wetlands are anticipated to be a net carbon sink.

Because the construction-related emissions will be temporary, and the project is expected to be a net carbon sink, no mitigation is required.

It should be noted that sea level rise could potentially increase or decrease carbon fixation and sequestration, depending on the rate of sea level rise. Gradual sea level rise keeps tule marshes productive and peat (and sequestered carbon) buried. Rapid sea level rise could drown tule marsh, make sediment more mobile, and increase tidal energy and erosion, mobilizing sequestered carbon. This uncertainty does not change the conclusion that the long-term impact of project GHG emissions is considered less than significant and no mitigation is required.

MITIGATION 3.6.1-3.1: BEST MANAGEMENT PRACTICES TO REDUCE GREENHOUSE GAS EMISSIONS (ALL OPTIONS)

Construction crews will be required to follow BMPs for reduction of emissions, such as limits on idling, keeping engines in tune, and possibly retrofits to increase fuel efficiency. These BMPs will be included in worker environmental education sessions. All measures in the CARB "Heavy-Duty Vehicle Greenhouse Gas Emission Reduction Measures" will also be adhered to if the measures have been instituted by the time construction starts.

MITIGATION 3.6.1-3.2: OPEN WATER AREAS MANAGED FOR CARBON SEQUESTRATION

If future research (prior to project implementation) shows that the restored wetlands are likely to sequester significantly less carbon than current estimates, the open water areas will be designed to be managed for maximum carbon sequestration.

Alternative 2: Moderate Fill Alternative

IMPACT 3.6.2-1: VEHICULAR EMISSIONS (ALL OPTIONS)

The moderate fill alternative would generate the same level of operational trips at project conclusion as Alternative 1. Long-term operational impacts would be similarly less-than-significant. No mitigation is required.

IMPACT 3.6.2-2: CONSTRUCTION EMISSIONS (ALL OPTIONS)

Temporary construction activity impacts would be substantially greater because more heavy equipment will be required to operate on a much larger footprint. Project earthworks for this alternative are estimated at 1,320,000 cubic yards (including activities on all three project sites). Both the larger area disturbed, and the greater amount of fill material handled, will increase temporary dust generation. PM-10 impacts would be minimized by utilization of best management practices outlined in Table 3.6-6. They would also be minimized by prevailing meteorology that carries dust eastward during the day toward lightly developed areas rather than westward toward heavier concentrations of residential use.

The bulk of the fill material is presumed to be available from on-site borrow areas that would be excavated to restore the tidal marsh. The material would likely be somewhat damp and thus less given to fugitive dust generation. Damp material may, however, create odors from biological decay. Some volatile organic compounds (VOC) could be released from buried petroleum wastes. As described in Section 3.15, Hazards and Hazardous Materials, and in Mitigation 3.6-3, below, prior to any final conclusions on the use of possible on-site fill material resources, the candidate material would be tested for low biological and chemical content that would prevent the release of odorous or toxic materials associated with on-site borrow/fill transfer.

Material transfer would likely be accomplished by self-loading scrapers after a ripper-hook dozer loosens the material. Compactors would operate on the receiving end to spread and layer the fill. At peak transfer operations, a fleet of perhaps 20 pieces of equipment may be operating on-site. Daily emissions associated with 20 scrapers, as the dominant equipment source, are as follows (lbs/day):

Reactive Organic Gases - 72.8

Carbon Monoxide - 336.2

Nitrogen Oxides - 322.3

Particulate Matter (PM-10) - 17.1

BAAQMD CEQA guidelines state that regional impacts from temporary construction activities can be considered less-than-significant because they have been accounted for in the regional emissions inventory, and are thus not "new" sources. However, the non-attainment status of the air basin for ozone, and the carcinogenic nature of diesel exhaust, requires that all reasonably available control measures for equipment exhaust be incorporated as impact mitigation.

MITIGATION MEASURE 3.6.2-2.1: TEST FILL MATERIALS FOR VOC (ALL OPTIONS)

A portion of all candidate fill material from borrow sites shall be tested to confirm its suitability in terms of very low VOC levels and low biological content that could create emissions of toxic or odorous materials during on-site cut/fill operations.

MITIGATION MEASURE 3.6.2-2.2: USE REDUCED NOX SCRAPERS (ALL OPTIONS)

During the contractor selection process, preference shall be given to any grading contractor that guarantees to provide scrapers that emit 20 percent less NOx and 45 percent less PM-10 than the statewide average for the same equipment.

Significance after Mitigation: Less than Significant

IMPACT 3.6.2-3: GREENHOUSE GAS EMISSIONS (ALL OPTIONS)

These impacts would be similar, though quantitatively larger, to those described for alternative 1, above. Using the same methodology used in Impact 3.6.1-3, the estimate for Alternative 2 is 850 metric tons of CO_2-equivalent.

Acreage of intertidal wetlands vary between the alternatives and options, but roughly range between 400 and 900 acres for Alternative 1, and approximately half of that area is expected to develop into tule marsh capable of sequestering significant amounts of carbon. All the open water and wetland areas are expected to release methane, though at varying rates depending upon plant type and cover. There will be roughly 600-900 acres of these habitats. Rates of sequestration and emission depend upon many factors, including plant species, depth and duration of inundation, and the age of the wetlands. There are too many variables to accurately estimate the amount of carbon the mature wetlands will sequester, but based on the Department's most current understanding of these systems, the restored wetlands are anticipated to be a net carbon sink, no mitigation is required.

Alternative 3: Maximum Fill

IMPACT 3.6.3-1: VEHICULAR EMISSIONS (ALL OPTIONS)

Operational air quality impacts would be identical to Alternatives 1 and 2 because the number of visitor vehicles is unchanged. No significant impacts would occur.

IMPACT 3.6.3-2: CONSTRUCTION EMISSIONS (ALL OPTIONS)

Implementation of this alternative would entail the placement of 3,200,000 cubic yards of fill. Off-site fill resources would need to be trucked to the site. Construction impacts and mitigation would be identical to Alternative 2, except that this alternative would additionally include on-road trucking activity emissions.

A daily hauling scenario of 250 loads of fill per day, traveling perhaps 20 miles round trip per load, has been assumed. The additional on-road emissions from this hauling scenario, above the on-site equipment emissions that may occur simultaneously, are calculated as follows for 10,000 on-road truck miles (lbs/day):

Reactive Organic Gases - 14

Nitrogen Oxides - 159

Carbon Monoxide - 135

Particulate Matter - 5

As with the on-site equipment emissions, temporary trucking emissions are not considered to have an individually significant air quality impact. Trucks may have a possible cumulative impact by increasing ozone precursor emissions, by contributing to diesel exhaust particulate matter, and by competing with existing traffic in developed areas for available roadway capacity.

MITIGATION MEASURE 3.6.3-2: MINIMIZE IMPORTED FILL TRUCK TRAVEL (ALL OPTIONS)

In addition to a requirement for inclusion of Mitigation Measures 3.6.2-2.1 and 3.6.2-2.2 in this alternative, the following additional mitigation measure is recommended for this alternative:

> Imported fill shall be obtained from locations that minimize truck travel through incorporated portions of the City of Oakley.

Significance after Mitigation: Less than Significant.

IMPACT 3.6.3-3: GREENHOUSE GAS EMISSIONS (ALL OPTIONS)

The type of impacts would be similar to those described for alternative 1, above, but the GHG emissions would be larger. No estimate of GHG emissions was made for Alternative 3 because a source for the required 1.5 million cubic yards of fill has not been identified, so haul distances could not be estimated with any degree of certainty. However, it is assumed that the carbon emissions from Alternative 3 would be at least 1,640 metric tons of CO_2-equivalent, or twice the emissions of Alternative 2.

Acreage of intertidal wetlands vary between the alternatives and options, but roughly range between 500 and 900 acres for Alternative 1, and approximately half of that area is expected to develop into tule marsh capable of sequestering significant amounts of carbon. All the open water and wetland areas are expected to release methane, though at varying rates depending upon plant type and cover. There will be roughly 600-900 acres of these habitats. Rates of sequestration and emission depend upon many factors, including plant species, depth and duration of inundation, and the age of the wetlands. There are too many variables to accurately estimate the amount of carbon the mature wetlands will sequester, but based on the Department's most current understanding of these systems, the restored wetlands are anticipated to be a net carbon sink, notwithstanding the larger construction-related emissions in this Alternative. No mitigation is required.

Alternative 4: No Project

No air quality impacts would derive from selection of this alternative.

Insert tab titled

3.7 - Noise

3.7 NOISE

This section briefly characterizes noise concepts and noise in the Dutch Slough area. Potential noise impacts of constructing and operating the proposed park and wetland restoration projects are described, and applicable mitigation measures are identified. It should be noted that noise impacts of park facilities beyond those shown in Figure 2-18, City Community Park Initial Improvements, and noise from special events at the proposed City Community Park are not addressed in this section, and would require subsequent CEQA review at the time that they are proposed. This section focuses on noise impacts to sensitive human receptors. Noise impacts to wildlife are described in Section 3.4, Terrestrial and Wetland Resources.

3.7.1 Affected Environment

Noise Characteristics

Noise is generally defined as unwanted or annoying sound that is typically associated with human activity and which interferes with or disrupts normal activities. Although exposure to high noise levels has been demonstrated to cause hearing loss, the principal human response to environmental noise is annoyance. Hearing loss requires that noise levels exceed thresholds generally not found in ambient environments. Hearing loss danger is generally associated with occupational exposures. Hearing damage is proportional to the product of noise magnitude time-exposure duration (dose), which accumulates over time. The combination of high noise levels and chronic, persistent exposure pose the greatest risk. The response to environmental noise is mainly psychological. Some physiological effects from loss of sleep, irritation or similar annoyance can be observed in people exposed to elevated environmental noise. The response of individuals to similar noise events is diverse and influenced by the type of noise, the perceived importance of the noise and its appropriateness in the setting, the time of day, the type of activity during which the noise occurs, and the sensitivity of the individual hearing the sound.

Airborne sound is a rapid fluctuation of air pressure above and below atmospheric pressure. Sound levels are usually expressed as the logarithmic ratio of the square of the ambient sound pressure level compared to the pressure from the faintest sound detectable by a young person with good auditory acuity. The units of this ratio are called decibels (dB). Most of the sound humans hear in the environment do not consist of a single frequency, but rather a broad band of frequencies differing in sound level. The intensities of each frequency add to generate the sound we hear. The method commonly used to quantify environmental sounds consists of determining all of the frequencies of a sound according to a weighting system that reflects that human hearing is less sensitive at low and extremely high frequencies than at the mid-range frequencies. This is called "A" weighting, and the decibel level measured is called the A-weighted sound level (or dBA). In practice, the level of a noise source is conveniently measured using a sound level meter that includes a filter corresponding to the dBA curve. Any further reference to decibels expressed at "dB" should be understood to be A-weighted unless otherwise noted.

Although the A-weighted sound level may adequately indicate the level of environmental noise at any instant in time, community noise levels vary continuously. Most environmental noise includes a combination of noise from distant sources that create a relatively steady background noise in which no particular source is identifiable. A single descriptor called the LEQ (equivalent sound level) is most commonly used for environmental noise. LEQ is the energy-mean A-weighted sound level during a measured time interval. It is the 'equivalent' constant sound level that would have to be produced by a steady state source to equal the fluctuating level measured.

Another sound descriptor has been developed in an attempt to characterize the "total" sound environment. This descriptor penalizes noise levels during periods of greater noise sensitivity to create an artificially weighted 24-hour exposure. This noise metric is known as the Community Noise Equivalent Level (or CNEL). It is calculated by adding a 5-decibel penalty to sound levels in the evening (7:00 p.m. to 10:00 p.m.), and a 10 decibel penalty to sound levels in the night (10:00 p.m. to 7:00 a.m.) to compensate for the increased sensitivity to noise during the quieter evening and nighttime hours.

California state law requires that development planning use CNEL as the appropriate noise/land use compatibility criterion. CNEL's are used mainly to make land use decisions regarding noise exposure for those noise sources pre-empted from local control such as motor vehicles, airplanes, and trains. In contrast to noise performance standards governing sources amenable to local control, CNEL levels are therefore more reactive to the noise environment rather than being proactive noise control standards.

Applicable Standards/Requirements

STATE NOISE STANDARDS

The State of California has established guidelines for acceptable community noise levels that are based upon the CNEL rating scale to insure that noise exposure is considered in any development, as shown in Table 3.7-1. CNEL-based standards apply to noise sources whose noise generation is preempted from local control (such as from on-road vehicles, trains, airplanes, etc.) and are used to make land use decisions as to the suitability of a given site for its intended use. These CNEL-based standards are provided in the Oakley Noise Element of the General Plan. Since local jurisdictions cannot regulate the noise generator, they exercise land use planning authority on the receiving property.

OAKLEY GENERAL PLAN NOISE STANDARDS

NOISE ELEMENT STANDARDS

The City of Oakley's General Plan Noise Element identifies the following maximum allowable noise exposure to transportation sources:

> Where the location of outdoor activity areas is unknown, the exterior noise level standard shall be applied to the property line of the receiving land use as determined for typical worst-case hour during periods of use.

Table 3.7-1: California Land Use Compatibility Guidelines for Exterior Community Noise

Land Use	Community Noise Exposure CNEL, dB			
	Normally Acceptable	**Conditionally Acceptable**	**Normally Unacceptable**	**Clearly Unacceptable**
Single Family, Duplex, Mobile Homes	50-60	55-70	70-75	Above 75
Multi-Family Homes	50-65	60-70	70-75	Above 75
Schools, Libraries, Churches, Hospitals, Nursing Homes	50-70	60-70	70-80	Above 80
Transient Lodging: Motels, Hotels	50-65	60-70	70-80	Above 80
Auditoriums, Concert Halls, Amphitheaters	-	50-70	-	Above 65
Sports Arena, Outdoor Spectator Sports	-	50-75	-	Above 70
Playgrounds, Neighborhood Parks	50-70	-	67-75	Above 72.5
Golf Courses, Riding Stables, Water Recreation, Cemeteries	50-75	-	70-80	Above 80
Office Buildings, Business and Professional Commercial	50-70	67-77	Above 75	Above 75
Industrial, Manufacturing, Utilities, Agriculture	50-75	70-80	Above 75	Above 75

Source: State of California Governor's Office of Planning and Research, General Plan Guidelines, 1990.

Normally Acceptable: Specified land use is satisfactory based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.

Conditionally Acceptable: New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.

Normally Unacceptable: New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design.

Clearly Unacceptable: New construction or development should generally not be undertaken.

The City of Oakley Noise Element specifies an exterior noise exposure level of 65 dB CNEL for all noise sensitive uses, with an interior level of 45 dB CNEL. If the 45 dB CNEL interior noise level can only be achieved with the closed window configuration, then mechanical ventilation (i.e., air conditioning) must be provided. These standards are the levels that must be achieved within the Dutch Slough Restoration Project as a basis for an acceptable residential noise exposure. The City's Noise Element standards are shown in Table 3.7-2

Table 3.7-2: City of Oakley Noise Element Maximum Allowable Noise Exposures			
Land Use	Outdoor Activity Areas (dB CNEL)	Interior Spaces (dB CNEL)	Interior Spaces (Leq, dB)
Residential	65	45	--
Transient Lodging	65	45	--
Hospitals, Nursing Homes	65	45	-
Theaters, Auditoriums, Music Halls	--	--	35
Office Buildings	--	--	45
Schools, Libraries, Museums	--	--	45
Playgrounds, Parks	70	--	--

NOISE ELEMENT POLICIES

The following City of Oakley Noise Element Policies would be relevant to the proposed Project:

Policy 9.1.1 - New development shall comply with the land use compatibility standards identified in Table 1 above.

Policy 9.1.2 - New development of noise-sensitive uses shall not be allowed where the noise level due to non-transportation sources exceed noise ordinance standards.

Policy 9.1.3 - Noise created by new non-transportation sources shall be mitigated to not exceed noise ordinance standards.

OAKLEY NOISE ORDINANCE STANDARDS

Uses that are amenable to local control are generally considered "stationary sources." Local jurisdictions generally regulate the level of noise that one use may impose upon another. Table 3.7-3 shows the City of Oakley's adopted noise performance standards for new projects affected by or including non-transportation noise sources.

BASELINE NOISE LEVELS

Noise measurements were made in order to document existing baseline levels in the area. These help to serve as a basis for projecting future noise exposure, both from projects upon the surrounding community and from ambient noise activity upon the proposed project. Noise measurements were made at four locations surrounding the Dutch Slough Restoration Project and City Community Project sites. The results of the measurements and location description are detailed d in Table 3.7.14.Wind noise created somewhat artificially elevated noise levels at all locations. Locations away from Cypress Road recorded similar CNEL readings as those closer to the roadway. All monitors recorded levels close to 65 dB CNEL because the winds during the night created substantial rustling noise within nearby eucalyptus trees at each site. Nocturnal noise levels are penalized an additional 10 dB in calculating CNEL. The true CNEL without wind noise is lower, especially in more rural environments away from traffic noise sources. Based upon water-recreation and sports park compatibility noise standards of 70 dB CNEL, existing noise levels are well within acceptable levels.

Table 3.7-3: City of Oakley Noise Ordinance Standards

Noise Level Descriptor	Daytime (7 a.m. to 10 p.m.)	Nightime (10 p.m. to 7 a.m.)
Hourly Leq, dB	55	45

1. Each of the noise levels specified above shall be lowered by five dB for simple tone noises, noises consisting primarily of speech or music, or for recurring impulsive noises (e.g. humming sounds, outdoor speaker systems). These noise level standards do not apply to residential units established in conjunction with industrial or commercial uses.
2. The City can impose noise level standards that are more restrictive than those specified above based upon determination of existing low ambient noise levels.
3. Fixed noise sources which are typically of concern include, but are not limited to the following:

HVAC Systems	Cooling Towers/Evaporative Condensers
Pump Stations	Lift Stations
Emergency Generators	Boilers
Steam Valves	Steam Turbines
Generators	Fans
Air Compressors	Heavy Equipment
Conveyor Systems	Transformers
Pile Drivers	Grinders
Drill Rigs	Gas or Diesel Motors
Welders	Cutting Equipment
Outdoor Speakers	Blowers

The types of uses which may typically produce the noise sources described above include but are not limited to: Industrial facilities including pump stations, trucking operations, tire shops, auto maintenance shops, metal fabricating shops, shopping centers, drive-up windows, car washes, loading docks, public works projects, batch plants, bottling and canning plants, recycling centers, electric generating stations, race tracks, landfills, sand and gravel operations, and athletic fields.

TABLE 3.7-4. ON-SITE NOISE MONITORING SUMMARY

Parameter	Site 1	Site 2	Site 3	Site 4
24-Hour CNEL	65	64	65	66
Peak 1-HR LEQ	64	63	63	68
When (?)	9-10 p.m.	8-9 p.m.	10-11 a.m.	10-11 a.m.
2nd Highest LEQ	63	62	62	64
When (?)	8-10 p.m.	7-8 p.m.	9-10 p.m.	8-9 a.m.
Quietest Hour	51	52	56	53
When (?)	1-2 a.m.	1-2 a.m.	1-2 a.m.	1-3 a.m.
Maximum	84	84	84	91
Minimum	40	43	49	40

Source: Giroux & Associates

Site 1: N end of Sellers Road at ranch buildings

Site 2: Sellers Road, 150 feet N of Cypress Road

Site 3: Jersey Island Road, 0.5 mile N of Cypress Road

Site 4: N end of Knightsen, 100 feet N of Cypress Road

3.7.2 Impacts and Mitigation Measures

Three noise concerns are typically identified with land use changes such as that proposed for the project area. First, construction activities, especially heavy equipment use during building demolition and grading, would create short-term noise increases near the project site. Second, upon completion, project-related (park and public access) traffic would cause an incremental increase in area-wide noise levels throughout the project area. Since, however, the number of trips generated by the proposed project would generally be limited, the impact of ambient noise on the project site, rather than project traffic noise impacts to the community, is the third concern. Third, park and ballfield noise impacts to adjacent houses also are of concern.

Significance Criteria

CEQA Guidelines identify significant impacts as those that cause standards to be exceeded where they are currently met. An impact is also considered significant if it "substantially" worsens an existing unacceptable noise environment, or creates an exposure of persons to noise levels exceeding standards established in the local general plan or other applicable regulations.

"Substantially" is not defined in any guidelines. The accuracy of sound level meters and of sound propagation computer models is no better than ± 1.0 dB. This is also the human loudness difference discrimination level under ideal laboratory conditions. Most people cannot distinguish a change in the noise environment that differs by less than 3 dB between the pre- and post-project exposure if the change occurs under ambient conditions. The proposed project is forecast to generate 125 daily trips. If 100 of those trips used Cypress Road into Oakley, the traffic noise from the proposed project would be 42 dB CNEL at 100 feet from the roadway centerline. Existing traffic noise at this set-back is 59 dB CNEL, and is forecast to increase to 63.5 dB CNEL at build-out conditions. Project traffic will increase noise by no more than 0.1 – 0.2 dB. Project traffic impacts to the acoustic baseline are less than significant because it will not be a perceptible change.
Any potential operational impacts are therefore only related to compatibility of proposed uses with the ambient acoustic environment. No traffic noise represents any constraint to the proposed for future build-out conditions. On-road traffic represents the only possible noise constraint to site development, and traffic noise is confined to a very narrow corridor along project vicinity roadways. The Oakley General Plan Noise Element catalogs the following distances to the 70 dB CNEL contour considered acceptable for park and water recreation uses:

Cypress Road @ Sellers Road	-	43 feet to centerline
Sellers Road N of Cypress	-	18 feet to centerline
Jersey Island Road N of Cypress	-	19 feet to centerline

The City of Oakley limits construction activities to hours of lesser noise sensitivity to minimize nuisance noise impacts. The weekday hours of 7:30 a.m. to 5:30 p.m. are allowed on grading permits. Standard conditions also require that all equipment must operate with factory-equipped mufflers, and that staging areas be located as far from residential uses as is practical. These conditions are considered as project features because they are required by City permit conditions.

Alternative 1: Minimal Fill

IMPACT 3.7.1-1: CONSTRUCTION NOISE IMPACTS (DUTCH SLOUGH RESTORATION PROJECT, RELATED PROJECTS, AND ALL OPTIONS)

Temporary construction noise impacts would vary markedly because the noise strength of construction equipment ranges widely as a function of the equipment used and its activity level. Short-term construction noise impacts tend to occur in discrete phases dominated initially by site clearing (including building demolition) and grading, then, for the park site, by foundation construction, and finish construction. Human hearing perceives a 3-dB increase as marginally perceptible and a 10-dB increase as twice as loud. Any impacts from project construction thus depend upon the setback distance between the source and receiver, and also on the number of pieces of equipment working within a fixed amount of space.

Measured noise levels at the closest receivers to various project activities have recorded maxima of around 80 dB. Construction activity noise levels exceeding 80 dB would be clearly perceptible. The earth-moving (grading) activities are seen in Figure 3.7.1 to be the noisiest sources during the site clearing, grading, and construction process, with equipment noise ranging from 75 to 90 dBA at 50 feet from the source. The range of noise levels shown in Figure 3.7.1 is meant to indicate that long-term (hourly or more) noise levels are at the lower end of the range (around 80 dB), while short-term peaks are at the upper end (around 90 dB).

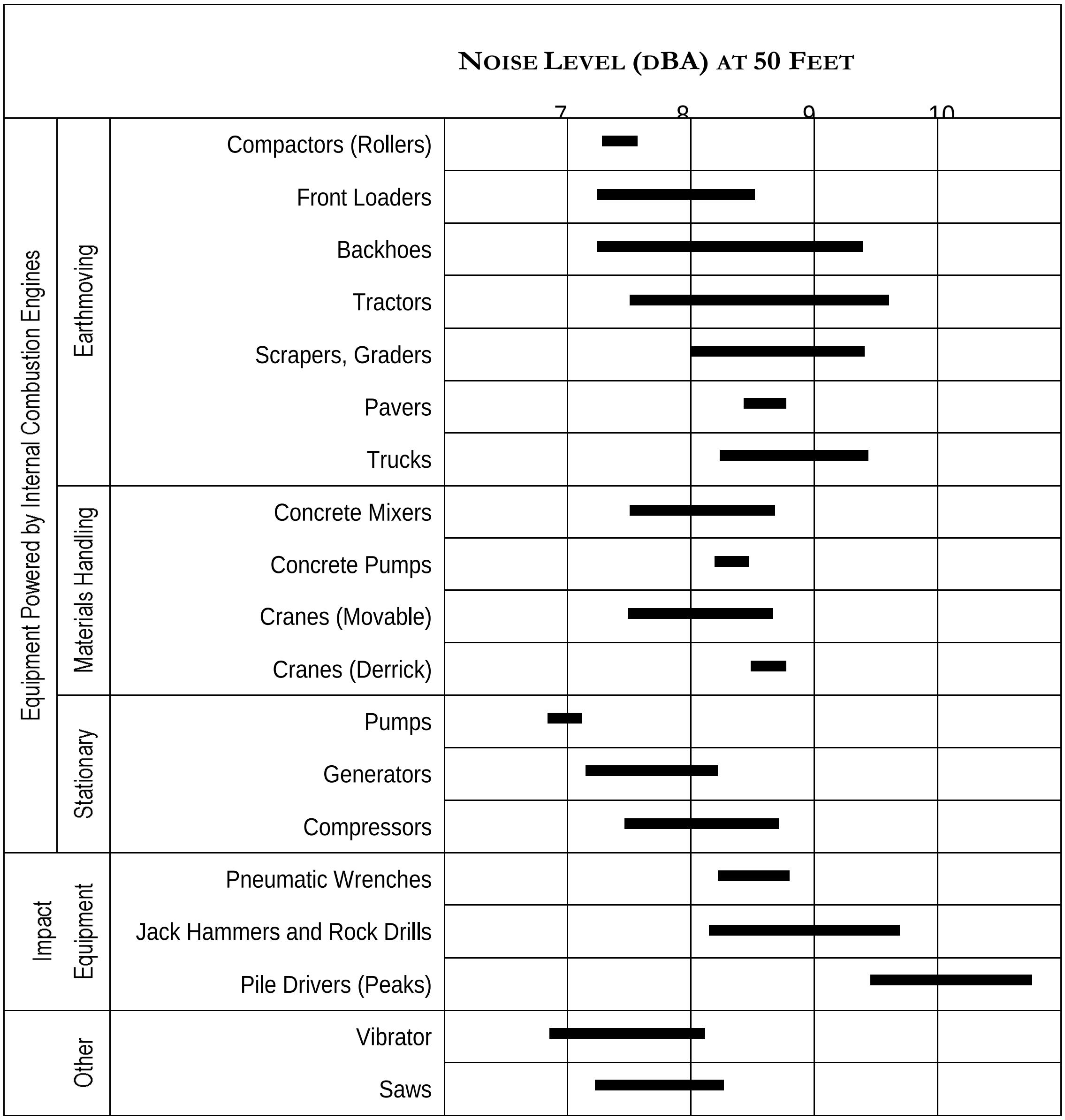
Spherically radiating point sources of noise emissions are atmospherically attenuated by a factor of 6 dB per doubling of distance, or about 20 dB in 500 feet of propagation. The quieter single pieces of construction noise sources would drop below 80 dB by about 50 feet from the source, while the loudest sources might still be detectable above the local background out to 160 feet from the construction area.

The minimum fill alternative would entail use of isolated pieces of heavy equipment. The noise impact envelope from a single piece of equipment extends to 50 feet on average, and perhaps 160 feet for single event maxima. Most activities would maintain a much greater separation distance from off-site noise-sensitive land uses. Construction noise impacts from construction activities associated with the minimum fill alternative are considered less-than-significant.

If multiple noise sources operate in close proximity, their noise characteristics are logarithmically additive. The same amount of equipment confined into a limited space obviously has a larger noise effect than single pieces of equipment. The cumulative effect of multiple-equipment operations is as follows:

2 pieces of equipment - 3 dB louder than a single piece
3 pieces of equipment - 5 dB louder than a single piece
10 pieces of equipment - 10 dB louder than a single piece

Figure 3.7.1: Typical Construction Equipment Noise Generation Levels



Source: EPA PB 206717, Environmental Protection Agency, December 31, 1971, “Noise from Construction Equipment and Operations.”

Mitigation 3.7.1-1: Noise from Hauling of Soils

Hauling of fill from off-site borrow sites or off-hauling of any contaminated site soils shall minimize passing any substantial collection of noise-sensitive land uses (i.e. occupied houses, schools, hospitals), and shall be limited to less than 250 loads per day.

Impact Significance after Mitigation

Less than significant with mitigation.

Impact 3.7.1-2: Park/Ballfield/Special Event Noise Impacts (City Community Park Project Only)

There are many handbooks that specify noise levels for heavy equipment, or cars, or mechanical equipment, but there are no published data on ballfield or other active recreation noise levels. Certainly the intensity of the action, the number of spectators and the sport itself will dictate how much intrusive sound is generated. It should be noted that ballfields are not proposed as part of the initial park development plans that are assessed at a project-level in this document, but rather as part of ultimate park buildout.To provide some basis for analysis, noise measurements were previously conducted at a cloverleaf softball complex (2 softball fields and two Little League fields with concession stands, restrooms and night lighting). These are summarized in Table 3.7-5. Noise measurements were made in the evening from 6:00 p.m. to 11:00 p.m with the last activity over at 10:00 p.m., with some "stragglers" remaining for a few minutes after 10:00 p.m. Measurements were made at 500 feet from the snack bar/ restroom in the middle of the complex. This distance would perhaps approximate the distance to the closest future home to the proposed sports complex. The measurements during Little League games and practice, and during adult league softball, were as follows (hourly average [Leq] and short-term maxima, in dBA):

Table 3.7-5. Representative Noise Levels From Ballfield Activities

Time (p.m.)	Avg. Level (dBA)	1-Sec. Max. (Lmax)
6 - 7	54	70
7 - 8	55	72*
8 - 9	52	64
9 -10	53	68
10 -11	49	66

*Brief use of public address system.
Source: Chapparosa Park Nocturnal Noise Study; City of Laguna Niguel, 1994.

The measured baseline noise levels in the evening hours around the proposed sports park are in the higher 50 dB range. The City's noise standard before 10 p.m. is 55 dB Leq. Baseball/softball noise levels are less than this baseline level, and are within City noise standards at 500 feet from the center of the sports complex. Therefore, proposed park use for baseball/softball would not substantially increase off-site noise exposures to a level that would be considered significant.

Impact Significance

Less than significant

Alternative 2: Moderate Fill Alternative

IMPACT 3.7.2-1: CONSTRUCTION NOISE IMPACTS (DUTCH SLOUGH RESTORATION PROJECT, RELATER PROJECTS, AND AL OPTIONS)

Construction activities for this alternative would require operation of large numbers of scrapers and other noisy equipment. If ten pieces of equipment operate in close proximity, the 50-foot reference noise level would be increased from 85 dB for a single piece to 95 dB for a 10-piece fleet. The resulting noise impact envelope would extend to 160 feet from the work area for average conditions, and perhaps to 500 feet for short-term peaks. The maximum noise would occur in the primary cut and fill areas, which are typically well beyond even 500 feet from any concentration of residential uses. Although occasional noise perceptibility would be an adverse effect, the infrequency of such noise events, and the restriction to hour of lesser sensitivity would render this impact as less-than-significant.

MITIGATION 3.7.2-1: NOISE FROM HAULING OF SOILS

Same as Mitigation 3.7.1-1

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.7.2-2: PARK/BALLFIELD/SPECIAL EVENT NOISE IMPACTS (CITY COMMUNITY PARK PROJECT ONLY)

Same as for Alternative 1.

Alternative 3: Maximum Fill Alternative

The maximum fill alternative would generate on-site construction activity impacts similar to Alternative 2, which are considered adverse, but less-than-significant. However, this alternative requires the use of off-site trucks to import fill. A typical daily haul scenario might include 250 truck trips possible passing various noise-sensitive uses (residences, Ironhouse School, etc.). The noise level associated with 250 truck trips in/out is 60 dB CNEL at 100 feet from the centerline of any haul route. The existing baseline level along Cypress of 60 dB CNEL, and less along Sellers Road south of the site. Any access alternative involving fill trucking at levels of 250 loads per day will raise noise levels along any haul route by +3 dB or more. Such impacts are considered temporarily significant.

MITIGATION 3.7.3-1: NOISE FROM HAULING OF SOILS

Same as Mitigation 3.7.1-1

Impact 3.7.3-2: Park/Ballfield/Special Event Noise Impacts (City Community Park Project Only)

Same as for Alternative 1.

Alternative 4: No Project Alternative

No construction, traffic, or ballfield noise impacts would be associated with this alternative.

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3.8 - Aesthetics

3.8 AESTHETICS

This section describes visual quality of the project site and project vicinity, and assesses the visual quality impacts on Dutch Slough Restoration Project, Ironhouse Project and City Community Park Project sites. Visual quality issues addressed include scenic vistas, scenic resources, visual character, light and glare. This analysis is based on field reconnaissance and review of reports prepared by private consultants and resource agencies.

3.8.1. Affected Environment

This section assesses the effects of the proposed project on views from public viewpoints at or near the Dutch Slough Restoration Project, Ironhouse Project and City Community Park Project sites. Agricultural uses, urban uses, and open space characterize the project vicinity. Recreational users of the project area, such as boaters, anglers, bird watchers, cyclists, joggers, and pedestrians, value the aesthetic views. The open space character of water and marshes affords views of wildlife and their habitat.

Views of the project site include open space, sloughs, levees, a complex of former dairy buildings, three farm-residential compounds, electrical transmission towers, transmission lines, electrical equipment, electrical transformers, pipelines, pumping facilities, and gas wells. The primary open space views are of pasture and ruderal vegetation. Viewers of the site also see vineyards, freshwater marsh, seasonal ponds, alkali meadow, riparian, blackberry, and willows. Photographs of the Dutch Slough Restoration Project and City of Oakley park sites are shown in Section 3.4, Biological Resources.

Public viewpoints of the Dutch Slough Restoration Project, City Community Park Project, and Ironhouse Project sites are from the south at the Contra Costa Canal and Sellers Avenue, and from the north at Dutch Slough and Jersey Island. The sites are visible from the west by Marsh Creek and Big Break. From the east, the Dutch Slough Restoration Project site is visible from Jersey Island Road. The levees on the site offer the closest, overall views of the project site. The project site is also visible from high elevations, such as Mount Diablo. Site elevations range from approximately ten feet below sea level to fifteen feet above sea level. The interior of the project site is relatively flat and is surrounded by levees obscuring views into the interior of the site, and therefore is not visible from similar elevations that are relatively distant, like Bethel Island. The site is not visible from Cypress Road because of the embankment of the Contra Costa Canal.

Regulatory Framework

The City of Oakley 2020 General Plan's goal for community and character design is to: "Encourage projects exhibiting excellent design and sensitivity to the community, while preserving the community character of the City of Oakley." (City of Oakley 2002).

SCENIC RESOURCES

Scenic resources identified for preservation by the City of Oakley's General Plan Goals include the Delta waterways, surrounding habitats, open space, and Mount Diablo (west of the city) (City of Oakley 2002). The City of Oakley strives to preserve these scenic resources by implementing its Oakley 2020 General Plan Open Space and Conservation Element, Scenic Resources Goals and Policies. The following policies that are applicable to this goal are:

- Policy 6.7.1. Encourage preservation and enhancement of views of the Delta and Mount Diablo to the extent possible.
- Policy 6.7.2. New development and redevelopment along the Delta, adjacent to Marsh Creek and throughout the City should take advantage of view opportunities and visual impacts to the waterway and Mount Diablo, respectively.

The applicable program to implement the policies is:

- Program 6.7.B. Review development applications for discretionary actions to determine aesthetic impacts and visual compatibility with surrounding property.

OPEN SPACE RESOURCES

Open space resources in the project vicinity include parks, natural and recreational open space areas, and waterways. Goals, policies, and programs address the City of Oakley's desire to preserve, enhance, and expand open space resources to maintain the natural physical and visual quality of Oakley. City General Plan goals include: "encourage preservation and enhancement of existing open space resources in and around Oakley and balance open space and urban areas to meet the social, environmental and economic needs of the City now and for the future" (City of Oakley 2002).

The applicable policies to implement the goal are:

- Policy 6.6.1. Encourage public access in multiple forms and improvements along the City's waterways, particularly the San Joaquin Delta, Marsh Creek and Dutch Slough.
- Policy 6.6.2. Establish buffers from adjoining land uses to protect the natural open space resources in the City.
- Policy 6.6.3. Encourage preservation and enhancement of the watershed, natural waterways, and areas important for the maintenance of natural vegetation and wildlife populations.
- Policy 6.6.4. Where feasible and desirable, major open space components shall be combined and linked to form a visual and physical system in the City.

The applicable programs to implement the policies are:

- Program 6.6.A. Adopt land use controls that prevent incompatible uses for parcels adjacent to existing open space resources.
- Program 6.6.B. Pursue opportunities for additional open space in the form of parkland dedication, and public open space easements, leaseholds, land donations/dedications, and gift annuities.

3.8.2 Impacts and Mitigation Measures

Significance Criteria

Criteria for determining significant impacts are based upon the CEQA Guidelines (Appendix G) and professional judgment. These guidelines state that the project would have a significant impact on visual quality if it would:

- Have a substantial adverse effect on a scenic vista
- Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway

- Substantially degrade the existing visual character or quality of the site and its surroundings, or
- Create a new source of substantial light or glare, which would adversely affect day or nighttime views in the area

Alternative 1: Minimum Fill

IMPACT 3.8.1.1: EFFECT ON A SCENIC VISTA

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

The restoration of the Dutch Slough and Ironhouse parcels would transform the visual character from predominantly open space views of pasture and ruderal vegetation to natural open space/open water with restored wetlands and wildlife habitat.

Views of the existing structures and infrastructure on the Dutch Slough Restoration Project site would change because they would be removed when the site is excavated. The Dutch Slough Restoration Project includes the removal or reconfiguration of levees, buildings (such as the Burroughs and Gilbert house complexes), and surface facilities in the proposed wetlands and open water areas such as pipelines, pumping facilities, and gas wells.

Development of the City Community Park and Public Access Master Plan would transform the former dairy operation, buildings, structures, and open space into views of a park and educational center with passive and recreational activities as described in the Project Description. There would be views of wetland and upland habitat and access on the Dutch Slough property and Ironhouse parcel. Views of the City Community Park would be of fields, playgrounds, picnic areas, an amphitheater, concession stand, pavilion, interpretive and educational facilities, restrooms, off-leash dog use area, a canoe/kayak boat launch at the head of Emerson Slough, and parking lots. There would also be levee trails visible around the DWR lands. The park would use sustainable design principles so that it is compatible with the habitat. Historic buildings would be reused for park functions, while remnants and materials from outbuildings will be incorporated into the design.

With the restoration of the Ironhouse parcel, its visual character would change from vegetated agricultural fields to natural open space/open water with restored wetlands and wildlife habitat.

The City of Oakley General Plan does not identify any scenic vistas either on or adjacent to the project site that could be impacted by the project. Although the project's proposed park facilities would reduce distant views across the site, primarily from the south, the project would not impact any scenic vistas. In addition, the views of Mount Diablo, scenic resources, waterways, and view corridors within the City of Oakley would be preserved with implementation of the project. There would not be a substantial adverse effect on a scenic vista.

The architects of the park and trail system are coordinating with the City of Oakley to ensure that the design of the proposed buildings, streetscape, landscape, sports facilities, passive recreation areas, signage, and other park components would comply with City of Oakley design standards and would be aesthetically evocative of the site's agricultural history. Therefore a less than significant impact would occur and no mitigation is required.

OPEN WATER MANAGEMENT OPTIONS

Viewers using the City Community Park and public access trails, as well as boaters using the site waterways, would see more expanses of open water if the option to breach open water areas were selected. The option for managing open water pond habitat would look similar to the breaching option. Viewers would see more tules if the option for using tules as a subsidence reversal technique were selected. Viewers would see more wide marsh berms and a skeletal tidal channel network if the option to construct berms were selected.

SIGNIFICANCE

No Impact; no mitigation required.

IMPACT 3.8.1.2: EFFECT ON A SCENIC RESOURCE

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

There are no scenic resources, such as trees, rock outcroppings, and historic buildings within a State scenic highway.

OPEN WATER MANAGEMENT OPTIONS

The impact would be the same with the various open water management options.

MARSH CREEK DELTA RELOCATION OPTIONS

The impact would be the same with the various Marsh Creek Delta Relocation options.

SIGNIFICANCE

No Impact; no mitigation required.

IMPACT 3.8.1.3: EFFECT ON VISUAL QUALITY OF THE SITE AND ITS SURROUNDINGS

DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS

The closest overall views of the Dutch Slough Restoration Project and Related Projects sites would be from the proposed trails and embankments of the levees. Views would change from agricultural land, open space, the former dairy, and residential areas to more open water, marsh, tidal channels, uplands, and a developed park and recreation area. Uplands would consist of riparian woodland, native grassland, transitional habitat, levees, trails, or roads.

Views from the proposed new Jersey Island Road levee, would be of the City Community Park Project to the south and the Dutch Slough Project restored wetlands to the north.

From Sellers Avenue entry gateway to the park, landscaping would primarily be visible. The landscape of the City Community Park would reflect the natural and historic setting. Native plants would be used throughout the park except in turf areas, existing historic ornamental trees around the Gilbert House, community gardens, and two contained orchard theme planting areas. 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 City Community Park. A landscaped vegetated zone would extend around the entire perimeter of the park.

The Dutch Slough and Ironhouse wetlands restoration projects would not substantially degrade the existing visual character or quality of the site and its surroundings. As described above, the City Community Park project would change the aesthetic character of the site, but this change would not be considered an adverse impact.

OPEN WATER MANAGEMENT OPTIONS

The impact would be the same with the various open water management options.

MARSH CREEK DELTA RELOCATION OPTIONS

The impact would be the same with the various open water management options.

SIGNIFICANCE

Less than Significant Impact; no mitigation required

IMPACT 3.8.1.4: EFFECT ON LIGHT AND GLARE (CITY COMMUNITY PARK PROJECT ONLY)

The City Community Park Project would include outdoor and indoor light sources that would introduce lighting and glare, potentially affecting views in the area. Outdoor lighting would include the proposed lighted ballfields, amphitheater, security lighting, and parking areas. Low-level pedestrian lighting is proposed at the park and would be shielded to not have direct line-of-sight visibility from the marsh restoration area. With the exception of the ballfields, the City Community Park is proposed for day use only. The park lights would be off from approximately 11 pm to 5 am (Miller 2006). The East Bay Regional Parks' Martinez Regional Shoreline and Antioch-Oakley Regional Shoreline are open from 5 am to 10 pm. Evening (after sunset) uses would be limited to the ballfield area (seasonal) and the historic zone on a permit basis.

Indoor light sources include the proposed vista pavilion, Ironhouse School, education center/boat storage, museum education center, restrooms, and other buildings associated with the park.

Existing and proposed trees, other landscaping, levees, and embankments would screen the light and glare from public viewpoints at a similar elevation as the project site, including the future occupants of residences under construction across from the canal. Viewers from a higher elevation, such as Mount Diablo, would experience light from the project site. Light and glare impacts may be potentially significant.

SIGNIFICANCE

Potentially significant

MITIGATION MEASURE 3.8.1.4.

The City of Oakley shall review its Community Park and Public Access Master Plan to ensure the city's goals, policies, and programs are met. Park plans shall be revised as appropriate. A detailed lighting plan and study shall be prepared for the Community Park. Park lighting shall be designed and oriented to minimize its spillover into nearby residential areas and into the wetland restoration area. Lights shall be shielded so that light is directed onto the fields. Park landscape plans shall include vegetative buffers (i.e. cottonwoods) to help shield surrounding sensitive human and wildlife receptors from park lighting. This issue shall be evaluated in detail in the analysis of the future phases of the Community Park at such time they are proposed for development.

SIGNIFICANCE OF IMPACT AFTER MITIGATION

Potentially significant but mitigable

IMPACT 3.8.1.5: CUMULATIVE IMPACTS (DUTCH SLOUGH RESTORATION PROJECT AND RELATED PROJECTS)

The visual changes from the Dutch Slough and Related Projects would not be visible from public viewpoints at a similar elevation as the project site. Viewers from the second floors of proposed residential project to the south would have views into the project site over the Contra Costa Water District's existing levees, as well as its proposed embankment for the proposed encased pipeline, would screen the site. In addition, views of the park from adjacent houses would be expanded by implementation of the proposed removal of the CCWD canal levees as part of the CCWD's proposed encasement project. In addition, new levees are being planned for areas to the south and east of the project site, which would also screen views into the project site.

The potential increase in light and glare from the City Community Park project would contribute to cumulative light and glare impacts because the park would be visible from higher elevations, such as Mount Diablo; glare impacts from the lights could be exacerbated by the increased nearby residential receptors. No mitigation is required beyond that identified above for project impacts.

SIGNIFICANCE OF IMPACT AFTER MITIGATION

Potentially significant but mitigable

Alternative 2: Moderate Fill Alternative

IMPACT 3.8.2.1: EFFECT ON A SCENIC VISTA (ALL OPTIONS).

Impacts and mitigations are the same as Alternative 1.

IMPACT 3.8.2.2: EFFECT ON A SCENIC RESOURCE (ALL OPTIONS).

Impacts and mitigations are the same as Alternative 1.

IMPACT 3.8.2.3: EFFECT ON VISUAL QUALITY OF THE SITE AND ITS SURROUNDINGS (ALL OPTIONS)

Views of the Emerson parcel would have less open water, more low and mid marsh, a more extensive tidal channel, and less upland than under Alternative 1. On the Gilbert parcel, less open water, more low marsh, more extensive tidal channels, and less upland would be viewed. Views of the Burroughs parcel would have less open water, more low- and mid- marsh, more extensive tidal channels, and less upland. Restoration of the Marsh Creek Delta would change views from the Ironhouse Sanitary District's wastewater sprayfield to tidal marsh, upland, creek, and tidal channels. Under the options, views would look similar except the proposed bridge would be visible in different locations.

SIGNIFICANCE

Less than significant impact; no mitigation required

IMPACT 3.8.2.4: EFFECT ON LIGHT AND GLARE (CITY COMMUNITY PARK PROJECT ONLY)

Impacts and mitigations are the same as Alternative 1.

Alternative 3: Maximum Fill

IMPACT 3.8.3.1: EFFECT ON A SCENIC VISTA (ALL OPTIONS)

Impacts and mitigations are the same as Alternative 2.

IMPACT 3.8.3.2: EFFECT ON A SCENIC RESOURCE (ALL OPTIONS)

Impacts and mitigations are the same as Alternative 2.

IMPACT 3.8.3.3: EFFECT ON VISUAL QUALITY OF THE SITE AND ITS SURROUNDINGS

DUTCH SLOUGH RESTORATION PROJECT

On the Emerson parcel, changes in visual quality would be similar to those under Alternative 2. On the Gilbert parcel, there would be no views of open water except in the slough and tidal channels.

Views of the Gilbert parcel would primarily be mid marsh and more tidal channels than under Alternative 2. On the Burroughs parcel, there would be no views of open water except in the slough and tidal channels. Views of the Burroughs parcel would primarily be low marsh. On the Burroughs parcel, there would be fewer tidal channels than under Alternative 2. The proposed park and trail system would look the same as under Alternative 1.

SIGNIFICANCE

Less than significant impact; no mitigation required.

OPEN WATER MANAGEMENT OPTIONS

The impact would be the same with the various open water management options.

MARSH CREEK DELTA RELOCATION

The impact would be the same with the various Marsh Creek delta relocation options.

IMPACT 3.8.3.4: EFFECT ON LIGHT AND GLARE (CITY COMMUNITY PARK PROJECT ONLY)

Impacts and mitigations are the same as Alternative 1 and 2.

Alternative 4: No Project

IMPACT 3.8.4.1: EFFECT ON A SCENIC VISTA

No scenic vistas would be affected. It is possible that additional agricultural uses could occur, but the general quality would be similar to the present conditions.

IMPACT 3.8.4.2: EFFECT ON A SCENIC RESOURCE

No scenic resources would be affected. It is possible that additional agricultural uses could occur, but the general quality would be similar to the present conditions.

IMPACT 3.8.4.3: EFFECT ON VISUAL QUALITY OF THE SITE AND ITS SURROUNDINGS

The existing visual quality of the site and its surroundings would remain. It is possible that additional agricultural uses could occur, but the general quality would be similar to the present conditions.

IMPACT 3.8.4.4: EFFECT ON LIGHT AND GLARE

The existing minimal light and glare from the site and its surroundings would remain. It is possible that additional agricultural uses could occur, but the general light and glare impacts would likely be similar to the present conditions.

Insert tab titled

3.9 - Land Use

3.9 LAND USE AND SOCIOECONOMICS

This section describes the existing land uses and land use designations at the Dutch Slough Restoration Project and Related Projects sites and vicinity, assesses the effects of the proposed actions to land uses, and defines mitigation measures that would reduce the impacts to less than significant levels. The compatibility of the proposed action and alternatives with land use designations, policies and goals also is evaluated. This section also characterizes the socioeconomic conditions in the project vicinity. Section 3.10, Agricultural Resources, describes agricultural uses, including Williamson Act lands and Prime Farmland designations and Section 3.11, Recreation, describes recreational use of the project site and vicinity.

3.9.1 Affected Environment

The Dutch Slough Restoration Project and Related Projects sites are located in the eastern portion of the City of Oakley in northeast Contra Costa County. The Dutch Slough property was purchased by the California Department of Water Resources (DWR) in 2003. The 1,166-acre Dutch Slough Restoration Project site and the 55-acre City of Oakley Community Park are 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 100-acre Ironhouse Project site is located immediately west of Marsh Creek on lands owned by the Ironhouse Sanitary District (ISD).

Site Land Uses

The Dutch Slough Restoration Project and City Community Park Project sites encompasses three adjacent parcels: the 438-acre Emerson, the 292-acre Gilbert, and the 436-acre Burroughs properties. The Emerson parcel was a dairy from 1913 until 2003. The Gilbert and Burroughs parcels were dairies from the early 1900's until the mid 1970's. For the last 30 years they have been used as grazing lands.

The Dutch Slough Restoration Project and City Community Park sites land uses include three residential compounds, grazing lands, a public access trail, a vineyard, gas wells, and various utility easements. A complex of former dairy buildings also remains on the restoration and park sites. The 100-acre Ironhouse Project site is currently used as a spray-field for treated wastewater effluent, upon which hay is grown.

Marsh Creek runs along the western boundary of the Emerson Parcel and along the eastern boundary of the Ironhouse parcel. The Contra Costa County Flood Control and Water Conservation District owns the Marsh Creek flood control channel in fee title. Marsh Creek is the principal waterway and flood control facility for both the City of Oakley and the eastern portion of Contra Costa County.

Several utility easements traverse various portions of the Dutch Slough Restoration Project site (see Figure 2-6). A PG&E high voltage power line traverses the northeast corner of the Burroughs parcel. A PG&E gas line passes underneath the site 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 799 maintains and operates two storm-water pumping stations on the Burroughs parcel.

Under an existing lease, there are eleven gas wells on the Burroughs and Gilbert parcels. Wells #6-1 and 6-2, on the Burroughs parcel are active, all other wells are scheduled to be plugged and abandoned consistent with state regulation on an accelerated schedule. DWR does not own the mineral rights for the Dutch Slough property. As part of the purchase agreement, it was agreed that future drill pads would be set aside to allow the mineral rights holders access to gas in the unlikely event that future drilling on the site became economically viable.

Adjacent/Vicinity Land Uses

The sites are bordered to the south and east by open space and farmland. To the north is 3,600-acre Jersey Island, land owned by ISD, where reclaimed water is spread on fields used for cattle grazing and hay production. (ISD 2006) To the west is the open water of Big Break Regional Shoreline Park, Marsh Creek, and ISD spray fields and treatment facilities.

Most of the adjacent agricultural land to the south and east is planned for conversion to other uses, and construction of residential development has occurred on many of the sites. The portion of the East Cypress Corridor Specific Plan area adjacent to the project site is primarily agricultural land planned for development. Approximately 500 homes already exist in the plan area, and construction of the Summer Lake subdivision, an approved project occupying approximately 678 acres in the specific plan area, began in 2004. Most of the land in the specific plan area adjacent to the project site is Prime Farmland or Farmland of Statewide Important that has been designated by the city as Single Family Low or Very Low in anticipation of the residential development envisioned for the area. Buildout of the 2,500-acre specific plan area is anticipated for 2018 (CCWD 2006). See Section 5.3 Cumulative Impacts, for a complete discussion and map of all adjacent development projects.

The City is in the process of approving plans to develop approximately 1,342 residential units on approximately 300 acres immediately south of the Dutch Slough Restoration Project site between the Contra Costa Canal and Cypress Road. The future development area south of the Contra Costa Canal consists of 140 acres of the Emerson property, which is anticipated to have approximately 662 residential units; 120 acres of the Gilbert property, which the City certified an EIR and approved a tentative map for 506 residential units in November of 2007; and 44 acres of the Burroughs property, which is anticipated to have approximately 174 residential units. This development is planned for construction in the next five years.

The Contra Costa Canal, on the south border of the project site, entered service in 1940 to deliver water to large areas of Contra Costa County. CCWD is currently proposing to encase the canal in a pipeline from Rock Slough to Pumping Plant No. 1 (CCWD 2006). Phase I of the encasement is scheduled to being in April, 2008 from Pumping Plant No. 1 to the west side of Marsh Creek (approximately 2,000 feet). The Canal Encasement project has not received final permits. .

Urban development is also planned for most of the agricultural land immediately south of the project site. Along the southern boundary of the Contra Costa Canal, the area between Marsh Creek and Jersey Island Road is primarily vacant, fallow farmland, and all of the area adjacent to the canal is designated for residential development. Construction of the Cypress Grove project, located south of the Emerson parcel just south of the Contra Costa Canal and adjacent to Marsh Creek (shown on Figure 5.3-1 in the Chapter 5.3, Cumulative Impacts) a high-density single-family residential development located on approximately 150 acres began in 2004 and is expected to be completed in 2008.

The remainder of the property along the southern boundary of the Dutch Slough Restoration Project and City of Oakley Community Park sites is agricultural land located in unincorporated Contra Costa County. It is designated Agricultural Limited, which allows for vineyards, orchards, and row crops; animal husbandry; and very low-density residential uses. This land is also slated for development, the Dutch Slough Properties Development, shown on Figure 5.3-1.

Regulatory Framework

OAKLEY 2020 GENERAL PLAN

GOALS AND POLICIES

The Oakley General Plan has specific goals, policies, and implementation programs for Land Use. Applicable Land Use Goals and Policies are included below. Goals and Policies specific to Recreation, Trails and Open Space are provided in Section 3.12 Recreation.

Land Use Goals

> Goal 2.1 Guide development in a manner that creates a balanced and desirable community, maintains and enhances the character and best qualities of the community, and ensures that Oakley remains an economically viable City.

Land Use Policies

> 2.1.5 Preserve open space areas, of varying scales and uses, both within development projects and at the City's boundary.
>
> 2.1.6 Ensure a strong physical connection to the Delta and the waterfront, including convenient public access and recreational opportunities.

Implementation Programs

> 2.1.F Provide public access to the Delta and the Oakley waterfront through discretionary approvals of development projects, coordinated efforts with involved agencies and organizations, and the improvement of City public facilities.

LAND USE DESIGNATIONS

The City of Oakley's 2020 General Plan (City of Oakley 2002) identifies the Land Use Designation for the Dutch Slough Restoration Project site as Delta Recreation, the City Park site as Parks and Recreation, the Ironhouse parcel as Public/Semi-Public and Marsh Creek as Waterways. (Dutch Slough is located along the northern boundary of Oakley, an area formerly identified by Contra Costa County as the M-8 Planning Area.) These designations are defined below:

(DR) DELTA RECREATION

This land use designation encompasses the lowlands of the San Joaquin Delta along the City's northern edge. Most of the land designated Delta Recreation is currently within the 100-year floodplain as mapped by FEMA, which means the area is subject to periodic flooding.

Due to the proximity of the Delta, these lands have substantial recreational value and offer important opportunities for public access to the Oakley waterfront, including parklands and trails offering public access. Agriculture and wildlife habitat are also considered appropriate uses of these areas. Additional uses that may, at the City's discretion, be allowed within this designation include but are not limited to marinas, shooting ranges, duck and other hunting clubs, campgrounds, golf courses and other outdoor recreation complexes.

Conditional uses allowed in the Delta Recreation land use designation shall be limited to those low- to medium-intensity establishments that do not rely on urban levels of service or infrastructure, and which will not draw large concentrations of people to flood-prone areas. Specific regulations for development within the Delta Recreation designation are provided within the Goals, Policies and Programs section of this Element.

The potential for flooding on lands designated Delta Recreation is due to the possibility that bay and river waters will overtop existing levees during periods of storms. It is also possible that portions of the earthen levees may fail entirely during storms or earthquakes, resulting in flooding of low-lying areas. The effects of subsidence and high tides coincident with major storms may increase the danger of flooding.

Additionally, lands within this designation may support valuable wildlife habitat, possibly including state and federally protected wildlife species. This area is an important component of the Pacific Flyway, a major waterfowl migration route in North America.

PARKS AND RECREATION (PR)

The Parks and Recreation (PR) designation includes publicly owned city, county, and regional parks facilities, as well as publicly or privately owned golf courses. The City should strive to maintain a ratio of six (6) acres of park to every 1,000 population. The ratio of six acres of park per 1,000 population is based upon the existing inventory of developed and undeveloped park and open space lands within Oakley that are under the jurisdiction of the City, the local school districts and the East Bay Regional Park District.

Appropriate uses in this designation are passive and active recreation oriented activities, local and regional park and trails facilities, and ancillary commercial uses specifically related to the adjoining recreational activities. The construction of privately owned residences or general commercial uses, or the subdivision of land for purposes of urban development, is inconsistent with the Parks and Recreation land use designation.

PUBLIC AND SEMI-PUBLIC FACILITIES (PS)

Numerous public, semi-public and private facilities are required to serve the needs of the community. These uses support government, civic, cultural, health, education, and infrastructure aspects of the City.

Public and Semi-Public facilities should be located in a manner that best serves the community's interests, allows for adequate access by bus, bicycle, or foot to minimize trip generation and provides for access by all residents, where appropriate. This designation includes properties owned by public agencies such as libraries, fire stations, public transportation corridors, and schools, as well as privately owned transportation and utility corridors such as railroads, and power transmission lines. In specific locations, such as downtown Oakley, mixed use projects may be determined consistent with this designation.

A wide variety of public and private uses are allowed with this General Plan category. However, construction of private commercial uses will be limited to uses related to the public or semi-public activity. Residential subdivision of this designation is not allowed.

CYPRESS CORRIDOR PLANNING AREA

The project site is within the Cypress Corridor Special Planning Area, which encompasses approximately 2,371 acres of land located both north and south of Cypress Road. This Area in entirely within the Oakley city limits and is bounded by the San Joaquin Delta on the north, Marsh Creek on the west, the BNSF Railroad on the southwest, Sellers Avenue and East Cypress Road on the southeast, and Jersey Island Road on the east. The Cypress Corridor Area is envisioned as a primarily residential area with supporting commercial and public uses. As described above, the Cypress Corridor Area has been the subject of various development proposals.

The Cypress Corridor Area includes approximately 1,257 acres located to the north of the Contra Costa Canal. This portion of the Area, generally referred to as the North Canal Lands within the General Plan, includes the wetland restoration and community park portions of the project site, but it does not include the Ironhouse parcel (all three project component sites are however within the City of Oakley boundaries). The General Plan states that this area "is not proposed for urban development and is anticipated to remain as open space and possibly restored as marsh habitat", in reference to the Dutch Slough Restoration Project. There is no Specific Plan for the Cypress Corridor Planning Area (Henson 2006).

THE DELTA PROTECTION ACT

The Delta Protection Act was enacted in 1992 in recognition of the increasing threats to the resources of the Delta from urban and suburban encroachment with the potential to impact agriculture, wildlife habitat, and recreation uses. Pursuant to the Act, a Land Use and Resource Management Plan was completed and adopted by the Delta Protection Commission in 1995.

The staff of the Commission reviewed the NOP for this project and determined that the proposed project is located within the Secondary Zone of the Legal Delta, adjacent to the Primary Zone. The Primary Zone is a portion of the "Legal Delta", defined in Section 12220 of the Water Code (California Delta Protection Commission 2006). Approval or denial of projects in the Secondary Zone are not subject to appeal to the Commission, however, potential impacts of the proposed project on the Primary Zone are analyzed in this EIR.

Socioeconomic Conditions

The project area is located near to the City of Oakley in Contra Costa County, California. The ethnic and economic breakdowns of the City of Oakley, Contra Costa County, the State of California, and Census Tract 3020.02, Block Group 1 (which covers the site area and the northeastern edge of Oakley and is referred to as "project vicinity" in the following text) are shown in Table 3.9-1. Data is taken from the 2000 U.S. Census.

Racially, the City of Oakley and the project vicinity have a lower proportion of minorities than Contra Costa County or the State: Figure for the percentage of population counted as white, non-Latino, in 2000 were project vicinity (62.4%), Oakley (64.3%), Contra Costa Co. (57.9%) and California (46.7%). Minorities living in the project vicinity are slightly different than the County or State. (0.5%).

Table 3.9-1 Ethnicity/Race and Income for California, Contra Costa County and City of Oakley

	California				Contra Costa County				Oakley		Census Tract 3020.02, Block Group 1	
Year	**2000**		**2006 Estimate**		**2000**		**2006 Estimate**		**2000**		**2000**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Total Population	33,871,648	100.0%	36,457,549	100.0%	948,816	100.0%	1,024,319	100.0%	25,619	100.0%	673	100.0%
Race												
White	15,816,790	46.7%	15,600,175	42.8%	549,409	57.9%	530,288	51.8%	16,469	64.3%	423	62.4%
Hispanic or Latino	10,966,556	32.4%	13,074,155	35.9%	167,776	17.7%	224,134	21.9%	6,399	25.0%	192	28.3%
Asian	3,648,860	10.8%	4,424,529	12.1%	102,681	10.8%	135,351	13.2%	708	2.8%	2	0.3%
Black or African American	2,181,926	6.4%	2,201,043	6.0%	86,851	9.2%	92,863	9.1%	832	3.2%	5	0.74%
American Indian and Alaska Native	178,984	0.5%	168,486	0.5%	3,648	0.4%	2,720	0.3%	151	0.6%	13	1.9%
Native Hawaiian and Other Pac Isl.	103,736	0.3%	120,837	0.3%	3,157	0.3%	4,316	0.4%	65	0.3%	5	0.7%
Some Other Race	71,681	0.2%	150,184	0.4%	2,636	0.2%	5,785	0.6%	42	0.2%	2	0.3%
Two or More Races	903,115	2.7%	718,140	2.0%	32,658	3.4%	28,862	2.8%	953	3.7%	36	5.3%
Income and Poverty	**1999**	**%**	**12 months**	**%**	**1999**	**%**	**12 months**	**%**	**1999**	**%**	**-**	
Median household income	$47,493	-	$56,645	-	$63,675	-	$74,241	-	$65,589	-	NA	NA
Median family income	$53,025	-	$64,563	-	$73,039	-	$85,737	-	$68,888	-	NA	NA
Per cap. income	$22,711	-	$26,974	-	$30,615	-	$35,790	-	$21,895	-	NA	NA
Individuals in poverty	4,706,130	14.2%	4,690,140	12.9%	71,575	7.6%	79,636	7.8%	1,257	5.0%	NA	NA

The percentage of Asian inhabitants is lower in the project vicinity (0.3%) and Oakley (2.8%) than the County (10.8%) and State (10.8%). Conversely the percentage of American Indians or Alaskan Natives in the project vicinity (1.9%) and Oakley (0.6%) is higher than the County (0.4%) and State

The median household income for Oakley in 1999 at $65,589 was more than Contra Costa County, which was $63,675. Contra Costa County is a comparatively high-income County compared with the average for California where the median household income in 1999 was $47,493. The 2000 census also counted fewer individuals in poverty in Oakley (5.0% of the population) compared with Contra Costa County (7.6%) and California in general (14.2% - falling to 12.9% by 2006-7). No income data was available for Census Tract 3020.02.

The project area and vicinity is not therefore a minority area under any of the most commonly used definitions, nor does it have a large number of low income inhabitants compared with the City, County or State.

3.9.2 Impacts and Mitigations

Significance Criteria

The project's land use impacts would be considered potentially significant if they resulted in any of the following effects, which are identified as potentially significant in the CEQA Initial Study Checklist (CEQA Guidelines, Appendix G):

- Physically divide an established community
- Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect
- Conflict with any applicable habitat conservation plan or natural community conservation plan

Alternative 1: Minimum Fill Alternative

IMPACT 3.9.1-1: PHYSICALLY DIVIDE AN ESTABLISHED COMMUNITY.

The proposed projects would not divide an established community because the project sites are, and would remain, primarily open space separated from the residential areas to the south and east, and is surrounded by waterways on the north. The community park would be located at the southern boundary of the site adjacent to new development off-site, and would form a transition to the undeveloped portions of the restoration area. There would be no impact and no mitigation is required.

IMPACT 3.9.1-2: CONFLICT WITH ANY APPLICABLE LAND USE PLAN, POLICY, OR REGULATION OF AN AGENCY WITH JURISDICTION OVER THE PROJECT.

The Dutch Slough Restoration Project is consistent with the City of Oakley's 2020 General Plan Goals and Policies. Specifically, the project is consistent with and fulfills the intent of land use policies 2.1.5 and 2.1.6. The Ironhouse parcel that is proposed for restoration is currently designated as Public/Semi-Public while the remainder of the Dutch Slough Restoration Project site is designated as Delta Recreation. In addition, the zoning for the Dutch Slough wetland restoration parcel and the community park parcel is AG-3 Heavy Agricultural and for the Ironhouse parcel is AG-2 General Agricultural. Park uses are allowed under these zoning designations with a land use permit (see Section 3.11 Agricultural Resources.

NATURAL GAS SITES

There are eleven gas wells on the Burroughs and Gilbert parcels. Wells #6-1 and 6-2, on the Burroughs parcel are active, all other wells are scheduled to be plugged and abandoned consistent with state regulation on an accelerated schedule. The continued operation of wells #6-1 and 6-2 would not conflict with the wetland restoration as that well site is located in the proposed upland area and the restoration and trail would be designed so that they do not interfere with the operation of this facility.

Since DWR does not own the mineral rights for the Dutch Slough property, as part of the purchase agreement, it was agreed that future drill pads would be set aside to allow the mineral rights holders access to gas in the unlikely event that future drilling on the site became economically viable. If such pads are used in the future, separate environmental documentation may be needed at that time.

The effects of drilling and operating gas wells within Oakley are addressed in the Draft Drilling Ordinance, was adopted by the City in 2006. Since future access to these mineral rights would be retained, there would be no impact to future gas production at the site. No impacts are anticipated, and no mitigations necessary.

DELTA PROTECTION COMMISSION'S MANAGEMENT PLAN

The proposed Dutch Slough Restoration Project, Ironhouse Project and City Community Park Project are consistent with the policies and recommendations of the Delta Protection Commission's Management Plan. The project specifically fulfills and is consistent with the following policies:

- Environment Policy 3 regarding wildlife habitat management to provide several inter-related habitats
- Land Use Policy 3 to provide buffer zones between new developments and agricultural land
- Water Policy 3 on water quality standards and beneficial uses of State waters
- Recreation and Access Policy 3 on siting recreation facilities to minimize impacts on agricultural uses, levees, public drinking water supply intakes, and wetland and habitat areas.
- Recreation and Access Policy 7 for improved access to bank fishing
- Recreation and Access Policy 9 to encourage recreation facilities that take advantage of the Delta's unique characteristics.

The proposed Dutch Slough Restoration Project, Ironhouse Project and City Community Park Project would not have indirect impacts to land use in the Primary Zone and no mitigation is required.

IMPACT 3.9.1-3 CONFLICT WITH ANY APPLICABLE HABITAT CONSERVATION PLAN OR NATURAL COMMUNITY CONSERVATION PLAN. (ALL OPTIONS)

No habitat conservation plan (HCP) or natural community conservation plan (NCCP) currently applies to the project area. The East Contra Costa County Habitat Conservation Plan and Natural Community Conservation Plan has been prepared by the East Contra Costa County Habitat Conservation Plan Association, a joint powers authority made up of a variety of agencies, including the City of Oakley and CCWD.

Although the Dutch Slough Restoration and Related Project sites are located in the area covered by the HCP/NCCP, the purpose of the HCP/NCCP is to allow a more regional, rather than project-by-project, approach to growth and development while providing species conservation and habitat planning. The proposed Dutch Slough wetland restoration and park development would not cause a conflict with the HCP/NCCP. No impact would occur and no mitigation is required.

CUMULATIVE IMPACTS

Extensive development is proposed and/or is under construction adjacent to the project site on both the southern and eastern boundaries. Conflicts between these new residential developments (planned or under construction) and the Dutch Slough Restoration Project would be reduced through a vegetation perimeter buffer between the proposed Community Park and the nearby residential uses. The proposed buffer also would reduce conflicts between the proposed Community Park and adjacent residential uses. Therefore no impact would occur and no mitigation is required.

Alternative 2: Moderate Fill

Land use impacts would be the same as under Alternative 1 (all options).

Alternative 3: Maximum Fill

Land use impacts would be the same as under Alternative 1 (all options).

Alternative 4: No Project

There would be no land use impacts under the No Project Alternative.

Table 3.9-2: Summary of Land Use Impacts for Dutch Slough Restoration and Related Projects

Impact	Dutch Slough Restoration Project	Related Projects	
		Ironhouse Project	**City Community Park Project**
Impact 3.9.1-1: Physically divide an established community	No impact	No impact	No impact
Impact 3.9.1-2: Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project.	The proposed wetland restoration would be consistent with the current zoning of AG-3 Heavy Agricultural.	The proposed wetland would be consistent with the current zoning of AG-2 General Agricultural.	Park uses are allowed with a Special Land Use Permit.
Impact 3.9.1-3: Conflict with any applicable habitat conservation plan or natural community conservation plan	No impact	No impact	No impact

Insert tab titled

3.10 - Agricultural Resources

3.10 AGRICULTURAL RESOURCES

This section discusses the existing agricultural resources on the Dutch Slough Restoration Project and Related Projects sites and vicinity, and describes potential impacts to agricultural resources from those projects. The section includes an analysis of the conversion of prime/unique farmland and farmland of statewide or local importance to non-agricultural uses.

3.10.1 Affected Environment

SITE SOILS AND TOPOGRAPHY

The City of Oakley is on flat land that gently slopes north to the Delta. There are no significant hillsides or ridges. Oakley soils are comprised primarily of lowland soil associations, with some tidal flat-delta-marsh lowland along the northern boundary of the City. The lowland soil associations are slowly to very slowly permeable, highly expansive and corrosive with slight erosion hazards. The tidal flat-delta-marsh lowland soils are highly expansive, very highly corrosive and moderately to slowly permeable. Most of Oakley is composed of Class II Delhi sand, described by the U.S. Soil Conservation Service as "excessively drained soils" where runoff is slow or very slow. Delhi sand is used to grow irrigated almonds, vineyards and other fruit crops, and some walnuts (City of Oakley General Plan 2002)

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. Approximately one-third of the northern end of the project site is subsided; as a consequence, the groundwater table is high, making it difficult to farm due to wet soil conditions most years. The sites encompass ten different types of organic and mineral soils.

The Dutch Slough Restoration Project and Related Projects sites total approximately 1,373 acres of land, of which approximately 1,274 acres (93%) are classified as prime/unique farmland and farmland of state/local importance as detailed in Table 3.10-1 and Figure 3.10-1. Definitions for the classifications are below the Project Site Classifications, Table 3.10.1. The related City Community Park Project and Ironhouse Project include another approximately 188 acres, of which approximately 144 acres fall into the above agricultural land categories.

The natural deposition of soils from Marsh Creek provided a rich base for growing crops suitable for some farming operations. However, as these soils came under frequent cultivation and dry conditions, the top peat layers were eroded due to oxidation and wind erosion, resulting in subsidence. These soils also supported natural riparian habitats and wetlands that are known to act as beneficial filters to reduce biological and chemical contaminants, resulting in fewer water quality impacts to drinking and recreational water sources.

The United States Department of Agriculture (USDA), Natural Resource Conservation Service (NRCS) uses two systems to determine a soil's agricultural productivity: the Soil Capability Classification and the Storie Index Rating System. The Farmland Mapping and Monitoring Program (part of the California Department of Conservation, Division of Land Resource Protection) uses the information from the USDA and the NRCS to create maps that illustrate the types of farmland in the area.

HISTORICAL AGRICULTURAL USES

Historic agricultural use of the Dutch Slough Restoration Project and City Community Park Project sites included dairies and a small vineyard. Currently the only agricultural uses are cattle grazing and the vineyard. The sites' past agricultural uses were primarily as dairy ranches; the last dairy ranch on the site closed in 2002. The Ironhouse Project site also was historically grazing land.

Agriculture has been a predominant industry in Contra Costa County. In the eastern portion of the County (East County), where the Dutch Slough and Related Project sites are located, for decades vegetable row crop farms (tomato, asparagus, sweet corn, squash, and beans) produce significant annual sales, as do wine grapes. The East County has the largest concentration of small and medium-sized orchards, with apricot, apple, and walnut crops. Agricultural lands and corresponding production have decreased due to urbanization since 1940. Both rangelands and field crops have been reduced by more than half since that time.

As described in the Oakley General Plan, Oakley has historically been an agricultural community, with a wide variety of agricultural crops (City of Oakley 2002). Within Oakley, agricultural uses include equestrian and livestock enterprises, as well as row crops, vineyards and orchards. Much of the land used for agriculture has been developed into urban uses, or is planned for development in the future. While the City recognizes the historic role of agriculture within the Oakley community and supports continued agriculture, the transition from agriculture to urban uses limits the potential for large-scale commercial agriculture within Oakley's urban areas.

SITE SOILS

The Dutch Slough Restoration Project and Related Project sites total approximately 1,373 acres of land, which approximately 1,274 acres (93%) are classified as prime/unique farmland and farmland of state/local importance as detailed in Figure 3.10-1 and Table 3.10-1. An additional 39.5 acres of water features are located on the three project sites. Definitions for the classifications are provided below.

Prime Farmland (P). Farmland with the best combination of physical and chemical features able to sustain long-term agricultural production. This land has the soil quality, growing season, and moisture supply needed to produce sustained high yields. Land must have been used for irrigated agricultural production at some time during the four years prior to the mapping date.

Farmland of Statewide Importance (S). Farmland similar to Prime Farmland but with minor shortcomings, such as greater slopes or less ability to store soil moisture. Land must have been used for irrigated agricultural production at some time during the four years prior to the mapping date.

Unique Farmland (U). Farmland of lesser quality soils used for the production of the state's leading agricultural crops. This land is usually irrigated, but may include nonirrigated orchards or vineyards as found in some climatic zones in California. Land must have been cropped at some time during the four years prior to the mapping date.

Farmland of Local Importance (L). Land of importance to the local agricultural economy as determined by each county's board of supervisors and a local advisory committee.

Grazing Land (G). Land on which the existing vegetation is suited to the grazing of livestock. This category was developed in cooperation with the California Cattlemen's Association, University of California Cooperative Extension, and other groups interested in the extent of grazing activities. The minimum mapping unit for Grazing Land is 40 acres. Due to variations in soil quality, smaller units of Grazing Land may appear within larger irrigated pastures.

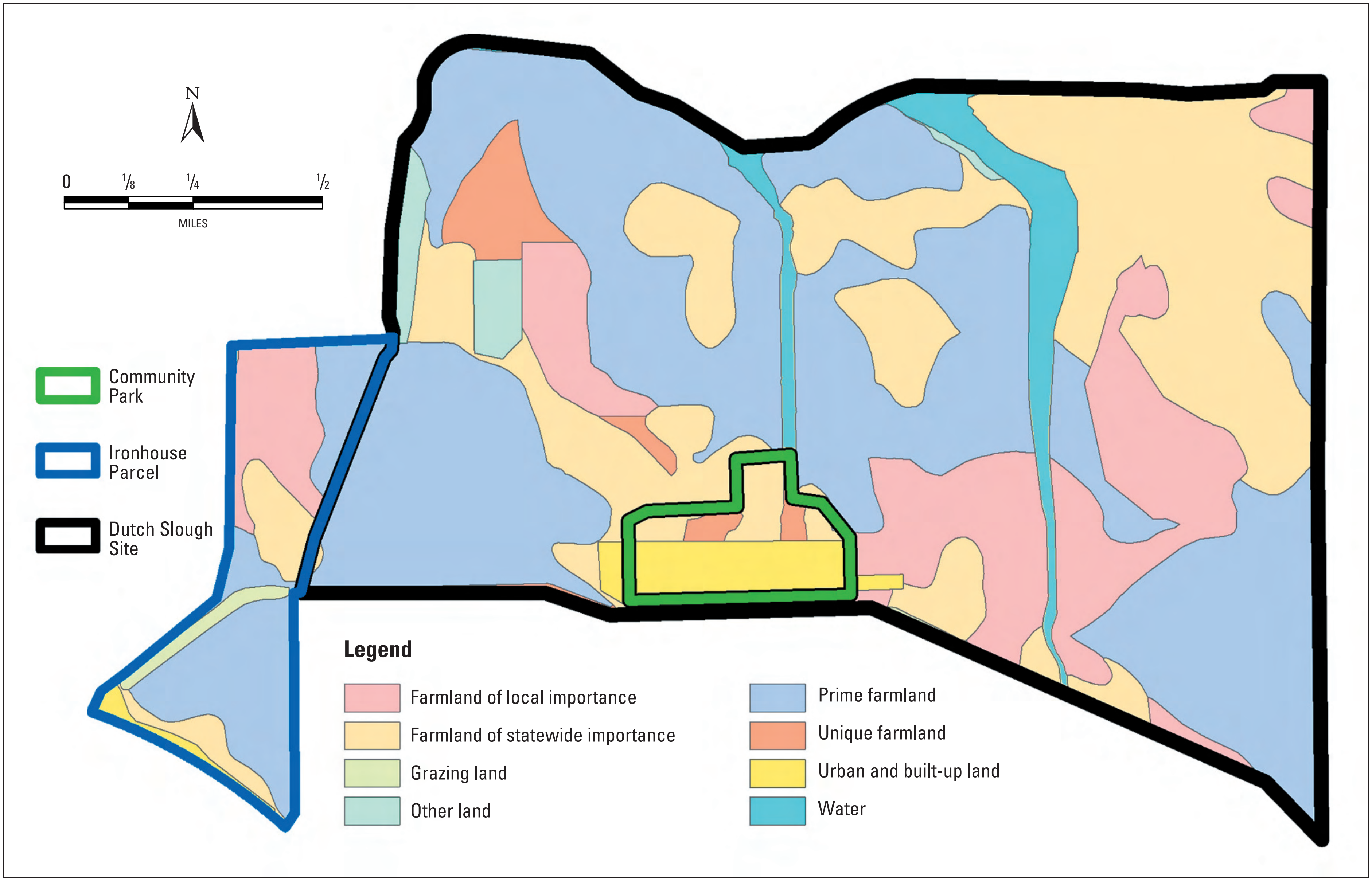

Figure 3.10-1

Project Site Agricultural Lands

Source: Farmland types from FMMP

Table 3.10-1 Agricultural Land Classifications for Dutch Slough Restoration Project and Related Sites

Classification	Dutch Slough Restoration Project (acres)	Related Projects		Total (acres)
		Ironhouse Project (acres)	City Community Park Project (acres)	
Prime Farmland	563.1997	68.0935	0.2920	631.5852
Farmland of Statewide Importance	349.5418	21.9920	16.5241	388.0579
Farmland of Local Importance	184.4406	30.5443	0.1236	215.1085
Unique Farmland	32.8496	0.0	6.0850	38.9346
Grazing Land	21.4449	6.3055	0.6052	28.3556
Other Land	25.4221	1.1762	0.0	26.5983
Urban and Built-Up Land	8.4143	6.2947	29.8338	44.5428
Water	39.5319	0.0	0.0	39.5319
Total	1224.8449	134.4062	53.4637	1412.7148

Source: California Department of Conservation 2006a.
Note: All area measurements are exclusive.

Urban and Built-up Land (D). Land occupied by structures with a building density of at least 1 unit to 1.5 acres, or approximately 6 structures to a 10-acre parcel. This land is used for residential, industrial, commercial, construction, institutional, public administration, railroad and other transportation yards, cemeteries, airports, golf courses, sanitary landfills, sewage treatment, water control structures, and other developed purposes.

Other Land (X). Land not included in any other mapping category. Common examples include low density rural developments; brush, timber, wetland, and riparian areas not suitable for livestock grazing; confined livestock, poultry or aquaculture facilities; strip mines, borrow pits; and water bodies smaller than forty acres. Vacant and nonagricultural land surrounded on all sides by urban development and greater than 40 acres is mapped as Other Land.

Water (W). Perennial water bodies with an extent of at least 40 acres.

Regulatory Framework

CONTRA COSTA COUNTY URBAN LIMIT LINE/LAND PRESERVATION PLAN (65/35)

The Contra Costa County General Plan, limits urban development within the county to no more than 35 percent of land within the county; all of this land is outside of the urban limit line (ULL). Land within the ULL is designated for development; the remaining 65 percent of the land is to be preserved for agriculture, open space, wetlands, parks and other non-urban uses. The Dutch Slough Restoration Project Site and the City Community Park Project site are within the ULL, while the Ironhouse Project site is outside the ULL (Contra Costa County 2000a, 2000b).

CITY OF OAKLEY AGRICULTURAL LANDS POLICIES

The area of the proposed project is zoned Public/Semi-Public and Delta Recreation (see discussion below). Most cultivated agricultural lands in Contra Costa County are primarily in the far eastern portions of the county, in and around an area designated in the County General Plan as AC (Agricultural Use). Agricultural lands in the northeastern part of the County, where the project is located, have been rapidly converting to urban development.

Use of the Dutch Slough site as a restoration/recreation area is contemplated in the development of the City of Oakley General Plan (City of Oakley 2002). The General Plan recognized that the prior owners of the Dutch Slough Restoration Project site applied (to CALFED) for funding to establish a substantial wetland restoration area within the Dutch Slough area. Based upon this application and presentations by the property owner's representative, the City removed the urban land use designations from lands located north of the Contra Costa Canal within the Dutch Slough area. The Delta Recreation designation is intended to ensure the preservation of open space within the area, while providing the opportunity for enhancement of biological resources and development of passive recreational activities.

Chapters 6 and 7 of the General Plan provides use of the Dutch Slough Restoration Project site for anticipated open space and recreational needs of the community. The relevant policies include:

> 6.3.4 Encourage preservation and enhancement of the natural characteristics of the San Joaquin Delta and Dutch Slough in a manner that encourages public access."
>
> 6.6.1 Encourage public access in multiple forms and improvements along the City's waterways, particularly the San Joaquin Delta, Marsh Creek and Dutch Slough.
>
> 7.4.3 Manage shoreline and regional parks along Oakley's waterfront such as the Big Break and Dutch Slough shoreline in a manner that provides for appropriate public access and enhances the natural environment.

In a similar vein, the General Plan proposed a program to acquire and develop lands situate in the Dutch Slough area for recreational uses:

> 7.4.C Pursue public and private partnerships needed to acquire necessary land and to improve a public or private/public commercial recreation area at Dutch Slough.

The City, in its General Plan 2020, recognizes the benefits of maintaining agricultural land uses in the community. Agriculture contributes to the rural character of the community, maintains land as primarily open space, and reduces further degradation of the natural environment.

The City's General Plan and the program environmental impact report were prepared concurrently to allow the Plan to mitigate for the impacts associated with the land use policies developed under the Plan. The Mitigation and Monitoring Reporting Program adopted for the General Plan provides that the mitigation measures are incorporated into the Plan itself. The EIR evaluated the loss of agricultural lands that will result from land use patterns identified in the plan (Impact 3.5.C). The EIR noted conversion of this area is consistent with prior planning by Contra Costa County with developed an urban limit line with a 65/35 Land Preservation standard.

The City's EIR recognizes that due to a lack of large contiguous agricultural land blocks and several other economic and logistic constraints, commercial agricultural production with city's planning area has become less viable. Agricultural lands in the City of Oakley are planned for and accommodated in three General Plan land use designations: Agriculture, Agricultural Limited, and Delta Recreation. The City of Oakley's General Plan 2020 (City of Oakley 2002) identifies the Land Use Designation for the Dutch Slough Restoration Project site as Delta Recreation, the City Community Park Project site as Parks and Recreation, the Ironhouse Project site as Public/Semi-Public, and Marsh Creek as Waterways. The Delta Recreation land use designation encompasses the lowlands of the San Joaquin Delta at the City's northern edge, most of which is located within the 100-year floodplain. The most appropriate land uses in this designation include agriculture, low intensity recreation and wildlife habitat. The Plan provides for a "Community Waterfront Vision." This vision includes the Dutch Slough wetlands preserve (page 7-35 of the General Plan; http//cityofoakley.org/ subPage.cfm?page=572363).

The City of Oakley and DWR entered into a memorandum of understanding that provides for the agencies to partner on mutually beneficial issues such as trail improvements, dedication of a regional park site, and enhancement of public access to the Delta, in addition to promoting restoration of wildlife values within Oakley. (General Plan page 7-15)

The following applicable goals and policies are from the Oakley 2020 General Plan (Oakley 2002):

Goal 6.1 Allow agriculture to continue as a viable use of land that reflects the community's origins and minimizes conflicts between agricultural and urban uses.

