FINAL

NAPA PLANT SITE RESTORATION PROJECT

RESTORATION MANAGEMENT PLAN

Prepared for

California Department of Fish and Game
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TABLE OF CONTENTS

Figures

Appendices

Figures that are available in the Draft EIR (Figures 1-1, 1-4, 1-5, 1-7, and 1-8) were not printed again for this report. The table below shows the comparable figure to look at in the DEIR.

Figure in Restoration Management Plan	Figure number in Draft EIR (DEIR)
Figure 1-1 Project Area with Topography	Figure 2-5 Project Area with Topography
Figure 1-2	Not in DEIR
Figure 1-3	Not in DEIR
Figure 1-4 Project Area with Historic Surveys	Figure 1-2 Project Area with Historic Surveys
Figure 1-5 Project Vicinity Map with Regional Wetland Habitats	Figure 1-1 Project Vicinity Map with Regional Wetland Habitats
Figure 1-6 Evolution of alternative 3	Not in DEIR
Figure 1-7 Recreation and Public Access Features	Figure 2-3 Planning Units and Public Access Features
Figure 1-8 Marsh Plain Development	Figures 2-6a, 2-6b, 2-6c Predicted Tidal Wetland Development
Figure 1-9 Decomposed Granite Surface Shared Trail	Not in DEIR
Figure 1-10 Decomposed Granite Surface Maintenance Access/Foot Trail	Not in DEIR
Figure 2-1 Duration of Inundation	Not in DEIR

BCDC	San Francisco Bay Conservation and Development Commission
Caltrans	California Department of Transportation
CDFG	California Department of Fish and Game
DO	Dissolved Oxygen
FAA	Federal Aviation Administration
Goals Project	San Francisco Bay Area Wetlands Ecosystem Goals Project
m/s	meter per second
MHW	mean high water
MLLW	mean lower low water
NCMAD	Napa County Mosquito Abatement District
NPSR	Napa Plant Site Restoration
NSMR	Napa Sonoma Marsh Restoration
NSMWA	Napa Sonoma Marshes Wildlife Area
O&M	Operation and Maintenance
RWQCB	Regional Water Quality Control Board
SSC	suspended sediment concentration
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

The Restoration Management Plan is comprised of three sections:

- Section 1 Alternatives Development Process
- Section 2 Alternatives Evaluation
- Section 3 Identification of a Preferred Alternative and Potential Project Phasing

This section introduces the Napa Plant Site Restoration project's purpose and goals, presents the development of the wetland restoration alternatives, the evolution of the public access and recreation components, describes the three final alternatives and discusses the major opportunities and resource trade-offs. Section 2 contains the evaluation of the alternatives relative to each goal and objective. Evaluation criteria were established for each objective. Section 2 contains the evaluation of each objective's specific criteria. The evaluation compares the ability of three final alternatives to meet the project's goals and objectives. In summary, Section 1 presents the evolution of the three alternatives and Section 2 compares the three alternatives relative to the project's goals.

1.1 INTRODUCTION

The purpose of the Napa Plant Site Restoration (NPSR) project is to start the process of transforming a site, which was used to harvest salt since 1952, to wetlands. Developing restoration alternatives is based on selecting wetland types that are ecologically appropriate in a local, regional and historical context, as well as physically and economically feasible. This report presents the three final alternatives and the preferred alternative that will be the subject of the project's upcoming Environmental Impact Report. The report documents the evolution of the alternative wetland restoration configurations and public access components developed to achieve the project's goals.

The project's goals are to:

Goal 1. Create conditions that will lead to the establishment of a full range of tidal habitats

Goal 2. Identify areas to be operated as managed ponds

Goal 3. Maintain existing levels of flood protection in the project reach of the Napa River

Goal 4. Implement design and management measures to maintain current levels of vector management

Goal 5. Promote environmental benefit and reduce impacts

Goal 6. Provide wildlife compatible recreational opportunities consistent with CDFG policies and regulations.

Goal 7. Minimize ecological risks from restoration

Goal 8. Design restoration implementation, management, and monitoring that can be effectively executed with minimal cost. Phase construction to meet funding availability.

In April 2005 a list of opportunities and constraints were assembled for each project goal. The opportunities and constraints analysis stimulated and informed the development of project design alternatives that were responsive to the project's goals. The list of opportunities and constraints was assembled in steps beginning with a site visit and team brainstorming meeting attended by 20 members of the consultant team, CDFG, Cargill and GAIA. The draft list was revised by discipline specialists and the project team at the June 1, 2005 team meeting. The list was submitted to the project's Science Team in July 2005 to encourage discussion regarding alternatives. The complete opportunities and constraints list is included in Appendix A.