POLICIES

> 6.1.1 Participate in regional programs that promote the long-term viability of agricultural operations within the City
>
> 6.1.2 Reduce the negative impacts resulting from urban uses and neighboring agricultural uses in close proximity
>
> 6.1.4 Incorporate parks, open space and trails between urban and agricultural uses to provide buffer and transition between uses.

The General Plan EIR concludes that the Oakley Planning Area falls in the thirty-five percent that is designated for development under the county plan. In addition, currently agricultural resources are fragmented and commercial agriculture is substantially compromised. The General Plan accommodates limited agriculture, while providing for urban needs of the City. The EIR determined that incremental environmental effect of the General Plan on agriculture is less than significant upon implementation of the previously mentioned Policies and Programs. (City of Oakley EIR 2002, p. 3-77).

FEDERAL AND STATE FARMLAND PROTECTION POLICIES

WILLIAMSON ACT

The California Land Conservation Act, better known as the Williamson Act, has been the state's primary agricultural land protection program since its enactment in 1965. The Act preserves agricultural and open space lands by discouraging premature and unnecessary conversion to non-agricultural uses through an arrangement whereby private landowners contract with counties and cities to voluntarily restrict land to agricultural and open space uses. The contract is a rolling 10-year term contract that automatically renews annually unless either party files a "notice of non-renewal". In return, these parcels are assessed for property tax purposes at a rate consistent with their actual use, rather than potential market value. There are no Williamson Act lands within the project site (California Department of Conservation 2006b) or on the City park or Ironhouse Project sites.

NATIONAL FARMLAND POLICY

Loss of farmland is an important concern that is captured by the development of federal, state and local policies calling for protection of Prime, Unique or Statewide Important Farmland. Under the Federal Farmland Protection Policy Act (FPPA)(Subtitle I of Title XI, Section 1539-1549), projects are subject to FPPA requirements if they may irreversibly convert farmland (directly or indirectly) to nonagricultural use and are completed by, or with the assistance of, a federal agency. However, as the U.S. Department of Agriculture's Farmland and Conversion Impact Rating form advises, "The purpose of the rating process is to insure that the most valuable and viable farmlands are protected from development projects sponsored by the Federal Government...Accordingly, a site with a large quantity of non-urban land surrounding it will receive a greater number of points for protection from development." The form advises that the "LESA system (Land Evaluation-Site Assessment) is used as a tool to help assess the options for land use on an evaluation of productivity weighed against *commitment to urban development*." (USDA Farmland Conversion Impact Rating Form AD-1006 (10-83) at pages 4 and 7. Emphasis added.)

The Federal (FFPPA) or state (LESA) farmland evaluation and assessment reviews can help in determining whether a project has an impact on agricultural land but it is not designed to determine environmental impacts. The LESA model distinguishes between land committed to nonagricultural use by virtue of development and protection of resource lands that are compatible or supportive of agricultural uses of land.

STATE POLICY WITH RESPECT TO AGRICULTURAL LAND USES

Under Public Resources Code Section 21095(a), the California Resources Agency was required to develop optional methodology that considers the impacts on the environment from the conversion of agricultural land to non-agricultural uses. The California Department of Conservation developed a LESA model to evaluate agricultural conversions, which was incorporated into the CEQA guidelines (Appendix G) as an optional tool under the law. However, an analysis conducted by the California Resources Agency found the LESA model poorly suited to evaluating impacts to agriculture from habitat projects because "wildlife habitat and other open space lands are specifically considered consistent with agricultural land uses in the model". (Resources Agency 2006).

In applying the California LESA model the proposed project would not qualify as "Land Committed to Nonagricultural Use", because such land is designated as having received discretionary *development* approvals such as a tentative subdivision map, tentative or final parcel map, or recorded development agreement. (Department of Conservation California Agricultural LESA Model 1997

Instruction Manual (Manual) at page 26). In contrast, the proposed project falls within the California LESA model definition of "protected resource lands." The model defines protected resource lands as "those lands with long term use restrictions that are compatible with or supportive of agricultural uses of land. Included among them are the following: publicly owned lands maintained as park, forest, or watershed resources; and lands with agricultural, wildlife habitat, open space, or other natural resource easements that restrict the conversion of such land to urban or industrial uses" (Manual at page 28).

LESA Model Results and the Site's Agricultural Viability

A California Agricultural Land Evaluation and Site Assessment (LESA) computation was done for the site. As authorized by SB 850, the Resources Agency allows lead agencies to use this model to evaluate the impact of agricultural conversion on the environment Nonetheless, given the uncertainty concerning the state of law regarding impacts to agricultural resources, the LESA analysis was performed to fully inform the lead agency concerning the potential impacts to agriculture.

The LESA model allows evaluation of a site on the bases of soil capability, storie index, site size, availability of water resources, surrounding agricultural lands, and protected resources lands. These factors are grouped into two overall categories for rating, each accounting for 50% of the score: Land Evaluation (soil and farmland quality) and Site Assessment (availability of water, surrounding farm lands, compatible land uses). In general, projects will receive a LESA score sufficiently high to register as a "Significant" impact if the parcels can support economically viable agricultural operations.

The LESA model results in scores up to 100; sites with scores of under 39 are not considered significant agricultural resources. Impacts of conversion of sites with scores from 40 to 59 points are considered significant only if the Land Evaluation and Site Assessment scores are both over 20. The total LESA score for the project site was calculated to be 54, with both the land evaluation portion and site assessment portions scoring more than 20 (the threshold for significant agricultural lands). However, as described in the impact analysis, below, the project sites are not considered to have the potential to support current or future economically viable agricultural operations. A high LESA score in this case does not demonstrate environmental importance.

Because the project area is within the urban limit line several large housing developments are proposed, approved, or under construction to the east and south of the project site. Accordingly future use of this land for agriculture would be difficult or costly. Costs for maintaining levees and electricity and irrigation systems would likely exceed the value of farming revenue because such conversion would include a need to rebuild levees to current flood protection standards, or a 300-year flood event. The construction of these new levees (about $2- 3 million/mile) would far exceed the value of any crops grown and harvested within the perimeter of the levees, which of themselves would require additional farmland in order to be constructed (i.e., setback).

In addition, associated nuisances such as noise, dust, odors, and the use of farming chemicals would be incompatible with uses at the City Community Park Project and residences adjacent to the site. Public recreation and trails around the site would also compromise any future farming operations. Maintaining the existing, isolated, 14-acre vineyard is not economically or technically viable. The high maintenance activities of this crop and transportation of a minimal harvest would incur additional overhead costs.

Consideration of Applicable CALFED Mitigation Strategies

The CALFED Programmatic EIR included a large number of mitigation strategies to reduce impacts on agricultural lands. These are summarized in the CEQA Findings of Fact for approval of the CALFED Program (August 28, 2000), and include avoiding or minimizing impacts to agricultural lands by prioritizing developing new habitat on degraded, public, or other non-agricultural lands, obtaining easements on existing agricultural lands, acquiring lands in agricultural preserves, and using farmer-initiated restoration projects as a means of reaching program goals, among others. Each of these proposed mitigation strategies has been evaluated by the city and county in their land use planning policies and resulted in the identification of these lands in the City of Oakley General Plan 2020 and the Contra Costa General Plan as appropriate for restoration/open space uses.

The CALFED Final PEIS/EIR recognized that the Preferred Program Alternative could have potentially significant effects on agricultural land and water use. The CALFED Final PEIS/EIR specifically identified potential effects of converting Prime, Statewide Important and Unique Farmland to project uses. It also identified potential conflicts with local government plans and policies and potential incompatibilities with adjacent land uses. As a result, the CALFED Program developed mitigation strategies to reduce potential impacts to agricultural land and water use.

The Dutch Slough Restoration Project has been designed to meet CALFED Program objectives and to be consistent with the mitigation strategies adopted as part of the CEQA Findings for the approval of the CALFED Program. A review of Section 7.1, "Findings on Specific Impacts and Mitigation Measures: Potentially Significant Adverse Impacts on Agricultural Land and Water Use Associated with the Preferred Program Alternative" resulted in identification of a number of mitigation strategies (described below) that have been incorporated into the design of this proposed habitat restoration project:

IMPACT 1. CONVERSION OF PRIME, STATEWIDE IMPORTANT, AND UNIQUE FARMLAND TO PROJECT USES.

MITIGATION STRATEGY 4:

If public lands are not available for restoration efforts, focus restoration efforts on acquiring lands that can meet ecosystem restoration goals from willing sellers where at least part of the reason to sell is economic hardship (i.e., lands that flood frequently or where levees are difficult to maintain).

The public lands on which the proposed Dutch Slough Restoration Project and City Community Park Project are planned for implementation were acquired from willing sellers where at least part of the reason for selling was economic. Dairying was no longer considered economically viable on the site, and development pressures were mounting towards conversion to residential as the most likely future economic use of the property. The Ironhouse Sanitary District has stated that it will no longer need its restoration site parcel for spray irrigation of effluent. Therefore, the proposed habitat restoration and park projects are consistent with Mitigation Strategy 4.

MITIGATION STRATEGY 15. *Use a planned or phased habitat development approach in concert with adaptive management.*

As detailed in Chapter 2, Project Description, Dutch Slough Restoration Project is carefully designed and will be managed under an adaptive management framework. Therefore, the proposed habitat restoration projects are consistent with Mitigation Strategy 15.

MITIGATION STRATEGY 16: *Minimize the amount of water supply required to sustain habitat restoration acreage.*

The proposed habitat restoration projects would significantly reduce the volume of water needed for irrigation. A minimal amount of water would temporarily be needed to establish upland habitat and some wetlands before tidal influence is restored. (Some irrigation would be required for the City Community Park Project.) Therefore, the proposed habitat restoration projects are consistent with Mitigation Strategy 16.

MITIGATION STRATEGY 17: *In implementing levee reconstruction measures, work with landowners to establish levee reconstruction methods that avoid or minimize the use of agricultural lands.*

The Dutch Slough Restoration Project would locate a new levee on approximately 14 acres of agricultural lands. Reconstructed levees would be placed on the sites of existing levees. Therefore, this proposed habitat restoration project is consistent with Mitigation Strategy 17.

MITIGATION STRATEGY 23: *Dredged materials will be analyzed, dredged, and handles in accordance with permit requirements. Permits will incorporate mitigation strategies identified in Section 5.3 [of the Calfed ROD] to prevent release of contaminants of concern.*

Any dredged materials to be used in Dutch Slough Restoration Project construction will be tested and handled in accordance with permit requirements, as described in Section 3.15 of this EIR. Therefore, this proposed habitat restoration project is consistent with Mitigation Strategy 23.

"NO BURROUGHS" OPTION

In this option, the Burroughs parcel would not be restored to tidal marsh, and would remain as terrestrial habitat. No farmland would be converted in this option, and existing land uses would not change significantly. Exercising this option would result in the preservation of approximately 90 acres of Farmland of Local Importance, 190 acres of Farmland of Statewide Importance, and 140 acres of Prime Farmland.

IMPACT 2. CONFLICTS WITH LOCAL GOVERNMENT PLANS AND POLICIES.

Mitigation Strategy 1: *Implement features that are consistent with the local and regional land use plans.*

As described in Section 3.9, Land Use, the proposed Dutch Slough Restoration and Related Projects would be consistent with local and regional land use plans. Therefore, the proposed Dutch Slough Restoration and Related Projects are consistent with Mitigation Strategy 1.

Mitigation Strategy 2: *Involve all affected parties, especially landowners and local communities, in developing appropriate configurations to achieve optimal balance between resource effects and benefits.*

As described in Sections 1.2.1 and 1.5 of this EIR, the Dutch Slough Restoration Project included extensive public outreach and coordination with landowners, local communities, other public agencies, and the public in order to develop a set of project alternatives that optimized the balance between competing resources interests. Therefore, these proposed habitat restoration projects are consistent with Mitigation Strategy 2.

IMPACT 3. CONFLICTS WITH ADJACENT LAND USES.

Mitigation Strategy 1: *Develop buffers and other tangible support for remaining agricultural lands. Vegetation planted on these buffers should be compatible with farming and habitat objectives.*

The proposed Dutch Slough Restoration Project and Related Projects have been designed to serve as a buffer between encroaching residential land uses and agricultural lands to the north and east. The project's tidal and upland restoration activities would be compatible with those land uses. Therefore, this proposed habitat restoration projects are consistent with Mitigation Strategy 1.

Mitigation Strategy 5. *Implement seepage control measures.*

As described in Chapters 3.1 Hydrology, and Geomorphology, and 3.2, Water Quality, the Dutch Slough Restoration Project includes levees designed to minimize seepage onto adjacent residential parcels. Therefore, this proposed habitat restoration projects are consistent with Mitigation Strategy 5.

3.10.2 Impacts and Mitigations

Significance Criteria

Appendix G of the CEQA Guidelines indicates that a project could have a significant impact on the environment if it would:

A. Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use;

B. Conflict with existing zoning for agricultural use, or a Williamson Act contract.

C. Involve other changes in the existing environment, which, due to their location or nature, could result in conversion of farmland, to non-agricultural use.

Alternative 1: Minimum Fill

IMPACT 3.10.1-1: CONVERSION OF PRIME/UNIQUE FARMLAND OR FARMLAND OF STATEWIDE SPACE AND RECREATIONAL USES: DUTCH SLOUGH RESTORATION PROJECT (ALL OPTIONS) AND RELATED PROJECTS

Under Alternative 1, minimal grading would occur; approximately 190,000 cubic yards of soil would be graded for levee construction on the Dutch Slough Restoration Project site. Approximately 480 acres would be converted to open water, 440 acres to marsh, and 180 acres would be uplands. Therefore, of those uses, only the uplands could potentially be reverted to agricultural uses; the remaining 920 acres would be lost due to filling and submersion. Although it would be technically possible to build new levees and re-drain the site for use as agricultural lands, this would not be considered feasible from a regulatory and economic perspective.

The 100-acre Ironhouse parcel may be stripped of 500,000 to 600,000 cubic yards (1 –3 fee deep) of soil and mostly converted to wetlands, so most or all of that parcel also would be permanently removed from agricultural use.

The City Community Park Project would convert an additional 53 acres (including irreversible conversion of land for infrastructure such as parking lots, restroom facilities, trails, and park facilities), however most of this land is currently not classified as agricultural land.

The Resources Agency memorandum notes that CEQA documents for Resources-related projects should include an evaluation of the social and economic consequences of the conversion, and identify the steps that the agency has taken in designing the project to minimize such consequences. (Memo to Resources Agency Departments from Mike Chrisman, Secretary for Resources, April 12, 2005). The agricultural economic potential of the site is limited as evidenced by the market-place decision of the landowners to discontinue the dairy operation. Further, encroaching residential development, as described in Section 3.9 on adjacent parcels make agricultural operations in this area difficult. As described above, large numbers of single family residences are under construction directly south of the site, and thousands of residences have been approved for the property to the east of the site. The western portion of the site abuts a sewage treatment plant's spray field, which is used for agriculture, and the northern side abuts Dutch Slough. Continued use of the site as a dairy would generate odors that would conflict with these surrounding residential land uses. Other large-scale agriculture with the concomitant use of heavy equipment and pesticides are also impacted by the surrounding land uses.

The removal of the Dutch Slough site (as well as the Related Project sites) from agricultural production would not stimulate further conversion of agricultural lands because the project site is within the Urban Limit Line and the last privately held parcel of agricultural land in this part of the City of Oakley. The Surrounding private parcels have already been proposed, approved for, or developed as, residential or commercial uses, and this area has been planned as a restoration/open space site by the City of Oakley's General Plan (see section 3.10.1, Regulatory Framework). As noted previously, the City's General plan considered the secondary effects of eliminating agricultural land use patterns in the Dutch Slough Restoration Project when it designated the area Delta Recreation and open space. In addition, the Dutch Slough Project incorporated applicable CALFED mitigation measures described in the setting section above, which further reduce project impacts to agricultural resources. That analysis concluded that elimination of these lands would have a less than significant effect on the availability of agricultural land within the County. Therefore the impact of the loss of Dutch Slough Project and Related Projects agricultural lands would be less than significant.

SIGNIFICANCE AFTER MITIGATION

Less than significant impact; no mitigation required.

IMPACT 3.10.1-2: CONFLICT WITH EXISTING ZONING FOR AGRICULTURAL USE, OR A WILLIAMSON ACT CONTRACT: DUTCH SLOUGH RESTORATION PROJECT (ALL OPTIONS) AND RELATED PROJECTS

The Dutch Slough Restoration Project is consistent with the site's General Plan designations (see Section 3.9, Land Use). The City of Oakley uses the Contra Costa County zoning designations until such time that the City adopts its own zoning. The City Community Park Project and Ironhouse Project also would be consistent with City zoning. The Dutch Slough Restoration Project site and the park site are zoned A-3 Heavy Agricultural while the Ironhouse parcel is zoned A-2 General Agricultural. Contra Costa Zoning Code (section 84-38.404) for both A-2 and A-3, which is currently used by the City of Oakley, allows for the use of land if a land use permit is obtained from the City (Contra Costa County 2006). This area is not designated as an area of agricultural significance by the Contra Costa County General Plan and is identified as Delta Recreation by the City of Oakley General Plan (City of Oakley General Plan, chap. 6). Thus, impacts from conflicts with existing zoning for agricultural uses would be less than significant**.**

SIGNIFICANCE AFTER MITIGATION

Less than significant impact; no mitigation required.

Impact 3.10.1-3: otherwise result in conversion of farmland to non-agricultural use: Dutch Slough Restoration Project (all options) and Related Projects

Land to the east of the project site (East Cypress Corridor Specific Plan Area) is planned for development and land south of the project site has recently been developed. These developments resulted in agricultural land conversion to urban uses, but these developments are independent of the Dutch Slough Restoration Project, and their impacts would not be a result of the Dutch Slough Restoration Project. No other conversion of agricultural lands or impacts to agricultural lands has been identified from the Dutch Slough Restoration Project. A historic ranch house is proposed to be preserved by the City Community Park Project and could serve to provide a historic connection to past agricultural activities at the site. Therefore there is no impact and no mitigations are required from this proposed impact.

Impact 3.10.1-4: Cumulative Conversion of Prime/Unique Farmland or Farmland of Statewide Importance to Non-Agricultural Use: Dutch Slough Restoration Project (all options) and Related Projects

The proposed Dutch Slough Restoration Project, Ironhouse Project, and City Community Park Project would result in conversion of approximately 1,274 acres of prime/unique farmland and farmland of statewide and local importance. The City of Oakley is undergoing significant development in the area surrounding the project site, which in combination with the proposed project would result in substantial acreages of agricultural land conversion.

Growth trends or uses of the properties in the area include a development expansion corridor to the north and east from the city of Oakley. Single-family residences are the primary growth industry as more citizens find it more feasible to purchase a home in the area and commute to the bay area for work. Farming at the project site became uneconomical as this land became more attractive and valuable for the rapidly expanding growth in eastern Contra Costa County and specifically within the City of Oakley's sphere of influence. Farmlands have become more isolated as urban encroachment surrounds existing farming operations, plus available farm product disposal facilities (e.g., creameries and wineries) were closed, thus increasing transportation costs and erosion of net income. Surrounding land use conflicts at the agricultural-urban interface have also increased including trespassing, theft and vandalism of farming equipment and buildings

In order to address the increasing concern over the loss of prime agricultural lands, Contra Costa County adopted a program to allow for the transfer or purchase of development credits (TDR/PDR). Other strategies for the continued viability of agricultural pursuits included preservation agreements with the County, granting conservation easements, direct purchase, leasebacks, tax benefits for agriculture open space land, purchase or transfer of development rights, clustering development, establishment of an agricultural soils trust fund, and agricultural mitigation fees or land dedication (in-lieu-fee). In response to the proliferation of five-acre "ranchettes", the County adopted a resolution establishing rural residential development of ranchettes as an inappropriate use of prime agricultural land. Finally, the Contra Costa County General Plan incorporates an Urban Limit Line (ULL) and has established a minimum 40-acre lot size for prime agricultural lands outside the Urban Limit Line.

In addition, the Oakley General Plan includes many policies and programs that when implemented would reduce impacts associated with the conversion of agricultural land to non-agricultural uses. The General Plan EIR identifies 19 general plan policies and programs that would mitigate the impact of agricultural land use conversion. The City's General Plan EIR determined that "Implementation of the General Plan would reduce this impact to less than significant level" (City of Oakley 2002).

Larger tracts of agricultural lands on Bethel Island, to the north, across Dutch Slough from the project site, are protected by County zoning that strives to protect agricultural uses and recognizes the extreme flood hazards on those subsided parcels. Similarly, agricultural use of Jersey Island is protected by zoning, flood hazards, and its ownership by the Ironhouse Sanitary District, which uses its land as sewage disposal spray fields. This would eliminate potential future loss of agricultural lands to the East.

The City and County General Plans and other factors limiting future conversion of agricultural lands, as described above, result in the cumulative impacts of the project and other local projects on the loss of agricultural lands being considered less than significant.

SIGNIFICANCE AFTER MITIGATION

Less than significant impact; no mitigation required.

Alternative 2: Moderate Fill

IMPACT 3.10.2-1: CONVERSION OF PRIME/UNIQUE FARMLAND OR FARMLAND OF STATEWIDE SPACE AND RECREATIONAL USES (ALL OPTIONS)

Impacts to Agricultural Resources would be similar to under Alternative 1, except that greater acreage of the site is proposed to be marsh and less would be open water. Under Alternative 2, approximately 210 acres would be permanently converted to open water, 660 acres to marsh, and 80 acres would be uplands. Under this alternative, over 1.3 million cubic yards of soils would be moved from the higher parts of the site to fill in the deeply subsided parts of the site (along with 360,000 cubic yards of imported fill), which would then be flooded as marsh or open water.

IMPACT 3.10.2-2: CONFLICT WITH EXISTING ZONING FOR AGRICULTURAL USE, OR A WILLIAMSON ACT CONTRACT (ALL OPTIONS)

Potential impacts would be the same as under Alternative 1; no mitigation required.

IMPACT 3.10.2-3: OTHERWISE RESULT IN CONVERSION OF FARMLAND TO NON-AGRICULTURAL USE (ALL OPTIONS)

Potential impacts would be the same as under Alternative 1; no mitigation required.

IMPACT 3.10.2-4: CUMULATIVE CONVERSION OF PRIME/UNIQUE FARMLAND OR FARMLAND OF STATEWIDE IMPORTANCE TO NON-AGRICULTURAL USE

Cumulative potential impacts would be the same as under Alternative 1; no mitigation required.

Alternative 3: Maximum Fill

IMPACT 3.10.3-1: CONVERSION OF PRIME/UNIQUE FARMLAND OR FARMLAND OF STATEWIDE SPACE AND RECREATIONAL USES (ALL OPTIONS)

Impacts to Agricultural Resources would be the similar to Alternative 2, except that a greater acreage of the site is proposed to be marsh and less would be open water. Under Alternative 3, approximately 110 acres would be permanently converted to open water, 830 acres to marsh, and 80 acres would be uplands. Under this alternative, approximately 1.3 million cubic yards of soils and another 1.7 million cubic yards of fill of unspecified origin would be moved from the higher parts of the site to fill in the deeply subsided parts of the site, which would then be flooded as marsh or open water. Therefore only the uplands could potentially be reverted to agricultural uses; the remaining 940 acres would be permanently lost by filling and submersion.

IMPACT 3.10.2-2: CONFLICT WITH EXISTING ZONING FOR AGRICULTURAL USE, OR A WILLIAMSON ACT CONTRACT (ALL OPTIONS)

Potential impacts would be the same as under Alternative 1; no mitigation required.

IMPACT 3.10.2-3: OTHERWISE RESULT IN CONVERSION OF FARMLAND TO NON-AGRICULTURAL USE (ALL OPTIONS)

Potential impacts would be the same as under Alternative 1; no mitigation required.

IMPACT 3.10.2-4: CUMULATIVE CONVERSION OF PRIME/UNIQUE FARMLAND OR FARMLAND OF STATEWIDE IMPORTANCE TO NON-AGRICULTURAL USE

Potential impacts would be the same as under Alternative 1; no mitigation required.

Alternative 4: No Project

IMPACT 3.10.4-1: CONVERSION OF PRIME/UNIQUE FARMLAND OR FARMLAND OF STATEWIDE SPACE AND RECREATIONAL USES (ALL OPTIONS)

Existing cattle grazing and vineyard uses at the project site could continue under the No Project Alternative consistent with the City zoning and land use designations, assuming they were economically viable. There would be no conversion of prime/unique farmland and farmland of statewide importance to non-agricultural uses. In the long term, it is possible that the site would be conveyed to another entity for other open space uses and conversion of agricultural land would be possible at that time, however the impacts would be the same in this event.

IMPACT 3.10.2-2: CONFLICT WITH EXISTING ZONING FOR AGRICULTURAL USE, OR A WILLIAMSON ACT CONTRACT (ALL OPTIONS)

No impacts would occur.

IMPACT 3.10.2-3: OTHERWISE RESULT IN CONVERSION OF FARMLAND TO NON-AGRICULTURAL USE (ALL OPTIONS)

No impacts would occur.

IMPACT 3.10.2-4: CUMULATIVE CONVERSION OF PRIME/UNIQUE FARMLAND OR FARMLAND OF STATEWIDE IMPORTANCE TO NON-AGRICULTURAL USE

No impacts would occur.

Insert tab titled

3.11 - Recreation

3.11 RECREATION

This section describes existing and proposed recreation uses in the Dutch Slough Restoration Project vicinity, potential impacts and benefits to recreation from implementation of the proposed projects, and identifies mitigation measures that would reduce the impacts to recreation to less than significant levels.

3.11.1 Affected Environment

This section describes the existing and planned recreation uses in the project area and nearby vicinity, the various plans and policies related to recreation use, and the regulatory agencies that oversee recreation planning and use.

Regional Recreation Uses

The predominant recreational feature in Oakley is the San Joaquin Delta. This waterway serves as an open space area, sensitive plant and wildlife habitat, and recreational opportunity for the City. The Delta region provides a variety of recreational opportunities including fishing, hunting, boating, camping, picnics, and viewing nature. In a survey to study recreation uses of the Delta conducted by the Delta Protection Commission in 1996, Contra Costa County had the highest percentage of people partaking in recreation activities along the Delta region.

During the City's General Plan process, participants expressed the desire to ensure that open space and natural landscapes remain a major component of lands near the Delta. Additionally, participants requested a focus on recreational development of the Delta to provide a center for tourism and a base for recreational activity.

Designated Open Space

Oakley's open space resources include public and private open space and recreation facilities, lands, waterways, habitat areas, and agricultural lands. Open space resources in Oakley consist of designated parkland, natural and recreational open space areas, and waterways (Delta and creeks). Generally, open space land is unimproved land (and water) used for preservation, recreation, public safety, and/or managed production of resources.

Open space lands in the City of Oakley are included in several City General Plan land use designations as listed below:

- *Agriculture*. This land use designation is primarily intended for agricultural uses, but allows limited residential uses.
- *Agriculture Limited*. This designation includes agriculture and low-density (rural) residential land use.
- *Delta Recreation*. This land use designation encompasses the lowlands of the San Joaquin Delta at the City's northwestern edge, most of which is located within the 100-year flood plain.

- *Parks and Recreation.* This designation includes publicly owned city, county, and regional parks facilities, as well as publicly or privately owned golf courses.
- *Waterways.* Waterways through Oakley include the Contra Costa Canal, Marsh Creek, and the Dutch Slough.

Adjacent Recreation Uses

Several East Bay Regional Parks District (EBRPD), California Sate Parks system, and City of Oakley preserve and park facilities exist, are in the planning stages, or are proposed for the Oakley area including:

ANTIOCH/OAKLEY REGIONAL SHORELINE PARK

The Antioch/Oakley Regional Shoreline Park is a newly completed 7.5-acre day-use park at the end of Bridgehead Road in the City of Oakley.

BIG BREAK REGIONAL SHORELINE

The Big Break Regional Shoreline, owned by the East Bay Regional Park District, is 1,668 acres. Much of the property is under water or tidal marshlands, with some uplands along the southerly edge. A Regional Shoreline, as defined by EBRPD, provides significant recreational, interpretive, natural, or scenic values on land, water, and tidal areas along the San Francisco Bay and the Sacramento/San Joaquin Delta (EBRPD 1997). California's Delta Master Recreation Plan identifies Big Break as an area of scenic beauty and unique resource warranting preservation and management in the public interest.

DELTA SCIENCE CENTER AT BIG BREAK

The site for the Delta Science Center is located at the southwestern edge of Big Break lagoon within the City of Oakley and consists of 40 acres, slightly over one third of which are tidal wetlands. The Center will encourage people of all ages and backgrounds to appreciate, understand, and become active stewards of the Bay-Delta ecosystem. The Center will offer access to an integrated program of education, research, and restoration.

FRANK'S TRACT STATE PARK

The closest state-operated recreation area is Frank's Tract State Recreation Area, located northeast of Bethel Island, covering 3,310 acres, and consisting mainly of open water surrounded by perimeter levee remnants. The park is maintained for water-oriented recreational activities, but currently lacks both park and public boat- launching facilities. Private marinas and launch facilities on Bethel Island, Big Break, adjacent sloughs, and public boat ramps in Antioch and Pittsburg provide water access to the Tract. The park is located approximately two miles northeast of the project site and provides opportunities for fishing and waterfowl hunting (California State Parks 2006).

BRANNON ISLAND STATE RECREATION AREA

This is a recreational park on the Delta, about eight miles north of the Antioch Bridge on Highway 160, with a swimming beach, boat launch, and campground. Across the highway from the park is the Windy Cove windsurfing access, which provides facilities for windsurfers and fishermen.

DELTA VISTA SCHOOL/COMMUNITY PARK

The City of Oakley park closest to the project sites is the Delta Vista School/Community Park, approximately 0.5 miles southwest of the project site.

JERSEY ISLAND

The Ironhouse Sanitary District allows fishing, hiking and pheasant hunting on their Jersey Island property north of the project site across Dutch Slough, by permit only (Ironhouse Sanitary District 2006).

Trails

Three main trails are located adjacent to the project sites: The Marsh Creek Regional Trail, the Delta De Anza Regional Trail and the Big Break Regional Trail (proposed). These three trails are shown on Figure 3.11-1.

THE MARSH CREEK REGIONAL TRAIL

This 6.5 mile-long, paved, multi-use trail, administered by the EBRPD, runs along Marsh Creek, from Creekside Park in Brentwood to the shores of Big Break Regional Park. The trail provides recreational opportunities for pedestrians, bicyclists, and equestrians and a plan exists to extend the trail southward for an additional 7.5 miles. At its northern end, approximately 2,000 feet north of where the trail crosses the project site, the trail connects to the Big Break Regional Trail, which parallels the Big Break shoreline westward for approximately 1.6 miles (CCWD 2006).

Marsh Creek Trail runs along Marsh Creek along the western boundary of the Dutch Slough Restoration Project site and crosses the Contra Costa Canal at Marsh Creek. The Marsh Creek Trail also provides connectivity with the Delta de Anza Regional Trail, which extends approximately 15 miles to the west.

DELTA DE ANZA REGIONAL TRAIL

This is a paved, multi-use hiking, bicycling and equestrian trail that spans over 15 miles of the planned 25-mile length. When completed, it will generally follow the East Bay Municipal Utility District's corridor and the Contra Costa Water District's canal.

BIG BREAK REGIONAL TRAIL (PROPOSED)

This 5-mile trail would run along the shoreline at Big Break from Marsh Creek Road to Big Break Road, then move inland near the Santa Fe railroad tracks south of the DuPont property, and then north along the road to Antioch Pier. Big Break Shoreline Regional Trail connects from the Marsh Creek Trail at the northwestern side of the Dutch Slough Restoration Project site.

Figure 3.11-1 Regional Trails in the Project Vicinity

Dutch Slough Area Recreation Uses

The Dutch Slough area is a contiguous block of land that includes agricultural lands, ruderal lands and Delta frontage, providing riparian habitat, foraging and shelter opportunities for several resident and migratory wildlife species. The land was designated "Delta Recreation" by the City of Oakley General Plan, a designation that is intended to ensure the preservation of open space within the area, while providing the opportunity for enhancement of biological resources and development of passive recreational activities.

Because the wetland restoration site and city park site had been privately held land used for agricultural purposes, the only historic recreation use of the site was along the Marsh Creek Regional Trail on the northern end of the property. Although within private property, occasional boaters enter the Emerson Slough and Little Dutch Slough. There is no recreation use within the Ironhouse parcel.

City of Oakley Recreation and Open Space Planning

The Oakley General Plan states that in order to preserve and enhance the City's open space resources, the City will continue to implement existing tree preservation ordinances, implement the Parks and Recreation Master Plan, expand recreation trails and access to the Delta, and establish restoration programs for areas such as Dutch Slough. The City will also support the joint-venture use of open space areas to reduce City maintenance costs, and participate/cooperate with other jurisdictions in the region to enhance regional open space resources.

The General Plan also identifies the potential waterfront opportunities at Dutch Slough, and specifically discusses the plans for a wetlands preserve, a community park and community recreation.

The Parks and Recreation Element of the Oakley General Plan describes the public input process including seven public workshops addressing parks issues that were held in the City of Oakley dating back to 1997. The public workshop results indicate that a major underlying concern of the community is the strong need for more open, green spaces and recreation facilities in Oakley.

The Oakley General Plan identifies the need for a learning, recreation and meeting center to serve the entire community. The goal of the proposed facility would be to serve a mixture of community users with a variety of facilities and programs such as: a recreation center, library, swimming pool, skateboard park, trail staging area, open space, and a basketball court.

Park and Recreation Master Plan

The City has developed a Park and Recreation Master Plan identifying all existing and proposed park and recreation facilities within the City and surrounding areas. This document will serve as an implementation tool for the General Plan, consistent with the goals and policies of the Park and Recreation, Land Use, and Open Space and Conservation Elements.

The City of Oakley Parks and Recreation Master Plan – 2020 (Master Plan) serves as the basis for the General Plan Parks and Recreation Element. While this Element provides the overall policy statement for Oakley's park and recreation facilities, the Master Plan will provide recommendations for the day-to-day tasks, as well as standards for planning future parks and recreation facilities.

The Delta Recreation Master Strategy

In 1997, the California Department of Parks and Recreation conducted recreation use assessment for the entire Delta region for the Delta Protection Commission and the Department of Boating and Waterways. This assessment included demand projections in five-year increments to the year 2020. The study described needed boating facilities, attractions, and infrastructure throughout the Delta.

Oakley is located within the "Delta Breezeway" zone as defined by the California Department of Parks and Recreation. Findings presented in the Master Strategy identified that Oakley is within an "Urban Edge Zone" defined as areas of opportunity for Delta aquatic recreation. Urban edges should include water-oriented features as part of development or redevelopment actions (City of Oakley 2006).

Regional Partnerships

The Oakley community will require park and recreation facilities that may be beyond the City's financial means for the foreseeable future. In such cases the City will work cooperatively with local and regional entities to serve the needs of the community.

In addition to partnering on the Dutch Slough Restoration Project, major projects and potential partnerships include working with:

> **Contra Costa County/TRANSPLAN.** On- and off-street bikeways exist, and there is an East Bay Bike Coalition working on the east county bikeway plan. CalTrans has a competitive grant program that can help adopt the needed bikeway plan.
>
> **East Bay Regional Park District.** The EBRPD is responsible for preserving and managing the regional shoreline and trails in the project vicinity. The EBRPD can work on unique preservation and education opportunities, environmental sciences, and partnering to improve access to the wetlands areas and educate on natural resource protection.

Regulatory Framework

A variety of state agencies exert influence over the Delta, Eastern Contra Costa County and, therefore, Oakley. Those agencies primarily concerned with recreation include the State Department of Parks and Recreation, the Department of Fish and Game, and the State Resources Agency, and the Delta Protection Commission, amongst others.

At a minimum, any shoreline development should incorporate the Bay Conservation and Development Commission (BCDC) standards for public access to the Bay Edge. The BCDC was created in 1965 to protect and manage coastal resources on a large and complex scale. In addition to the BCDC, the California Environmental Quality Act (CEQA), the Suisun Marsh Preservation Act, and the Federal Coastal Zone Management Act (CZMA), provide important policies and regulations that relate to regional resource management.

The provision of recreational opportunities at all levels is recognized as a key goal of the City of Oakley. Relevant goals and policies from the General Plan are provided below.

OPEN SPACE

Goal 2.6 Ensure that open space areas are properly managed and designed to conserve natural resources and enhance the community's character and provide passive recreational opportunities.

POLICIES

2.6.1 Provide public access to the Delta and the waterfront wherever appropriate and feasible. Typically, such access should be unobstructed to the public by foot or bicycle, and where appropriate by horse, automobile and/or boat.

2.6.2 Preserve, enhance and/or restore selected existing natural habitat areas, as feasible.

2.6.3 Create new wildlife habitat areas in appropriate locations, which may serve multiple purposes of natural resource preservation and passive recreation, as feasible.

TRAILS

Goal 2.7 Provide a system of multi-use trails that connects residential districts, parks and schools, employment centers and natural areas, throughout Oakley and the region, including the Delta.

POLICY

2.7.1 Promote a comprehensive trail program throughout the Oakley community and give preference to developments that incorporate the design of the trails, including trails of neighboring communities where feasible, and associated open space into their design.

OPEN SPACE RESOURCES

Goal 6.6 Encourage preservation and enhancement of existing open space resources in and around Oakley and balance open space and urban areas to meet the social, environmental and economic needs of the City now and for the future.

POLICIES

6.6.1 Encourage public access in multiple forms and improvements along the City's waterways, particularly the San Joaquin Delta, Marsh Creek and Dutch Slough.

6.6.2 Establish buffers from adjoining land uses to protect the natural open space resources in the City.

6.6.3 Encourage preservation and enhancement of the watershed, natural waterways, and areas important for the maintenance of natural vegetation and wildlife populations.

GENERAL PARKS AND RECREATION

Goal 7.1 Develop and maintain a system of parks, recreational facilities and open space areas to meet the needs of the City of Oakley.

POLICIES

7.1.1 Develop and maintain a park system that provides 6 acres of parkland per 1,000 residents.

7.1.2 Offer a wide variety of indoor and outdoor recreational opportunities in proximity to all residents of the City, enabling residents to participate in activities that will enhance the quality of life in the community.

7.1.3 Provide a full range of park and recreation facilities and programs for all community residents.

7.1.4 Provide recreation services that enhance the quality of life and meet the changing needs of residents.

7.1.5 Maintain and improve existing parks and develop new neighborhood and community parks in new residential neighborhoods as growth occurs.

7.1.7 Provide sufficient playfields within the City to accommodate both practice and competitive demands for organized and informal activity.

7.1.8 Develop and operate recreational facilities in the most efficient and economical method possible, providing multi-use facilities where feasible.

7.1.10 Consider multiple uses for open space land (i.e. land use buffer zones and green-ways for trails and linear parks, flood control basins for basin and park joint use, and school sites for neighborhood/community park joint use).

7.1.11 Distribute public parks in Oakley to provide adequate community-wide facilities while emphasizing neighborhood recreation within walking distance of most residents. Different kinds of public parks and recreation facilities are required to serve a range of needs. Greenways and trails also constitute important ways in which residents use open space.

COMMUNITY PARKS, PLAYFIELDS, AND RECREATION CENTERS

Goal 7.2 Provide a vital system of community parks, playfields, and recreation facilities to serve the residents of Oakley.

POLICIES

7.2.4 Locate a community park generally within 1 mile of almost all Oakley residents. Parks should be located on a major arterial or thoroughfare, where impact to surrounding residential neighborhoods is minimized. If the community park should abut residential areas, those uses common to neighborhood parks would be used as buffers. Wherever possible, incorporate community parks and trails that are part of the Citywide trail network.

7.2.5 Design community parks to have a minimum size of 10 acres, comfortably 15 to 20 acres with an ideal size of 40 to 50 acres. As recreation activities will drive the design of the community park, these parks should host formal and organized recreation tournaments, and should meet adult recreation opportunities, which generally requires larger fields and therefore larger sites.

7.2.7 Eliminate all biological and/or ecological restrictions on land designated as active use areas within proposed park sites.

7.2.8 Design community parks to contain features that serve the community at large and provide economies of scale. Allocate at least 65% of the land to be available for active recreation. Appropriate features include:

- Multiple play fields for organized play with lighting of some fields
- Multiple play courts
- Separate play areas for both school age and pre-school children
- Special features such as a skate park or playground with water play
- Areas for special events such as an amphitheater or festival facilities
- Group picnic as well as individual picnic areas
- Restrooms and concessions

- Parking
- Equipment storage

7.2.9 Include community facilities appropriate to community parks.

Special Purpose Facilities

Goal 7.4 Provide a system of creek corridors and special purpose facilities to serve the residents of Oakley.

Policies

7.4.9 Public park uses adjacent to the Delta should meet the following criteria:

- Related primarily to water activities
- Compatible with surrounding residential and commercial activities
- Available for year round use and enjoyment
- Provision for barrier-free public access and use for active and passive recreational and social enjoyment
- Balance between retention of natural resources and the creation of hard urban features

7.4.10 Connect special purpose facilities, shoreline, and regional parks, whenever possible, by trails and paths. Use of trails by pedestrians, joggers, bikers or other non-motorized transportation, or equestrian activity shall be determined and posted as necessary.

Trails

Goal 7.5 Establish and maintain a comprehensive system of local and regional trails linking open space, neighborhood parks, community parks and recreation centers, libraries and schools, public transportation nodes, governmental buildings and commercial uses throughout Oakley to provide for pedestrian, equestrian and bicycle circulation.

Policies

7.5.1 Construct trails to provide transportation, exercise, and connection to nature and leisure opportunities for Oakley residents.

7.5.2 Construct short feeder trails to connect proposed developments to the regional trail system.

7.5.5 Provide easements along stream corridors of not less than 100 feet in length and 20 feet in width.

7.5.6 Construct trails, whenever possible, for multiple uses (i.e., pedestrian, bicycle and equestrian).

7.5.7 Whenever possible, separate the activities (i.e., pedestrian, bicycle and equestrian) of multi-use trails, by providing easements on each side of major arterials, to provide safe resolution of potential conflicts between users, animals, and vehicles.

7.5.8 Construct trails, whenever possible, to be accessible to persons with disabilities.

7.5.9 Construct trails to provide for proper grading, drainage and erosion control.

7.5.10 Construct pedestrian trails to have a surfaced width of 6-8 feet (emergency and service vehicle accessible) providing sufficient space for two people to walk abreast.

7.5.12 Provide clearance over trails of not less than 7 feet for pedestrian and bike trails, and not less than 9 feet for equestrian trails.

3.11.2 Impacts and Mitigations

Significance Criteria

Significance criteria are derived from the CEQA Guidelines, Appendix G. A project could have a significant impact on recreational resources if it would:

- Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated;
- Result in conflicts with other recreational uses; or
- Include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment

The second of these criteria is addressed in this EIR's technical analyses with respect to the City of Oakley's Dutch Slough Community Park and Public Access Conceptual Master Plan. Therefore, the analysis below focuses on the first and third criteria.

Alternative 1: Minimum Fill

IMPACT 3.11.1-1: CONFLICTS BETWEEN NON-MOTORIZED WATERCRAFT AND MOTORIZED WATERCRAFT (ALL OPTIONS)

The proposed projects do not include any facilities for increased motorized watercraft use. However, the proposed City Community Park Project would add a kayak/canoe boat ramp into Emerson Slough. Since motorized watercraft occasionally use the waterways at Dutch Slough, Emerson Slough, and Little Dutch Slough, and there are no restrictions currently on watercraft use, there is the potential for conflicts between motorized watercraft and non-motorized watercraft that would use the new boat ramp. The tidal marsh restoration area sloughs and open water areas would be managed for non-powered boating access only, except for emergency access and project monitoring under the adaptive management program. (City of Oakley 2006).

MITIGATION 3.11.1-1: WATERCRAFT RESTRICTIONS (ALL OPTIONS)

To minimize conflicts between motorized and non-motorized watercraft, 5 mile-per-hour speed limit signs (no wake zone) should be posted in Emerson and Little Dutch sloughs. In addition, signs should be posted at the entry points to the new open water areas indicating that no motorized watercraft are allowed. A mutual aid agreement with the Contra Costa Sheriff's Department Marine Unit and the California Department of Boating and Waterways would provide enforcement oversight as well as provide for public safety.

SIGNIFICANCE AFTER MITIGATIONS

Less than Significant

IMPACT 3.11.1-2: TEMPORARY EFFECTS ON RECREATIONAL ACCESS DURING PROJECT CONSTRUCTION (ALL OPTIONS)

The only existing recreational use that would be affected by construction activities (on the Dutch Slough Restoration Project and, possibly, the Ironhouse Project) would be access to the Marsh Creek Trail. Access to the trail could be restricted, or closed temporarily, along the project site during some portions of construction.

MITIGATION 3.11.1-2: MINIMIZE TRAIL ACCESS RESTRICTIONS AND POST RESTRICTION NOTICES DURING CONSTRUCTION (ALL OPTIONS)

Construction activities shall be phased and coordinated to minimize the amount of time that Marsh Creek Trail access would be restricted. Public notices with information on restricted access conditions and timeframes shall be posted on site and provided to any recreation users who have requested notification.

SIGNIFICANCE AFTER MITIGATIONS

Less than Significant

IMPACT 3.11.1-3: LONG-TERM CHANGES IN RECREATIONAL OPPORTUNITIES

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 would afford many opportunities to celebrate the cultural and ecological history of the site. Existing buildings, including a former one-room schoolhouse, would be reused for park functions, while remnants and materials from the remaining outbuildings would be incorporated into the design. The City Community Park would balance active uses, including ball fields, picnic areas, restrooms, 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 (City of Oakley 2006).

The proposed action would create an all-weather multi-use trail around the entire perimeter of the Emerson parcel, the three-mile long Emerson Loop Trail. The proposed Gilbert-Burroughs Trail, also approximately 3-miles long, would lead east from the City Community Park parallel to the Contra Costa Canal then follow the Jersey Island Road levee north to the City Community Park. A spur trail would travel west along the Dutch Slough levee. These trails would provide public access to the shoreline and would provide linkages to the Marsh Creek Regional Trail and the Big Break Regional Trail and Shoreline. The portion of the Emerson Loop Trail that would overlap with the Marsh Creek Trail would be administered by EBRPD, CCFCD, and the City of Oakley. The remainder of the trail and the Gilbert-Burroughs Trail would be administered by the City of Oakley alone (Kaiser 2006). The public access component of the project would also provide interpretive points and learning stations along the trails, a fishing platform, and canoe/kayak access to Emerson Slough.

The City Community Park Master Plan envisions an outdoor classroom, a museum education center, group and family picnic areas, lighted and fenced adult softball fields, multi-use open fields, an equestrian staging area, multiple play areas (sand dune, a meadow, grass maze and others), an off leash dog area, and an amphitheatre. In addition, the Emerson Slough Water Access would provide a graded sandy area for sunning and informal water access.

Because the City is currently deficient in park and active recreational facilities, the proposed action would have a beneficial impact by providing additional facilities. These facilities would help meet the City's passive and active recreation goals including providing access to the Delta. The proposed multi-use trails would provide access to regional trails and shorelines to pedestrians, bicyclists and equestrians, meeting City goals to provide such access (Policy 7.4.10). The City Community Park facility would meet active recreation goals including adult recreation opportunities such as ball fields which require larger parks. Specific General Plan programs support the City Community Park (Program 7.4.C). Providing these recreation facilities and meeting City recreation goals and policies would represent a beneficial impact.

The proposed multi-use trails would include a 12-foot wide paved trail with a 2-foot shoulder on one side and a 6-foot wide graded shoulder with a natural impacted surface on the other side. This shared use trail would accommodate pedestrians, joggers, bicyclists and equestrians.

Some conflicts between the groups of trail users (such as pedestrians, bicyclists and horse riders) may occur due to differences in speed, sight distance requirements, surface types and width. In addition, faster moving users such as bicycles can spook horses if the bicycle comes up from behind quickly and silently. Studies have shown that trail users are not aware of the "right of way" etiquette. By having a two trail system (paved adjacent to natural trail surface) all types of trail users can safety be accommodated. The faster modes of travel (bicycle and rollerbladers) can use the paved section of the trail, and pedestrians and equestrians can use the softer trail base.

MITIGATION 3.11.1-3: PROVIDE SIGNAGE AND EDUCATION ON TRAIL RULES AND ETIQUETTE

Signs shall be posted displaying the proper protocol and pamphlets shall be provided at the park and at all trailheads. In addition, outside of the dog run area, dogs must be on leashes no longer than 10 feet. There shall be a limit of 3 dogs per person in the City Community Park and Dutch Slough Restoration Project public access areas.

SIGNIFICANCE AFTER MITIGATIONS (ALL OPTIONS)

Less than Significant

CUMULATIVE IMPACTS: LONG-TERM CHANGES IN RECREATIONAL OPPORTUNITIES (ALL OPTIONS)

The proposed Dutch Slough Restoration Project and City Community Park Project would provide a variety of recreational facilities for both active and passive recreation and education. Proposed development surrounding the project site would be required to pay park and recreational fees to the City, which would be used to provide additional city recreational facilities, including neighborhood parks and community trails. For example, a neighborhood access trail is planned along the south side of the Contra Costa Canal, outside of the project boundary. The combination of increased recreational facilities through the proposed action and surrounding development would result in a beneficial impact to recreational use, and no mitigation is required.

A separate project, the proposed Dutch Slough Access Park at the northeastern corner of the Dutch Slough Restoration Project site, proposes a boat ramp to Dutch Slough. The potential increase in watercraft from this boat ramp could increase potential conflicts with non-motorized watercraft in Emerson Slough, and Little Dutch Slough. Mitigation 3.11.1-1 would reduce this impact to a less than significant level.

SIGNIFICANCE AFTER MITIGATIONS

Less than significant

Alternative 2: Moderate Fill Alternative

Impacts to Recreation would be the same as under Alternative 1 (all options).

Alternative 3: Maximum Fill

Impacts to Recreation would be the same as under Alternative 1 (all options).

Alternative 4: No Project

The No Project Alternative would not result in an increase in recreational facilities to help meet the recreational needs of the City. The City would continue to be deficient in providing recreational facilities and public access to the Delta.

Table 3.11-1 Summary of Impacts to Recreation Resources for Dutch Slough and Related Restoration Projects

Impact	Dutch Slough Restoration Project	Related Projects	
		Ironhouse Project	City Community Park Project
Impact 3.11.1-1: Conflicts between Non-Motorized Watercraft and Motorized Watercraft	Potential conflicts within the Emerson Slough and Little Dutch Slough	No Impact.	No Impact
Impact 3.11.1-2: Temporary Effects on Recreational Access during Project Construction	Potential for restricted access including closure of the Marsh Creek Trail during construction	Potential for restricted access including closure of the Marsh Creek Trail during construction	No Impact.
Impact 3.11.1-3: Long-term Changes in Recreational Opportunities	Some conflicts between the groups of trail users (such as pedestrians, bicyclists and horse riders)	No Impact.	Some conflicts between the groups of trail users (such as pedestrians, bicyclists and horse riders)

Table 3.11-2 Summary of Mitigation Applicability for Dutch Slough and Related Restoration Projects			
Impact/Mitigation	**Dutch Slough Restoration Project**	**Related Projects**	
		Ironhouse Project	**City Community Park Project**
Mitigation 3.11.1-1 Watercraft Restrictions	X		
Mitigation 3.11.1-2: Minimize trail access restrictions and post restriction notices during construction	X	X	X
Mitigation 3.11.1-3: Provide signage and education on trail rules and etiquette	X		X

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3.12 - Cultural Resources

3.12 CULTURAL RESOURCES

This section addresses the cultural resources issues associated with the Dutch Slough Restoration Project. Cultural resources are defined as prehistoric and historic sites, structures, and districts or landscapes, or any other physical evidence associated with human activity for scientific, traditional, religious, or other reasons. These include resources considered important to contemporary cultures, subcultures, or communities that have been integral to the culture of that population for at least the past 50 years. Prehistoric resources of the Emerson, Burroughs, and Gilbert parcels were evaluated by DWR archaeologists in April 2004 (DWR 2004); the archaeological resources of the Ironhouse parcel were evaluated by Holman & Associates in September 2005 (Holman 2005). A detailed evaluation of historic architectural and landscape resources evaluation was prepared by Ward Hill, Marjorie Dobkin and Denise Bradley in 2006. Cultural resources evaluation forms and findings are on file at the Department of Water Resources offices.

3.12.1 AFFECTED ENVIRONMENT

Natural Setting

The Dutch Slough project area is located at the western end of the Sacramento-San Joaquin Delta in Contra Costa County, directly south of Jersey Island and just east of the city of Oakley. It is bound by Dutch Slough to the north, Marsh Creek on the west, Jersey Island Road on the east, and the Contra Costa Canal to the south. Two man-made channels, Little Dutch Slough and Emerson Slough, extend south off of Dutch Slough and divide the project area roughly into thirds to contain the Burroughs, Gilbert, and Emerson properties, from east to west, respectively. Acreage directly adjacent to Dutch Slough, particularly on the Emerson property, is below sea level and is protected from bay waters by the presence of a levee. In general the project area rises in elevation from north to south, from approximately 9 feet below sea level to 8 feet above sea level.

A vast majority of the project area is densely covered with non-native annual grasses and forbs, such as Bermuda grass and wild oats. The sloughs and canals within the project area support stands of willows and berry brambles. Fourteen acres of dry-farmed grapes are cultivated on high ground at the west edge of the Emerson parcel. The vineyard was planted in the early years of the 20th century. Lastly, numerous large, old cottonwoods grow on the Burroughs property. These trees were planted in the 1920s. Other ornamental plants have been planted around the Burroughs houses and ranch complex. The entire area has been subject to a great deal of modification.

PREHISTORIC CONTEXT

The project area lies in the Delta area of the Central California archaeological region. Archaeological resources strongly reflect those of the southern Sacramento Valley, which has been studied extensively and, thus, has a well defined chronological sequence. From these investigative efforts, three distinct patterns, the Windmiller, the Berkeley, and the Augustine, have been established to describe the area's prehistory (Moratto 2004).

The Windmiller Pattern dominated the region from approximately 5,000 to 2,500 years ago. Relative to subsequent periods, Windmiller subsistence appears to have focused largely on hunting, as evidenced by large quantities of faunal remains and projectile points in the archaeological record.

However, fishing and seed procurement were also evident. With regard to tool technology, both flaked stone and ground stone industries are well represented. Facilitating the acquisition of materials for tool and ornament production was a vast trade network, where obsidian was obtained from North Coast Range and eastern Sierran sources, shell beads from the coast, and quartz and alabaster from the Sierra foothills. The Windmiller Pattern is also characterized by distinctive burial patterns, with bodies typically buried fully extended, face down, with the head oriented toward the west, and the placement of funerary objects (Moratto 2004).

The Berkeley Pattern has been identified in the Sacramento Valley from approximately 3,600 to 1,000 years ago. This pattern is represented by an apparent increase in the use of pestles and mortars, which is thought indicative of an intensified reliance on acorns as a principal dietary staple. In addition, the Berkeley Pattern exemplifies a well-developed bone tool industry, distinctive diagonal flaking of large concave-base points, and marked forms of shell beads and ornaments. In contrast to the Windmiller pattern, Berkeley burials are found in a flexed position with variable orientation and fewer funerary artifacts (Moratto 2004).

The Augustine Pattern occurred in the Sacramento Valley from approximately 2,000 to 250 years ago. This pattern is distinguished by large populations with complex social systems that depended heavily upon fishing, hunting, and gathering. Tool technology is represented by shaped pestles and mortars, bone awls, the bow and arrow, and in some cases pottery. There was considerable variation in mortuary practices including flexed burials, cremation, and funerary object differentiation (Moratto 2004).

ETHNOGRAPHIC BACKGROUND

The project area lies within territory historically occupied by speakers of the Bay Miwok language (Bennyhoff 1977; Levy 1978). Little is known about this group due to the fact that they had been devastated by disease and missionization by the early 1800s; however it is thought that they held lands all around and including Mount Diablo, the south shore of the Carquinez Straits to the mouth of the San Joaquin River and a small portion of land north of Carquinez Strait at Benicia. Mission records indicate the presence of two tribelet centers in the vicinity of Dutch Slough: *Chupcan* near Antioch and Julpun located further to the east. There are no known ethnographic villages located in the immediate vicinity of the Dutch Slough project area.

HISTORIC BACKGROUND

Pedro Fages led the first Spanish exploration of the future area of Contra Costa County in 1772. During the Spanish period, the present-day Oakley area was under the control of Mission San Jose, which may have grazed sheep and cattle in parts of the project vicinity during the early 19th century, though the mission did not maintain a settlement on or near the project site.

After Mexico seceded from Spain in 1822, the Mexican government began making land grants to private citizens. The number of land grants increased substantially after the secularization of the missions enacted by the Mexican legislature in 1833. The government made 16 land grants in Contra Costa County including about half the present day county area.

In 1836 Jose Noriega received a land grant to the Rancho Los Meganos that includes present-day Oakley, Knightsen and Brentwood. In 1837 Noriega sold the 13,316-acre rancho to physician Dr. John Marsh, a native of Massachusetts who was the first prominent American settler in the region.

With the help of local Indian workers, Marsh established a cattle ranch with about 6,000 head of cattle. He also raised grain and had several vineyards and fruit orchards. From that time the Rancho Los Meganos was also known as the Marsh Rancho (Smith and Elliott 1879: 11;Historic Record Company 1926:166,381).

California's isolation from Mexico and the increasing number of Anglo-American settlers culminated in the 1846-47 war with Mexico. In 1848, California became a United States territory through the Treaty of Guadalupe Hidalgo which ended the war. California remained a U.S. territory from 1848-1849 and was not formally admitted as a state of the union until 1850. Contra Costa County was one of the original California counties created by the state legislature after 1850. Contra Costa originally included all of present day Alameda County which became a separate entity in 1853.

Throughout the 19th and for much of the 20th century, Contra Costa County maintained its rural character as a place of small farms and country homes. Despite the presence of squatters starting in the 1850s, it was not until the 1870s that permanent homesteaders settled in the Oakley and Knightsen areas.

The Gold Rush of the late 1840s and early 1850s brought a massive influx of immigrants to California from all parts of the world. California's 1848 population of less than 14,000 (exclusive of Indians) increased to 224,000 in four years. In 1847, the ferry service across the Carquinez Straits from Martinez to Benicia became an important route to the gold fields for those traveling from San Francisco.

As more and more gold seekers became discouraged with mining, they turned to farming as a livelihood. Farmers started to raise crops and livestock for a commercial market, rather than family consumption. In response, during the late 1860s, construction of the Sacramento-San Joaquin Delta levees began in an effort to prevent flooding on some of the most fertile farmland in the nation and to remedy the rising riverbeds resulting from increased silt deposits due to hydraulic mining (Department of Water Resources Levee Repair – History of Levees 2008). The project properties were drained and leveed in the mid to late 1800s in support of agricultural ventures. The entire Dutch Slough Restoration Project area has supported dairies for nearly 100 years. As a result, numerous dairy-related structures exist within the property along with homes and other associated out-buildings. Histories for each of the Burroughs, Gilbert, and Emerson dairies follow.

BURROUGHS DAIRY

The Burroughs Bros. Dairy was founded by Benjamin Burroughs and his brothers Willis and Ernest Burroughs, who purchased 320 acres of ranch land in the project area in about 1905-1907. The Burroughs brothers had started a small dairy operation and bottling plant in Oakland in the early 1900s. The Burroughs brothers also had a milk processing plant in Stockton from 1931 to 1964. In 1964 the Burroughs retail milk delivery business was sold to Crystal Dairy of Sacramento, although the ranch continued operating until 1977.

The first home on the ranch, the "Tule House," or "two Tule cabins, linked together." This house was remodeled in the summer of 1910. The house had a cozy wood stove and an indoor bathroom. Water was piped in from the slough, which they boiled and filtered for drinking. Other buildings in the early years included a windmill house, barn, men's quarters, coal and wood shed.

After the flood of 1909-1910, the family kept the dairy going on 80 acres behind a levee in the southwest corner of the ranch. The levees were built by a horse drawn "scraper". The flooding of Marsh Creek in the fall and winter of 1910-11 was a ranch emergency. Benjamin and his wife Edna were marooned by floodwater at their small ranch house, and evacuated by "a derelict but sturdy scow" manned by a local rancher, Joaquin Jose.

Benjamin Burroughs was a prime mover in the organization of Reclamation District 799 (RD 799), established in 1910, which won state support for construction of more effective levee and pumping systems. Benjamin Burroughs was the first secretary of RD 799. Levees were built by the Reclamation District, and paid for by assessments to property owners. RD 799 (still operating) is one of eleven in Contra Costa County, and 135 in California that were formed under the 1885 California Swamp and Overflowed Act. RD 799 was one of many formed in the early 1900s to finance reclamation of lands by building levees and operating drainage pumps to take water off the land behind the levees. These levees and drainage systems that have made it possible to farm the Delta's rich peat soil.

The work of the Reclamation District allowed the Burroughs family to return to the project area in March, 1913, with their one year old son Renny. Edna Burroughs explained the state of California's support for RD 799 was crucial to the survival of the ranch. In 1913, soon after Benjamin and Edna Burroughs returned to the project area, Edna's parents the Nelsons came to live on the ranch and started building themselves a cottage in 1914, which still stands. They lived there for ten years.

The Burroughs Bros. ranch in Knightsen made significant progress during the World War I period. In the 1920s the ranch got electricity from the Reclamation District, which provided power to pump the water and run ranch machinery, replacing the old coal or wood fired pumps. New telephone service gave them peace of mind in winter flood season. Electrical power made Edna Burroughs' housework much easier. They had lights, electric heat instead of a coal stove, a washing machine, a refrigerator instead of a cooler, and an electric iron instead of the red-hot stove. By the mid 1920s the ranch made the transition from horse drawn transportation to cars and trucks.

By 1926, the Burroughs Bros. dairy farm in Knightsen was a success, and prominently featured in The Historic Record Company's 1926 History of Contra Costa County (Historic Record Co. 1926:172-73). The Historic Record Company's 1926 profile mentioned a "modern residence" on the ranch, the dairy main ranch house still standing today. After the Burroughs family moved to the big house, the ranch manager Will Olds and his wife, Lois, and their three children took over the old family ranch house, or Tule House, which they relocated to and renovated in the mid 1920s. They also had boarding house for the ranch men's quarters.

After Benjamin Burroughs' death in 1942, his sons Ernest and Oscar took over the family dairy business started by their father and uncles. Ernest Burroughs succeeded his father Benjamin as Trustee on Reclamation Board 799. In 1946, Oscar Burroughs acquired the adjacent ranch (now the Gilbert Ranch), significantly expanding the Burroughs Brothers Dairy. The two Burroughs Bros. ranches merged operations after 1946, and were linked by a new bridge and road. Ernest married Mary Loo Sanders of Hollister in 1947 and the following year the young couple moved into the big family house. Edna Burroughs, Ernest's mother, lived in a small adjoining house, and divided her time between the Knightsen ranch and her son Oscar's ranch in Orland. Ernest and Oscar ran the Burroughs Bros. Dairy in Knightsen until 1977 (Burroughs 2006). Edna Burroughs lived on the ranch until her death in 1982, at age 98.

Ernest and his family moved to Denair, near Turlock, in 1979, on a dairy ranch now operated by their sons. His wife Mary Loo died there in 2004. Ernest gave the ranch to his children. His daughter Katy Burroughs Treat moved into the big ranch house in 1985 with her husband Rob. The Burroughs family decision to sell the Knightsen ranch to the state was especially difficult for Katy Burroughs Treat, who was still living at the family house in 2004.

CENTRAL SHUEY/GOLDEN STATE DAIRY

The present-day "Gilbert" parcel was known as Babbe's Landing in the late 19th century, and became a horse rehabilitation ranch in the 1890s. During the first half of the 20th century it was a 294-acre commercial dairy ranch, changing ownership several times. Before the coming of the Santa Fe Railroad in 1900, most of the dairy products, asparagus, celery, and hay grown in the Oakley and Knightsen area had been shipped to San Francisco from Babbe's Landing, on a dredged channel off Dutch Slough at the north end of Sellers Road (the site of the present day Gilbert property). Fred Babbe was a Prussian-born settler of the area who came to California during the Gold Rush and bought a 300 acre farm in the project vicinity in 1854.

In about 1895-1897, Babbe's property became a horse rehabilitation ranch, Brentwood Stock Farm, owned by Henry Dutard, a San Francisco grain and commission merchant. The ranch was known as a horse sanitarium where cart horses could be treated for injuries sustained from treading on cobblestone streets in San Francisco. The farm was also used for breeding race horses. There were paddocks, stables, and houses for ranch staff. The large 1896 house on the property appears to date from the horse ranch period. The house was later the Oscar Burroughs family home from 1946-1986.

In about 1915, the Brentwood Stock Farm site became a commercial dairy ranch. The property had several changes of ownership in a brief period, but many of the older dairy buildings still standing today were built by Oakland's Central-Shuey dairy company in the early 1920s and its successor company, San Francisco-based Golden State Milk Co. in the 1930s.

The Central Shuey Dairy was founded by Robert A. Shuey. By 1930 the Central-Shuey Creamery had merged with a big statewide dairy company, Golden State Milk Products Co., headquartered in San Francisco. Official maps of Contra Costa County show Central Shuey as the owner of the "Gilbert" parcel in 1930, and Golden State Co. Ltd. as the owner in 1938. According to local historian Kathy Leighton, Golden State enlarged the dairy ranch in the project area. The property was acquired by San Joaquin Farms, owned by Turnbull and Gray, in the late 1930s, then sold to the Kenner brothers of Utah. County historian May Purcell described the parcel in 1940 as owned by San Joaquin Farms in her history of Contra Costa County, noting it was one of the prominent dairies in the region at the time (Leighton 2001:249; Purcell 1940:212).

In 1946, Oscar Burroughs acquired the adjacent Golden State Dairy property as an expansion of the Burroughs Bros. Dairy. His brother Ernest Burroughs lived with his family on the Burroughs house built by their parents. Shortly afterwards, operations were merged and the properties connected by road. Oscar Burroughs and his wife Emogene "Genie" Nelson Burroughs, who had married in 1941, moved to the 294-acre property in Knightsen in 1946. Oscar Burroughs owned the ranch in the project area until 1986, when he sold it to the Gilbert family, the current owners.

EMERSON DAIRY

The Emerson Dairy, located on a 625-acre parcel in the town of Oakley, in eastern Contra Costa County, was established by the Emerson family in 1913, on ranch property they had owned since the 1850s. The various generations of the Emerson family acquired the 625-acre ranch through several acquisitions over decades, starting with Silas B. Emerson, a native of Harrison County, Maine, who arrived in California in 1849. According to his grand-nephew Ralph Emerson, Silas Emerson "was not interested in gold but in land," and he obtained substantial property in Mountain View. Frank and Edwin were the sons of Carlos Emerson, Silas' younger brother. Carlos Emerson settled in California in 1869 and became a co-owner with his brother Silas of part of the Emerson Ranch in the project area (Stan Emerson 2006; Ralph Emerson, 1974; Katy Emerson 1984:82-83).

The first generation of the Emerson family in California - Silas Emerson and his brother Carlos Emerson - did not live or work on the ranch. Carlos Emerson's sons Edwin and Frank first developed the Emerson Dairy in 1913 with 30 cows. Day-to-day operations were run by a tenant farmer, Frank Holdener, who leased the ranch buildings. Typically, owners would pay for all ranch buildings such as barns and milk houses, and all other facilities except for maintenance of the tenant's personal property (Stan Emerson 2006).

When Edwin and Frank Emerson began their dairy ranch in the project area, the land was raw and undeveloped. The ranch's proximity to Dutch Slough and the San Joaquin River required levee construction and water pumps for flood control. The Emersons established the first levees on their property, continuing to maintain them as a private family enterprise throughout the years. The Contra Costa Canal which runs through the Emerson property was built by the County in 1941 (Ralph Emerson 1974; Stan Emerson 2006).

There are two surviving 1913-era buildings on the property – a hand-milking barn and a horse stable. The milking barn was large enough to accommodate 186 cows. Dairy workers in California typically milked cows by hand until the 1920s and the 1930s, when dairies began using milking machines. The machines had been invented in the 1870s but did not become popular until the 1920s. In the 1860s and the 1870s, in Marin County and other dairy regions of California, dairy cows were milked outdoors, in special milking corrals. Big wooden milking barns such as the one on the Emerson Dairy ranch were a later development typically not built until the 1880s and 1890s (Livingston 1994:56).

The 1913-era horse barn on the Emerson Dairy was laid out to accommodate a string of work horses on each side and hay and alfalfa in the middle. Clydesdale horses were used as draft animals in late 19th and early 20th century farms in Contra Costa County and throughout the Delta. They were used in dairy and row crop farming until the early 1930s. The horses were, however, slow workers. Barn maintenance was costly, and horse feed requirements took land out of cash crop production (Stan Emerson 2006; Thompson 1957:400).

Frank Holdener, the tenant farmer at the Emerson ranch, may have lived in a house near the old dairy barn that was later used as a ranch cookhouse. The cookhouse dates from about the 1920s (Stan Emerson 2006).

Ralph L. Emerson was the first Emerson family member to establish a homestead and raise a family on the ranch. Ralph and his wife Ione moved to the ranch in the early 1930s. At the time the dairy had about 100 cows and five or six ranch hands. Ralph and Ione Emerson raised their sons Stan and Dale in the 1925 house still standing on the Emerson property. To build the 1925 house, Ralph's father-in-law, a carpenter, tore down an older, larger, two-story house on the same site, formerly used as a residence for ranch hands. Nearby is a 1940s-era quarantine barn built by Ralph Emerson to isolate sick cows during a tuberculosis outbreak (Stan Emerson 2006; Ralph Emerson 1974).

In 1941, Ralph Emerson also replaced the 1913 milk house used for milk storage that was adjacent to the 1913 dairy barn. The milk house has cement sides and foundation, and was built according to sanitary regulations with plaster inside. This was where milk was carried from the barn, and where it was filtered, stored and refrigerated (Stan Emerson 2006).

During the tenure of both Ralph and Stan Emerson, the family dairy sold filtered, un-pasteurized milk to dairy cooperatives, which then processed it and sold it to a variety of sources, including big companies such as Carnation and Nestle. The milk was trucked from Emerson Dairy in 10-gallon cans, in contrast to the neighboring Burroughs Bros. Dairy, where milk was bottled on the ranch, and distributed through retail milk routes (Stan Emerson 2006).

In the 1930s, Ralph Emerson hired many ranch hands who were Dust Bowl refugees from Oklahoma and Arkansas. During World War II and in later years, when able-bodied male workers were scarce, Emerson sometimes hired men from Stockton's Skid Row, as did the Burroughs Bros. Dairy (Stan Emerson 2006; Ernie Burroughs 2006). The dairy workers lived on the Emerson property in the worker housing across from the dairy barn. The oldest part of the ranch bunk-house with four units dates from the early 1940s; later additions to the bunkhouse date from about the 1960s.

The Emerson dairy operation eventually occupied about 614 acres of the total ranch property, but throughout the years the Emersons also grew feed and silage – alfalfa and corn—as well as commercial farm crops including almonds, walnuts, asparagus, soy, asparagus, and oats. There is also a vineyard on the northwest corner of the property. It was established almost 100 years ago by a Basque or Portuguese rancher, Joaquin Jose. The Emersons bought the 70-acre vineyard parcel from Joaquin Jose in the 1950s. The middle section of the ranch, about 100 acres, was irrigated in the 1950s and the 1960s. An engineer hired by Ralph Emerson built a system of buried water pipelines. Until then, the ranch had been dry-farmed (Stan Emerson 2006).

Ralph Emerson's sons Stan and Dale grew up working on the dairy farm, which by then had about 600 Holstein cows, and both sons continued the dairy business after their father's retirement in 1960.

After his marriage in the early 1960s, Stan Emerson and his wife Katy lived in a remodeled 1896 school house, the former Ironhouse School, situated at the intersection of Sellers and Cypress Roads. Silas and Carlos Emerson had donated land for the school to Contra Costa County in 1885, with a provision that the land would revert to Emerson family ownership if it were no longer used for a school. After the school closed in 1935, Ralph Emerson remodeled the school house as a residence for Emerson Dairy foreman, Glenn Yoder, and his family. In 1962, Katy Emerson planned the second remodeling of the schoolhouse, as a residence for her own growing family. The Emersons moved into the schoolhouse in 1963, just before the birth of their first child. In 1972 the former school house was moved from its location one quarter of a mile back from Cypress Road to a knoll on the Emerson Dairy property, where it still stands, between the Ralph Emerson house and the quarantine barn (Katy Emerson 1984: 5-6, 49-50, 83-85).

A modern, open 32-stall milking barn was built on the Emerson Dairy in 1979. Cows were brought there for milking from big free-stall barns built in the 1970s and 1980s; each free-stall barn housed 400 cows. The 100 by 400 foot free stall barns allowed cows to either stand or lie down on a pile of sterile compost. The compost was made from the cows' manure, which was flushed down a concrete stall in the free stall where it was dried for use both in the stalls and in fertilizer. Three of the free-stall barns have been torn down. Calves were born year-round in a ranch corral known as the freshening pen.

By the 1990s, the Emerson Dairy had grown into a highly productive 2000-cow milking operation with 35 to 40 ranch hands, most of them employed year-round. The increase in production was achieved not only through expansion of the herd, but through state-of-the-art modern equipment purchased in 1980 that allowed more intensive milking. By 2001, the dairy was producing about 20,000 gallons of milk a day.

Stan and Katy Emerson raised three sons on the dairy ranch – Patrick, Michael, and Christopher; all three sons moved to the city to pursue other careers. When Emerson Dairy closed in 2002, after 89 years of continuous operation by four generations of the Emersons family, it was the last dairy ranch in Contra Costa or Alameda Counties. The property is now owned by Emerson Properties, Inc., a California corporation that is co-owned by Stan and Dale Emerson.

Study Methods and Results

ARCHAEOLOGICAL RESOURCES

ARCHIVAL RECORDS SEARCH

An archival record search was conducted for the project area at the Northwest Information Center of the California Historical Resources Information System, Sonoma State University, on March 12, 2004. The purpose of the search was to identify any previously recorded cultural resources within ¼ mile of the project parcels and to determine if any of the properties had been subject to previous cultural resources studies. Other sources reviewed for the archival study included the National Register of Historic Places (United States Department of the Interior, with updates through June 2008), the California Register of Historical Resources (CAL/OHP listings through June 2008), the *California Inventory of Historic Resources* (CAL/OHP 1976)*, California Points of Historical Interest* CAL/OHP 1992)*, California Historical Landmarks* (CAL/OHP 1996) and the *Historic Properties Directory* file for Contra Costa County (CAL/OHP 2006), as well as historic maps of the area. Furthermore, letters were also sent to the Contra Costa County Historical Society and the Antioch Historical Society regarding any concerns they may have pertaining to cultural resources within the project area.

The records search indicated that no cultural resources had been previously recorded within the proposed project area. The search did, however, identify ten cultural resources inventories that had been conducted within or directly bordering the project acreage. Most of these surveys were for linear projects such as pipelines and canals, but one survey (Baker 1985) involved all 320 acres of the Gilbert property located in the center of the Dutch Slough Restoration Project.

NATIVE AMERICAN CORRESPONDENCE

The Native American Heritage Commission (NAHC) was contacted on March 1, 2004 to request a search of their files regarding sacred sites or locations of cultural importance to local Native American communities. Three members of the Native American community, identified by the NAHC, were contacted by letter to solicit input about the project. The NAHC reported that no Native American cultural resources were known to exist within the project boundaries. One telephone response was received from one of the Naïve American community members contacted. The concern was about the status of the environmental document.

FIELD METHODS

An archaeological survey of the project area was conducted by DWR archaeologists in March 2004. Survey efforts included pedestrian transects spaces 20 to 30 meters apart. The study focused on acreage of Piper and Delhi Sands at elevations above sea level, although not all areas above sea level were examined. A little more than 90 acres were subject to pedestrian survey. Areas above sea level that were not surveyed included acreage that had clearly been subjected to a great deal of disturbance, such as leveling, or were covered with impenetrable vegetation. All of the knolls within the project boundaries exhibited evidence of disturbance, from extreme leveling to the construction of dairy facilities or ranch buildings. Because the Gilbert property had been previously surveyed (Baker 1985), it was not re-examined. Portions of the project area were again visited by DWR archaeologists in July 2008 to confirm the 2004 findings.

The Holman & Associates archaeological survey of the Ironhouse parcel included a literature review and site inspection. The Ironhouse parcel was inspected with 30-meter transects; in all, less than 50% of the parcel was subjected to adequate visual inspection due to dense standing and/or mowed hay. Soils throughout the parcel consisted of a grey-brown loam with scant amounts of native rock. The surveys discovered no evidence of prehistoric and/or historic resources on the Ironhouse site and concluded that development of the site "will have no effects on cultural resources" (Holman & Associates, September 2005).

RESULTS: ARCHAEOLOGICAL RESOURCES

The field study identified no archaeological resources on the Gilbert, Emerson, or Burroughs parcels (DWR 2008).

HISTORIC RESOURCES

ARCHIVAL RECORDS SEARCH

Pre-field sources consulted included the *Preliminary Historic Resources Inventory, Contra Costa County, California* (CAL/OHP 1976)*; National Register of Historic Places* (United States Department of Interior, 1991, and California Office of Historic Preservation updates to 1996), *California Inventory of Historic Resources* (CAL/OHP 1976), *California Historical Landmarks* (CAL/OHP 1996) and the California Points of Historical Interest (1992). Other sources consulted later included: the *Historic Properties Directory* for Contra Costa County (CAL/OHP 2006) with the most recent updates of the National Register of Historic Places; California Historical Landmarks; and, California Points of Historical Interest as well as other evaluations of properties reviewed by the State of California Office of Historic Preservation; *The California History Plan* (CAL/OHP 1973); the *Revised Preliminary Historic Resources Inventory, Contra Costa County, California (1989)* and, the *Contra Costa County Map of Historical Points of Interest (*CCCoHS 1994).

Research also was conducted at the following historical archives: University of California, Berkeley Libraries: Bioscience and Natural Resources Giannini Foundation of Agricultural Economics, Earth

Sciences Map Collection; San Francisco Public Library, Government Documents; San Francisco History Room, Periodicals; East Contra Costa Historical Society; Contra Costa Historical Society; Contra Costa County Public Library, Pleasant Hill; the Office of the Contra Costa County Assessor; and, the Oakland History Room, Oakland Public Library. Interviews were conducted with numerous individuals who had expert knowledge of the area.

FIELD METHODS

Field work for historic resources within the project area was conducted in the spring and early summer 2006 (Hill and Dobkin 2006). This included a tour of the structures with property owners Stan and Chris Emerson, and with Ernest Burroughs. All structures to be evaluated were physically examined and photographed; written descriptions were prepared of all buildings evaluated for the study. Each resource was recorded on California Department of Parks and Recreation record form 523.

RESULTS: HISTORIC RESOURCES

BURROUGHS PARCEL OVERVIEW

The Burroughs parcel is bounded by Jersey Island Road on the east, Cypress Road on the south, Little Dutch Slough on the west and Dutch Slough on the north. The buildings are located approximately at the center of the parcel. The Burroughs property's spatial organization includes two main clusters of buildings: the farm cluster and the housing cluster. The farm cluster includes a modern open shed for storing hay, an adjacent shed, a corrugated metal barn, a milking shed with a large circa 1960s addition, two wood-frame silos and shop/office building. North of the farm cluster is the housing cluster, that includes eight buildings: a large Colonial Revival style house, a Bungalow style house, a small remodeled house and a bunkhouse. The cluster includes a barn, new and old vehicle sheds and a wash house. All these buildings are within the project area of the Dutch Slough project.

BURROUGHS PARCEL DAIRY FARM CLUSTER

Access to the dairy building complex is from a gravel driveway perpendicular to Jersey Island Road, continuing west about 0.5 mile to the buildings. Several large trees are adjacent to the south side of the road. The first building approached from the driveway is the wood-frame rectangular plan office/refrigeration building with a three part hipped roof covered with asphalt shingles. The building was constructed in 1915. The exterior walls are rustic siding. The building has a corrugated metal covered addition on the south. The main (east) façade has an entrance porch with projecting porch roof supported by 6 wood posts set on a concrete pad. The dairy office is on the north side of the building. The adjacent spaces were for storing milk and other items related to the dairy operation. A heavy hinged door opens into the refrigeration unit; two sliding wood doors are to the south. The windows in the building (some are not boarded over) have been replaced with aluminum sliders.

Just west of the office/refrigeration building are two cylindrical wood-frame feed silos (approximately 20 feet in circumference). West of the silos was a large, rectangular plan (68 by 34 feet), wood-frame hay barn with a gable roof and corrugated metal walls. The barn collapsed in 2008 thus it no longer retains historic integrity. A cylindrical silo covered with corrugated metal is adjacent to what was the west façade of the barn.

Southwest of the hay barn, the hospital barn (circa 1915) is a square-plan, wood-frame building with a gable roof covered with corrugated metal. The building has a high concrete foundation. The exterior walls are covered with horizontal boards; a single sliding door is on the east facade.

The dairy barn or milking shed (constructed in 1915) just north of the hay barn is an approximately square plan (100 by 100 feet), wood-frame structure divided into two sections under double parallel gables covered with corrugated metal. A corral area is adjacent to the north. The building has four sliding doors on the north and south façades. A large square opening (covered with plywood on the north) is under the gable of the western section. The east façade, rebuilt in concrete block, was likely constructed in the 1960s along with the rectangular plan, concrete block addition, which extends to the east. The addition housed the bottling, refrigeration and processing facilities. The interior of the dairy barn is divided into aisles oriented north/south for milking the cows. The aisles are divided by the interior structural posts and tube steel stanchions used for holding the cows during milking.

BURROUGHS PARCEL HOUSING CLUSTER

A road, now abandoned, from the dairy complex continued northwest to two barns (no longer extant) originally south of the housing cluster. Wind-rows of trees are planted along this road as it continues north to the housing cluster. East of this road, the main road (still extant) from the dairy cluster continues north about 0.5 miles to the housing cluster. The main road first approaches the two-story, main farm-house, then continuing north in a loop to the other buildings in the housing cluster. A number of large trees are in the vicinity of the three houses and the bunkhouse in the housing cluster. The rectangular plan (38 by 31 feet), wood-frame, Colonial Revival style main house has steeply pitch gable roof covered with asphalt shingles. Inside, the house has a first floor living room, dining room and kitchen and a second floor with four bedrooms.

The single-story, apartment addition has clapboard siding and a gable roof matching the main house. Built in 1947 for Edna Burroughs, the addition is a separate living unit with its own living room, bedroom and kitchen. The addition has its main entrance on the north façade with a shed roof over the porch. A side-recessed porch is on the west façade of the addition. A modern porte-cochere and a side door are on the east facade of the main house.

In back of the main house to the north is the small, wood-frame, rectangular plan (about 12 by 20 feet) wash house for washing and drying clothes.

Two houses are adjacent and west of the main house. The wood-frame, single-story, rectangular plan (28 by 35 feet) Bungalow style house near the main house has a gable roof with wide eaves. Built in 1914 for the Nelson family, Edna Burroughs's parents, the house has a front yard enclosed by a wood picket fence. A single-car, wood-frame garage with a gable roof and rustic exterior siding is just south of the house.

A small, simply detailed bunk-house is just west of the Nelson's house. The building housed 4 dairy workers according to Ernest Burroughs. Obscured behind trees and vegetation, the wood-frame, rectangular plan building has a gable roof and exterior walls covered with rustic siding.

Northwest of the main house and bungalow is a c. 1900 house moved to this site in the 1950s and extensively remodeled (Burroughs 2006). The rectangular plan, single-story, stucco-sided, wood-frame house has a steeply pitched gable roof.

Across the driveway from the remodeled house is a large horse barn probably constructed in the 19th century, then later remodeled by the Burroughs family. The wood-frame, rectangular plan (51 by 64 feet) barn has a steeply pitched gable roof covered with corrugated metal.

Across from the barn is a long, L-shaped vehicle shed/shop/garage with a shed roof and exterior corrugated metal walls. A two-car, wood-frame garage with a gable roof and board-and-batten siding extends south facing the main house. A modern corrugated metal vehicle shed is east of the old vehicle shed.

A bunkhouse, dairy office and cook house originally included on the Burroughs property were moved to site on Jersey Island Road outside the project area. The buildings were moved in the late 1940s after the Burroughs Brothers acquired the adjacent parcel from Golden State Dairy.

GILBERT PARCEL OVERVIEW

The Gilbert parcel is bounded by Dutch Slough on the north, Emerson Slough on the west, Little Dutch Slough on the east and the Contra Costa Canal on the south. At the northern end of Sellers Avenue after crossing the Contra Costa Canal, a gravel driveway leads north to main building complex. Continuing north, a corral area is on the left and dairy barns and related buildings on the right. Oleander trees are along the main road to the main house. The road ends in a loop at the housing area circling around the main house adjacent to the boat landing on Emerson Slough north of the house.