1.2 DEVELOPMENT OF WETLAND RESTORATION ALTERNATIVES

The 1,460-acre Napa Plant Site has been subdivided into three planning units based primarily on geographic features, Figure 1-1. The three wetland planning units are as follows:

- **Ponds 9 and 10:** 170 acres located between the Northwest Pacific Railroad and Fagan Marsh Ecological Reserve (a tidal wetland also owned by the CDFG).
- **Ponds W1, W2, and W3:** 94 acres formerly used as wash ponds in the salt making operation, clustered around Green Island, and bisected by the plant site's access road.
- **Crystallizer beds 1-9 and ponds B-1, B-2, B-3 and Unit 3:** 1048 acres located south of the wash ponds and the plant operations buildings.

Wetland restoration, creation and enhancement can take many forms. Tidal marsh, managed ponds and playa (seasonal wetland) are the wetland habitat types mixed in various proportions among the alternatives discussed in this evaluation. In addition ecotone, transitional habitat from wetland to upland, is a small but ecologically important component of the habitat mix.

The first step in developing wetland restoration alternatives is to identify water sources: in this case tidal flows and seasonal precipitation. All three planning units are adjacent to the Napa River, facilitating potential restoration of tidal action. Alternatives are developed that vary water source and management, for example:

- Tidal wetland with unrestricted tidal flow,
- Managed ponds using a highly managed tidal source and seasonal precipitation,
- Playa or seasonal wetland fed by seasonal precipitation only.

The second variable in developing restoration alternatives is determining the quantity and location of the restored wetland habitat types in the landscape. CDFG prepared initial drawings of three restoration alternatives and included them in the Request for Environmental and Engineering Services (CDFG 2004). These drawings were revised numerous times to develop the three final alternatives. The revisions were crafted as a result of identification of opportunities and constraints and in response to comments from stakeholders. Field investigations and hydrologic modeling informed the development of alternatives. Modeling demonstrated that it is feasible to tidally flood and drain each unit (URS 2005 a and b). The evolution of each alternative is discussed below.

1.2.1 Evolution of Alternative 1

Alternative 1 had two versions. CDFG created the Initial Version (Figure 1-2.1) comprised of tidal action to all ponds except W2 and W3 which would be operated as managed ponds. The Final Version (Figure 1-2.2) of alternative 1 would restore tidal action to all ponds. The rationale for change included the following factors:

- Keeping the wash ponds as a single tidal unit increases the tidal prism moving through the barge channel, decreasing sedimentation and future potential maintenance dredging costs.
- Relatively high surface elevations will lead to rapid revegetation in the wash ponds after tidal action is restored.
- The wash ponds' location adjacent to Green Island provides an uncommon opportunity to have a full continuum of habitats from tidal sloughs to grassland.
- The entire area was tidal wetland prior to diking in the 1850s.

1.2.2 Evolution of Alternative 2

Alternative 2 went through three versions. The first version was developed by CDFG (Figure 1-3.1). It consisted of managed ponds in crystallizer beds 1-6, W2 and W3 and tidal action for all other ponds. This was the maximum managed pond alternative. The second version (Figure 1-3.2) – included managed ponds in crystallizer beds 1-4 and tidal action to all other ponds. The Final Version (Figure 1-3.3) is comprised of managed ponds in crystallizer beds 1-3 and tidal action to all other ponds.

The rationale for changing ponds W2 and W3 to tidal action is stated above in Alternative 1. The rationale for decreasing the area of managed ponds from crystallizer beds 1-6 to 1-3 is based on the goal of creating a full range of tidal habitats and the opportunity to re-establish the historic tidal channel alignment (Figure 1-4) and maintain its drainage area. In addition, CDFG manages over three thousand acres[1] of managed ponds on the opposite side of the Napa River in the Napa River Unit of the Napa-Sonoma Marsh Wildlife Area (Figure 1-5). The rationale for locating the managed ponds adjacent to the river is two-fold: the river provides a ready supply of water and because this corner of the site is the lowest in elevation and would take the longest amount of time to restore intertidal marsh plain.

1.2.3 Evolution of Alternative 3

Alternative 3 went through the most changes. The initial CDFG version (Figure 1-6.1) included managed ponds in W2, W3, and crystallizer beds 4-6 and tidal action to all other ponds. The second version (Figure 1-6.2) had managed ponds in crystallizer beds 1-4 and 7. The rationale for changing ponds W2 and W3 to tidal action is stated above in Alternative 1. The rationale for re-shaping the managed ponds was to add managed pond area in low elevation ponds in areas that would have the least effect on the spatial integrity of the tidal marsh.