The Gilbert property includes a large complex of 15+ buildings. One building separate from the densely built-up main complex is a large 1960 barn about a 0.5 mile to the north an area (up to Dutch Slough) that is otherwise open fields. This barn is located on the project site for the Dutch Slough project; all other buildings, as described below, are on the project site for the City of Oakley Community Park.

The Gilbert property's spatial organization includes two main clusters of buildings: the housing cluster and the diary farm cluster. Major landscape features at the Gilbert property include its circulation system, the concrete boat launch at the south end of Emerson Slough, the buildings and structures (main house, worker housing, farm buildings) and their spatial organization, fields, fencing, ditches and levees, low retaining wall that defines the edge of the front yard, and vegetation.

GILBERT PARCEL HOUSING CLUSTER

The housing cluster includes the main house, the caretaker’s house, two additional single-family houses, the bunk-house (worker housing)/cook house, the cook’s house and a vehicle shed.

The large main house, set off west of the driveway in a large lawn with perimeter palm trees, is a mid-1890s Queen Anne style building. The landscaping in the vicinity of the house includes the grass lawn around the house; palm trees along the east edge of Emerson Slough; palm and pepper trees along the east edge of the yard around the house; roses along the east edge of the yard; foundation plantings in front of the main house; palm trees flanking the boat launch into the slough; a magnolia tree and a sycamore tree in the yard of the main house; and walnut trees south of the main house.

The square plan (40 by 45 feet), single-story, wood-frame house has a moderately pitched hipped roof covered with projecting gables on the north, south and east facades. Two brick chimneys project above the roof at the ridge. A porte-cochere on the east façade joins the house to a two car garage built in 1947. The garage is a single-story structure with a gable roof.

To the east of the main house across the main road are two additional single-family houses: the old caretaker's house and a modern house in the Ranch House style. The single story, H-shaped plan Ranch House style house was built in 1947-48 for Ernie Burroughs's aunt Leola (i.e. his mother's sister) (Burroughs 2006). The house is set in a yard with a lawn and a perimeter wood picket fence.

The small vernacular house east of the main house (and south of the 1947 house) is known as the caretaker's or dairy manager's house. This house likely dates from 1890s, the period when the main house was constructed. The square plan (about 30 by 30 feet), wood-frame, single-story house has a gently pitched hipped roof with shallow plain eaves. A detached single-car garage is adjacent to this house. The garage appears to date from the 1920s.

A long, rectangular plan, circa 1930s vehicle shed, with exterior walls covered with vertical wood boards and gabled roof covered with rolled roofing, is just north of the 1947-8 house. The cook's house is at the eastern end of the shed and just north of the worker's dining room and housing. The cook's house is a small, square plan, wood-frame structure with a shed roof.

The multi-unit worker housing building or "bunk-house" with an attached cook house for serving meals dating from the early 1930s housed apartments for 20 workers (Burroughs 2006). The bunk-house is a long, rectangular plan (116 by 25 feet) structure with a cross gable roof. There are pepper and walnut trees around the worker housing. The building has stucco exterior walls. The cook-house and dining room extends east about 40 feet from the bunk house. The cook-house resembles the bunk house with its cream colored, stucco walls, gable roof and wood-sash, double-hung windows. A modern 1970s concrete block building just south of the worker housing was a sitting and rest area for the dairy workers (Burroughs 2006). A small wood-frame single-family house with a gable roof and rustic siding is sited to the east of the housing cluster. Workers also resided in this house (now very deteriorated), moved to this location by the Burroughs family (Burroughs 2006).

GILBERT PARCEL DAIRY FARM CLUSTER

An east/west road separates the housing cluster on the north and the dairy farm cluster to the south. The dairy farm cluster includes two hay barns, two vehicle sheds, the old dairy barn, two modern dairy milking structures, the office/milk house, two concrete grain silos, and modern open milking shed, vehicle shed and hay storage shed.

Across from the bunk house to the south is a large hay barn with a gable roof covered with corrugated metal and walls covered with vertical wood planks of varying widths. In addition to the main house and caretaker's house, this barn dates from the mid-1890s, one of the few surviving buildings from the Brentwood Stock Farm period.

A long vehicle shed is just west of the barn. The wood-frame shed with a concrete foundation has a gable roof covered with corrugated metal. A second smaller vehicle shed is just east of the main vehicle shed. The small vehicle shed has a gable roof covered with corrugated metal and the exterior walls are covered with vertical wood boards. A shop/storage area on the east is enclosed with wood boards. The area to the west is open spaces for vehicle parking.

South of the small vehicle is a second large hay barn. The tall wood-frame barn has a steeply pitch gable roof covered with corrugated metal. The exterior walls are vertical wood planks on the east and west; the north wall is covered with corrugated metal.

The adjacent dairy barn (also known as a milking shed) south of the hay barn is wood-frame, square plan (about 110 by 110 feet) structure with four shed roofs with roof monitor windows. The building dates from the early 1920s. The building has a high concrete perimeter foundation with horizontal wood siding. A concrete-block milking shed is adjacent to the old dairy barn on the north.

West of the old dairy barn are two tall cylindrical concrete feed silos and the office/milk house (refrigeration) building. These structures also date from the 1920s. The rectangular plan (36 by 60 feet), single-story, wood-frame office/milk house has a flat roof. South of the dairy barn are additional buildings related to the dairy operation including a modern (1970s) open metal hay/vehicle shed and a large, open air steel-frame milking shed.

EMERSON PARCEL OVERVIEW

The Emerson property in the project area is flat or gently rolling grasslands north of the Contra Costa Canal. The buildings on the Emerson dairy farm are organized into two complexes north and south of the Contra Costa Canal. North of the Canal, the dairy cluster is in the area planned for the City Community Park Project area. The Emerson houses and one barn are south of the Canal in the area of the Dutch Slough Properties Project. All of these buildings are located within the project area for the City of Oakley Community Park.

EMERSON PARCEL HOUSING CLUSTER

A driveway perpendicular to Sellers Road leads west to the two Emerson houses and a barn used for quarantining cows with tuberculosis. The dirt road has a number of small trees along its length. Perpendicular to the main driveway, a road to the north continues to the barn (southeast of the house) and the first Emerson house (the original 1896 Ironhouse School), looping back to the main driveway. The rectangular plan (with a gabled extension on the west), wood-frame, 1940s barn is set on a high concrete foundation. The barn has a central gable with shed roofs over the side wings. The wood-frame, rectangular plan house northwest of the barn has a white picket fence adjacent enclosing the front yard. The house has a main, two-story, cross-gable roof. A fence encloses the modern swimming pool, an adjacent modern pool house and a modern wood-frame, detached garage is east of the house.

The second house (1925 Ralph Emerson house) is at the western end of the main driveway. The rectangular plan, wood-frame house has a gable roof covered with asphalt shingles. The exterior walls are covered with vertical wood siding. The front façade has a center entrance porch below an extension of the main roof supported by turned posts (the wood ramp to the entrance is a later addition).

EMERSON PARCEL DAIRY FARM CLUSTER

The Emerson dairy complex (approximately a half mile to the north of the houses) includes five older buildings - the dairy barn, a horse stable, worker housing, a large vehicle shed – a couple of modern structures (milking shed and hay storage) related to the dairy operation. Access to the dairy buildings is from second dirt road perpendicular to Sellers Road, immediately after it crosses the Contra Costa Canal.

Across from the circa-1930 vehicle shed are the stable and the dairy barn, both built in 1913. The wood-frame stable has a rectangular plan and a steeply pitched gable roof covered with corrugated metal. The south façade retains its original vertical wood boards; the side facades are partially stucco. The gabled milk house and other ancillary facilities are housed in the long, rectangular structure connected to the north side of the dairy barn.

The worker housing (early 1940s) east of the dairy barn is a long, rectangular wood-frame structure with a series of doors and flanking windows opening into the individual apartments on the west facade. The 1920s cook-house northwest of the worker housing is a square plan, wood-frame building with a hipped roof. The exterior walls are covered with stucco and the windows are modern.

HISTORIC STRUCTURE EVALUATION

The main house on the Gilbert property and the main Burroughs house appear to be eligible under California Register Criterion 3 as distinguished examples of farmhouses of their styles (Queen Anne and Colonial Revival) and periods in Eastern Contra Costa County. Both houses retain high levels of historic integrity. The periods of significance would be the construction dates for the two houses: 1895 for the Gilbert house and 1926 for the Burroughs house. The main Gilbert house is proposed to be preserved as part of the City Community Park. The main Burroughs house is on the site of the Dutch Slough Restoration Project.

The former Ironhouse School (Emerson house) is on the California History Plan (CAL/OHP 1973:55) and California Inventory of Historic Resources under the theme of Social/Educational (CAL/OHPO 1976:209, 229), is listed on the Revised Preliminary Historic Resources Inventory of Contra Costa County as a "Structure of Historical Significance" (CCCo/CDD 1989:East Contra Costa area), and is on the Contra Costa County Map of Historical Points of Interest places (Contra Costa County Historical Society (CCCoHS) 1994:#148). Ironhouse School is listed on the Historic Properties Directory (HPD) on Cypress Road in Brentwood [sic] as a "code 7, Not evaluated for inclusion on the National Register of Historic Places or the California Register of Historical Resources or needs reevaluation." The HPD assigns Number P-07-000903 to the school (CAL/OHP 2006). The extensive alterations to the Ironhouse School since it was moved in 1973 have compromised its historic integrity, thus it does not appear to be eligible for the California Register. This structure is currently located off the project sites and is proposed to be moved onto the City Community Park site.

None of the other buildings in the Dutch Slough Restoration Project area or City Community Park area appear to be architecturally significant as building types, thus they do not appear to be significant under California Register Criterion 3. Historically, the members of the Emerson and Burroughs families do not appear to be sufficiently significant figures in local, state or national history for their properties to be eligible under California Register Criterion 2.

California OHP concurrence with the above proposed eligibility evaluations for individual structures is pending.

HISTORIC LANDSCAPE EVALUATION

Although only two structures within the Dutch Slough Restoration Project area appear to be individually eligible for listing on the California Register, the building complexes that contain the dairies do appear to contribute to a historic landscape. Identifying a rural historic landscape involves a complex analytic process. The standard guidelines for evaluating a rural historic landscape are outlined in *National Register Bulletin 30 - Guidelines for Evaluating and Documenting Rural Historic Landscapes*. A rural historic landscape is defined as a "geographical area that historically has been used by people, or shaped or modified by human activity, occupancy, or intervention, and that possesses a significant concentration, linkage, or continuity of areas of land use, vegetation, buildings and structures, roads and waterways, and natural features." As a type of historic district, a rural historic landscape is characterized by having extensive acreage in relation to the buildings and structures (such as a ranch or farming community), unlike a typical historic district. Rural historic landscapes are also distinct from a designed landscape in that they are not the work of professional designers.

A detailed evaluation of the Dutch Slough properties as a potential historic landscape was conducted for this EIR by Ward Hill, Marjorie Dobkin and Denise Bradley in July 2006. That evaluation concluded that The Dutch Slough area appears to be a rare surviving dairy landscape dating from the 19th or early 20th Century in the San Francisco Bay Area. Historically, in addition to the Knightsen area (south of the project site), Contra Costa County had many family-run dairy farms in the Orinda/Moraga area and the Pinole area, none of which survive today. The dairies in Alameda County have also been replaced by modern development in the last 40 years. The only significant surviving enclave of historic dairy farms in the Bay Area is in Western Marin County, an area now largely protected as part of the Golden Gate National Recreational Area.[1]

The conclusion of the historic evaluation by Hill et al. is that the area appears to qualify as a "Rural Historic Landscape" under Criterion 1 of the California Register. The area included in the proposed rural historic landscape encompasses the Emerson, Gilbert and Burroughs parcels (including the Dutch Slough Restoration Project area), the City Community Park area and the Dutch Slough properties project south of the Contra Costa Canal. The approximate boundaries of the district are historic boundaries of the Emerson, Golden State Dairy and Burroughs Brothers Dairy: Cypress Road on the south, Jersey Island Road on the east, Dutch Slough on the north and Marsh Creek on the west. The period of significance is from 1913 to 1955. The development of the Dutch Slough levee systems after 1913 stabilized the land, thus making the dairy farms feasible by protecting them from the damaging floods of previous years. The period of significance concludes approximately 50 years ago. The approximate boundaries of the district are historic boundaries of the Emerson, Golden State Dairy and Burroughs Brothers Dairy: Cypress Road on the south, Jersey Island Road on the east, Dutch Slough on the north and Marsh Creek on the west.

The buildings contributing to the district on the Emerson parcel include:

- Ralph Emerson house
- Emerson house (Ironhouse School)
- "tuberculosis" barn

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1 The historic dairy district in West Marin has been documented in D.S. Livingston's major study- *A Good Life Diary Farming in the Olema Valley* (National Park Service,1995). No dairies survive in the Santa Clara Valley and one dairy producing goat cheese (Harley Farms) survives in San Mateo County. Since World War II, the Bay Area dairies with the exception of Marin and Sonoma Counties have largely moved to Fresno and Tulare Counties in the Central Valley.

- main dairy barn
- horse stable
- vehicle shed
- worker housing
- cook house.

The Ralph Emerson house, Ironhouse School, and tuberculosis barn are located on the Dutch Slough Properties Project (outside the sites covered by this EIR); the other five buildings are within the project area for the City of Oakley Community Park.

The contributing buildings on the Gilbert parcel include:

- main house
- caretaker's house
- worker housing/cook house
- the cook's house
- two hay barns
- dairy barn
- office/refrigeration building
- 3 vehicle sheds.

All of these buildings are within the project area for the City of Oakley Community Park except for the dairy barn built in the 1960's, which is on the Dutch Slough Restoration Project site.

The buildings contributing to the district on the Burroughs property include:

- main dairy barn
- office/refrigeration building
- wood-frame silos
- hospital barn
- main house
- Nelson's house
- bunk house
- old vehicle shed
- horse barn.

All of these buildings are within the project area for the Dutch Slough Restoration Project.

The hay barn (originally identified as contributing) near the silos collapsed in 2008 is no longer contributing because of the loss of historic integrity. A number of significant landscape features contribute to the district. The levee system and major defining waterways (Dutch Slough, Emerson Slough, Little Dutch Slough and Marsh Creek) contribute as boundary defining landscape features. The flood control provided by the levees also made this area a viable for agriculture. The open fields adjacent to the building clusters define the relationships between the agricultural (grazing, crops etc.) and the work/living areas. Roads to the Emerson house, driveways to the Burroughs dairy cluster and housing cluster, the road joining the Gilbert parcel to the Burroughs parcel are significant as part of the historic circulation patterns in the district. The palm trees in the vicinity of the main house and other major trees in the vicinity of the housing cluster on the Gilbert parcel are also contributing resources.

California OHP concurrence with the above proposed eligibility evaluation for a historic landscape is pending.

Regulatory Setting

Numerous laws and regulations require federal, State, and local agencies to consider the effects a project may have on cultural resources. These laws and regulations stipulate a process for compliance, define the responsibilities of the various agencies proposing the action, and prescribe the relationship among other involved agencies (e.g., State Office of Historic Preservation [OHP] and the Advisory Council on Historic Preservation). The National Historic Preservation Act (NHPA) of 1966, as amended; the California Environmental Quality Act (CEQA); and the California Register of Historical Resources, Public Resources Code (PRC) 5024, are the primary federal and State laws governing and affecting preservation of cultural resources of national, State, regional, and local significance.

Implementation of the proposed action or an alternative would require compliance with Section 106 of the National Historic Preservation Act (NHPA) and CEQA. Federal and State significance criteria are provided below. The significance of project impacts on cultural resources is related to the following factors: the presence, nature, and importance of any cultural resources that may be present in the treatment area; the location, size, and access requirements of the treatment areas; and need for heavy equipment.

FEDERAL REGULATIONS

The NHPA defines the nation's policy for the protection and preservation of the country's most significant cultural resources, which are those resources identified as eligible for listing in the National Register of Historic Places (National Register). Cultural resources eligible for the National Register are referred to as historic properties.

To be eligible for listing in the National Register, a resource must be significant in American history, architecture, archaeology, engineering, or culture. Districts, sites, buildings, structures and objects of potential significance must meet one or more of the following four established criteria, as defined under Title 36 Code of Federal Regulations (CFR) Part 60.4:

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

b) Are associated with the lives of persons significant in our past;

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

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

In addition to meeting these four criteria, a historic property must also possess integrity. The various aspects of integrity include location, design, setting, materials, workmanship, feeling, and association. Furthermore, unless the resource possesses exceptional significance, it must be at least 50 years old to be considered for National Register listing.

The implementing regulations for the protection of historic properties are defined under Title 36 Code of Federal Regulations (CFR) Part 800. The regulation defines effect and adverse effect on historic properties as follows:

Section 800.9(a) Criterion of Effect: An undertaking has an effect on a historic property when the undertaking may alter characteristics of the property that may qualify it for inclusion in the National Register. For the purpose of determining effect, alteration to features of a property's location, setting, or use may be relevant depending on a property's significant characteristics and should be considered.

Section 800.9(b) Criteria of Adverse Effect: An undertaking is considered to have an adverse effect when the effect on a historic property may diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Adverse effects on historic properties include, but are not limited to:

- Physical destruction, damage, or alteration of all or part of the property;
- Isolation of the property from or alteration of the character of the property's setting when that character contributes to the property's qualification for the National Register;
- Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting;
- Neglect of a property resulting in its deterioration or destruction; and/or
- Transfer, lease, or sale of the property without adequate provisions to protect historic integrity.

STATE REGULATIONS

Policy for the protection and preservation of the State's most significant cultural resources is found in various sections of CEQA, the State CEQA Guidelines, and in statutes of the PRC. In September, 1992, Governor Wilson signed Assembly Bill 2881 which created more specific guidelines for identifying historic resources during the project review process under the CEQA:

A project that may cause a substantial adverse change in the significance of an historical resource is a project that may have a significant effect on the environment. For purposes of this section, an historical resource is a resource listed in, or determined eligible for listing in, the California Register of Historical Resources (California Register).[2]

Consequently, under Section 21084.1 of the PRC, an historic resource eligible for the California Register would by definition be an historic resource for purposes of CEQA compliance. The regulations for nominating resources to the California Register were published January 1, 1998. Under the regulations, a number of historic resources are automatically eligible for the California Register if they have been listed under various state, national or local historic resource criteria.

[2] California State Assembly, Assembly Bill 2881, Frazee, 1992. An Act to Amend Sections 5020.1, 5020.4, 5020.5, 5024.6 and 21084 of, and to add Sections 5020.7, 5024.1, and 21084.1 to, the Public Resources Code, relating to historic resources.

California historic resources listed in, or formally determined eligible for the National Register are automatically listed on the California Register.

In order for a resource to be eligible for the California Register, it must satisfy all of the following three criteria:

A. A property must be significant at the local, state or national level, under one or more of the following four criteria of significance (these are essentially the same as National Register criteria with more emphasis on California history):

   1. The resource is associated with events or patterns of events that have made a significant contribution to the broad patterns of local or regional history and cultural heritage of California or the United States.

   2. The resource is associated with the lives of persons important to the nation or to California's past.

   3. The resource embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of a master, or possesses high artistic values.

   4. The resource has the potential to yield information important to the prehistory or history of the state or the nation (this criteria applies primarily to archaeological sites).

B. The resource retains historic integrity (defined below) and

C. It is 50 years old or older (except for certain cases described in the California Register regulations).

The California Register regulations define "integrity" as "… the authenticity of a property's physical identity, evidenced by the survival of characteristics that existed during the property's period of significance," that is, it must retain enough of its historic character or appearance to be recognizable as an historical resource. Following the National Register integrity criteria, California Register regulations specify that integrity is a quality that applies to historic resources in seven ways: location, design, setting, materials, workmanship, feeling and association. A property must retain most of these qualities to possess integrity.

The use of the phrase ".. . . appears potentially eligible or not eligible" for the California Register is standard practice in an evaluation discussion. Only the State Office of Historic Preservation can make an actual determination of eligibility for the California Register.

3.12.3 Impacts and Mitigation Measures

Significance Criteria

Under Appendix G of the *CEQA Guidelines*, a proposed project is considered to have a significant impact if it would result in any of the following:

• A substantial adverse change in the significance of a historical resource that is either listed or eligible for listing in the National Register, the California Register, or a local register of historic resources;
• A substantial adverse change in the significance of a unique archaeological resource;

• Disturbance or destruction of a unique paleontological resource or site or unique geologic feature; or
• Disturbance of any human remains, including those interred outside of formal cemeteries.

CEQA provides that a project may cause a significant environmental effect where the project could result in a substantial adverse change in the significance of a historical resource (Public Resources Code, Section 21084.1). *CEQA Guidelines* Section 15064.5 defines a "substantial adverse change" in the significance of a historical resource to mean physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of a historical resource would be "materially impaired" (*CEQA Guidelines*, Section 15064.5[b][1]).

CEQA Guidelines, Section 15064.5(b)(2), defines "materially impaired" for purposes of the definition of "substantial adverse change" as follows:

The significance of a historical resource is materially impaired when a project:
• Demolishes or materially alters in an adverse manner those physical characteristics of a historical resource that convey its historical significance and that justify its inclusion in, or eligibility for, inclusion in the California Register; or

• Demolishes or materially alters in an adverse manner those physical characteristics that account for its inclusion in a local register of historical resources pursuant to Section 5020.1(k) of the Public Resources Code or its identification in a historical resources survey meeting the requirements of Section 5024.1(g) of the Public Resources Code, unless the public agency reviewing the effects of the project establishes by a preponderance of evidence that the resource is not historically or culturally significant; or

• Demolishes or materially alters in an adverse manner those physical characteristics of a historical resource that convey its historical significance and that justify its eligibility for inclusion in the California Register as determined by a lead agency for purposes of CEQA.

In accordance with *CEQA Guidelines* Section 15064.5(b)(3), a project that follows the Secretary of the Interior's *Standards for the Treatment of Historic Properties* is considered to have mitigated impacts to historic resources to a less-than-significant level.

Alternative 1: Minimum Fill

IMPACT 3.12.1-1: LOSS OF UNKNOWN ARCHAEOLOGICAL RESOURCES (ALL PROJECTS AND ALL OPTIONS)

Although there are no known archaeological resources on any of the project sites, there is some potential that such resources could be encountered on the project parcels during excavation of channels and borrow areas. Therefore, the project could have a potentially significant impact to any such resources.

MITIGATION MEASURE 3.12.1-1: CEASE WORK AND CONDUCT ASSESSMENT

Should archaeological materials (including, but not limited to, flaked stone tools and chipping debris, ground stone tools, human skeletal remains, historic bottles, structure foundations, etc.) be uncovered while conducting activities associated with the proposed project sites, all work should temporarily cease in the vicinity of the finds until they can be assessed by a qualified archaeologist and an appropriate course of action can be determined in consultation with the State Historic Preservation Officer. Furthermore, should human remains be discovered during project-related activities, the requirements of Section 7050.5 of California's Health and Safety Code shall be followed. This includes stopping work within proximity of the finds and contacting the County Coroner for an evaluation of the remains. If the remains are determined to be ancestral Native American, the coroner must contact the Native American Heritage Commission within 24 hours.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant after mitigation.

IMPACT 3.12.1-2: DEMOLITION OF HISTORIC STRUCTURES/LANDSCAPE FEATURES THAT CONTRIBUTE TO RURAL HISTORIC LANDSCAPE (DUTCH SLOUGH RESTORATION PROJECT AND CITY COMMUNITY PARK)

The Dutch Slough Restoration Project and the City Community Park Project propose to demolish the buildings and related landscape features on the Burroughs, Emerson and Gilbert properties except for four buildings retained in the "Historic Area" of the City Community Park Project area. The four buildings to be retained in the "Historic Area" are Gilbert House, the adjacent caretaker's house, a barn, and Ironhouse School (Emerson house), which would be moved from its current location south of the two projects. The other buildings on the Emerson (all on the site of the City Community Park), Gilbert (all but one on the site of the City Community Park) and Burroughs (all on the site of the Dutch Slough Restoration Project) parcels would be demolished or otherwise removed. Materials from some buildings may be incorporated in the design of new buildings planned for the Park.

The contributing Dutch Slough Restoration Project and City Community Park buildings and landscape features outlined in the Setting section, above, appear to be eligible for the California Register as a Rural Historic Landscape. Under the CEQA Statutes and Guidelines a "substantial adverse change" such as "…demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of the historic resource would be materially impaired" is considered to be a significant effect on historic resources. The demolition of the contributing buildings, related structures and landscape features in the Dutch Slough Rural Historic Landscape would constitute a substantial adverse change to an historic resource, thus it is a significant impact under CEQA.

"NO BURROUGHS" OPTION

If the Burroughs parcel is not restored to tidal action, approximately 350 acres of rural landscape would be preserved. If the buildings on the parcel were to be preserved as part of this option, a resident caretaker would be required to maintain them.

MITIGATION MEASURE 3.12.1-2.1: RELOCATE HISTORIC STRUCTURES

The historic structures, which are those buildings that meet the "Criterion 3" as defined above, include the main Gilbert House and the main Burroughs House. Both structures shall be offered to be moved to other locations in the Dutch Slough area. If a building is moved from its original location, the new location must be appropriate to the historic character of the building, i.e. rural location similar to its historic location. Project impacts would be reduced further the closer the moved site is to a building's historic site.

The feasibility of moving the buildings has not been determined, and is beyond of the scope of this analysis. The feasibility of moving the building can only be determined by a contractor or engineer experienced in moving historic buildings. Although most wood-frame buildings can usually be moved without difficulty, the structural condition needs to be evaluated to determine if it can be moved and not significantly damaged. The dairy barns and other buildings are too large to be moved.

MITIGATION 3.12.1-2.2: SALVAGE MATERIALS AND FEATURES

This mitigation measure shall apply only to those buildings that meet "Criterion 1" as defined and listed above, except for those buildings that are covered under "Criterion 3" and subject to Mitigation 3.12.1-2.1. For the contributing buildings that are not retained or moved, salvaging materials and features of the buildings shall be done to reduce project impacts. The salvaged materials could be incorporated into buildings on the project site or on other sites in the area. Preserving features and materials of the buildings at their historic location would reduce project impacts more than moving these features and materials to a new site. Representatives of the East Contra Costa County Historical Society, the Contra Costa County Historical Society, the City of Oakley and other interested parties shall be contacted and given the opportunity to examine the buildings and provide suggestions for salvaging various features.

The project impacts would be reduced commensurate with the percentage of the existing structures that can be salvaged or otherwise preserved. The preservation of one or more of the significant interior and exterior features from the buildings as part of a new building would reduce projects impacts, but not to a less-than-significant level since most of the structure would still be demolished.

MITIGATION MEASURE 3.12.1-2.3: HISTORIC DOCUMENTATION

Prior to the demolition, salvage, or moving of the contributing Dutch Slough buildings and related landscape features, they shall be photographically documented according to the Historic American Building Survey (HABS) *Photographic Specifications* published by the Great Pacific Basin Office of the National Park Service, Oakland, California. This documentation shall include archival quality, large format (minimum 4 by 5 inch) photographs of the exterior and interior of the buildings. The documentation shall focus on the individual buildings and structures, related landscape and surrounding pastures/crop lands used as part of the dairy operations. Written documentation shall include a narrative report according to the instructions in the *Historic American Building Survey Guidelines for Preparing Written Historical and Descriptive Data* published by the Cultural Resources division of the Pacific Great Basin Support Office of the National Park Service, Oakland. The documentation should include oral histories with appropriate members of the Emerson and Burroughs families regarding the histories of the Dutch Slough dairies. In addition to photographs, the documentation shall include historic maps and aerials. A copy of the documentation, with original photo negatives, prints and plans, should be donated to an historical archive accessible to the public and with facilities for storing archival photographs, such as the East Contra Costa County Historical Society, Oakley or the Contra Costa County Historical Society, Martinez.

MITIGATION 3.12.1-2.4: DUTCH SLOUGH DAIRY EXHIBIT

A museum exhibit shall be mounted on the subject of the Dutch Slough Rural Historic Landscape in the City Community Park Project area. The material assembled for the HABS documentation can be used in the exhibit. The exhibit would somewhat reduce the project impacts, but not to a less-than-significant level.

IMPACT SIGNIFICANCE AFTER MITIGATION.

The mitigation measures identified above would reduce the project impacts, however this would remain a Significant Unavoidable Impact.

Cumulative Impacts to Historic and Prehistoric Resources

Recent and planned residential development throughout the local area, including the three projects addressed in this EIR, will have cumulative impacts on historic and prehistoric resources. Eastern Contra Costa County is undergoing a significant land use change from rural to suburban, resulting in land clearing and disturbance of many hundreds (or thousands) of acres.

The main project and one related project addressed in this EIR (Dutch Slough Restoration Project and City Community Park, respectively), together with an adjacent unrelated project (Dutch Slough Properties), form a Rural Historic Landscape. This Landscape will be lost once all three projects have been constructed, and each will contribute to the cumulative impact.

The combination of projects could potentially add to the cumulative loss of archaeological sites in the project area. However, due to the lack of known archaeological sites on the project sites and the acceptability of the proposed mitigation measures, the Dutch Slough Restoration Project, Ironhouse Project, and City Community Park Project contributions to this cumulative impact to archaeological sites would be less than significant.

The proposed land plan for the Dutch Slough Properties project south of the Contra Costa Canal includes commercial and residential development. The plan includes trails, parks, levees, storm water detention ponds as well as the infrastructure improvements necessary to accommodate the new development. The Dutch Slough Properties residential development project (south of the CCWD canal) would include removal of the Ralph Emerson house and the "tuberculosis" cow barn (the adjacent Ironhouse School would be moved to the Community Park). The existing roads, landscaping and pastures will be developed with new buildings and infrastructure.

The combined impacts of the Dutch Slough Restoration Project, the City Community Park Project, and the Dutch Slough Properties project on the Dutch Slough Rural Historic Landscape would result in a significant cumulative impact on historic resources. Because there are no structures on the Ironhouse parcel, that project would not contribute to this cumulative impact.

The mitigation measures discussed above would reduce the project's cumulative impacts. Cumulative loss of archaeological resources would be less than significant, however cumulative loss of historic landscapes would remain significant and unavoidable.

Alternative 2: Moderate Fill Alternative

IMPACT 3.12.2-1: LOSS OF UNKNOWN ARCHAEOLOGICAL RESOURCES (ALL OPTIONS)

Same as Alternative 1.

MITIGATION MEASURE

Same as Alternative 1.

IMPACT 3.12.2-2: DEMOLITION OF HISTORIC BUILDINGS/LANDSCAPE FEATURES (ALL OPTIONS)

Same as Alternative 1.

MITIGATION MEASURES

Same as Alternative 1.

Alternative 3: Maximum Fill

IMPACT 3.12.3-1: LOSS OF UNKNOWN ARCHAEOLOGICAL RESOURCES (ALL OPTIONS)

Same as Alternative 1.

MITIGATION MEASURE

Same as Alternative 1.

IMPACT 3.12.3-2: DEMOLITION OF HISTORIC BUILDINGS/LANDSCAPE FEATURES (ALL OPTIONS)

Same as Alternative 1.

MITIGATION MEASURES

Same as Alternative 1.

Alternative 4: No Project

The No Project would reduce impacts to a less-than-significant level because the buildings and landscape features would not be removed. The buildings would likely continue to deteriorate if they are not used and maintained. Any as-yet undiscovered archaeological resources would not be affected.

Table 3.12-1 Summary of Cultural Resources Impacts for Dutch Slough and Related Restoration Projects

Impact	Dutch Slough Restoration Project	Related Projects	
		Ironhouse Project	**City Community Park Project**
Impact 3-12.1-1: Loss of Unknown Archaeological Resources	Potentially Significant	Potentially Significant	Potentially Significant
Impact 3-12.1-2: Demolition of Historic Buildings/Landscape Features	Potentially significant loss of buildings/landscape Burroughs parcel	No impact; no structures	Potentially significant loss of buildings/landscape on Gilbert and Emerson parcels
Impact 3-12.1-3: Cumulative Impacts	Cumulative loss of historic and prehistoric resources	Cumulative loss of prehistoric resources	Cumulative loss of historic and prehistoric resources

Table 3.12-2 Summary of Cultural Resources Mitigation Applicability for Dutch Slough and Related Restoration Projects

Mitigation	Dutch Slough Restoration Project	Related Projects	
		Ironhouse Project	City Community Park Project
Mitigation 3.12-1– Cease Work and Conduct Assessment	X	X	X
Mitigation 3.12-2– Relocate Buildings (Main Gilbert and Burroughs Houses- Criterion 3)	X		X
Mitigation 3.12-3– Salvaging Buildings (Criterion 1)	X		X
Mitigation 3.12-4– Historic Documentation	X		X
Mitigation 3.12-5– Dutch Slough Dairy Exhibit	X		X

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3.13 - Transportation

3.13 TRANSPORTATION/TRAFFIC

This section briefly characterizes the existing and expected traffic generation of the proposed Dutch Slough Restoration Project, Ironhouse Project and City Community Park Project. It briefly describes the existing traffic network and trip levels on project area roadways, identifies the City's traffic goals and policies, and projects traffic levels that may occur upon completion of the various project elements. Parking also is addressed. Mitigation is identified as appropriate. The traffic and parking analyses for the City Community Park are at a conceptual level; additional CEQA review may be required when the final park plans are developed, or for special events.

3.13.1 Affected Environment

Existing Roadway Network

Access to the project sites would be from an extension of Sellers Avenue north of Cypress Road. Cypress Road is a two-lane arterial roadway that is a major east-west access across Oakley and which connects to Bethel Island. It would be reconstructed as a four- and six-lane divided arterial roadway in stages, and should be completed within the next few years. Sellers Avenue north of Cypress Road is currently a minimal two-lane road that also would be reconstructed. New residential subdivisions are being constructed along Sellers Avenue along with a shopping area on the corner at Cypress Avenue. Sellers Avenue will be reconstructed to a 60-ft wide collector street with a number of driveways, and with a bike lane – parking lane on each side. This roadway work would be constructed as a part of the commercial development, and also would include a dead-end connection at the end of Sellers Avenue where it connects to the City Community Park Project. It also would be completed prior to the construction of the Dutch Slough Restoration Project.

Existing Local Traffic Levels

Existing local traffic levels on Cypress Road and Sellers Avenue are approaching a critical condition where the roadway and intersection capacity standards are being exceeded. With the reconstruction of these roads, and the installation of a new traffic signal at the intersection, the roadway capacity conditions would be improved to Level of Service "A". Recent traffic studies of the Cypress Road corridor by the City of Oakley show that the intersection of Cypress Road and Sellers Avenue will operate at Level of Service "A" with the completion of currently planned residential projects. The long-range plans (2025) with full build-out of the corridor show that the intersection would operate at Level of Service "D", which is within the City standards.

Regulatory Framework

The City of Oakley General Plan has established Level of Service "D" as the acceptable threshold for future traffic conditions. The new roadways in this area have been planned and designed to meet these standards. The General Plan also calls for the consideration of bus transit routes, pedestrian and bicycle facilities, and neighborhood traffic calming measures to manage future traffic flow.

3.13.2 Impacts and Mitigations

Significance Criteria

The applicable transportation standard for the City of Oakley establishes Level of Service "D" as the maximum acceptable condition for signalized intersections. Traffic generated by the Dutch Slough Restoration Project, Ironhouse Project, and City Community Park Project interim Improvements is evaluated to determine the projects' impact with respect to this standard. CEQA Guidelines, Appendix G, also requires consideration of adequacy of parking and traffic hazards as potentially significant impacts.

Alternative 1: Minimum Fill

IMPACT 3.13.1-1: TRAFFIC GENERATION AND ROADWAY CAPACITY

The Dutch Slough Restoration Project and Related Projects would generally generate low volumes of traffic that are closely related to weather conditions and seasonal activities. The two wetland restoration projects would generate minimal traffic. The primary traffic generator would be the City Community Park. It is expected that the hours of operation of the park and the public access trails and would be from 5 am to 11 pm. Evening uses (after sunset) would be limited to the proposed sports field areas (seasonal) and to the historic zone (on a permit basis). It is possible that the ball fields may be lighted for seasonal play in the evening. The normal trip generation assumptions have been based on this use plan.

Trip generation has been estimated for the ultimate condition when the Dutch Slough property has been restored and is being used for park and recreation purposes. An estimate has also been made of trip generation issues during the site restoration stage that may occur due to short-term construction traffic impacts.

All vehicle access to the City Community Park would occur from a roadway into the Dutch Slough Restoration Project at the end of Sellers Avenue. For this traffic evaluation, it is assumed that a parking area would be provided near the Sellers Avenue entrance as shown on the site plan. The parking lot would be used as a staging area for recreational users, and for park staff and other visitors, as well as for users of the sports fields. The precise size of the parking lot has not yet been determined, and would be considered during the final design of the City Community Park.

During the weekday commute peak on the streets of Oakley, which generally occurs about 8-9 AM and 5-6 PM, the City Community Park would generate only about 8 vehicle trips, which would be split into 4 trips inbound and 4 outbound. The average daily traffic (ADT, 24-hour) in and out of the park on a weekday would be about 125 vehicle trips per day. These include trips associated with public access to the Dutch Slough Restoration Project.

The trip generation for this type of use has been estimated in the ITE Trip Generation Manual under the category of County Park (Land Use 412). Trips have been measured by using the park acreage as the independent variable. These studies have resulted in an average trip generation rate of 2.28 trips per acre, with 0.06 trips per acre during the commute peak hour. These studies of parks have generally been conducted during the heaviest seasons of the year. Separate studies have also been conducted on weekends and holidays. Using the ITE data, Table 3.13-1 shows the trip generation characteristics that have been assumed for the Dutch Slough Restoration Project area.

The resulting trip generation from the City Community Park, and the number of new trips at the intersection of Sellers Avenue and Cypress Road are estimated to be about 30 vehicle trips during the peak hour of park activities.

Table 3.13-1: Trip Generation Characteristics of the City Community Park[1]

		Weekday Commute Peak Hr (8:00-9:00 AM)			Weekend Peak Hour (1:00-2:00 PM)		
Development	Daily Trips	In	Out	Total	In	Out	Total
ITE Trip Generation Rates (Trips per Acre)							
Recreational Use – County Park (Trip Rate per Acre)	2.28	0.03	0.03	0.06	0.29	0.30	0.59
Total City Community Park Project Trip Generation							
City of Oakley Community Park (55 acres)	125	4	4	8	16	17	33

[1] The City Community Park trips include trips associated with public access to the Dutch Slough Restoration Project trails.

TRIP DISTRIBUTION AND TRAFFIC IMPACTS

It is estimated that the trips would be distributed about 70 percent toward the west on Cypress Road, 20 percent to the south on Sellers Avenue, and 10 percent to the east on Cypress Avenue. Based on this trip generation and level of new traffic, it can be concluded that the activities from the City Community Park/Dutch Slough Restoration Project area would not result in a significant traffic-related impact. This level of traffic is below the threshold where it would have a measurable effect on vehicle delay or intersection capacity (Level of Service). Similarly, the addition of this traffic would not statistically affect the results of models used to estimate air quality or noise impacts.

SHORT-TERM CONSTRUCTION-RELATED TRAFFIC IMPACTS

The extent of this impact is difficult to estimate. The major component of any construction- related traffic would be related to earthmoving and grading activities within the sites. Under Alternative 1, it is expected that the cut and fill would be largely balanced on the Dutch Slough Restoration Project and City Community Park sites, or amongst those sites and the Ironhouse Project site, so there would be very little off-site (off-haul) construction truck traffic. Based on this estimate of construction traffic, it can be concluded that the activities at the sites would not result in any traffic-related environmental impacts.

In the event of grading that required off-site hauling, it is conceivable that the number of truck trips during the heaviest period of activity could be as much as 30 truck trips per hour during a mid-day weekday peak hour. This type of construction traffic, estimated to be 15 inbound and outbound truck trips per hour, would likely travel on Sellers Avenue between the park entrance and Cypress Avenue. From there the truck route would likely be Cypress Avenue to Highway 4, and from there to a final site. Similarly to the findings above, this level of traffic is below the threshold where it would have a measurable effect on vehicle delay or intersection capacity (Level of Service).

IMPACT 3.13.1-2: PARKING

The City Community Park is planned to have a parking capacity of about 430 spaces. A parking management plan has not yet been completed. Some of this parking may be provided in a formal paved parking lot, while other spaces could be accommodated along the access roads within the park. Other similar parks with sports fields have created parking lots for about 150 to 200 cars, with the expectation that there may be rare occasions when parking is at capacity, and some vehicles may be forced to use nearby on-street parking.

The City Community Park may be used for occasional special events, such as the annual Almond Festival. This event could draw up to 5,000 people per day (spread out throughout the day). The Draft City Community Park Master Plan states that special events would occur in the park that would focus on the amphitheater and the areas near the concession stand. These special events "would support the central field as the focal place for events of 3,000 to 5,000 people at one time. Field areas and other places within the City Community Park could be used for overflow parking, but it is likely that that additional parking for such events may be required offsite. This occasional impact is considered to be less than significant because the City of Oakley would require a permit for such special events, and parking management plans would be a requirement of such a permit.

IMPACT 3.13.1-3: CUMULATIVE TRAFFIC CONSIDERATIONS

On Sellers Avenue, the City Community Park and Dutch Slough Restoration Project public access traffic would be mixed with traffic from the adjacent residential developments, and from trips from the shopping area at the corner of Cypress and Sellers. On Cypress Avenue, the future estimated ADT is about 35,000 vehicle trips per day (in 2025), based on the East County Traffic Model that is conducted by the Contra Costa Transportation Authority (CCTA). About 100 of these trips may be related to the Dutch Slough Restoration Project. This would not result in a measurable impact on the traffic conditions, and would not result in a cumulatively considerable contribution to the overall traffic impact.

Cypress Road would have a growing level of traffic as a result of the development of new housing in the Corridor. The total development in the corridor could be as many as 8,000 new residential units. Once again, the park and public access traffic would not result in a cumulatively considerable contribution to this traffic and therefore this would not be considered a significant impact.

Alternative 2: Moderate Fill/Preferred Alternative

IMPACT 3.13.2-1: TRAFFIC GENERATION AND ROADWAY CAPACITY

Under this alternative, onsite grading would be increased to about 1.32 million cubic yards, and about 360,000 cubic yards of imported fill would be required. This imported fill would be either trucked overland directly from the Ironhouse parcel or dredged from the adjacent Dutch Slough Restoration Area open water areas and, therefore, would not generate additional vehicular traffic on project area roadways. The traffic impact would, therefore, be the same as for Alternative 1.

IMPACT 3.13.2-2: PARKING

Same as for Alternative 1.

Alternative 3: Maximum Fill

IMPACT 3.13.3-1: TRAFFIC GENERATION AND ROADWAY CAPACITY

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. Fill would be trucked overland directly from the Ironhouse parcel and supplemented by additional material dredged from the adjacent Dutch Slough Restoration Area open water areas. This transport would not generate additional vehicular traffic on project area roadways. The traffic impact would, therefore, be the same as for Alternative 1.

IMPACT 3.13.3-2: PARKING

Same as for Alternative 1.

Alternative 4: No Project

This alternative would continue existing uses on the project properties. No traffic or parking impacts would occur.

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3.14 - Public Services

3.14 PUBLIC SERVICES, UTILITIES AND SERVICE SYSTEMS

This section addresses the public services and utilities of the Dutch Slough Restoration Project and Related Projects. Public services and utilities issues addressed include: police protection, fire protection, water supply, wastewater, storm drainage, and electrical and gas transmission.

3.14.1. AFFECTED ENVIRONMENT

Police Protection

The City of Oakley contracts with the Contra Costa County Sheriff's Department for police services. The contract allows the City to have a Chief of Police and for the Sheriff's Department personnel to be identified as Oakley Police Department on their vehicles and uniforms. The Oakley Police Department controls the specifics of delivery of law enforcement services in the City, and this control results in a City-based police operation.

The staffing level of the City of Oakley Police Department is 19 officers, three sergeants, and one chief. The department is also allocated one full-time and three part-time non-sworn police service assistants. The ratio of sworn officers to the City of Oakley's population is dynamic as the city's population increases. The average ratio is approximately 0.75 to 0.80 officers per 1,000 residents. The nationally accepted average is one police officer per 1,000 residents. Using the national average is not always an accurate reflection of the actual need due to different circumstances of each police department. In addition, the City's contract with the County Sheriff's Department allows for additional and highly specialized support, such as homicide investigators, to respond to emergency and extreme situations as needed. This specially trained auxiliary support is not reflected in Oakley's ratio of sworn officers, so the comparison with national average tends to understate the City's police capacity and services (Rebecca Willis, email correspondence, June 5, 2007).

The project sites are located in District 5 of the Police Department's service area. The City of Oakley has mutual aid agreements with neighboring law enforcement agencies that are managed through the Contra Costa County Sheriffs Office (McLarand Vasquez Emsiek & Partners, Inc., et al. 2005).

The level of crime at the Dutch Slough Restoration Project and Related Projects sites is very low. The Police Department does not receive calls for service there on a frequent basis. The majority of calls which are received by the Department are related to litter dumps and occasional stolen vehicles which are left in or around the site. Additional staff and equipment are proposed as the population of the East Cypress area grows, thus accompanying the potential increase in service needs to the sites. (Thorsen 2006)

Each new housing unit in the residential developments surrounding the Dutch Slough area is assessed a special police tax, referred to as the P-6 tax, for police services. Currently, that tax is approximately $650.00 annually per unit. In addition, The City has committed to impose a new annual assessment on the development area south of the Contra Costa Canal (planned for about 1400 units) for police protection and maintenance of the Dutch Slough Community Park. The City also is applying an annual assessment on new development on properties in the East Cypress Corridor Specific Plan (planned for about 4000 units), which was annexed to the City in October 2006.

Fire Protection

The East Contra Costa Fire Protection District provides fire suppression and emergency services for the communities of Oakley, Bethel Island, Brentwood, Byron, Discovery Bay, and Knightsen, together with portions of Marsh Creek Canyon and Morgan Territory. The District consists of three former fire service districts (East Diablo, Oakley-Knightsen, and Bethel Island Fire Districts). They were consolidated in November of 2002. Designed to enhance efficiencies of operation and training as well as to ensure more effective fire and emergency service, the consolidation enabled District staff to take advantage of economies of scale while eliminating duplicative personnel and services. The District is headquartered at 134 Oak Street in Brentwood (City of Oakley 2006). The District has a mutual aid agreement with the Contra Costa County Fire Protection District (Gonzalez 2006).

The District is headed by a Fire Chief and is staffed with 93 full-time administrative and on-shift fire suppression personnel, including career and paid on-call professionals. The District staffs eight fire stations. District services include fire suppression, hazardous materials mitigation, fire prevention, public education, and emergency medical service (City of Oakley 2006).

The closest fire station to the Dutch Slough Restoration Project and Related Projects sites is Fire Station 93 at 215 Second Street in the City of Oakley, approximately two miles from the site. Fire Station 93 is equipped with a 1,500 gallons per minute (gpm) pumper truck and a 500 gpm pumper truck. This unit is staffed by the engine crew as needed to respond to areas of the city with significant wildfire threat. It typically has a crew of two and has an average response time of five to ten minutes. The second closest fire station is Fire Station 94 at 15 A Street in the City of Knightsen, approximately two miles from the site. It is staffed by volunteer firefighters and they are on-call (East Contra Costa Fire Protection District 2006).

The District's high priority goals include completion of the Fire Service and EMS Master Plan. The master plan study assesses and makes recommendations specific to: Performance and Efficiency; Community Risks and Demand for Service; Growth Projections; Organization and Staffing; Deployment and Concentration of Resources; Level of Service and Standards for Response Coverage; and Needs Assessment. The District plans to obtain new fire apparatus (type 3 wildland units and type 1 structural units) and construct a new fire station in the East Cypress Corridor Specific Plan area in 2007. They are also planning the relocation of the district administrative office (Gonzalez 2006).

The East Contra Costa Fire Protection District operates a Fire Prevention Bureau to give residences and business owners the knowledge and skills to lead safer lives. Led by a Battalion Chief, members of the Bureau review building plans and complete inspections to ensure new construction or remodeling projects meet the Fire Code. In addition, the Bureau visits classrooms and meets with businesses and homeowners to discuss fire prevention and safety (East Contra Costa Fire Protection District 2006).

The Marine Fire/Rescue Division's primary objective is fire suppression in the waterfront residential areas, the shipping channel, and all waters of Eastern Contra Costa County. Search and rescue missions, including emergency medical responses are also within the scope of the Marine Division's mission. The marine division maintains two 25-foot firefighting vessels capable of pumping 500 gpm. To maintain levee access and vegetation on levees, the Uniform Fire Code states that fire access routes on roadways should be no less than 20 feet wide and 13 feet, 6 inches in height (East Contra Costa Fire Protection District 2006).

The existing fire hazard on the project site is moderate. The fire hazard depends on the season, fuel load, and integrity of structures (Gonzalez 2006).

Water Supply

Domestic water service within the Dutch Slough Restoration Project and Related Projects area is provided by private wells and water systems, and Diablo Water District (DWD), a retail water supplier. The primary treatment facility, Randall-Bold Water Treatment Plant (WTP), on Neroly Road, is owned by DWD and Contra Costa Water District (CCWD). CCWD provides water service to more than 500,000 customers in central and eastern Contra Costa County. CCWD provides water from the Sacramento-San Joaquin Delta under a contract with the federal Central Valley Project (CVP) through contracts with the U.S. Bureau of Reclamation (McLarand Vasquez Emsiek & Partners, Inc., et al. 2005).

DWD provides treated water service to the City of Oakley through a primary water treatment facility and network of water distribution mains. DWD provides service to over 7,500 water connections. DWD operates and maintains over 90 miles of water pipelines, pumping systems, valves and reservoirs. DWD receives the majority of its water from CCWD. DWD has a capacity of up to 30 million gallons per day (mgd) at the Randall-Bold WTP, which is capable of delivering 15 mgd of water. The plant has delivered approximately eight million gallons during the hottest days. In 1997 the quality and reliability of the water was improved when the Los Vaqueros Reservoir was placed into service. Los Vaqueros Reservoir provides up to three months of emergency water storage for DWD customers (City of Oakley 2006).

Small private water systems are owned and operated by DWD and private entities. These entities operate and maintain community wells for the benefit of two or more landowners. Distribution facilities generally consist of interconnected two-inch to eight-inch pipes. Water quality is sufficient to meet current State Health Code requirements with no treatment required. Disinfection of potential water borne contaminants is achieved through chlorine injection at the wellhead (McLarand Vasquez Emsiek & Partners, Inc., et al. 2005).

The closest water line to the Dutch Slough Restoration Project and City Community Park sites is a 24-inch water main on the north side of Cypress Road. There are three drinking water intakes located near the Dutch Slough site: the Contra Costa Old River intake, Contra Costa Rock Slough intake, and the Harvey O. Banks intake.

Wastewater

Sanitary services are provided to the Oakley area by Ironhouse Sanitary District (ISD) and private septic tanks and leach fields. ISD operates and maintains sanitary sewer mains throughout the project vicinity. The system consists of a series of gravity mains flowing to local lift stations (McLarand Vasquez Emsiek & Partners, Inc., et al. 2005).

ISD conveys treated sewage effluent through a pipeline along the northwestern border of the Emerson parcel. Reclamation District 799 maintains and operates two pumping stations on the Burroughs parcel. ISD uses treated wastewater to irrigate Jersey Island and the Ironhouse parcel.

ISD is in the process of constructing a new wastewater treatment facilities just west of the project site on the Ironhouse parcel. The District is completing a capital improvement program to increase capacity to accommodate projected demand in ISD's service area (from 3 mgd to 8.6 mgd). ISD plans to eliminate land-based wastewater irrigation on mainland properties and construct a surface water discharge system with tertiary treatment at Jersey Point on Jersey Island. ISD is evaluating an expansion of its wastewater irrigation on Jersey Island and construction of lined storage ponds on its mainland property. The Central Valley Regional Water Quality Control Board would work with ISD to determine the location and amounts of land-based versus surface water application of wastewater. ISD plans to begin construction in 2007 (McLarand Vasquez Emsiek & Partners, Inc., et al. 2005).

The Contra Costa County Environmental Health Services Department regulates septic tanks and leach fields.

Storm Drainage

The Emerson and Gilbert parcels each have a discharge pump to remove drainage from the respective sites. The Burroughs parcel's drainage for the northern section is handled by Pump Station 1 that is maintained by Reclamation District 799. Pump Station 1a serves approximately 100 acres of the south end of the Burroughs parcel (Hall 2006).

Areas south of the Dutch Slough Restoration Project site gravity drain into Emerson Slough and Little Dutch Slough.

Electrical and Gas Transmission

Pacific Gas & Electric Company (PG&E) has an extensive network of distribution lines within the Dutch Slough Restoration Project and City Community Park sites and surrounding area. PG&E obtains its energy supplies from hydroelectric, nuclear, and gas-fired power plants in northern and central California. In addition, it purchases energy from out-of-state and delivers it through high-voltage transmission lines. A PG&E 500-kilovolt electrical transmission line traverses the northeast corner of the Burroughs parcel. Some of these lines serve the project site and some lines serve customers beyond the site. Electricity is also provided to the project area with overhead power lines that extend along East Cypress Road, Jersey Island Road, and Bethel Island Road (McLarand Vasquez Emsiek & Partners, Inc., et al. 2005).

A PG&E 42-inch main gas line that parallels the footprint of the transmission line passes underneath the Dutch Slough Restoration Project site across the Burroughs parcel. PG&E also provides gas to the Dutch Slough Restoration Project area via natural gas lines in East Cypress Road, the East Cypress Corridor Specific Plan project site, and Bethel Island Road (McLarand Vasquez Emsiek & Partners, Inc., et al. 2005).

Natural gas wells are on all three Dutch Slough Restoration Project parcels. 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 gas well on each parcel. The Burroughs property retains eight natural gas wells. Two of these wells are plugged and abandoned, four wells are inactive, and two wells actively produce natural gas for commercial use. Storage tanks, concrete, and site contamination at the plugged and abandoned wells were removed and cleaned up. Under terms of an agreement, inactive gas wells must be plugged and abandoned on or before July 1, 2008.

PG&E is planning to significantly strengthen the circuit located in the Burroughs Parcel. The engineers at PG&E planning this rebuilding project would coordinate with the project sponsors of the Dutch Slough project (Willoughby 2006).

Regulatory Framework

The Growth Management Element of the Oakley General Plan addresses a range of community issues, with an emphasis on ensuring that public facilities and services are maintained as the City of Oakley's population grows (City of Oakley 2002).

Fire Protection and Emergency Services

The City of Oakley's General Plan Goal 4.4 is to promote a high level of emergency preparedness to protect public health and safety in the event of a natural or human-caused disaster (City of Oakley 2002). The following policies that are applicable to this project are:

- Policy 4.4.2 Require that new development pay its fair share of costs for new fire protection facilities and services.
- Policy 4.4.6 Require the provision of fire fighting equipment access to open space areas in accordance with the Fire Protection Code and to all future development in accordance with Fire Access Standards.

The applicable program to implement the policies is:

- Program 4.4.D Afford fire protection agencies the opportunity to review development projects and submit conditions of approval for consideration to determine whether: 1) there is adequate water supply for fire fighting; 2) road widths, road grades, and turnaround radii are adequate for emergency equipment; and 3) structures are built to the standards of the Uniform Building Code, the Uniform Fire Code, other State regulations, and local ordinances regarding the use of fire-retardant materials and detection, warning, and extinguishment devices.

Law Enforcement

The City of Oakley's General Plan Goal 4.5 is to provide a high standard of police protection services for all citizens and properties throughout Oakley. The following policies that are applicable to this project are:

- Policy 4.5.2 Incorporate police protection standards and requirements into the land use planning process.
- Policy 4.5.4 The City shall strive to provide sufficient personnel and capital facilities to ensure adequate police protection and appropriate response times.
- Policy 4.5.5 Require that the Community Development Department refer, as appropriate, development proposals to the Police Department for review and comments.

WATER SERVICES

The City of Oakley's General Plan Goal 4.8 is to assure the provision of potable water availability in quantities sufficient to serve existing and future residents. The following policies that are applicable to this project are:

- Policy 4.8.12 Reduce the need for water system improvements by encouraging new development to incorporate water conservation measures to decrease peak water use.
- Policy 4.8.14 All proposals for development, including requests for building permits, within 1,000 feet of the Contra Costa Canal property line shall be referred to Contra Costa Water District for comment to ascertain the District's standards for the proposed development project.

The following program that is applicable to this project is:

- Program 4.8.C Cooperate with other regulatory agencies to control point and non-point water pollution sources to protect adopted beneficial uses of water.

WASTEWATER SERVICES

The City of Oakley's General Plan Goal 4.9 is to assure the provision of sewer collection, treatment and disposal facilities that are adequate to meet the current and projected needs of existing and future residents. The following policies that are applicable to this project are:

- Policy 4.9.1 Coordinate future development with the Ironhouse Sanitary District to ensure facilities are available for proper wastewater disposal.
- Policy 4.9.4 Reduce the need for sewer system improvements by requiring new development to incorporate water conservation measures, which reduce flows into the sanitary sewer system.

The following program that is applicable to this project is:

- Program 4.9.A Require new development to pay its fair share of the cost of on- and off-site infrastructure. This shall include installation of necessary public facilities, payment of impact fees, and participation in a Capital Improvement Program.

DRAINAGE FACILITIES

The City of Oakley's General Plan Goal 4.10 is to protect persons and property from the damaging impacts of flooding. The following policies that are applicable to this project are:

- Policy 4.10.5 Improve and expand the functionality of Marsh Creek as a major drainage corridor.
- Policy 4.10.6 Develop new drainage facilities and/or improvements to existing facilities to provide additional recreational or environmental benefit, where possible.

The following programs that are applicable to this project are:

- Program 4.10.C Pursue improvement of existing levees within the City and, as appropriate, compliance and certification from the United States Army Corps of Engineers.

- Program 4.10.G Require, upon development, the dedication of property or drainage easement adjacent to Marsh Creek to be used to increase width and capacity of the stream corridor.

3.9.2 Impacts and Mitigation Measures

Significance Criteria

Criteria for determining significant impacts are based upon the CEQA Guidelines (Appendix G) and professional judgment. These guidelines state that a project would have a significant impact on public services and utilities if it:

- Will result in substantial adverse physical impacts associated with the provision of new or physically altered government facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for fire and police protection;
- Exceeds wastewater treatment requirements of the applicable Regional Water Quality Control Board;
- Requires or results in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects;
- Requires or results in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects;
- Has sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed; or
- Results in a determination by the wastewater treatment provider, which serves or may serve the project's projected demand in addition to the provider's existing commitments.

Alternative 1: Minimum Fill

IMPACT 3.14.1.1: EFFECT ON POLICE PROTECTION

The proposed City Community Park would generate the primarily increase the demand for police services depending on the increased calls for service. The two proposed wetland restoration projects would have a minimal affect on police protection services. The proposed park and wetland restoration projects would attract visitors to the project site who wish to experience nature, sports activities, water activities, passive recreation, historic resources, the museum center, educational facilities, and other activities. The proposed amphitheater would be a focal place for events and attract up to 5,000 people throughout a day. There would be no more than five special events per year (Miller 2006).

The City of Oakley Police Department's has concluded that the proposed park would result in a substantial impact to the City of Oakley Police Department because of the demand for more service (Thorsen 2006). The City of Oakley imposes the P-6 tax on new development, which is specifically allocated for law enforcement use. The tax is used to hire additional officers, purchase new vehicles, and support other police protection needs. Fees assessed to residential developers in the City of Oakley would be adequate to fund police protection staff and equipment needed to serve the project. The potential increase in demand for police services for the proposed project would be mitigated through the fees imposed for new development.

OPEN WATER MANAGEMENT OPTIONS

The potential impacts would be the same with the open water management options.

MARSH CREEK DELTA RELOCATION OPTIONS

Not applicable.

SIGNIFICANCE AFTER MITIGATION

Less than significant impact; no mitigation required.

IMPACT 3.14.1-2: EFFECT ON FIRE PROTECTION (ALL OPTIONS)

The proposed City Community Park would primarily increase the demand for fire protection services depending on the increased calls for service. The two proposed wetland restoration projects would have a minimal affect on fire protection services because most of the restoration area would be inundated with water. The potential fire hazard caused by the proposed park would be moderate depending on the season, fuel load, and integrity of structures. Fees assessed to developers in the City of Oakley may not be adequate to fund fire protection staff and equipment needed to serve the project and cumulative development in the project area (Gonzalez 2006).

Prior to the issuance of building permits, the East Contra Costa Fire Protection District would review the proposed park plan to ensure that it complies with applicable fire codes and regulations. The codes require a development plan that provides for fire equipment ingress and egress, maximum occupancy limitations, construction techniques and materials dictated by the proposed use of the structures, and built-in fire protection systems. The District also would evaluate on-site water pressure and availability, occupancy loads (for example, for the proposed amphitheater), and sprinkler systems for buildings proposed for the park.

MITIGATION 3.14.1-2: FIRE DEPARTMENT REVIEW AND FUNDING

The City of Oakley shall incorporate recommendations by the East Contra Costa Fire Protection District on park design relating to access for fire vehicles and equipment, water pressure in proposed fire hydrants, fire safety and prevention, and other issues into the requirements for development approval (Gonzalez 2006). In addition, the City shall ensure that there is a funding mechanism implemented for the District to serve the proposed park.

SIGNIFICANCE AFTER MITIGATION

Less than significant impact; no mitigation required.

IMPACT 3.14.1-3: EFFECT ON WATER SUPPLY (ALL OPTIONS)

The two proposed wetland restoration projects would not affect water demand. Water supply concerns associated with possible contamination of CCWD'S nearby canal are addressed in the Water Quality section of this document.

The proposed City Community Park would increase the demand for water for landscaping, fire protection, drinking, and restrooms. As shown in City of Oakley's Dutch Slough Community Park and Public Access Conceptual Master Plan, the potable water system is proposed along the western and southern boundaries of the park site. It would also connect the northern end of the park, running on the west side of Emerson Slough. An extension of the water system is also proposed in areas around the lighted sports field area and Ironhouse School. The proposed restrooms, kitchens, water fountains, and other potable needs would connect to DWD's domestic water supply system. Water lines would extend from Sellers Avenue into the park. Proposed landscaping on the park site would be irrigated with groundwater from on-site wells (Miller 2006).

In the proposed City Community Park, the riparian corridor themed play areas would include constructed drainage channels that would be created as creeks. They would be fed in the summer months by water pumped from on-site windmills.

DWD would extend water mains from the Cypress Grove project from the west and to the north from Cypress Road. The water mains would be adequately sized to serve the proposed project (Yeraka 2006).

SIGNIFICANCE AFTER MITIGATION

Potentially significant impact but mitigated to less than significant by mitigation measure 3.1.1-5 (Hydrology).

IMPACT 3.14.1-4: EFFECT ON WASTEWATER

The two proposed wetland restoration projects would not affect wastewater demand or capacity. However, the Dutch Slough Restoration Project includes relocating ISD's pipeline from the toe of the Emerson parcel levee along Marsh Creek to near the top of the levee. The pipeline is buried in the Emerson parcel just beyond the toe of the Marsh Creek levee. Since 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 feet and 11 feet National Geodetic Vertical Datum of 1929 (NGVD), respectively] would be adequate for access requirements. The new pipeline would be buried two feet below the top of the levee. 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.

ISD would determine if it is better to route a sewer or force main under Marsh Creek to access ISD property or cross under the Contra Costa Canal. To the south, the Cypress Groves subdivision has sewers and a pump station. Systems to serve the Emerson/Burroughs/Gilbert properties are in the planning stages for sewers and a pump station (Skrel 2006).

The proposed City Community Park would increase the demand for wastewater treatment and disposal. As shown in the City Community Park Plan, the proposed restrooms are proposed at the west end of the park near the Emerson Point Lookout and the concession stand. Restrooms would also be in buildings on the east end of the park, such as the Gilbert Home, Ironhouse School, offices, and Caretaker's Cottage. The two wetlands restoration project would not affect sewage treatment demand.

The closest sewer is an eight-inch line on the Cypress Groves project site. There is a pump station located on Frank Hengle Way in the northeast vicinity of the Cypress Groves development. Adequate wastewater facilities can be provided for the park (Skrel 2006). Therefore, potential impacts would be less than significant and no mitigation is required.

OPEN WATER MANAGEMENT OPTIONS

The potential impacts would be the same with the open water management options.

MARSH CREEK DELTA RELOCATION OPTIONS

A pipeline crosses over Marsh Creek to the Emerson parcel at a footbridge and would be moved into the Marsh Creek levee. A bridge would span the Marsh Creek diversion to allow for a trail and maintenance of the pipeline. If the creek is diverted on-site downstream of the existing pipeline crossing, the pipeline may need to cross the creek diversion at the new bridge. Such a bridge would be provided as part of the project. This impact is less than significant.

SIGNIFICANCE AFTER MITIGATION

This impact is less than significant and no mitigation is required.

IMPACT 3.14.1-5: EFFECT ON STORM DRAINAGE (ALL OPTIONS)

The project would increase the demand for storm drainage on the park component of the proposed project, not including the Ironhouse parcel. The majority of the park site would be 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. Water quality swales would be installed at all major parking areas. Drainage from the western portions of the park would be directed to constructed creek channels designed to also serve as water quality features. Potential impacts would be less than significant and no mitigation is required.

SIGNIFICANCE AFTER MITIGATION

This impact is less than significant and no mitigation is required.

IMPACT 3.14.1-6: EFFECT ON ELECTRICAL AND GAS TRANSMISSION FACILITIES (ALL OPTIONS)

The City Community Park would increase the demand for electrical and gas transmission on the project site. The two wetland restoration projects would not affect electrical and natural gas demand. All utility service lines would be underground within the park. Electrical lines would be extended from Sellers Avenue into the proposed park. Inactive wells and power lines that are no longer needed would be removed, closed, or demolished as part of site preparation.

Electricity would be supplied to the west end of the park near the Emerson Point Lookout, the lighted ball fields, and the concession stand. It would also be needed in buildings on the east end of the park, such as the Gilbert Home, Ironhouse School, offices, and Caretaker's Cottage. New electrical and gas facilities would be constructed to accommodate the proposed structures, facilities, and buildings. Existing electrical and gas facilities would be altered, expanded, or demolished. PG&E has adequate capacity to serve the proposed project (Willoughby 2006). Potential impacts would be less than significant and no mitigation is required.

The alignment of the new east levee on the Burroughs parcel (as part of the Dutch Slough Restoration Project) would protect and preserve access to PG&E's electric transmission line, high-pressure gas line, and gas gathering line. These PG&E lines cross the northeast corner of the Burroughs parcel, which would not be restored to tidal marsh. The new levee would be immediately west of Jersey Island Road and the easement for PG&E's electric transmission line. It would preserve the existing level of flood protection for the area northeast of the new levee. The final project design would ensure that the PG&E facilities would remain fully accessible to PG&E crews.

As part of the of the Dutch Slough Restoration Project planning process, the Dutch Slough Restoration Project sponsors would coordinate with PG&E to assure to PG&E's satisfaction that the project would not interfere with their transmission lines and other facilities (PWA 2006).

SIGNIFICANCE AFTER MITIGATION

This impact is less than significant and no mitigation is required.

Cumulative Impacts

Cumulative impacts on public services and utilities are considered in the context of the service area of the service providers. The potential increase in demand for police services, fire services, water supply, wastewater treatment and disposal, electrical transmission, and gas transmission that could result from the proposed project would be a minor increment of the total demand. The primary demands would be from the numerous residential developments proposed, approved, or under construction in the project area. Services and utilities are made available as those developments proceed. As noted above, fees and taxes associated with those developments, as well as monthly utility charges, are intended to mitigate their impacts on services and utilities. No additional mitigation is required.

Alternative 2: Moderate Fill Alternative

IMPACT 3.14.2-1: EFFECT ON POLICE PROTECTION

Potential impacts would be the same as under Alternative 1.

IMPACT 3.14.2-2: EFFECT ON FIRE PROTECTION

Potential impacts would be the same as under Alternative 1.

IMPACT 3.14.2-3: EFFECT ON WATER SUPPLY

Potential impacts would be the same as under Alternative 1.

IMPACT 3.14.2-4: EFFECT ON WASTEWATER

Potential impacts would be the same as under Alternative 1.

IMPACT 3.14.2-5: EFFECT ON STORM DRAINAGE

Potential impacts would be the same as under Alternative 1.

IMPACT 3.14.2-6: EFFECT ON ELECTRICAL AND GAS TRANSMISSION

Potential impacts would be the same as under Alternative 1.

Alternative 3: Maximum Fill

IMPACT 3.14.3.1: EFFECT ON POLICE PROTECTION

Potential impacts would be the same as under Alternative 1.

IMPACT 3.14.3.2: EFFECT ON FIRE PROTECTION

Potential impacts would be the same as under Alternative 1.

IMPACT 3.14.3.3: EFFECT ON WATER SUPPLY

Potential impacts would be the same as under Alternative 1.

IMPACT 3.14.3.4: EFFECT ON WASTEWATER

Potential impacts would be the same as under Alternative 1.

IMPACT 3.14.3.5: EFFECT ON STORM DRAINAGE

Potential impacts would be the same as under Alternative 1.

IMPACT 3.14.3.6: EFFECT ON ELECTRICAL AND GAS TRANSMISSION

Potential impacts would be the same as under Alternative 1.

Alternative 4: No Project

Public services and utilities would remain the same as under existing conditions under this alternative. No new facilities would be constructed and no existing facilities would be altered, expanded, or demolished. No new demand would be created. Therefore, this alternative would have no impacts on Public Services and Utilities.

Insert tab titled

3.15 - Hazards

3.15 HAZARDS AND HAZARDOUS MATERIALS

This section describes known soil contamination on the Dutch Slough Restoration Project and Related Projects sites as a result of past agricultural uses. It is based on Phase I and II Environmental Site Assessments (ESAs) for the Burroughs, Gilbert, and State-owned portions of the Emerson parcels and on soil sampling performed on the adjacent Ironhouse parcel. The Ironhouse parcel is the potential source for imported soils to be used as fill if Alternatives 2 or 3 are carried out. It should be noted that no ESA has been conducted for the City Community Park Project site due to access limitations. Issues associated with groundwater quality and groundwater contamination are addressed in Section 3.2, Water Quality.

3.15.1 Affected Environment

Phase I Environmental Site Assessments (Phase I ESAs) for the Emerson, Gilbert and Burroughs Parcels

Phase I Environmental Site Assessments (Phase I ESA) were performed in January 2003, for the Emerson, Gilbert and Burroughs Parcels. The Site Assessments included a review of historical records and aerial photographs for each property and of the regulatory databases maintained by county, state and federal agencies, in a search for potential hazards. In addition, a follow-up, Phase I/II study was performed of the soil and groundwater in and around the six inactive and one active gas well on the Burroughs Property, and another follow-up soil and groundwater testing report was conducted in July 2003 for the State-owned portions of the Emerson properties. The Department of Water Resources (DWR) reviewed these documents in various memoranda in 2003 and concluded that the landowners had complied with their recommendations.

EMERSON PARCEL

The Phase I ESA, dated January 29, 2003, was performed by ENGEO Inc. on behalf of Mr. Stan Emerson (ENGEO, Inc. 2003a). Contra Costa County Building Inspection Department, Community Development Department and Assessors Office were contacted for information about the property. Historical aerial photographs dating back to 1953 were reviewed. The ESA noted that the property was used for cattle grazing as part of the Emerson Dairy operations. The only developments on the property were livestock pens. There was also a small vineyard.

The Phase I ESA included a search for of records pertaining to the property in the following agency databases: Contra Costa County Hazardous Materials Division; California Environmental Protection Agency (CAL-EPA) Department of Toxic Substances Control (DTSC); State Regional Water Resources Control Board (SRWCB); California Regional Water Quality Control Board (RWQCB); State Division of Oil and Gas (DOG); Environmental Protection Agency (Region IX). Maps of the geologic, hydrologic and topographic characteristics of the site also were reviewed. The site also was observed for visible signs of contamination and past owners and occupants were interviewed.

County, state and federal records and databases were checked to see if there were any National Priority List (NPL) sites, Resource Conservation and Recovery Act (RCRA) treatment/storage/disposal facilities, or state NPL/CERCLIS equivalent sites within one mile of the property. No registered hazardous waste generators were documented within a quarter mile of the property. Four registered underground storage tank facilities (UST) were listed within a quarter mile of the property and two of these were listed as active. One leaking underground storage tank site at Food and Liquor #86 at 101 Cypress Road is within a half mile of the property but the consultants concluded this was unlikely to have impacted the property (ENGEO, Inc. 2003a).

Follow-up soil and groundwater testing of portions of the site to evaluate nitrate/nitrite contamination was conducted in June 2003. That assessment included testing of eight soil samples and seven groundwater samples. That study found nitrite and nitrate levels well below the USEPA's residential and aquatic toxicity criteria (ENGEO, Inc. 2003d).

GILBERT PARCEL

The Phase I ESA, dated January 15, 2003 was performed by Sequoia Environmental Consulting Services on behalf of Mr. Brent Gilbert (Sequoia Environmental Consulting Services, 2003). The Phase I for the Gilbert Parcel was similar to that performed by ENGEO Inc. on the two parcels to the west and east, but also included an asbestos and lead-based paint survey. The California Environmental Protection Agency (CalEPA) performed air sampling to determine the presence of radon gas. Depth to groundwater was determined to be approximately five feet below surface.

The ESA noted that the property was used for cattle grazing and included some related structures such as a horse and feeding barn and an abandoned shed. Two gas wells managed by Tonka Energy Corp. were located in the east and southeast corners of the property.

BURROUGHS PARCEL

The Phase I ESA, dated January 29, 2003, was performed by ENGEO Inc. on behalf of Mr. Robert Burroughs (ENGEO, Inc. 2003b). The Phase I ESA for the Burroughs Parcel (ENEGO, Inc. 2003b) used the same methodology as for the Emerson Parcel. The ESA noted that most of the property was undeveloped open space. There was a residential/ranch complex and abandoned dairy. Seven gas wells, of which only one was still active, four were idle and two were plugged, and associated structures including storage tanks, were also found on the property.

A additional investigation of the soil and groundwater around the six inactive and one active natural gas wells was also performed by ENGEO Inc. for Mr. Robert Burroughs and is dated July 30, 2003 (ENGEO, Inc. 2003c). The Phase II Natural Gas Well Site Assessment (ENEGO, Inc. 2003b) was performed to follow up on possible areas of concern found in the Phase I. This work included the following field and laboratory investigations:

- Excavation of 53 exploratory test pits 24 to 30 inches in depth across the gas well sites
- Recovery of 14 composite soil samples from the exploratory trenches
- Recovery of four, four-point composite soil samples from the area of the four remaining meter sheds
- Seven *Geoprobe* borings at the well site with groundwater sampling
- Laboratory analysis of the soil and groundwater samples for the following:
    - Test Pits: Total Petroleum Hydrocarbons (TPH) as gas, diesel, motor oil, benzene/toluene/ethylbenzene/xylenes (BTEX); barium and mercury

- Meter Sheds: mercury
- Groundwater Samples from Test Pits: Total Petroleum Hydrocarbons (TPH) as gas, diesel, motor oil, benzene/toluene, ethylbenzene, xylenes (BTEX)

Results and Potential Concerns

EMERSON PARCEL

The Phase I ESA for the Emerson Parcel (ENGEO, Inc. 2003b) did not find any mention of the property or of nearby properties in any agency records consulted, with one exception: the Emerson Dairy was listed on the Contra Costa County Hazardous Substances Database and a request for a Hazardous Material Business Plan was found in a review of the facility file. No other information was available. ENGEO, Inc. found no areas of concern other than the possibility of elevated levels of nitrate in soil and groundwater, given the past use of the property for cattle-raising.

Further testing was carried out of groundwater and soil (ENGEO, 2003d). Results showed nitrate levels higher than established drinking water guidelines, but DWR (2003h) concluded that groundwater beneath the property would not be used for drinking, was anyway unlikely to come into contact with surface water and would be diluted by tidal water on inundation of the site.

DWR (2003c) recommended that ENGEO, on behalf of the site owners, provide additional information on: an abandoned gas well; a water well (and its proper decommissioning); railroad ties and telephone poles that could have been treated with a wood preservative containing arsenic, copper, chromium and zinc; if the pole-mounted transformers ever contained PCBs; characterize the debris piles and recommend methods for their disposal; and perform a cultural resources records search.

The landowners were found to have substantially complied with DWR when DWR (2003d) and Department of General Services (DGS 2003) performed further site inspections in 2003. DWR and DGS concluded that: two sites for gas wells had been drilled but no pipes installed and the locations would be noted on a topographic map; PCBs that were formally present in the pole-mounted transformers had been removed; the solid waste and debris piles had been removed. In-ground fence posts with pressure-treated wood would remain in the ground and would be removed with the other structures when restoration proceeded. DWR made their final inspection of the Emerson parcel on August 26, 2003 (DWR 2003e).

GILBERT PARCEL

The Phase I ESA for the Gilbert Parcel (Sequoia Environmental Consulting Services 2003) did not find any mention of the property or of nearby properties in any agency records consulted with one exception: the California Oil and Gas Well Report listed two gas wells on the property.

Inspection of the gas wells indicated some leaks around joints in the pipes and noted the potential for subsurface contamination. The asbestos and lead-based paint inspection showed that asbestos-containing materials were present in the shed but lead-based paint was not detected. Air sampling did not show any excessive exposure to radon.

DWR (DWR 2003a) recommended Sequoia, on behalf of the site owners, provide additional information on: the gas wells; water well (and its proper decommissioning); chemicals used in the treatment of the wood posts; sewage system used at the single-family residence; historic use and storage of hazardous materials at the site, in particular 55-gallon drums and pole-mounted transformers that could have contained PCBs; abandoned vehicles and machines and debris piles; onsite treatment and disposal of effluent from cattle-grazing activities; and perform a cultural resources records search.

The landowners were found to have substantially complied with DWR when DWR (2003d) and Department of General Services (DGS, 2003) performed further site inspections in 2003. DWR and DGS concluded that: the three idle gas wells would be plugged and abandoned by the end of 2003; the above-ground fuel tank and all 55-gallon drums had been removed as had any surface residue; the pole-mounted transformers formerly PCBs but the PCBs had been removed; the solid waste and debris piles had been removed; the manure separation area east of the barn and the barn itself had not been used for dairy operations for some time and did not pose any threats to the environment. DWR made their final inspection of the Gilbert parcel on August 26, 2003 (DWR 2003e).

BURROUGHS PARCEL

The Phase I ESA for the Burroughs Parcel (ENGEO, Inc. 2003b) noted the following concerns:

- Soil or groundwater around the structures associated with the natural gas wells might be impacted by hydrocarbons, mercury or barium. A Phase II investigation was recommended (see below).
- Soil near the above-ground fuel tanks might be impacted due to past use of these tanks and this should be investigated further if the tanks were removed.
- Soil near the carport/garage might be impacted due to possible discharges of motor oil, fuels or solvents and this should be investigated further if the structures were removed.
- Asbestos-containing materials and lead-based paint could be contained in the structures and that this should be assessed prior to demolition.
- Septic systems/water wells should be removed in accordance with current regulations.

The Phase II Natural Gas Well Site Assessment (ENGEO, Inc. 2003c) concluded the following:

- There were did no significant petroleum hydrocarbon impacts for near surface soil at the well sites, with the exception of around the active Well #5 (Tonka 6-1). There were visible impacts to soil around the compressor unit at that well site.
- There were no significant barium or mercury impacts with the exception of the meter shed area of Well #7 (Tonka 3-2). The mercury concentration of 40 ppm exceeded both State hazardous waste criteria and the USEPA Preliminary Remediation Goal (23 ppm).
- Detectable petroleum hydrocarbons were reported in groundwater at four of the seven well sites. No BTEX was reported for the seven well sites. The reported diesel/gas concentrations at the well sites of five and seven exceeded the water quality goals established by the Central Valley Regional Water Quality Control Board. According to ENGEO, Inc, because the shallow aquifer underneath the Burroughs site was unlikely to be considered a municipal water source, the hydrocarbon contamination in groundwater was not a significant environmental concern.

DWR (2003b) recommended ENGEO provide, on behalf of the site owners, additional information on: the gas wells; water wells (and their proper decommissioning); septic systems from the single-family residence and an asbestos and lead-based paint survey if they are demolished; historic and current use of hazardous materials at the site (such as the 55-gallon drums of petroleum products); an inventory made of the vehicles and abandoned farm equipment and characterization of the composition of the waste piles be characterized; onsite treatment and disposal of the effluent from the dairy and cattle-grazing activities; a complete inventory of all material stored at the dairy farm and related structures; and a cultural resources records search.

The landowners were found to have substantially complied with DWR when DWR (2003d) and Department of General Services (DGS 2003) performed further site inspections in 2003. DWR and DGS found that: the idle gas wells on the property would be plugged and abandoned within five years and the mercury and petroleum contamination identified at two of the drilling pads would be removed prior to the close of escrow; the chemicals used in the ongoing farming operation would be removed on termination of the lease and other chemicals had already been removed; surface-contaminated soil beneath the above-ground fuel tanks had been removed but further remediation was planned; abandoned vehicles and machinery had been removed and those in active use could remain for the time being; wood debris piles had been removed; there was no evidence of animal waste concentrations because the site had not been used as a dairy for years; the 30-gallon drum had been removed from the dairy farm and all of the buildings had been emptied and cleaned.

The landowners contracted with ENGEO to remove the petroleum-contaminated soil at the above-ground tank site and the petroleum/mercury-contaminated soil at the well site (DWR 2003f). Phase II remediation activities on the Burroughs property were completed and a final inspection made October 10, 2003 (DWR 2003e). The petroleum and petroleum/mercury-contamination soil was excavated and removed at the above-ground fuel tank and gas well site. Residual petroleum from beneath the tank was considered to be at levels too low to be of significant concern.

Soil Sampling of the Ironhouse Parcel

Soils from the Ironhouse parcel were analyzed by Stellar Environmental Solutions, Inc. (SES) in August 2006. Samples were taken from above two feet above mean sea level to obtain information about the soil that would be used to fill areas of open water if Alternatives 2 or 3 are carried out in restoration of the main part of the site. Three vertical sample sets were collected at five locations for a total of 15 samples analyzed. The locations for sampling included areas known by the Sanitary District to have received proportionately more, or less, wastewater. As results were relatively similar (despite the different lithologies of the samples), it was concluded by SES that the samples were representative of the site in general and no further sampling was necessary.

Samples were analyzed for CA Title 22 (CAM 17) Metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium and zinc) semi-volatile organic compounds (SVOCs) and polynuclear aromatic hydrocarbons (PAHs); chlorinated herbicides; ammonia (as nitrogen) and chloride; and total petroleum hydrocarbons (motor oil range). No SVOCs, PAHs or herbicides were detected above the reporting limits. Petroleum hydrocarbons (diesel and motor oil grade) were reported at low concentrations (averaged 18.5 mg/kg), dominantly in the near surface (upper one foot) of soil. Petroleum hydrocarbons were found at low concentrations near to the ground surface. Metals were present at concentrations too low to be of concern according to criteria for reuse of dredged materials established by San Francisco Regional Water Quality Control Board (SFRWQCB, 2000).

A fuller discussion of the analyses of Ironhouse parcel soil is included in Section 3.2 on Water Quality because the Ironhouse soils may be used as fill for the main part of the site and may therefore affect water quality at that location.

Vectors

The Dutch Slough Restoration Project and Related Project sites support extensive seasonal and freshwater perennial wetlands similar to those of managed wetlands in the Central Valley and Suisun Marsh. They are also substantially similar in terms of potential mosquito breeding habitat. Mosquito production in wetland habitats in the Dutch Slough setting, however, differs in being directly adjacent to proposed extensive residential development (sensitive human receptors) on adjacent parcels, and being integrated with a recreational community park surrounded by tidal wetlands or managed wetlands (depending on alternatives and design options). Mosquito species differ in their potential to act as vectors for human diseases known to occur or have occurred in California, such as West Nile Virus, malaria, encephalitis viruses, and other pathogens.

Depending on seasonal and environmental conditions and the particular mosquito species involved, it generally takes from three to twelve days for a mosquito to complete its life from developed egg to early adult stage. In general, as temperature increases, the number of days required from hatching to emergence as an adult decreases. The potentially rapid life-cycle of mosquitoes can result in rapid, eruptive mosquito populations related to relatively short-term variations in marsh flooding and emergence, or seasonal tidal cycles.

There are four principal pest mosquitoes (*Ochlerotatus melanimon, Culex tarsalis, Culex erythrothorax, Anopheles freeborni*) that can be produced in freshwater (or fresh-brackish) perennial and seasonal marshes, and which been the subjects of control efforts by Mosquito Vector Control Districts (MVCDs) in the Central Valley. These four species can be categorized by life history and associated wetland habitats.

FLOODWATER MOSQUITOES *(OCHLEROTATUS MELANIMON)*

Floodwater mosquitoes have been identified as a primary nuisance species and as secondary or "bridge" vectors for California encephalitis virus and western equine encephalitis, and are considered moderately effective as vectors of West Nile Virus. The life cycle of the floodwater mosquito begins with flooding of ground that has undergone a dry period. Females lay their eggs singly on drying soil of seasonal wetlands, in leaf litter, in cracks in the soil, or at the bases of grasses and other plants in areas that have been flooded previously. Once flooded, eggs that were laid during the previous dry cycle hatch, pupate, and emerge as adults. Eggs are very drought resistant. Within the project site, floodwater mosquitoes are likely to be risks associated with seasonal wetlands that undergo seasonal or periodic wetting/flooding/drying cycles, such as irrigated pasture, alkali-meadow, freshwater marshes in drought years, or ruderal areas.

STANDING WATER MOSQUITOES (CULEX TARSALIS, CULEX ERYTHROTHORAX, ANOPHELES FREEBORNI)

Culex tarsalis is considered the primary vector for western equine encephalomyelitis virus to humans and horses. It is the primary vector for St. Louis encephalitis virus in humans. *Culex tarsalis* has also been identified as a primary vector of West Nile virus in the western United States. Females lay their eggs on the water surface in rafts of 100-150 eggs. Eggs hatch within one day after deposition.

The larval stages can be found in almost any source of standing, sheltered water in marshes. During the summer, development from egg to adult takes about seven to nine days. Peak populations of *C. tarsalis* occur in late June or early July, but may continue into late summer. Adults can emerge throughout the summer and fall in marshes that have been flooded for more than two or three weeks. Within the existing project area, *C. tarsalis* may be associated with seasonal ponds (freshwater marsh). Within proposed restoration habitats, *C. tarsalis* could be associated with managed open water areas or isolated, marginal ponded habitats within restored freshwater tidal marsh.

Culex erythrothorax is highly susceptible to West Nile Virus infection and may act as a bridge vector of this virus in California. These mosquitoes prefer to deposit their egg rafts within thick aquatic or marsh vegetation in ponds, often over relatively deep water. The larvae can be difficult to sample because they are extremely sensitive to physical disturbances (e.g. vibrations from the collector's footsteps or dipper), and tend to remain submerged longer than other mosquito species after being disturbed. They tend to remain sheltered among dense shoots and foliage of wetland plants, making detection and treatment difficult. There they remain relatively inaccessible to mosquito predator fish. Within the existing project area, *C. erythrothorax* may be associated with seasonal ponds (freshwater marsh). Within proposed restoration habitats, *C. erythrothorax* could be associated with margins of managed open water areas, isolated, marginal ponded habitats, or poorly drained areas within restored freshwater tidal marsh.

Anopheles freeborni is a potential a vector of malaria in the western United States, where three major outbreaks occurred in the last 40 years. This species also occurs in the Central Valley and is numerous during the summer, peaking in late July or August. Ricefields, and semi-permanent and permanent wetlands are the primary production areas for this species, although the immature stages are also found in ditches, seepages, and sloughs. Females lay their eggs singly on the surface of the water where they hatch approximately 24 hours later. In autumn, females enter a semi-dormant or resting state (diapause). In winter, warm day temperatures may cause them to become active and seek blood meals. After obtaining a blood meal, many females resume their over-wintering state until April or May when they begin laying eggs once more. The females will readily bite humans and livestock. Within the existing project area, *Anopheles freeborni* may be associated with seasonal ponds (freshwater marsh). Within proposed restoration habitats, *Anopheles freeborni* could be associated with margins of managed open water areas, isolated, marginal ponded habitats, or poorly drained areas within restored freshwater tidal marsh.

3.15.2 Impacts and Mitigations

Significance Criteria

Criteria for determining significant impacts are based upon the CEQA Guidelines (Appendix G) and professional judgment. These guidelines state that a project would have a significant impact on to public health and safety if it:

- Creates a significant health or safety hazard to workers associated with the construction of the proposed park and wetlands.
- Creates a significant health hazard to the public or sensitive sub-populations (e.g., children) through the routine use or transport of hazardous materials.

- Creates a significant hazard to workers or the public through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment.

As noted in the introduction to this section, water quality impacts associated with soil contamination are addressed in that section of the EIR.

Criteria for significance of mosquito vector impacts would include:

- Changes in the demand for MVCD activities within the project area that would consistently exceed normal (long-term average) costs for managing the Dutch Slough wetlands, adjusted for residential population (receptor) increases beyond the control of the project.
- Substantial changes in the type or frequency of MVCD activities (monitoring or treatment) or equipment needed to maintain existing levels of mosquito production.
- Epidemiologically substantial changes in the frequency of mosquito-born illnesses that correspond with proximity of residence to the project site, or frequency of visits to the site.

Alternative 1: Minimum Fill

IMPACT 3.15.1-1: EFFECTS OF DUTCH SLOUGH RESTORATION PROJECT AREA SOILS CONTAMINATION (ALL OPTIONS)

Workers on the Dutch Slough Restoration Project site could be exposed to hazardous conditions associated with natural gas wells on the property. In addition, as described above, some higher levels of soils contamination were found in association with those wells on the Burroughs parcel; a detailed assessment of the natural gas well sites on the Gilbert parcel has not yet been performed, but preliminary assessment indicated that some contamination may occur near those wells. Exposure to high nitrate levels on the former cattle waste pond area on the Emerson parcel would not have any human health effects.

MITIGATION 3.15.1-1: EFFECTS OF SOILS CONTAMINATION (ALL OPTIONS)

A. The Dutch Slough Restoration Project shall comply with the ESA recommendations regarding the natural gas well sites. Specifically, the remaining appurtenances at the plugged and abandoned wells shall be removed, mercury impacted soils at Well Site #7 shall be excavated and removed for disposal and hazardous materials management practices at active Well Site #5 shall be reviewed: Petroleum impacted soils should be excavated and removed for disposal. The status of the remaining idle well sites (#3, #8, #11, #16) shall be determined and if they are not to be retained for future operation they shall be properly plugged and abandoned.

B. Prior to development of the Dutch Slough Restoration Project, a Phase II ESA shall be performed to identify any hazardous materials issues associated with natural gas wells on the Gilbert parcel, and any remediation recommendations in that report shall be implemented.

C. Prior to development of the City Community Park, Phase II ESA shall be performed to identify any hazardous materials issues associated with the former cattle waster pit on the Emerson parcel, and any remediation recommendations in that report shall be implemented.

SIGNIFICANCE AFTER MITIGATION

Implementation of mitigation 3.15.1-1, above, would reduce this impact to a less than significant level.

IMPACT 3.15.1-2: HEALTH RISKS ASSOCIATED WITH DEMOLITION ACTIVITIES (ALL OPTIONS)

As noted in the Phase I and Phase II environmental studies prepared for various site parcels, asbestos-containing materials and lead-based paint could be contained in the structures proposed for demolition to clear the site for Dutch Slough Restoration Project and City Community Park development. Most of these structures would be associated with the City Park property. There are no structures on the Ironhouse Project site.

MITIGATION 3.15.1-2: HEALTH RISKS ASSOCIATED WITH DEMOLITION ACTIVITIES (ALL OPTIONS)

All structures proposed for demolition shall be assessed for asbestos and lead-based paints, and all recommendations of those evaluations shall be implemented. Details of these evaluations for the City Community Park property shall be included in the subsequent CEQA documentation for the park .

SIGNIFICANCE AFTER MITIGATION

Implementation of mitigation 3.15.1-2, above, would reduce this impact to a less than significant level.

IMPACT 3.15.1-3: HEALTH EFFECTS TO WORKERS ASSOCIATED WITH DISTURBANCE OF SOILS FROM IRONHOUSE PARCEL (ALL OPTIONS)

Under Alternative 1, no additional fill material would be imported to the Dutch Slough Restoration Project site, although the soils would be disturbed in the Ironhouse parcel from the restoration of the Ironhouse Project. Based on the preliminary soil sampling results form the Ironhouse parcel, this impact is considered insignificant.

IMPACT 3.15.1-4: HEALTH EFFECTS FROM MOSQUITOES

The specific design or habitat features of wetland restoration alternatives, including specific design options, that are most relevant to human health relate to (a) mosquito production (frequency, type, abundance and location of mosquitoes produced), and (b) human exposure to mosquitoes by either dispersal of mosquitoes from source areas, or entry of source areas (marshes, sloughs) by humans.

Specific marsh habitat features that are most likely to be risks for excessive production of mosquitoes include:

(a) Poorly drained, flat to gently sloping sheltered marsh areas with gradually fluctuating water levels, low turbulence, and rich organic matter from decomposition. Marsh plains edged by artificial berms that obstruct sheetflow drainage across marshes are likely to be associated with this mosquito subhabitat.

(b) Areas of dense marsh vegetation with minimal access to fish predators, strong surface currents, or exposure to wind-generated waves.

(c) Areas of gradual seasonal fluctuation in water levels, alternating between wetted and desiccated ground.

Conversely, marsh habitat features that are inherently likely to constrain mosquito production are associated with strong daily tidal fluctuation and currents, exposure to surface turbulence (wind-waves, currents) of open water surfaces, and exposure to fish predators that are widespread in tidal sloughs. Unlike managed marshes with artificial engineering designs, the basic purpose of tidal restoration is to replicate as much of the ecological structure, composition, and patterns of natural or historic tidal marshes to the greatest extent feasible. This may limit the range of compatible marsh design features (or Best Management Practices) for mosquito management and that are traditionally applied to managed marshes in the Central Valley and Suisun Marsh.

Dutch Slough Restoration Project alternatives and options differ in the extent to which they contribute to potential increases or decreases of mosquito production relative to existing conditions. Generally, deep (over 2 ft) open water areas are likely to be unproductive of mosquitoes. Low intertidal marshes (tule marshes with bed elevations near Mean Low Water) with full tidal range are also unlikely to produce mosquitoes. Marsh types or options that have variably higher risk of mosquito production would include: (a) interior areas of mid-intertidal or high intertidal marsh, remote from tidal channels; (b) zones of wrack (tidal debris) accumulation within the marsh plain or marsh edge, particularly at downwind ends (corners) marshes or near topographic high areas; (c) channel reaches that develop obstructed circulation (e.g., blockage by debris jams); (d) marsh areas that are exposed to flood deposits of sediment leaving variable topography, drainage, and debris; (e) any constructed seasonal wetlands or isolated ponds.

Alternative 1 includes the greatest areas of open water and terrestrial habitat, and thus the least potential for mosquito production. Alternative 1 is likely to reduce levels of mosquito production below those of existing conditions because it significantly reduces seasonal wetland areas and unmanaged (slow seasonal drawdown) nontidal freshwater marsh. Some mosquito production would occur along gently sloped margins of tidal marsh (essential to restoration of native species diversity in restored tidal marsh), and marsh plains edged by berms. Some mosquito production (possibly above existing conditions) may be caused by non-tidal open water management options. Alternative 1 would increase exposure of humans to mosquito production compared with existing conditions by increasing public access and exposure time to wetland habitats. The exposure would vary with time of day, temperature, humidity, and wind conditions (generally greatest around dusk in summer).

The Ironhouse Project would create a narrow, slender tidal marsh unit that would tend to trap flood debris and sediment, and has a high perimeter:area ratio compared with the main Dutch Slough Restoration Project area. It is designed to maximize marsh plain area, and it is drained by a single elongated channel. This unit would have a substantially higher potential for mosquito production overall and per unit area compared with the main units. It is also directly adjacent to and downwind (thermal Bay-Delta breezes) of a newly developed residential area.

MARSH CREEK DELTA RELOCATION OPTIONS

The Marsh Creek Delta relocation options (see Figure 2-13) vary in the degree to which new flood deposits (coarse sediment, debris jams) across marsh plains with pre-existing tidal channels may cut off isolated channel segments (creating channel pools). Option 3 has the greatest potential to create coarse sediment/debris obstructions or dams in front of the greatest total length of constructed channels, thus creating the greatest amount of poorly circulating, sheltered vegetated pool habitat for mosquito breeding. Option 1 has the least potential to impound tidal channel flows, but has high potential to create high deltaic marsh plains (effectively seasonal marsh) near the limits of tide (low tidal energy). Option 2 has intermediate but high potential for channel obstruction and impoundment by deposition of coarse flood sediment and debris.

OPEN WATER MANAGEMENT OPTIONS

Options for open water management based on tidal flows (skeletal marsh channels, deep subtidal, shallow subtidal with native SAV planting) all have low potential for mosquito production, because all include extensive, turbulent, unsheltered open water surfaces with significant daily tidal range. Managed nontidal options (managed pond, subsidence reversal/managed tule marsh) have substantial potential to produce mosquitoes if they are not managed according to regional Best Management Practices for mosquito abatement.

MITIGATION 3.15.1-4.1: ADAPT AND APPLY REGIONAL (CENTRAL VALLEY/SUISUN) BEST MANAGEMENT PRACTICES (BMPS) FOR MANAGED MARSHES TO TIDAL MARSHES

Adapt BMPs for managed marsh to be compatible with basic ecological restoration objectives of freshwater tidal marsh restoration in the western Delta, following applicable precedents from San Pablo Bay (Petaluma, Napa-Sonoma) and Suisun and Grizzly Bay marshes, in consultation with Contra Costa, Solano, and Marin-Sonoma MVCDs, the California Department of Fish and Game, and the U.S. Fish and Wildlife Service. Add tidal marsh MVCD activities to regional permits for MVCD activities in wetlands in the Central Valley.

MITIGATION 3.15.1-4.2: ADAPT AND APPLY REGIONAL (CENTRAL VALLEY/SUISUN) BEST MANAGEMENT PRACTICES (BMPS) FOR MANAGED MARSHES TO OPEN WATER MARSHES

BMPs are habitat-based strategies that can be implemented when needed for mosquito control in managed wetlands. These strategies represent a range of practices that wetland managers can incorporate into existing habitat management plans or in the design of new wetland restoration or enhancement projects. Ideally, BMPs can be used to decrease the production of mosquitoes and reduce the need for chemical treatment without significantly disrupting the ecological character, habitat function, or wildlife use in managed wetlands. Not all BMPs would be appropriate for a given wetland location or set of circumstances.

TIMING OF MANAGED MARSH FLOODING AND DRAWDOWN (NONTIDAL MANAGED OPEN WATER OPTIONS). Timing of flooding and drawdown shall be coordinated with local MVCD, adapted to current-year temperature, rainfall patterns, and mosquito vector risks, to minimize mosquito production and vector risks.

RAPID FLOODING AND DRAWDOWN OF MANAGED MARSH. Marshes shall be flooded and drawn down (emerged bed) as quickly as operational controls allow.

WATER CONTROL. Once wetlands have been flooded, water surface elevations shall minimally fluctuate prior to drawdown, except during winter periods of low mosquito production. Minimal fluctuation is based on the need to circulate water (maximize turnover). Marsh submergence depths shall be managed to maximize areas with minimal initial flooding depths of two feet (twenty four inches).

WETLAND DESIGN FEATURES TO REDUCE MOSQUITO PRODUCTION. Managed wetland edges shall be constructed to enable efficient access by MCVD field crews for monitoring and treatment. Edge slopes of managed nontidal marsh areas shall be steeper than to 4:1 (horizontal:vertical). Open water areas with sufficient fetch and wind-wave turbulence to minimize mosquito production shall be interspersed within managed marsh, at least 20% of total area. Floating aquatic vegetation shall be actively suppressed in open water areas within managed marsh.

MITIGATION 3.15.1-4.3: MODIFY DESIGN OF IRONHOUSE RESTORATION PROJECT (IRONHOUSE PROJECT ONLY)

Modify design of Ironhouse Project to minimize trapping of coarse sediment and debris (reduction or elimination of overflow zones), and to minimize recurrent creation of complex backwater marsh areas with poor drainage and difficult access for MCVD field crews. Enlarge channel cross-section area to improve tidal drainage and circulation. Install coarse debris screens at the single channel mouth at Marsh Creek to minimize debris jams that may create backwater marsh areas or channel pools (standing water mosquito habitat). Pre-install coarse woody debris in this marsh unit to compensate for wildlife habitat loss due to reduction in variable-size debris.

IMPACT SIGNIFICANCE AFTER MITIGATION: Less than significant

Alternative 2: Moderate Fill Alternative

IMPACT 3.15.2-1: EFFECTS OF DUTCH SLOUGH RESTORATION PROJECT AREA SOILS CONTAMINATION (ALL OPTIONS)

This impact would be similar to that of Alternative 1.

MITIGATION 3.15.2-1: EFFECTS OF DUTCH SLOUGH RESTORATION PROJECT AREA SOILS CONTAMINATION (ALL OPTIONS)

Same as for Alternative 1

SIGNIFICANCE AFTER MITIGATION

Implementation of mitigation 3.15.1-1, above, would reduce this impact to a less-than-significant level.

IMPACT 3.15.2-2: HEALTH RISKS ASSOCIATED WITH DEMOLITION ACTIVITIES (ALL OPTIONS)

This impact would be similar to that of Alternative 1.

MITIGATION 3.15.2-2: HEALTH RISKS ASSOCIATED WITH DUTCH SLOUGH RESTORATION PROJECT AREA DEMOLITION ACTIVITIES (ALL OPTIONS)

Same as for Alternative 1

SIGNIFICANCE AFTER MITIGATION

Implementation of mitigation 3.15.1-2, above, would reduce this impact to a less than significant level.

IMPACT 3.15.2-3: HEALTH EFFECTS TO WORKERS ASSOCIATED WITH DISTURBANCE OF SOILS FROM IRONHOUSE PARCEL (ALL OPTIONS)

Under Alternative 2, some fill material would be imported from the Ironhouse site to the Dutch Slough site. However, as no contaminants of concern have been found in excess of criteria levels, this is not considered significant.

IMPACT 3.15.2-4: HEALTH EFFECTS FROM MOSQUITOES

This alternative includes extensive open water areas with minimal mosquito production, but it also includes extensive marsh plains filled to mid-intertidal to upper intertidal elevations. Much of the marsh plain in Gilbert and Burroughs parcels is intersected by berms that are designed to act as drainage divides for short-term adaptive management experiments related to fish habitat quality. Berm edges may restrict marsh sheetflow and produce areas of poorly drained marsh surface that would increase risks of mosquito production, especially after unusually high tides. The interaction between the extensive constructed marsh plain and channel system of the Emerson Parcel, and Marsh Creek delta relocation options, also distinguishes Alternative 2 in elevating mosquito impact potential. (See discussion of Marsh Creek Relocation option, above).

MITIGATION 3.15.2-4: HEALTH EFFECTS FROM MOSQUITOES

Same as for Alternative 1, but with the following additions: (a) minimize or eliminate artificial berms within middle or high marsh plains; replace their drainage divide functions with temporary structures that restrict fish movement without impounding water on the marsh surface, such as mesh or geotextile fabric fences; (b) adaptively modify marsh plain drainage patterns with amphibious excavation/dredging equipment to expose poorly drained backwater marsh areas to adequate tidal circulation and mosquito predator fish access; (c) Orient the Marsh Creek delta so that flood sediment deposition does not obstruct, occlude, or cut off tidal flows from channels and create standing water mosquito habitat.

SIGNIFICANCE AFTER MITIGATION

Less than significant.

Alternative 3: Maximum Fill

IMPACT 3.15.3-1: EFFECTS OF DUTCH SLOUGH RESTORATION PROJECT AREA SOILS CONTAMINATION (ALL OPTIONS)

This impact would be similar to that of Alternative 1.

MITIGATION 3.15.3-1: EFFECT OF DUTCH SLOUGH RESTORATION PROJECT AREA SOILS CONTAMINATION (ALL OPTIONS)

Same as for Alternative 1

SIGNIFICANCE AFTER MITIGATION

Implementation of mitigation 3.15.1-1, above, would reduce this impact to a less-than-significant level.

IMPACT 3.15.3-2: HEALTH RISKS ASSOCIATED WITH DEMOLITION ACTIVITIES (ALL OPTIONS)

This impact would be similar to that of Alternative 1.

MITIGATION 3.15.3-2: EFFECTS OF DUTCH SLOUGH RESTORATION PROJECT AREA SOILS CONTAMINATION (ALL OPTIONS)

Same as for Alternative 1

SIGNIFICANCE AFTER MITIGATION

Implementation of mitigation 3.15.1-2, above, would reduce this impact to a less than significant level.

IMPACT 3.15.3-3: HEALTH EFFECTS TO WORKERS ASSOCIATED WITH DISTURBANCE OF SOILS FROM IRONHOUSE PARCEL (ALL OPTIONS)

Under Alternative 3, some fill material would be imported from the Ironhouse site to the Dutch Slough Restoration Project site. However, as no contaminants of concern have been found in excess of criteria levels, this is not considered significant.

IMPACT 3.15.3-4: HEALTH EFFECTS FROM MOSQUITOES

This alternative includes extensive open water areas with minimal mosquito production only on the Emerson Parcel. It supports extensive marsh plains filled to mid-intertidal to upper intertidal elevations (relatively high mosquito production risk or potential) throughout the Gilbert Parcel, adjacent to the City Community Park. Much of the marsh plain in Gilbert and Burroughs parcels is also intersected by berms that are designed to act as drainage divides for short-term adaptive management experiments related to fish habitat quality. Berm edges may restrict marsh sheetflow and produce areas of poorly drained marsh surface that would increase risks of mosquito production, especially after unusually high tides. The interaction between the extensive constructed marsh plain and channel system of the Emerson Parcel, and Marsh Creek delta relocation options, also distinguishes Alternative 3, like Alternative 2 in, elevating mosquito impact potential. (See discussion of Marsh Creek Relocation option, above)

MITIGATION 3.15.2-4: HEALTH EFFECTS FROM MOSQUITOES

Same as Alternative 2.

SIGNIFICANCE AFTER MITIGATION

Less than significant.

Alternative 4: No Project

IMPACT 3.15.4-1: EFFECTS OF EXISTING CONTAMINATED SOILS

Soils contamination would remain as present, and may continue to be transported into the groundwater. No exposure to construction workers or site users is likely because no excavation of materials or public use of the site is proposed. Therefore this impact would be less than significant, and no mitigations would be required.

IMPACT 3.15.4-2: HEALTH RISKS ASSOCIATED WITH DEMOLITION ACTIVITIES (ALL OPTIONS)

No demolition would occur under this alternative, so no demolition-related health risks would occur.

IMPACT 3.15.4-3: HEALTH EFFECTS TO WORKERS ASSOCIATED WITH DISTURBANCE OF SOILS FROM IRONHOUSE PROJECT SITE (ALL OPTIONS)

No soils disturbance would occur under this alternative, so no soil-disturbance health risks would occur.

IMPACT 3.15.4-4: HEALTH EFFECTS FROM MOSQUITOES

There would be no change in mosquito production and associated health risks compared with existing conditions.

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4 Evaluation of Alternatives

4.0 EVALUATION OF PROJECT ALTERNATIVES

4.1. COMPARISON OF DUTCH SLOUGH RESTORATION PROJECT ALTERNATIVES

This chapter describes alternatives to the Dutch Slough Restoration Project. This Project is expected to provide many ecological, scientific, and recreational benefits. There are, however, both long-term and short-term environmental consequences of implementing this Project. This section presents a comparison of the alternatives to allow the reader and the decision-makers to understand the balance between the impacts and benefits of the Project's alternatives.

The main difference among the alternatives is in the design of the restored wetland and terrestrial landscape, and their associated aquatic habitats (channels, open water). The three alternatives represent different mixes of habitats, with different amounts of grading and imported fill to create these habitats.

The alternatives are:

- **Alternative 1:** Low marsh and open water emphasis with minimal grading (Minimum Fill Alternative)
- **Alternative 2**: Mix of mid marsh, low marsh, and open water with moderate fill (Moderate Fill Alternative)
- **Alternative 3:** Mid marsh and low marsh emphasis with imported fill (Maximum Fill Alternative)
- **Alternative 4:** No Project Alternative: leaving the site in current uses.

In Alternatives 2 and 3, Marsh Creek may be diverted into the project site at one of three locations to restore a natural delta at the mouth of the creek. In addition, a number of possible management options are considered for the open water areas under Alternatives 1, 2 and 3. All three restoration alternatives are consistent with providing high quality public access and restoration opportunities and provide for protection of existing infrastructure.

There are numerous natural resources that are fundamental to the basic goals of the tidal freshwater wetland restoration and were used as benchmarks for broad comparison of the alternative's benefits. Similarly, there are certain categories of environmental risks or predictable impacts that are generally given outstanding policy weight in wetland ecosystem planning and regulation in the Bay-Delta ecosystem. Without eclipsing other potentially significant project benefits or impacts, these key wetland planning factors are highlighted for purposes of guiding the comparison of alternatives. These key factors were instrumental in early planning and review of the project design, prior to the formulation of alternatives, and they are broadly summarized here:

- Special-status native estuarine fish and their essential habitats (benefit);
- Risk of spread and/or dominance of non-native submerged aquatic vegetation (potential impact);
- Nonnative predator fish species (potential impact);

- Production of methylmercury in the aquatic/wetland food chain (potential impact);
- Contaminant effects to water quality (potential impact);
- Feasibility (logistical, technical, geographic) of tidal wetland restoration (risk)
- Rapidity of tidal wetland restoration (ecological succession) processes (risk);
- Stability/resilience of tidal wetland habitats during accelerating sea level rise (risk);
- Native riparian woodland vegetation (benefit);
- Native marsh vegetation, including special-status plant species and their communities (benefit);
- Native wetland wildlife species diversity and abundance, including special-status wildlife species and their habitats (benefit);
- Native terrestrial wildlife species diversity and abundance in declining terrestrial habitats of the Bay-Delta ecosystem, including special-status wildlife species (benefit);
- Integration of wetland and terrestrial landscape structure, approaching historic, natural conditions as much as feasible within modern constraints (benefit);

Many of these key planning factors may be either antagonistic or mutually supportive in different wetland restoration designs. For example, maximizing wetland restoration area may magnify impacts to terrestrial or nontidal wetland habitats and species. Maximizing restored intertidal marsh in subsided delta lands may induce risks of exposing contaminants in fill material to the aquatic environment (depending on fill sources and sediment quality), or require increased "cannibalization" of restoration sites for borrow pits that become deepwater habitats. Marsh restoration itself may in some circumstances induce increases in perturbations or losses of existing wetland and terrestrial habitats, or, depending on the location of Marsh Creek channel, increases in the availability or production of methylmercury in the aquatic environment. Each of these examples of interactions among planning factors is relevant to the comparison of alternatives.

Alternative 3 generates the greatest extent of tidal freshwater marsh habitat, fully occupying the Gilbert and Burroughs parcel with the maximum area of tidal marsh and constructed marsh sloughs. For this reason, it is a useful standard of comparison for all alternatives that share the same basic wetland restoration objectives. Alternative 3 yields the greatest area of mid-marsh (middle intertidal marsh zone), which would fully occupy the Gilbert parcel. The design of Alternative 3 also would minimize increases in tidal prism that risks short-term tidal damping (reduction in tidal range) that may trigger the need for dredging tidal sloughs to ensure adequate tidal conveyance to the restoration site. The extent of slough dredging potentially needed would be minimized by Alternative 3, and so would its costs and impacts to existing tidal marsh and channel habitats. Alternative 3 also would minimize the risk of potential spread and dominance of SAV by minimizing the area of constructed open water subtidal areas (restricted to the Emerson Parcel). The greatest extent of potential native estuarine fish habitat ("blind", dead-end tidal sloughs bordering marsh banks) would be available soonest with Alternative 3 if the time required to complete its construction were the same as that of other alternatives. Alternative 3 would virtually eliminate most of the project impacts associated with potential wind-wave erosion of interior levee slopes or marshes adjacent to large open water areas of the Gilbert and Burroughs parcel in Alternative 2 (and especially in Alternative 1).

The potential benefits of integrating a relocated, self-constructing Marsh Creek deltaic marsh would be the same in Alternative 3 as Alternative 2, which shares the same Emerson parcel design. Alternative 3 would provide somewhat less interspersion of terrestrial and tidal wetland "edge" habitats than Alternative 2, because the island-like low constructed/retained mounds (restored as riparian woodland, floodplain grassland) in the Burroughs parcel would be graded down to low tidal marsh. In contrast, Alternative 2 includes these semi-terrestrial habitat "islands" in the Gilbert parcel, in proximity to constructed new tidal sloughs. Both Alternatives 3 and 2 otherwise maximize the trade-off between restored tidal wetlands and terrestrial habitats in favor of wetlands. Neither would retain large, substantial blocks of terrestrial habitat to support wildlife that may move between terrestrial and wetland habitats. Terrestrial habitats (grassland, oak woodland, and riparian woodland) are reduced to a narrow fringe at the southern end of the project site. Current or planned residential development of most adjacent and neighboring parcels has largely eliminated terrestrial habitat that could interact significantly with restored tidal wetlands.

The apparent advantage of Alternative 3 over Alternative 2 in terms of basic wetland restoration objectives may be offset, or outweighed, by significant feasibility, cost, and impact considerations. Alternative 3 has the appearance of providing more tidal marsh area than Alternative 2, but without reference to realistic project schedule factors. Even assuming that funds were available immediately for full construction of Alternative 3, the availability of sufficient fill volumes of sufficient quality to complete construction is highly uncertain. Tidal restoration could not proceed until internal site construction of any alternative is completed. If Alternative 3 construction required multiple imported fill sources, with delivery staggered over many years (depending on independent projects generating fill, such as navigational dredging), there could be prolonged delays in the actual initiation of tidal restoration. Delay itself may induce further risks of cost and logistic complications for project completion. This risk is not speculative: the only large-scale brackish tidal marsh restoration project in the Bay-Delta (Montezuma Wetlands) is still not filled to the point at which actual tidal breaching may proceed, after nearly a decade of incremental construction. Large-scale wetland restoration that relies on large volumes of imported dredged or fill sediment risks dependency on the schedule of fill-generating projects outside its control. Alternative 2, with more modest (but still substantial) demands for imported fill, reduces the area of immediate tidal marsh after construction compared with Alternative 3, but it is more likely to be completed sooner, and with lower risk of project delay due to cost or fill availability constraints. The practical benefits of Alternative 2, therefore, may be realized sooner and with greater reliability than the more ambitious Alternative 3.

Differences in potential project schedules among alternatives may also influence the final outcome of tidal restoration success. As indicated in the assessment of hydrology and geomorphology, it is likely that sea-level rise will accelerate during the next century, including the next decade in which the project's tidal marsh restoration would initiate. Tidal marshes in subsiding coasts, such as the Gulf of Mexico, are subject to marsh "drowning" (conversion to open water) when thresholds of submergence tolerance by marsh vegetation are exceeded. Alternative 3 proposes extensive areas of "low marsh" establishment close to the lowest elevation threshold of the dominant pioneer marsh vegetation (tules); nearly the entire Burroughs parcel is proposed as low marsh in Alternative 3. This indicates a significant risk of a foundering marsh restoration (rapid conversion of young low marsh to open water) if tidal restoration is delayed (due to fill availability or cost constraints) and sea level rise accelerates significantly in the same time period.

Alternative 3 also maximizes the potential for methylmercury production in tidal marsh (Water Quality, Section 3.2). Because the relationship between tidal freshwater marsh with unimpeded, full tidal drainage, and methylmercury production and trophic availability are not adequately understood, it is difficult to use this factor to discriminate among alternatives. Still, the placement of fill and full marsh construction is effectively an irreversible commitment of resources in Alternative 3. If methylmercury production in tidal marsh exceeded that in open shallow water, and was determined to be detrimental to the Dutch Slough's aquatic resources, it would be extremely difficult or infeasible to correct.

Alternative 2 includes the most balanced gradient between terrestrial ecotone (transition) habitats, high marsh, mid marsh, and low marsh zones. This alternative provides the greatest integration of habitats that are ecologically linked by seasonal or tidal movements of fish and wildlife, or variable habitat requirements for their different life-history stages. It places potential flood refuge habitat, nesting habitats, and foraging habitats in greater proximity (and potential interaction) than Alternative 3. Alternative 1 exhibits comparable degree of habitat integration, but at a smaller scale of wetland habitat.

Alternative 1 is distinguished by its retention of a large block of terrestrial habitat adjacent to restored tidal marsh, mostly at the southwest corner of the Emerson Parcel. This would be a long-term advantage if sea level rise causes the adjacent tidal marshes to become submerged. This alternative has the least potential long-term significant adverse impact to terrestrial wildlife species. It also generates, however, the least tidal marsh (the primary habitat goal of the project), and generates the maximum amount of shallow to deep open water, which may become nuisance habitat (SAV beds with high concentrations of predatory fish that impact high-priority listed salmonids and native estuarine fish). Alternative 1 is likely to require the most remedial levee stabilization and repair because it retains the greatest open water area and fetch (wind-wave potential), which is likely to be significant in open water management strategies other than subsidence reversal. Alternative 1 has some advantage over Alternatives 2 and 3 in that it is likely to be constructed most quickly and be available for tidal restoration soonest after project approval. It also provides a degree of wetland and terrestrial habitat integration (interspersion of different marsh zones, gradients, and related terrestrial habitats) similar to Alternative 2, but over a smaller area.

All tidal restoration alternatives (1-3) stand in marked contrast with the long-term consequences and risks of Alternative 4, the "no project" alternative, viewed in context of the same weighted evaluation factors. Alternative 4 conservatively retains extensive existing productive agricultural (grazing) and terrestrial habitat features and functions (mixed lowland grassland and pasture habitats bordering riparian woodland and tree groves), and in an area of the Delta that is undergoing rapid urbanization and cumulative impacts (mostly direct losses, conversion) to these terrestrial habitats. This is important for conservation of a number of special-status terrestrial species, such as Swainson's hawk. Alternative 4 also preserves, for the foreseeable future, some internal, non-tidal freshwater marsh habitats that support breeding populations of special-status reptiles such as western pond turtle (and potential habitat for other sensitive/special-status wetland wildlife species as well). Alternative 4 avoids risks of significant expansion of non-native, noxious submerged aquatic vegetation, and adds no additional risk of increased methylmercury production.

These "foreseeable" environmental benefits of Alternative 4, however, may be tenuous in the long-term context of accelerated sea-level rise and the sustainability of terrestrial habitats that have already subsided below modern sea level. The risk of catastrophic levee failure, or the risk of escalating levee maintenance costs, may offset or cancel the near-term benefits of protecting terrestrial habitats and agriculture in the long term. Even if restored tidal tule marshes encounter challenges, such as marsh "drowning" thresholds (failing to adjust to accelerated sea level rise), in future decades, they will at least be initially close to a threshold for long-term sustainability, even under higher forecast rates of sea level rise. Terrestrial and non-tidal wetland habitats below sea-level will inevitably face increasing risks of catastrophic flooding, increasing costs of preventing or recovering from flooding, and decreasing resilience as flood events become more frequent. If Alternative 4 turns out to be unsustainable because of sea level rise, tidal restoration initiated later may be less feasible and more costly to initiate than at current sea level. Furthermore, Alternative 4 would result in lost opportunities for estuarine fish recovery and tule marsh and special-status wetland species habitat creation.

In comparing alternatives in view of impacts to existing habitats and biological resources, it is important to note that most direct impacts are due to elimination of existing habitats by nearly all aspects of the restoration process – construction of restoration features and the restoration (habitat conversion) itself. Construction of all three alternatives will result in loss of almost all existing vegetation, and therefore, habitats. Most major indirect (primarily post-construction) impacts, such as the disturbance of wetland wildlife habitats by recreational uses of the site (emanating from the community park or general public access) also do not substantially differ among tidal restoration alternatives.

Overall, Alternative 2 achieves the most advantageous and reliable long-term balance of environmental restoration benefits and risks, given realistic assumptions about project implementation, funding, and schedule, and full consideration of the long-term sustainability of publicly-owned conservation lands managed for habitat values in the Delta landscape.

4.2 ENVIRONMETALLY SUPERIOR ALTERNATIVE (Dutch Slough Restoration Project)

CEQA Guidelines (Section 15126.6(a) and (e)(2)) require that an EIR's analysis of alternatives identify the "environmentally superior alternative" among all of those considered. In addition, if the No Project Alternative is identified as environmentally superior, then the EIR also must identify the environmentally superior alternative among the other alternatives. As described above, because the Dutch Slough Restoration Project is an environmental restoration and public access project, its primary adverse impacts are related to hydrology, water quality and biological resources. A number of these impacts are short-term conditions that would result from construction. The No Project Alternative would eliminate these potential impacts, and, because it would have the fewest impacts overall, would nominally be the Environmentally Superior Alternative. However, this alternative would also forego the longer-term environmental benefits of the project on fisheries, and marsh and special-status wetland species habitat.

As required by CEQA, the Dutch Slough Restoration Project alternatives were analyzed to determine which would be the Environmentally Superior Alternative. Alternative 1 could have somewhat less environmental impacts to existing environmental resources than Alternatives 2 and 3, considered without reference to long-term environmental benefits. Therefore this EIR considers the Dutch Slough Restoration Project's CEQA Environmentally Superior Alternative to be Alternative 1. It should be noted, however, that even this alternative and mitigation, would result in some significant adverse impacts, as with Alternatives 2 and 3.

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5 CEQA Analyses

5.0 CEQA TOPICAL ANALYSES

5.1 GROWTH INDUCEMENT

CEQA requirements for evaluation of growth-inducing impacts are set forth in Section 15126.2 (d) of the CEQA Guidelines (California Code of Regulations, Title 14, Division 6, Chapter 3, Sections 15000-15387). CEQA requires that both direct and indirect impacts of all phases of a proposed project be considered. Growth-inducement is typically considered to be a direct or indirect effect of an action that either directly fosters growth or removes an obstacle to economic or population growth, or the construction of new housing. The CEQA Guidelines also require evaluation of new infrastructure and service facilities needed to serve growth induced by a project. The Guidelines note that "it must not be assumed that growth in any area is necessarily beneficial, detrimental, or of little significance to the environment". Therefore, the nature of the effects of any induced growth also must be considered to determine if the impacts of that growth are potentially significant.

Some projects may be considered growth inducing while others may be growth accommodating (i.e. they are intended to accommodate planned growth, but do not induce that growth). The distinction here is primarily whether or not a project removes an obstacle to growth. It is sometimes argued that, if growth is already planned for in a jurisdiction's General Plan, then infrastructure supporting that development is growth accommodating rather than growth inducing. However, CEQA is concerned with on-the-ground impacts to the environment. Therefore, if planned development cannot move forward absent a particular infrastructure project, or the development is substantially encouraged by that infrastructure, that project is generally considered growth inducing.

The CEQA Guidelines also state (Section 16064 (d)(3) that an indirect physical change is to be considered only if that change is "a reasonably foreseeable impact which may be caused by the project. A change which is speculative or unlikely to occur is not reasonably foreseeable".

The Dutch Slough Restoration Project includes wetland restoration and public access components. The wetland restoration components would not have any affect on growth, as they would not provide any new housing, infrastructure, or economic activity. It would not, however remove any obstacles to growth, expand infrastructure, or develop housing or economic activity.

The Related Projects also would not be growth inducing. Both the City Community Park and Ironhouse projects would permanently remove potentially developable land from that use. Neither is expected to substantially induce demand for new residences or businesses in Oakley, although the Park would provide a new public amenity that would slightly increased the likelihood of a resident choosing to live in Oakley versus the surrounding communities.

Therefore this impact would be less than significant with respect to the Dutch Slough Restoration Project and the Related Projects.

5.2 UNAVOIDABLE SIGNIFICANT ADVERSE IMPACTS

Under each resource topic, any unavoidable significant adverse impacts identified are analyzed in detail. Significant unavoidable impacts under Dutch Slough Restoration Project Alternatives 1, 2, or 3 include:

- Impacts to burrowing owls if they are present;
- Creation of habitat that benefits non-native fish species;
- Demolition of buildings and landscape features that contribute to the Rural Historic Landscape.

5.3 SUMMARY OF CUMULATIVE IMPACTS/MITIGATION

The Dutch Slough Project Restoration and Related Projects would be located in a rapidly growing area of eastern Contra Costa County. See Figure 5-1 for the relevant cumulative projects in the project area. A cumulative impact refers to two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts. The individual effects may be changes resulting from a single project or a number of separate projects. The cumulative impact from several projects is the change in the environment, which results from incremental impacts of the project when added to other closely related past, present, and reasonably foreseeable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period.

Contra Costa County Projects

Mariner Estates LLC

The project involves Conditions of Approval (COA) for 62 remaining residential permits in the off-Island area, in Oakley. The project was approved in April 2005.

Delta Coves

560 residential units are proposed on Bethel Island, including a marina. The project was approved in September 2005 and is under construction.

Han Yang International

An 18-hole golf course is proposed on Bethel Island. It is currently pending approval.

Bethel Island Bridge Replacement

The Bethel Island Bridge replacement is a proposed County capital improvement project. It was approved and scheduled for construction in 2008.

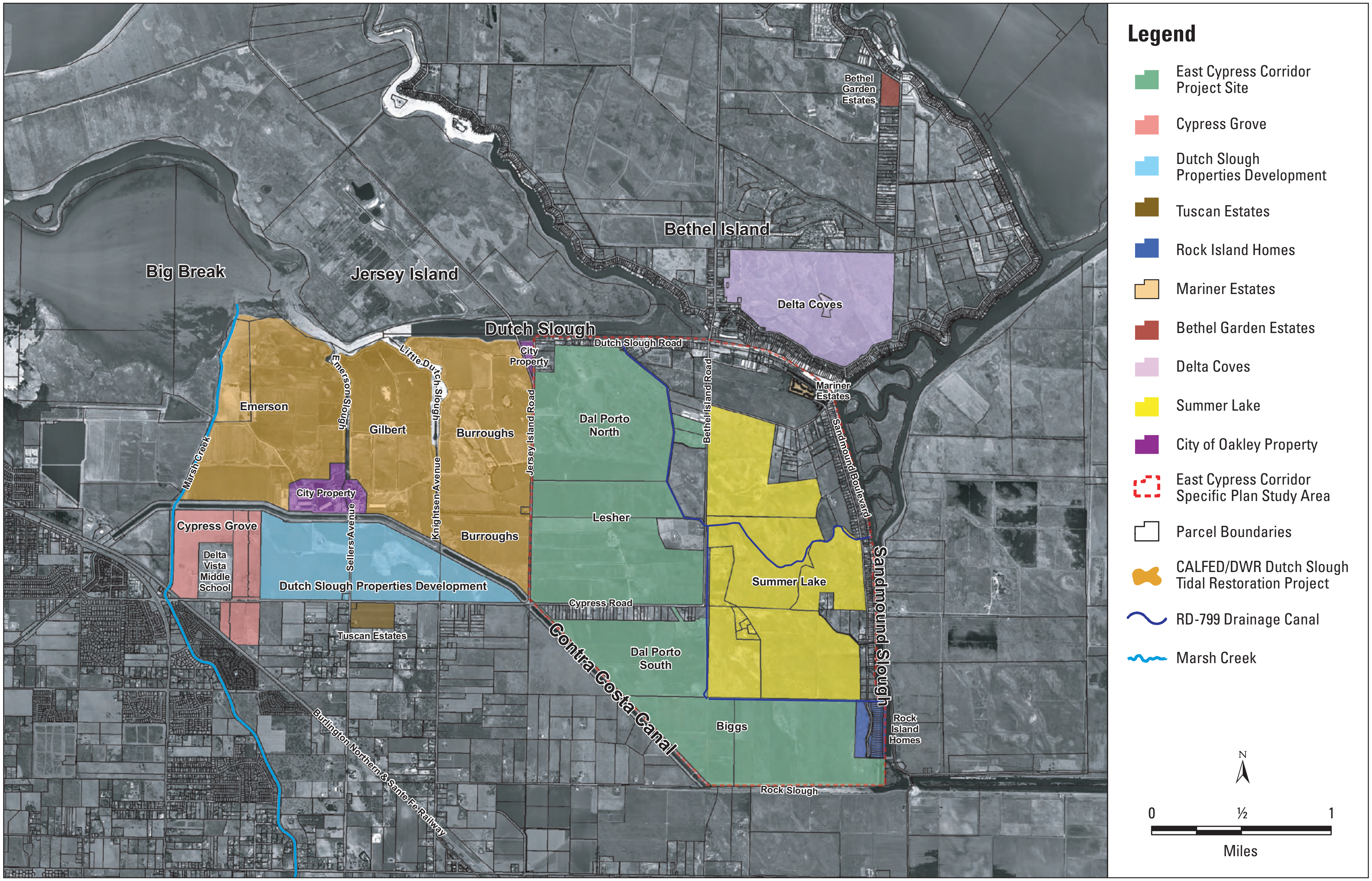

Figure 5.3-1

Cumulative Projects Map

Source: Sycamore Associates, LLC

City of Oakley Projects

City Community Park

The City of Oakley is proposing a Community Park and Public Access Conceptual Master Plan (hereinafter referred to as "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 (See Figures 2-15 through 2-17). The City Community Park will provide parking and trailheads for the public access components of the Dutch Slough Restoration Project.

Ironhouse Project

The Ironhouse Sanitary District (ISD) is proposing the West Marsh Creek Delta Restoration Project (hereinafter called 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 ISD (See Figure 2-14). The Ironhouse Project could support, and be linked to the Dutch Slough Restoration lands.

Cypress Grove

The Cypress Grove EIR was certified by the City of Oakley in 2003. This development is under construction and will consist of 637 new residential units on approximately 147 acres. The project is adjacent to and south of the Contra Costa Canal and adjacent to and east of Marsh Creek.

Oakley Westerly Annexation

In 2005, the Contra Costa County Local Agency Formation Commission approved annexation of approximately 80 acres south of East Cypress Road and east of Sellers Avenue to the city of Oakley. Subdivision 8904 (24 acres known as Tuscany Estates and formerly the Baldocchi property) is undergoing tentative map review. Tuscany Estates consists of 100 homes.

East Cypress Corridor Specific Plan and Summer Lake

The City is preparing a Supplemental EIR for the East Cypress Corridor Specific Plan and anticipates it will release the Draft SEIR for public review in February 2008**.** The specific plan proposes the development of up to 5,759 residential units on an approximately 2,500-acre site adjacent to 1.5 miles of the Contra Costa Canal, from the Rock Slough trash rack to Cypress Road. The specific plan area is within the City of Oakley's sphere of influence. The City of Oakley is proposing to annex the entire specific plan area. Approximately 500 homes are in the East Cypress Corridor Specific Plan area. Most of the existing homes are along Sand Mound and Dutch Sloughs.

Summer Lake

The Summer Lake subdivision (formerly Cypress Lake and Country Club) consists of 678 acres and 1,330 homes and is in the East Cypress Corridor Specific Plan area. It was approved in 2005.

Dutch Slough Properties Development

The City is in the process of approving plans to develop approximately 1,342 residential units on approximately 300 acres immediately south of the Dutch Slough Restoration Project site between the Contra Costa Canal and Cypress Road. The future development area south of the Contra Costa Canal consists of 140 acres of the Emerson property, which is anticipated to have approximately 662 residential units; 120 acres of the Gilbert property, which the City certified an EIR and approved a tentative map for 506 residential units in November of 2007; and 44 acres of the Burroughs property, which is anticipated to have approximately 174 residential units. This development is planned for construction in the next five years.

Ironhouse Sanitary District Expansion

Ironhouse Sanitary District (1SD) is completing an accelerated capital improvement program to increase capacity to accommodate projected demand in ISD's service area (from 3.0 million gallons per day [MGD] to 8.6 MGD). ISD plans to eliminate land-based wastewater irrigation on "mainland" properties (i.e., near the Contra Costa Canal) and construct a surface water discharge with tertiary treatment at Jersey Point (on Jersey Island) as the least expensive and preferred alternative. ISD is also evaluating an expansion of its wastewater irrigation on Jersey Island and construction of lined storage ponds on its mainland property. The Central Valley Regional Water Board will work with ISD to determine the allowable location and relative amounts of land-based versus surface water application of wastewater. ISD began construction in 2007.

Other Local Projects

Contra Costa Water District's Encasement of the Contra Costa Canal

The Contra Costa Water District proposes to replace up to 3.97 miles of the unlined portion of the Contra Costa Canal with buried pipeline. The pipeline installation would extend from the intake/trash rack near Rock Slough and Pumping Plant No.1. A portion of this project is adjacent to the Dutch Slough Restoration Project, on the southern boundary. The first phase of this project, extending about 2000 feet from Pumping Plant No. 1 to Marsh Creek, is scheduled for construction in 2008.

Cumulative Impacts

Each resource topic analyzed in this EIR includes an analysis of the cumulative impacts and identifies mitigation measures. The cumulative impacts identified in this EIR include issues regarding: hydrology and geomorphology, water quality, geology and soils, air quality, noise, aesthetics, land use, recreation, transportation/traffic, public services, utilities and service systems, and hazardous materials.

Hydrology

If CCWD proceeds with its water supply encasement project, then any groundwater seepage from the Dutch Slough Restoration Project into the canal and its associated introduction of brackish water would no longer affect drinking water quality. Consequently, the project impact regarding groundwater seepage into the Contra Costa Canal would not occur. If CCWD fills in and eliminates the Contra Costa Canal concurrent with encasing the water supply, as proposed but not yet permitted, then the Dutch Slough Restoration Project may increase southward groundwater flux to the Cypress Grove and Dutch Slough Properties. Under current conditions, the Canal is a tidal water body that exerts a controlling factor on groundwater connectivity between lands to its north and south.

Water Quality

During construction of the developments, there could be increased pollution. Due to a greater amount of impervious surfaces, these new housing developments will cause more stormwater runoff laden with the contaminants common in urban/suburban areas (i.e. pesticides, lawn fertilizers, hydrocarbons). The increased volume of municipal sewage from the new developments would introduce more pollutants to the waters. The method in which the treated wastewater is discharged would determine the severity of the impact to water quality. More pollutants will be introduced if the effluent is discharged to surface waters as opposed to being used for irrigation on Jersey Island.

The implementation of the Dutch Slough Restoration Project could affect these new housing developments through the impacts to drinking water quality listed above. However, the mitigations offered should reduce the impacts to less than significant levels. Contra Costa Water District's planned encasement of the Contra Costa Canal, described above, would eliminate the project's impact related to degradation of water quality due to increased salinity concentrations in the Contra Costa Canal (from elevated groundwater).

Geology and Soils

Implementing the Dutch Slough Restoration Project would not result in cumulative impacts upon geology and soils as proper design and construction of levees and structures and adherence to building code regulations would reduce impacts to less than significant. These mitigated impacts are not additive in nature and do not produce cumulative impacts. Impacts of soil erosion are minor or temporary and can be effectively mitigated by using Best Management Practices at time of construction, as previously discussed. The potential flood hazard due to levee failure impacting residential and commercial developments located on subsided lands in historical floodplain is a concern throughout the Delta. The increase in residential development around Dutch Slough increases overall flood hazard potential in the event of levee failure. Negotiations are underway to determine the design of the proposed new Jersey Island Road levee which, if constructed, would be an improvement over the existing levee and offer greater flood protection than currently provided. The existing levees on the Emerson and Gilbert parcels would continue to be maintained and therefore implementation of the Dutch Slough Restoration Project would not increase likelihood of levee failure and would not add to cumulative impacts.

Biological Resources – Terrestrial and Wetland

It is uncertain whether significant cumulative impacts related to loss of terrestrial habitats and seasonal wetlands associated with irrigated pastures (over 800 acres) can be mitigated by off-site compensatory mitigation measures or otherwise minimized with on-site development. It may be feasible to mitigate for these related cumulative impacts by offsite mitigation (protection, maintenance, and enhancement of offsite habitat as close as possible to the project site). Thus, there may be significant unmitigated cumulative impacts related to loss of terrestrial grassland habitats. Other cumulative impacts are likely to be fully mitigated by a combination of on-site mitigation measures to minimize, avoid, or rectify individual project impacts, and limited off-site mitigation.

Biological Resources – Aquatic Resources

Proposed developments could have potential impacts on fishery resources in the Dutch Slough site and the greater project vicinity. The new housing developments would increase the human population in the area, leading to more recreation pressure at the site. Specific impacts to fisheries could include increased angling and littering. The increased volume of municipal sewage from the new developments would introduce more pollutants to the waters. The method in which the treated wastewater is discharged would determine the severity of the impact to aquatic organisms. More pollutants could potentially be introduced to the site if the effluent is discharged to surface waters as opposed to being used for irrigation on Jersey Island. However, the point of surface water discharge is planned to be located at Jersey Point on Gallagher Slough, which is on the opposite side of Jersey

Island from the Dutch Slough site. This would allow pollutants to be diluted and dispersed before they reach the site, thus reducing their potential impact on aquatic life. The aquatic resources in Gallagher Slough and potentially Big Break and Franks Tract would be more severely impacted.

Contra Costa Water District's proposal to encase up to almost four miles of the Contra Costa Canal in the vicinity of the project would eliminate any fishery resources currently in the canal. However, the project calls for fish relocation efforts prior to construction, which should mitigate for this impact.

None of the proposed developments involve wetland or fish habitat restoration, so the implementation of the Dutch Slough Restoration Project would not have any impact on other fish habitat restoration activities in the immediate vicinity.

Air Quality

Construction emissions by trucks may have a possible cumulative impact by increasing ozone precursor emissions, by contributing to diesel exhaust particulate matter, and by competing with existing traffic in developed areas for available roadway capacity.

Aesthetics

The proposed buildings and facilities would not be visible from public viewpoints at a similar elevation as the project site. Viewers from the second floors of proposed residential project to the south would have views into the project site over the Contra Costa Water District's existing levees, as well as its proposed embankment for the proposed encased pipeline, would screen the site. In addition, views of the park from adjacent houses would be expanded by implementation of the proposed removal of the CCWD canal levees as part of the CCWD's proposed encasement project. In addition, new levees are being planned for areas to the south and east of the project site, which would also screen views into the project site.

The potential increase in light and glare from the park project would contribute to cumulative light and glare impacts because the park would be visible from higher elevations, such as Mount Diablo; glare impacts from the lights could be exacerbated by the increased nearby residential receptors.

Land Use

Conflicts between the new residential developments (planned or under construction) and the City's Community Park would be reduced through a vegetation perimeter buffer that 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 as well as residences to the south from park activities.

Agricultural Resources

The proposed Dutch Slough Restoration Project and Related Projects would result in conversion of approximately 1,274 acres of prime/unique farmland and farmland of statewide and local importance. The City of Oakley is undergoing significant development in the area surrounding the project site, which in combination with the proposed project would result in substantial acreages of agricultural land conversion. As described in Section 3.10, this potentially significant cumulative impact would be reduced to less than significant by implementation of the City's General Plan.

Recreation

The proposed project would provide a variety of recreational facilities for both active and passive recreation and education. The proposed development surrounding the project site would be required to pay park and recreational fees to the City, which would be used to provide additional city recreational facilities, including neighborhood parks and community trails. For example, a neighborhood access trail is planned along the south side of the Contra Costa Canal, outside of the project boundary. The combination of increased recreational facilities through the proposed action and surrounding development would result in a beneficial impact to recreational use.

A nearby City of Oakley project, the proposed Dutch Slough Access Park, proposes a boat ramp to Dutch Slough at the northeastern corner of the Dutch Slough Restoration Project site and Jersey Island Road bridge. (This project is not a part of the City's Community Park project, but rather is a separate 8-acre parcel.) The potential increase in watercraft from this boat ramp could increase potential conflicts with non-motorized watercraft in Emerson Slough, and Little Dutch Slough.

Cultural Resources

Cumulatively, the buildings present on the sites of the City Community Park, Dutch Slough Properties Development, and the Dutch Slough Tidal Marsh Restoration Project (project), make up a Rural Historic Landscape. The impacts of the three projects on the Dutch Slough Rural Historic Landscape would result in a significant cumulative impact on historic resources. However, for the Dutch Slough Restoration Project, only the Burroughs property has buildings which contribute to the Rural Historic Landscape, so if the "no Burroughs" option is exercised, the project would have no impact on historic resources.

Transportation/Traffic

The traffic generation from the park will essentially be the same throughout the life of the park activity. On Sellers Avenue, the traffic will be mixed with traffic from the adjacent residential developments, and from trips from the shopping area at the corner of Cypress and Sellers. On Cypress Avenue, the future estimated traffic averages about 35,000 vehicle trips per day (in 2025), based on the East County Traffic Model that is conducted by the Contra Costa Transportation Authority (CCTA). Fewer than 100 of these trips may be directly or indirectly related to the Dutch Slough Restoration Project. This is not a measurable impact on the traffic conditions, and would not result in a cumulatively considerable contribution to the overall traffic impact.

Cypress Road will have a growing level of traffic as a result of the development of new housing in the corridor. The total development in the corridor could be as many as 8,000 new residential units. The park traffic would not result in a cumulatively considerable contribution to this traffic.

Public Services, Utilities and Service Systems

Cumulative impacts on public services and utilities are considered in the context of the service area of the service providers. The potential increase in demand for police services, fire services, water supply, wastewater treatment and disposal, electrical transmission, and gas transmission that could result from the proposed Dutch Slough Restoration Project would be a minor increment of the total demand. The primary demands would be from the numerous residential developments proposed, approved, or under construction in the project area. Services are made available as those developments proceed. Fees and taxes associated with those developments, as well as monthly utility charges, are intended to mitigate their impacts on services and utilities.

5.4 IRREVERSIBLE/IRRETRIEVABLE IMPACTS

As described above, the Dutch Slough Restoration Project would permanently convert land to wetland and public access uses. The Dutch Slough Restoration Project also would irreversibly convert upland and permanent and seasonal freshwater wetland habitat to aquatic and tidal wetland habitat. The Dutch Slough Restoration Project, in combination with the proposed City Community Park, would result in the loss of a locally unique historic agricultural landscape, including historic houses and dairy structures, a historic vineyard, and other agricultural lands. Construction of the Dutch Slough Restoration Project would result in the irretrievable use of natural resources including fuels and building materials.

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7 Definitions

7.0 DEFINITIONS

Acute Exposure: Either a single or short-term exposure to a compound.

Adsorption: Adhesion of a gas, liquid, or dissolved substance to a surface, such as the surface of a soil particle.

Archaeological Resource: means any material remains of past human life or activities including (but not limited to): pottery, basketry, bottles, weapons, weapon projectiles, arrowheads, tools, structures or portions of structures, pit houses, rock paintings, rock carvings, intaglios, graves, human skeletal materials, or any portion of the foregoing items at least 100 years of age. Defined by Section 4(a) of the Archaeological Resources Protection Act and 43 CFR Part 7.3.

Berm: A constructed rise at the edge of a road, or along a canal.

Beneficial Impact: An impact that has beneficial consequences.

Bioaccumulation: an increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment.

Bioconcentration: The degree to which a chemical can be concentrated in the tissues of organisms.

Biodegradation: Capable of being decomposed by biological agents, especially bacteria or other microorganisms.

Brackish: Marine or estuarine water salinity between 0.5 and 30 parts per thousand, due to ocean-derived salts.

Cultural Resources: The physical remains, objects, historic records, and traditional lifeways that connect us to our nation's past.

Datum: A point, line, or surface used as a basis for measurement or calculation in mapping or surveying.

Dike: An embankment built along the shore of a sea or lake or beside a river to hold back the water and prevent flooding; a raised roadway across a swamp or body of water; a drainage ditch or other artificial watercourse

Endangered [species]: A species of animal or plant that is in danger of becoming extinct.

Epifauna: Animals that live on the surface of marine or freshwater sediment or mud.

Eradication: To destroy; to remove by the roots; exterminate.

Erosion: The gradual wearing away of rock or soil by physical breakdown, chemical solution, and transportation of material, as caused, for example, by water, wind, or ice.

Eustatic: Pertaining to world-wide changes of sea levels.

Evapotranspiration: The return of moisture to the air through evaporation from the soil and transpiration by plants

Exotic [species]: A species of animal or plant that is not indigenous to the region.

Hectare: A hectare is a metric unit of land measurement equal to 10,000 square meters or approximately 2.5 acres.

Historic Property: The term used to describe any prehistoric or historic district, site, building structure, or object included in, or eligible for inclusion in, the National Register. The term includes artifacts, records, and remains that are related to such properties. As a general guideline, and cultural resource should be at least 50 years old to be considered as a historic property.

Identification Inventory or Field Survey (Cultural Resources): This involves background research and in-field inspection of the area of potential effects (APE) to seek and record historic properties.

Infauna: Animals that burrow into marine or freshwater sediment and live beneath the mud surface.

Introduced [species]: Species of animals or plants intentionally or unintentionally released into an area or region where it is not indigenous. Introduced species may or may not become invasive once established.

Invasive [species]: Typically an exotic species of animal or plant that establishes and spreads over time, ultimately forming a population.

Levee: A natural embankment alongside a river, formed by sediment during times of flooding.

Marsh: A saturated, poorly drained area, intermittently or permanently covered with water; having aquatic and grass-like vegetation.

Mean High Water: The average height of the high waters of spring tides.

Mean Low Water: The average height of the low waters of spring tides.

Mesic: Moderately moist.

Microorganism: An organism of microscopic or submicroscopic size, especially a bacterium or protozoan.

NGVD (National Geodetic Vertical Datum): A “benchmark” elevation roughly equivalent to mean sea level.

National Register Eligible: A property that meets the National Register Criteria. for Section 106 purposes, an eligible property is treated as if it were already listed.

No Effect (Cultural Resources): When no effect is determined, the agency finds that the undertaking will have no effect on historic properties and notifies the State Historic Preservation Officer (SHPO) and interested persons of the findings. Unless the SHPO objects within 15 days of receiving such notice, the agency official is not required to take any further steps in the Section106 process.

Non-native: Plants or animals originating in a part of the world other than where they are growing.

Overbank: Water flow over the top of the bank.

Persistence: Persistence is the length of time required for a chemical to degrade to the point where it can no longer be detected.

pH: The degree of acidity or alkalinity of a solution. Values from 0 to 7 indicate acidity, values from 7 to 14 indicate alkalinity.

Population: Any group of organisms capable of interbreeding and coexisting at the same time and in the same place.

Siltation: The filling-in of lakes and stream channels with soil particles, usually as a result of erosion on adjacent land.

Species: A fundamental category of taxonomic classification, ranking below a genus or subgenus and consisting of related organisms capable of interbreeding.

Stormwater: Rainfall that runs off roofs, roads and other surfaces where it flows into gutters, streams, rivers and creeks, and eventually into the bays. This water can carry contaminants such as plastic bags, detergents, nutrients and heavy metals.

Tailwater: The water surface immediately downstream from a dam.

Threatened [species]: A species of animal or plant that is rare and may become an endangered species in the near future.

Toxicity: The degree to which a substance is toxic; poisonous.

Turbidity: Having sediment or foreign particles stirred up or suspended; muddy, turbid water.

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8 References

8. REFERENCES

2.0 PROJECT DESCRIPTION

Morris, J.T., P.V. Sundareshwar, C.T. Nietch, B. Kjerve, and D.R. Cahoon. 2002. Responses of coastal wetlands to rising sea level. Ecology 83: 2869-2877.

Overpeck, Jonathan, T. Bette L. Otto-Bliesner, Gifford H. Miller, Daniel R. Muhs, Richard B. Alley, Jeffrey T. Kiehl. 2006. Paleoclimatic Evidence for Future Ice-Sheet Instability and Rapid Sea-Level Rise. Science 24 March 2006: Vol. 311. no. 5768, pp. 1747 – 1750.

Reed, D.J. 1995. The response of coastal marshes to sea-level rises: survival or submergence? Earth Surface Processes and Landforms 20: 39-48.

Reed, D.J. and Cahoon, D.R. 1992. The relationship between marsh surface topography, hydroperiod, and growth of Spartina alterniflora in a deteriorating Louisiana salt marsh. Journal of Coastal Research 8: 77-81.

3.1 HYDROLOGY

Balance Hydrologics. 2004. Stormwater Management Plan, Cypress Grove Project, City of Oakley, California. Prepared for Sycamore Associates LLC. Berkeley, CA. June.

California Climate Change Center (CCCC) 2006. Our Changing Climate: Assessing the Risks to California. http://www.climatechange.ca.gov/biennial_reports/2006report/index.html. Accessed August 2006.

California State Water Resources Control Board (SWRCB). 2006. Revised Draft Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. November.

City of Oakley

______.2005. Notice of preparation of an environmental impact report for the proposed Dutch Slough properties project. Memorandum from Rochelle Henson, Senior Planner. October 20.

______.2006. East Cypress Corridor Specific Plan. Draft. February.

Contra Costa County Flood Control and Water Conservation District (CCCFCWCD). 2006. Letter to Tom Hall, California Department of Water Resources. May 4.

Contra Costa Water District (CCWD)

______.2006. Letter to Tom Hall, California Department of Water Resources. May 5.

______.2006. Initial Study/Proposed Mitigated Negative Declaration for the Contra Costa Canal Encasement Project. April.

ENGEO Incorporated. 2005. Groundwater Study, Cypress Corridor Specific Plan Area, Contra Costa County, California. October 31.

FEMA (Federal Emergency Management Agency). 1987. Flood Insurance Study, Contra Costa County, California, unincorporated areas.

Hultgren-Tillis Engineers. 2005. Geotechnical Consultation, Seepage and Levees, Dutch Slough Tidal Marsh Restoration, Oakley, California. Appendix F *in*: PWA 2006, Dutch Slough Tidal Marsh Restoration Conceptual Plan and Feasibility Report.

Intergovernmental Panel on Climate Change (IPCC) 2001. Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Houghton, J.T.,Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 881pp. http://www.grida.no/climate/ipcc_tar/wg1/409.htm Accessed August 2006.

Jones and Stokes. 2005. East Contra Costa County Habitat Conservation Plan and Natural Community Habitat Conservation Plan. Draft. June. (J&S 01478.01.) San Jose, CA. June.

Kleinfelder, Inc. 2006. Geotechnical Services Report: Jersey Island Road Levee Evaluation, Cypress Corridor Specific Plan Area, Contra Costa County, California. Prepared for KB-Home – South Bay. May 1.

Luhdorff and Scalmanini Consulting Engineers (LSCE) . 2006. Groundwater investigation and monitoring program, Dutch Slough restoration area. Prepared for the Department of Water Resources and Contra Costa Water District. Woodland, CA. May 22.

Natural Heritage Institute (NHI)

_______.2002. Marsh Creek Delta Preliminary Conceptual Restoration Plan.

_______.2004. Dutch Slough Tidal Marsh Restoration Project Preliminary Opportunities and Constraints Report. Prepared for The California State Coastal Conservancy. February 20.

Natural Heritage Institute (NHI) and Delta Science Center at Big Break. 2003. Marsh Creek Watershed Report 3rd Edition. Prepared for The California State Coastal Conservancy, the San Francisco Bay Fund, and the CALFED Bay-Delta Program. November.

Phil Williams & Associates (PWA). 2006. Dutch Slough Tidal Marsh Restoration Conceptual Plan and Feasibility Report. Prepared for the California State Coastal Conservancy. San Francisco, CA. May 12.

NOAA COOPS (National Oceanic and Atmospheric Administration Center for Operational. Oceanographic Products and Services). 2003. URL: http://www.co-ops.nos.noaa.gov/benchmarks/9415053.html. Accessed May 2006.

Williams, Tom (Ironhouse Sanitary District). Written comments to ADEIR, July 3, 2008.

3.2. WATER QUALITY

Amy GL, Thompson JM, Tan L, Davis MK, Drasner SW. 1990. Evaluation of THM precursor contributions from agricultural drains. Journal of the American Water Works Association 80:57-64.

Balance Hydrologics, Inc. 2005. Hydrology and Water Quality Analyses for the East Cypress Corridor Specific Plan. Report.

Birkett, J.W. 2003.Scope of the Problem, in Endocrine disrupters in wastewater and sludge treatment processes Eds: J.W. Birkett and J.N. Lester. CRC Press LLC, FL. p295.

Bloom N. S.1992. On the chemical form of mercury in edible fish and marine invertebrate tissue. Can J Fish Aqua Sci 49:1010-1017

Bodaly, R.A., and R.J.P. Fudge. 1999. Uptake of mercury by fish in an experimental boreal reservoir. Arch. Environ. Contam. Toxicol. 37(1):103–109

Brown, L.R. 2003. Potential effects of organic carbon production on ecosystems and drinking water quality In: Larry R. Brown, editor. Issues in San Francisco Estuary Tidal Wetlands Restoration. San Francisco Estuary and Watershed Science. Vo. 1, Issue 1 (October 2003), Article 3. http://repositories.cdlib.org/jmie/sfews/vol1/iss1/art3.

Brown and Caldwell. 2006. Dutch Slough Water and Sediment Quality Monitoring Plan. Appendix C-2 of Dutch Slough Tidal Marsh Restoration Conceptual Plan and Feasibility Report, Philip Williams and Associates, May 12, 2006.

California Climate Change Center (CCCC) 2006. Our Changing Climate: Assessing the Risks to California. http://www.climatechange.ca.gov/biennial_reports/2006report/index.html. Accessed August 2006.

City of Brentwood 2006. Public Works, Sewer Division. http://www.ci.brentwood.ca.us/department/publicworks/sewer.cfm

Clarkson TW. 2002. The three modern faces of mercury. Environ Health Perspect. Feb;110 Suppl 1:11-23.

CVRWQCB. 2004. Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board Central Valley Region, Sacramento River Basin and San Joaquin River Basin. Fourth Edition, Revised September 2004.

Department of Water Resources (DWR). 2003. Modeled impacts of Delta peat island drainage on organic carbon levels at selected Delta municipal water intakes – Memorandum Report. Division of Environmental Services, Office of Water Quality, Municipal Water Quality Investigations Unit. October 2003.

ENGEO Inc. 2003a. Phase I Environmental Site Assessment, Burroughs Property (State Parcels), Jersey Island Road, Oakley, CA. January 29, 3003.

ENGEO Inc. 2003b. Phase I Environmental Site Assessment report for the Emerson Properties (State Parcels), Sellers Ave, Oakley, CA. January 29, 3003.

Giger, W. 1999. Emerging chemical drinking water contaminants. In Identifying future drinking water contaminants.\Ed.: National Research Council, National Academy Press, Wash DC, 1999.

Gomes, R.L. and J.N. Lester. 2003a. Endocrine disrupters in receiving waters, in Endocrine disrupters in wastewater and sludge treatment processes. Eds.: J.W. Birkett and J.N. Lester. CRC Press LLC, FL. p295.

Gomes, R.L. and J.N. Lester. 2003b. Endocrine disrupters in drinking water and water reuse, In Endocrine disrupters in wastewater and sludge treatment processes. Eds: J.W. Birkett and J.N. Lester. CRC Press LLC, FL. p295.

Grieb, T. M., Driscoll, C. T., Gloss, S. P., Schofield, C. L., and Porcella, D. B.: 1990, Factors Affecting Mercury Accumulation in Fish in the Upper Michigan Peninsula, Environ. Toxicol. Chem. 9, 919–930.

Hall, B.D., Bodaly, R.A., Fudge, R.J., Rudd, J.W., and Rosenberg, D.M. 1997. Food as the dominant pathway of methylmercury uptake by fish. Water Air Soil Pollut. 100: 13–24.

Harms, H.H. 1986. Bioaccumulation and metabolic fate of sewage sludge-derived organic xenobiotics in plants, Sci. Total Environ., 185, 83, 1986.

Hecky RE, Ramsey DJ, Bodaly RA and Strange NE 1991.Increased methylmercury contamination in fish in newly formedfreshwater reservoirs. In: Suzuki T, Imura N and Clarkson TW (eds) Advances in Mercury Toxicology. Plenum Press, New York, pp 33–52.

Intergovernmental Panel on Climate Change (IPCC) 2001. Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Houghton, J.T.,Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 881pp. http://www.grida.no/climate/ipcc_tar/wg1/409.htm Accessed August 2006.

Ironhouse Sanitary District. 2005. Background Groundwater Quality Study Report. Submitted to the Central Valley Regional Water Quality Control Board, May 12, 2005.

James Montgomery Consulting Engineers, Inc. 1991. Preliminary Analysis for a Constructed Wetlands. Prepared for Oakley-Bethel Island Wastewater Management Authority, April 1991.

Jassby AD. 1992. Appendix A: Organic carbon sources for the food web of San Francisco Bay. In: Herbold B, Jassby AD, Moyle PB. Status and trends report on aquatic resources in the San Francisco Estuary. Oakland (CA): San Francisco Estuary Project.

Jassby AD, JECloern, and TMPowell. 1993. Organic carbon sources and sinks in San Francisco Bay: variability induced by river flow. Marine Ecology Progress Series95:39-54.

Jassby AD, Cloern JE. 2000. Organic matter sources and rehabilitation of the Sacramento-San Joaquin Delta (California, USA). Aquatic Conservation: Marine and Freshwater Ecosystems 10:323-352.

Levine, B., K. Reich, P. Shields, I.H. Suffet and V. Lazarova. 2001. Water quality assessment for indirect potable reuse: a new methodology for controlling trace organic compounds at the West Basin Water Recycling Plant (California, ISA), Water Sci. Technol. 43, 249.

Mahaffey KR. 2000. Recent advances in recognition of low-level methyl mercury poisoning, in Curr Opin Neurol, 13(6), 699-707.

National Research Council, National Academy of Sciences, 2000. Toxicological Effects of Methylmercury.

National Science and Technology Council, Committee on Environment and Natrual Resources (NSTC). Health and Ecological Effects of Endocrine Disrupting Chemicals, A Framework for Planning.

Oltmann, R.N. 1998. Indirect Measurement of Delta Outflow using Ultrasonic Velocity Meters and Comparison with Mass-Balance Calculated Outflow. An article from the Interagency Ecological Program (IEP) for the Sacramento-San Joaquin Estuary NewsletterVol.11, No.1 -- Winter 1998

Orr, J. C., O. Aumont, A. Yool, G.-K. Plattner, F. Joos, E. Maier-Reimer, M.-F. Weirig, R. Schlitzer, K. Caldeira, M. E. Wickett, R. J. Matear, B. Mignone, J. L. Sarmiento, J. Davison. 2003. The GOSAC project to predict the efficiency of ocean CO_2 sequestration using 3-D ocean models. Proceedings of the Sixth International Conference on Greenhouse Gas Control Technologies.

Patterson, M., J. Rudd, and V. St. Louis. 1998. Increases in Total and Methylmercury in Zooplankton following Flooding of a Peatland Reservoir. Environmental Science and Technology, 32, 3868-3874.

Philip Williams & Associates, Ltd. (PWA). 2006. Dutch Slough Tidal Marsh Restoration Conceptual Plan & Feasibility Report.

Reddy, K.R. 2005. Review of Delta wetlands water quality: release and generation of dissolved organic carbon from flooded peatlands. Wetland Biogeochemistry Laboratory Soil and Water Science Department, University of Florida, Gainesville, Fl. 32611. Final Report prepared for In-Delta Section, Division of Planning and Local Assistance, Department of Water Resources, Sacramento, CA

San Francisco Bay Regional Water Quality Control Board (SFRWQCB). 2000. Beneficial Reuse of Dredged Materials: Sediment Screening and Testing Guidelines. Staff report prepared by Fred Hetzel and Glynnis Collins, San Francisco Bay Regional Water Quality Control Board, Oakland, CA May 2000. 31 pp.

Schober SE, Sinks TH, Jones RL, Bolger PM, McDowell M, Osterloh J, et al. 2003. Blood mercury levels in U.S. children and women of childbearing age, 1999-2000. JAMA 289:1667-1674.

Sequoia Environmental. 2003. Phase I Environmental Site Assessment Report, 7100 Sellers Ave. (CALFED), Oakley, CA [Gilbert Property]. January 15, 2003.

Slotton, D. G., Ayers, S. M., Reuter, J. E., 1998. Marsh Creek Watershed Mercury Assessment Project. Conducted for Contra Costa County, California.

Slotton, D. G., S.M. Ayers, R.D. Weyand. 2006. California Bay Delta Authority Biosentinel Mercury Monitoring Program, First Year Draft Data Report Covering Sampling Conducted August 2005-February 2006. BIOSENTINEL

State Water Resources Control Board. 2003. Section 303(d) List of Water Quality Limited Segments. http://www.waterboards.ca.gov/tmdl/303d_lists.htm

Stellar Environmental Solutions, Inc. 2006. Soil Sampling and Analytical Results, Dutch Slough Restoration Project. Draft Report.

U.S. Environmental Protection Agency (USEPA). 2006. Conceptual Model for Organic Carbon in the Central Valley and Sacramento-San Joaquin Delta. Final Report. Prepared for USEPA region 9 and Central Valley Drinking Water Policy Group by Tetra Tech, Inc.

U.S. Geological Survey (USGS). 2000. Delta Subsidence in California. The Sinking Heart of the State.

Wiener, J.G., C.C. Gilmour and D.P. Krabbenhoft. 2003. Mercury Strategy for the Bay-Delta Ecosystem: A Unifying Framework for Science, Adaptive Management, and Ecological Restoration:Final Report to the California Bay Delta Authority.

Ying, G., R. Kookana, and T. D. Waite. 2004. Endocrine disrupting chemicals (EDCs) and Pharmaceuticals and Personal Care Products (PPCPs) in reclaimed water in Australia. Australian Water Conservation and Reuse Research Program. 35 pp.

3.3 GEOLOGY AND SOILS

Association of Bay Area Governments (ABAG) 2006. Shaking Intensity Maps and Information. http://www.abag.ca.gov/bayarea/eqmaps/mapsba.html. Accessed July 2006.

Atwater, B. I. 1982. Geologic Maps of the Sacramento-San Joaquin Delta, California, USGS MF 1401.

CALFED 1998. Seismic vulnerability of the Sacramento-San Joaquin Delta Levees, CALFED Bay-Delta Program, Seismic Vulnerability. December.

California Building Code. 1998.

California Climate Change Center (CCCC) 2006. Our Changing Climate – Assessing the Risks to California. http://www.climatechange.ca.gov/biennial_reports/2006report/index.html. Accessed August 2006.

California Department of Conservation, Division of Mines and Geology 1999. Fault-Rupture Hazard Zones In California, Alquist-Priolo Earthquake Fault Zoning Act with Index To Earthquake Fault Zones Maps. Special Publication 42. Authored by Earl W. Hart And William A. Bryant. Revised 1997, Supplements 1 and 2 added 1999.

Cao, Tianqing, William A. Bryant, Badie Rowshandel, David Branum, and Christopher J. Wills. 2003. The Revised 2002 California Probabilistic Seismic Hazard Maps. June.

DWR 2005. Flood Warnings: Responding to California's Flood Crisis. Department of Water Resources. January.

ENGEO Inc. 2004. Geotechnical Update Lesher Property, Contra Costa County. Prepared for KB Home Southbay, Inc. April 30.

Graymer, R. W. Jones D. L. and Brabb E. E., 2002, Geologic Map and Map Database of Northeastern San Francisco Bay Region, California: Most of Solano County and Parts of Napa, Marin, Contra Costa, San Joaquin, Sacramento, Yolo, and Sonoma Counties. US Geological Survey.

Hultgren-Tillis Engineers 2005. Geotechnical Consultation Seepage and Levees Dutch Slough Tidal Marsh Restoration. August 17.

Intergovernmental Panel on Climate Change (IPCC) 2001. Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Houghton, J.T.,Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 881pp. http://www.grida.no/climate/ipcc_tar/wg1/409.htm. Accessed August 2006.

Kleinfelder Inc.

______.2003. Geotechnical Levee Evaluation Cypress Lakes and Country Club Hotchkiss Tract Contra Costa County. Prepared for Shea Homes. February 2003.

______.2004. Soils, Geologic and Seismic Conditions East Cypress Corridor Specific Plan City of Oakley, California. Prepared for McLarand Vasquez Emsiek & Partners, Inc. December 13.

______.2006. Geotechnical Services Report Jersey Island Road Levee Evaluation Cypress Corridor Specific Plan Area Contra Costa County. Prepared for KB Home South Bay. May 1.

Soil Conservation Service (SCS) 1977. Soil Survey of Contra Costa County. United States Department of Agriculture Soil Conservation Service. September.

Petersen et al. 1996. Probabilistic Seismic Hazard Assessment for the State of California: California Division of Mines and Geology Open-File Report 96-08.

PWA 2006. Dutch Slough Tidal Marsh Restoration Conceptual Plan & Feasibility Report. Prepared for the California State Coastal Conservancy by Philip Williams & Associates, Ltd.

Roger Foott and Associates (1993). Levee Upgrading Study, Hotchkiss Tract, Contra Costa County, California, 175-003.

United States Army Corps of Engineers (USACE) 2005. Design Guidance for Levee Underseepage. Engineering and Design Technical Letter No. 1110-2-569.

United States Geological Survey (USGS) Working Group on California Earthquake Probabilities 2003. Earthquake Probabilities in the San Francisco Bay Region: 2002-2031. Open-File Report 03-214. US Geological Survey. http://pubs.usgs.gov/of/2003/of03-214/WG02_OFR-03-214_ExecSummary.pdf. Accessed May 11, 2006.

United States Geological Survey (USGS) 2006. Preliminary Maps Of Quaternary Deposits And Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California: A Digital Database Open-File Report 00-444. Online version 1.0. http://pubs.usgs.gov/of/2000/of00-444/

3.4 BIOLOGICAL RESOURCES: TERRESTRIAL AND WETLANDS

Arnold, R.A.

_____.2005. Habitat assessment for special-status insects and invertebrates for the Dal Porto North, Dal Porto South, Lesher, and Biggs Properties near Oakley in Eastern Contra Costa County, California. Unpublished letter report.

_____.2005. Report on focused surveys for five special-status beetles, Dal Porto North, Dal Porto South, Lesher, and Biggs Properties near Oakley in Eastern Contra Costa County, California. Unpublished letter report.

Baye, P.R., P.M. Faber and B. Grewell. 2000. Tidal marsh plants of the San Francisco Estuary. In: Olofson, P.R., ed. 2000. Baylands Ecosystem Species and Community Profiles: life histories and environmental requirements of key plants, fish, and wildlife. Goals Project (Baylands Ecosystem Habitat Goals), pp. 9-32. San Francisco Bay Regional Water Quality Control Board, Oakland, California.

Dexter, W.

_____.2004-2005 Wet season branchiopod survey report – Biggs, Oakley, Contra Costa County, California. Condor Country Consulting, Martinez, CA.

_____.2005. 2004-2005 Wet season branchiopod survey report – Dal Porto South, Oakley, Contra Costa County, California. Condor Country Consulting, Martinez, CA.

_____.2005. 2004-2005 Wet season branchiopod survey report – Dal Porto North and Lesher, Contra Costa County, California. Condor Country Consulting, Martinez, CA.

DWR

_____.2005. Botanical Assessment of the Dutch Slough Wetlands Restoration Project, (with maps). Unpublished report, California Department of Water Resources, Sacramento, California.

_____.2005b. Dutch Slough Wetlands Restoration Project Avian Report: Analysis of Impacts and Benefits. Unpublished report prepared by Michael Bradbury, California Department of Water Resources, Sacramento, California.

Estep, J. A. 1989. Biology, movements, and habitat relationships of the Swainson's Hawk in the Central Valley of California, 1986-87.Calif. Dept. Fish and Game, Nongame Bird and Mammal Sec. Rep., 52pp.

NHI. 2004. Dutch Slough Tidal Marsh Restoration Project Preliminary Opportunities and Constraints Report. Prepared by the Natural Heritage Institute, San Francisco, for the California State Coastal Conservancy.

Pavlik, B. 1996. Identity and status of *Oenothera* population, Summit Project Site, Concord, CA. Unpublished letter report to James A. Martin, Environmental Collaborative, Pt. Richmond, CA.

Sycamore Associates

______.1999. Biological Assessment of the Emerson and Burroughs Properties, Oakley, Contra Costa County, California. Sycamore Associates LLC, Walnut Creek, California.

______.2004. Biological Assessment for the 180-acre Dal Porto Property, Oakley, Contra Costa County. Sycamore Associates, Walnut Creek, CA.

______.2004. Biological Assessment for the 351-acre Biggs Property, Oakley, Contra Costa County. Sycamore Associates, Walnut Creek, CA.

______.2004. Biological and Wetlands Assessment for the 362-acre Lesher Property, Oakley, Contra Costa County. Sycamore Associates, Walnut Creek, CA.

______.2005. Biological Assessment for the 180-acre Dal Porto South Property, Oakley, Contra Costa County. Sycamore Associates, Walnut Creek, CA.

______.2005. Biological Assessment for the 360-acre Lesher Property, Oakley, Contra Costa County. Sycamore Associates, Walnut Creek, CA.

______.2005b. Silvery legless lizard presence/absence surveys for the Biggs, Lesher, and Dal Porto South properties within the East Cypress Corridor Specific Plan Area. Sycamore Associates, Walnut Creek, CA.

______.2005c. Swainson's hawk foraging habitat analysis for the East Cypress Corridor Specific Plan Area, Oakley, Contra Costa County, California. Sycamore Associates, Walnut Creek, CA.

______.2005d. Burrowing Owl Habitat Assessment and Focused Nesting Season and Winter Season Surveys for the 351-acre Biggs Property, Oakley, Contra Costa County. Sycamore Associates, Walnut Creek, CA.

______.2005d. Burrowing Owl Habitat Assessment and Focused Nesting Season and Winter Season Surveys for the 180-acre Dal Porto South Property, Oakley, Contra Costa County. Sycamore Associates, Walnut Creek, CA.

______.2005d. Burrowing Owl Habitat Assessment and Focused Nesting Season and Winter Season Surveys for the 362-acre Lesher Property, Oakley, Contra Costa County. Sycamore Associates, Walnut Creek, CA.

Swaim, K.

______.2004. Results of surveys for the giant garter snake (*Thamnophis gigas*) in Marsh Creek and the Contra Costa Canal, Northeast Contra Costa County, California. Report prepared for Sycamore Associates LLC, Walnut Creek, by Karen Swaim, Swaim Biological Consulting, Livermore CA.