[1] Ponds 1, 1A, 2 (1,663 acres) are designated as permanently managed ponds and it will be many years before some portion of the currently managed ponds 6, 6A, 7, 7A, and 8 (1,800+ acres), if any, will be restored to tidal action.

The third version, Figure 1-6.3 decreased the area of managed ponds to crystallizer beds 1-4 and added playa in wash ponds W1, W2, and W3. All other ponds are tidal. The rationale for change was that adding playa or seasonal wetland in the wash ponds increased wetland habitat diversity adjacent to the core of the site to take advantage of future educational/interpretive opportunities centered around that core.

The fourth version, Figure 1-6.4, further decreased the area of managed ponds to crystallizer beds 1-3 for the reasons described above.

1.3 EVOLUTION OF PUBLIC ACCESS AND RECREATION COMPONENTS

Goal number 6 is "Provide wildlife compatible public access and recreational opportunities consistent with CDFG policies and regulations." There are multiple opportunities to integrate wildlife compatible recreation and public access components into the project. These opportunities include levee trails, hand launching of water craft into the river from the barge channel, picnicking, and educational/interpretive opportunities. Many of these activities will be centered around the core of the site adjacent to the barge channel and plant operations buildings. The components included in the plan have evolved; however, the recreation and public access features are the same for each of the three final alternatives.

The recreation and public access features were developed in tandem with the wetland restoration alternatives. They were first addressed in the April 2005 team meeting and site visit. Two additional site visits were conducted to further assess existing conditions within the site and neighboring areas, including greater American Canyon, northern Vallejo, Highways 37 and 12/121, eastern Sonoma and southern Napa. Additionally the Napa County and City of American Canyon general plans, studies and guidelines relative to parks and recreational facilities, and the relationship of these facilities to the Napa Plant site and its vicinity were reviewed.

The first version of the public access and recreation plan included proposed trails on the perimeter levee of the entire project site, including from the southern end of crystallizer bed 7 to pond B-3. This trail segment was eliminated because levee breaches will not be bridged, making this area inaccessible by land. The first version also included a trail on the perimeter levee of Ponds 9 and 10. The rationale for eliminating this trail was three-fold: 1) the levee breach to Fagan Slough; 2) the lowering of the levee between ponds 9 and 10 and Fagan Marsh; and 3) there is no direct or properly signed crossing over the railroad corridor for pedestrian/bicycle access from Green Island Road or other project trails. As described in the Napa County Bikeways Plan, the railway will remain in operation for the foreseeable future (LandPeople et. al., 2005).

The initial plan included a primary public access staging area to be located off Green Island Road based on the April site visit. After site reconnaissance work and research, it was determined that better access would be provided from the existing barge channel area and boat dock facility. The final alternative still includes a small staging area at the end of Green Island Road which is currently used by fishers and for casual river levee access. However the site's primary staging area is planned to be adjacent to the barge channel and former plant operations buildings. A description of the recreation and public access features is shown on Figure 1-7 and included in the description of alternative 1, below.

CDFG intends to manage Ponds 9 and 10 as part of the Fagan Marsh Ecological Reserve. All land south of Ponds 9 and 10 would be managed as a component of the Napa Sonoma Marshes Wildlife Area (NSMWA). Land use in these areas would be consistent with the CDFG management designations. For example, waterfowl hunting may be allowed in the southern portion of the project site (i.e., crystallizer beds, Unit 3, Ponds B-1 through B-3) but not in the north, because hunting is not a permissible activity in DFG Ecological Reserves. The rules and regulations for Wildlife Areas and Ecological Reserves are promulgated in Fish and Game Code Sections 1525-1530 and 1580-1586, respectively.

1.4 DESCRIPTION OF THE FINAL ALTERNATIVES

The process described in Section 1.3 resulted in the selection of three final alternatives. The evaluation of the three final alternatives is presented in Section 2 below. The following sections describe the three final alternatives and discuss the major opportunities and constraints and resource and access trade-offs associated with each.