______.2005. Results of surveys for the giant garter snake (*Thamnophis gigas*) at the Biggs Property in Northeast Contra Costa County, California. Report prepared for Sycamore Associates LLC, Walnut Creek, by Karen Swaim, Swaim Biological Consulting, Livermore CA.

______.2005. Results of surveys for the giant garter snake (*Thamnophis gigas*) at the Lesher Property in Northeast Contra Costa County, California. Report prepared for Sycamore Associates LLC, Walnut Creek, by Karen Swaim, Swaim Biological Consulting, Livermore CA.

______.2005. Results of surveys for the giant garter snake (*Thamnophis gigas*) at the Dal Porto North Property in Northeast Contra Costa County, California. Report prepared for Sycamore Associates LLC, Walnut Creek, by Karen Swaim, Swaim Biological Consulting, Livermore CA.

______.2005. Results of surveys for the giant garter snake (*Thamnophis gigas*) at the Dal Porto South Property in Northeast Contra Costa County, California. Report prepared for Sycamore Associates LLC, Walnut Creek, by Karen Swaim, Swaim Biological Consulting, Livermore CA.

3.5 BIOLOGICAL RESOURCES (AQUATIC)

Baker, J.T. 1969. Histological and Microscopial Observations on Copper Poisoning in the Winter Flounder (*Pseudopleuronectes americanus*). Journal of the Fisheries Research Board of Canada 26: 2785-2793.

Bennett, W. A., David J. Ostrach and David E. Hinton. 1995. Larval Striped Bass Condition in a Drought-Stricken Estuary: Evaluating Pelagic Food-Web Limitation. Ecological Applications 5 (3): 680-692.

Brown, Larry R. 2003. Will Tidal Wetland Restoration Enhance Populations of Native Fishes? In: Larry R. Brown, editor. Issues in San Francisco Estuary Tidal Wetlands Restoration. San Francisco Estuary and Watershed Science. Vol. 1, Issue 1 (October 2003), Article 2. http://repositories.cdlib.org/jmie/sfews/vol1/iss1/art2

Brown, Larry R. and Dennis Michniuk. 2007. Littoral Fish Assemblages of the Alien-dominated Sacramento-San Joaquin Delta, California, 1980-1983 and 2001-2003. Estuaries and Coasts 30 (1): 186-200.

California Climate Change Center (CCCC) 2006. Our Changing Climate: Assessing the Risks to California. http://www.climatechange.ca.gov/biennial_reports/2006report/index.html. Accessed August 2006.

Cain J.R. and J. D. Robins. 2003. The past and present condition of the Marsh Creek Watershed. National heritage Institute. http://www.n-h-i.org/Publications/Publications.html.

Conomos, John T., editor. 1979. San Francisco Bay: The Urbanized Estuary. Investigation into the natural history of San Francisco Bay and Delta with reference to the influence of man. Reproduced from: Pacific Division AAAS, San Francisco, California. 493 p. http://www.estuaryarchive.org/archive/conomos_1979

Dege, M. and L. R. Brown. 2004. Effect of Outflow on Spring and Summertime Distribution and Abundance of Larval and Juvenile Fishes in the Upper San Francisco Estuary in F. Feyrer, L. R. Brown, R. L. Brown, and J. J. Orsi, editors. Early Life History of Fishes in the San Francisco Estuary and Watershed. American Fisheries Society, Symposium 39, Bethesda, Maryland.

Edwards, R.W and V.M. Brown. 1967. Pollution and Fisheries; a Progress Report. Water Pollution Control 66: 63-78.

Federal Register 1993. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Delta Smelt; Final Rule, 58 Federal Register 42 (5 March 1993) pp. 12854-12864.

Federal Register 1999. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Sacramento Splittail; Final Rule, 64 Federal Register 25 (8 February 1999) pp. 5963-5981.

Feyrer, F., and M. P. Healey. 2003. Fish community structure and environmental correlates in the highly altered southern Sacrament-San Joaquin Delta. Environmental Biology of Fishes 66:123-132.

Gomez, R.L. and J.N. Lester. 2003. Endocrine Disruptors in Receiving Waters, *in* Endocrine Disruptors in Wastewater and Sludge Treatment Processes, J.W. Birkett and J.N. Lester *eds*. CRC Press LLC, FL. 295pp.

Grimaldo, L.F. and Z. Hymanson. 1999. What is the impact of the introduced Brazilian Waterweed *Egeria densa* to the Delta Ecosystem? IEP Newsletter 12(1): 43-45.

Grimaldo L. F., R. E. Miller, C. M. Peregrin, and Z. P. Hymanson. 2004. Spatial and Temporal Distribution of Native and Alien Ichthyoplankton in Three Habitat Types of the Sacramento-San Joaquin Delta *in* F. Feyrer, L. R. Brown, R. L. Brown, and J. J. Orsi, editors. Early Life History of Fishes in the San Francisco Estuary and Watershed. American Fisheries Society, Symposium 39: 81-96, Bethesda, Maryland

Hobbs, D.F. 1937. Natural reproduction of quinnat salmon, brown and rainbow trout in certain New Zealand waters. N.Z. Mar. Dep. Fish. Bull No. 6.

Intergovernmental Panel on Climate Change (IPCC) 2001. Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Houghton, J.T.,Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 881pp. http://www.grida.no/climate/ipcc_tar/wg1/409.htm Accessed August 2006.

Kemp, H. A. 1949. Soil Pollution in the Potomac River Basin. American Water Works Association, Journal 41 (9): 792-796.

Kimmerer W. J. 2002. Physical, biological, and management responses to variable freshwater flow into the San Francisco estuary. Estuaries 25 (6B): 1275-1290.

Kneib R. T. 2003. Bioenergetic and landscape considerations for scaling expectations of nekton production from intertidal marshes. Marine Ecology-Progress Series 264: 279-296.

Kneib R. T. and S. L. Wagner. 1994. Nekton use of vegetated marsh habitats at different stages of tidal inundation. Marine Ecology-Progress Series 106 (3): 227-238

Madon S. P., G. D. Williams, J. M. West, J. B. Zedler. 2001. The importance of marsh access to growth of the California killifish, *Fundulus parvipinnis*, evaluated through bioenergetics modeling. Ecological Modeling 136 (2-3): 149-165.

Madej, A. 2004. How suspended organic sediment affects turbidity and fish feeding behavior. USGS Sound Waves. http://soundwaves.usgs.gov/2004/11/research2.html

Marchetti M. P., P. B. Moyle, R. Levine. 2004. Alien fishes in California watersheds: Characteristics of successful and failed invaders. Ecological Applications 14 (2): 587-596.

Matern S. A., P. B. Moyle, L. C. Pierce. 2002. Native and alien fishes in a California estuarine marsh: Twenty-one years of changing assemblages. Trans. Amer. Fish. Soc. 131 (5): 797-816.

Matthiessen, P. and J. P. Sumpter. 1998. Effects of Estrogenic Substances in the Aquatic Environment. Fish Ecotoxicology: 319-335.

Minello T. J., K. W. Able, M. P. Weinstein, and C.G. Hays. 2003. Salt marshes as nurseries for nekton: testing hypotheses on density, growth and survival through meta-analysis. Marine Ecology-Progress Series 246: 39-59.

Moyle, P.B. 2002. Inland fishes of California. University of California Press, Berkeley and Los Angeles, CA

Moyle, P.B., B. Herbold, D. E. Stevens and L. W. Miller. 1992. Life history and status of delta smelt in the Sacramento-San Joaquin Estuary, California. Trans. Amer. Fish. Soc. 121:67-77

Moyle, PB., J.E. Williams, and ED. Wlkramanayake. 1989. Fish species of special concern of California. Final report prepared for State of California. Department of Fish and Game, Inland Fisheries Division, Rancho Cordova, California. 222 pp.

Moyle P. B. 1976. Some effects of channelization on fishes and invertebrates of rush creek, Modoc-county, California. California fish and game 62 (3): 179-186.

Nobriga M., M. Chotkowski. 2000. Recent historical evidence of centrarchid increases and tule perch decrease. Interagency Ecological Program Newsletter 13 (1): 23-27.

Nobriga M. L., F. Feyrer, R. D. Baxter, and M. Chotkowski. 2005. Fish community ecology in an altered river delta: Spatial patterns in species composition, life history strategies, and biomass. Estuaries 28 (5): 776-785

Nobriga, M. L. and F. Feyrer. 2007. Shallow-Water Piscivore-Prey Dynamics in California's Sacramento-San Joaquin Delta. San Francisco Estuary and Watershed Science. 5 (2): 4.

Orsi, James J. 1999. Report on the 1980-1995 Fish, Shrimp, and Crab Sampling in the San Francisco Estuary, California. http://www.estuaryarchive.org/archive/orsi_1999.

Philip Williams & Associates, Ltd. 2006. Dutch Slough Tidal Marsh Restoration Conceptual Plan & Feasibility Report.

Rockriver, A. 2007. 2007 Decker Island fish monitoring report. Draft report to the Delta Levee Habitat Improvement Program, CA Department of Fish and Game. 19pp.

RWQCB, Central Valley Region.

_____.2004. The water quality control plan (Basin Plan) for the California Regional Water Quality Control Board, Central Valley Region, 4th Edition. Sacramento, CA. 94 pp.

Simenstad, C., J. Toft, H. Higgins, J. Cordell, M. Orr, P. Williams, L. Grimaldo, Z. Hymanson, and D. Reed and others (BREACH Interdisciplinary Research Team). 2000. Sacramento/San Joaquin Delta Breached Levee Wetland Study (BREACH), Preliminary Report to CALFED.

Sindermann, C.J., R. Lloyd, S. Vader, R. Bourve. 1982. Implications of oil pollution in production of disease in marine organisms. Philosophical Transactions of the Royal Society of London, Series B: Biological Sciences 28: 385-399.

Stellar Environmental Solutions, Inc. 2006. Soil Sampling and Analytical Results, Dutch Slough Restoration Project. Draft Report.

Vogelbein, W. K. and M.A. Unger. 2006. Liver Carcinogens in a Non-Migratory Fish: the Association with Polycyclic Aromatic Hydrocarbon Exposure. Bulletin of the European Association of Fish Pathologists 26 (1): 11-20.

Wang, Johnson C. S. 1986. Fishes of the Sacramento-San Joaquin Estuary and Adjacent Waters, California: A Guide to the Early Life Histories California Department of Water Resources, California Department of Fish and Game, U. S. Bureau of Reclamation and U. S. Fish and Wildlife Service. Technical Report 9

Waters, T.F. 1995. Sediment in streams: sources, biological effects, and control. American Fisheries Society Monograph 7. Bethesda, MD.

Williams G. D., J. B. Zedler. 1999. Fish assemblage composition in constructed and natural tidal marshes of San Diego Bay: Relative influence of channel morphology and restoration history. Estuaries 22 (3A): 702-716 SEP 1999.

Yang, X. 2005. Use of Fish Biomarkers to Assess the Contaminant Exposure and Effects in Lake Erie Tributaries. Dissertation Abstracts International Part B: Science and Engineering 66 (1): 182.

Long-term monitoring studies in the San Francisco Estuary:

(1) CDFG Summer Townet Survey

(2) CDFG Fall Midwater Trawl Survey

(3) USFWS Chipps Island trawl survey

(4) U.C. Davis Suisun Marsh trawling and seining surveys

(5) USFWS Beach Seine Survey

(6) CDFG San Francisco Bay trawling survey

3.6 AIR QUALITY

Association of Environmental Professionals 2007. Alternative Approaches to Analyzing Greenhouse Gas Emissions and Global Climate Change in CEQA documents. June 29, 2007. 25 pp.http://counties.org/images/public/Advocacy/ag_natres/AEP_Global_Climate_Change_June_29_Final%5B1%5D.pdf Accessed October 2008.

CEC 2006. Inventory of California Greenhouse Gas Emissions and Sinks: 1990-2004. California Energy Commission December 2006. 132 pp.

USEPA 2008. Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2006. USEPA #430-R-08-005. U.S Environmental Protection Agency. 394 pp. http://www.epa.gov/climatechange/emissions/usinventoryreport.html Accessed Oct 2008.

USEPA 2006. High Global Warming Potential (GWP) Gases. http://www.epa.gov/highgwp/ Accessed Oct 2008.

http://www.energy.ca.gov/2006publications/CEC-600-2006-013/CEC-600-2006-013-SF.PDF. Accessed October 2008

Miller, Robin. US Geological Survey, personal communications October 29 and November 3, 2008

3.8 AESTHETICS

City of Oakley, 2002. City of Oakley 2020 General Plan.

Miller, Patrick, 2006. Email to Lori Cheung, Cheung Environmental Consulting.

3.9 LAND USE

California Delta Protection Commission 2006. Website accessed on August 9, 2006. http://www.delta.ca.gov/about.asp.

City of Oakley

_____.2002a. City of Oakley General Plan Draft Environmental Impact Report. September 13, 2002.

_____.2002b. City of Oakley 2020 General Plan.

_____.2006. Dutch Slough Community Park and Public Access Conceptual Master Plan. Prepared by 2M Associates and Design Community and Environment. Administrative Draft, May 2006

Ironhouse Sanitary District 2006. www.ironhousesanitarydistrict.com/mainframe.html.

Rochelle Henson 2006. Rochelle Hensen, Senior Planner, City of Oakley, Personal communication with Karen Frye, July 26, 2006.

3.10 AGRICULTURAL RESOURCES

California Department of Conservation

_____.2006a. Division of Land Resource Protection. Farmland Mapping and Monitoring Program. http://www.consrv.ca.gov/DLRP/fmmp/index.htm

_____.2006b. Division of Land Resource Protection. Williamson Act Program. Contra Costa County Williamson Act Lands 2002, Land Enrolled in Williamson Act and Farmland Security Zone Contracts as of 01-01-2002. http://www.consrv.ca.gov/DLRP/lca/

City of Oakley

_____.2002a. City of Oakley General Plan Draft Environmental Impact Report. September 13, 2002.

_____.2002b. City of Oakley 2020 General Plan.

Contra Costa County

_____.2000a. Modifications to the Urban Limit Line Approved by the Board of Supervisors in August and September 2000. http://www.co.contra-costa.ca.us/depart/cd/advance/ull-map.pdf

_____.2000b. Summary Results of June 2000 65/35 Land Use Inventory. June 2000. http://www.co.contra-costa.ca.us/depart/cd/advance/6535_map.pdf

_____.2006. Contra Costa County Code, Title 8 Zoning, through Ordinance 2006-05, passed February 28, 2006. http://www.co.contra-costa.ca.us/

East Contra Costa County Habitat Conservation Plan Association 2006. Final East Contra Costa County Habitat Conservation Plan/Natural Community Conservation Plan. October 2006.

Henson, Rochelle 2006. City of Oakley, Senior Planner. Personal communication with Karen Frye on July 27, 2006.

3.11 RECREATION

California State Parks 2006. Website accessed August 9, 2006. http://www.parks.ca.gov/default.asp?page_id=490

Ironhouse Sanitary District 2006. www.ironhousesanitarydistrict.com/mainframe.html accessed on July 25, 2006.

East Bay Regional Park District 1997. Master Plan 1997. Adopted: December 17, 1996.

http://www.ebparks.org/resources/pdf/misc/RPM_Plan97.pdf

City of Oakley

______.2002a. City of Oakley General Plan Draft Environmental Impact Report. September 13, 2002.

______.2002b. Oakley 2020 Draft General Plan. adopted on December 16, 2002. http://www.ci.oakley.ca.us/html/plan/index.asp

______.2006. Dutch Slough Community Park and Public Access Conceptual Master Plan. Prepared by 2M Associates and Design Community and Environment. Draft, August 2006.

Kaiser, Nancy 2006. City of Oakley Parks and Recreation Director. Personal communication with Karen Frye, August 14, 2006.

3.12 CULTURAL RESOURCES

Baker, S. 1985. Archaeological Reconnaissance of the Burroughs Property, Contra Costa County, California. Report #S-07639 on file at the Northwest Information Center of the California Historical Resources Information System, Sonoma State University.

Burroughs, Ernie. 2006. Personal Communication with Marjorie Dobkin, June 14, 2006.

California Department of Water Resources (DWR). April 2004. Negative Archaeological Survey Report, Dutch Slough Wetland Restoration Project.

California, Office of the Governor.

______1992. California Environmental Quality Act: Statutes and Guidelines. Governor's Office of Planning & Research, Technical Publications.

______1994. CEQA and Historical Resources. Governor's Office of Planning & Research, Technical Publications.

California, State of, Department of Parks and Recreation, Office of Historic Preservation (CAL/OHP)

______1973. The California History Plan. Volume One - Comprehensive Preservation Program, Volume Two - Inventory of Historic Features.

______1976. California Inventory of Historic Resources.

______1992. California Points of Historical Interest.

______1996. California Historical Landmarks.

______2001a. California Environmental Quality Act (CEQA) and Historical Resources. Technical Assistance Series 1.

______2001b. Historical Resource Registration Programs in California. Technical Assistance Series 2.

______2001c. California State Law and Historic Preservation: Statutes, Regulations and Administrative Policies Regarding Historic Preservation and Protection of Cultural and Historical Resources. Technical Assistance Series 10.

______2004. User's Guide to the California Historical Resources Status Codes & Historic Resources Inventory Directory. Technical Assistance Bulletin 8. November.

______2006. Historic Properties Directory [Historic Properties Data File] for Contra Costa County (includes National Register of Historic Places status codes, California Historical Landmarks and California Points of Historical Interest listings, etc.). Dated 4/06/06.

California (State of), Department of Water Resources. Negative Archaeological Survey Report. Dutch Slough Wetland Restoration Project.

Contra Costa County Community Development Department (CCC/CDD)

______1976. Preliminary Historic Resources Inventory, Contra Costa County, California.

______1989. Revised Preliminary Historic Resources Inventory, Contra Costa County, California.

Contra Costa County Historical Society (CCCoHS). 1994. Contra Costa County Map of Historical Points of Interest: giving precise locations of 195 sites of historical interest. Scale [ca. 1:96,000] (W 122016'—W 121032'/N 38007'—N 37013'). The Society, [Martinez, Calif.].

Emerson, Katy. 1984. Ironhouse School. Self Published. Lodi, Abrahamson Printing.

Emerson, Ralph. 1974. Oral History Interview on File, Emerson Family, East Contra Costa Historical Society.

Emerson, Stan. 2006. Personal Communication. April 27, 2006.

Holman & Associates, A Report of Findings of a Cultural Resources Survey of the Ironhouse Sanitary District (ISD) Project, Oakley and Jersey Island, Contra Costa County, California. September 2005.

Historic Record Co. 1926. History of Contra Costa County. Los Angeles, Historic Record Co.

Hulaniski, Frederick J. 1917. History of Contra Costa County. Berkeley, Elms Publishing Co.

Leighton, Kathy. 2001. Footprints in the Sand. Ann Arbor, Sherdian Books, Inc. City of Brentwood and East Contra Costa Historical Society Publication.

Livingston, D.S.

______1994. Ranching on the Pt. Reyes Peninsula. National Park Service, Department of the Interior.

______1995. A Good Life: Dairy Farming in the Olema Valley. National Park Service, Department of the Interior.

Purcell, Mae Fisher. 1940. History of Contra Costa County. Berkeley, Gillick Press.

Slocum, W.A. & Co. 1882. History of Contra Costa County. San Francisco, W.A. Slocum & Co.. Reprint Brooks-Sterling.

United States Department of Interior, National Park Service

______1990. National Register Bulletin 32 - Guidelines for Evaluating and Documenting Properties Associated with Significant Persons.

______1997. National Register Bulletin 15 - Guidelines for Applying National Register Criteria of Evaluation.

______National Register Bulletin 16 & 16A - Guidelines for Completing National Register of Historic Places forms.

______1997. National Register Bulletin 30 – Guidelines for Evaluating and Documenting Rural Historic Landscapes.

Official Map of Contra Costa County

______1908. T.A. McMahon, Comp.

______1930. R.R. Arnold, Comp.

______1938. R.R. Arnold, Comp.

______1965. Victor Sauer, Comp.

United States Geological Survey

______1910. Jersey Island, Calif.

______1914. Brentwood , Calif.

______1970. Jersey Island, Calif. Orthophoto Quad.

______1978. Jersey Island, Calif.

3.14 PUBLIC SERVICES, UTILITIES AND SERVICE SYSTEMS

City of Oakley 2006. City of Oakley website, http://www.ci.oakley.ca.us. Accessed in July and August 2006.

East Contra Costa Fire Protection District 2006. East Contra Costa Fire Protection District website, http://www.eccfpd.org. Accessed in July 2006.

Gonzalez, Jake 2006. Battalion Chief, East Contra Costa Fire Protection District.

Hall, Tom 2006. Department of Water Resources. Email to Lori Cheung, Cheung Environmental Consulting.

McLarand Vasquez Emsiek & Partners, Inc., et al. 2005. East Cypress Corridor Specific Plan Environmental Impact Report. Prepared for the City of Oakley.

Miller, Patrick T. 2006. Landscape Architect, 2M Associates. Email to Lori Cheung, Cheung Environmental Consulting.

Skrel, Jenny 2006. District Engineer, Ironhouse Sanitary District. Email to Lori Cheung, Cheung Environmental Consulting.

Thorsen Chris, 2006. Police Chief, City of Oakley Police Department. Email to Lori Cheung, Cheung Environmental Consulting.

Willoughby, Steve 2006. Pacific Gas & Electric Company. Email to Lori Cheung, Cheung Environmental Consulting.

Yeraka, Mike 2006. General Manager, Diablo Water District. Email to Lori Cheung, Cheung Environmental Consulting.

3.15 HAZARDS AND HAZARDOUS MATERIALS

California Department of Water Resources:

______2003a. Review of Phase I Environmental Assessment Report for Gilbert Property – Dutch Slough Tidal Marsh Restoration Project. DWR Memorandum, March 19, 2003.

______2003b. Review of Phase I Environmental Assessment Report for Burroughs Property – Dutch Slough Tidal Marsh Restoration Project. DWR Memorandum, April 7, 2003.

______2003c. Review of Phase I Environmental Assessment Report for Emerson Property – Dutch Slough Tidal Marsh Restoration Project. DWR Memorandum, April 7, 2003.

______2003d. DWR Action/Response to Site Assessment Section's Review of Dutch Slough Phase I Reports. Internal DWR Memo to Dutch Slough File, August 25, 2003.

______2003e. Environmental Remediation with the Dutch Slough (Burroughs, Emerson & Gilbert) properties. DWR letter to State Coastal Conservancy, October 30, 2003.

______2003f. Residual TPH in Soil – Burroughs Excavation. Internal DWR Memo to Dutch Slough File, October 9, 2003.

______2003g. Review of Emerson Dairy Soil and Groundwater Testing Report. DWR Memorandum, August 18, 2003.

California Department of General Services 2003. Environmental Services Action/Response to Review of Dutch Slough Phase I/II Reports and Site Visit. Internal Memo, September 15, 2003.

Central Valley Joint Venture's Mosquito Working Group. printed by U.S. Bureau of Reclamation.

Collins, J. N., and V. H. Resh. 1989. Guidelines for the ecological control of mosquitoes in non-tidal wetlands of the San Francisco Bay Area. Sacramento: California Mosquito Vector Control Association, Inc., and University of California Mosquito Research Program.

Kwasny, Dean C., Mike Wolder, and Craig R. Isola. 2004. Central Valley Joint Venture Technical Guide to Best Management Practices for Mosquito Control in Managed Wetlands

ENGEO, Inc. 2003a. Phase One Environmental Site Assessment. Emerson Properties (State Parcels) Sellers Avenue, Oakley, California. Project No. 4603.1.007.01. January 29, 2003.

ENGEO, Inc. 2003b. Phase One Environmental Site Assessment. Burroughs Properties (State Parcels) Jersey Island Road, Oakley, California. Project No. 4603.1.004.01. January 29, 2003.

ENGEO, Inc. 2003c. Natural Gas Well Site Assessment. Burroughs Properties (State Parcels) Jersey Island Road, Oakley, California. Project No. 4603.1.004.03. July 30, 2003.

ENGEO, Inc. 2003d. Soil and Groundwater Testing. Emerson Properties (State Parcels) Sellers Avenue, Oakley, California. Project No. 4603.1.007.03. July 23, 2003

Sequoia Environmental Consulting Services. 2003. Phase I Environmental Site Assessment Report. 7100 Sellers Avenue (CALFED), Oakley California. Project Code BG-01A. January 15, 2003.

Insert tab titled Appendix A

APPENDIX A: NOTICE OF PREPARATION

NOTICE OF PREPARATION

TO: DISTRIBUTION

DATE: March 24, 2006

SUBJECT: **Notice of Preparation of Draft Environmental Impact Report (EIR)**

LEAD AGENCY: California Department of Water Resources

PROJECT NAME: Dutch Slough Restoration Project

PROJECT LOCATION: The Dutch Slough restoration site is located in the City of Oakley in northeast Contra Costa County. It 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 project may also entail restoration of 100 acres immediately west of Marsh Creek on lands owned by the Ironhouse Sanitary District.

The California Department of Water Resources (DWR) will prepare an environmental impact report for the Dutch Slough Restoration Project, which includes the following components:

- Dutch Slough Restoration Project and various operational scenarios
- Marsh Creek Delta Restoration Project (Iron House Parcel)
- Dutch Slough Community Park and Public Access Conceptual Master Plan

The project description, location, and environmental issues are contained in the attached **Notice of Preparation.**

We need to know the views of your agency as to the scope and content of the environmental information which is germane to your agency's statutory responsibilities in connection with the proposed project. Your agency may need to use this EIR when considering your permit or other approval for the project. **Due to the time limits mandated by State law, your response must be received at the earliest possible date but not later than May 5, 2006.**

A public scoping hearing will be held on April 5, 2006 from 9:00 a.m. to 12:00 p.m. at the City of Oakley Community Annex, 204 2nd Street, Oakley, CA 94561. Please send your written response, including the name of a contact person with your agency, to **California Department of Water Resources, attention Tom Hall** at the address below.

Department of Water Resources
Delta Suisun Marsh Office
P.O. Box 942863
Sacramento,CA94236-0001
Tel: (916) 651-7005
Fax: (916) 651-9678
thall@water.ca.gov

DATE ISSUED: **MARCH 24, 2006**

NOTICE OF PREPARATION
OF A DRAFT ENVIRONMENTAL IMPACT REPORT

The California Department of Water Resources (DWR), the California Environmental Quality Act (CEQA) lead agency for the Dutch Slough Restoration Project, will prepare an Environmental Impact Report (EIR). This Notice of Preparation (NOP) has been prepared to satisfy the requirements of CEQA.

This EIR will evaluate the environmental effects of implementation of a restoration plan for 1,266 acres of agricultural lands adjacent to Dutch Slough in the Sacramento/San Joaquin River delta, in the City of Oakley. The EIR also will address, at a conceptual level, the proposed 55-acre City of Oakley Community Park adjacent to the restoration parcels, and a public access master plan for the restoration site. Subsequent CEQA review by the City of Oakley may be required for the City Park.

The Dutch Slough restoration project will restore a mosaic of wetland habitat types including tidal freshwater marsh and riparian vegetation, open water, and tidal sloughs. The purpose of the project is to provide public access, restore native habitats and species, and increase scientific understanding of tidal marsh systems. The California Bay-Delta Authority and the California State Coastal Conservancy funded acquisition of the site and project planning. The Dutch Slough property is owned and managed by the Department of Water Resources. This EIR will be tiered off of the CALFED Programmatic EIR.

The project will be conducted in close coordination with California Department of Fish and Game (CDFG), US Army Corps of Engineers, City of Oakley, and other local agencies, and landowners in the project area.

The NOP is an important step in the environmental scoping process, which is designed to determine the range of issues to be addressed in the EIR. The objectives of scoping include:

- Ensuring agency and public involvement in the environmental review process,
- Determining which specific impacts must be evaluated in the EIR,
- Establishing a reasonable range of alternatives, and
- Identifying the scope of issues that must be discussed in order to adequately and accurately address the potential impacts of the project as they relate permitting and approval authority.

The California Department of Water Resources requests your comments on the scope and content of the draft EIR.

Pursuant to CEQA Section 21080.4(a) responsible and trustee agencies are asked to provide in writing the scope and content of the environmental information that is germane to their statutory responsibilities, as these agencies will need to use the EIR prepared by the Department of Water Resources when considering permits or other approvals for the project. Responsible and trustee agencies are also requested to provide a list of the permits and/or other approvals that must be obtained in order to implement the project.

A Notice of Preparation, prepared pursuant to CEQA Section 21080.6, is attached and includes: 1) a description of the proposed action and alternatives and the basis for selecting the alternatives, 2) a list of the potentially significant effects on the environment of the project, and 3) the scope of, and analyses and methodology for, EIR preparation. As indicated in the NOP, the major environmental issues to be addressed include water quality, biological resources, hydrology, visual resources, historic resources, land use, air quality, and noise.

For additional information about the project or the scoping process, please contact:

Tom Hall
California Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236-0001
Tel: (916) 651-7005
Fax: (916) 651-9678
thall@water.ca.gov

Written comments on the scope and content of the EIR should be directed to Tom Hall and must be received at the above address no later than **May 5, 2006**.

A formal scoping hearing, designed to solicit public comment on the proposed action and alternatives, has also been scheduled for **April 5, 2006 at 9:00 a.m. at the City of Oakley Community Annex, 204 2nd Street, Oakley, CA 94561.**

ATTACHMENT: Notice of Preparation

NOP DISTRIBUTION:

This Notice of Preparation/Intent was sent to the following agencies, organizations, firms, and individuals:

California Department of Fish and Game
California Regional Water Quality Control Board
California State Clearinghouse
California State Coastal Conservancy
California State Lands Commission
California State Parks
City of Oakley Community Development Department
Contra Costa County Community Development Department
Contra Costa County Flood Control and Water Conservation District
Contra Costa County Mosquito and Vector Control District
Contra Costa Water District
Delta Protection Commission
East Bay Regional Park District
Ironhouse Sanitary District
National Marine Fisheries Service (National Oceanic and Atmospheric Administration Fisheries)
Pacific Gas and Electric Company
Reclamation District 2137
Reclamation District 799
U. S. Army Corps of Engineers
U. S. Bureau of Reclamation
U. S. Fish and Wildlife Service
University of California Natural Reserve System

NOTICE OF PREPARATION

FOR THE DUTCH SLOUGH RESTORATION PROEJCT
ENVIRONMENTAL IMPACT REPORT

INTRODUCTION:

The Dutch Slough Restoration Project is a 1,166-acre tidal marsh restoration project in northeast Contra Costa County. The goals of the project are to:

1. Provide shoreline access, educational and recreational opportunities.

2. Benefit native species by re-establishing natural ecological processes and habitats.

3. Contribute to scientific understanding of ecological restoration by implementing the project under an adaptive management framework.

The environmental impact report (EIR) will be prepared in compliance with the California Environmental Quality Act (CEQA) and the CEQA Guidelines, as amended. This EIR will be tiered off of the CALFED Programmatic EIR. Because the document may be adapted or otherwise used by the US Army Corps of Engineers for compliance with the National Environmental Policy Act (NEPA), it will be formatted to address all alternatives at an equal level, as required under NEPA. The California Department of Water Resources (DWR) will be the lead agency under CEQA. In accordance with CEQA, the lead agency has the responsibility for the scope, content, and legal adequacy of the document.

The Draft EIR (DEIR) will incorporate public concerns associated with the Proposed Action and associated project alternatives, and will be sent out for a 45-day public review period, during which time both written and verbal comments will be solicited on the adequacy of the document. The Final EIR (FEIR) will address the comments received on the DEIR during public review. The document will be furnished to all who commented on the DEIR, and made available to anyone that requests a copy during the 45-day public comment period. The draft and final EIR must 1) provide a full and fair discussion of the proposed action's significant environmental impacts, and 2) inform the decision-makers and the public of reasonable alternatives that would avoid or minimize adverse impacts.

The final step in the CEQA process for the EIR is certifying the EIR and adopting a Mitigation Monitoring and Reporting Plan. A certified EIR indicates that the environmental document has been completed in compliance with CEQA; that the decision-making body of the lead agency reviewed and considered the FEIR prior to approving the project; and that the FEIR reflects the lead agency’s independent judgement and analysis.

SCOPING PROCESS:

Public participation in the environmental scoping process is an important step in determining the full scope of issues to be addressed in the EIR. DWR requests your comments on the scope and content of the EIR, as outlined in this NOP. Written comments must be provided to Tom Hall at DWR **no later than May 5, 2006.**

A formal scoping hearing has also been scheduled for April 5 April 5, 2006 at 9:00 a.m. at the City of Oakley Community Annex, 204 2nd Street, Oakley, CA 94561.

PROJECT LOCATION:

The 1,166-acre Dutch Slough Restoration Project site and the 55-acre Community Park site are located in the City of Oakley in northeast Contra Costa County. The Restoration site and community park comprise 1,221 acres that 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 project may also entail restoration of an additional 100 acres of land immediately west of Marsh Creek on lands owned by the Iron House Sanitary District.

BACKGROUND:

The 1,166-acre Dutch Slough property was purchased in 2003 with funds from the California Bay-Delta Authority and the California State Coastal Conservancy (SCC). DWR owns the 1,166 Dutch Slough property and is serving as the lead agency under CEQA. The City of Oakley owns 55-acres at the end of Sellers Avenue that is contiguous with the Dutch Slough property. The City has developed a conceptual plan for developing a community park on the 55-acres and providing public access to approximately 4 miles of trails around the Dutch Slough property. Over the last two years SCC and DWR have developed the Draft Dutch Slough Tidal Marsh Restoration Conceptual Plan and Feasibility Report. The City of Oakley has similarly completed a Draft Dutch Slough Community Park and Public Access Conceptual Master Plan for the 55-acre community park site as well as the public access component of the Dutch Slough Restoration Project. These reports provide a detailed description of the project.

PURPOSE:

The Dutch Slough Restoration Project is a 1,166-acre tidal marsh restoration project in northeast Contra Costa County. The goals of the project are to:

1. Provide shoreline access, educational and recreational opportunities.

2. Benefit native species by re-establishing natural ecological processes and habitats.

3. Contribute to scientific understanding of ecological restoration by implementing the project under an adaptive management framework.

A more detailed list of project objectives is identified in the Draft Dutch Slough Tidal Marsh Restoration Conceptual Plan and Feasibility Report.

PROJECT DESCRIPTION:

The core project entails wetland and upland restoration on the 1,166-acre Dutch Slough properties owned by DWR. Two projects that are closely associated with the Dutch Slough Restoration Project will also be evaluated in the EIR including the City of Oakley Community Park and restoration of the Marsh Creek Delta on lands owned by the Iron House Sanitary District to the west of Marsh Creek. Additional environmental documentation under CEQA may be necessary for the Community Park site depending on the specifics of the plan that have not yet been identified.

Project Components to be assessed in the Dutch Slough EIR include:

- Dutch Slough Restoration Project and various operational scenarios
- Marsh Creek Delta Restoration Project (Iron House Parcel)
- Dutch Slough Community Park and Public Access Conceptual Master Plan
- The EIR will evaluate individual and cumulative impacts of THREE alternatives, as well as the no project/no action alternative, in accordance with CEQA.

The Draft 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 project cost (figure 1). The alternatives represent different mixes of habitat, with different amounts of grading and imported fill to create these habitats. The City of Oakley worked with DWR and SCC to develop a Draft Dutch Slough Community Park and Public Access Conceptual Master Plan that is consistent with the restoration alternatives.

The restoration alternatives are:

- No Action Alternative
- Alternative 1: Low marsh and open water emphasis with minimal grading (Low cost alternative)
- Alternative 2: Mix of mid marsh, low marsh, and open water with moderate fill (Preferred alternative)
- Alternative 3: Mid marsh and low marsh emphasis with imported fill

  The “action” alternatives (Alternatives 1 – 3) vary the mix of restored habitats and the amount of fill used to create emergent tidal marsh. Alternative 1 will use minimal grading in all three parcels. Alternative 2 will use 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 will use a larger amount of grading and imported fill (approximately 3 million cubic yards total).

The alternatives have many features in common, including the restoration approach for native plant revegetation, marshplain microtopograhy, tidal channel networks, levee breaching and lowering, open water areas, infrastructure protection, and the accommodation of public assess and recreation. Restored habitats will be revegetated with native plant species to provide a diversity of habitat functions (shelter, food, nesting) for fish, birds, and other wildlife. Tules will be pre-established in restored low marsh and mid marsh areas prior to breaching by encouraging natural recruitment with flood irrigation, with limited supplemental planting of rhizomes using farm equipment and/or volunteers. The pre-establishment of tules will inhibit the invasion of non-native species such as egeria, golden flag iris, and arundo, especially at lower tidal elevations where natural colonization of tules is less likely to occur under tidal conditions. Planting high marsh and the ecotone (transition area) between marsh and riparian communities will be important to minimize the establishment of invasive weeds like perennial pepperweed and Himalayan blackberry.

Under the action alternatives, a levee will be constructed to protect on-site infrastructure, Jersey Island Road, and adjacent property to the east from flooding and groundwater seepage (using approximately 190,000 cubic yards of fill material). Pacific Gas and Electric’s on-site infrastructure crosses the northeast corner of the Burroughs parcel, which includes electric transmission line, high pressure gas line, and gas gathering line. This area (approximately 25 acres) will not be restored to tidal marsh and will remain diked behind the new levee. It may be possible to restore upland or other habitat in this area.

All three restoration alternatives include areas of open water, which will 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.

Restoration of a Delta at the mouth of Marsh Creek along the western edge of the parcel will be analyzed as a potential option under all of the action alternatives. There are several options for restoring a Delta. It could either be diverted onto the Emerson parcel or diverted onto the Westside of Marsh Creek onto lands owned by the Ironhouse Sanitary District. The decision regarding whether and where to divert Marsh Creek will be based in part on the water quality implications of diverting Marsh Creek into the restored Dutch Slough site, cost, fill availability, and ecological benefit.

If Marsh Creek is diverted onto the Emerson parcel, it will 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 will 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 will raise ground elevations within low marsh areas.

Marsh Creek could be diverted onsite in one of several potential locations (figure 2). The existing Marsh Creek channel will be blocked below the diversion to re-direct flow into the restored delta. A vehicle-accessible bridge will span the Marsh Creek diversion 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 will 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.

Marsh Creek may also be diverted onto a 100 acre parcel owned by the Ironhouse Sanitary District to the west of Marsh Creek and the Dutch Slough site as a coordinated project (figure 3). 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 parcel. 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 will be determined in future design phases. The design of the Marsh Creek diversion and delta restoration will need to maintain or improve the existing level of flood protection provided by the Marsh Creek flood control channel. Restoring a large marsh floodplain has the potential to lower flood levels in Marsh Creek. Hydraulic modeling and consideration of sediment dynamics are recommended to evaluate potential changes in flood risk.

POTENTIAL DISCRETIONARY ACTIONS AND APPROVALS:

The following actions and approvals are anticipated to be required:

Potentially Required Agency Approvals and Actions:

- U. S. Army Corps of Engineers permits underSection 10 of the Rivers and Harbors Act and Section 404 of the Federal Clean Water Act;
- Federal and State Endangered Species Act Consultations;
- California Department of Fish and Game Streambed Alteration Agreements(s), Section 1601 of the CDFG code;
- California State Regional Water Quality Control Board 401 Certification and/or Discharge Permit (s);
- California State Bay Area Air Quality Management District Permit (s);
- City of Oakley grading permit.

Responsible, cooperating, and trustee agencies are requested to review and refine this list of required actions and approvals.

ISSUE ANALYSIS (ENVIRONMENTAL CONSEQUENCES)

For each issue listed below, the EIR will include a discussion of the parameters used in evaluating impacts; potential impacts from the various alternatives; recommended mitigation, indicating the effectiveness of mitigation measures proposed to be implemented and what, if any, additional measures would be required to reduce the impacts to below a level of significance. Impact analysis will include a discussion of direct and indirect impacts, short- and long-term impacts, cumulative impacts, and unavoidable impacts. In addition, the impact discussion will also identify any areas of known controversy. Finally, the EIR will identify any unavoidable adverse impacts that would result from project implementation.

The list of issues presented below are preliminary both in scope and number. Additional issues may be identified during the scoping process.

Aesthetics Issues: *The various project components will change the aesthetic character of the project sites. This change could be viewed either positively or negatively.*

The EIR will:

- describe and present photographs of the existing project aesthetic conditions.

- compare the scenic and visual resources of the project sites in their existing condition (drained, diked bayland, derelict dairy operation, agricultural fields) with short-term conditions during wetland construction, and long-term conditions for predicted stages of wetland restoration and park development.

Air Quality Issues. *The proposed project components could have significant short-term air quality impacts due to fugitive dust, which could contain hazardous contaminants, from earthmoving, dredging, and filling operations during construction and adaptive management activities.*

The EIR will:

- identify and discuss short-term construction dust impacts, as well as necessary mitigation measures to reduce these impacts to a less than significant level.

- assess the project's operational (traffic) air quality impacts, including contribution to cumulative air quality impacts, based on the anticipated levels of activity at the City park and onsite trails.

- address the project's conformity with applicable air quality plans, exposure of sensitive receptors to criteria air pollutants, and odors, as well as Federal Clean Air Act conformity.

Agricultural Resources. *The project will remove existing agricultural operations from the proposed Dutch Slough, City Park, and Marsh Creek sites. Loss of prime agricultural soils, if any, could be a significant impact.*

The EIR will:

- assess project effects on loss of agricultural resources including any prime agricultural soils and Williamson Act issues.

Biological Resources.

Wetland Biological Resources. *The project will eliminate the existing wetlands on much of the site, and replace them with tidal freshwater marsh and riparian vegetation, open sub-tidal basins and channels, and tidal sloughs (channels within tidal marshes). This loss of habitat could be significant.*

The EIR will:

- identify and describe existing wetland and upland habitats on the site.

- evaluate how project alternatives are likely to differ in producing different amounts and configurations of wetland and aquatic habitats over time, and how they vary in the way they relate to adjacent habitats, such as grassland (floodplain), relict dune soils, Marsh Creek, and Big Break.

- consider potential differences in restored marsh form, function, and biological diversity among alternatives over time. The discussion will emphasize key biological resources with special public and agency interest, such as rare or endangered species, dominant species and communities, pest species (invasive nonnative wetland plants and submernged aquatic vegetation (SAV), nonnative predators, etc.).

- address potential project effects on existing non-tidal wetlands on site, and tidal wetland and other aquatic habitats in the site vicinity.

Aquatic Biological Resources. *Native fish benefits are a major objective of the Dutch Slough project and most of the site does not currently support fish life. Other aquatic species which could benefit from the project include giant garter snake and western pond turtle. Benefits can vary across species with differing wetland restoration approaches, as does the potential to create habitats that support predatory fish detrimental to target species.*

The EIR will:

- describe existing fish conditions onsite and in the project area.

- review available information to evaluate how each alternative provides both beneficial and detrimental ecological conditions for target species.

- emphasize the most important issues related to the potential effects of tidal marsh restoration on native and nonnative fish populations.

- address many of the main uncertainties and underlying assumptions about the benefits of tidal marsh restoration for native estuarine fish, so that non-technical public will be able to evaluate and contrast alternatives in terms of potential effects on fish resources.

- consider effects on recreational and commercial fisheries as well as non-game fish resources.

Terrestrial Biological Resources. *Existing upland biological resources will be adversely affected by development of the project. The marsh restoration alternatives will restore terrestrial habitats present on the site, including terrestrial habitats that will persist after wetlands are restored, and artificially reclaimed "uplands" (diked, drained historic agricultural lands subsided below sea level) that currently support some terrestrial (and wetland) biological resources.*

The EIR will:

- describe existing upland terrestrial biological habitats and sensitive species.

- evaluate the loss of terrestrial habitats from project development.

- evaluate potential future interactions between restored wetlands and persistent, managed terrestrial habitats, and the effects of marsh restoration alternatives on reclaimed terrestrial habitat below sea level.

Cultural Resources. *The project site includes a number of potentially historic structures and landscapes, some of which will be substantially altered or removed by the project. The site also may contain prehistoric cultural resources that may be affected by project development.*

The EIR will:

- review available information, including the existing archaeological site resources report on the existence of cultural resources on the site and available studies on file at the City and the Northwest Information Center, Sonoma State University to determine if any previous cultural resources have been identified in the project area.

- prepare an architectural history analysis of potential historic structures, including 3 farm and ranch complexes in the project area.

- evaluate the Dutch Slough area as a potential historic landscape as per the evaluation criteria in National Register Bulletin 30 Guidelines for

Evaluating and Documenting Rural Historic Landscapes.

- document potential historic structures and landscape features (on California Department of Park and Recreation 523 forms).

- identify appropriate mitigation measures to address the possibility of encountering previously unknown cultural resources during construction, public access, or adaptive management activities, as well as effects of moving, altering, or demolishing any historic structures on the site or altering potentially significant landscape features.

Geology and Soils. *Geologic issues include potential erosion during and after construction due to proposed grading, dredging, channel reconfiguration, levee reconfiguration, and armoring. Geotechnical considerations will arise relative to existing perimeter levee stability and to the newly constructed levee alongside Jersey Island Road.*

The EIR will:

- describe the site's geologic conditions/hazards based on existing information and geologic/geotechnical/hydrologic reports for the site and nearby past projects.

- Summarize the implications of these conditions with respect to project outcomes, and identify appropriate mitigation measures.

Hazards and Hazardous Materials. *This section of the EIR will address site contamination issues. Portions of that site may be contaminated from a former animal waste pond. The Iron House parcel may be contaminated from its use as a land based sewage treatment system. The proposed wetland restoration also may increase health risks associated with mosquitoes.*

The EIR will:

- discuss and summarize the existing Environmental Site Assessments' findings on soil contamination and other potential hazards at the site, and contact the Regional Water Quality Control Board and the Contra Costa County Health Services Department, Hazardous Materials Programs, if appropriate.

- review and summarize Iron House Sanitary District data on potential soil contamination of that site.

- identify potential impacts to project workers and recreation users due to soil contamination and other potential hazards at the project site, and describe necessary mitigation measures. No additional studies on hazardous materials are proposed

- contact the Contra Costa County Mosquito Abatement District to identify the severity of mosquito health risks associated with the proposed wetlands, and potential mitigation measures.

Hydrology and Water Quality. *The project could affect water quality through release of contaminants and sediment from construction activities, as well as through mercury methylation and interactions of dissolved organic carbon (DOC) with water purification chemicals. The project could also alter hydrodynamic processes which control local salinity levels in Delta waters. The project also could increase turbidity during and after construction, adversely affecting water quality. In addition, flows along Dutch Slough, Marsh Creek, and the dead-end sloughs bisecting the site parcels are likely to change with the increased tidal prism following restoration; these increased flows could affect water quality, erosion along these waterways, and fisheries use of these waterways. The project also could result in a groundwater seepage problem on off-site properties after the levees are breeched. Potential flood hazards issues also exist.*

The EIR will:

- review and summarize the existing methyl-mercury studies and identify any potential impacts based on that information.
- review available project data to evaluate potential effects on salinity levels in Delta water and identify mitigation measures as appropriate.
- review the PWA hydrodynamic studies and, based on those studies, evaluate the ability of the restored tidal wetlands to achieve the degree of tidal circulation and exchange along with the appropriate geomorphology necessary to provide the habitats of interest on the project site.
- evaluate the potential water quality effects of diverting Marsh Creek onto the project site versus retaining the creek in its current configuration, based upon available studies, modeling results, design documents, and related information from other wetland restoration projects, and develop conceptual mitigations as necessary.
- analyze project impacts on water quality and hydrology on the basis of existing information.
- Describe levee seepage and groundwater elevation issues (based on existing studies) and summarizes potential flood hazards associated with the project.

Land Use/Planning. *The project may conflict with City of Oakley land use plans and policies, and with adjacent land uses.*

The EIR will:

- describe nearby land uses in the project area, assess project impacts on nearby existing and planned land uses, and identify any potential land use conflicts.
- review and summarize applicable goals and policies in the City's General Plan, and assess the project's consistency with General Plan goals and policies, land use designations, and the Zoning Ordinance, including conformity with height and density limits and parking requirements.

Noise. *The project will result in temporary noise impacts from construction, and possible long-term noise from traffic and use of the park facilities.*

The EIR will:

- review the existing applicable noise standards to determine the appropriate noise descriptors.
- describe existing onsite noise levels.
- compare the future noise levels with existing noise levels to determine if the project would cause a significant increase.
- compare future noise levels with applicable noise goals as promulgated by the City of Oakley General Plan.
- evaluate the potential for temporary noise impacts from construction and adaptive management activities, including any construction noise impacts to noise-sensitive biotic species.

Public Services. *The proposed park and public access could increase demand on local police and fire protection services. It is not anticipated to generate significant impacts on other public facilities.*

The EIR will:

- contact the Oakley Fire Department and Police Department to identify any concerns or constraints associated with provision of fire and police protection.

Recreation. *The project will result in benefits to recreation from public access and the new park.*

The EIR will:

- analyze potential recreation benefits to the public as a result of the project and identify mitigation measures if significant impacts are identified.

Transportation/Traffic. *The proposed public access and park will increase traffic to the area, potentially affecting levels of service on local streets.*

The EIR will:

- review and organize the existing documentation available regarding the existing and future transportation conditions and summarize existing transportation conditions and trends.
- describe existing roadway facilities, bicycle/pedestrian facilities, and transit services, and discuss the existing traffic volumes and level of service in the project study area. In addition, current plans to improve transportation facilities

and services will be summarized, and the traffic impacts associated with currently planned developments will be described.

- address potential traffic and parking impacts from the restoration project, including construction traffic impacts. Oakley park traffic impacts will be assessed at a conceptual level.

- qualitatively assess project impacts on transit services, pedestrian activity, and bicycle activity in the study area.

- if appropriate, develop a series of potential mitigation measures for analysis. These mitigations may range from roadway improvements (such as traffic signals and turn lanes), to bicycle/pedestrian facilities, to improvements in public transit and shuttle systems.

Utilities/Service Systems. *Construction and operation of the project may affect water, wastewater, and other utility services.*

The EIR will:

- contact the City of Oakley and applicable utility districts to identify possible constraints to provision of water and wastewater service to the proposed City park, and identify any significant impacts and required mitigation measures. Impacts on storm drainage will be summarized.

- discuss maintaining sufficient access to Pacific Gas and Electric Company's overhead transmission lines.

ALTERNATIVES.

The EIR will:

- assess the comparative impacts of the three "action" alternatives identified in the Draft Dutch Slough Tidal Marsh Restoration Conceptual Plan and Feasibility Report, and the No-Project Alternative.

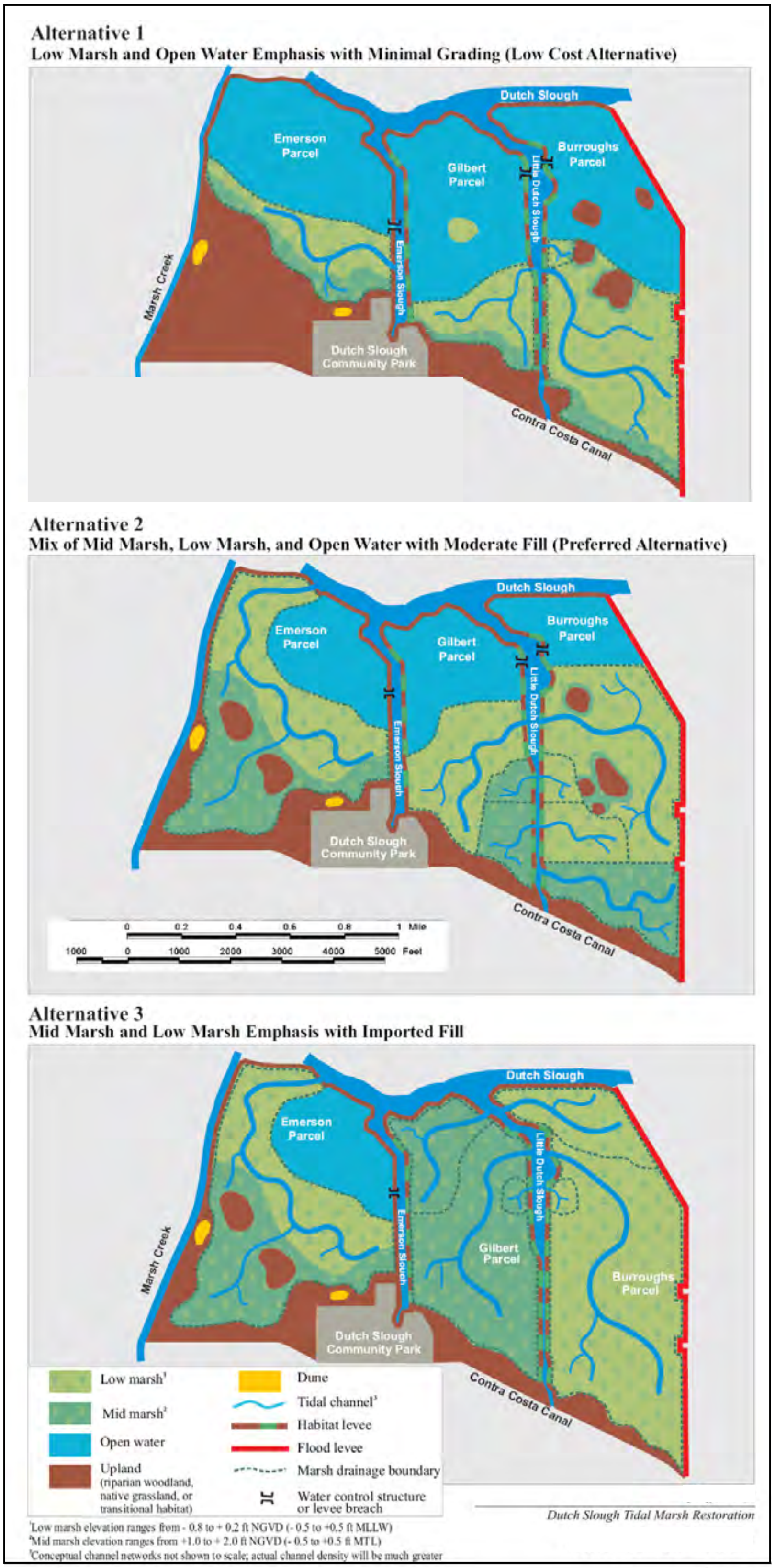
- include the two Marsh Creek options for two of the alternatives.

- describe different operational scenarios and inclusion of the Marsh Creek delta restoration on the Ironhouse parcel for each of the "build" alternatives.

- Include the City's park in the various project alternatives at a conceptual level (the EIR will not address alternative configurations for the proposed park).

- treat alternatives' impacts at equivalent levels of detail to meet possible National Environmental Policy Act evaluation requirements.

Figure 1: Alternatives Identified in the Draft Dutch Slough Tidal Marsh Conceptual Plan and Feasibility Report



PWA

Figure 2: Options for diverting Marsh Creek onto the Emerson Parcel

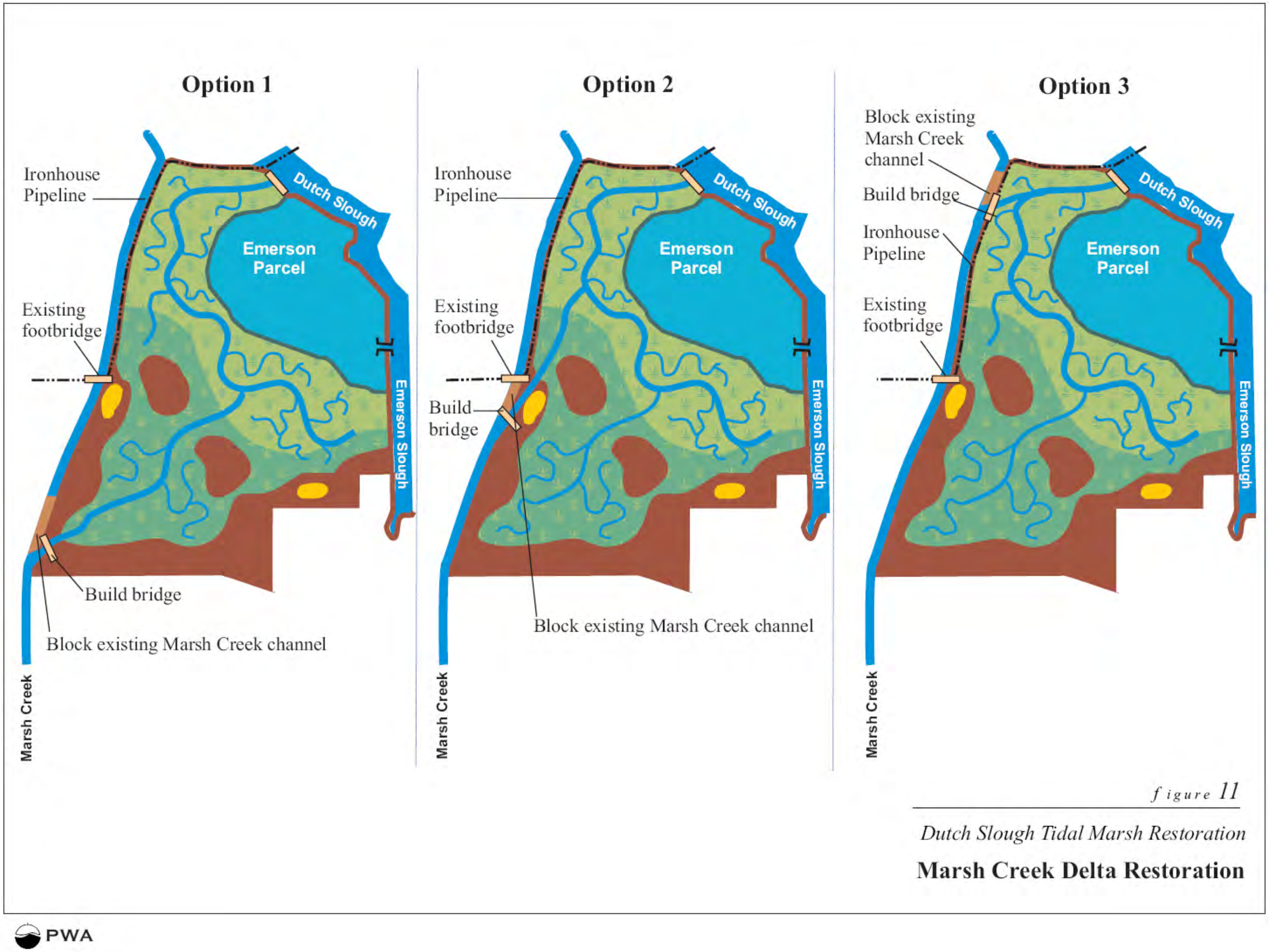
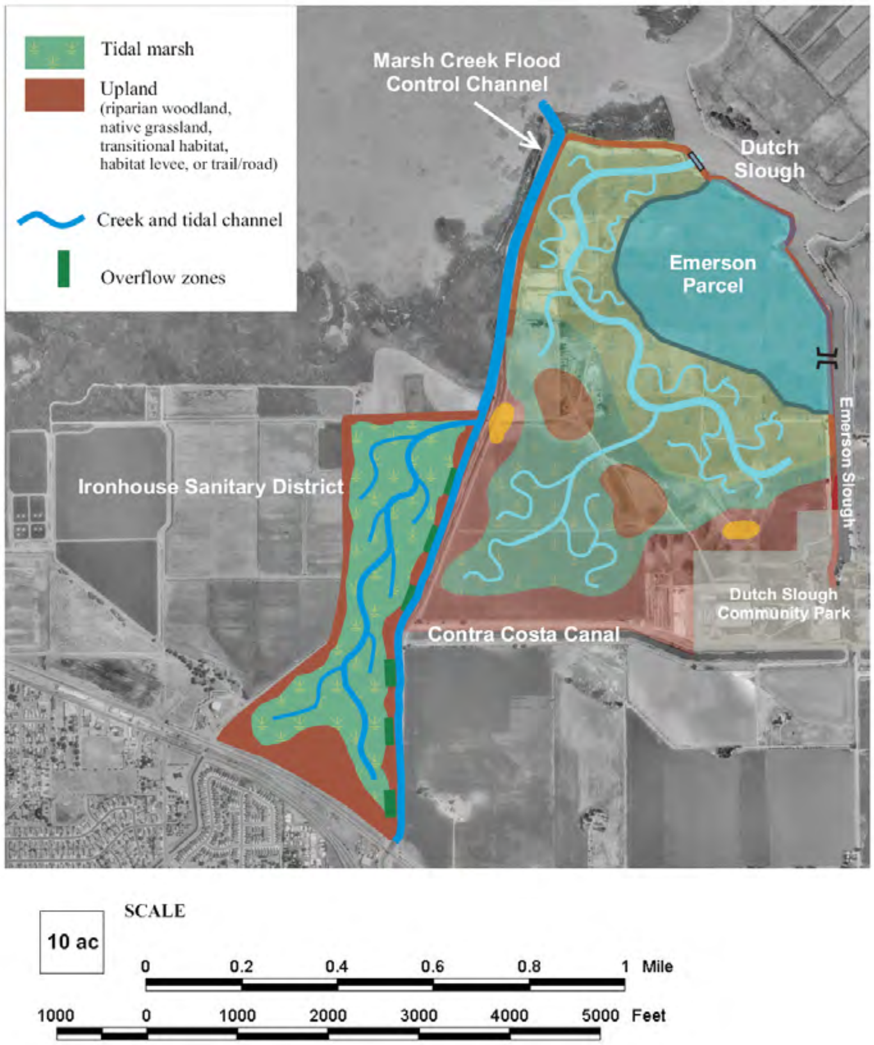


Figure 3: Marsh Creek delta restoration component proposed for lands owned by the Ironhouse Sanitary District on the west side of Marsh Creek



Dutch Slough Tidal Marsh Restoration

West Marsh Creek Delta Restoration

PWA

Insert tab titled Appendix B

APPENDIX B: RESPONSES TO NOTICE OF PREPARATION

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ADVANCE COpy FAXED ON MAY 4, 2006

Mr. Tom Hall
California Department of Water Resources Delta Suisun Marsh Of'fice
P.O. Box 942863
Sacramento, CA 94236-0001

5594875397

P.02/03

Subject: Notice of Preparation of Draft Environmental Impact Report (EIR) for thc Dutch Slough Restoration Project

~

Dear Mr. Hall:

Th~ Bureau ofRcclamation has rcvicwcd tho above-referenced document. B~ed upon our review, we would like to express our desire that the planning and dcvclopm~nt of th~ Dutch Slough Restoration Project (restoration project) be carried out in close coordination with the adjacent Contra Costa Canal Replacement Project (replacement project, formerly known as the Contra Costa Canal Encasement Project). The proposed restoration project has the potential to impact water quality in the Contra Costa Canal (CCC). The CCC. which is a Central Valley Project facility owned by Reclamation a.,d operated by the Contra Costa Water District (CCWD), serves as a source of drjnking water for over 500,000 residents in Contra Costa County.

Por thC' restoration project to achieve its goal of restoring tidal influcncc to thc Dutch Slough property, the replacement project must be completed to prevent any degradation to CCWD's water supply,

Reclamatiol' appreciates tl1e opportunity to comment 00 this Notice ofPreparatioo and we look forward to working with you on the development of your project- If you have any questions, please contact Ms. Shauna McDonald, Wildlife Biologist, at 559-487-5202, or at 559-487-5933 for 1he hearing: impaired.

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Received

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Sincerely,

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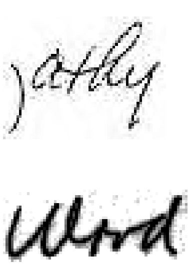

Kathy Wood,
Chief, Resource Management Division

Frcm-5594S75397

To-

PaiS 002

April 25, 2006

Tom Hall
Department of Water Resources
Delta Suisun Marsh Office
P.O. Box 942863
Sacramento, CA 94236-0001

Dear Mr. Hall:

This is in response to the March 24, 2006 Notice of Preparation (NOP) of a Draft Environmental Impact Report (EIR) for the proposed Dutch Slough Restoration Project. California Urban Water Agencies (CUWA) is an eleven member association of urban water agencies which provide drinking water to two-thirds of Californians. CUWA's mission is to provide a forum for combining the expertise and resources of its member agencies to study and promote the need for a reliable, high quality water supply for the state's current and future urban water needs.

Consistent with CUWA's mission and the interests of our member agencies, we have long been supportive of ecosystem restoration efforts aimed at reducing water and ecosystem conflicts in the Delta. Our members were instrumental in providing early funding for the CALFED ecosystem restoration program. We are also strong supporters of the CALFED target of continuously improving water quality for all uses (CALFED Record of Decision, page 65). Prior to DWR's acquisition of the Dutch Slough property a few years ago, there were many discussions of the potential conflicts between tidal marsh ecosystem restoration and water quality improvement. We are pleased that the NOP (page 14) recognizes this potential, and states that the EIR will review and evaluate potential water quality impacts.

It is essential that the alternatives considered in the draft EIR fully consider and evaluate potential adverse impacts to water quality, particularly for those constituents that are of increasing concern to drinking water utilities (organic carbon, bromide, chloride, total dissolved solids, nutrients, and pathogens). More important than evaluating potential water quality impacts, CUWA believes it is crucial to develop alternatives that meet ecosystem goals while at the same time avoiding adverse water quality impacts. CUWA expects to participate in the review of the draft EIR, and would like to be added to your list of interested parties.

Sincerely,

Steve Macaulay
Executive Director

(Advanced copy sent via email to thall@water.ca.gov)

455 Capitol Mall, Suite 705, Sacramento, CA 95814 916.552.2929 FAX 916.552.2931

Contra Costa County
FLOOD CONTROL
& Water Conservation District

Maurice M. Shiu
ex officio Chief Engineer

255 Glacier Drive, Martinez, CA 94553-4825
Telephone: (925) 313-2000
FAX (925) 313-2333

May 4, 2006

Tom Hall
California Department of Water Resources
Delta Suisun Marsh Office
P.O. Box 942863
Sacramento, CA 94236-0001

Our File: 3074-06 APN 037-191-036
97-74 & 4001-00

Dear Mr. Hall:

We have reviewed the Notice of Preparation (NOP) for the Draft Environmental Impact Report (DEIR) for the Dutch Slough Restoration Project, located north of the Contra Costa Canal by Dutch Slough in the City of Oakley. We received the NOP on March 30, 2006, and reviewed it for its scope and general contents, reserving our more detailed comments for the upcoming DEIR.

The Contra Costa County Flood Control and Water Conservation District (District) is the fee title owner of Marsh Creek flood control channel through the project reach. Marsh Creek is the principal waterway and flood control facility for both the City of Oakley and the eastern portion of Contra Costa County as a whole. As such, the District's primary interest and task with regard to Marsh Creek is improving and maintaining it to provide flood protection for the citizens in East County. While we are open to the concept of the Dutch Slough Restoration Project, we will require that any aspects of the project that impact Marsh Creek be looked at carefully to ensure the creek's ability to provide an appropriate level of flood control over the long-term. This summary is the basis behind most of the District's comments on the NOP.

1. This project is located within Drainage Area 74, an unformed drainage area. Therefore, no drainage area fees will be applied to the limited impervious surfaces proposed by this project.

2. The District owns Marsh Creek in fee title. While Marsh Creek is mentioned prominently in the NOP, we could find no mention of the District's ownership of the creek. This should be clearly explained in the DEIR.

3. Any work proposed on District property will require a flood control encroachment permit. Issuance of flood control encroachment permits should be clearly mentioned in the DEIR. The DEIR should also address any proposed real property transactions with regard to Marsh Creek. The District is not interested in retaining "orphaned" portions of Marsh Creek right-of-way north of any proposed diversion locations to the restoration area.

4. The DEIR should analyze the hydraulic impacts of the proposed project on the Marsh Creek flood control channel upstream of the project. As a guideline, and at a minimum, we require that the project design and construct a drainage system to adequately collect and convey stormwater runoff, entering or originating within the project to the nearest natural watercourse or adequate man-made drainage facility, without diversion of the watershed. Page 9 of the NOP states that "the design of the Marsh Creek diversion and delta restoration will need to maintain or improve the existing level of flood protection provided by the Marsh Creek flood control channel." It is unclear what is meant by "existing level." Marsh Creek is designed to convey the 100-year storm based on ultimate development. FEMA 100-year storm run-off is typically based on existing conditions and would not be acceptable for Marsh Creek.

5. The restoration area should be designed to convey the 100-year design flow-rate through the various meandering channels and marshes. We recommend that the initial design of the restoration area have a lower target starting water surface for Marsh Creek (below the original design tailwater). The project design should analyze the accumulation of sediment and debris before maintenance would be necessary to prevent impacts to the flood control channel.

6. Due to siltation and other factors, the existing cross-section of Marsh Creek within the project varies in its ability to convey the 100-year design flow-rate. The analysis and design of the restoration project should not look only at the existing creek section, but should look also at the original "as-built" cross-section. The project should not preclude the reestablishment of the original channel capacity.

7. The hydraulic analysis of Marsh Creek is not addressed in the "Hydrology and Water Quality" section of the Issue Analysis (Environmental Consequences). Preservation of the ultimate flood control capacity of Marsh Creek should be adequately addressed.

8. The District is currently finalizing a Marsh Creek watershed hydraulic model (using the Corps of Engineers HEC-RAS computer program). The District would be willing to conduct some of the Marsh Creek analysis for this project under our fee for service program. As this is a model we have constructed and approved "in-house," this may expedite the District's review process.

9. As natural siltation is a welcomed part of the restoration project, a sedimentation and siltation study should be conducted as part of the DEIR process to determine what the long-term upstream invert elevation of the delta channels going through the wetland will be. This study should also investigate if this sedimentation will move up the Marsh Creek channel. The restoration area should be constructed low to allow for the build-up of sediment, while not impacting Marsh Creek. The project should consider the construction of a fixed point in the Marsh Creek channel invert (e.g., by using rock slope protection) at the boundary of the restoration area so that the higher upstream channel area can be stable and remain sediment-free, while the flows can then drop into the restoration area where the natural process of sedimentation is expected.

10. Marsh Creek was originally constructed by the National Resource Conservation Service (NRCS), formerly the Soil Conservation Service (SCS). It is unclear, at this time, if major modifications to Marsh Creek will need to be approved by the NRCS. If a right-of-way transfer of portions of Marsh Creek is being proposed, we are unsure of the process for releasing the facility to another agency.

11. The long-term maintenance and funding for the proposed facility and impacted portions of Marsh Creek should be addressed in the DEIR. A perpetual funding source should be identified. The District has no funds for increased maintenance to the Marsh Creek channel. Therefore, impacts to the Marsh Creek channel as a result of this project, which lead to increased maintenance, can not be funded by the District.

12. An agreement should be prepared between the District and maintenance entity responsible for the restoration area, which outlines the flow capacity and water surface elevation that needs to be maintained through the project to ensure the proper flood control function of the Marsh Creek channel. Provisions should be made for the maintaining agency to make periodic checks on accumulation of sediment and debris in the restoration area. Provisions should be made for reporting to and coordinating with the District on certain monitoring and maintenance activities.

We appreciate the opportunity to review this NOP and look forward to reviewing the DEIR when it becomes available. If you have any questions, or would like more information, please call me at (925) 313-2304 or Tim Jensen at (925) 313-2396.

Very truly yours,

Wes Cooley
Civil Engineer
Flood Control Engineering

WC:cw
G:\FldCtl\CurDev\CITIES\Oakley\Dutch Slough Restoration\NOP.doc

c: Jason Vogan, City of Oakley
G. Connaughton, Assistant Chief Engineer, Flood Control
B. Faraone, Flood Control
P. Detjens, Flood Control
T. Jensen, Flood Control
Sarah Beamish Puckett
National Heritage Institute
100 Pine Street, Suite 1550
San Francisco, CA 94111

CONTRA COSTA
WATER DISTRICT

1331 Concord Avenue
P.O. Box H20
Concord, CA 94524
(925) 688-8000 FAX (925) 688-8122

May 5, 2006

VIA FACSIMILE (916) 651-9678
Hard Copy to Follow

Mr. Tom Hall
Department of Water Resources
Delta Suisun Marsh Office
P.O. Box 942836
Sacramento, CA 94236-0001

Subject: Dutch Slough Restoration Project Notice of Preparation

Dear Mr. Hall:

The Contra Costa Water District (District) appreciates the opportunity to respond to the March 24, 2006 Notice of Preparation (NOP) of a Draft Environmental Impact Report (EIR) for the proposed Dutch Slough Restoration Project. The District is responsible for maintaining and operating the Contra Costa Canal which borders the proposed project for approximately two miles. This water supply channel is owned by the U.S. Bureau of Reclamation as part of the Central Valley Project and conveys drinking water to the District's nearly 500,000 customers. The purpose of writing this letter is to make certain that the proposed project is adequately scoped to ensure that all potential impacts are addressed, particularly those that could impact the District's water quality.

The proposed restoration project has potential to be a significant asset to the local community, the ecosystem, and to the Delta in general. However, features of the design have potential to impact other beneficial uses of water such as drinking water quality and these potential impacts should be thoroughly explored. To that end, our comments on the scope of the pending environmental documentation fall into two distinguishable categories.

First, due to the potential impacts to the unlined portion of the Contra Costa Canal, analysis of potential impacts must include an alternative that assumes the Contra Costa Canal remains unaltered. In this case, the infiltration and ground water movement from the wetland area to the unlined Canal with Delta water will raise the already high ground water table and this will adversely impact the lower salinity water diverted from Rock Slough within the Contra Costa Canal. Without proper set backs, there is potential for storm surge and/or high winds to create overtopping of water in wetlands into the canal in the eastern reaches of the project. These conditions could also create additional hydrostatic pressure on the existing berms which could affect their stability and increase seepage of poor quality water into the Canal.

The District understands that the proposed project has assumed for the purpose of analyzing potential impacts, that the unlined Canal is replaced with a buried pipeline. Although, the District is aggressively pursuing the Contra Costa Canal Replacement Project, a capital project to replace the unlined Canal with a pipeline, a completion date for the project is uncertain until all permits, environmental documentation and funding are secured. The Dutch Slough tidal restoration project should not assume that full implementation of the restoration project could occur until the new pipeline is complete. Therefore, a new interim alternative must be designed to avoid impacts or it must mitigate impacts and ensure funds to replace the Canal with a pipeline as a requirement.

Existing land use adjacent to the Canal includes drainage management that artificially lowers the local groundwater table. The existing groundwater elevation is known to seep into the Canal at times due to the difference in elevation between the groundwater table and the Canal and the highly porous local soil. The groundwater is also known to have much greater salinity concentration than the Canal (Luhdorff & Scalmanini Consulting Engineers 2006).

Wetlands restoration of the Department's property will presumably increase the local groundwater elevation, providing a corresponding increase to the local subsurface groundwater gradient near the Canal. This potential change suggests that there could be a greater magnitude and persistence of groundwater influx into the Canal during wet periods as compared to what presently occurs (LSCE 2006). In light of these potential impacts to the drinking water quality of nearly 500,000 people, the Department should provide mitigation measures that avoid impacting the water quality of the Contra Costa Canal. One way to avoid such impacts is for the Department to provide funding to the District to replace the Contra Costa Canal with a pipeline. The District estimates that if the Canal is not in a pipe that a significant buffer zone is needed and would consist of hundreds of acres in order to ensure no impacts are detected in the Canal. Restoration alternatives that do not include this buffer must include analysis of potential impacts associated with the existing unlined Canal.

The District also notes that the Dutch Slough Tidal Restoration Project NOP sets forth a possible 100-acre restoration project around lower Marsh Creek. That project as illustrated in the NOP assumes that wetlands are constructed on United States Bureau of Reclamation property. As presently shown, this project is not possible as long as the Contra Costa Canal is unlined and even if the Canal is placed into a pipeline, consideration must be given to retaining upland features for the District to access/maintain the pipeline. Before any restoration effort is considered, agreement will be needed with Reclamation and the District.

Second, considering the timing and proximity of the District's and the Department's projects (and other regional projects), the EIR should include an alternative that recognizes the potential to enhance the restoration project by better integrating with Reclamation's adjacent property and the District's planned pipeline project. Such an alternative would demonstrate the mutual and expanded benefits of integrating regional planning.

Many implementation synergies are possible. One example is to develop an agreement between the District, Reclamation, and the Department to ensure that upon completion of the District's project, final grading of Reclamation's property, placement of a maintenance road, placement and type of fences, placement of re-located power poles, public access points, pipeline alignment, and drainage/runoff locations, are designed to be compatible with the adjacent restoration project. An additional opportunity would be to ensure that the design of the District's project allows the restoration project to be further enhanced by including an appropriate conservation easement within Reclamation's property, and/or providing an easement for a potential recreational trail (a recreational/public access trail would be a separate project with a separate environmental document, funding, and operation/maintenance agreement).

As a final comment the District also wants to underscore the comments from the California Urban Water Agencies (CUWA) who believe it is crucial to develop alternatives that meet ecosystem goals while at the same time avoiding adverse water quality impacts, in addition to adequately assessing potential impacts for each alternative. The NOP appropriately acknowledges the broader and regional potential to affect water quality in the Delta through release of contaminants and sediment and through alteration of hydrodynamics which could affect salinity distribution in the Delta. The alternatives considered in the draft EIR should fully consider and evaluate potential adverse impacts to water quality, particularly for those constituents that are of increasing concern to drinking water utilities (organic carbon, bromide, chloride, total dissolved solids, nutrients, and pathogens).

The District looks forward to collaborating with your team in the future. If you have any comments please do no hesitate to call me at (925) 688-8073.

Sincerely,

David A. Briggs/MAS.

David A. Briggs
Project Manager
Contra Costa Canal Replacement Project

DAB/MS/rlr

cc: Kathy Wood, U.S. Bureau of Reclamation

State of California - The Resources Agency
ARNOLD SCHWARZENEGGER, Governor
DEPARTMENT OF FISH AND GAME
http://www.dfg.ca.gov
Sacramento Valley - Central Sierra Region
1701 Nimbus Road, Suite A
Rancho Cordova, CA 95670
916/358-2900

May 5, 2006

Mr. Tom Hall
The Department of Water Resources
Delta Suisun Marsh Office
P.O. Box 942863
Sacramento, CA 94236-0001

Dear Mr. Hall:

The Department of Fish and Game (DFG) has reviewed your request for comments regarding a Notice of Preparation (NOP) of a Draft Environmental Impact Report (EIR) for the Dutch Slough Restoration Project. The restoration plans for this site cover approximately 1200 acres and mainly consist of converting agricultural rangelands/wetlands into tidal marsh. The project is located in the City of Oakley, Contra Costa County.

The scope and content of the EIR, as outlined in the NOP, are sufficient to uncover and address potential impacts to most biological resources here. As noted, the wetland impacts could be substantial and will be addressed. The following comments are listed to enhance the scope of the biological resources section.

In general, shallow water (0.5'-1.5') throughout most of the tidal marsh would benefit more target aquatic and waterfowl species than would greater depths. When looking at potential impacts to sensitive species, please survey for California Tiger Salamanders and vernal pool species which have been noted upriver along the Marsh Creek drainage. Lastly, terrestrial burrows, platforms, nests, and perches should be preserved where possible.

The environmental document should consider and analyze whether implementation of the proposed project will result in reasonably foreseeable, potentially significant impacts subject to regulation by the DFG under Section 1600 et seq. of the Fish and Game Code. In general, such impacts result whenever a proposed project involves work undertaken in or near a river, stream, or lake that flows at least intermittently through a bed or channel, including ephemeral streams and water courses. Impacts triggering regulation by the DFG under these provisions of the Fish and Game Code typically result from activities that:

- Divert, obstruct, or change the natural flow or the bed, channel, or bank of a river, stream, or lake;

- Use material from a streambed; or

  Result in the disposal or deposition of debris, waste, or other material where it may pass into a river, stream, or lake.

Pursuant to Public Resources Code Sections 21092 and 21092.2, the DFG requests written notification of proposed actions and pending decisions regarding this project. Written notifications should be directed to this office.

Thank you for the opportunity to review this project. We applaud such large-scale habitat restoration efforts! If the DFG can be of further assistance please contact Mr. Jason Holley, Associate Wildlife Biologist, at (916) 984-7123.

Sincerely

Kent Smith
Acting Assistant Regional Manager

cc: Mr. Jason Holley
Mr. Dan Gifford
Department of Fish and Game
Sacramento Valley-Central Sierra Region
1701 Nimbus Road, Suite A
Rancho Cordova, CA 95670

Ms. Janice Gan
Region 3
7329 Silverado Trail
Napa, CA 94587

DEPARTMENT OF CONSERVATION

DIVISION OF LAND RESOURCE PROTECTION

801 K STREET • MS 18-01 • SACRAMENTO, CALIFORNIA 95814

PHONE 916 / 324-0850 • **FAX** 916 / 327-3430 • **TDD** 916 / 324-2555 • **WEBSITE** conservation.ca.gov

May 3, 2006

Mr. Tom Hall
Department of Water Resources
Delta Suisun Marsh Office
P.O. Box 942863
Sacramento, CA 94236-0001

Subject: Notice of Preparation of a Draft Environmental Impact Report for the Dutch Slough Restoration Project, Contra Costa County

Dear Mr. Hall:

The Department of Conservation's Division of Land Resource Protection's staff has reviewed the Notice of Preparation (NOP) for the above-referenced project. The Dutch Slough site is approximately 1,166 acres of prime farmland, and is located within the jurisdiction of Oakley. Until the acquisition occurred, about two-thirds of the property was used as pasture land, and the remaining land supported a dairy operation and forage crops. According to the NOP, there are three major goals of the proposed project:

1. Provide shoreline access, educational and recreational opportunities
2. Re-establish tidal marsh, ecological processes, and natural habitats
3. Use an adaptive management approach to ecosystem restoration

The NOP Project Description indicates that the proposed project involves establishment of the City of Oakley City Park, restoration of the Marsh Creek Delta on lands owned by the Iron House Sanitary District to the west of Marsh Creek, and wetland and upland restoration on the 1,166 acre property. Staff attended several meetings for the project. Project activities that will result in physical changes to the project site include a construction of a 55-acre park, the importing of fill material, excavation, construction of levees, permanent inundation of portion of the project site, a change in the marsh plain elevation, and dunes restoration. Not all activities are identified in the NOP, but were discussed in the public meeting held on April 5, 2006. Regardless of the intensity of ultimate land use, we consider the inundation of land and the project's various construction activities that affect soil productivity of 1,166 acres of prime farmland to be a potentially significant impact. If the lead agency determines otherwise, we request that documentation and data that would rationally support a lesser determination be included as part of the DEIR.

The acquisition of the land, and subsequent feasibility studies were found to be categorically exempt under the California Environmental Quality Act (CEQA) section 15313, and 15262. It appears that the "whole of the project", which is the CEQA standard for review was not fully considered. If the lead agency feels that acquisition itself was the precursor or cause of agricultural land conversion, it would appear that the 2003 Categorical Exemption was faulty, and the impact of agricultural land conversion must be addressed at this time. We fully understand that the area was under development pressure and we can support the effort to retain and restore open and natural areas throughout the state.

We encourage the lead agency to consider the meaning of the term of Agricultural Resource, which is discussed but not specifically defined in Government Code Section 51201. Although the term is closely linked with the ability of the soil to be productive, it has been subjected to a narrow interpretation that considers only soil properties. We request that the lead agency acknowledge the importance and value of the agricultural resources in the region, and we also request that the impacts associated with the conversion of substantial acreage of prime agricultural lands to tidal or habitat areas and recreational uses with infrastructure (parking lot, lighting, restroom facilities, trails) be mitigated. We request that our concerns be addressed in the DEIR, and that the commitments in the May 2005 memo signed by the Secretaries of the Resources Agency and the Department of Food and Agriculture and the Record of Decision are complied with.

The following is a brief list of items to be addressed:

Completion of the Land Use Checklist prepared by CALFED agencies

- A determination of whether the proposed project involves the conversion of agricultural land. Although the land was acquired by a public agency in 2003, we ask that the number of acres of previous Williamson Act contracted lands, Prime Farmland, Unique Farmland and Farmland of Local and Statewide Importance be included.

Identification of funding source(s) for mitigation to impacts to agricultural resources

A requirement that mitigation measures for any project funded within the CALFED solution area are consistent with the CALFED EIR/S Record of Decision.

Thank you for the opportunity to provide comment regarding this project. Please send us a copy of the DEIR when it becomes available. We would be pleased to meet with you and your staff to discuss these comments should the need arise. If you have any questions, please contact Jeannie Blakeslee at (916) 323-4943.

Sincerely,

Dennis J. O'Bryant
Acting Assistant Director

STATE OF CALIFORNIA—BUSINESS, TRANSPORTATION AND HOUSING AGENCY ARNOLD SCHWARZENEGGER, Governor

DEPARTMENT OF TRANSPORTATION
111 GRAND AVENUE
P. O. BOX 23660
OAKLAND, CA 94623-0660
PHONE (510) 286-5505
FAX (510) 286-5559
TTY (800) 735-2929

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April 10, 2006

CC004903
CC-4-R34.92
SCH2006042009

Mr. Tom Hall
Department of Water Resources
Delta Suisun Marsh Office
P.O. Box 942836
Sacramento, CA 94236-0001

Dear Mr. Hall:

Dutch Slough Restoration Project – Notice of Preparation

Thank you for including the California Department of Transportation (Department) in the early stages of the environmental review process for the Dutch Slough Restoration Project. We have reviewed the Notice of Preparation and have the following comments to offer:

Traffic Analysis

The Department is primarily concerned with potential project impacts to the State Highway System. Please ensure that the environmental analysis evaluates the proposed project's impacts by applying the following criteria to determine if a traffic analysis for State highway facilities is warranted:

1. The project will generate over 100 peak-hour trips assigned to a State highway facility.

2. The project will generate between 50 to 100 peak-hour trips assigned to a State highway facility, and the affected highway facilities are experiencing noticeable delay; approaching unstable traffic flow (level of service (LOS) "C" or "D") conditions.

3. The project will generate between 1 to 49 peak-hour trips assigned to a State highway facility, and the affected highway facilities are experiencing significant delay; unstable or forced traffic flow (LOS "E" or "F") conditions.

We recommend using the Department's *Guide for the Preparation of Traffic Impact Studies,* which is available at the following website address:
http://www.dot.ca.gov/hq/traffops/developserv/operationalsystems/reports/tisguide.pdf

Encroachment Permit

Work that encroaches onto the State Right of Way requires an encroachment permit that is issued by the Department. Traffic-related mitigation measures will be incorporated into the construction plans during the encroachment permit process. See the following website link for more information: http://www.dot.ca.gov/hq/traffops/developserv/permits/

To apply for an encroachment permit, submit a completed encroachment permit application, environmental documentation, and five (5) sets of plans (in metric units) which clearly indicate State Right of Way to:

Department of Transportation
Office of Permits
Attn: Sean Nozzari
111 Grand Avenue, 6th Floor
Oakland, CA 94612

Should you require further information or have any questions regarding this letter, please call Christian Bushong of my staff at (510) 286-5606.

Sincerely,

Timothy C. Sable

TIMOTHY C. SABLE
District Branch Chief
IGR/CEQA

c: State Clearinghouse

STATE OF CAUFORNIA-THERESOURCES AGENCY

DELTA PROTECTION COMMISSION
14215 RIVER ROAD
P.O. BOX 530
WALNUT GROVE, CA 95690
Phone (916) 776-2290
FAX (916) 776-2293
E-Mail: dpc@citlink.net Home Page: www.delta.ca.gov

April 28, 2006

Scott Morgan
State Clearinghouse
P.O. Box 3044
Sacramento, CA 95812-3044

ARNOLD SCHWARZENEGGER. *Governor*

Subject

Dutch Slough Restoration Project Notice of Preparation of Draft E;nvironmental Impact Report (SCH # 2006042009)

Dear Mr. Morgan,

The staff of the Delta Protection Commission (Commission) has reviewed the subject notice dated March 24,2006. From the information provided, staff has determined that the proposed project is located within the Secondary Zone of the Legal Delta, adjacent to the Primary Zone. Actions for approval or denial of projects in the Secondary Zone are not subject to appeal to the Commission. However, the environmental analysis for the proposed project should address any potential impacts to the resources of the Primary Zone resulting from activities in the Secondary Zone.

The Delta Protection Act (Act) was enacted in 1992 in recognition of the increasing threats to the resources of the Primary Zone of the Delta from urban and suburban encroachment having the potential to impact agriculture, wildlife habitat, and recreation uses. Pursuant to the Act, a Land Use and Resource Management Plan *for* the Primary Zone (Management Plan) was completed and adopted by the Commission in 1995.

The Management Plan sets out findings, policies, and recommendations resulting from background studies in the areas of environment, utilities and infrastructure, land use, agriculture, water, recreation and acces-s, levees, and marine patroVboater education! safety programs. As mandated by the Act, the policies of the Management Plan are incorporated in the General Plans of local entities having jurisdiction within the Primary Zone, including Contra Costa Counry. Both the Act and the Management Plan are available for your reference at the Commission's website, www.delta.ca.gov.

The policies and recommendations within the Management Plan that should be reviewed for consistency relative to the potential for the proposed restoration project to impact the Primary Zone include, but are not limited to, the following:

Environment:
.Policy 3: Lands managed primarily for wildlife habitat shall be managed to provide several inter-related habitats.

Recommendation 2: Wildlife habitat on the islands should be of adequate size and configuration to provide significant wildlife habitat fol birds, small mammals, and other Delta wildlife.
Recommendation 4: Feasible steps to protect and enhance aquatic habitat should be implemented as may be determined by resource agencies consistent with balancing other beneficial uses of Delta resources.
Recommendation 5: Publicly-owned land should incorporate, to the maximum extent feasible, suitable and appropriate wildlife protection, restoration and enhancement as part of a Delta-wi.de plan for habitat management.

Land Use:
.Policy 3: New residential, recreational, commercial, or industrial development shall ensure that appropriate buffer areas are provided by those proposing new development to prevent conflicts between any proposed use and existing agricultural use. Buffers shall adequately protect integrity of land for existing and future agricultural uses. Buffers may1nclude berms and vegetation, as well as setbacks of 500 to 1,000 feet. .
.Recommendation 2: Public agencies and non-profit groups have or propose to purchase thousands of acres of agricultural lands to restore to wildlife habitat. The amount, type, and location of land identified to be enhanced for wildlife habitat should be studied by wildlife experts to determine goals for future acquisition and restoration. Lands acquired for wildlife habitat should also be evaluated for recreation, access, research and other needed uses in the Delta. Habitat restoration projects should not adversely impact surrounding agricultural practices. Public-private partnerships in management of public lands should be encouraged. Public agencies shall provide funds to replace lost tax base when land is removed from private ownership.

Water:
.Policy 3: Water agencies at local, State, and federal levels shall work together to ensure that adequate Delta water quality standards are set and met and that beneficial uses of State waters are protected consistent with the CALFED Record of Decision dated August 8,2000.
.Recommendation 3: Programs to enhance the natural values of the State's aquatic habitats and water quality will benefit the Delta and should be supported.
.Recommendation 8: Water quality at Delta drinking water intakes should be maintained or enhanced.

Recreation and Access:
.Policy 3: Local governments shall develop siting criteria for recreation projects which will ensure minimal adverse impacts on agricultural land uses, levees, and public drinking water supply intakes, and identified sensitive wetland and habitat areas.

.Policy 7: Local governments shall support improved access for bank fishing along State highways and county roads where safe and adequate parking can be provided and with acquisition of proper rights-of-access from the landowner. Adequate

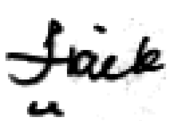
policing, garbage cleanup, sanitation facilities, and fire suppression for such access shall be provided.
Policy 9: Local governments shall encourage new recreation facilities that take advantage of the Delta's unique characteristics.
Recommendation 3: New projects in the Secondary Zone, adjacent to the Primary Zone, should include commercial and public recreation facilities which allow safe, supervised access to and along the Delta waterways (pedestrian and bike trails, launch ramps including small boat launch ramps, overlooks, nature observation areas, interpretive information, picnic areas, etc.)
Recommendation 3: State and federal projects in the Primary and Secondary Zones should include appropriate recreation and/or pub.iic access components to the extent consistent with project purposes and with available funding. State and federal agencies should consider private or user group improvements on publicly-owned lands to provide facilities.

Levees: "
.Recommendation 1: Levee maintenance, rehabilitation, and upgrading should be established as the first and highest priority of use of the levee. No other use whether for habitat, trails, recreational facilities, or roads should be allowed to unreasonably adversely impact levee integrity or maintenance.

Thank you for the opportunity to provide input into this process. Please contact me at (916) 776-2292 or lindadQc@citlink.net if you have any questions about the Commission or the comments provided herein.

Sincerely,

t~



Linda Fiack, Executive Director

cc

Chair, Contra Costa County Board of Supervisors Tom Hall, Dept. of Water Resources

Dan Skopec
Acting Secretary
Cal/EPA

Department of Toxic Substances Control

Maureen F. Gorsen, Director
700 Heinz Avenue, Suite 200
Berkeley, California 94710-2721

Arnold Schwarzenegger
Governor

April 26, 2006

Mr. Tom Hall
Department of Water Resources
P.O. Box 942836
Sacramento, California 94236-0001

Dear Mr. Hall:

The Department of Toxic Substances Control (DTSC) has reviewed the Notice of Preparation (NOP) of a Draft Environmental Impact Report (EIR) dated April 3, 2006 for the Dutch Slough Restoration Project (SCH #2006042009). As you may be aware, DTSC oversees the cleanup of hazardous substance release sites pursuant to the California Health and Safety Code, Division 20, Chapter 6.8. As a potential Responsible Agency, DTSC is submitting comments to ensure that the California Environmental Quality Act (CEQA) documentation prepared for this project adequately addresses any remediation of hazardous substance releases that might be required as part of the project.

The NOP states in the Hazards and Hazardous Materials section on page 13 that the Iron House parcel may be contaminated with materials related to its historical use as a land-based sewage treatment system. The NOP indicates that the Draft EIR will review and summarize existing Iron House Sanitary District data pertaining to soil contamination at the site. The NOP also states that no additional studies on hazardous materials are proposed. The existing data may not provide a complete characterization of soil contamination that is present on the Iron House parcel. The potential presence of groundwater contamination also needs to be considered. If, upon review of the existing data, further site characterization is determined by the Department of Water Resources to be necessary, DTSC recommends that soil and groundwater on the site be sampled and analyzed for contaminants of potential concern prior to the completion of the Draft EIR. The results of all site investigations should be summarized in the Draft EIR.

The NOP states that the Draft EIR will identify potential impacts to project workers and recreation users due to soil contamination. Any screening levels used in determining whether detected contaminants pose a potential, significant human health or environmental risk should be identified in the Draft EIR. Project planners are referred to the California Human Health Screening Levels (CHHSLs) and the US-EPA Preliminary Remediation Goals (PRGs) as potentially-applicable human health risk-based screening levels. Resources for conducting risk assessments may be obtained at the DTSC website (www.dtsc.ca.gov) or from the US-EPA (www.epa.gov).

If remediation activities are to be implemented as part of the project, these activities should be discussed in the Draft EIR along with the cleanup levels that will be applied and the anticipated regulatory agency oversight. Potential impacts associated with the remediation activities should also be addressed by the Draft EIR. If the remediation activities include soil excavation, the Draft EIR should include: (1) an assessment of air impacts and health impacts associated with the excavation activities; (2) identification of any applicable local standards which may be exceeded by the excavation activities, including dust and noise levels; (3) transportation impacts from the removal or remedial activities; and (4) risk of upset should there be an accident during cleanup.

DTSC can assist your agency in overseeing characterization and cleanup activities through our Voluntary Cleanup Program. A fact sheet describing this program is * enclosed. We are aware that projects such as this one are typically on a compressed schedule, and in an effort to use the available review time efficiently, we request that DTSC be included in any meetings where issues relevant to our statutory authority are discussed.

Please contact Eileen Belding at (510) 540-3844 if you have any questions. Thank you in advance for your consideration of our comments.

Sincerely,

Mark Piros

Mark Piros, P.E., Unit Chief
Northern California - Coastal Cleanup Operations Branch

Enclosure

cc: without enclosure

Governor's Office of Planning and Research
State Clearinghouse
P. O. Box 3044
Sacramento, California 95812-3044

Guenther Moskat
CEQA Tracking Center
Department of Toxic Substances Control
P.O. Box 806
Sacramento, California 95812-0806

* No enclosure rec'd; 5/1/06; 0805 hrs: Spoke w/ Ms. Belding to request fact sheet.

N&B NEUMILLER & BEARDSLEE
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73665-25557

John W. Stovall

509 WEST WEBER AVENUE
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STOCKTON, CA 95203

POST OFFICE BOX 20
STOCKTON, CA 95201-3020

(209) 948-8200
(209) 948-4910 FAX

FROM MODESTO:
(209) 577-8200
(209) 577-4910 FAX

April 20, 2006

VIA U.S. MAIL

Tom Hall
Department of Water Resources
Delta Suisun Marsh Office
P.O. Box 94236-0001

Re: Notice of Preparation of Draft Environmental Impact Report for Dutch Slough Restoration Project

Dear Mr. Hall:

We are the legal counsel for Reclamation District 799 ("RD 799") and have been authorized and directed by the Board of Trustees of RD 799 to submit these comments on the Notice of Preparation referenced above ("NOP"). These comments have been reviewed and approved by RD 799's Engineer, Barbara Burns, Burns Engineering and its Consulting Engineer, Chris Neudeck, Kjeldsen, Sinnock, & Neudeck. We appreciate the opportunity to comment on the NOP. RD 799 conceptually supports the Project, subject to the Draft Environmental Impact Report ("DEIR") adequately responding to the following comments:

1. RD 799 is the agency responsible for flood protection and drainage on Hotchkiss Tract. Those portions of the project located within the boundaries of RD 799 that potentially have an affect on drainage, flood protection or levee integrity will require permit approval from RD 799. This includes the portion of the project on the Burroughs's Ranch property and the proposed levee along Jersey Island Road, ("JI levee"). RD 799 must be identified in the Mitigation Measures and identified as a responsible agency, whose permit process must be listed under "required agency approvals and actions."

2. Grading deeper into pervious soil strata on the Burroughs's Ranch may cause seepage or impact the ground water table east of the JI levee, which could impact future house foundations, lake under-drainage and lining systems, and interior levees.

3. If the JI levee is constructed before the wetlands restoration is completed, in the event of a failure of the perimeter Burroughs' levee, the wetside of the JI levee

would be subject to greater wind fetch and wave run-up than would occur if the JI levee were constructed after the wetlands project is completed.

4. There is a potential for seepage impacting the stability of RD 799's levee along the Burroughs's Ranch and drainage of the Burroughs's Ranch property if the project is phased in such a way that the Gilbert Ranch is flooded and not the Burroughs's Ranch.

5. The construction of JI levee may impact the existing RD 799 levee at Dutch Slough, including, but not limited to, foundation densification.

6. RD 799 will require that the design criteria for JI levee include seepage control and flood protection from a 200 year flood event.

7. There is a potential impact should a leak occur from the gas collection line now located along the west side of Jersey Island Road on the new JI levee.

8. The proposed JI levee will reduce the flood plain within Hotchkiss Tract if the existing perimeter levee should fail. This reduction in the flood plain would cause the remaining area within the Tract to fill with flood waters faster, reducing the evacuation time of existing residents.

9. The proposed JI levee will be built to the 200 year flood protection standards. Therefore, 2.3 miles of the existing perimeter levee of the Burroughs' Ranch, which currently does not meet the 100 year flood protection level will be replaced with 200 year flood protection provided by the proposed JI levee.

10. Drainage of areas that currently drain to Pump Station 1A (including offsite water from 45 acres northwest of the canal) and Pump Station 1 (including the area east of Jersey Island Road near Dutch Slough) will be changed.

11. Public use of JI levee as a trail introduces maintenance problems. These problems include surfacing maintenance; the potential erosion of slopes due to foot, bicycle, and/or equestrian traffic; and litter control including trash and manure removal.

12. Landscaping of JI must be approved by RD 799 and be compatible with levee maintenance access and inspection visibility requirements.

13. The section of existing perimeter levee on the Burroughs's Ranch along Dutch Slough from the intersection of the JI levee to the Jersey Island Bridge (Station

455 to 470) is substandard. RD 799 will require this section to be improved, which will include raising and widening the levee crown to 20' wide at elevation 10.2; flattening the landside slope to 4:1; a 15' wide patrol road at the toe; a toe ditch; and a 20' wide ditch access strip. This area may be presently wetlands, in which case alterations and/or fill will need to be mitigated.

Public Services:

14. The Project may economically impact RD 799 due to the additional maintenance responsibility for the JI levee, and the reduced maintenance responsibility of the Burroughs' levee.

15. The Project may economically impact RD 799 due to the loss of assessment of a large portion of the Burroughs's Ranch Property, (except for the remaining triangle at the northeast corner).

For additional information, please call Barbara Burns, Burns Engineering at (925) 684-3470.

Very Truly Yours,

JOHN W. STOVALL
Attorney at Law

JWS/RAA: msb

cc: Barbara Burns

Insert tab titled Appendix C

APPENDIX C: DISTRIBUTION LIST

Dutch Slough Draft EIR Distribution List
October 15, 2008

First Name	Last Name	Affiliation/Organization	Title/Position
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Bill	Guthrie	ACOE, Sacramento District	Project Manager Regulatory Branch
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Anna	Holmes	CA DFG - Central Valley Bay-Delta Branch	Environmental Scientist
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Lauren	Hastings	California Bay-Delta Authority	
Darcy	Jones	California Bay-Delta Authority Ecosystem Restoration Program	Delta Regional Coordinator
Kim	Schwab	California Regional Water Quality Control Board Central Valley Region	Engineering Geologist
Christine	Sotelo	California Regional Water Quality Control Board Central Valley Region	Environmental Scientist - Sacramento and Contra Costa County MS4
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Alyson	Aquino	Natural Resources Conservation Service	District Conservationist
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Sarah	Puckett	NHI	Restoration Ecologist
		Oakley library	
Peggy	Olofson	Olofson Environmental	Water Quality Engineer
Erica	Brand	Pacific Gas & Electric	Environmental Support and Services Department
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Philip	Williams	Philip Williams & Associates. LTD	Senior Principal, President
Adam	Parris	Philip Williams & Associates. LTD	Michelle's assistant
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Jackie	Skrehot	RD 799	Landowner
Angelia	Tant	RD 799	District Secretary
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Tom	Lindemuth		
Linda	Weeks		

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Appendix D

APPENDIX D: DUTCH SLOUGH ADAPTIVE MANAGEMENT PLAN

Dutch Slough Adaptive Management Plan

Version 1

January 2008

Dutch Slough Adaptive Management Plan

Version 1
January 2008

Prepared by:

John Cain
Natural Heritage Institute
100 Pine Street, Suite 1550
San Francisco, CA 94111

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1.0 Executive Summary

Goal
The goal of the Dutch Slough Adaptive Management Plan (DSAMP) is to generate scientific information that can be used to guide future tidal marsh restoration projects elsewhere in the Delta. The DSAMP focuses on generating information regarding native fish and water quality, but the DSAMP is only one component of the larger Dutch Slough restoration project. The Dutch Slough project is also designed to provide numerous ecological benefits as well as provide public access to the Delta shoreline.

Purpose of Plan
The purpose of this plan is to document the process used to design the Dutch Slough Adaptive Management Restoration Project and to provide a framework for future monitoring and design of the project. This plan should not be viewed as a rigid prescription, but rather should be viewed as a framework for future monitoring and design. The plan should evolve and grow in detail as information is generated or new opportunities arise.

Strategic Focus
The DSAMP strategically focuses on the effects of various types of tidal marsh on water quality parameters and native fish growth and survival. Specifically, the plan focuses on the role of tidal marsh elevation and size in growth and survival of juvenile Chinook salmon and Sacramento splittail as well as the production of methylmercury and dissolved organic carbon. Despite this focus, the Dutch Slough project will be designed and managed to facilitate research on other subjects such as subsidence reversal, marsh plain evolution, and wildlife habitat relationships.

Approach
The Dutch Slough management team worked with a group of scientists to design large-scale project features to test specific hypotheses regarding fish and water quality responses to different tidal wetland types. The scientists also identified a number of smaller scale features that could be incorporated into the project to evaluate environmental factors that influence subsidence reversal, avian habitat, invasive species, and production of methylmercury and dissolved organic carbon.

The DSAMP is primarily designed to generate information that can guide the design of future restoration projects elsewhere in the Delta. The plan does not anticipate reconstruction of the project to maximize fishery benefits or other ecological values if the original project does not perform optimally. In many cases, adaptive management implies that a management or restoration treatment will be iteratively revised based on monitoring data to maximize benefits. Restoration at Dutch Slough, however, involves millions of dollars of earthmoving to create tidal wetlands. This plan assumes that the financial costs and permitting challenges associated with regrading or reconstructing a restored tidal wetland would be prohibitive. The plan does, however, provide for smaller changes in management practices to improve the ecological performance of the project over time. For example, the plan anticipates testing and refining management techniques for controlling invasive plant species.

The DSAMP will also generate information to determine the best long-term strategy for managing Marsh Creek and the deeply subsided areas along the northern boundary of the Dutch Slough project. Diverting Marsh Creek onto the Dutch Slough site could create major benefits, but there is a risk that routing the creek onto the site would pollute the restored wetland. Further studies, including water quality monitoring will help determine whether it would be beneficial to route Marsh Creek onto the restoration site. Additionally, a suite of pilot studies in the more subsided areas along the northern portion of the site will guide the long-term management of those areas to either reverse subsidence, maximize avian habitat, or minimize the adverse impacts of exotic submerged aquatic vegetation.

Phased Implementation
Implementation of the project will be phased due to practical construction and financial considerations.

- *Phase 1:* The first phase will extend 2-3 years and entail baseline monitoring, borrowing material from the Ironhouse Sanitary District parcel, reinforcing the levee toe berms, minor grading, tule cultivation on the lowest portions of the site, and management of upland vegetation to minimize colonization of exotics.
- *Phase 2:* The second phase will extend 1-3 years and will include continued water quality monitoring of Marsh Creek, major grading, widespread tule cultivation in the future subtidal zones, and active riparian planting of the levees.
- *Phase 3:* The third phase would include construction of a new levee along Jersey Island Road, breaching of the existing levees and possibly reconfiguration of Marsh Creek. This phased approach will be easier to finance and will allow for information gained in initial phases to shape subsequent phases. Financing the project in these phases will be easier than raising all of the implementation funds before commencing any construction.

The Dutch Slough Management Team and the Adaptive Management Working Group (AMWG) considered restoring each of the parcels in sequence so that lessons learned from restoration of the first parcel could be applied on the second and third parcels. They rejected this approach because it would significantly prolong the implementation period and would confound scientific comparison between different parcels. Since it would take a minimum of 3-5 years of post project monitoring to obtain useful data from the first parcel, design of the second parcel, let alone the third parcel, could not begin for several years. Furthermore, chronological variations such as year type or an exotic species invasion, would greatly confound potentially interesting comparison between restoration treatments on different parcels that were implemented in different years. As a result, full restoration will proceed simultaneously on all three parcels to yield information as soon as possible that can guide future restoration efforts elsewhere in the Delta.

2.0 Adaptive Management

Adaptive management is a high-priority of the CALFED Ecosystem Restoration Program (ERP) (ERP Strategic Plan), the primary funding source for the Dutch Slough Project. Adaptive management is a strategy for reducing uncertainty by learning from restoration and management actions. It is particularly important for tidal marsh restoration projects like Dutch Slough since there is so much scientific uncertainty about how best to restore tidal marsh to benefit endangered fish species – a key goal of the CALFED ERP.

The key to successful adaptive management is learning from restoration and management actions. Subsequent restoration actions can then be revised or redesigned to be more effective or instructive. Lessons learned at Dutch Slough can be used to change future management actions at Dutch Slough or simply to inform the design of similar restoration projects elsewhere in the Delta.

2.1 Description of Adaptive Management

Adaptive management employs the scientific method to maximize the information value of restoration and management actions. Resource managers identify competing hypotheses about ecosystem structure and function based upon the best available information, and then they design restoration actions to test these competing hypotheses. 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 understanding of the ecosystem at the time of implementation.

Adaptive management can be practiced both actively and passively. Passive adaptive management entails monitoring the effectiveness of restoration actions and making management changes based on the results of monitoring data. Active adaptive management, however, requires specifically designing the restoration project to test hypotheses regarding various management strategies. The Dutch Slough project pursues an active adaptive management approach, but will also include passive adaptive management elements.

A comprehensive and integrated adaptive management approach involves the following steps:

1) Define the **problem,**
2) Articulate measurable **goals and objectives**,
3) Develop a **conceptual model** that synthesizes existing knowledge and theories, and identifies and describes the key attributes of the system, the interrelations among them, and the important environmental factors (including stressors) that influence them,
4) Generate **hypotheses** about what management actions are necessary to achieve objectives and incorporate these hypotheses into the conceptual model,

5) Explicitly disclose **assumptions and uncertainties** regarding how the biophysical system will respond to these hypothetical management interventions,
6) Test and refine the conceptual model with a **numerical model(s)**,
7) Design **management interventions** to test competing hypotheses and achieve goals and objectives,
8) **Implement** interventions, pilot or demonstration projects, targeted research, or some combination of these,
9) **Monitor and analyze** results using Bayesian statistical techniques to judge progress and update probabilities among competing hypotheses, and adjust models to reflect analyzed results,
10) **Adjust** and **design** future management interventions according to results of monitoring.

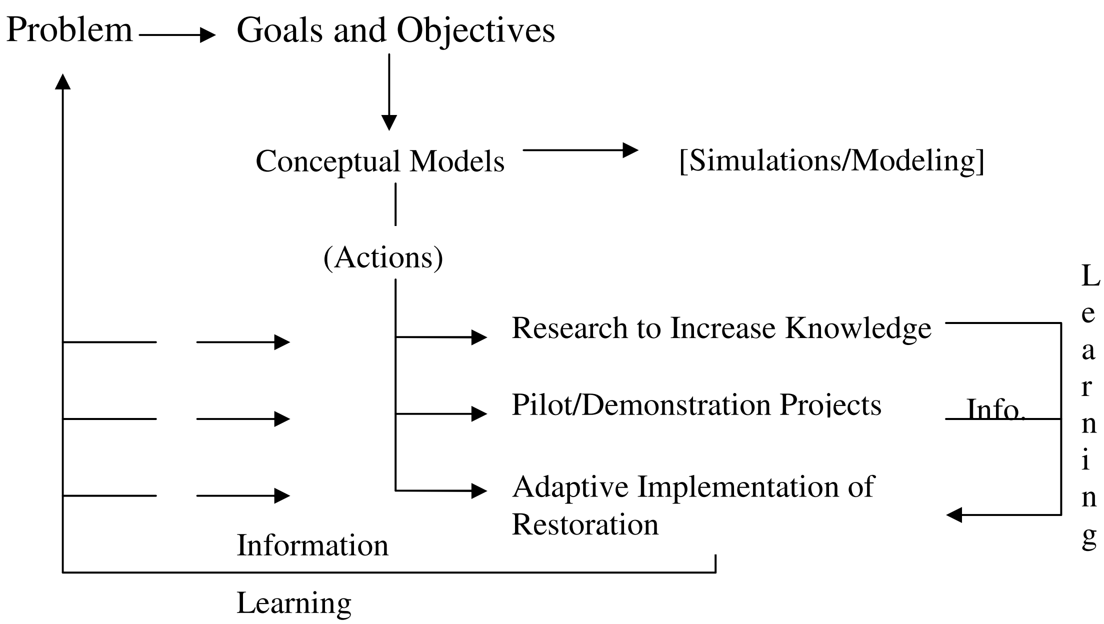


Figure 1: Adaptive Management Process Flow Diagram

These decision steps are diagrammatically presented in Figure, 1 which was adapted from the California Bay-Delta Authority's Strategic Plan for Ecosystem Restoration. The Dutch Slough project management team and the Dutch Slough AMWG have both agreed to use the Strategic Plan as a foundational, guiding document in the implementation of the Dutch Slough Project.

2.2 Dutch Slough Adaptive Management Working Group Process

Process

The Dutch Slough restoration design and adaptive management plan grew out of the AMWG process and coordination with the CALFED Bay-Delta Science Program. The AMWG is a group of scientists convened by the Dutch Slough management team to develop a restoration and adaptive management monitoring design for the project. The project team and the chair of the AMWG solicited input from the CALFED Science Board. The Science Board convened a sub-committee that consisted of Dr. Peter Moyle, Dr. Denise Reid, and Dr. Robert Spies.

Scientists who regularly participated in the AMWG included:

Bruce Herbold, USEPA (chair)
Mark Stacey, UC Berkeley
Joan Florsheim, UC Davis
Peter Baye, Consultant
John Takekawa, USGS
David Sedlak, UC Berkeley
Lars Anderson, UC Davis
Stuart Siegel, Consultant

They were assisted by members of the Dutch Slough management and consultant team by the following scientists, planners, and managers:

Sarah Beamish Puckett, NHI
John Cain, NHI
Nick Garrity, Philip Williams and Associates
Tom Hall, DWR
Lauren Hastings, CALFED Bay-Delta Program
Jeff Melby, State Coastal Conservancy
Michelle Orr, Philip Williams and Associates
Si Simenstadt, University of Washington
Mary Small, State Coastal Conservancy
Philip Williams, Philip Williams and Associates

2.3 Modes of Adaptive Management

The Dutch Slough project site is easily subdivided into three similar parcels that will allow the project managers to treat each parcel differently to test restoration techniques and hypotheses in the spirit of adaptive management.

The AMWG discussed three adaptive management restoration approaches that could be employed at Dutch Slough: sequential implementation and learning, a compare and contrast approach, and an iterative management approach. These three approaches are not mutually exclusive and all of them could be applied at Dutch Slough. Sequential implementation would allow lessons learned from restoration of the first parcel to be applied on subsequent parcels. The comparative approach would test various restoration strategies to determine the most effective strategies for application elsewhere in the Delta. An iterative management approach would entail changing management actions or reconstructing restoration treatments as the project management team monitored the project and gained new information about ecosystem function and the efficacy of different restoration treatments.

The main problem with the sequential approach is that it would require 10-20 years or more to complete implementation and draw reliable conclusions, since planning, implementation, and post project monitoring would require 5-10 years for each parcel. A faster schedule for implementation and monitoring would more quickly yield results and would inform design of restoration projects elsewhere in the Delta. Further complicating the merits of a sequential approach is the probability that preliminary conclusions regarding the success of the site will change as the different parcels evolve over time. After 5 years of monitoring on the first site, we might develop the second parcel very differently because we don't like how the first parcel is proceeding. But after 10 years of monitoring on the first site, we may conclude that the restoration of the first site was actually performing effectively.

The iterative approach entails trying one approach and then modifying it based on the monitoring data it if it does not perform as expected. This approach is well suited for periodic management interventions such as ocean fishery harvest regulations, but it is less useful for tidal marsh restoration actions that involve substantial earthwork. For example, the report of the Delta Habitats Group prepared by the Adaptive Management Subcommittee of the CALFED Independent Science Board (ISB) proposed restoring tidal action on one parcel without grading tidal channels. If channels did not form naturally after five years, the report suggested that the "marsh surfaces would be graded and sculpted to initiate channel development." The Dutch Slough management team concluded that it was not realistic to assume that it would be possible to get funding and permits to reconstruct a wetland that was created at considerable public expense only five years previously. The iterative approach, however, may make sense for improving periodic management interventions at Dutch Slough such as controlling exotic plant species.

The Dutch Slough AMWG ultimately recommended focusing on a comparative approach that involves comparing a range of treatments to determine the most effective treatment. The AMWG warned, however, that the comparison would not be a statistically valid scientific replication, because numerous factors would preclude establishment of true replicates or control treatments. Nevertheless, the AMWG, along with input from the CALFED ISB, concluded that such a comparison would still yield useful information. Both the ISB and the AMWG recommended that all of the different treatments (the entire project) be implemented at the same time, to facilitate comparison between the different treatments. They cautioned that temporal and chronological factors such as age of treatment, meteorological variations, and episodic events would make it difficult to compare treatments started at different times.

3.0 Problem Statement

The Sacramento-San Joaquin Delta was historically composed of over 350,000 acres of tidal marsh and adjoining seasonal wetlands (Atwater, 1982). Over 97 percent of the Delta's tidal marshes have been eliminated (The Bay Institute, 1998) and many of the native fish species that once depended upon them are in danger of extinction.

The CALFED Ecosystem Restoration Program Plan (ERP, 2000) assumes that restoring large tracts of tidal marsh will improve conditions for the Delta's native fish assemblages. Unfortunately, there is considerable uncertainty regarding how best to restore tidal marsh and the extent to which restored marshes may benefit or impact native fish and water quality in the Delta. Restoring some types of tidal habitat could simply provide habitat for exotic species or could degrade water quality conditions in the Delta. And restoring the Delta's subsided lands to tidal marsh could be prohibitively expensive unless we identify strategies for reducing costs.

The Dutch Slough restoration project is an opportunity to both restore tidal marsh and learn more about the function of tidal marsh in the Bay-Delta ecosystem. The site is one of the only locations in the Western Delta with suitable elevations for tidal marsh restoration and is configured in three separate tracts which will allow scientists to compare and contrast the efficacy of different approaches on the different parcels.

4.0 Goals and Objectives

Adaptive management is one of three broad goals for the Dutch Slough restoration project:

1. Provide shoreline access, educational and recreational opportunities.

2. Benefit native species by re-establishing natural ecological processes and habitats.

3. Contribute to scientific understanding of ecological restoration by implementing the project under an adaptive management framework.

Several objectives are associated with each goal and described in greater detail below as well as in appendix A. As is the case with many projects, there is an unavoidable tension between the three different goals. This section describes the distinct purposes of goals 2 and 3 and the tension between these two goals.

The restoration objectives of the Dutch Slough project are substantially broader and distinctly different than the more focused adaptive management goal. The restoration objectives are oriented to provide broad ecological benefits while the research objectives are primarily focused on generating information about native fish and water quality. While there is potential for conflict between the ecological objectives and the research oriented, adaptive management objectives, the overall approach is to achieve the adaptive management objectives within a larger effort aimed at achieving the restoration objectives of the project. The restoration objectives are:

- 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.
- Restore a mosaic of wetland and upland habitats.
- Contribute to the recovery of endangered and other at-risk species and native biotic communities.
- Minimize establishment of and reduce impacts from non-native invasive species.

For comparison, the adaptive management objectives are:

- Generate information that will guide the design and effectiveness of future wetland restoration projects in the Delta.
- Generate information regarding the ecological function of different types and sizes of freshwater tidal marsh habitats and their value to native fish species, particularly Sacramento splittail and juvenile salmon.
- Generate information regarding the processes that control the production and dispersal of both methylmercury and dissolved organic carbon in different types of wetlands.
- Provide the opportunity to establish field scale research projects at Dutch Slough to measure ecological processes and test the efficacy of management interventions for a variety of reasons including exotic species control, avian habitat enhancement, wetland species restoration, control of mercury methylation and subsidence reversal.

The measurable, ecological objectives or "performance measures" guiding design of the Dutch Slough experimental adaptive management project are far narrower:

- Juvenile salmon rearing (growth and survival)
- Splittail spawning and rearing (reproduction, growth, and survival)
- Minimize mercury methylation and dissolved organic carbon formation
- Food production for pelagic organisms (phytoplankton and zooplankton abundance)

The tension between restoration objectives and research objectives was a recurring theme at the AMWG meetings. Some members felt strongly that the research objectives should not in any way reduce the restoration benefits of the project. They worried that designing the physical restoration as an experiment to generate information might limit the ecological benefits of the project. Others argued, however, that the choice between restoration and research was a false dichotomy. Equally important, they countered that we did not know which type of treatment would have the greatest benefit for native fish and would therefore never be able to design the project to maximize benefits for native fish without the benefit of an adaptive management restoration experiment.

This debate was never fully resolved, but the ultimate restoration design for the Dutch Slough project reflects a give and take between these two positions throughout the design process. The project is designed to benefit a wide array of species, but is configured in large part to generate information about how native fish respond to different types of tidal wetland habitat. Existing upland areas are maintained within some of the restored marsh treatments to provide for a diverse range of habitats and species, despite the fact that these uplands might confound analysis of how different wetland types affect native fish. Similarly, the opportunity to route Marsh Creek onto the Emerson Parcel is held open due to its unique ecological value, even though that might preclude comparing treatments on the Emerson Parcel with treatments on the other parcels. These potential benefits thus outweighed the desire to create a more controlled experiment that could facilitate comparison between treatments. The configuration of the overall project, however, is based on an experimental strategy designed to generate information regarding the value of a range of wetland types for a limited number of native fish species.

5.0 Conceptual Model

5.1 Purpose and Definition

The purpose of this section is to explain the underlying scientific assumptions that guided the development of the Dutch Slough restoration and adaptive management design. It should provide a benchmark from which to measure future evolution in our understanding of the processes that shape structure and function of freshwater tidal marshes and the species dependent upon them. The conceptual model and accompanying text provided below are both a starting point and a history of how and why the Dutch Slough AMWG arrived at this starting point. The conceptual model was developed prior to the Delta Restoration Implementation Plan (CALFED, 2008) conceptual models and should be revised to be consistent with them.

The CALFED Strategic Plan for Ecosystem Restoration (pg. 16-17) describes the definition and purpose of conceptual models and guided the development of conceptual models for the Dutch Slough project:

> "Many resource managers, scientists, and stakeholders interested in the restoration and management of the Bay-Delta ecosystem have implicit beliefs about how the ecosystem functions, how it has been altered or degraded, and how various actions might improve conditions in the system. That is, they have simplified mental illustrations about the most critical cause-and-effect pathways.

> Conceptual modeling is the process of articulating these implicit models to make them explicit."

The Plan also points out that "conceptual models are based on concepts that can and should change as monitoring, research, and adaptive probing provide new knowledge about the ecosystem."

Future revisions or wholesale changes to the model will constitute progress in our understanding of the Delta ecosystem. Given how difficult it was for the AMWG to develop a conceptual model, it is entirely predictable that future managers and scientists will avoid the difficult task of re-articulating the model as it evolves and changes. For the DSAMP to succeed, however, future managers and scientists working at Dutch Slough must make it a priority to routinely revisit, revise, and explicitly restate the underlying scientific assumptions that will guide long term implementation of the Dutch Slough Adaptive Management and Restoration Project.

In the difficult process of developing a conceptual model, the AMWG 1) articulated how they believe the ecosystem functions, 2) evaluated competing models, 3) identified key uncertainties that could be effectively addressed through experimental manipulations at Dutch Slough, and 4) designed experimental manipulations for implementation at Dutch Slough given the opportunities and constraints associated with the site.

5.2 Delta Habitat Groups Conceptual Model

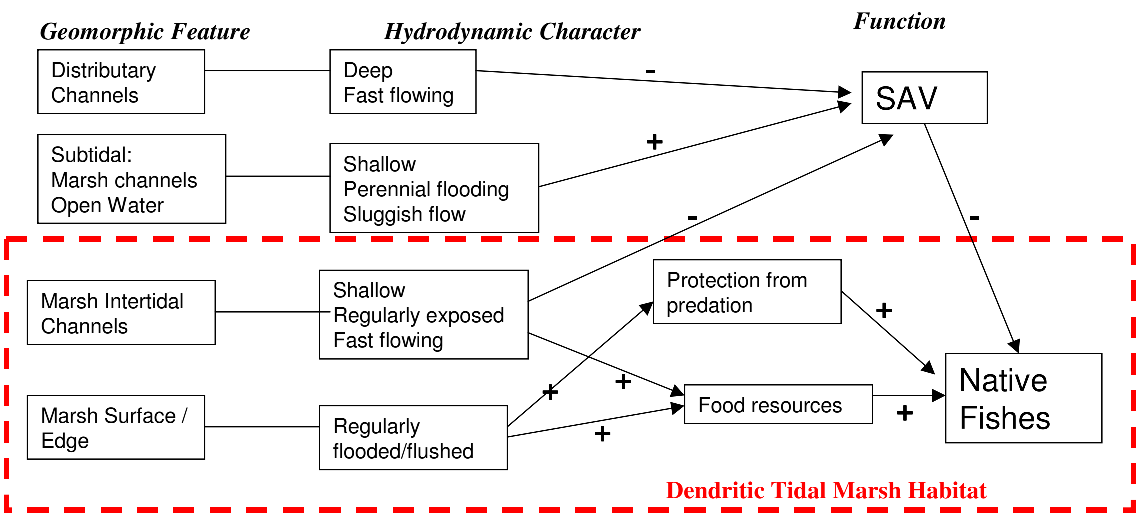
The CALFED Bay-Delta program convened a group of scientists, the Delta Habitat Group (DHG), to develop a conceptual model for tidal marsh restoration in the Bay-Delta ecosystem (Figure 2). The Dutch Slough management team and restoration consultant, PWA, presented the DHG's model and experimental design as a starting point for the Dutch Slough Conceptual Model. The AMWG, however, concluded that the conceptual model and experimental design proposed by the CBDA DHG was not suited to the Dutch Slough project in a few important respects regarding the following issues.

Limitations of the DHG Conceptual Model

- The model assumes that dendritic channels will increase tidal velocities and that increased velocities will significantly reduce submerged aquatic vegetation (SAV), which is not consistent with AMWG observations in the Delta. AMWG members referenced high velocity environments such as Franks Tract or tidal channels on Sherman Lake where SAV persists despite relatively high velocities.
- The model does not distinguish between different marsh plain and floodplain elevations and their respective benefits for native fish or inhibition of exotic species.
- The model does not encompass the unique opportunities to create other habitats beneficial to fish at Dutch Slough, such as the Marsh Creek delta and riparian habitat.

- The model assumes that sedimentation will be the dominant process contributing to marsh plain accretion and ignores the potential for marsh plain accretion from tule growth, and overstates the potential for accretion from sedimentation.

Figure 2: CALFED Delta Habitats Group Conceptual Model for Tidal Marsh Restoration



(Reed and Digenero, 2002)

Problems with the DHG Experimental Design

The experimental design proposes 3 treatments for comparison, but there is some question whether some of these treatments would yield ecological benefits or new information.

- Treatment 1, no intervention: At Dutch Slough this treatment would most likely result in large areas of shallow water infested with Egeria densa. Even though some additional information about fish utilization of such a habitat could be gained, the AMWG generally agreed that creation of more of this habitat type was not necessary to develop more information regarding its attributes. There are plenty of these types of habitats in the Delta already.
- Treatment 2, fill to intertidal elevation – no channel excavation: While such a treatment may be warranted in a saline environment, the AMWG were not confident that channels would form under this treatment. The vigorous growth of tules in fresh water would allow them to rapidly colonize the entire marsh plain, greatly diminishing the prospect for formation of small channels or a high-order channel network.
- Treatment 3, fill marsh plain to intertidal elevation – excavate channels: This treatment is most likely to succeed, but it is unlikely that steep, vertical banked

channels would form in soft fill sediments, increasing the likelihood that small channels will be colonized by tules.

5.3 Dutch Slough Adaptive Management Working Group Conceptual Model

The AMWG and the consultant labored to develop an alternative conceptual model. This effort involved identifying the limitations of the DHG model (discussed above), attempting to develop a comprehensive and unifying conceptual model, identifying a broad range of uncertainties regarding tidal marsh restoration, and finally narrowing their efforts to a set of nested models focused solely on resolving a limited number of uncertainties associated with the role of wetlands on native fish growth and survival and the production of problematic water quality constituents (methylmercury [MeHg] and dissolved organic carbon [DOC]).

Figure 3 illustrates the AMWG critique of the Delta Habitats Group model and identifies numerous factors that were not addressed. The DHG model was clear and concise, but, as discussed above, the AMWG considered it an oversimplification based on an erroneous assumption about Egeria densa and an overly general model that did not cater to the site-specific opportunities at Dutch Slough.

Figure 4 depicts the initial efforts to develop a comprehensive conceptual model. Although the model illustrates important linkages and factors, the AMWG concluded that it neither simplified nor focused the planning effort at Dutch Slough. It encompasses the full set of issues that might be interesting to scientists studying tidal marshes, but did not prioritize the issues that might be addressed through a field scale experiment at Dutch Slough.

Equally important, Figure 4 did not clearly communicate the basic assumptions about how physical processes drive ecological structure and function and it did not illuminate the key issues and uncertainties that should guide future management. To remedy this, the AMWG developed a more generic conceptual model (Figures 5 and 6) to clearly represent the relationship between physical processes and ecological outcomes and identified key uncertainties (Table 1).

Figure 3: Diagrammatic illustration of AMWG questions regarding the CALFED DHG Tidal Marsh Conceptual Model

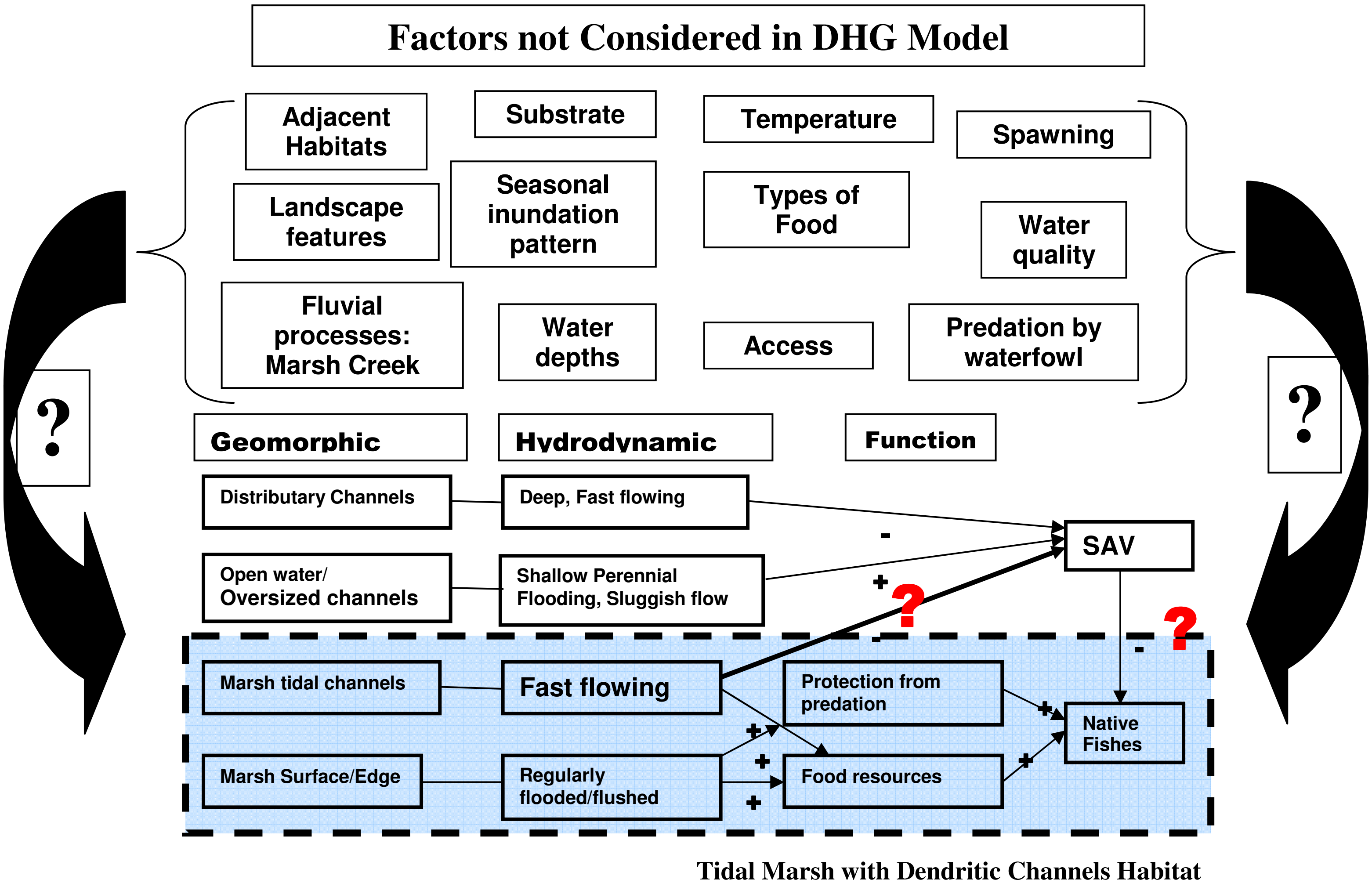


Figure 4: Initial Conceptual Model

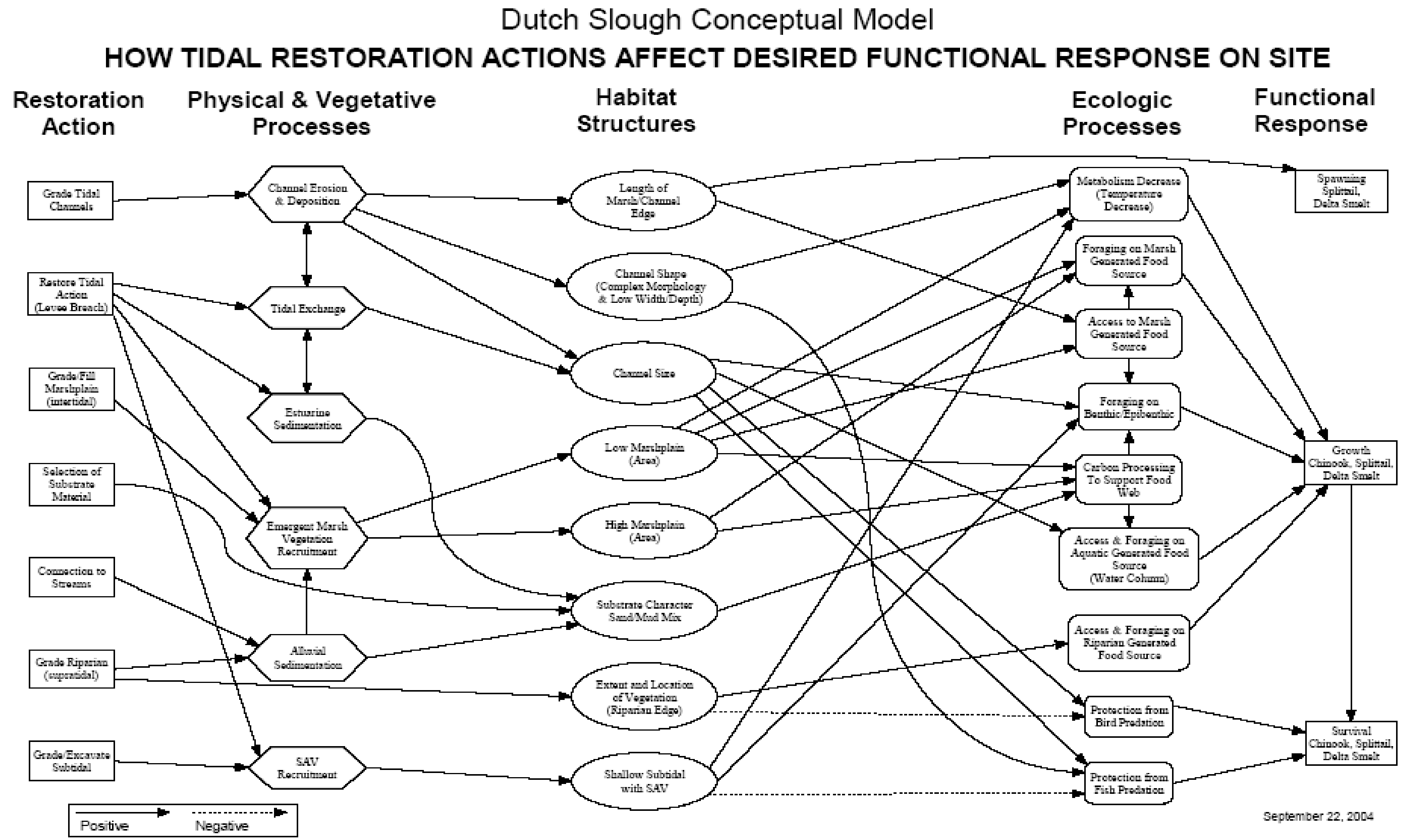


Figure 5: Generalized conceptual model for Dutch Slough project.

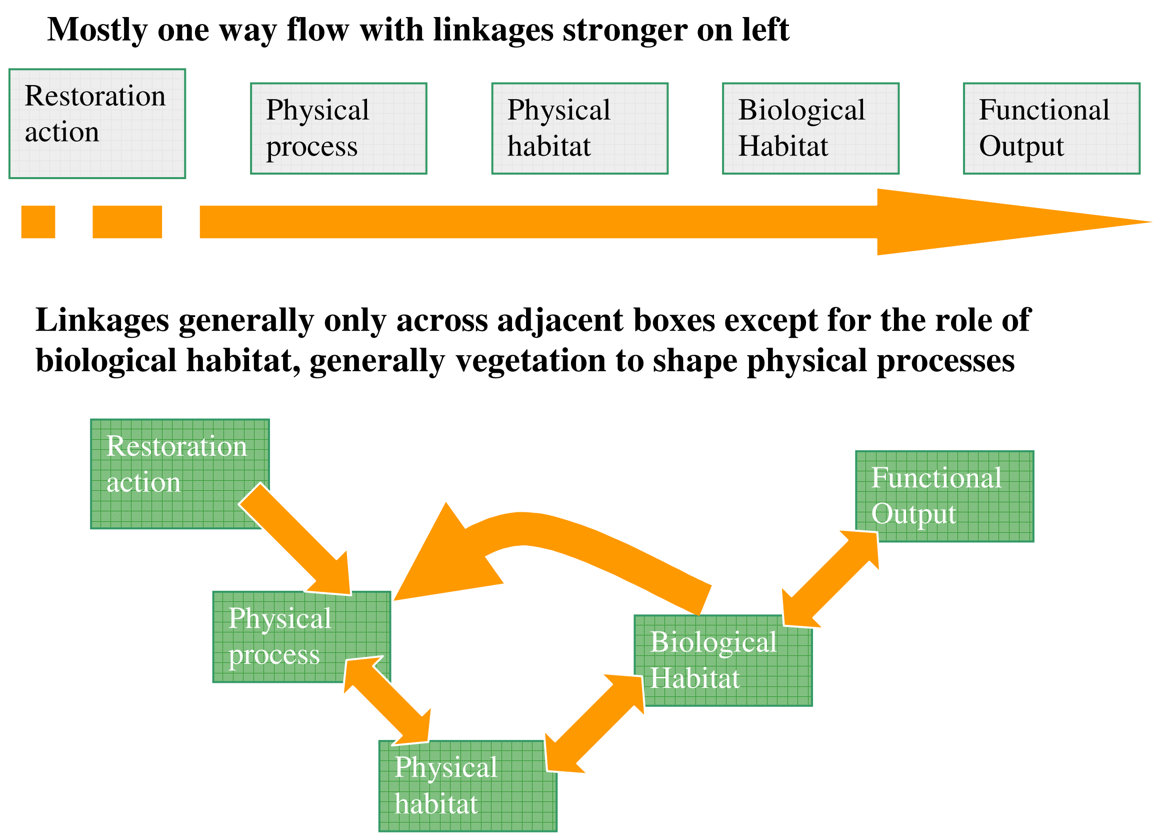


Figure 6: Generalized conceptual model for Dutch Slough Project.

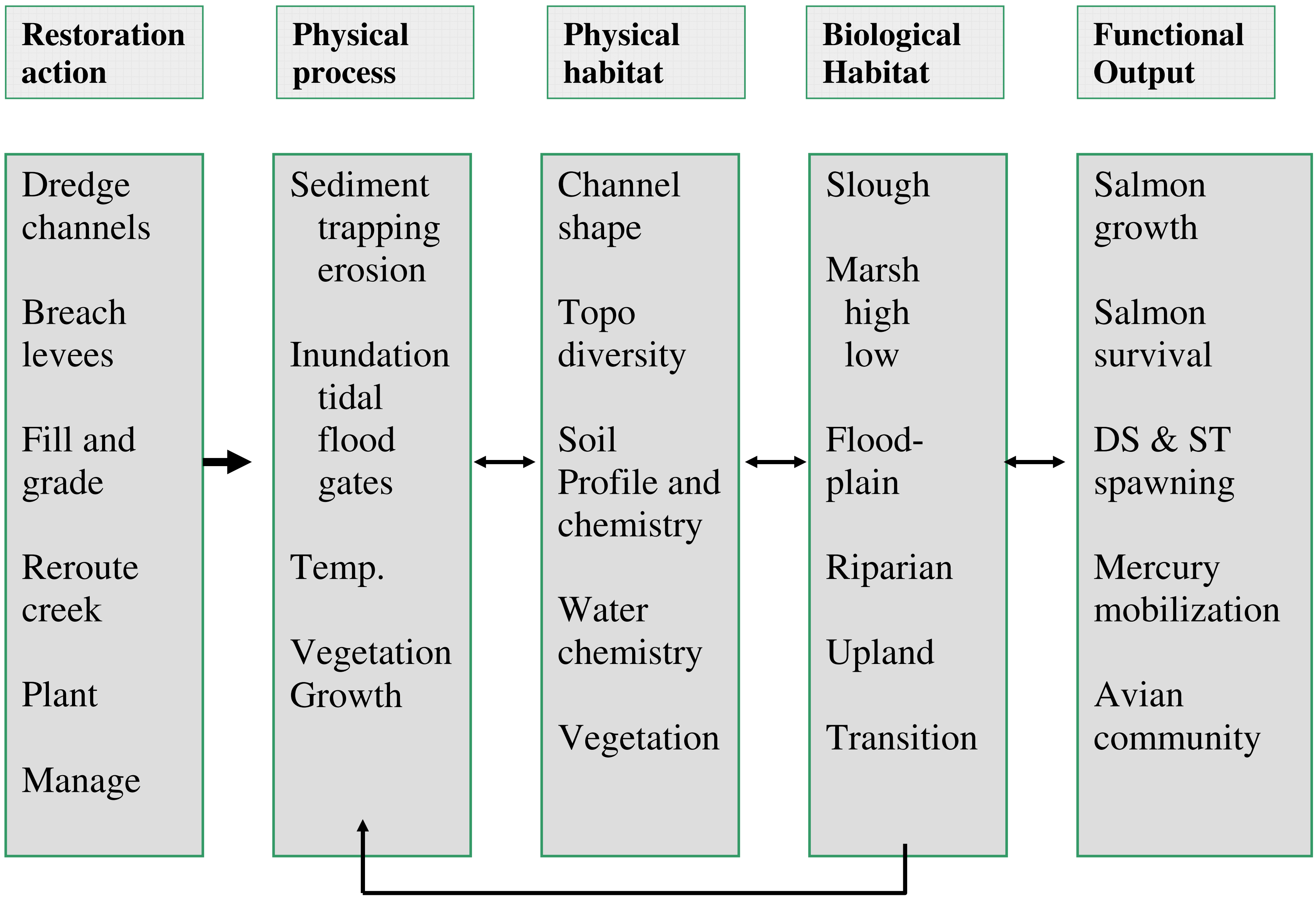


Figure 7: Conceptual Model for Chinook Salmon growth

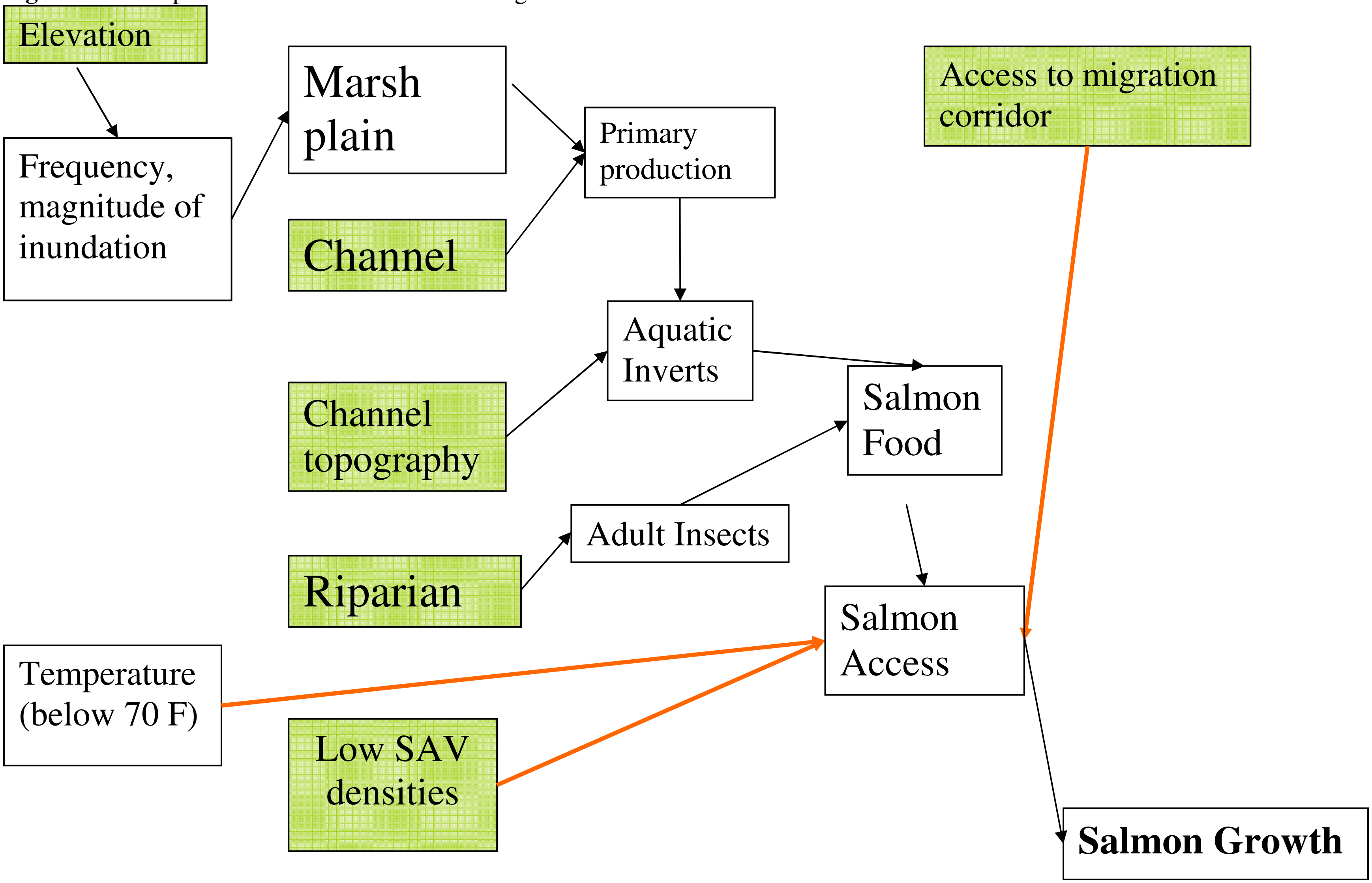


Figure 1. Chinook salmon growth: habitats, processes and attributes

Figure 8: Conceptual model for Chinook salmon survival

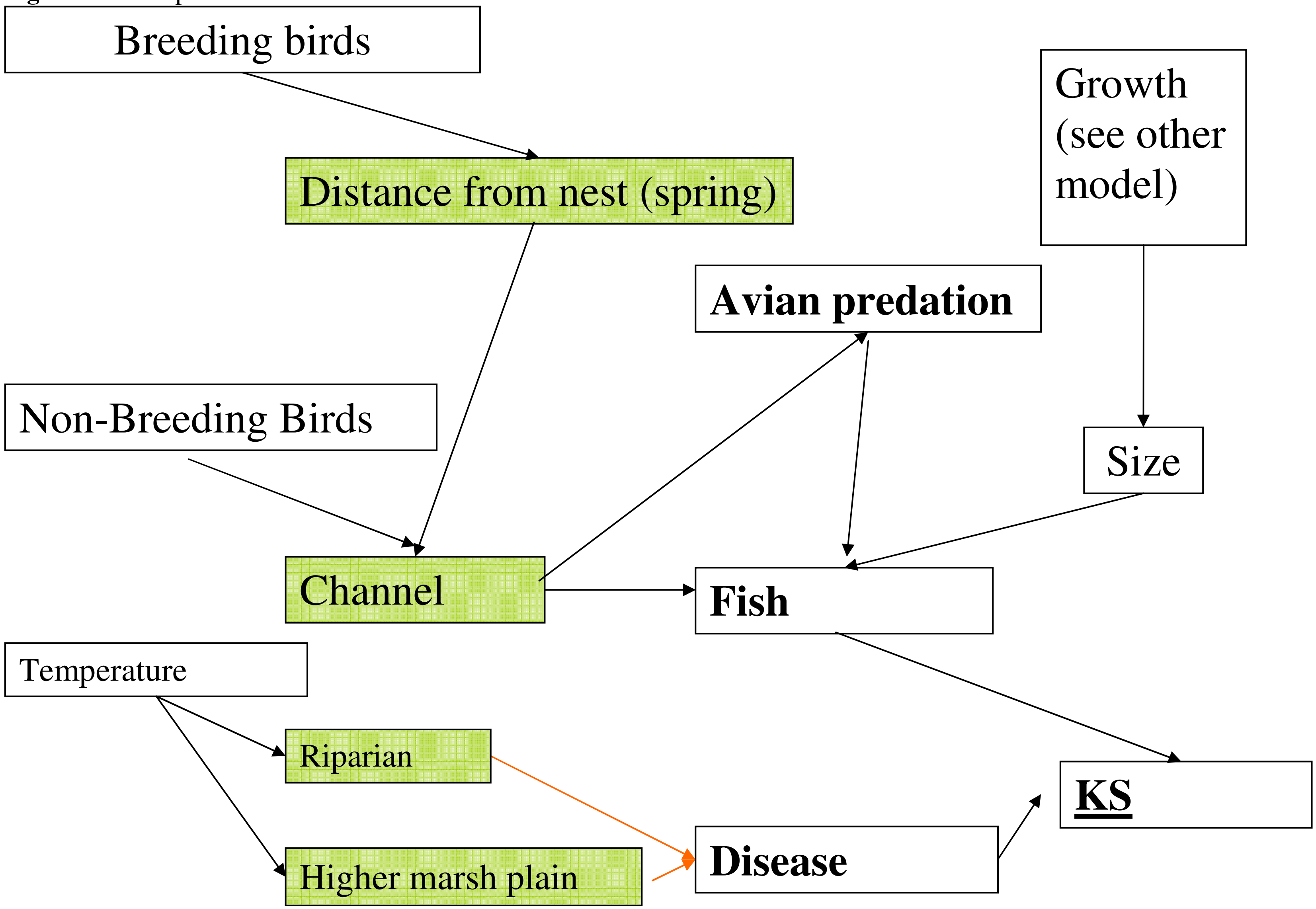
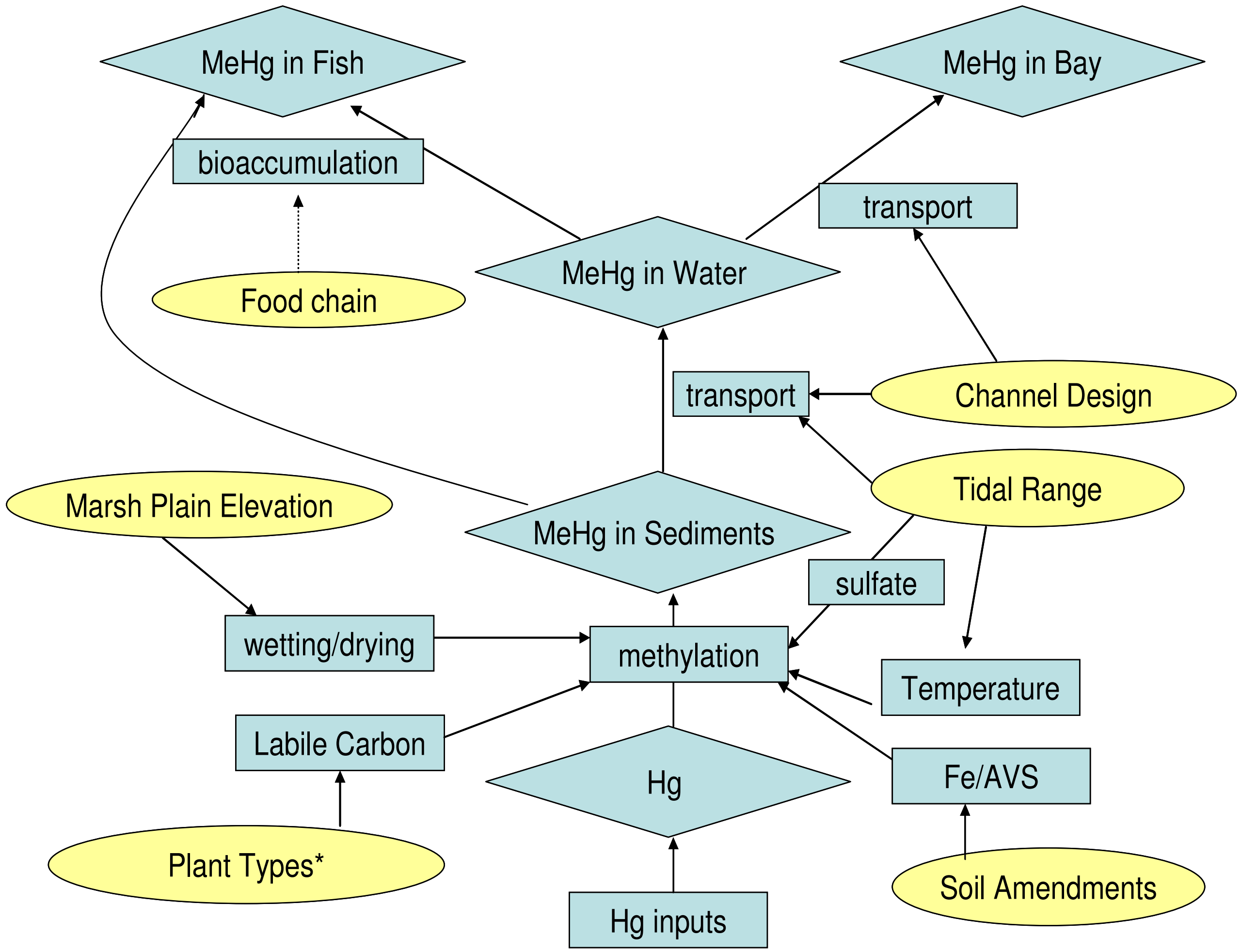


Figure 9: Simplified conceptual model for mercury methylation showing outcomes (blue diamonds), processes (blue rectangles), and restoration interventions (yellow circles).



6.0 Identifying and Prioritizing Key Uncertainties

The conceptual models described in the previous section and further in this section are approximations of how the ecosystem works and the relationship between restoration, physical processes, habitats, and species. There are, however, large and important uncertainties regarding how physical processes shape habitat and how various habitats affect target species. Explicitly identifying these uncertainties and designing restoration actions or management interventions to generate information that can reduce uncertainty is the purpose of adaptive management. The purpose of this section is to list the uncertainties identified by the AMWG and describe why the AMWG winnowed the large and general list of uncertainties down to a limited number of key uncertainties for focused research at Dutch Slough.

The AMWG quickly recognized that a field-scale experiment would only succeed if it was focused on a very narrow set of variables. There are many important uncertainties, but it is not possible to configure a large, field-scale experiment at Dutch Slough to address them all. After reviewing the DHG model and discussing research priorities, the AMWG recommended maintaining the experimental design focus on native fish and revising the conceptual model with a series of nested sub-models (Figures 7, 8, 9) that illustrate how we addressed the following measurable phenomena:

- Chinook salmon survival and growth
- Splittail spawning and rearing
- Delta smelt spawning (high uncertainty)
- Production and dispersal of dissolved organic carbon and methylmercury

The project management team and AMWG also wanted to address questions associated with avian utilization and water quality impacts (DOC and MeHg production) of marsh habitats. Avian and water quality experts on the AMWG, however, did not believe that the overall spatial configuration of the project needed to be configured to test avian and water quality hypotheses. Rather, they were confident that important water quality and avian questions could be addressed as smaller scale projects within a larger experimental configuration designed to address questions associated with native fish growth and survival[1]. Other questions, such as how best to control exotic plant species or reverse subsidence, could also be addressed on a smaller scale.

There are two distinct parts of the water quality problem: (a) formation of methylmercury and dissolved organic carbon (DOC); and, (b) transport of methylmercury and dissolved organic carbon from the wetland. Due to the highly toxic effects of methylmercury,

[1] After the results of a CALFED research program on mercury identified the temporal and spatial patterns of mercury methylation in the Delta and developed new methods for measuring methylmercury production, the Dutch Slough management team realized that the large scale experimental design configuration for fish was also well suited for testing water quality hypotheses. In short, key water quality questions could be addressed both at micro and meso scales as originally envisioned as well as at a very large scale across hundreds of acres.

transport of methylmercury from the wetlands is a very important issue for the Delta and San Francisco Bay TMDLs. Formation of methylmercury in the wetland could be an issue because it could pose risks to birds and fish that feed within the wetland, but it will not be a significant problem for the larger Delta ecosystem unless methylmercury formed in the marsh is transported out of the marsh. Similarly, DOC formation is not a problem unless it is exported from the wetland in significant amounts, and then it is only a problem if it becomes entrained into drinking water diversions.

The AMWG identified the key uncertainties that directly or indirectly influence outcomes for fish and water quality. The uncertainties are grouped in the following five categories and organized accordingly in table 1.

1. Fish Limiting Factor Uncertainties
2. Uncertainties Regarding Linkages between Geomorphic Habitat Type Uncertainties and Functional Response (fish or bird density, MeHg, DOC)
3. Geomorphic Process Uncertainties
4. Submerged Aquatic Vegetation (SAV) Uncertainties
5. Construction Feasibility Uncertainties

6.1 Prioritization Criteria

All of the uncertainties identified in Table 1 are important, but it is not possible to physically design the Dutch Slough restoration to address all of these uncertainties. Many of these uncertainties cannot be effectively evaluated at Dutch Slough because they are controlled by factors outside of the project boundaries. Other uncertainties could be better or more cost effectively resolved through research at other sites. Other uncertainties could be evaluated on a smaller scale at the site, but the entire site would not be physically configured to specifically evaluate these other uncertainties.

The AMWG loosely applied the following criteria, in no order of priority, to identify which uncertainties could be most effectively addressed through field-scale experimental manipulations at Dutch Slough.

1. What variables/uncertainties have the greatest implications for the future cost and feasibility of marsh restoration elsewhere in the Delta?
2. What variables can we test at Dutch Slough? What variables can be just as easily tested elsewhere?
3. What design feature variables will maximize the chances of seeing a response?
4. What variables can be experimentally tested while still maximizing the restoration value of the project?
5. What variables can be experimentally tested without significantly increasing the restoration costs?
6. Which variables can we control?
7. Which variables need to be tested on a large scale vs. variables that can be effectively tested on a smaller scale within the larger project.

Table 1: Categories of Uncertainties

1. Fish Uncertainties

a. Are target fish populations habitat limited?
b. Are target fish populations food limited?
c. Are target fish populations predation limited?
    fish predators?
    bird predators?
d. Are fish populations limited by contaminants?
e. Do Delta smelt spawn in marshes or channels?

2. Geomorphic-Habitat Type Uncertainties

a. What are important characteristics of open water vs. dendritic marsh for fish growth and reproduction, avian habitat, and MeHg and DOC production and dispersal?
b. Role and value of large channels vs. small channels for fish and birds?
c. Role and value of large order channel networks vs. small order for fish habitat and MeHg and DOC production and dispersal?
d. Relationship of channel density to fish utilization?
e. Value and role of high and low marsh for fish growth and reproduction, avian habitat, and MeHg and DOC production and dispersal?
f. What is the transport connection (fish, food, sediment, HG, DOC) between marshes and channels?
*g. How does shallow water habitat adjacent to tidal marsh affect the value of the marsh for fish?

3.Geomorphic Process Uncertainties

a. What factors influence slough channel development and sustainability?
b. What elevation of marsh plain will allow channel development or maintenance through scour?
c. Is Marsh plain elevation influenced by sediment supply, peat accumulation, tidal range, initial elevation, subsidence and compaction?
d. Will marsh plain accretion keep pace with sea level rise?
e. What is the lowest elevation tules will establish and persist?
f. How will system respond to extreme events?

4. Submerged Aquatic Vegetation Uncertainties

a. What is the relative stability of native SAV population?
b. Linkages of different SAV structure and fish habitat?
c. Role of SAV as habitat for invertebrates?
d. Fish and bird benefits of different aquatic plants?
e. Can we control SAV by managing submerged substrate?

5. Construction Feasibility Uncertainties

*a. Can we build steep banked channels presumably preferred by fish?
*b. Can we restore subsided lands with techniques other than placement of mineral soil fill material?

* Denotes uncertainties added by John Cain after the 5/28/04 AMWG meeting.

The following is a discussion of how the criteria applied to the five general categories of uncertainties.

Category 1: Fish Limiting Factor Uncertainties
Are native fish limited by habitat or food or predation or contaminants? This question did not fare well against criteria #2, since it cannot be answered at Dutch Slough alone. Even if many fish use habitat at Dutch Slough and the total population goes up, it will be nearly impossible to determine whether it was due to habitat or food created at Dutch Slough or whether it was associated with some other factor elsewhere in the Delta.

Category 2: Uncertainties Regarding Linkages between Geomorphic Habitat Type Uncertainties and Functional Response (fish or bird density, MeHg, DOC)

How do various configurations and types of habitat and channels influence the number of native fish and birds or the production and dispersal of MeHg and DOC?

Questions in this category can be divided into meso-scale features and macro-scale features, both of which can easily be cost effectively tested at Dutch Slough (criteria #2 and #5). Macro-scale features are larger scale, defining features such as marsh plain elevation, channel density, and channel order that will control the flow of water, nutrients, and chemicals onto and off the site. The elevation of the marsh plain will influence wetting and drying cycles – key parameters affecting fish utilization, mercury methylation, and DOC production. Both the density of channels and marsh plain elevation will strongly influence the flow of water, nutrients, and fish in the restored site and thus are likely to increase the likelihood of a clear and measurable response (criteria #3). In short, these macro-scale features will determine biogeochemical cycles on the restored site as well as the biogeochemical connectivity of the site to the waters of the Bay-Delta system.

Marsh plain elevation is also a key factor in the cost and feasibility of future restoration elsewhere in the Delta (criteria #1). Clean sources of fill to restore subsided lands to marsh are extremely limited and the cost of transporting and placing fill is significant. If lower marsh plains provide as much value for fish, we could restore fish habitat for significantly less money. Constructing high-density channels may be more expensive than low-density channels, but it is not nearly as significant a cost consideration as marsh plain elevation. Many AMWG members concluded that higher density channels were likely to provide more habitat and therefore any experimental design that called for lower density channels would violate criteria #4.

Meso-scale features include channel shape, depth, size, and substrate, and localized habitat types. These may affect local fish and bird density or localized rates of DOC and MeHg production, but they don't significantly affect the overall pattern and flow of inundation, nutrients, and chemicals. Even where they might influence these factors, the AMWG was not confident in our ability to control some factors such as channel shape due to constructability uncertainties (criteria #6). Once we construct the project, we may be able to collect some useful data regarding how species use deep channels vs. shallow channels, but it is problematic to design the project around these difficult to control, meso-scale features. Rather, as John Takekawa has suggested repeatedly, we can overlay studies of bird (and fish) utilization of meso-scale habitat types on top of a restoration design that focuses on macro-scale features such as channel density or marsh plain elevation.

Scale and topology are important variables that should be considered in any experimental design that evaluates the relative value of both meso and macro scale features. The scale of the site will greatly influence the order, size, and diversity of channel features and therefore is likely to produce a clear response (criteria #3). Without achieving some threshold of size, it will be more difficult to measure differences between small channels and large channels or low order and high order channels. Without differences in scale, it will be impossible to compare the value of low order channel networks to high order networks.

Topology, the spatial relationship between different geographic features, can determine the value of those features. Brood ponds adjacent to nesting grasslands are far more valuable to breeding waterfowl than ponds surrounded by water. An expanse of egeria-infested shallow water habitat between the restored marsh and the existing sloughs would reduce the value of the marsh for fish. Low marsh adjacent and hydrologically connected to high marsh or uplands may be less or more valuable to fish than an expanse of low marsh. To some degree, these issues could be tested on a smaller scale within a larger scale project and therefore should not dictate overall design (criteria #7).

Category 3: Geomorphic Process Uncertainties

What factors influence channel and marsh plain structure, sustainability, and evolution? Since these processes shape the marsh plain and channel habitat discussed in category 2 above, they are important to understand. Controlling some major geomorphic factors such as tidal range, however, would involve major infrastructure such as gates and major interventions over time (operations). These would be expensive and score poorly against criteria #5. Some AMWG members were dubious about their potential environmental impact (criteria #4). Restoring diverse channel types on marsh plains of varying elevations as would occur when addressing uncertainty #2 above and measuring change over time would largely test the questions in this category. In other words, it should be possible to address questions in this category by designing a project to address uncertainty #2. But a more detailed description of these uncertainties and the underlying conceptual model may be needed to design a meso-scale experiment around them. For example, more specific hypotheses about the processes that maintain channels and prevent them from filling or being colonized by tules is necessary to design an experiment around this question. Is channel depth the key factor that prevents vegetation encroachment? If so, what prevents deposition and subsequent channel shallowing? Perhaps tidal pannes are important for maintaining small, terminal channels? If so, perhaps meso-scale features such as tidal pannes should be designed into the larger experiment to test these meso-scale processes. These features could also be evaluated on a smaller scale and therefore should dictate overall design (criteria #7).

Category 4: SAV Uncertainties
What are the fish and bird values of various SAV and can we manage to enhance SAV that benefits target species?

In order to test these uncertainties, the project design would need to include shallow water habitat areas suitable for SAV. We would then need to manage shallow open water areas differently to obtain a diversity of SAV types. There is a relatively high level of certainty, however, that non-native SAV will colonize these habitats without active management and a high probability that such habitat would not be beneficial for target native fish species. Thus, designing the project to specifically test the effects of SAV appears to conflict with criteria # 4 since it would probably diminish the restoration value of the project. Equally important, there are other sites with an abundance of non-native SAV where the value of SAV for native species could be evaluated obviating the need to spend millions of dollars to do it at Dutch Slough to the detriment of other research priorities (criteria #2).

Conversely, it appears likely that cost and feasibility considerations may dictate the inclusion of tidal or non-tidal open water areas on subsided portions of the site (criteria #5). This may create an opportunity to study these issues at Dutch Slough, but the overall project should not be designed to answer these questions (criteria #7)..

Category 5: Construction Feasibility Uncertainties
Can we cost effectively build the type of channels and the elevation of marsh plains we think fish prefer?

These are important questions that will inform future restoration projects, but are best addressed as small-scale pilot projects on the site rather than as the focus of the large-scale site configuration and experimental design (criteria #7). For example, a novel channel construction technique could be tested on 1,000 feet of channel. Thus, although important, these questions should not drive the overall design of the project, because they can easily be addressed on a smaller scale within a larger project design.

6.2 Key Uncertainties Selected

The Dutch Slough AMWG recommended focusing experimental design on the following key attributes and questions:

Marsh Plain Elevation

What is the relationship between elevation of marsh plain:

- to salmon and splittail growth and survival?
- fish food production and access or transport to fish?
- splittail and Delta smelt spawning?
- methylmercury formation and dispersal?

- dissolved organic carbon formation and dispersal?

Channel Planform and Scale

What is the relationship between the density, length, order (scale of marsh plain), width, depth, and shape of tidal channels to:

- rearing and foraging habitat for salmon and splittail?
- avian predation?
- fish predation?
- access to marsh food supply?
- transport and dispersal of food, water, sediment, DOC, and MeHg into and out of the Marsh?

6.2.1 Role of Marsh Plain Elevation

The AMWG recommended Marsh plain elevation for experimental design for the following reasons:

- Marsh plain elevation controls the frequency of wetting and drying, which is a key driver that determines all of the following factors: vegetation type and character, access for native fish, habitat for fish and birds, residence time and primary productivity, mercury methylation and dissolved organic carbon formation.
- Marsh plain elevation is also a key cost factor, since it costs far more to restore high marsh on subsided lands.

Several of the geomorphologists and ecologists participating on the AMWG struggled with the distinction between high marsh and low marsh since low, emergent marsh was naturally rare or non-existent in the Delta. Although there is not a clear natural distinction between lower and higher marshes in the Delta, the intent is to compare "lower" and "higher" marsh plains that differ enough in elevation to show different ecological responses, while not making the "higher" marsh so high that it becomes fill-limited or cost prohibitive.

The origins of higher and lower marshes vary substantially. High freshwater marsh in the Delta was formed naturally over the last 6,000 years as sea level rose and formation of organic soil from deposition of wetland vegetation kept pace (Atwater, 1982). The persistence of tule marshes even as sea level rose is evidence that biological accretion of the marsh plain was faster or equal to sea level rise and was apparently limited by the upper extent of common high tides. As a result, the elevation of natural marsh plains in freshwater environments generally corresponds with mean higher high tide.

Low emergent marsh, in contrast, is an artifact of human settlement in the Delta. Vegetated marsh plain lower then mean high tide occurs in the Delta where subsided islands have been intentionally or unintentionally restored to tidal inundation. Tules persist below mean lower low water in some freshwater tidal environments, because they can apparently tolerate frequent and persistent inundation. (Simenstad et al, 2000)

AMWG members also cautioned that constructed high marsh may perform very differently then natural high freshwater marsh. Natural marsh plains in the Delta would have been characterized by hummocky, organic soils built over centuries by decomposing tules and rafted organic material including large woody debris. Constructing high marsh plain with earth moving equipment and mineral soil would provide a far different and presumably less diverse environment. Rather, they recommend that we not attempt to construct high marsh, but rather let it grow to high marsh from a constructed mean tidal elevation marsh plain. For this reason, and because constructing high marsh would cost significantly more, the experimental design will compare low marsh plain environments (-0.5 to 0.5 MLLW) to mid marsh (MTL) as described below. We believe that the constructed marsh plains will gradually accrete biologically until they reach an elevation approximating mean higher high water, provided that biological accretion of tules occurs faster then sea level rise as it did during the last 6,000 years. A ten year pilot project by DWR and USGS on Twitchel Island measured tule accretion rates of more than one inch per year which far exceeds estimates for sea level rise.

6.2.2 Role of Marsh Plain Scale

Channel geometry and scale also influence potential fish access, residence time and primary productivity, wetting and drying of channel edge, and fate and transport of water quality constituents. The AMWG considered a range of channel geometry measures such as channel density, cross sectional area, and channel order. Channel density was eliminated from further consideration based on the assumption that higher density was better for fish and more consistent with the overall ecological objectives.[2] Although channel cross section shape is important, the AMWG recognized that it was not a good experimental variable both because it would be difficult to control on a large scale due to constructability issues and because it is determined in part by marsh plain elevation, the other independent variable they wanted to design the experiment around.