1.4.1 Alternative 1 – Full Tidal Restoration

This alternative would restore tidal action to all salt ponds within the project area, increasing tidal wetland habitat in this reach of the Napa River by more than 1,300 acres. This alternative maximizes the potential for restoration of tidal habitat to serve aquatic and marsh-associated wildlife. The site will evolve over time, first providing intertidal and subtidal open water habitat for fish, waterfowl and shorebirds. Then, low tidal marsh would develop. This low marsh and its associated channels would provide potential foraging habitat for the California clapper rail (*Rallus longirostris obsoletus*) and juvenile salmonids. Ultimately, high marsh would develop and the marsh plain would provide habitat for locally threatened and endangered species such as the salt marsh harvest mouse (*Reithrodontomys raviventris*), black rail (*Laterallus jamaicensis coturniculus*), and the San Pablo song sparrow (*Melospiza melodia*).

The location of initial colonization by vegetation will be affected by topographic variation and sedimentation processes. Figure 1-8 shows the results of sedimentation calculations based on hydrologic modeling[2]. Vegetation will begin colonizing the new marsh plain when it reaches elevations between mean sea level and mean high water. This will occur soon after breaching in some of the higher areas. The calculations indicate that by approximately 4 years after breaching to restore tidal action to the wash ponds, the vast majority of the tidal marsh plain should be suitable for low marsh plants such as cordgrass (*Spartina foliosa*) and various bulrushes (*Scirpus robustus* or *maritimus*, *S. acutus*, *S. californicus*). The estimate is 9 years for ponds 9 and 10 and 13 years for the remainder of the southern ponds to reach this stage. Pickleweed (*Salicornia virginica*) will become established over time as the marsh plain continues to accrete. The calculations suggest that by approximately 65-75 years after breaching the tidal marsh plain should be suitable for pickleweed colonization, or the site-specific climax vegetation community. Pickleweed will undoubtedly colonize many areas of the site long before this, beginning on the lower fringe of the ecotone.

[2] The formula and assumptions used in the calculations are presented in detail in Section 2.

This alternative would re-establish historic channels, hydrologic processes and tidal marsh plain. Unrestricted breaches would be located at historic channel sites: the southern end of crystallizer bed 8 to the Napa River, the northern edge of Pond 9 to Fagan Slough, and on the western edge of Pond B-3 to the Napa River (Figure 1-2.2). Opening the area to the river will increase off-line flood storage under some conditions, e.g., at low tide. However, opening the area to the river also introduces tidal action to the eastern perimeter levee, which will need to be raised to maintain the current level of flood protection to neighboring properties. Modeling also shows that the project does not increase flood elevations in the river because the tides in San Pablo Bay determine the flood elevation (URS 2005b).

The 1,300 acres included in Alternative 1 are subdivided into 18 separate ponds. This equates to several thousand of feet of internal levees. Construction of the restoration project will include numerous activities affecting these internal levees. They will be breached along the main channel excavation alignment. All internal levee surface elevations will be lowered to the elevation of mean high water. The internal levees will be disconnected from the perimeter levee to discourage predator access. Some of the levee material will be placed into internal ditches, creating ditch blocks to prevent hydrologic short-circuiting. In other type of application, material generated by lowering the levee between ponds 9 and 10 to mean high water (MHW) will be returned to the borrow ditch located immediately east of the levee. The remaining levee segments that are allowed to remain will serve a number of purposes. They will break the wind fetch across the ponds, decreasing potential wind-wave induced erosion on the east perimeter levee and facilitating sedimentation. In addition, these levee sections provide topographic variation and are submerged by the tides for a shorter duration than the pond bottoms and thus can provide roosting habitat. Soil will be added to some levee segments to create low relief islands that will later be integrated into the marsh plain.

Locations for major construction components for alternative 1 are shown in Figure 1-2.2 and include the following:

- excavate breaches into crystallizer bed 8, and Ponds 9, B-3 and W1. The levee located between the breaches into crystallizer bed 8 and Pond B-3 will be abandoned due to lack of access.
- excavation of approximately 22,000 linear feet of large order of tidal channels along historic slough alignments
- perimeter levee raising to maintain flood control on the eastern and southern edges of pond 10, the northern edge of pond W1, eastern edge of ponds W2 and W3, and the eastern edge of ponds B-1, B-2, and B-3
- levee lowering to mean high water (MHW) on the northern edge of Ponds 9 and 10 to merge these ponds with Fagan Marsh
- breaching internal levees at selected locations and lowering internal levees to MHW
- realign the plant site access road to immediately south of pond W3 to allow the wash ponds to function as a single unit
- install a 12 inch potable water line to the plant site, along Green Island Road
- ecotone creation along selected perimeter levees where it can be contiguous with adjacent upland (e.g. around Green Island and on the eastern edge of ponds B1 and B2, and in

conjunction with raising the perimeter levee to maintain flood control). In areas where a broad ecotone is not appropriate, add material to the in-board side of perimeter levees, as it is available, to create a habitat "bench" and keep erosive forces farther from the levee core

Public access and recreation components are shown in Figure 1-7. The primary staging areas for parking, picnicking, restrooms, and boat launch would be centered around the barge channel. Hand launched water craft (e.g. canoes and kayaks) would be possible at the existing boat docks in the barge channel. Presently, the barge channel is a dead end slough that requires periodic maintenance dredging to prevent it from filling with sediment. Opening the wash ponds to tidal action would increase the flow in the barge channel; however, the tidal prism generated by opening the wash ponds would not be large enough to maintain the barge channel at its existing size of over 200 feet. Hydraulic geometry relationships developed for San Francisco Bay estuary tidal marshes (Williams et al. 2002) suggest that opening the wash ponds (approximately 90 acres) to tidal action would result in a channel that is about 70 feet wide and likely less than 10 feet deep (at MLLW). Initially, the channel may be wider until the wash ponds fill with sediment and the tidal prism reduces. To maintain a boat launching facility, the launch ramp would need to be located near the breach location or possibly at the end of a dock that extends into the main part of the channel.

Connections to bicycle lanes on Green Island Road and future connections to other outlying areas will be facilitated. Figures 1-9 and 1-10 show conceptual sketches of trail types for the perimeter trail. The perimeter trail would support both pedestrians and cycling and has the potential to connect to a regional trail network. Discussions have begun with the City of American Canyon to coordinate trail connection opportunities. Smaller trails would foster bird watching, native plant and wildflower viewing, and be good locations for interpretive panels. Hunting will not be allowed in the Fagan Marsh Ecological Reserve, including Ponds 9 and 10. Hunting may be allowed in southern ponds, in compliance with all CDFG standard regulations. In the long term, CDFG would like to have an environmental interpretive center on the property. The available road access and upland area for locating a center immediately adjacent to the Napa River and its wetlands presents a rare opportunity.

Resource Trade-offs

The resource trade-offs resulting from an all tidal restoration alternative are that in the long term the fully vegetated marsh plain will support a less diverse waterbird community than managed ponds (L. Wyckoff, personal communication). However, ducks and shorebirds will utilize the site during the first phase of marsh plain development. Ultimately having fewer habitats (tidal marsh, channels, small areas of playa, and river) could limit the educational interpretive opportunities on the site, as compared with having managed pond habitat on the site as well. The advantage to a less diverse waterbird community is that it reduces bird strike potential. The potential for bird strikes to aircraft using the Napa County Airport once the vegetated marsh plain is established will be low. This is due to the types, sizes and behaviors of the birds that use a mature tidal marsh. These birds are small in size and do not occur in large flocks; examples include salt marsh common yellowthroat (*Geothlypis trichas)* and marsh wren (*Cistothorus palustris).*

1.4.2 Alternative 2 – Tidal Restoration and Managed Ponds

This alternative would restore two primary types of habitat: 986 acres of tidal wetland and 175 acres of managed pond. Tidal action would be restored to all salt ponds except crystallizer beds 1-3, which would be operated as managed ponds. The description of tidal wetland restoration for Alternative 1, above, applies equally to this alternative except in the managed pond area. The crystallizer bed 1-3 area would be operated as shallow open water habitat and managed for waterfowl and shorebirds. The ponds would be operated using water control structures to manage intake and discharge or water from the Napa River. The managed pond area would contain water year-round. Water would be approximately 2 to 3 feet deep and salinity would be low in the winter to provide habitat for waterfowl. In the spring the water depth would be lowered to less than 1 foot, and salinity would increase passively (via evaporation), to create optimal shorebird foraging conditions. Grading of the pond substrate during construction would create an undulating surface capable of sustaining multiple water depths for both short and long-legged shorebirds.

The managed pond construction features include work on perimeter and internal levees as well as installation of water control structures. Multiple, large diameter culverts with slide gates would be installed at the northern end of crystallizer bed 2. The gates would facilitate intake from and discharge to the Napa River. Raising the perimeter levee around the managed pond unit, located at the southern edge of crystallizer beds 1-3 and the eastern side of 3 would be required to minimize daily tidal flooding across the low points in the levee separating crystallizer beds 1 and 7. The internal levees will be lowered and the material used to create refugial mounds/islands for roosting, high tide refugia and potential nesting habitat. The current conceptual level design includes 16 acres of refugial habitat within the managed pond area.