The AMWG decided to focus on the role of the size of the channel network (i.e., the size of the marsh drainage), because it could be tested independent of marsh plain elevation and because it influences a number of meso- and macro-scale factors including tidal exchange, the diversity and size of channels in a given marsh drainage, the exchange of nutrients and other water quality constituents between the marsh and neighboring sloughs, wetting and drying of the marsh plain, and the extent of low water refugia for target and predatory fish. As discussed in the hypothesis section below, small-scale marsh areas are more likely to fully drain on low tide while large areas are less likely to fully drain.

[2] According to AMWG consultant, Si Simenstadt, target fish species such as juvenile salmon will only occupy channels where they feed along the edge and will not utilize interior marsh plains. Thus, more channels and channel edge would provide more habitat for juvenile salmon to feed and would provide more restoration benefit than less channel.

6.3 Comparison of Dutch Slough Priorities to Delta Habitat Group Uncertainties

The CALFED Delta Habitats Group (DHG) previously identified several key uncertainties that should be addressed through future tidal marsh restoration projects (Reed and DiGenero, 2002). The purpose of this section is to explain why the Dutch Slough project does not address many of the uncertainties identified by the DHG. The annotated list below identifies the key uncertainties addressed by the CALFED Delta Habitats Group, and provides the reasoning why some of these uncertainties are not targeted by the Dutch Slough Adaptive Management Restoration Program.

1. *Will SAV colonize and persist in and immediately adjacent to a dendritic channel system adjoining an active distributary channel?* The AMWG did not believe that this was a key uncertainty. Although they recognized that SAV was probably a major issue limiting native fish restoration, they were relatively certain that SAV would colonize and persist in and adjacent to any freshwater dendritic channel system in the Delta as evidenced by the persistence of SAV at Sherman Lake wetlands. While it is possible that high velocity, dentritic channels may limit SAV at Dutch Slough and thereby provide information on the factors controlling SAV, the AMWG opted not to configure the multi-million dollar restoration treatment around this question.

2. *Can tidal action alone develop and maintain dendritic channels?* At least two members of the AMWG emphatically believed that dendritic channels would not form on their own (i.e., without excavation). Rather, they believed that tule vegetation would rapidly colonize tidal flats and preclude the development of small tidal channels for the foreseeable future. Although naturally formed channels would probably be superior to artificially excavated channels, the AMWG recognized that artificial channels are far more beneficial to native target fish species than no channels at all. The Delta Habitat Group had proposed that channels could be excavated post restoration if they did not form on their own accord within the first five years, but the AMWG and the Dutch Slough Management Team did not believe that it was realistic to assume that a restored wetland could be re-excavated due to regulatory and fiscal constraints.

3. *What are fish responses to dendritic tidal marsh habitat in estuarine vs. tidal riverine dominated systems?* Although important, this question can only be addressed by evaluating a variety of sites across a gradient extending from the saline bay marshes to the river dominated freshwater tidal marshes.

4. *What is the relationship between marsh channel pattern, hydrodynamics, and marsh plain vegetation characteristics?* This question will be informed by the Dutch Slough experimental design, but is not the focus of that design.

5. *What are the important characteristics of dendritic channels and adjacent marsh that benefit native fishes?* This question is the focus of the Dutch Slough experimental design.

6. *What are the process linkages that lead to these benefits?* This question will also be addressed in the Dutch Slough experimental design. The process linkages are posited in the fish hypotheses listed in the following section.

7. *Can we cost effectively design and construct tidal marsh plain channel systems that are stable and sustainable in the long term (over decades)?* This is an engineering question that will undoubtedly be informed by the Dutch Slough project. Since marsh elevation and fill material is the key cost factor, evaluation of the value of varying marsh elevations is the fundamental factor that needs to be addressed in order to limit restoration costs in the future.

7.0 HYPOTHESES AND MONITORING STRATEGY

The AMWG crafted several specific hypotheses to guide research to reduce the key uncertainties identified in the previous section.

These hypotheses are identified below along with a general description of the monitoring strategy for testing each hypotheses. More detailed monitoring methods must be developed prior to implementation in order to effectively test these hypotheses. The hypotheses are divided into three categories: fish, water quality, and miscellaneous bio-geomorphic. Most of the fish and water quality hypothesis are targeted to address the key uncertainties identified in the previous section. They are the highest priority for monitoring and research, since the overall physical configuration of the restoration project is intentionally designed to test them. Some of the water quality hypotheses and all of the miscellaneous hypotheses are not targeted to the key uncertainties, but they can be tested in smaller-scale experimental plots that will be integrated into the larger restoration project to the extent that they are consistent with funding and scientific priorities. As the project evolves, project managers should remain flexible and accommodate meso-scale experiments to test additional hypotheses as scientific priorities evolve.

7.1 Fish Hypotheses

1. **Food resources for splittail and juvenile salmon will be greater in lower marsh due to increased residence times and increased water column volume in the photic zone.** Water will remain on the marsh plain for longer periods (increased residence time) and more water per area will be available for photosynthetic activity which drives primary productivity. The relative abundance of food resources will be measured by sampling phytoplankton and zooplankton resources in both mid elevation marshes (MTL) and low marshes (MLLW) at the project site.

2. **Low marshes will export more food resources to adjacent Delta channels than mid elevation marshes due to increased food production on low marshes and greater tidal prism.** Exported food resources can be measured by dissolved organic carbon, phytoplankton, and zooplankton exiting and entering restored tidal marsh zones during different seasons of the year.

3. **Splittail and juvenile salmon growth will be greater in lower marsh and channels that drain less often due to increased feeding opportunities.** This would largely be a function of greater food resources in lower marshes, but could also stem from increased feeding opportunity since low marshes would drain less frequently and thereby potentially provide longer duration wetted channel edge for feeding. Caged and/or tagged fish experiments would probably be necessary to measure relative growth rates in various types of marshes since fish might travel between marsh plots.

4. **Fish survival will be greatest within a intermediate-scale channel marsh areas, because higher order networks will harbor predators and lower order networks lack sufficient refuge during low tides.** The amount of channel inundated to a depth of over 0.5 meter at low tide is a function of marsh size. This hypothesis is based on the assumption that most predator fish require depths of greater then 0.5 meter[3]and would therefore be more abundant in the largest marshes or at the mouth of small marshes that completely drain on each tide cycle. Intermediate sized marshes would drain enough to limit predator habitat in the marsh channel, but would not drain so completely as to force target juvenile fish into the main sloughs where predators are known to be abundant. This hypothesis could be tested directly by releasing tagged fish into varying marshes and then measuring survival. The underlying physical and biological assumptions could be tested by field surveys at low tides to measure the abundance of deep water and predator fish in varying size marshes.

5. **Fish growth will be greatest in intermediate- and large-scale channel marsh areas, because higher order networks are more likely to maintain wetted channel feeding opportunities during low tides.** The mechanisms are similar to hypothesis 4 above. Small marshes will drain completely at low tide, limiting feeding opportunities. Large marshes will provide feeding opportunities at low tide. This hypothesis assumes that smaller marshes will always drain completely, but they may not drain completely during late winter and spring months when Delta water levels are often higher than normal due to river inflow. To the extent target fish (juvenile salmon and splittail) are most abundant in late winter and spring, the actual extent and effect of marsh drainage may not significantly limit feeding and growth during this life stage when it is most important.

[3] This assumption was based on the professional opinion of AMWG members, but should be verified with published literature before commencing with design of project.

7.2 Water Quality Hypotheses

Many of the water quality hypotheses discussed below involve measuring fluxes of MeHg or DOC off of restored marshes. The accuracy of the flux measurements will depend in large part on the ability to accurately quantify tidal inflow and outflow. Therefore, a high priority of the monitoring program will be to develop a numerical hydrodynamic model and a reliable method for measuring flow into and out of the various marshes to calibrate the model. It may be efficient to do this through establishment of a network of tidal gauges and optimal backscatter devices. Utilizing a calibrated model is an important first step for cost effectively testing hypotheses one through four below.

1. **Methylmercury production will be greatest on mid elevation marshes characterized by periodic wetting and drying and lowest on perennially inundated emergent marsh.** This hypothesis is based on the assumption that flooding of vegetated wetlands or uplands or fluctuating water levels during tidal cycles could stimulate microbial methylation of inorganic mercury, increasing concentrations of methylmercury in water and biota. Measurements of methylmercury in fish from the Bay-Delta reveal that fish have higher levels in areas subject to periodic inundation such as high marshes and seasonal floodplains (Ye, et al, 2006). In contrast, fish from perennially inundated areas such as the Central Delta have relatively low levels of methylmercury suggesting that the more frequent and continuous inundation that would occur on lower marshes would result in lower methylmercury production (Slotton, 2007). Methylmercury production could be measured with soil and water samples from small plots, caged fish bioassays from various marshes, and on larger scales by measuring import and export of methylmercury or its surrogate (DOC) on tidal cycles. Monitoring techniques at Dutch Slough would be based on methods recently developed by the USGS, Moss Landing Marine Laboratory, and the UC Davis Mercury Group as part of the CALFED funded mercury monitoring program.

2. **Methylmercury and DOC flux from the marsh to Delta channels will be greatest during extreme low tides during spring tide cycles.** Data collected by both USGS and the Moss Landing Marine Laboratory indicate that fluxes of methylmercury and DOC from tidal marshes fluctuate greatly across the tidal cycle and that exports from marshes are greatest during extreme low tide events when tidal sloughs, banks, and associated pore water drain from the marsh. Methylmercury levels may concentrate in the pore waters where residence time and microbial activity are both high and then diffuse to adjacent channels and sloughs when the pore water drains from the soil. This hypothesis could be tested by measuring fluxes of DOC and methylmercury at the mouth of different marshes across the tidal cycle or by collecting water samples from marsh channels across the tidal cycle. These techniques were recently developed by the CALFED-funded mercury monitoring program.

3. **Total methylmercury and DOC flux from the restored marsh to the Delta will be highest on small-scale, mid elevation marshes that drain frequently and lowest on large-scale, low marshes that seldom drain completely.** This hypothesis is based on the assumption that methylmercury production will be greatest on higher marshes (hypothesis 1 above) and that fluxes will be greatest on smaller marshes since they are more likely to drain completely on low tides (hypothesis 2). This assumes that DOC and methylmercury produced on the marsh plain will be efficiently exported out of the marsh. On larger marshes, in contrast, it would be cycled within the marsh. Pore water rich in DOC and methylmercury would not have time to drain from the marsh before flood tides would redisperse it across the marsh plain. However, to the extent that tidal prism and total volume of water draining lower marshes is greater per unit area, it is possible that total methylmercury and DOC flux from lower marshes could be greater than mid elevation marshes even if hypothesis 1 and 2 are correct. This hypothesis could be tested with monitoring approaches described for hypothesis 1 and 2 above.

4. **For a given marshplain elevation, total methylmercury and DOC export from the marsh to Delta channels will be greatest per unit area for small drainage areas and least for large marsh drainage areas.** This hypothesis is very similar to hypothesis 3 above and could be tested with similar monitoring methods. This hypothesis may be particularly policy relevant since it may be far easier to implement many small restoration sites then it is to implement one large restoration site. If this hypothesis is correct, however, many small sites may have significantly greater water quality impacts then a equal area of large sites.

5. **Photo-demethylation in open water areas significantly reduces net-methylmercury production.** Photo-demethylation may be the most important factor limiting methylmercury levels in the central Delta and is one of the key uncertainties in the Delta mercury mass balance. It may be possible to test this hypothesis by discharging waters with relatively high methylmercury levels into the freshwater ponds on the north side of each parcel. Water control structures on the ponds could be operated to maximize diversion of methylymercury laden waters into the ponds during the end of spring ebb tides when pore water drains out of the soil. Changes in concentrations of methyl mercury could then be measured in the ponds after the diversion event.

6. **Soil substrate and vegetation characteristics influence methylmercury levels.** Vegetation and soil type may influence the size of the reactive mercury pool, the rate microbial activity and corresponding methylation, and the cycling of methylmercury. This hypothesis could be tested by establishing numerous small scale experimental plots with a range of soil and vegetation types. Measurements would include reactive mercury pool as well as methylmercury levels in soil, pore water, vegetation, and resident biota. Techniques developed by USGS and SFEI as part of the CALFED mercury monitoring program would be used (CBDA, 2007). Vegetation type, which is closely correlated to elevation on the marsh plain, will influence rates of mercury methylation and DOC formation. Certain

plants may alter the rhizosphere by production of organic acids or release of dissolved oxygen, both of which are likely to affect mercury methylation rates. The effects of plant species on water quality could be investigated in test plots on a small scale.

7. **Soil amendments such as iron will limit mercury methylation.** Soil amendments could be added to experimental plots to evaluate mitigative effects. Data collected from the experimental plots could be compared with one another and with data generated from sampling conducted from the general restoration area to evaluate the respective impact on methylmercury production. This could be tested with similar measurements as described for hypothesis 5 above.

8. **The diversion of Marsh Creek onto the restoration site will not significantly increase the methylmercury levels in restored marshes.** Although there is an abandoned mercury mine and elevated mercury levels in the upper Marsh Creek watershed, fish from the mouth of Marsh Creek and nearby Big Break actually have the lowest mercury levels of all fish measured in the Bay-Delta watershed (Slotton, 2007). Even if inorganic mercury levels are high in Marsh Creek, they will not necessarily increase mercurymethylation in restored marshes since levels of methylmercury may be controlled by microbial activity in methylating environments, not the total amount of mercury available. This hypothesis can be tested by comparing methylmercury levels from marshes connected to Marsh Creek with similar marshes not connected to Marsh Creek.

9. **The diversion of Marsh Creek onto the restoration site will filter, trap, and/or bio-remediate pollutants in Marsh Creek and thereby reduce pollutant loads to the Delta.** Water quality in Marsh Creek is poor. Creation of a wetland at the mouth of Marsh Creek may improve Marsh Creek water quality before it enters the Delta. Alternatively, wetlands at the mouth of Marsh Creek may simply accumulate heavy metals such as copper or increase the levels of methylmercury. Even if the hypothesis is correct, acute toxicity events (pesticides, herbicides, chemical spill during low summer flows) in Marsh Creek could significantly harm biota in the restored wetland at the mouth of Marsh Creek. For this reason, it is not prudent to assume that a wetland at the mouth of this urban creek can both provide stable habitat for biota and filter pollutants that would otherwise flow into the Delta. This hypothesis could be tested by measuring Marsh Creek water quality upstream, in, and downstream of the restored Marsh, and before and after Marsh restoration.

10. **Tidal marsh restoration will increase production of dissolved organic carbon, result in net positive export of DOC out of the restored marsh, and thereby increase the level of DOC at the Delta's drinking water diversions.** There are three parts to this hypothesis: 1) increase production of DOC, 2) export out of the marsh, and 3) entrainment in drinking water diversions. Even if restoration increases both production and export, it will not create negative water quality impacts unless DOC is transported from the restoration site to the drinking water

intakes when water is being diverted. Due to Dutch Slough's westerly location in the Delta, DOC produced at Dutch Slough will most often be transported westward into Suisuin Marsh and San Francisco Bay and therefore is not likely to increase DOC at drinking water intakes. Westward movement of DOC from Dutch Slough will be most pronounced in periods when net westward flow is greatest (presumably winter and spring). Conversely, the potential for eastward flow and dispersion is greatest when net-flow is lowest (summer and fall). Therefore, evaluation of the timing of net DOC production at Dutch Slough is directly relevant to questions regarding the impact of Dutch Slough on DOC concentrations at the Delta drinking water diversions. Furthermore, since some type of DOC is more likely to form trihalomethanes (THM), monitoring efforts should focus on the timing and potential transport of these more reactive species.

7.3 Miscellaneous Bio-geomorphic Hypotheses

1. **Marsh plains will accrete at rates equal to or greater than sea level rise in a variety of wetland environments.** This is based on USGS measurements of non-tidal tule ponds on Twitchell Island where organic material has accreted on the marsh plain at 1-2 inches per year and has enormous implications for the long-term restoration potential of tidal marsh in the Delta. This can be tested by measuring marsh plain accretion in a variety of different wetland environments across the Dutch Slough site. Feldspar markers could be deposited on the as-built surface shortly after construction and periodic sediment cores could be used to measure accretion from that surface over time.

2. **Deposition of organic material is the dominant process driving marsh plain accretion and greatly exceeds marsh plain accretion from deposition of mineral soil.** In freshwater environments with low sediment loads such as the Delta, biological processes drive marsh plain accretion. This could be tested by measuring the ratio of organic to inorganic material in sediment cores.

3. **Subtidal emergent marshes (below MLLW) will accrete orders of magnitude faster than open water (including vegetation) areas with the same elevation.** This hypothesis is based on the assumption that the presence of emergent vegetation is a catalyst for both physical and biological accretion processes that enable accretion rates to cross a threshold from very slow (mm per year) to relatively fast (cm per year). This could be tested by measuring accretion rates and sediment cores in restored emergent marshes compared to open water areas at Dutch Slough or in nearby Big Break and Franks Tract.

4. **Tule vegetation established on subtidal elevations prior to tidal inundation will persist at elevations 1 foot below MLLW, but will not survive at greater depths**. Confirmation of this hypothesis is critical to knowing the minimum elevation for establishing tidal marsh and achieving the accretion threshold addressed in hypothesis 3 above. If tule vegetation persists at greater depths, then it may be possible to restore non-tidal subsidence reversal ponds to tidal marsh at a lower elevation. This hypothesis can be tested by measuring the presence, density, growth, and persistence of emergent marsh established at various subtidal elevations. Tules will be cultivated on a variety of surface elevations above and below MLLW prior to tidal inundation and then monitored after tidal inundation.

5. **SAV will not colonize subtidal areas that are vegetated with emergent tule marsh**. Colonization of shallow water zones by invasive, exotic submerged aquatic vegetation (SAV) is a major, pervasive problem. Pre-inundation cultivation of tules at subtidal elevation as described in hypothesis 4 may preempt establishment of undesirable SAV, even if the tule do not persist. Even dead, submerged tules may prevent establishment of SAV.

6. **Non-native SAV will colonize areas vegetated with native SAV at slower rates than similar open water areas without native SAV.** Establishment of native SAV may preempt or otherwise limit establishment of non-native SAV. This hypothesis may only be tested if the northern cells are managed for tidal or non-tidal open water rather than subsidence reversal or managed marsh.

7. **Geomorphic and habitat factors such as marsh plain elevation and channel depth will affect utilization by avian species.** This hypothesis is a general place holder for more specific hypotheses that might be tested regarding habitat factors that might influence avian species distribution and abundance. As more detailed construction plans are developed, the Dutch Slough management team will work with avian ecologists to design meso-scale experiments into the project design.

8. **Wetlands (tidal and non-tidal) can be managed to optimize subsidence reversal.** The USGS has demonstrated that subsidence reversal wetlands on Twitchell Island can accrete up to two inches of organic material each year. This process sequesters atmospheric carbon and depending on methane emissions from the wetlands, may substantially reduce greenhouse gases. This hypothesis can be tested by measuring carbon accretion and methane fluxes in managed wetlands.

9. **Rice straw bales can be used to build-up subsided surfaces and sequester carbon without degrading water quality or marsh vegetation growth.** Rice straw bales could be used to build-up subsided lands, but there are concerns about how rice straw bales could affect water quality or marsh vegetation. If rice straw bales are buried under 1-3 feet of mineral soil, tules and other wetland vegetation may be able to grow normally on the restored surfaces. Vegetation over shallower soils may be limited by competition for nutrients with organisms decomposing rice straw in the shallow soil. Decomposing rice straw could also increase DOC or other undesirable water quality constituents. This hypothesis could be tested through a pilot project using rice straw to rebuild subsided surfaces as a substrate for restored marsh.

10. **Deep non-tidal ponds could provide breeding ponds for the extirpated Sacramento perch.** Sacramento perch were once common in the Delta but were extirpated in the last century due to loss of habitat and predation by exotic fish such as bass. Non-tidal ponds managed to exclude predators could provide excellent breeding habitat. Raised perch could be used to control mosquitoes and potentially repatriate perch where habitat conditions are favorable.

8.0 EXPERIMENTAL DESIGN

The Dutch Slough project will be constructed and managed to test the hypotheses described above and new hypotheses that may be generated as the project evolves. The overall project will be configured to test a limited number of hypotheses regarding the role of marsh plain elevation and scale (fish hypotheses 1-5 and water quality hypotheses 1, 3, and 4 above) but smaller experimental plots may be established within the larger project to test hypotheses relating to a range of factors including but not limited to subsidence reversal, exotic species management, dissolved organic carbon formation, mercury methylation, and avian habitat (Table 2).

Figure 10 depicts the experimental design recommended by the AMWG and shows several different marsh plots of varying sizes and elevation. Hypotheses regarding the role of marsh plain elevation and scale will be tested by comparing how the different parcels affect factors such as native fish growth and survival, primary productivity, and methylmercury production and export. Hypotheses regarding subsidence reversal, managed wetlands, or submerged aquatic vegetation can be tested in the areas labeled open water on the north end of the three parcels. The role of creeks and fluvial processes in tidal marshes could be tested by restoring a natural delta for Marsh Creek as depicted in Figure 11.

8.1 Marsh Plain Elevation and scale

The marsh plain and channel configurations of the Gilbert and Burroughs parcels (Figure 10) will allow scientists to test the adaptive management hypotheses related to marsh plain elevation and spatial scale. These experiments will compare low marsh and mid marsh areas drained by large channel networks (approximately 80 to 90 acres), medium sized channel networks (approximately 30 to 40 acres), and small networks (approximately 10 to 15 acres). Paired sampling of low and mid marsh will 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) will 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 will be drained by one breach to Little Dutch Slough. As possible, the channels draining paired sample areas will be located equidistant from the mouth of Little Dutch Slough and designed to have similar hydraulic properties. For example, breach channels will 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 will be defined by high marsh drainage divides, which will 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 will 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 will 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.

Figure 10: Preferred experimental, conceptual design for the Dutch Slough Project.

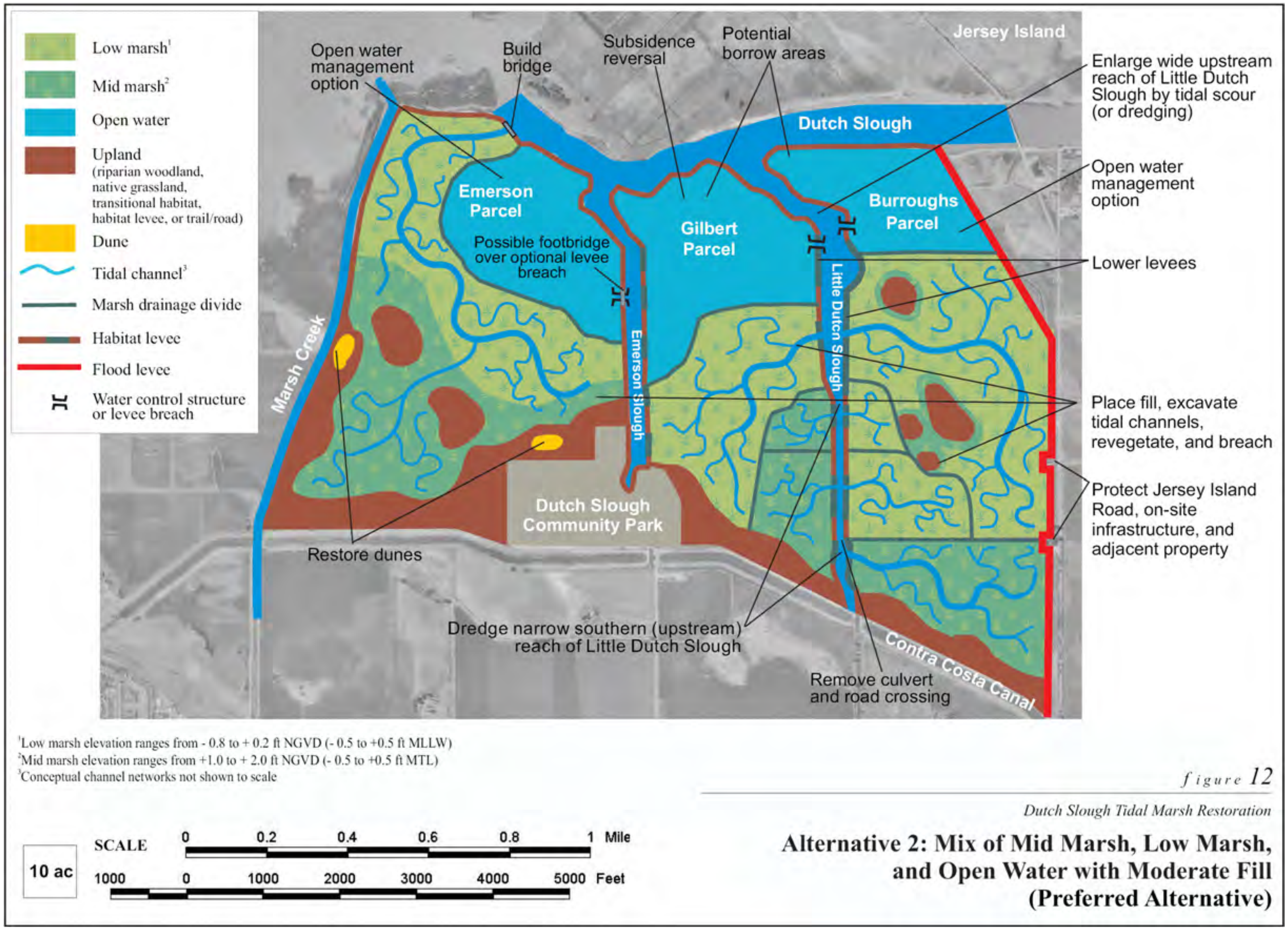
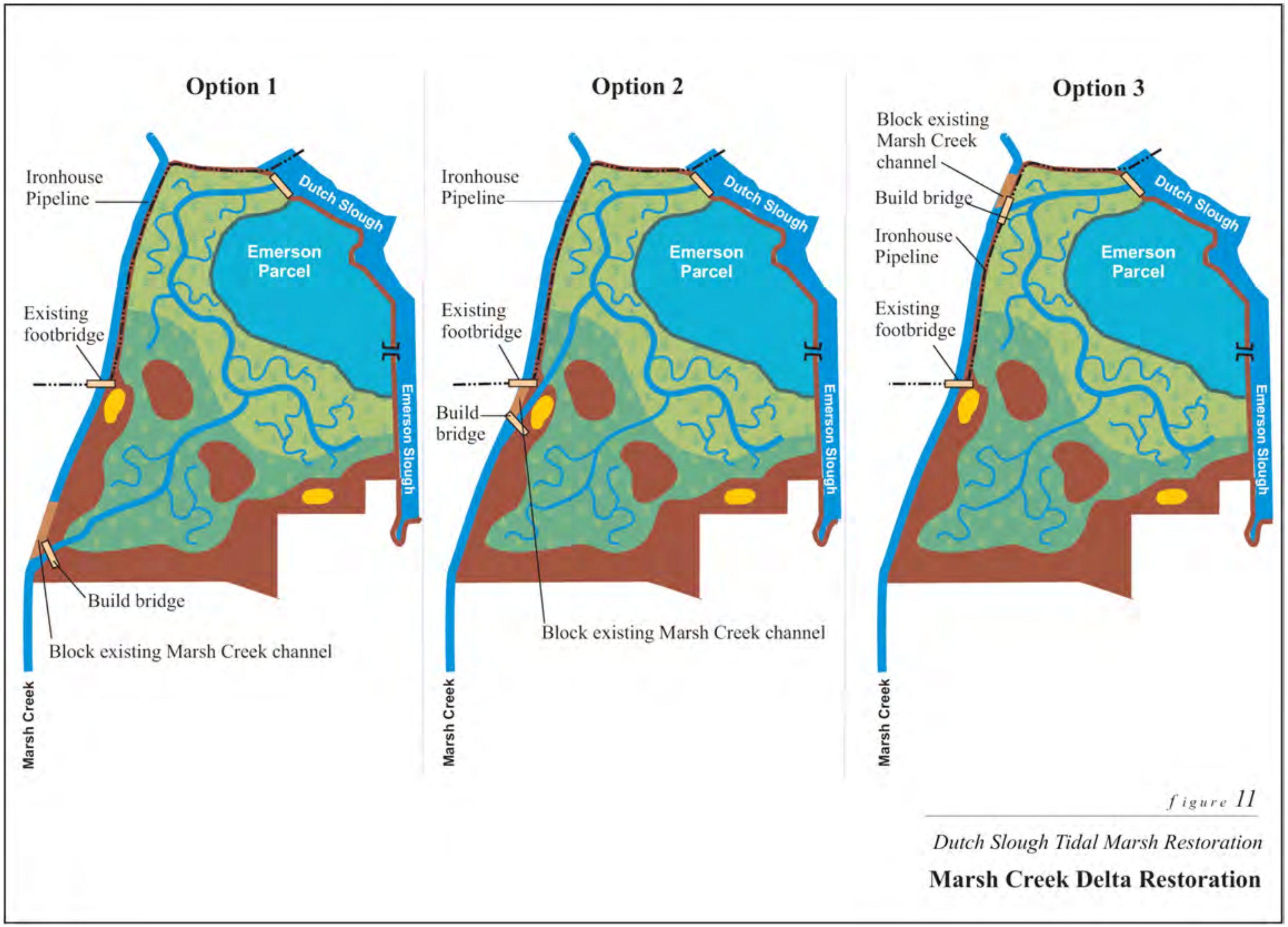


Figure 11: Adaptive management options for restoration of Marsh Creek delta on Emerson Parcel



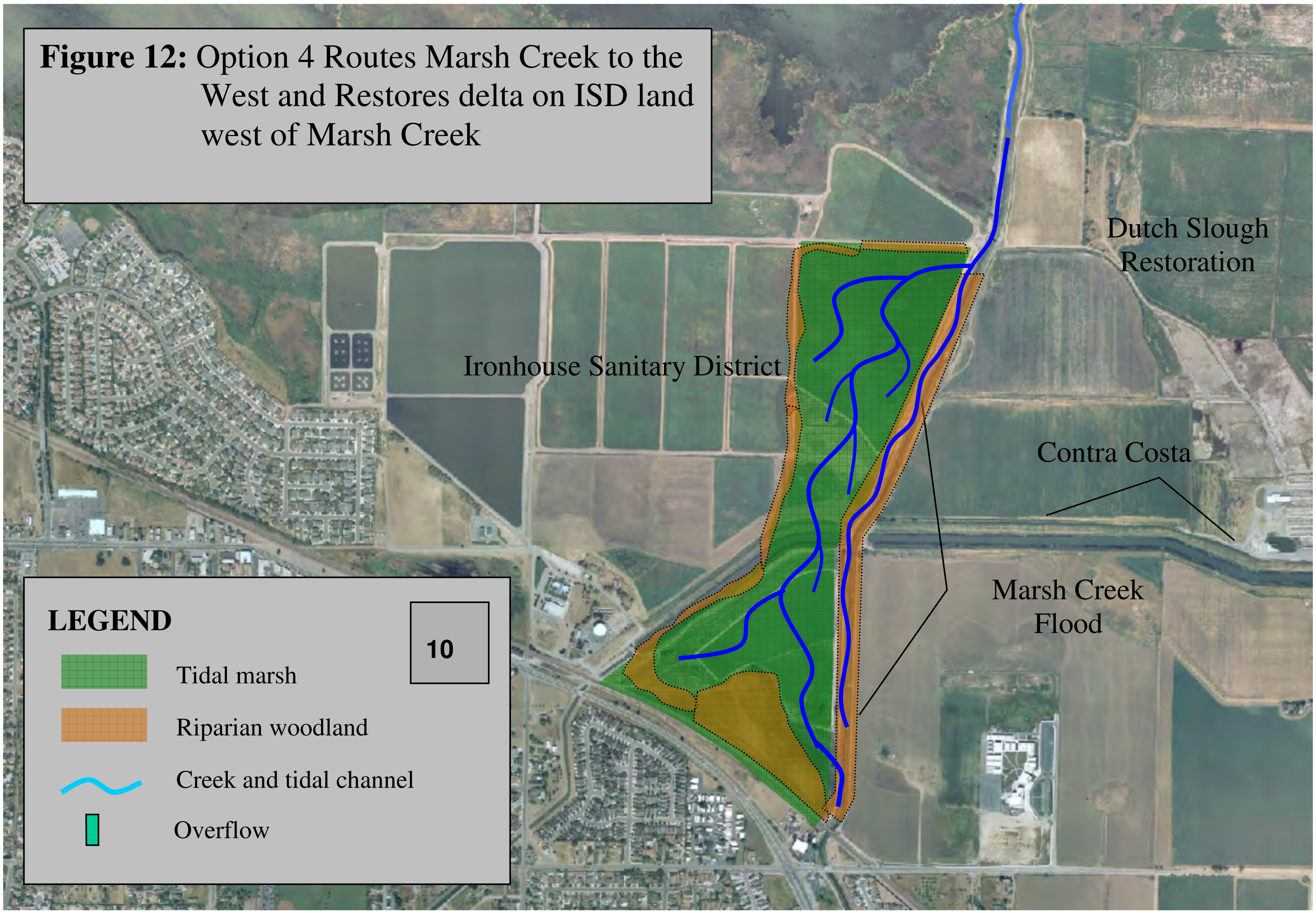


Figure 12: Option 4 Routes Marsh Creek to the West and Restores delta on ISD land west of Marsh Creek
Ironhouse Sanitary District
Dutch Slough Restoration
Contra Costa
Marsh Creek Flood
LEGEND
10
Tidal marsh
Riparian woodland
Creek and tidal channel
Overflow

8.2 Subsided Land Management

The "open water" areas on the northern portion of each parcel in figure 10 are not proposed for tidal marsh restoration at this time due to cost considerations associated with raising these subsided lands to sea level in the short-term. These areas will not necessarily be managed as open water, but rather may be managed to test a range of options for managing subsided lands including subsidence reversal, carbon sequestration, open water habitat, managed waterfowl habitat, or native submerged aquatic vegetation habitat.

8.3 Marsh Creek

Restoration of a natural delta on Marsh Creek would enable managers to evaluate the effects of creek deltas on tidal marsh function. Creek deltas periodically deposit pulses of sediment on their delta burying established marsh, triggering primary succession of new vegetation, and creating a diverse mosaic of habitat and hydrologic patterns. Comparison of the tidal marsh parcels on the Burroughs and Gilbert Parcels with the restored delta of Marsh Creek could generate important information regarding the role of fluvial geomorphic disturbance events or habitat diversity on water quality and species utilization.

Restoring a natural delta at the mouth of Marsh Creek, however, could result in water quality or flood management impacts. In early phases of the project, water quality and sedimentation patterns in Marsh Creek will be monitored to determine the best strategy for restoring a delta at the mouth of Marsh Creek.

The AMWG identified four potential strategies for restoring a delta on Marsh Creek three of which are illustrated in figure 11. They are:

- Diverting Marsh Creek onto the Ironhouse Sanitary District immediately downstream of the railroad crossing (Figure 12).
- Diverting Marsh Creek on to the Emerson parcel immediately downstream of the Contra Costa Canal.
- Diverting Marsh Creek on to the Emerson parcel immediately downstream of the Contra Costa Canal.
- Diverting Marsh Creek on to the Emerson parcel near the northern boundary of the Emerson parcel.

It may make sense to divert Marsh Creek onto the restored marshes at more than one of these locations.

9.0 PHASED IMPLEMENTATION

The Dutch Slough project implementation will be phased to facilitate adaptive management and construction. Large areas of tidal marsh will be restored to all three parcels simultaneously to facilitate comparison of the different tidal marsh restoration treatments, but construction will be phased leading up to full scale tidal marsh allowing managers to incorporate new information into final tidal marsh restoration. Phased implementation will also allow managers to gather information that will inform future decisions regarding restoration of Marsh Creek and the subsidence management on the northern portion of each parcel.

The project phasing approach described below is not a rigid prescription for how the project will be constructed, but rather as an illustration of how early phases of the project could inform later phases of project development.

Phase I: West Marsh Creek Grading and Restoration and Dutch Slough Levee Improvements

Phase I could include the following elements:

1. *Base-line monitoring program.* The base-line monitoring program should include the following elements:
    a. Continue bi-annual bio-sentinel monitoring in Big Break, lower Marsh Creek, and Emerson Slough to determine trends in mercury levels in fish (Slotton).
    b. Periodic (semi-annual) wildlife monitoring programs on Dutch Slough parcels following protocol used in first round of monitoring by DWR.
    c. Establish new Interagency Ecological Program monitoring station at confluence of Dutch Slough and Emerson Slough to measure trends in fish abundance and distribution, hydrodynamics, and water quality.
    d. Geomorphic monitoring of Marsh Creek to measure sedimentation and changes in channel cross section or bed elevation.
    e. Continue monitoring water quality in Marsh Creek to identify water quality problems and trends to determine whether remedial actions are needed upstream to protect Delta waters or whether it would be beneficial to divert Marsh Creek onto the ISD or Dutch Slough restoration areas. Details of the water quality monitoring plan including exact parameters to be measured will be informed by the existing Marsh Creek monitoring program (appendix) as well as results of related programs such as the mercury biosentinel monitoring program being conducted by the UC Davis mercury group.

2. *Upland vegetation management and monitoring to limit invasive weeds*. The purpose of this element is to assure that the site is not overwhelmed by exotic weeds in the transition from grazing to tidal marsh restoration. The primary concern is establishment of invasive species above the high tide level such as pepper grass. Invasives that become established below the mean tide elevations prior to tidal inundation will most likely not survive tidal inundation. Therefore, this activity should focus on management practices to limit establishment of weedy vegetation on the upland portions of the site (>3 NGVD).
3. *Grade 100-acre area west of Marsh Creek and deposit material on the Dutch Slough parcel for marsh restoration and levee improvements*. Borrowing fill material from Ironhouse Sanitary District (ISD) land west of Marsh Creek is the least cost option, and perhaps the only option for obtaining fill material to construct the preferred restoration design. This material must be excavated and placed on the Dutch Slough site before tidal restoration can occur and therefore must occur during an early phase of the project. Most of the material excavated from ISD lands will probably be deposited on the central and

northwestern portions of the Emerson Parcel. Phase 2 grading efforts will probably entail transporting material from the southwestern portion of the Emerson parcel to the Gilbert and Burroughs properties.

4. *Construct habitat levee section.* Use borrow from ISD or from on-site to enlarge levee toe berms and create a 5:1 or 10:1 interior levee slope that can eventually be vegetated to serve as a habitat levee. To prevent destabilizing the levee, it will take twoto three annual applications to build-up the toe berm.
5. *Restore 100-acre area west of Marsh Creek to tidal marsh*. Excavation of the ISD land west of Marsh Creek would create the opportunity for restoring tidal marsh west of Marsh Creek. Once the area is excavated to tidal elevations, the area could be tidally inundated in phase 1 or phase 2 by breaching the levee on Marsh Creek near the East Bay Regional Park District pedestrian bridge. Breaching the levee on the downstream portion of the site would allow tidal inundation without diverting flood flows and sediment onto the ISD parcel. Breaching the levee and restoring 100 acres of tidal marsh in phase 1 would provide an opportunity to monitor the restored site and gain information that could inform design and restoration of later phases of the project. During a later phase of the project, it may be beneficial to breach the levee on the upstream portion of the site to divert creek flows and sediment through the ISD parcel. Information on water quality and sediment loads collected during phase 1 will be used to determine if it would be beneficial to breach the upstream levee of Marsh Creek and route the creek through the restored site.
6. *Cultivate tules in selected areas.* Cultivate tules in areas that are already at elevations suitable for tidal marsh or areas that will be managed for subsidence reversal over the long-term provided that selection of tule cultivation areas does not interfere with large scale grading contemplated in phase 2. Widespread tule cultivation before the large-scale earthwork planned for phase 2 would be premature, but it would be advantageous to cultivate tules on areas that will not be graded in phase 2. These include areas that are already at design tidal marsh elevations or subsided areas that will not be elevated during phase II grading. During phase I, it may be worthwhile to grade berms to facilitate tule pond cultivation.
7. *Limited upland and riparian planting*: Plant areas and establish test plots in areas that will not be graded or disturbed in subsequent phases. Test plots can help establish the most effective planting strategies.

Phase II: Major Grading and Tule Cultivation

1. *Continue Baseline Monitoring Program. Monitor water quality in Marsh Creek.* Continue water and sediment quality monitoring in Marsh Creek to determine whether it would be beneficial to reroute Marsh Creek through restored tidal marsh on Dutch Slough or ISD.
2. *Monitor tidal marsh restoration site on ISD lands west of Marsh Creek.* Monitor site to evaluate success of restoration strategies with focus on tule establishment on subtidal elevations, persistence of small tidal channels, sedimentation patterns in Marsh Creek, and construction techniques particularly for tidal sloughs.
3. *Continue upland vegetation management and monitoring to limit invasive weeds*.
4. *Large-scale site grading:* Grade the site to tidal restoration elevations. This is the single most expensive implementation measure. It could occur in phase I if funds are available, but does not have to occur until phase II. Under this schedule, phase II grading efforts will

probably entail transporting material from the southwestern portion of the Emerson parcel to the Gilbert and Burroughs properties, while phase I grading will entail moving material from ISD to the north and central Emerson parcel.

5. *Widespread tule cultivation:* Once large-scale grading is completed, the site will be ready for wide-scale tule cultivation. At least one to two years of tule cultivation in sub-tidal zones may be necessary before tidal inundation of the site under the assumption that pre-cultivation of the tules will serve two critical functions: accelerating marsh plain accretion and discouraging colonization of non-native, invasive SAV. Monitoring data from ISD restoration site may help inform how long it takes for tules to become established.
6. *Riparian and Upland Vegetation Planting*

Phase III: Tidal Inundation

1. *Construct east levee parallel to Jersey Island Road:* This is one of the most expensive elements of the restoration project, but is not needed until a final decision has been made to restore tidal inundation on the Burroughs property.
2. *Grade tidal channels:* Grading tidal channels could either occur in phase II or in phase III. Since it will be difficult to grade desired, steep banked channels in mineral soil during phase II, it may be worth developing strategies for grading channels through non-tidal tule marsh on the assumption that established tule vegetation will help maintain vertical banks. This could be tested in phase I or II on the ISD parcel.
3. *Grade and vegetate levee segments*: Prior to tidal breaching, large portions of the levees will be graded down during the low water season to allow for greater connectivity between the restored tidal marsh and the existing tidal sloughs. To avoid uncontrolled flooding of the site, this step probably cannot be done until the summer before tidal breaching occurs.
4. *Breach Levees:* Breach levees and allow tidal inundation.

Phase IV: Long-term monitoring and adaptive management

10.0 Long-Term Adaptive Management Program

10.1 Future Decision Points

As implementation and monitoring proceed over the next 10-20 years, managers may need to make a half dozen key decisions including:

1. How best to treat subsided portions of the site: subsidence reversal or open water creation?
2. Where and whether to divert Marsh Creek onto restored tidal marsh?
3. Whether to manipulate tidal hydrology to minimize water quality impacts, if any?
4. Whether to aggregate smaller marsh areas into larger ones if larger ones are better?
5. Whether to raise the elevation of low marsh areas if mid elevation marsh areas perform better?

Managers will need to make decisions on the first issue in the next 2-3 years, while decisions on the subsequent issues could wait indefinitely.

Treatment of subsided lands: Should the subsided lands on the northern edge of the Dutch Slough site be managed as open water or for subsidence reversal and eventual marsh restoration? This decision should be made based on research priorities, capital costs, maintenance costs, ecological benefits, potential risks, and long-term sustainability. If managed as open water, the areas could provide opportunities for restoring native SAV habitat but could risk invasion by exotic species such as *Egeria densa.* Management as open water probably forecloses any future opportunity to restore these areas to tidal marsh. Management for subsidence reversal will not provide estuarine fish habitat in the next 20 years, but promises to restore a sustainable habitat for estuarine fish.

Diversion of Marsh Creek: Diversion of Marsh Creek onto restored marshes on either Emerson or ISD parcels would allow for the restoration of a natural delta at the mouth of Marsh Creek, but could degrade habitat quality on the restored marsh with polluted water or increase flood risk on lower Marsh Creek due to sediment deposition. These issues need to be monitored and analyzed further before diverting Marsh Creek to create a natural delta.

Manipulate tidal hydrology to minimize water quality impacts: Several water quality hypotheses identified above suggest that water quality impacts may be greatest at lowest tides when the marsh fully drains. If these impacts materialize and are serious, it may be worthwhile to consider installing water control structures to limit drainage of the marsh during extreme low tides.

Aggregate small marshes into larger marshes: If large marshes prove to be far more beneficial for fish then small marshes, it may make sense to aggregate the marsh cells into one or more larger marsh areas. This would require blocking the mouths of the small marshes and then connecting them to larger marshes by excavating a new tidal channel between the small marsh and neighboring larger marshes. During the detailed design phase, the tidal slough planform should be designed to facilitate future connection of neighboring marshes.

Raise low marsh to mid elevation marsh: If mid elevation marshes prove to be far more beneficial for fish then low marshes, it may make sense to raise the low marsh. The most plausible technique for raising low marsh would be to slurry or spray clean dredged materials onto the marsh surface. This could be done all at once or over a period of years. The regulatory issues associated with altering wetlands with sediment may prohibit raising the marsh.

10.0 References Cited

Atwater, B.F. 1982 Geologic maps of the Sacramento-San Joaquin Delta, California. U.S. Geological Survey MF-1401, Menlo Park, CA.

Bay Institute, The. 1998 The Sierra to the Sea. San Rafael, California.

CALFED Bay Delta Program, 2000. Strategic Plan for Ecosystem Restoration.

CALFED Bay Delta Program, 2000 a. Ecosystem Restoration Program Plan: Volume 1 – Ecological Attributes of the San Francisco Bay-Delta Watershed.

CALFED Bay Delta Program Mercury Project Technical Review. Summary Evaluation CBDA Project Workshop April 23-25, 2007.

CALFED Ecosystem Restoration Program, 2008. Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) Conceptual Models.

Reed, D. and DiGenero, B. Report of the Delta Habitats Group CALFED ISB Adaptive Management Workshop 19-20 March 2002. Included as appendix B in this report.

Simenstad C, Toft J, Higgins H, Cordell J, Orr M, Williams P, Grimaldo L, Hymanson Z, Reed D. 2000. Sacramento-San Joaquin Delta breached levee wetland study (BREACH). Preliminary report. Seattle (WA): Wetland Ecosystem Team, University of Washington, School of Fisheries.

Slotton, D.G., Ayres, S. M., Weyand, R. CBDA Biosentinel Mercury Monitoring Program. May 29, 2007.

Ye, Donald; Collins, J.; Grenier, Letitia. Mercury and Methylmercury Processes in North San Francisco Bay Tidal Wetland Ecosystments – CALFED ERP02D-P62 Annual Project Report 2006.

Appendix A: Dutch Slough Tidal Marsh Restoration Project Goals and Objectives

Dutch Slough Tidal Marsh Restoration Project

The following list of implementation commitments, goals, and objectives is a work in progress that reflects the comments of the management team, the restoration committee, and the Adaptive Management Working Group. The purpose of this draft document is to develop consensus regarding the specific objectives of the project and communicate those objectives to the project consultants. Future drafts may be necessary to explain these detailed objectives to the general public.

Goals

1. Provide shoreline access, educational and recreational opportunities.

2. Benefit native species by re-establishing natural ecological processes and habitats

3. Contribute to scientific understanding of ecological restoration by implementing the project under an adaptive management framework.

Implementation Commitments

1. Avoid, measure and mitigate degradation of drinking water quality.
2. Minimize the potential for mercury methylation and other water quality impacts.
3. Minimize the establishment of nuisance species through design and management.
4. Design and manage project to minimize negative affects on public health, such as limiting conditions that promote the production of mosquitoes and associated diseases.
5. Avoid and/or mitigate impacts to existing infrastructure and easements on the project site.
6. Maintain existing flood protection on neighboring properties.

Draft Objectives

Goal 1: Provide shoreline access, educational and recreational opportunities

A. Provide and expand public access that is safe and consistent with the ecological goals of the project.
   1. Open trail around Emerson levee
   2. Create a 55-acre community park
   3. Provide public access to the Delta shoreline

B. Create educational opportunities compatible with wildlife and habitat goals.
   1. Create signage to educate public about restoration project
   2. Build wildlife viewing platforms
   3. Involve schools and community groups

C. Create recreational opportunities compatible with wildlife and habitat goals.
   1. Build non-motorized boat launch
   2. Create swimming opportunities for the public
   3. Create opportunities to canoe and kayak

Goal 2: Benefit native species by re-establishing natural ecological processes and habitats

A. Reestablish hydrologic, geomorphic, and ecological processes to sustain native habitats and the species that depend upon them.

   1. Reestablish tidal channels to the site for exchange of water, sediments, and nutrients.
   2. Contribute to primary productivity of the Suisun Marsh and San Francisco Bay through export of nutrients.
   3. Create food supply for target species identified in table 1.
   4. Seasonally inundate high marsh plain for spawning and rearing by Sacramento Splittail.
   5. Re-route Marsh Creek, if feasible, to reestablish a supply of natural freshwater flows and fluvial sediments to the site.

B. Restore a mosaic of wetland and upland habitats.

   1. Restore large areas of tidal emergent marsh and tidal channels. <invasives addressed separately in objective 2C below>
   2. Expand shaded riverine aquatic habitat along the sloughs and Marsh Creek.
   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.
   4. Create natural gradients between uplands and wetlands for the restoration of biologically rich transitional habitats (ecotones).
   5. Restore a dynamic, natural creek delta at the mouth of Marsh Creek, if feasible

C. Contribute to the recovery of endangered and other at-risk species and native biotic communities.
    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. (see Table 1 for list of tier 1, 2, and 3 species)

D. Minimize establishment of and reduce impacts from non-native invasive species.
    1. Design and manage the project to minimize the introduction of feral animals.
    2. Design and manage the project to minimize potential for establishment of non-native submerged aquatic vegetation (e.g. egeria densa).
    3. Design and manage to prevent colonization and establishment of arundo donax, pepper weed and Phragmites.
    4. Minimize human impacts to wildlife particularly nesting avian species..

Goal 3: Contribute to scientific understanding of ecological restoration by implementing the project under an adaptive management framework.

A. Establish technical review committees to review restoration design, management practices, and monitoring study design and results.

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

C. 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.

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

Table 1: Target Species for the Dutch Slough Restoration Project

	MSCS status	Fed. status	State status	CNPS status	Notes
Tier 1 Species					
Sacramento splittail *Pogonichthys macrolipidotus*	(R)	T	CSC		Fish. Spawning and rearing
Chinook salmon *Oncorhynchus tshawytscha*	(R)	varies	varies		Fish. Rearing habitat (all runs). Listing status varies by run.
Delta smelt *Hypomesus transpacificus*	(R)	T	CT		Fish. Spawning (questionable, need more research)
Antioch Dune Scrub species					Emphasis on community, not specific species
Tier 2 Species					
California black rail *Laterallus jamaicensis coturniculus*	(r)		CT/FP		Bird. Nesting Habitat
Giant garter snake *Thamnophis gigas*	(r)	T	CT		
Lange's metalmark *Apodemis mormo langei*	(R)	E			Butterfly. Antioch dune species
Western pond turtle *clemmys marmota*	(m)		CSC		Observed at lower Marsh Creek
Tri-colored black bird *Agelaius tricolor*	(m)		CSC		Bird. Observed at lower Marsh Creek
Yellow-breasted chat *Icteria virens*	(m)		CSC		Bird. Observed at lower Marsh Creek.
Western burrowing owl *Athene cunicularia hypugea*	(m)		CSC		
Mason's lilaeopsis *Lilaeopsis masonii*	(R)		R		Plant. Freshwater tidal marsh.
Delta tule pea *Lathyrus jepsonii* var. *jepsonii*	(r)			1B	Plant. Freshwater tidal marsh.
Suisun marsh aster *Aster lentus*	(R)			1B	Plant. Freshwater tidal marsh.
California hibiscus *Hibiscus lasiocarpus*	(m)			2	Plant. Freshwater tidal marsh.
Delta Mudwort *Limosella subulata*	(r)		R	2	Plant. Freshwater tidal marsh.

Sanford's Arrowhead *Sagittaria sanfordii*	(m)			1B	Plant. Freshwater tidal marsh.
Marsh skullcap *Scutellaria galericulata*	(m)			2	Plant. Freshwater tidal marsh.
Waterfowl					
Shorebirds and wading birds					
Tier 3 Species					
Long-billed curlew *Numenius americanus*	(m)		CSC		Bird. Observed on site.
White-tailed kite *Elanus leucurus*	(m)		FP		Bird. Observed on site.
White-faced ibis *Plegadis chihi*	(m)		CSC		
Northern harrier *Circus cyaneus*	(m)		CSC		Bird. Observed on site.
Shorebirds and wading birds					
Other Potential Tier 2 or 3 Species (need more research on habitat preferences)					
Sacramento Perch *Archoplites interruptus*	(r)				
Valley elderberry longhorn beetle *Desmocerus californicus demorphus*	(R)	T			
Curved-footed hygrotus diving beetle *Hygrotus curvipes*					Known from a single shallow muddy pool in Oakley area.
California red-legged frog *Rana aurora draytonii*	(m)	T	CSC		
Western spadefoot toad *Scaphiopus hammondii*	(m)		CSC		
Silvery legless lizard *Anniella pulchra pulchra*			CSC		
Coopers hawk *Accipiter cooperi*	(m)		CSC		
Swainson's hawk *Buteo swainsoni*	(r)		CT		
Numerous Antioch dune insect species					

- R – recover species within ERP Ecological Management Zones. (r) – contribute to recovery of the species. (m) undertake action to maintain species.
- F – federal endangered. T – federal threatened. CT – state threatened. CSC – state species of special concern. FB – state fully protected. R – rare under California Native Plant Protection Act.

Appendix B: Report of the Delta Habitats Group CALFED ISB Adaptive Management Workshop 19-20 March 2002

Report of the Delta Habitats Group
CALFED ISB Adaptive Management Workshop
19-20 March, 2002

Prepared by
Denise Reed, ISB Adaptive Management Subcommittee
Bruce DiGennaro, Kleinschmidt

Introduction

The Delta Habitats Group was charged with developing an adaptive management experimental manipulation of delta habitat configurations. A large number of restoration actions are being taken or considered in the delta to restore or improve physical habitat, and many in the group had experience with design, construction or monitoring of these projects and the potential array of delta habitats.

The group began their deliberations with a brainstorming session on important types of delta habitats, their attributes and major uncertainties associated with their restoration. Suggestions for experimental habitat restoration were then put forward by individuals for discussion by the group. The three possible experiments considered were:

Concept 1. Provide floodplain habitat during dry season by opening all or part of Merritt, Sutter, or lower Grand Island, via gates or control structures, to allow inundation driven by tidal flow.

Concept 2. Create a large tidal marsh area by removing all or a significant portion of a delta island levee and grading the levee material onto the island. Material would be graded to create a gradual sloping land surface elevation from MLLW to something above EHHW at the opposite side of the island. The lower elevation (marsh) edge would front an active channel.

Concept 3. Provide dendritic tidal marsh habitat with attributes which will benefit native at-risk species, and discourage attributes (i.e., non-native SAV) that do not, while exploring the most effective ways to create such habitat across deltaic gradients

The group broke into 3 sub-groups to develop these ideas further and the results were presented back to the group for discussion. Concepts 1 and 2 were thought to provide promising ideas for further consideration and brief descriptions have been developed. The consensus of the group was that Concept 3 should be developed in more detail as an experiment. The approach to developing the experiment from the concept was to follow the adaptive management approach described in Chapter 3 of the ERP Strategic Plan (Final EIS/EIR Technical Appendix 2002).

This report includes a description the detailed experiment developed for concept 3 which has been reviewed and revised by the group. Short descriptions of Concepts 1 and 2 were developed from the breakout session notes and were reviewed and modified by the concept ‘champions’.

Delta Habitats Breakout Group

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Marina Brand, CA Department of Fish and Game
Jon Burau, U.S. Geological Survey
Larry Brown, U.S. Geological Survey
Gonzalo Castillo, US Fish and Wildlife Service
Mike Chotkowski, U.S. Bureau of Reclamation
Steve Culberson, CA Department of Water Resources
Michael Dege, CA Department of Fish and Game
Bruce DiGennaro, KleinSchmidt (Recorder)
Lenny Grimaldo, CA Department of Water Resources
Bruce Herbold, U.S. Environmental Protection Agency
Lisa Lucas, U.S. Geological Survey
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Marc Vayssieres, CA Department of Water Resources
Phil Williams, Philip Williams and Associates

Constructing Tidal Marshes with Dendritic Channels to Benefit Native Fishes: an adaptive management experiment.

A product of the
CALFED ISB Adaptive Management Workshop
19-20 March, 2002
Delta Habitats Group

Concept
One of the major underlying assumptions of many tidal marsh restoration projects is that shallow subtidal and intertidal habitat is a significant factor limiting at-risk species in the Sacramento-San Joaquin Delta. However, this assumption has not been tested for many of these species. In addition, there is uncertainty about whether tidal marsh restoration will result in even further intrusion of non-native submerged aquatic vegetation (SAV) that marginalize marsh function for fish and wildlife. This adaptive management experiment seeks to reduce uncertainty surrounding this issue by testing some hypotheses regarding the design and location of such habitat restoration, and by assessing species-specific responses. Specifically, this project addresses the development of tidal wetlands with minimal non-native submerged aquatic vegetation and the value of dendritic tidal channels as fish habitat. This experiment has been designed in accordance with the adaptive management framework promulgated by CALFED ERP as articulated in Figure 2-4 of the 1998 Strategic Plan.

Problem Statement and Goals
This restoration seeks to address the problem of decline in native fishes in the Delta. The reduction in quantity, quality and diversity of habitat for native fishes has likely contributed to the listing of several species that are found in the Delta during parts of their life cycles. The ecosystem approach to species conservation adopted by CALFED calls for sustaining and enhancing the fundamental ecological structures and processes that support the species. **Thus, the goal of this project is to provide dendritic tidal marsh habitat with attributes which will benefit native at-risk species, and discourage attributes (i.e., non-native SAV) that do not.**

Conceptual Model

The conceptual model underlying the design of this restoration experiment is the link between the decline in natural dendritic intertidal marsh habitat, which historically dominated the Delta (Atwater, 1980), and the decline in native at-risk species, including delta smelt, splittail, chinook salmon and steelhead rainbow trout utilizing the Bay-Delta. The presence of extensive dendritic intertidal marsh habitat at a time when native at-risk species maintained healthy populations implies that habitat restoration will likely benefit the native species that coevolved over the development of the historic Delta. However, this is only one part of the conceptual model used here. Indeed, current conditions in the Delta mean we must question the benefits of restoring these habitats may provide for the native species because of the extensive invasions of non-native species and water management activities. Recent studies (Grimaldo et al., 2002) note an association between subtidal areas, frequently dominated by SAV, and non-native fishes that consume native fishes, or may displace or out-compete them.

The conceptual basis for this project is outlined in Figure 1. The figure shows how the hydrodynamic characters and physiographic setting of various geomorphic features in the Delta provide appropriate conditions, or not, for extensive SAV development. As a consequence, it is also assumed that those features associated with dendritic tidal marsh habitat also provide important functions that benefit native fishes. Essentially, intertidal marshes with extensive dendritic channels drain regularly compared to subtidal areas and thus less likely to be dominated by SAV. However these habitats prove beneficial to native fishes only if it is directly accessible (i.e., access is direct and not via a dense SAV bed adjacent to the marsh and channel system). Thus an important landscape component of the conceptual model is that active distributary or slough channels also exhibit conditions that are unsuitable (too deep or too turbid) for SAV growth. The final element of the conceptual model to be tested and developed using this experiment is that we have the geomorphic understanding and engineering to establish conditions promoting the development of dendritic tidal marshes with the attributes just described.

Uncertainties

The adaptive management experiment will be designed to address several key uncertainties contained in the conceptual model described above:

- Will SAV colonize and persist in and immediately adjacent to a dendritic channel system adjoining an active distributary channel?
- What are the important characteristics of dendritic channels and adjacent marsh that benefit native fishes?
- What are the process linkages that lead to these benefits?
- Can tidal action alone develop and maintain dendritic channels?
- Can we cost effectively design and construct tidal marsh plain channel systems that are stable and sustainable in the long term (over decades)?
- What are fish responses to dendritic tidal marsh habitat in estuarine vs tidal riverine dominated systems?
- What is the relationship between marsh channel pattern, hydrodynamics, and marsh plain vegetation characteristics?

Hypotheses

The above uncertainties will be addressed by testing the following hypotheses:

1. SAV coverage and density are lower or absent in tidal channels with stronger tidal flows and sandier substrate types.
2. Marsh with complex dendritic channel system will provide a greater quantity and diversity of more food for fish, (e.g., benthic and pelagic, macroalgal and microalgal) compared to open subtidal habitats. This effect may be direct or indirect via the provision of food for prey (e.g., chironomids or copepods).
3. Fish reproduction, growth and survival depend on geomorphological characteristics of the marsh tidal channel system, specifically:

- Channel density (hypothesized positive relationship)
- Channel shape in cross-section (hypothesized positive relationship with steep side slopes)
- Channel order
  - Hypothesized negative relationship for growth; however, this may depend upon the strength of flow out of the dendritic channel system, e.g., higher order may actually provide better overall habitat because fish are not entirely forced out of the marsh at low tide, but SAV may occupy the higher order channel[s] if flow is not sufficient to suppress SAV growth.
  - Hypothesized positive relationship for reproduction where dewatering at low tide may impact fish eggs.
- The ratio of marsh edge to marsh area (hypothesized positive relationship)

4. Hydrogeomorphic setting and construction of tidal channel systems can be optimized to minimize the impact of SAV
   - Grading can be used to design and construct functional tidal channels
   - Sedimentation from adjacent rivers will hasten the development of a dendritic tidal channel system

Experimental Design

The essential elements of the experimental design used to test these hypotheses will involve using different approaches to the creation of dendritic tidal marsh habitat, and testing these approaches in two areas:

- the eastern Delta (close to a riverine source of sediment). Possible location: McCormack-Williamson Tract
- the western Delta (remote from direct supply of sediments from riverine sources but close to sediments mobilized and transported by waves and tides). Possible location: Chipps Island

These sites have been selected for the suitability of their current elevations. Within each area land will be selected which is not greatly subsided (< 4 ft. below mean sea level - an elevation shallow enough for lateral colonization by tules.) and allocated into 3 parcels of 200 acres or greater in size. This size is considered a minimum to achieve the development of a mature (e.g., 4^{th} order or greater) tidal channel network. Initial elevations must be sufficiently high that achieving tidal marsh elevations through natural sedimentation processes is likely, and higher elevation areas may be included in one of the treatments that require grading. If necessary, some material may be added to achieve the elevations necessary to complete the treatments. The parcels must exchange directly into a deep distributary channel that is unfavorable for SAV growth (too dynamic or too turbid).

Each of these parcels will receive a different experimental treatment:

Treatment 1—No Intervention

At this site, tidal action will be introduced to the parcel via a very wide levee ‘breach’. No further action will occur and the site will be monitored to assess performance relative to the measures described below.

Treatment 2—Fill to Appropriate Elevations

At this site, the land will be graded or filled to achieve an elevation in the intertidal range and tidal action will be introduced to the site in a manner similar to Treatment #1.

Treatment 3—Fill and Excavate Channels

At this site, land will be graded or filled, as in Treatment #2, but in addition a proto-dendritic (i.e., “starter”) channel system will be excavated to ‘kick-start’ the channel development process.

The replication of these treatments in each area will allow the experimental evaluation of the role of riverine vs. tidal sediment sources to bring elevations to appropriate levels (Treatment 1 – hypothesis 5) as well as allowing the testing of hypotheses 1, 2 and 3 across a range of delta salinity, turbidity and hydrodynamic conditions. Hypothesis 4 is tested through the comparison of the physical performance of the treatments within an area.

Performance Measurements

The active adaptive management nature of this experiment means that in order to meet the stated goal the project must achieve specific performance measures or changes will be made accordingly. Thus, it is proposed that these treatments should be assessed relative to these measures 5 years after project implementation. This should be enough time for dendritic channel formation to at least begin in treatments 1 and 2, and for some natural adaptation of the channels in treatment 3. In addition, it is likely that within 5 years the area in the eastern Delta will be subjected to at least a moderate flood, supplying riverine sediments to the treatments.

The performance measures are linked to the development and function of the dendritic channel system – the goal is not just to achieve a channel network but one with functions and use patterns that allow our hypotheses to be tested. In some cases these performance measures can only be assessed by comparing the treatment sites with adjacent reference areas (e.g., sluggish subtidal areas as described in Figure 1). Where this is the case monitoring measures (see below) must encompass not just the restoration sites but also appropriate reference sites.

1. Composition and coverage of SAV

   The coverage of SAV within the channel system must be less than coverage in sheltered subtidal areas close to the treatment. The composition of SAV that is present must include native species.
2. Development of channels

   Each treatment in each area must develop a dendritic channel network of at least a third order level within five years.
3. Net vertical sedimentation

   Treatments which were implemented below mean marsh plain elevation must show vertical accretion (via accumulation of organic matter and/or sediments) towards marsh plain elevation. Treatments which were implemented at marsh plain elevation must show elevation increase at a rate at least equal to relative sea-level rise.

4. Microalgal composition and production

   The benthic, epiphytic, and planktonic microalgal communities include high-quality food organisms for primary consumers (e.g., cryptophytes, certain diatoms, etc.). Such microalgal production in the restoration sites should be similar to (equal to or greater than) that found in adjacent sheltered subtidal channels and sufficient to support desirable consumer densities.

5. Reproduction, growth and survival of at risk native species

   Monitoring must show that reproduction, growth and survival of appropriate at-risk species within the treatment areas is equal to or greater than similar measures in adjacent sheltered subtidal channels.

Adaptive Management Measures

We recommend using the performance measures above to determine whether the project is progressing towards its stated goal within the five-year timeframe. If these measures are not met, contingency actions must be instituted to adjust the design/operation of this project, and to improve the design and operation of future tidal marsh restoration projects. Specifically, the key to this restoration action is the development of dendritic tidal channels without a significant presence of SAV. If Performance Measure #1 is not met five years after project implementation, the initial design specifications will be modified and the site reconfigured, e.g., marsh surfaces will be graded and sculptured to initiate channel development (similar to the approach proposed for Treatment #3). If channels are developing (e.g., measure #1 is being met) but Performance Measures #2-#5 are not met then this implies that the dendritic tidal channel habitat is not functioning as anticipated in the conceptual model (Figure 1). The reasons for this will likely be clear from the monitoring data (see below) and the testing of the hypotheses. Information derived from this monitoring maybe used to modify the conceptual model and structurally alter the channel systems to improve function, but unless clearly justified structural improvements can be made, it is recommended that the project be redesigned, rather than adapted from its original concept.

Monitoring to Reduce Uncertainty

The role of the monitoring program is threefold:

1. to provide data on project performance relative to the measures described above;
2. to provide data to test the stated hypotheses and thus reduce uncertainties surrounding the construction and use of dendritic tidal marsh habitat to benefit at-risk species; and,
3. provide direction for adaptive modifications to the experimental treatments that do not meet performance measures.

We recommend that the monitoring design for the project is both ‘process-oriented’ and examine the evolution of the sites and the resulting structure-process interactions. These sites must be viewed as "open" systems, both influencing and influenced by processes in adjacent and remote environments. Specific measurements should include:

- evaluation of physical structure and processes (geomorphic character, hydrodynamics, sedimentation);
- emergent plants (composition over time and coverage);
- submerged and floating plants (diversity, coverage, and change over time);
- organic carbon (OC) fractions (forms of OC produced within and exported from the sites);
- invertebrate use and change over time;
- benthic algae production
- occurrence of juvenile and small pelagic fishes;
- turbidity/light attenuation (i.e., because algal production is light limited);
- inorganic nutrients;
- spatial habitat complexity; and,
- fish response to various habitat components of the marsh.

In particular monitoring must evaluate what the fish are eating; where the food came from (local or imported); and, the base of the food source (e.g., epiphytes vs. benthic microalgae vs. phytoplankton). Such measures will be essential to determine the causal mechanisms behind the functional performance of the habitat for fish and ultimately what attributes of the habitat should be replicated in other habitat designs.

The detailed design of the monitoring plan should be undertaken by a monitoring team, including (at a minimum) an ecologist, engineer, and agency resource manager. The team would provide advice on monitoring and help with "adaptive modifications" of the monitoring program, as well as the restoration project itself. The team would also ensure monitoring is coordinated with other monitoring programs (in terms of procedures and protocols, timing), would take advantage of existing monitoring programs and data, and would be responsible for integrated reporting, analysis, and interpretation of data, ensuring a long-term commitment to monitoring. The team would also be responsible for communicating the results and interpretations to the CALFED, other scientists, and other interested entities.

Given the limited existing monitoring of tidal marsh habitats in the Delta, it may be necessary for the team to design an extra-intensive (high frequency) preliminary study to determine the appropriate time and space scales for sampling. Similarly, it might plan for periodic revisiting of extra-intensive sampling to evaluate the "evolution" of the marsh system over time (such as prior to the 5-year post-implementation evaluation). The identification of appropriate reference sites or sampling stations (e.g., to document non-project related changes in fish and/or SAV) should also be considered by the team in the context of existing monitoring programs.

It is essential that the monitoring program be integrated to link landscape changes and biological response (recognizing that the physical evolution of the landscape and the biology of the marsh go hand in hand) and that data be collected to address Hypotheses 1, 2 and 3 which specifically address these linkages. New technologies should also be considered that allow identification of critical system responses, such as aerial surveillance with multi-spectral sensing to detect biological responses (e.g., vegetation composition and landscape structure) to physical changes on a variety of scales, and "biomarkers" for determining carbon sources and pathways.

Results from the monitoring program should be reported annually and biennially a synthesis report should be produced, tracking project performance over time and testing the hypotheses posed here. In addition, presentations to the Bay-Delta restoration community and publication in peer-reviewed journals should be employed to inform restoration practitioners and managers. The ultimate goal should be to systematically reduce the uncertainties associated with the value of dendritic tidal marsh restoration in the Delta for at-risk native fishes.

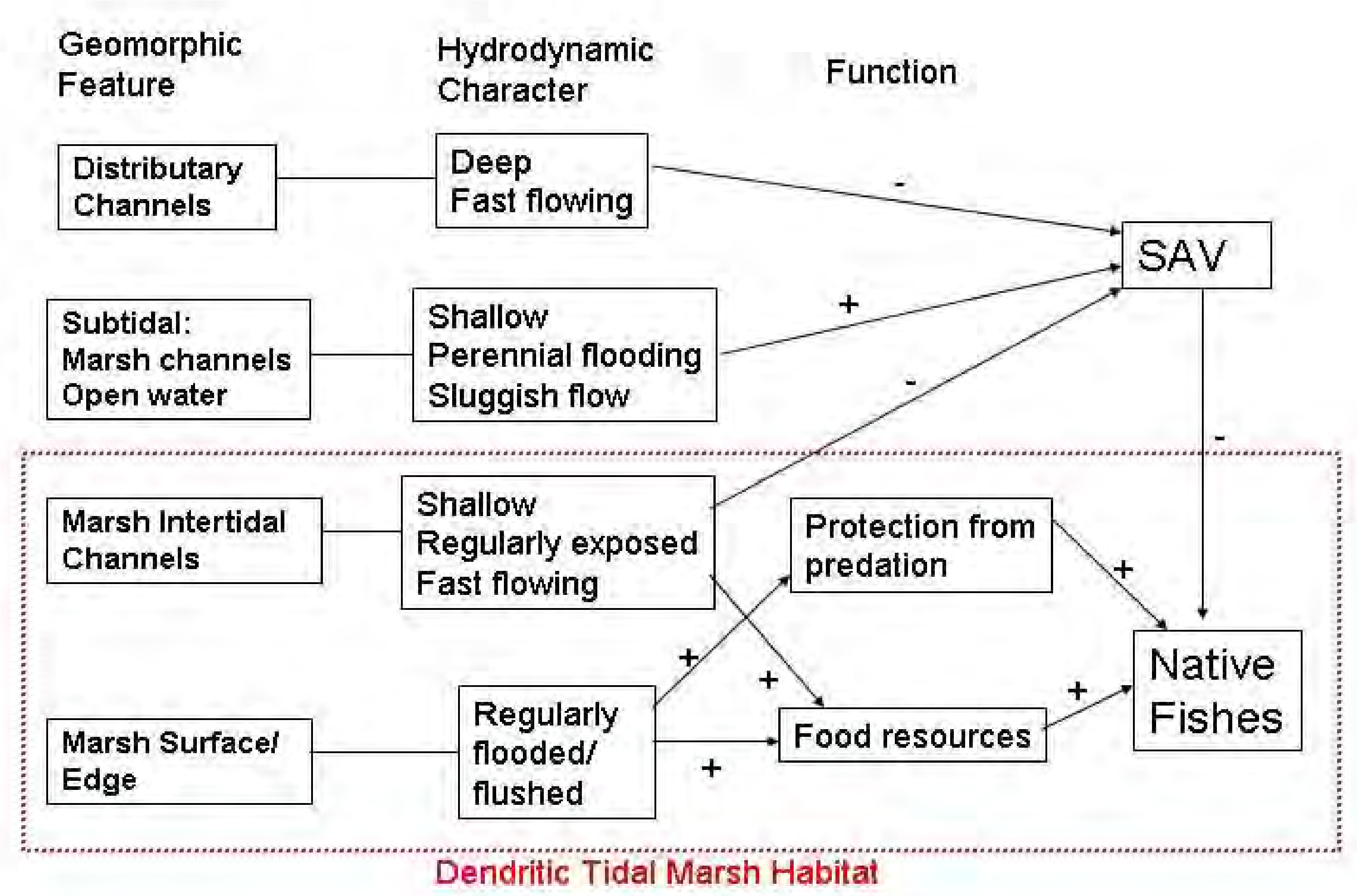

Figure 1. Outline of Conceptual Model relating geomorphic features to the success of native fish.

Additional Concepts for Delta Habitat Adaptive Management Experiments

A product of the
CALFED ISB Adaptive Management Workshop
19-20 March, 2002

Concept 1. Tidal/Seasonal Floodplain

Concept
Provide floodplain habitat during dry season by opening all or part of Merritt, Sutter, or lower Grand Island, via gates or control structures, to allow inundation driven by tidal flow.

Conceptual Model
Floodplain benefits that are lost in dry years or during dry seasons can be reproduced by tidal inundation.

Target Species
- Salmon, Steelhead, Splittail, Delta Smelt

Uncertainties
- What is the benefit of the Sutter or Steamboat Sloughs to target species?
- Can benefits of floodplain inundation be mimicked using tidal flows?
- If full drainage were not possible would benefits outweigh potential stranding?

Possible Later Stages
- Realign the opening of Sutter Slough to enhance movement into the opening
- Add more acreage
- Open Sacramento River into slough above Merritt Island.

Concept 2. In-Delta Levee Removal and Grading

Concept
Create a large tidal marsh area by removing all or a significant portion of a delta island levee and grading the levee material onto the island. Material would be graded to create a gradual sloping land surface elevation from MLLW to something above EHHW at the opposite side of the island. The lower elevation (marsh) edge would front an active channel.

Conceptual Model
Development of large tidal marsh area in the delta would provide important missing habitat and ecological processes that would benefit at risk native species. Marsh edge facing active channel would not support significant Egeria habitat.

Target Species

- Salmon, Steelhead, Splittail, Delta Smelt

Constraints

- Subsidence
- Sufficient levee material
- Low fetch
- Active channel with suspended bedload

Uncertainties

- Active channel erosion (creating egeria habitat)
- Extent and change in unvegetated and emergent vegetation in intertidal area
- Non-native clam colonization
- Fish use
- Development of tidal channel system(s)
- Wave fetch

Hypotheses

- Egeria will not colonize intertidal and active channel edge.
- Native at risk fish species will benefit from intertidal area (refuge, prey resources, spawning).
- Higher density of primary producers and benthic-pelagic coupling.
- Alien clam colonization less than on "reflooded" islands.
- Reducing residence time of water-borne contaminants (vs. flooded islands).

Performance Measures (relative to reference)

- Egeria colonization
- Short-term growth of fish
- Empirical measures coupled to bioenergetic modeling
- Predation on key fish species
- predation rates
- predator presence/abundance
- Fish residence time (interrelated to growth measures)
- Non-native clam colonization
- Benthic primary production and water column (microalgal, macroalgal, emergent/riparian)
- Transfer of autochthonous primary production to upper trophic levels
- Reproduction – Delta Smelt eggs
- Splittail eggs and rearing
- Erosion/sedimentation

Appendix C: Excerpts from the Dutch Slough Conceptual Plan and Feasibility Study

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MEMORANDUM

TO: Dutch Slough Restoration Project Management Team

FROM: Nick Garrity, Michelle Orr, and Philip Williams; PWA (Philip Williams & Associates)
With Bruce Herbold, EPA, and Charles Simenstad, University of Washington

DATE: May 4, 2006

RE: **Dutch Slough Tidal Marsh Restoration Conceptual Model**

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1. SUMMARY

This memorandum documents the Dutch Slough Tidal Marsh Restoration Conceptual Model and describes how the conceptual model informs large-scale adaptive management experiments in the Dutch Slough Tidal Wetland Restoration project. The memorandum describes the adaptive management context for the restoration project (Section 3), the conceptual model for freshwater tidal marsh restoration (Section 4), key uncertainties identified in the conceptual model (Section 5), hypotheses for the large-scale experiments for marshplain elevation and marsh scale (Section 6), and experimental design considerations for these large-scale experiments (Section 7).

The large-scale adaptive management experiments for marshplain elevation and marsh scale are intended to test the response of special status native fish to different methods of wetland restoration and to inform restoration design, including cost-effectiveness, for future Delta restoration projects. The hypothesis for the marshplain elevation experiment is that lower elevation marshes produce greater prey resources for juvenile salmon and splittail than higher elevation marshes, and thus greater potential for feeding, growth, and survival. The hypothesis for marsh scale is that tidal channel networks in larger marshes provide greater refuge from predation than in smaller marshes, and thus greater survival opportunities for juvenile salmon and splittail.

The Dutch Slough project includes small-scale and water quality adaptive management experiments, which are not described in this memorandum. These additional experiments are planned as part of the Dutch Slough project and will be described in the Dutch Slough Tidal Marsh Adaptive Management and Monitoring Plan (NHI, in progress) or developed in future phases of the project.

2. INTRODUCTION

The Dutch Slough Tidal Marsh Restoration is being planned by the California Department of Water Resources (DWR), the State Coastal Conservancy (SCC), the City of Oakley, and the California Bay-Delta Authority (CBDA) (who collectively form the Dutch Slough Management Team). DWR is the land owner, having purchased the site in 2003 with funds from CBDA and the SCC. The SCC is leading the restoration planning with assistance from the Natural Heritage Institute (NHI) and the PWA (Philip

Williams & Associates) consultant team. The PWA consultant team developed the Dutch Slough Tidal Marsh Restoration Conceptual Plan and Feasibility Study (Conceptual Plan and Feasibility Study) (PWA and others, 2006). An Adaptive Management Work Group (AMWG) provided scientific input to the Dutch Slough conceptual restoration plan. AMWG members (listed in Section 8) include agency and university scientists and local restoration practitioners.

One of the goals of the Dutch Slough restoration project is to contribute to scientific understanding of ecological restoration by implementing the project under an adaptive management framework. The AMWG, Dutch Slough Management Team, and PWA consultant team developed the Dutch Slough Tidal Marsh Restoration Conceptual Model (Dutch Slough Conceptual Model) to guide the adaptive management process. NHI is coordinating the AMWG and is developing the Dutch Slough Tidal Marsh Restoration Adaptive Management and Monitoring Plan (Adaptive Management and Monitoring Plan) (NHI, in progress).

The Dutch Slough Conceptual Model is based on the CALFED (2000) adaptive management process and guidance on developing conceptual models. CALFED's Strategic Plan for Ecosystem Restoration describes conceptual models as follows:

> Many resource managers, scientists, and stakeholders interested in the restoration and management of the Bay-Delta ecosystem have implicit beliefs about how the ecosystem functions, how it has been altered or degraded, and how various actions might improve conditions in the system. That is, they have simplified mental illustrations about the most critical cause-and-effect pathways. Conceptual modeling is the process of articulating these implicit models to make them explicit. (CALFED, 2000)

This memorandum documents the Dutch Slough Conceptual Model in its current state of development. The conceptual model is expected to evolve with continued input from the AMWG and through the adaptive management process, and is therefore a working document. As described by CALFED (2000), "conceptual models are based on concepts that can and should change as monitoring, research, and adaptive probing provide new knowledge about the ecosystem."

The large-scale adaptive management experiments are designed to test hypotheses that predict the response of special status native fish to different methods of wetland restoration. Providing habitat for special status native fish species was the key objective of the adaptive management program that drove development of the large-scale adaptive management experiments. The conceptual model documented in this memorandum focuses on special status native fish species.

Conceptual models for other elements of habitat restoration (in addition to habitat for special status native fish) and for other project elements (e.g., bioaccumulation of methylmercury) were developed and discussed as part of project planning. These conceptual models will guide the Dutch Slough restoration adaptive management program for elements of the restoration other than improving conditions for special status native fish. These conceptual models will be documented in the Adaptive Management and Monitoring Plan.

The conceptual model for special status native fish was developed during a series of meetings between the AMWG, the Dutch Slough Management Team, and the PWA consultant team. The CALFED Ecosystem Restoration Program Science Board provided feedback on a preliminary version of the conceptual model and adaptive management framework in a May 2004 meeting, and the Dutch Slough Sub-committee of the Science Board provided additional input in a May 2005 meeting.

3. ADAPTIVE MANAGEMENT CONTEXT

Adaptive management is the process of learning from restoration and management actions, then using this knowledge to inform and adapt future actions. Typically, these actions modify parts of a restoration that have already been implemented. Figure 1 from CALFED (2000) illustrates the steps in the adaptive management process.

Within the context of the Dutch Slough restoration, adaptive management also refers to informing actions for future restoration projects. This second type of adaptive management is sometimes referred to as "adaptive learning." Lessons learned at Dutch Slough are primarily intended to inform future restoration projects anticipated in the Sacramento-San Joaquin River Delta, but may also influence management actions at Dutch Slough after tidal restoration is implemented. The project will test different methods of wetland restoration, monitor the physical and ecological responses, and make these results available.

The process of adaptive management input to the design is as follows:

1. Define measurable ecological objectives. (These are discussed in Section 3 of the Conceptual Plan and Feasibility Study).
2. Articulate a conceptual model (or models) of the process linkages that explain how the restoration actions address the ecological objectives.
3. Identify key uncertainties in the conceptual model(s).
4. Articulate hypotheses for each of the key uncertainties.
5. Design experiments to test the hypotheses. (These are described in Section 7 of the Conceptual Plan and Feasibility Study and will be detailed in the Adaptive Management and Monitoring Plan.)
6. Implement a monitoring and adaptive management plan for the experiments and the restoration project. (This is in progress and will be documented in the Adaptive Management and Monitoring Plan.)

Adaptive management is an iterative process. Once monitoring results are available (from Step 6), the adaptive management process circles back to reassess the objectives (Step 1) and conceptual models (Step 2), etc. Steps 2 – 4 are described in this memorandum. Experimental design considerations (related to Step 5) for the large-scale experiments are also discussed. The Dutch Slough adaptive management process embedded within the overall restoration plan is more fully described in a draft memorandum to the AMWG (Cain, 2004) and will be documented in the Adaptive Management and Monitoring Plan.

4. CONCEPTUAL MODEL

4.1 Overview

This memorandum documents the conceptual model for growth, survival, and spawning of three special status fish species identified as “tier 1” target species for the project: Sacramento splittail (*Pogonichthys acrolipidotus*), Chinook salmon (*Oncorhynchus tshawytscha*) and Delta smelt (*Hypomesus transpacificus*) (see Conceptual Plan and Feasibility Report Appendix A).

The Dutch Slough Conceptual Model used a previous conceptual model by the Delta Habitats Group (Attachment B) as a starting point and the structure of Level 3 of the PSNERP (2006) conceptual model, developed for use in Puget Sound. In the Dutch Slough Conceptual Model, restoration actions are linked to ecological outcomes in cause-and-effect relationships. The conceptual model focuses on controllable actions at Dutch Slough. Other factors not directly related to the Dutch Slough restoration also affect outcomes, such as freshwater flows, Delta pump operations, water contaminants, fisheries management, or new introduced species. For clarity and simplicity, however, these factors are not included in the Dutch Slough Conceptual Model.

The Dutch Slough Conceptual Model consists of an overarching general conceptual model and more detailed, operational conceptual models for the large-scale experiments. Elements of the general conceptual model are organized into the categories (Figure 2):

- Restoration Actions
- Physical and Vegetative Processes
- Habitat Structures
- Ecological Processes
- Functional Response
- External Factors

The AMWG articulated detailed linkages among different elements of the conceptual model (see Attachment A1). Many of the linkages between processes and categories in the conceptual model are self-explanatory. This memorandum does not provide detailed descriptions of each linkage. Rather, this memorandum focuses on the key linkages between restoration actions with habitat structures that received the most discussion in developing the conceptual model.