Resource trade-offs

The managed pond alternative has one primary advantage and two primary disadvantages. The advantage is that another habitat type is present on the site for potential educational/ interpretive value, as well as habitat diversification. This later point is not as critical because thousands of acres of managed ponds operated by CDFG are located immediately across the Napa River and are heavily used by migratory water birds.

The first disadvantage is the long-term commitment to maintenance required by this alternative. The water control structures will need to be operated and will need to be replaced over time. Water control structures such as gated culverts also tend to settle differentially and can get blocked by sediment deposition at either end. The internal levee will be an additional length of levee that will require maintenance. A second potential disadvantage is that if the gates are operated bi-directionally, with a discharge to the Napa River, then water quality may be a concern. Water quality monitoring conducted for the Initial Stewardship Plan of the South Bay Salt Ponds Restoration Project suggests that managed ponds with limited tidal exchange can periodically experience low concentrations of dissolved oxygen, and elevated pH caused by algal blooms and accumulating organic matter that exerts a high biochemical oxygen demand (USFWS 2005).

Active management of the water control structures will be necessary to sustain the ponds' open water character. Operating the water control structures to maximize salt conservation, and potentially increase salt concentration, will help discourage vegetation colonization. The ponds

could also be drained or flooded rapidly, if necessary. Operation of the water control structures would assist in controlling the spread of avian disease, growth of mosquito larvae, managing water quality conditions and/or avoiding intake of fish.

1.4.3 Alternative 3 – Tidal Restoration, Managed Ponds and Playa

This alternative would restore tidal action to 889 acres of salt ponds, create 175 acres of ponds managed as seasonal wetlands, and allow 82 acres of ponds to function as playa habitat. This alternative has the potential to restore significant tidal marsh habitat, create seasonal wetland habitats that can be managed for waterfowl and shorebirds, and provide playa habitat adding landscape diversity. The habitat description and the pros and cons are the same for the tidal habitat and managed ponds as discussed above for alternatives 1 and 2. The difference in this alternative is the introduction of playa habitat in the wash pond area.

Limited earth moving would be required to construct the playa. The three wash ponds would essentially remain in their current condition, inundated by seasonal precipitation and drying in the summer months to a salt-crusted panne. The area may provide shorebird habitat.

Resource trade-offs

The primary advantage of this alternative is the addition of another habitat type. The playa habitat would provide additional open water area that may be utilized by shorebirds and waterfowl, and it would provide local educational interest. Tidal panne habitat, similar to playa, will develop over time in the tidal wetland, however, the spatial extent of this habitat type would likely be less than the proposed area of playa.

Maintaining the wash ponds as playa habitat will not require a breach in the wash pond levee. Without the levee breach the barge channel may fill with sediment (See Section 1.4.1). Dredging would be required to keep the barge channel open. If the channel is allowed to fill with sediment then the boat launch would need to be abandoned or moved to the edge of the river, and the water control structures associated with the managed ponds would need to be located closer to the Napa River to prevent them from being blocked by sediment.

Playa habitat would be low maintenance, if no water control structures are installed. If water control structures are installed they would require management and maintenance. If the primary access road remains in place for this alternative, then the playa would be bisected by the road and its associated activity. This could affect the avian use of the playa.

This alternative has the least amount of tidal habitat (about 6 percent less than Alternative 2) and is inconsistent with the historic extent of tidal wetland. Thus, in the long-term it would provide less habitat than alternatives 1 and 2 for special-status species associated with tidal wetland such as the salt marsh harvest mouse, California black rail and San Pablo song sparrow than.

This section presents the evaluation of the restoration alternatives. The goals and objectives established for the project are the backbone of the alternatives evaluation. Evaluation criteria were developed for each of the project objectives. The Science Team reviewed the criteria in July 2005, and their feedback was incorporated into the final screening analysis. The goals, objectives, and criteria have been organized into a matrix for the evaluation of the restoration alternatives. There are quantitative and qualitative criteria in the evaluation matrix. The criteria are not scored or weighted, and the matrix is not designed to select a preferred alternative. Rather, the matrix serves to organize a great deal of information from multiple disciplines (e.g., hydrology, biology, public access). This organization of information will facilitate the decision-making process. For some objectives the results of the evaluation does not differ among the alternatives, and some information is redundant. Additionally, because the project is only at the conceptual design phase of planning, information needed to evaluate certain criteria has not been fully developed, especially for quantitative values. Numerous assumptions have been made in the evaluation, and these assumptions are clearly stated. In general, the criteria are evaluated at a point in the future approximating tidal wetland dynamic equilibrium.

Evaluation Matrix

Goal 1. Create conditions that will lead to the establishment of a full range of tidal habitats.

Objective 1.A. Create tidal marsh

Criterion Acres of tidal marsh

Methods and Assumptions The calculation assumes that all areas currently at intertidal elevations that are open to tidal circulation will develop characteristics of tidal marsh. The acreage calculations include intertidal marsh and channel habitats shown on the Alternative development figures presented in Section 1.

Results

Alternative 1	Alternative 2	Alternative 3
1175 acres	984 acres	892 acres

Discussion All of the alternatives have the potential to provide for extensive tidal marsh development. Alternative 1 would provide approximately 15 and 22 percent more tidal marsh area than Alternatives 2 and 3, respectively.

Objective 1.B. Make use of historic slough channels/locations

Criterion Linear feet of historic channel excavated

Methods and Assumptions This objective was evaluated by projecting a geo-referenced historic survey (United States Coastal Survey 1856) over the proposed project excavation plan. The analysis assumes that tidal channels would be excavated to facilitate flooding and draining of the site in ponds 9&10, and crystallizer beds 4, 5, 6, 8, 9, Unit 3, and B-3 to accelerate tidal marsh development.

Results

Alternative 1	Alternative 2	Alternative 3
22,100 linear feet	21,000 linear feet	21,000 linear feet

Discussion Although each alternative will provide the same overall linear footage of excavated primary channel in the southern ponds, the managed pond levee in Alternatives 2 and 3 will push the primary channel outside of the historic channel extents for approximately 1,100 linear feet. There is no linear footage of channel excavation within the Wash Ponds for any of the alternatives.

Objective 1.C. Excavate tidal channel network template in the marsh plain to achieve full range of channel cross-section dimensions

Criteria a) Linear feet of channel excavated

b) Volume of excavated material associated with channel grading

Methods and Assumptions This objective was evaluated by projecting the proposed channel excavation plan for each alternative over the project topographic map in AutoCAD. This analysis assumes that the proposed channel excavation plan will lead to development of a marsh plain with a full range of channel cross-section dimensions of major tidal channels

Results

Alternative 1	Alternative 2	Alternative 3
a) 22,100 linear feet; b) 483,000 CY	a) 22,100 linear feet; b) 483,000 CY	a) 22,100 linear feet; b) 478,600 CY

Discussion Each alternative will excavate the same length of channel within the various portions of the project. However, the overall excavation volume for Alternative 3 is decreased slightly due to the fact that the breach to the Wash Ponds has been eliminated for this alternative.

Objective 1.D. Create large tidal drainage basins that will sustain subtidal channel habitat

Criteria a) Drainage basin area

b) Area and volume of subtidal channels

Methods and Assumptions This objective was evaluated by measuring the drainage area for each alternative, and by calculating the area of proposed channel below MLLW.

Results

CB= crystallizer bed
CY = cubic yards

Alternative 1	Alternative 2	Alternative 3
Southern Unit: CB8 = 890 acres B-3 = 160 acres	**Southern Unit:** CB8= 700 acres B-3 = 160 acres	**Southern Unit:** CB8= 700 acres B-3 = 160 acres
Wash Ponds: 92 acres	**Wash Ponds:** 92 acres	**Ponds 9 and 10:** 170 acres
Ponds 9 and 10: 170 acres	**Ponds 9 and 10:** 170 acres	**Subtidal Channels:** 55 acres; 90,000 CY
Subtidal Channels: 55 acres; 90,000 CY	**Subtidal Channels:** 55 acres; 90,000 CY	

Discussion The largest drainage basin will be formed by the breach in the levee at CB 8. The drainage basin for the southern unit is less for Alternatives 2 and 3 because CB 1, 2, and 3 will be managed ponds. Alternative 3 would not have the drainage basin associated with the wash ponds. The extent of subtidal channel does not vary among the three alternatives.

Objective 1.E. Create habitat for aquatic and terrestrial native species including migratory birds, fish mammals, plants, invertebrates, and special status species

Criteria

a) Acres of tidal marsh

b) Acres of channels

c) Acres of ecotone

d) Acres of managed ponds

e) Acres of playa

f) Acres of refugia

Methods and Assumptions The evaluation of this objective is based on the conceptual design of the three restoration alternatives. For this analysis we assume the following:

In areas open to tidal circulation sufficient sedimentation will occur for development of tidal marsh (see objective 1.H. and 1.A.)