4.2 Restoration Actions

Restoration actions are required to recreate freshwater tidal marsh on leveed sites in the Delta that are presently subsided. These restoration actions allow physical and vegetative processes to occur and create habitat structures. Restoration actions are required because natural processes that formed ancient and historic freshwater tidal marshes over the last 10,000 years in the Delta are not expected to restore marsh habitat structures on a restored (or restoring[1]) subsided site within the desired timeframe.

Restoration actions at Dutch Slough include: filling and grading marsh areas, excavating channels, managing or planting vegetation to favor native plant establishment (re-vegetation), diverting Marsh Creek, and breaching levees. Natural physical and vegetative processes include: sediment deposition and biomass accumulation (accretion), erosion, tidal inundation, vegetation colonization, and heating/cooling. Restoration actions and physical and vegetative processes create and interact with the following habitat structures: vegetated marshplain, tidal channels, subtidal open water, floodplain, riparian, upland and transition, soil profile and chemistry, and water chemistry. Key processes and habitat structures are discussed below.

4.3 Physical and Vegetative Processes

Generally, the physical processes part of the conceptual model predicts few significant geomorphic changes within several years to one or two decades after the site is constructed. Unlike its restoration counterparts in the more saline and sediment-rich parts of the estuary (San Francisco Bay) where sedimentation rates are higher, Dutch Slough is expected to experience slow rates of sedimentation in shallow subtidal and marshplain habitats, and likely limited formation of tidal channels through tidal scour. To achieve restoration and adaptive management goals within the planning horizon, it is therefore necessary to create restored marshes with features similar to equilibrium marshplain elevations and tidal channel networks, rather than relying on the evolution of equilibrium conditions through natural physical processes, in order to achieve the project goals within the planning horizons for restoration and adaptive management (50 years and from several years to one or two decades, respectively, as discussed in Section 7 of the Conceptual Plan and Feasibility Report). Constructed restoration features are expected to persist and evolve slowly over at least the next decade.

Physical and vegetative processes for the San Francisco Bay Estuary are generally described in Orr et al. (2003), Reed (2002), Simenstad et al. (2000), Atwater and Belknap (1980), and Atwater et al. (1979), and Gilbert (1917). Much of the discussion that follows is based on Orr and others (2003) and Simenstad and others (2000). The extensive freshwater tidal marshes of the Sacramento-San Joaquin River Delta formed gradually over the last 10,000 years as rising sea levels flooded former inland valleys at the mouth of the Sacramento and San Joaquin rivers (Atwater and others, 1979). Marshplain elevations kept pace with rising sea level (Atwater and Belknap 1980), building up peat and peaty mud through sediment deposition and biomass accumulation (peat formation). Minerogenic sedimentation was primarily in response to flood flows of the Sacramento and San Joaquin rivers and confined to the margins of their distributary channels. Distal from these internal deltas, organic-rich marshes began to accumulate (Atwater, 1982). These ancient and historic Delta freshwater tidal marshes are drained by intricate systems of sinuous and branching tidal channels. The predominant marsh vegetation type is tule *(Scirpus acutus, S. californicus*, and *S. americanus*), with cattails *(Typha* sp.) and common reed *(Phragmite* sp.) (Atwater and Hedel 1976).

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[1] The term "restoring" is sometimes used to indicate that restored marshes continually evolve.

Reclamation of delta wetlands – levee-building, ditching, and draining of lands primarily for agriculture – has caused subsidence through direct dewatering of the substrate and aerobic decomposition of organic material in marsh soils. Sediment supply to the delta has been highly modified by upstream activities, which include hydraulic mining, grazing, deforestation, marsh and floodplain reclamation, dam construction, and channel incision (Gilbert, 1917; Beeman and Krone, 1992; Wright and Schoellhamer, 2003 in Orr and others, 2003).

Accretion. Tidal marshplains sustain vertical growth (*i.e.,* accretion) through sediment deposition and organic biomass accumulation. Marshes in the Delta are sustained primarily by the accumulation of low density organic rich soils (typically 50% organic content) derived from surface vegetation growth (Atwater and Belknap, 1980; Atwater and others, 1979), and also fluvial and estuarine mudflat sediments, depending on the location within the Delta. Peat formation occurs as organic material is buried and accumulates beneath the water table, where decomposition is slowed under anaerobic conditions. Mineral sediments are transferred fairly efficiently through the system to Suisun and San Pablo bays.

Ancient and historic marshplain elevations kept pace with sea level rise at an equilibrium elevation of approximately MHHW through self-regulating accretionary processes (Atwater and others, 1979; Allen, 2000). Accretion above the MHHW elevation is limited by sea level rise and the decomposition of organic matter. Leveed former marshes such as the Dutch Slough site have subsided to elevations below mean sea level. When former leveed marshes are restored to tidal action by levee breaching, low elevation tidal areas are created where accretionary processes occur and are not limited by sea level rise. In subtidal areas below the vegetation colonization (see below), sediment deposition occurs; areas at intertidal elevations also accrete through biomass accumulation once vegetation is established.

Available empirical data on accretion in Delta marshes indicate that rates of sedimentation and biomass accumulation are slow compared to restoration timelines (Orr and others, 2003). Historic rates of accretion for natural (high elevation) marshes are limited by the rate of sea level rise (as high as 3 to 4 mm/yr at Brown's Island; Goman and Wells 2000). Limited data on long-term rates of accretion in restored (low elevation) marshes range from 9 – 18 mm/yr (at Sherman Lake, Lower Mandeville Tip, Mildred Island, and Frank's Tract; data from Reed, pers. comm., Simenstad and others 2000, and PWA unpublished). An ongoing study by the USGS to measure accretion in permanently flooded (managed) wetlands has found initial biomass accumulation rates of 26 mm yr -1 (with a wide variation) over a three-year period (Drexler and others, 2003); however, these rates are not expected to be representative of tidal conditions in restored marshes. Accretion rates may be limited by the extent of wave and current energy in exposed subtidal restored sites (Simenstad and others, 2000).

Vegetation colonization. Emergent vegetation colonization occurs in two ways: (1) pioneer colonization and (2) lateral expansion colonization. Pioneer colonization occurs by seed or deposition of vegetation fragments. Once vegetation becomes established, lateral expansion can extend lower in the tidal zone by extension of rhizomes. Higher elevation marshplains ("high marsh") are typically vegetated by a mix of plant species including common tule (*Scirpus acutus*), California bulrush (*Scirpus californicus*), common reed (*Phragmites communis*), spikerush (*Eleocharis* spp.), and narrowleaf cattail (*Typha angustifolia*);

whereas lower elevation marshplains ("low marsh") tend to be dominated by a monoculture of California bulrush (Simenstad et al, 2000; see Section 6.3 of the Conceptual Plan and Feasibility Report).

Note that while the terms "high" and "low" marsh are used here, the transition from high marsh to low marsh is not well defined. Morphologically-similar freshwater emergent marsh vegetation occurs over a range of intertidal elevations. Low marsh and high marsh are not generally-recognized habitat categories in the Delta, unlike in the more saline San Francisco Bay.

Vegetation colonization within the intertidal zone is expected to be rapid (Simenstad and others 2000, USFWS and USACE 1990). Areas below the vegetation colonization elevation are expected to remain as mudflats or to be colonized by non-native, invasive submerged aquatic vegetation (SAV). Limited data from Delta marshes show that tule vegetation becomes less dense in coverage with interspersed areas of mudflat and SAV within an elevation range between approximately +1 and -2 ft MLLW (Simenstad and others 2000; see Section 8.1.1 of the Conceptual Plan and Feasibility Study). In lower elevation zones near the bottom of this range, the extent of tule vegetation may be limited and SAV is expected to dominate plant communities (see Invasive SAV below). Subtidal areas below -12 ft mean tide level (MTL) are not expected to support SAV due to limited sunlight. At the marsh/channel edge, the lower limit of tules is expected to be similar in lower and higher elevation marshes. The quality of channel bank/marsh edge habitat is therefore also expected to be similar in different elevation marshes (see Figure 3 and Section 4.3).

Under non-tidal conditions (i.e., managed water or leveed conditions), the natural recruitment of tules can occur in response to periodic flooding and draw-down water levels. The natural recruitment of tules has occurred inadvertently in low areas of the leveed Dutch Slough site and other sites in the Delta. The USGS demonstration project at Twitchell Island has used flood irrigation to encourage natural recruitment as a technique for re-vegetation and biomass accretion. Water management can be used to grow tules in subsided sites at elevations below the range of tule colonization observed for tidal conditions; however, it is uncertain whether tules pre-established below this range will survive under tidal conditions if the site is breached.

Historically, natural channel levees formed along the banks of the fluvial distributary channels in some mature marshes (Atwater and Belknap, 1980; Simenstad and others, 2000; PWA, 2003). These natural levees were higher than the average elevation of the mature high marshplain and supported mature riparian vegetation, in contrast to the tule marshplain along tidal slough (non-distributary) channels. The natural channel levees decreased in elevation with both height and width with distance downstream in the Delta (Atwater and Belknap, 1980). They approached heights of 24 ft above MLLW near Sacramento and 14 ft above MLLW further downstream at the head of Grand and Sutter Islands (PWA, 2003). These levees were sustained by preferentially high sedimentation immediately adjacent to the distributary channels during flood flows. Vegetation-elevation transects surveyed by PWA at natural marshes along Lindsey Slough in the north Delta and Upper Mandeville Tip in the central Delta show that a subtle elevation difference of 0.5 ft between natural channel levees and the adjacent marshplain can support riparian vegetation along the levee (Simenstad and others, 2000; PWA, 2003).

In restored marshes, volunteer establishment of native woody and herbaceous riparian plants in higher elevation areas is expected to 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. Volunteer establishment is expected to be minimal in areas that lack 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, including Himalayan blackberry, perennial pepperweed, Bermuda grass, milk thistle, Italian ryegrass, vetch, and curly dock.

Tidal channel morphology. The formation of channels through tidal scouring of the compacted agricultural field surface in restored marshes is expected to be limited, and is an area of high uncertainty (see Section 5 below). Tidal velocities may be high enough in the large channels (the sloughs) and near the breaches to scour, as they have at Donlon Island; however, velocities in the small channels are hypothesized to be too low to scour channels into the marshplain. There may be a minimum restored marsh scale or tidal prism for tidal channels to form through tidal scour. Below this minimum, channels may not form and tules may colonize the potential channel footprint. The potential for tidal channel scour was identified as an area of uncertainty (see Section 5 below). In restored marshes, tidal channels that are constructed similar to natural channels (as possible) – both in cross-section (depth, width, side slope) and plan form (density, sinuosity, bifurcation) – are hypothesized to be sustainable habitat structures over the life of the restoration.

In ancient and historic Delta marshes, tidal channel systems are sinuous and branching. In cross-section, tidal channels maintain unvegetated channel beds and steep-sloping channel banks with vegetated edges, which provide fish habitat (see Section 4.3 below). Tidal channel morphology is controlled both by marsh hydrology and vegetation. The volume of tidal flows (tidal prism) is related to the cross-sectional area, depth, and width of tidal channels, which can be correlated in hydraulic geometry relationships (PWA, 2003; Williams and others, 2002; Simenstad and others, 2000). The density of tidal channels in freshwater marshes is less than in more saline marshes (SFEI, 2004), presumably because freshwater vegetation assemblages grow lower within the tidal range. In freshwater marshes, smaller tidal channels with bed elevations in the intertidal zone are few in number because intertidal areas tend to be vegetated with tules. In some cases, these small first order channels are overgrown with tules to form subsurface drainage "pipes;" in other marsh areas, small intertidal channels are not present or are indistinguishable from the marshplain (PWA observations and unpublished data).

The planform and cross-sectional geometry of tidal channels are expected to vary with marshplain elevation and marsh scale. Limited data suggest that channels in lower elevation restored marshes are wider than channels that drain the same area of higher elevation (MHHW) mature marsh, but that channel depths may not differ significantly (Simenstad and others, 2000). Tidal channel formation in restored marshes may also be controlled by antecedant conditions (*e.g.*, agricultural field surface, ditches, etc) in addition to marshplain elevation. The number of channel bifurcations (channel order) in larger marsh areas will be greater than in smaller marsh areas. The main (higher order) channels in larger marsh areas will be larger and deeper than in smaller marsh areas. Larger marsh areas will have a greater range of channel sizes and depths. The range in channel depths is important for native juvenile fish habitat and refuge (see Section 4.3 below).

Heating and cooling. Temperature dynamics in tidal marshes are primary controlled by depths and frequency of inundation (i.e., wetting and drying or desiccation) and vegetation cover and shading. Generally, temperatures in deeper areas and shaded areas are less variable. Temperature variability is greatest during the day, especially when tide levels drop below the marshplain elevation and the marshplain is exposed to high temperatures. Temperatures in lower elevation marshplain environments are expected to be less variable, and therefore more benign, than higher elevation marshplains. The difference in heating the water column above vegetated marshplains with different elevations (high and low) is not expected to be significant (Garrity, 2004).

Invasive SAV establishment. Conditions affecting the establishment and survival of non-native SAV (e.g., *Egeria densa*) were the focus in conceptual model development because of SAV's perceived detriment to native fishes (see below). SAV can colonize tidal areas and grow at depths of up to 8 to 12 ft below MTL (-6.5 to -10.5 ft NGVD). Based on limited data, tt is not expected to be possible to control non-native SAV by designing for high velocities or selection of substrate (L. Anderson, USDA, pers. comm.). High velocities are expected to slow, but not prevent, the initial establishment of SAV. SAV is expected to establish in pockets in low velocity areas adjacent to high velocity areas. Once established, SAV is expected to eventually spread to higher velocity areas, forming a continuous coverage. Similarly, compacted soils or other unsuitable substrates are expected to slow, but not prevent, SAV colonization.

4.4 Habitat Structures, Ecological Processes, and Functional Response

Juveniles of many of fishes, including several species of concern, will preferentially occupy shallow water habitats in the Delta through transitory periods in their early life history (Moyle, 1976; Wang, 1986). The AMWG developed several simple conceptual models that illustrate how an adaptive management strategy can be used to identify and test functional relationships between fish performance and restored wetland structure, where structure includes composition, structure, and arrangement of various fish habitat elements (Attachments A2 and A3). Performance measures for this strategy consist of juvenile Chinook salmon survival and growth, although similar mechanisms are expected to affect other fish using the restored wetlands, particularly Sacramento splittail. Performance measures can be tracked using both fish that are volitionally entering and using the sites and with manipulative release experiments using hatchery-produced juvenile salmon. These conceptual models show the expected responses of fish to marshplain elevation, channel characteristics and invasive SAV, and some of the fundamental assumptions behind these responses.

Tidal marshplain habitat. A key feature of tidal marshes that influences juvenile salmon (and splittail) performance is the edge of vegetation along tidal channels. These fish feed predominantly at the marsh edge and are not expected to venture onto the vegetated marshplain. Therefore, the capacity of a marsh to support fish is more likely related to the complexity (e.g., channel length and density) of the tidal channels than it is related to total marshplain area.

Access to prey. The opportunity for fish to access prey resources along the vegetated channel edge, and thus fish feeding rate and growth, is related most directly to the amount of time the fish have to access the channel edge over the tide cycle. Thus, assuming full tidal drainage, the quality of lower marsh and higher marsh channel bank habitats provide approximately equivalent benefits to fish feeding and growth if the lower edges of vegetation are comparable (Figure 3).

Prey productivity. Productivity, behavior and life history traits of juvenile salmon and splittail prey that occur along the marsh edge (i.e., dipteran fly larvae, pupae and adults; gammarid amphipods) may differ as a function of mean marshplain elevation (inversely related) because the duration of inundation will affect the amount of flooded habitat and the degree of elevation-associated stressors such as desiccation and elevated temperatures. It should be noted that other (generally less prominent) prey, such as planktonic cladocerans, do occur in the water column and in tidal channel mudflats and submerged and floating vegetation (e.g., gammarid amphipods).

Tidal channel habitat and refuge from predation. We make the fundamental assumption that short-term survival of juvenile salmon and splittail is greater in shallow subtidal channels than in either deep subtidal channels or intertidal channels. At low tide, shallow subtidal channels will provide refuge from predation by piscivorous birds for juvenile salmon and splittail, but will be too shallow to allow access for large, piscivorous fish predators. Predator fish are unable to access and forage channels with water depths of less than approximately 0.5 m because they will be exposed near or above the water surface (i.e., "their backs stick out of the water"). These predators will not enter shallow subtidal channels at low tide when channel depths are less than approximately 0.5 m, but will be confined to deeper subtidal channels (Figure 4). Piscivorous fish predators will enter the same channels during higher tide stages, when water depths are greater than 0.5 m, but they will likely enter these channels after small, juvenile fishes have followed the rising tide into smaller channels farther into the marsh. Tidal channels that dewater at low tides force even juvenile fish out into deeper sloughs and distributary channels, where they are presumably more vulnerable to piscivorous predators. We also assume that juvenile fish that are feeding and growing well will be less susceptible to predation due to their increased vigor.

Invasive SAV. In order for fish to take advantage of the feeding and refugia opportunities afforded by the Dutch Slough restoration effort, they must be able to find and enter the distributary channels. The greatest hindrance to access is expected to be growth of SAV in larger subtidal channels (Figure 5). Non-native SAV and also floating aquatic vegetation (*e.g.,* water hyacinth) lower dissolved oxygen levels under some conditions and may affect other water quality parameters, as well as create conditions that attract predators of native fish species. However, the times when out-migrating salmon are present and splittial are expected to spawn is in winter and early spring, when accumulated plant material may be flushed out of the western delta and before temperature and insolation have allowed regrowth.

4.5 External Factors

External factors – outside of the Dutch Slough site - have the potential to affect the ecological outcome of restoration actions. These factors cannot be controlled within the restoration design or adaptive management experiments. Examples of external factors include landscape factors such as regionally variable salinities and freshwater flows and other factors such as Delta pump operations, urban and agricultural pollutants, changes in fisheries management, and appearance of new invasive species. The conceptual model does not describe the effects of external factors in detail. The affect of external factors within the adaptive management process and experimental design can be addressed with monitoring of baseline conditions and reference sites.

5. KEY UNCERTAINTIES

The AMWG identified uncertainties related to: geomorphic and vegetative processes, linkages between habitat structures and functional response, water quality (mercury methylation and bioaccumulation, dissolved organic carbon (DOC) production), and construction feasibility. The AMWG considered which uncertainties were most uncertain and most important to test. In addition to the level of importance and uncertainty, the AMWG used the following criteria to select key uncertainties:

- What variables/uncertainties have the greatest implications for the future cost and feasibility of marsh restoration at Dutch Slough and elsewhere in the Delta?
- What variables can we test at Dutch Slough?
- What variables can be just as easily tested elsewhere?
- What design feature variables will maximize the chances of seeing a response?
- What variables can be experimentally tested while still maximizing the restoration value of the project?
- What variables can be experimentally tested without significantly increasing the restoration costs (e.g., the amount of fill required)?
- How many variables can be tested within the experimental design?
- To what degree should the Dutch Slough site be partitioned to test different variables?
- How does diverting Marsh Creek on to the site affect the ability to test variables?

The uncertainties identified for testing at Dutch Slough are listed in Table 1. Key uncertainties are those that are considered most important (i.e., high potential to affect the outcome and cost-effectiveness of restoration) and most uncertain. The AMWG selected tidal marshplain elevation and marsh scale as the key uncertainties for large-scale large scale experimental testing (Table 2 and Section 6). Marshplain elevation is considered important to test because lower vegetated marshes require less fill, but the habitat value may differ from that of higher, natural marshes. Marsh scale (*i.e.,* size of the marsh drainage area) is considered important to test to guide the selection of future restoration sites. Small sites are generally more available for restoration than large sites, but may not offer the same benefits on a per-acre basis (*e.g.,* tidal channel complexity). Both parameters have implications for the cost-effectiveness and feasibility of restoration, as filling restored marshes to higher elevations and acquiring larger areas for restoration are typically more expensive. Other uncertainties were selected for testing at smaller spatial scales (one to two acres) (Table 2).

Table 1. Importance and Uncertainty of Parameters to Test in Adaptive Management Experiments

		Uncertainty	
		Low	High
Importance	Low		• Rate and extent of tidal channel formation through tidal scour • Vector control ponds
	High	• Subsidence reversal (e.g., biomass accumulation, addition of organic matter such as rice straw) • Maximum inundation regimes for emergent marsh vegetation survival and inundation regimes for minimization of invasive plants	• Tidal marshplain elevation • Marsh scale • Water quality (dissolved organic carbon production, mercury methylation and bioaccumulation)

Table 2. Summary of Adaptive Management Parameters and Experimental Scale

Experimental Scale	**Parameters**
Large scale	• Tidal marshplain elevation • Marsh scale
Small scale	• Dissolved organic carbon production • Mercury methylation and bioaccumulation • Maximum inundation regimes for emergent marsh vegetation survival and inundation regimes for minimization of invasive plants • Subsidence reversal techniques (e.g., biomass accumulation, addition of organic matter such as rice straw) • Vector control ponds • Rate and extent of formation of channels through tidal scour

Water quality processes of DOC production and mercury methylation and bioaccumulation are both uncertain and important (see Section 8.3.5 in the Feasibility Study). Small-scale experiments may be designed to specifically test these water quality parameters; however, these parameters will also be measured for the large-scale experiments to determine the affect of marshplain elevation and marsh scale on DOC production and mercury methylation. The Natural Heritage Institute (NHI) is developing experimental hypotheses and design for water quality parameters as part of the Adaptive Management and Monitoring Plan.

6. HYPOTHESES FOR MARSHPLAIN ELEVATION AND MARSH SCALE

Experimental hypotheses, detailed operational conceptual models, and assumptions are described below for the large-scale experiments for marshplain elevation and marsh scale.

6.1 Tidal Marshplain Elevation

The hypothesis related to marshplain elevation is:

There is greater production of prey resources for juvenile salmon and splittail in lower elevation marshes than in higher elevation marshes, and thus greater potential for feeding, growth, and survival

The rationale behind this hypothesis is that a lower marshplain is inundated for a longer part of each tide cycle. A longer marshplain inundation period is expected to provide a more productive environment for fish prey (i.e., dipteran fly larvae, pupae and adults; gammarid amphipods) because there is less stress (*i.e.*, less desiccation and exposure to high temperatures). Greater fine sediment and detritus accumulation in lower marshplain environments may also provide increased productivity.

Low and high marshplain habitat structures are hypothesized to have somewhat different linkages between physical/vegetative processes and ecological processes (Figure 5). Vegetation colonization of lower marshplains is expected to be more susceptible to the invasion of non-native SAV; however, the hypothesis assumes that revegetation techniques will be used to encourage equal extents of tule cover on restored low and high marshplains. The tidal inundation duration of lower marshplains will be significantly greater than higher marshplains, assuming that the difference between lower and higher marshplain elevations is large (i.e., at least half the tide range). The rise and fall of tide levels are not expected to differ significantly, assuming that tidal circulation is not limited by constricted conveyance from the tidal source through external sloughs, breaches, and/or the restored (constructed) channel systems (and that the restoration is designed to avoid this). Sedimentation rates in lower marshplain habitats is expected to be greater than for higher marshplain habitats due to the greater tidal inundation duration.

6.2 Marsh Scale

The hypothesis related to marsh scale is:

Tidal channel networks in larger marshes provide shallow water refuge from predation throughout the tide cycle, whereas smaller channel networks in smaller marshes do not. Thus, larger marshes are expected to provide greater survival opportunities for juvenile salmon and splittail than smaller marshes.

The rationales behind this hypothesis are that: (1) the size of the tidal channel network is related to marsh scale and (2) channels with shallow water depths at low tide limit predator access and provide refuge for juvenile salmon and splittail. In larger marshes, some portion of the channel network is expected to always have water depths suitable for refuge during low tide. In smaller marshes, channel depth at low tide is not expected to be sufficient to provide refuge for juvenile salmon and splittail, which will be "flushed" into deep subtidal Delta slough channels (external sloughs) that likely harbor predators. In addition, larger marshes are hypothesized to provide greater structural heterogeneity and diversity (*e.g.*, relief, vegetation assemblages and tidal channel sizes) and complexity (*e.g.*, larger tidal channel systems, greater tidal energy, more refugia) than smaller marshes, and thus greater refuge and survival opportunities.

Marsh scale influences the linkages between restoration actions and functional response for habitat structures (Figure 6). Marsh scale directly relates to the following habitat structures: length of marsh/channel edge and the range of channel sizes. Larger-scale marshes are expected to have a greater length of marsh/channel edge and a larger range of channel sizes and depths. As with different elevation marshplains, the rise and fall of tide levels in different scale marshes are expected to be similar, assuming the tidal circulation is not limited by the restored (constructed) channel systems, breaches, or external sloughs. Because most of the fish forage along the vegetated edge of the tidal channels, increased access to prey is presumed to result from increased length of marsh/channel edge. Larger marshes therefore provide greater access to prey than smaller marshes; however, on a per-acre basis, the length of channel edge (*i.e.* linear channel density) is expected to be similar in larger and smaller marshes (SFEI, 2004; PWA, 1995). Prey access is therefore expected to also be similar in larger and smaller marshes on a per-acre basis. Protection from both fish and bird predation is linked to refugia such as shallow water, narrow channels and overhanging vegetation. Channel size is also assumed to influence foraging on benthic and epibenthic prey because larger channels have more surface area of low gradient, unconsolidated sediments ("mudflats").

The habitat value of a smaller marsh area and channel network is expected to be less than a marsh area of the same size within a larger marsh area. Due to the dendritic nature of tidal channel systems, smaller-scale channel and marsh systems are nested within large-scale marshes. The range of channel sizes in larger marshes is expected to provide more refugia (e.g., greater range of channel depths suitable for native fish refuge for varying tide levels, more ponded areas in dewatered channel bottoms). In smaller marsh systems, the range of channel sizes will be entirely limited to smaller channels. The larger external sloughs that are adjacent to both large and small tidal systems are typically armored and lack the refuge provided by the marsh edge. Thus, while juvenile fish may usually find refugia at some position within a larger channel system, varying as a function of tidal stage, they will be completely forced out of small channel systems during most low tides.

7. EXPERIMENTAL DESIGN CONSIDERATIONS

The preferred restoration plan, including large-scale experiments to test the marshplain elevation and marsh scale hypotheses, are described in Sections 7 and 8 of the Conceptual Plan and Feasibility Report. The following considerations and assumptions are incorporated in the experimental design to allow testing of the adaptive management hypotheses.

7.1 Tidal Marshplain Elevation.

Note that "lower elevation" and "higher elevation" marshes may be treated as distinct for adaptive management purposes, but are morphologically similar and not generally-recognized as distinct habitat categories in the Delta as discussed in Section 4.3. For adaptive management purposes, the intent is to compare "lower" and "higher" marshplains that differ enough in elevation to show different ecological responses, while not making the "higher" marsh so high that it becomes fill-limited or cost prohibitive. Selection of the exact elevations to compare requires an application of judgment. The preferred restoration plan includes low marsh areas (average marshplain elevation at mean lower low water) and mid marsh areas (average marshplain elevation at mean tide level) that differ in elevation by approximately two feet and have significantly different tidal inundation frequencies.

Revegetation methods (tule pre-establishment) will be used to encourage equal extents of vegetation cover on low and mid marshplains at the time of breaching, which is expected to aid the experimental comparison. Tule pre-establishment is expected to provide a somewhat greater probability of tule cover on low marshes than sites that undergo pioneer colonization under tidal conditions. Tule pre-establishment is also expected to aid in competition against invasive SAV.

Tidal channel systems in restored marsh areas will be constructed to be as similar to natural systems as possible, both in cross-section (depth, width, side slope) and plan form (density, sinuosity, bifurcation). Tidal channels are anticipated to be wider in low marshes to accommodate the larger tidal prism; however, the density and depth of channels are not expected to differ greatly from mid marshes. It is assumed that tidal channel systems in low and mid marshes with equal areas will be designed with similar channel densities and depths.

7.2 Marsh Scale

The large-scale experiment for marsh scale included in the Dutch Slough restoration plan will 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 will 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) will also be compared to the smaller paired-sample marsh areas. As discussed above, tidal channels will be excavated into the restored marshplain to ensure rapid tidal channel formation and provide fish habitat at the Dutch Slough restoration site.

The intent of the marsh scale experiment is to test the value of structural heterogeneity and tidal channel complexity with increasing marsh scale to special status native fish survival. The scale of the small marsh area and channel network is expected to approximate the minimum scale that will provide low tide refuge for target fish species. Limited data on the relationship between channel depth and marsh area in Delta marshes (Simenstad and others 2000) suggest that marsh areas from approximately 10 – 15 acres may provide sufficient channel depths for low tide refuge (Figure 7). The channel networks in these small-scale marshes are expected to be 3^{rd} order channel systems, based on data from historic freshwater and brachish marshes in other regions of the San Francisco Bay-Estuary (SFEI 2004). Medium-scale marsh and channel networks are expected to transition from 3^{rd} to 4^{th} order channel systems, with the largest channels allowing predator access at low tide, but a greater number of intermediate and small channel sizes that provide low tide refuge. The large and very large marsh areas and channel networks are expected to be 4^{th} and 5^{th} order channel systems and are hypothesized to have the greatest structural heterogeneity, diversity, and complexity.

The scale of each marsh area and channel network may be refined in future design phases for the purpose of the adaptive management experiments. Additional data on tidal channel depth and plan form relationships to marsh area would be required to reduce the uncertainty in designing and predicting fish response to tidal channel morphology.

The marsh scale hypothesis is that juvenile native fish in smaller marshes will be more likely to be exposed to predators in the external slough channels while juvenile native fish in larger marshes are expected to remain in the restored marsh for refuge. The adjacency of small- and large-scale marshes may constitute a confounding factor for the marsh scale adaptive management experiments when using fish access and abundance as the performance measure. This is because fish offered the option of entering a large and a small marsh in close proximity may select the large marsh because the larger channel will allow them earlier access in the tidal cycle and may not dewater to the extent that they must leave. We assume that the opportunity to enter the small marsh will occur somewhat later in the tidal cycle and the fish will typically be forced out of the small marsh on the ebbing tide. Because smaller marshes are separated from nearby larger marshes by the external slough, this adjacency is not expected to be a significant factor. In addition, while the density of fish might be affected by adjacency, the performance of fish in manipulative experiments (with fish releases) within the marshes would not be as vulnerable to any artifact introduced by adjacent marshes.

8. AMWG MEMBERS

The Dutch Slough Adaptive Management Work Group is:

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Peter Baye, Ph.D., Private Consultant
Joan Florsheim, Ph.D., UC Davis
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Mark Stacey, Ph.D., UC Berkeley
John Takekawa, Ph.D., USGS
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9. REFERENCES

Allen, JRL. 2000. Morphodynamics of Holocene salt marshes: a review sketch from the Atlantic and southern North Sea coasts of Europe. Quaternary Science Review 19(12):1155-1231.

Anderson, Lars. U.S. Department of Agriculture. Personal communication.

Atwater BF. 1982. Geologic maps of the Sacramento-San Joaquin Delta, California. Menlo Park (CA): U.S. Geological Survey MF-1401.

Atwater BF, Belknap DF. 1980. Tidal-wetland deposits of the Sacramento-San Joaquin Delta, California. In: Field ME, Bouma AH, Colburn IP, Douglas RG and Ingle JC, editors. Quaternary depositional environments of the Pacific Coast. Pacific Coast Paleogeography Symposium 4. Proceedings of the Society of Economic Paleontologists and Mineralogists. Los Angeles (CA): Society of Economic Paleontologists and Mineralogists. p 89-103.

Atwater BF, Conard SG, Dowden JN, Hedel CW, MacDonald RL, Savage W. 1979. History, landforms, and vegetation of the estuary's tidal marshes. In: Conomos TJ, Leviton AE, Berson M, editors. San Francisco Bay: the urbanized estuary. San Francisco (CA): Pacific Division, AAAS. p 347-385.

Atwater BF, Hedel CW. 1976. Distribution of seed plants with respect to the tide levels and water salinity in the natural tidal marshes of the northern San Francisco Bay estuary, California. Preliminary report. U.S. Geological Survey Open File Report 76-389.

Beeman and Krone. (Ogden Beeman & Associates, Inc., RB Krone & Associates, Inc.). 1992. Sediment budget study for San Francisco Bay. Final report. Prepared for the San Francisco District, U.S. Army Corps of Engineers. Located at: Ogden Beeman & Associates, Inc., Portland, OR. 25+ p.

Cain, John. 2004. Memorandum to Dutch Slough Adaptive Management Working Group candidates. Subject: Draft Memo on Adaptive Management Working Group. Revised March 30.

CALFED (CALFED Bay-Delta Program). 2000. Ecosystem restoration program plan final programmatic EIS/EIR. Sacramento (CA): CALFED Bay-Delta Program. Available from: http://calwater.ca.gov/CALFEDDocuments/Final_EIS_EIR.shtml.

Delta Habitats Group, 2002. Report of the Delta Habitats Group, CALFED ISB Adaptive Management Workshop, March 19-20, 2002. Prepared by Denise Reed, ISB Adaptive Management Subcommittee and Bruce DiGennaro, Kleinschmidt.

Drexler JZ, Fleck J, Wheeler G, Fujii R. 2003. Carbon storage and sediment accretion in restored wetlands on Twitchell Island in the Sacramento-San Joaquin Delta, California [abstract]. In: CALFED Science Conference 2003 Abstracts. CALFED Science Conference 14-16 Jan 2003, Sacramento Convention Center. Sacramento (CA): CALFED Bay-Delta Program. p 46.

Garrity NJ. 2004. Solar Heating and Temperature Dynamics of Over-Marsh Tides in Restored Marshes. U.C. Berkeley CEE209A Hydrologic Mixing Processes class project for Professor Mark Stacey. May 17.

Gilbert GK. 1917. Hydraulic mining in the Sierra Nevada. U.S. Geological Survey Professional Paper 105. Washington, DC: Government Printing Office.

Goman M, Wells L. 2000. Trends in river flow affecting the northeastern reach of the San Francisco Bay Estuary over the past 7000 years. Quaternary Research 54:206-217.

Moyle, PB. 1976. Inland fishes of California. University of California Press.

NHI (Natural Heritage Institute). In progress. Dutch Slough Tidal Marsh Restoration Adaptive Management and Monitoring Plan.

Orr MK, Crooks S, Williams PB. (2003). Will Restored Tidal Marshes Be Sustainable? *San Francisco Estuary and Watershed Science* **1**(1): Article 5.

PSNERP (Puget Sound Nearshore Ecosystem Restoration Project, Nearshore Science Team). 2006. Conceptual model for assessing restoration of Puget Sound Nearshore Ecosystems. Prepared by the Nearshore Science Team, Conceptual Model Working Group – C. Simenstad lead author, K. Fresh, M. Logsdon, J. Newton and H. Shipman. Olympia, WA. (in press)

PWA (Philip Williams & Associates, Ltd.). 2006. Dutch Slough Tidal Marsh Restoration Conceptual Plan and Feasibility Study. Prepared for The California State Coastal Conservancy; PWA Report 1714.

PWA (Philip Williams & Associates, Ltd.). 2003. Decker Island Phase II Restoration Project – Concept Design. Prepared for MBK Engineers and DWR. May 8, 2003 Memorandum from Michelle Orr, Nick Garrity, and Phil Williams, PWA to Gilbert Cosio and Don Trieu, MBK Engineers. PWA report#1666. Located at: PWA, San Francisco, CA. 10+ p.

PWA (Philip Williams & Associates, Ltd.), Pacific Estuarine Research Lab, and Louisiana Universities Marine Consortium. 1995. Design guidelines for tidal channels in coastal wetlands. Prepared for the U.S. Army Corps of Engineers Waterways Experiment Station. PWA report #934. Located at: PWA, San Francisco, CA. 46+ p.

Reed DJ. 2002. Sea-level rise and coastal marsh sustainability: geological and ecological factor in the Mississippi delta plain. Geomorphology 48:233-243.

SFEI (San Francisco Estuary Institute). 2004. Syntheses of Scientific Knowledge for Maintaining and Improving Functioning of the South Bay Ecosystem and Restoring Tidal Salt Marsh and Associated Habitats over the Next 50 Years at Pond and Pond-Complex Scales. Draft Final Report.

Simenstad C, Toft J, Higgins H, Cordell J, Orr M, Williams P, Grimaldo L, Hymanson Z, Reed D. 2000. Sacramento-San Joaquin Delta breached levee wetland study (BREACH). Preliminary report. Seattle (WA): Wetland Ecosystem Team, University of Washington, School of Fisheries. 46 p.

USFWS and USACE (U.S. Fish and Wildlife Service (Sacramento) and U.S. Army Corps of Engineers (Sacramento District)). 1990. Design and biological monitoring of wetland riparian habitats created with dredged materials. Final report. Deepwater Ship Channel monitoring program. Sacramento (CA): Sacramento District Corps of Engineers. 68 p.

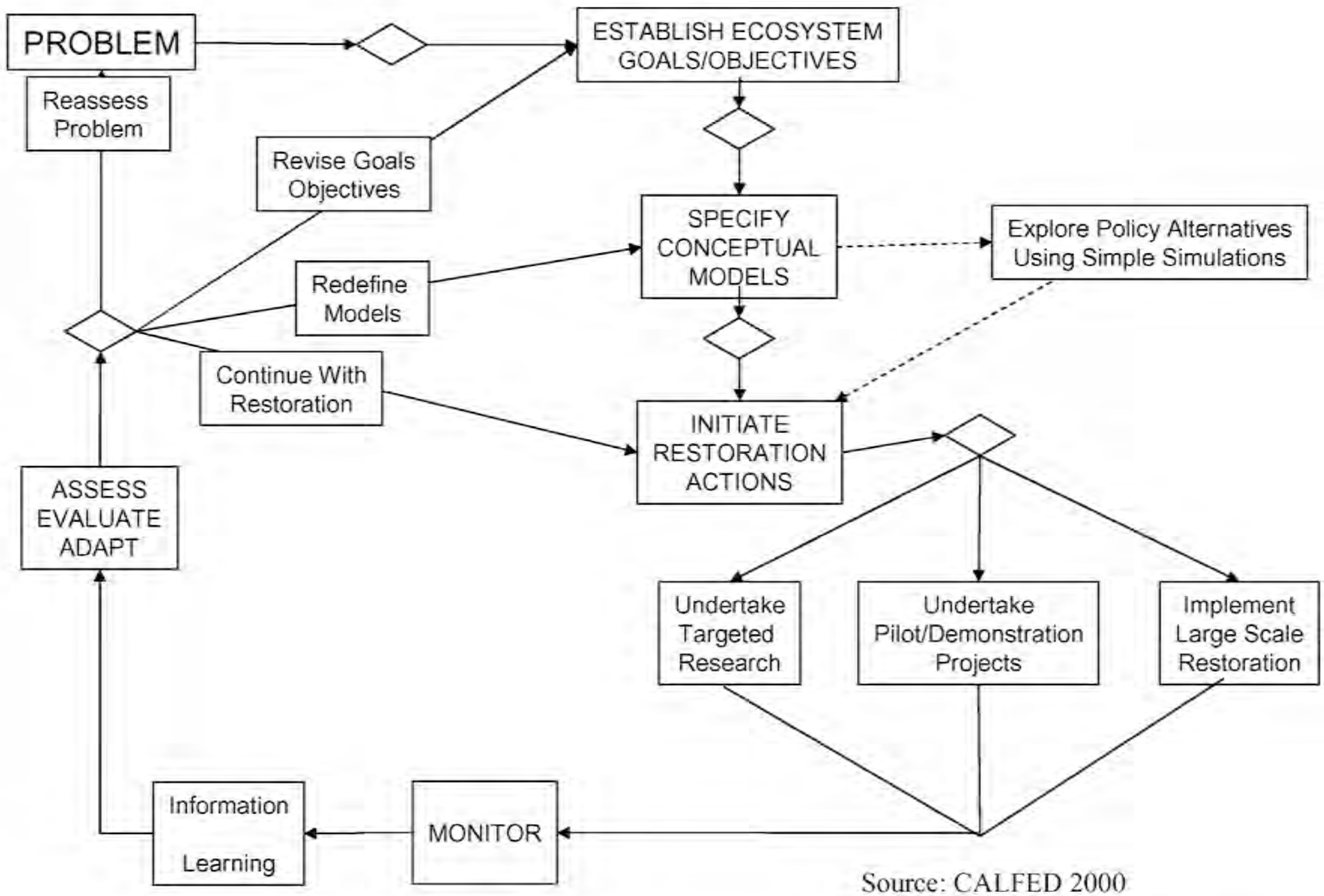
Wang JCS. 1986. Fishes of the Sacramento-San Joaquin Estuary and Adjacent Waters, California: A Guide to the Early Life Histories. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary.

Williams PB, Orr M.K., Garrity NJ. 2002. Hydraulic geometry: a geomorphic design tool for tidal marsh channel evolution in wetland restoration projects. Restoration Ecology 10:577-590.

Wright SA, Schoellhamer DH. 2003. Trends in the sediment yield of the Sacramento River, 1957-2001 [abstract]. In: CALFED Science Conference 2003 Abstracts; 14-16 Jan 2003, Sacramento. Sacramento (CA): CALFED Bay-Delta Program. p 177.

FIGURES

ATTACHMENTS



Source: CALFED 2000

Note: diamonds indicate decision points.

figure *1*

Dutch Slough Conceptual Model

Adaptive Management Process Flow Diagram

Appendix E

PWA

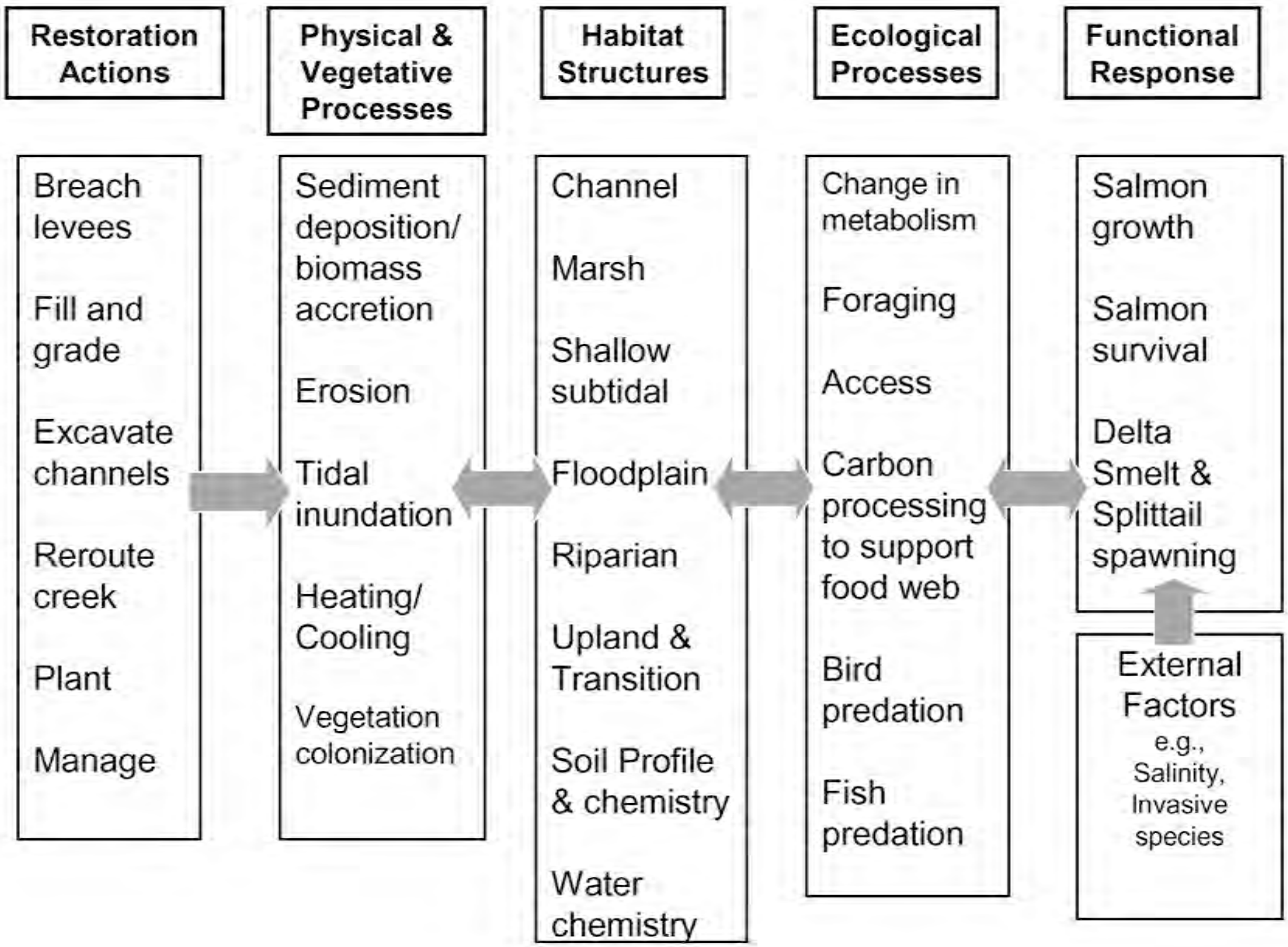


figure 2

Dutch Slough Conceptual Model

General Conceptual Model

Appendix E

PWA

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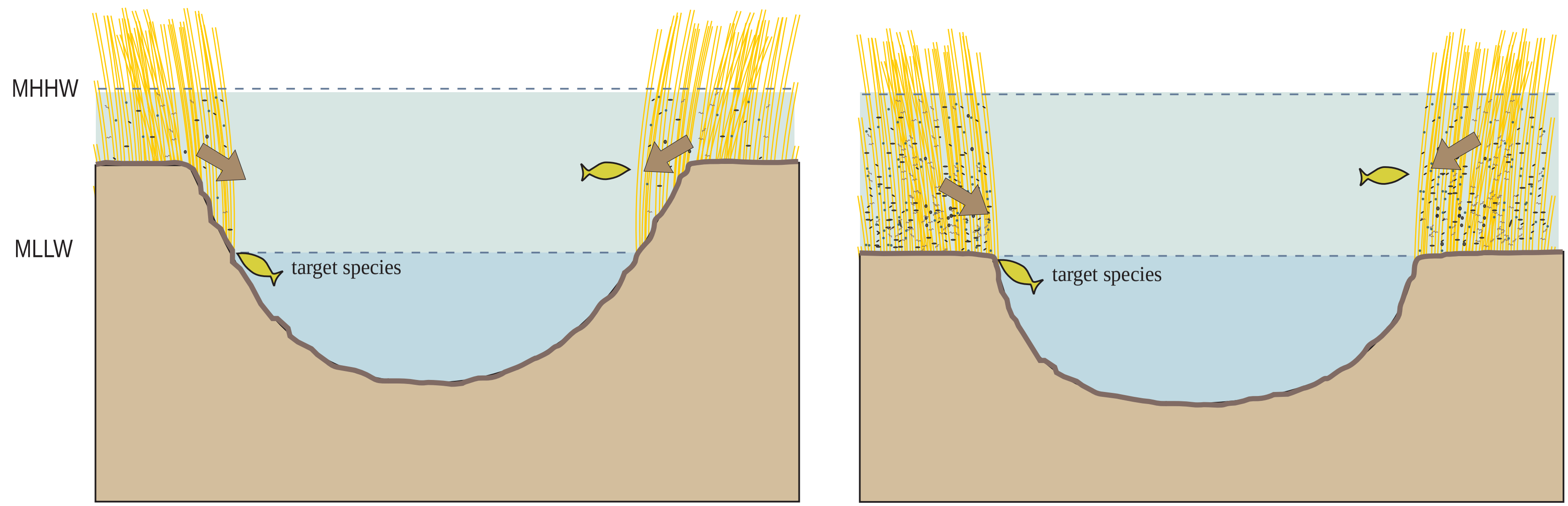
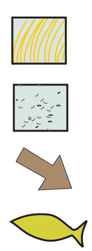


Hypothesis

There is greater production of prey resources for juvenile salmon and splittail in lower elevation marshes than in higher elevation marshes, and thus greater potential for feeding, growth, and survival.



Notes:
MHHW = mean higher high water
MLLW = mean lower low water
Not to scale

figure 3

Dutch Slough Conceptual Model

Tidal Marsh Elevation Hypothesis

Appendix E PWA

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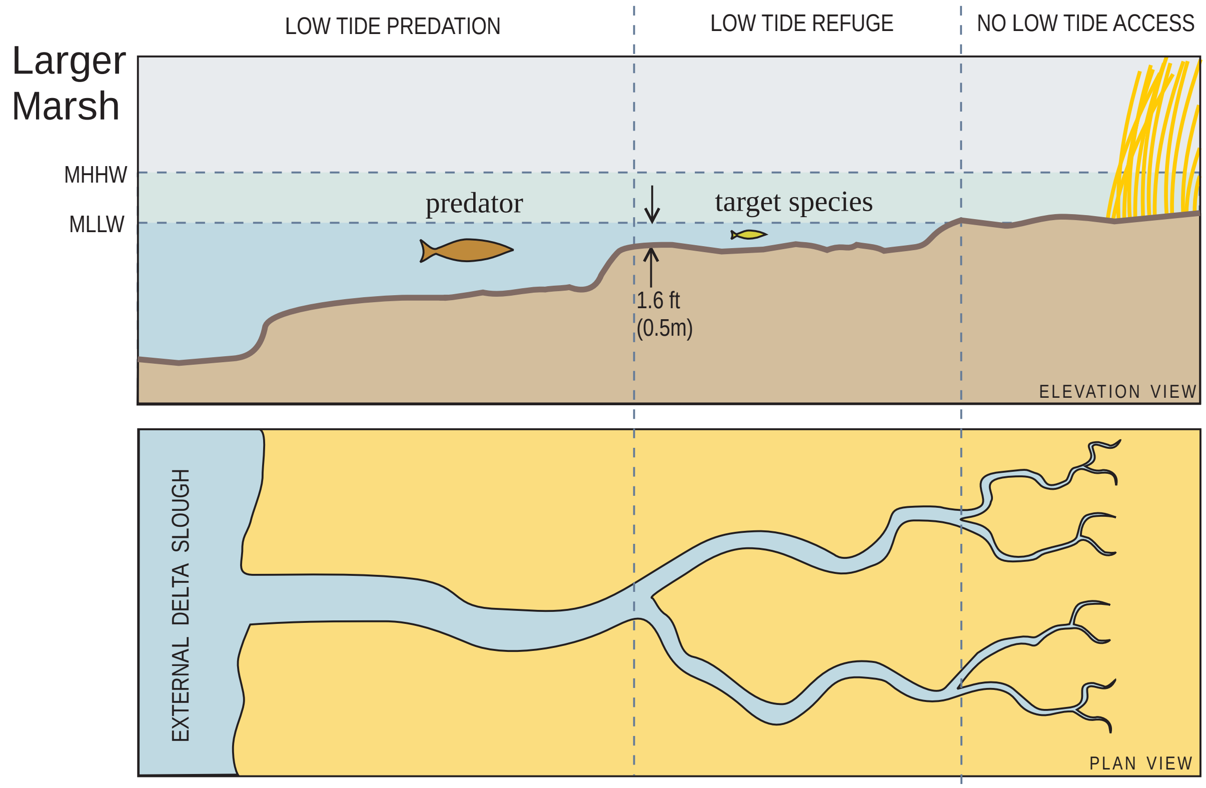

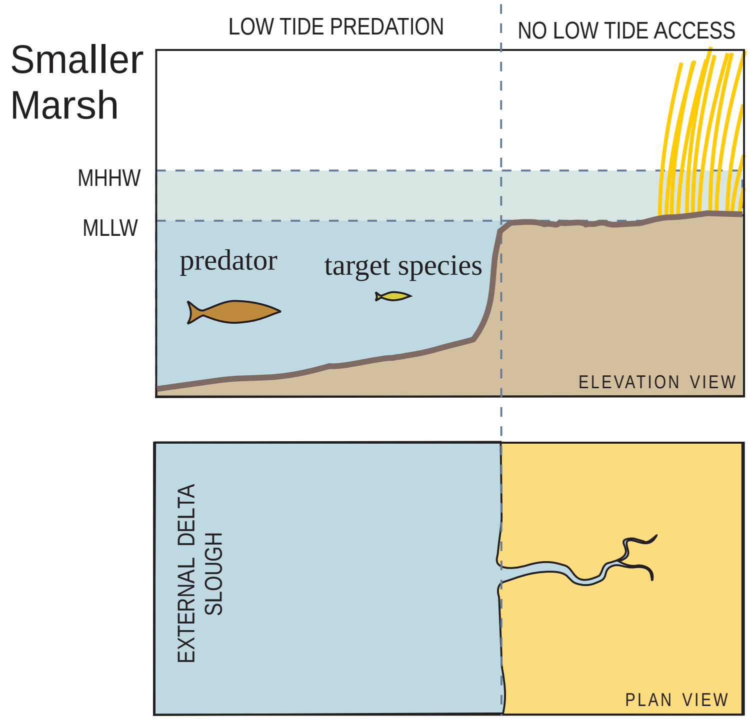

Hypothesis

Tidal channel networks in larger marshes provide shallow water refuge from predation throughout the tide cycle, whereas smaller channel networks in smaller marshes do not. Thus, larger marshes are expected to provide greater survival opportunities for juvenile salmon and splittail than smaller marshes.

Legend

tule vegetation

predator fish species

target special status native fish species (juvenile salmon and splittail)

Notes:
MHHW = mean higher high water
MLLW = mean lower low water
Not to scale

figure 4

Dutch Slough Conceptual Model

Marsh Scale Hypothesis

Appendix E

PWA

PWA Ref# 1714 AppendixE fig4 marshScale.cdr

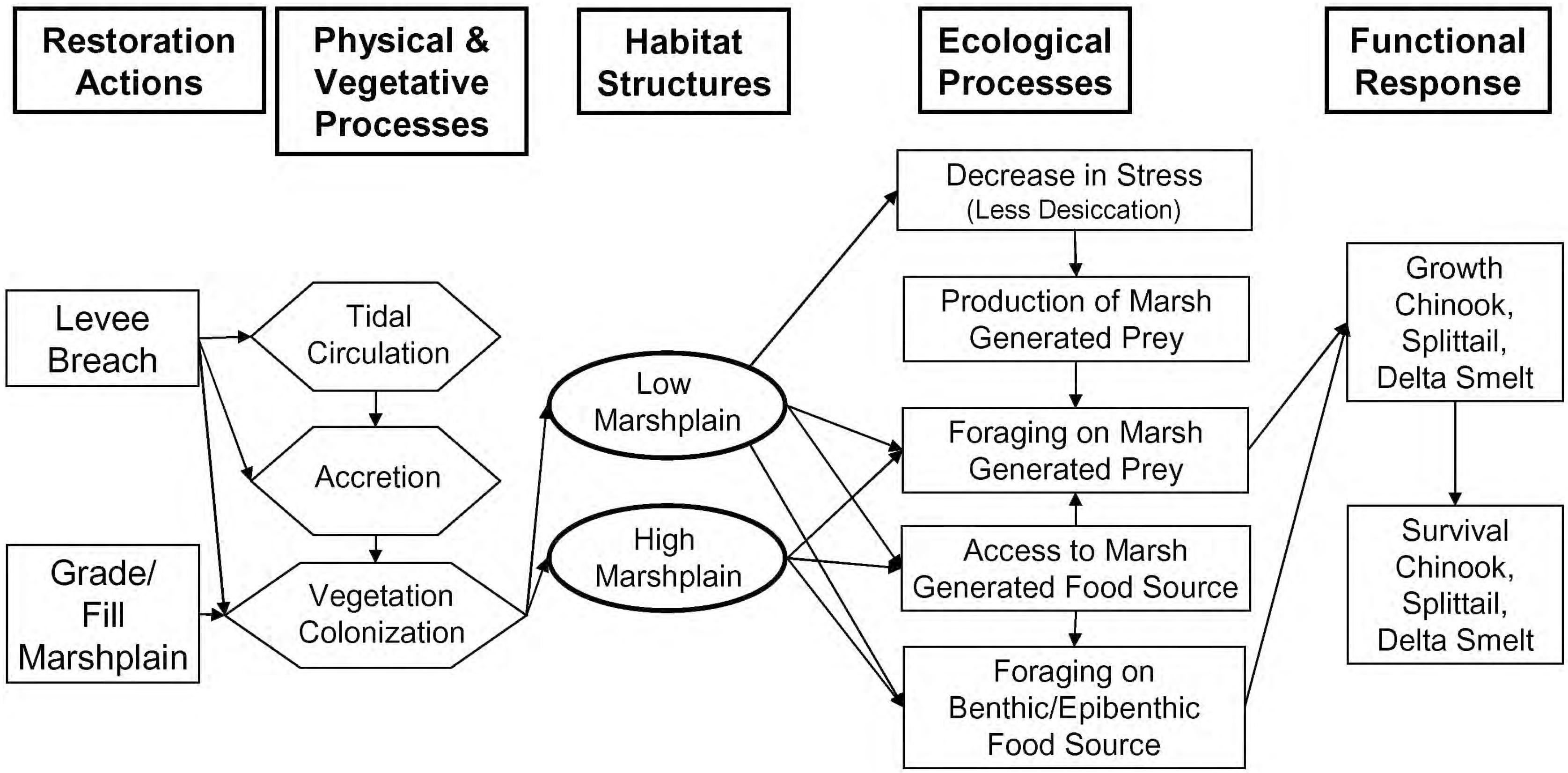

figure 5

Dutch Slough Conceptual Model

Tidal Marshplain Elevation Conceptual Model

Appendix E

PWA

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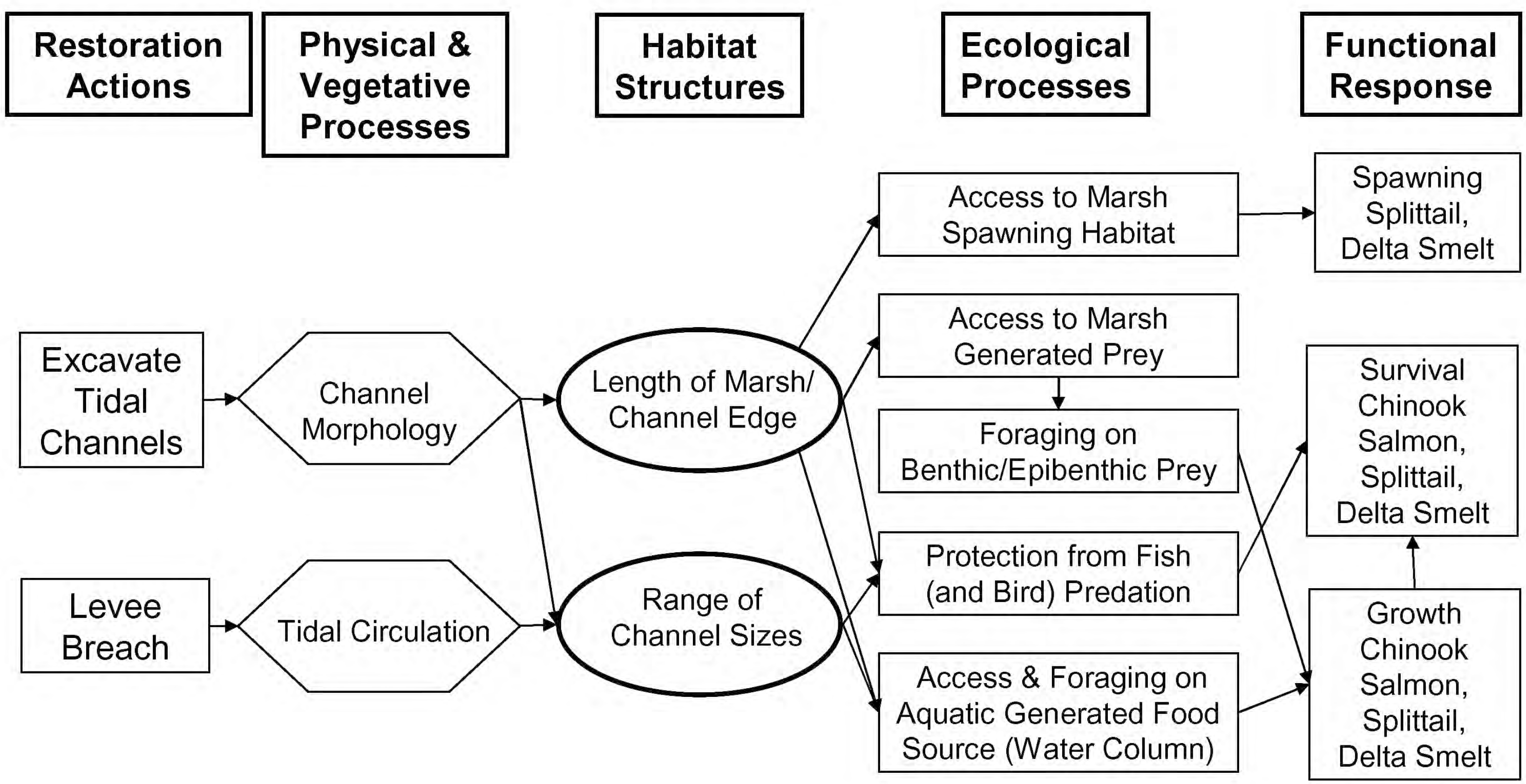


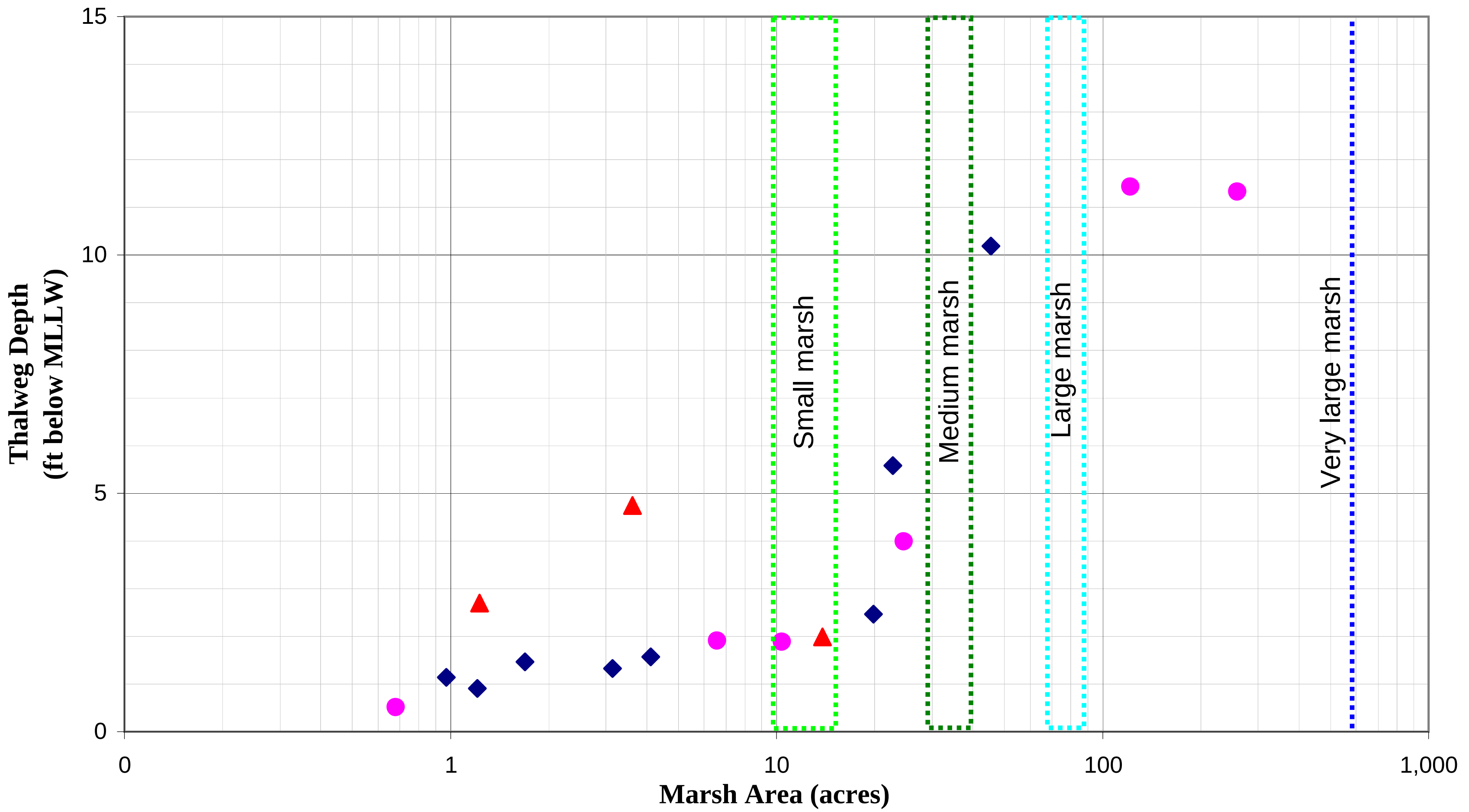
figure 6

Dutch Slough Conceptual Model

Marsh Scale Conceptual Model

Appendix E

PWA



Source: Simenstad and others, 2000

figure 7

Dutch Slough Conceptual Model

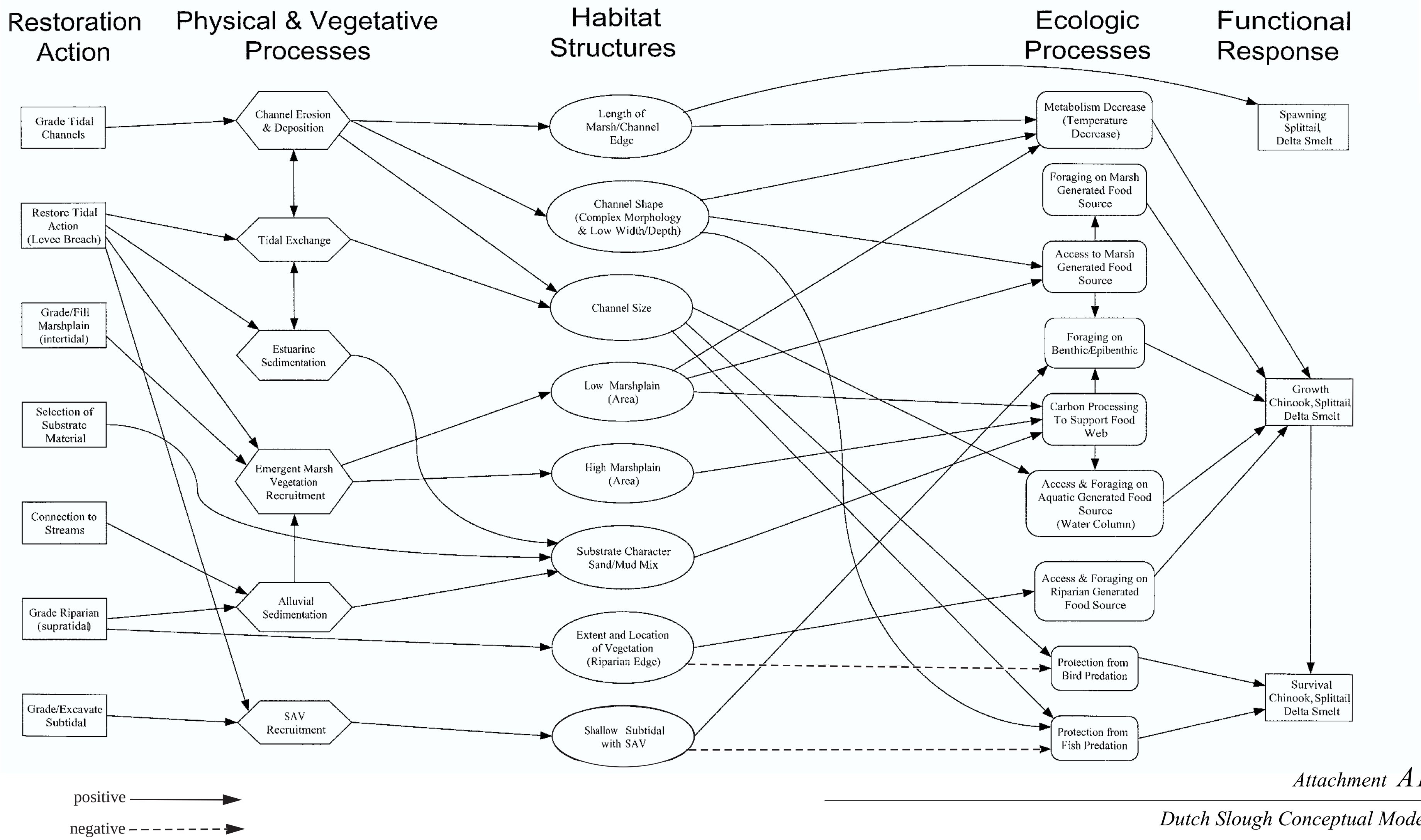
Channel Depth and Marsh Area Relationship

PWA#1714 **Appendix E**

Sept. 2004 DRAFT

Dutch Slough Conceptual Model

HOW TIDAL RESTORATION ACTIONS AFFECT DESIRED FUNCTIONAL RESPONSE ON SITE



Source: AMWG meeting discussion, PWA, and Simenstad

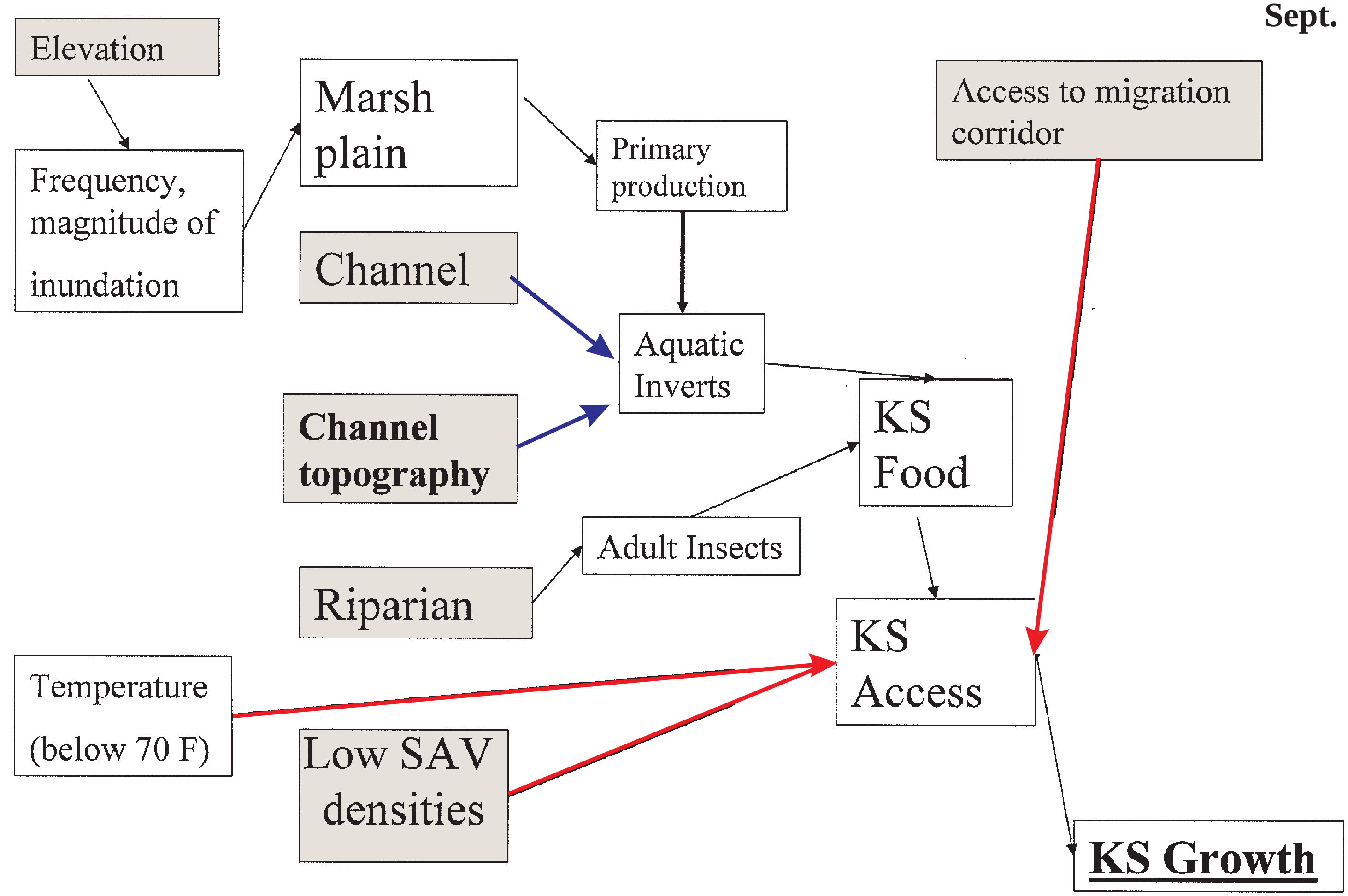
Attachment A1

Dutch Slough Conceptual Model

Initial Detailed Conceptual Model

Appendix E

PWA



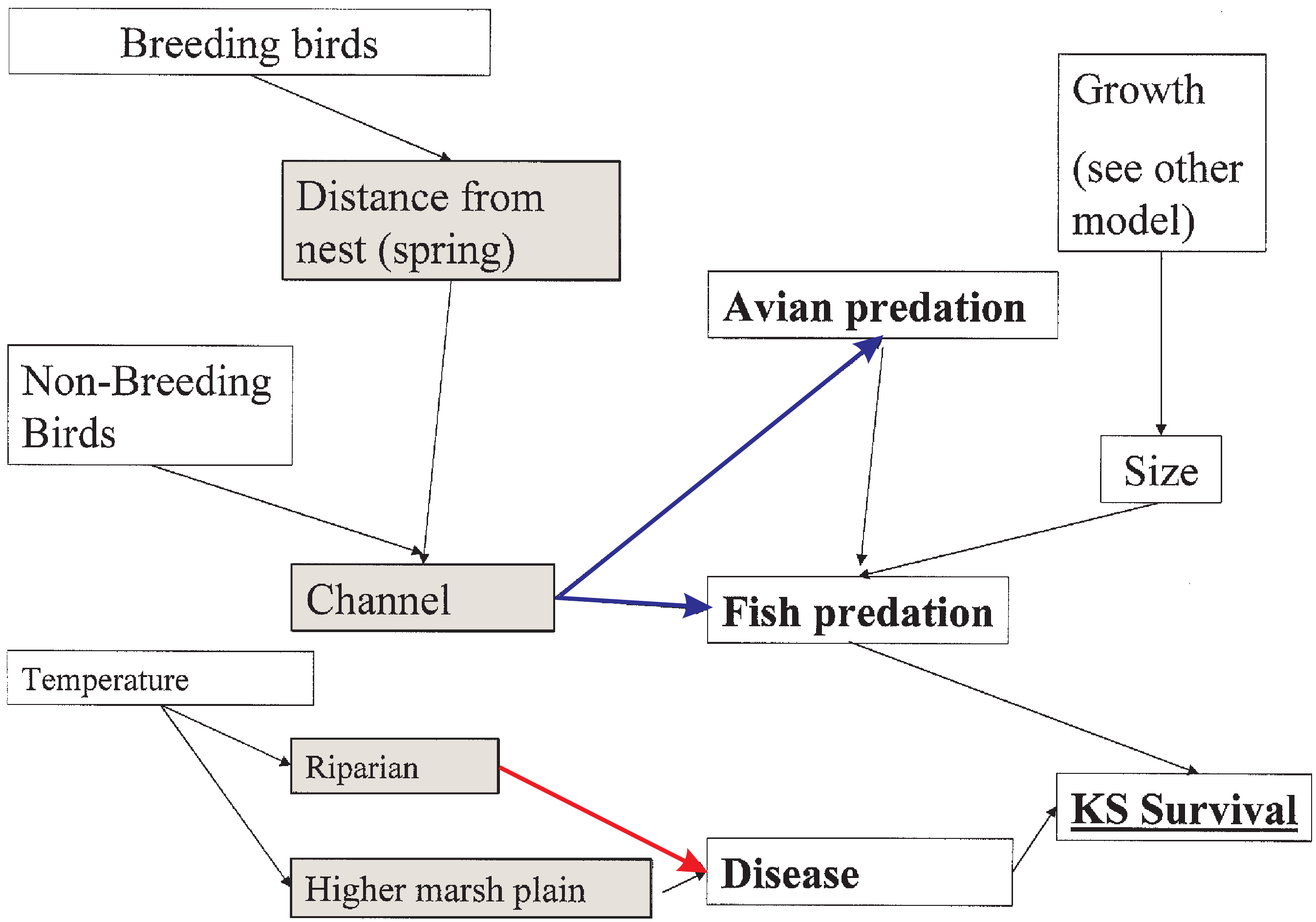
Note: blue arrows represent areas of high uncertainty, red arrow represent areas of high importance. Shaded boxes represent targets of restoration activities; implied within the shaded boxes are various possible configurations to maximize or minimize the effects represented by the arrows.

Attachment A2

Dutch Slough Conceptual Model

Initial Conceptual Model for Chinook Salmon Growth: Habitats, Processes and Attributes

Sept. 2004 DRAFT



Note: blue arrows represent areas of high uncertainty, red arrow represent areas of high importance. Shaded boxes represent targets of restoration activities; implied within the shaded boxes are various possible configurations to maximize or minimize the effects represented by the arrows.

Attachment A3

Dutch Slough Conceptual Model

Initial Conceptual Model for Chinook Salmon Survival: Habitats, Processes and Attributes

Source: AMWG meeting discussion

Appendix E

PWA

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APPENDIX E: CONSTRUCTION CARBON FOOTPRINT CALCULATIONS

APPENDIX E – CONSTRUCTION CARBON FOOTPRINT CALCULATIONS

The project's carbon emissions from construction was estimated by calculating the total weight of CO_2-equivalent emitted as exhaust from expected construction equipment, on-site passenger vehicles, and commute vehicles during all phases of construction. Using project conceptual designs and fill requirements (volumes to be excavated, imported, and graded) a DWR Division of Engineering (DOE) construction project manager estimated crew size, equipment needs, and duration of operation for each phase of construction. The design requirements included:

- Alternative 1 – onsite excavation, distribution and grading of 1.18 million cubic yards (M yd^3) of fill;
- Alternative 2 –importation and distribution of 500,000 yd^3 of fill from the adjacent ISD property, and onsite excavation, distribution, and grading of 1.18 M yd^3 for a total grading volume of 1.68 M yd^3; source yet to be determined), and onsite excavation, distribution and grading of 1.3 M yd^3, for a total grading volume of 3 M yd^3.

DOE Project Estimates

DOE estimated an average 3.5-minute fill transport circuit between the project site and the ISD source. By applying the 25 yd^3 scraper capacity to the circuit time, an import schedule of 73 days was calculated as follows:

- 60 min/(3.5 min/cycle) = 17.14 cycles/hr x 8 hrs = 137.14 cycles (loads)/day
- 137.14 loads/day/scraper x 2 scrapers = 274.29 loads/day x 25 yd^3/load = 6,857 yd^3/day
- 500,000 yd^3/ (6,857 yd^3/day) = 72.92 days ~ 73 days

For on-site grading, channel excavation and other minor activities (irrigation system removal, vegetation grubbing, levee breaching, placement of geo-textiles, etc.), DOE provided the following subjective estimates based on best professional opinion:

- Alt. 1 – 30 day schedule operating a motor grader, 2 small dozers, 3 excavators and a water truck for normal 8-hour shifts.
- Alt. 2 – Double the equipment for the effort estimated in Alt. 1 above.

Alternatives Analysis

Using fuel consumption rates provided by the Caterpillar Performance Handbook, and presumptions for passenger vehicles, estimated total consumption of diesel and unleaded fuel was calculated. World Resources Institute/World Business Council for Sustained Development GHG Protocol *CO_2 emissions from transport or mobile sources* calculation tool was used to convert diesel and unleaded totals into GHG emissions (CO_2-Equivalent). The methods are described in more detail for each alternative below.

Alternative 1 – For purposes of this analysis, an oversized crew of 17 was presumed necessary to operate construction equipment and perform on-site supervision by contractors and local/state project officers over the course of 30 days. Average commute distance was presumed to be 35 miles (based on distances connecting: Oakley, CA and Stockton, CA; and Oakley and Antioch, CA), with an average fuel efficiency rate of 17 mpg. Four on-site observation and supervisor's vehicles were presumed to be driven 5 miles per day at 10 mpg. Planting of the restored tidal wetland, following most construction activity, will take three months with the same crew size and passenger vehicle fleet demand aforementioned in this alternative. Again, this alternative does not involve fill imports.

Fuel consumption for Alternative 1 was calculated as follows:

<u>On-site excavation, transportation, distribution and contouring</u>:
30 days x 8 hrs/day = 240 hrs for each piece of equipment
240 hrs motor grader x 9 g/hr x (1) = 2,160 g. diesel
240 hrs small dozer x 19 g/hr x (2) = 9,120 g.
240 hrs excavator x 9 g/hr x (3) = 6,480 g.
240 hrs water truck x 8 g/hr x (1) = 1,920 g.
Total estimated diesel = 19,680 gallons

<u>On-site Observation and Construction Supervisor vehicles</u>:
(4 p x 30 days) = 120 person-days x (5 miles/day)/10 mpg = 60 g. unleaded

<u>Commute to/from project site for all staff</u>:
(17 p x 30 days) = 510 person-days x (35 miles/day)/17 mpg = 1050 g. unleaded

<u>Post-construction planting</u>:
60 g./month + 1050 g./month = 1110 g. unleaded/month x 3 months = 3330 g. unleaded

Total estimated unleaded: 60 + 1050 + 3330 **=** 4440 gallons

Carbon dioxide equivalent (CO_2-Eq.) from combustion exhaust was calculated as follows:

19,680 g. diesel x 0.1404235 GJ/gal x (74.01 $kgCO_2$/GJ)/1000 = 204.5 Metric tons CO_2-Eq.

4,440 g. unleaded x 0.130204 GJ/gal x (69.25 $kgCO_2$Eq./GJ)/1000 = 40.03 Metric tons CO_2-Eq.

Total CO_2-Eq. (Alt. 1) = 204.5 + 40.03 = <u>244.53 Metric tons CO_2-Eq.</u>

Alternative 2 – Importation of 500,000 yd^3 of material from ISD, and grading of a total of 1.68 M yd^3 of material. DWR estimates 73 8-hour days utilizing 3 scrapers to complete the importation. The construction equipment used in Alternative 1 would be doubled in order to utilize the same 30-day schedule and crew size of 17 persons in order to undertake the anticipated amount of grading. Commute and on-site passenger vehicle consumption was based on the mileage and efficiencies listed above.

Fuel consumption for Alternative 2 was estimated as follows:

<u>Transportation of fill from ISD</u>:

73 days x 8 hrs/day x 3 scrapers = 1,752 hrs x 21 gph = 36,792 g. diesel

<u>On-site excavation, transportation, distribution and contouring</u>:
30 days x 8 hrs/day = 240 hrs for each piece of equipment:
240 hrs motor grader x 9 g/hr x (1) = 2,160 g. diesel
240 hrs small dozer x 19 g/hr x (2) = 9,120 g.
240 hrs excavator x 9 g/hr x (3) = 6,480 g.
240 hrs water truck x 8 g/hr x (1) = 1,920 g.
Total, this section: 19,680 g. diesel x 2 sets of equip. = 39,360 g. diesel
Total estimated diesel: 36,792 + 39,360 = 76,152 g.

<u>On-site Construction Supervisor vehicles</u>:
(4 p x 103 days) = 412 person-days x (5 miles/day)/10 mpg = 206 g. unleaded

<u>Commute to/from project site</u>:
(17 p x 103 days) = 1751 pers-days x (35 miles/day)/17 mpg = 3,605 g. unleaded

<u>Post-construction planting</u>:
60 g. + 1050 g. = 1110 g. unleaded/month x 3 months = 3330 g. unleaded

Total estimated unleaded: 206 + 3605 + 3330 = 7141 g.

Carbon dioxide equivalent (CO_2-Eq.) from combustion exhaust was calculated as follows:

76,152 g. diesel x 0.1404235 GJ/gal x (74.01 kgCO_2/GJ)/1000 = 791.43 Metric tons CO_2-Eq.

7141 g. unleaded x 0.130204 GJ/gal x (69.25 kgCO_2Eq./GJ)/1000 = 64.39 Metric tons CO_2-Eq.

Total CO_2-Eq. (Alt. 2) = 791.43 + 64.39 = <u>855.82 Metric tons CO_2-Eq.</u>

Alternative 3 – Total grading of 3 M yd^3 of fill; of which 500,000 yd^3 of fill would be imported from ISD, and 1.2 million yd^3 of fill would be imported from a more distant source. GHG emissions were not calculated for this alternative since additional source(s) of fill have not been designated. Along with greatly increased operating costs associated with the transport of a large quantity of fill from an offsite source(s), we would expect a related increase in the size of the project's carbon footprint.

Sources:

Caterpillar Performance Handbook, Edition 38. 2008. Caterpillar, Inc.
CO_2 emissions from transport or mobile sources calculation tool, Version 1.3. June 2005. World Resources Institute/World Business Council for Sustained Development GHG Protocol Initiative.
http://www.ghgprotocol.org/calculation-tools/all-tools (registration required)