Tidal channels that would develop after construction and breaching are not considered in the area calculations

Ecotone refers to land between MHHW and EHW

Refugia refers to high ground in the managed pond complex

Results

Habitats with acres in parenthesis

Alternative 1	Alternative 2	Alternative 3
a) Tidal marsh (1175)	a) Tidal marsh (984)	a) Tidal marsh (892)
b) Channel (85)	b) Channel (85)	b) Channel (85)
c) Ecotone (60)	c) Ecotone (60)	c) Ecotone (60)
d) Managed ponds (0)	d) Managed ponds (175)	d) Managed ponds (175)
e) Playa (0)	e) Playa (0)	e) Playa (94)
f) Refugia (0)	f) Refugia (16)	f) Refugia (16)

Discussion All of the restoration alternatives will provide extensive habitat for aquatic and terrestrial native species. Alternative 1 will have the greatest extent of tidal marsh habitat, which is important for many species, but will lack the heterogeneity of Alternatives 2 and 3. Alternative 1 has less high tide refugial habitat because the entire area is subject to tidal action. Alternative 3, with managed ponds and playa habitat, provides the greatest opportunity to manage the project area for a diverse assemblage of wildlife species.

Objective 1.F. Create intertidal mudflat and shallow subtidal habitat

Criteria
a) Acres of intertidal mudflat
b) Acres of subtidal habitat

Methods and Assumptions
Acreage of intertidal mudflat was calculated from the marsh plain development analysis (see objective 1.H)

Acreage of subtidal habitat was calculated for the proposed channel below the MLLW elevation for the site.

Results

Alternative 1	Alternative 2	Alternative 3
a) Acres of intertidal mudflat a) 1175 acres (temporary) **b) Acres of subtidal habitat** b) 55 acres	a) 984 acres (temporary) b) 55 acres	a) 892 acres (temporary) b) 55 acres

Discussion

All portions of the project area opened to tidal action will have temporary intertidal mudflat. Alternative 1 will have the most intertidal habitat because the tidal area is larger. The intertidal mudflat habitat will persist from the time of breaching until the marsh plain becomes vegetated. For the majority of the project area this is expected to take approximately 10 to15 years (Figure 1-8). Intertidal mudflat will be a permanent landscape feature along the margins of tidal channels, and in naturally forming topographic depressions on the marsh plain (tidal panne).

The existing elevations of the bottom of all the ponds are above MLLW so initially subtidal wetland area will be limited to the lowest portions of the excavated channels. This acreage is consistent for all three alternatives. As new channels develop the subtidal area will increase in proportion to the area of the channels. It is estimated that tidal channels will comprise 10-15% of tidal wetland when the marsh system is fully developed (Williams et al 2002, which would be approximately 60 to 70 years post-restoration (Figure 1-8).

Objective 1.G. Enhance and expand existing ecotones and create new ecotone (upland transition area). Maximize good levee habitat in concert with flood control levee improvements.

Criterion Acres of ecotone habitat

Methods and Assumptions
For this analysis ecotone refers to land between MHHW and EHW

Results

Alternative 1	Alternative 2	Alternative 3
60 acres	60 acres	60 acres

Discussion	At this stage of design all of the alternatives have equal amount of ecotone habitat. The extent and location of the ecotone habitat will be refined in later stages of the design process. In addition, levee segments without broad ecotone will have a habitat bench (i.e., soil placed on the in-board side of the levee to form a small transition and provide erosion protection).

Objective 1.H.	Create conditions for the establishment of mature tidal marsh
Criterion	Mature marsh plain development over time (Acres)
Methods and Assumptions	A sediment mass balance was conducted similar to that described in Appendix D of the Napa Salt Marsh Feasibility Study (US Army Corps of Engineers 2004) for the Napa Sonoma Marsh Restoration (NSMR) project. For this analysis the rate of change in the marsh elevation was assumed to be a function of the sediment concentration in the flood tide waters and the settling rate of the sediment in the wetland. The following assumptions were used in the analysis: • The suspended sediment concentration (SSC) in the flood tide waters was 125 mg/l (the same as used in the Napa Salt Pond feasibility study). • A "typical" tide generated from the tidal data was used in the analysis. • Sediment was assumed not to be resuspended once settled. • The settling velocity was assumed equal to: Vs = kC4/3, where k = 0.00011 for SI units, C = sediment concentration in the wetland and Vs equals the settling velocity (m/s). This is the same relationship used in the Napa Salt Ponds Feasibility Study. • Dry density of inorganic sediment when deposited = 400 kg/m^3 • Only marsh rise through sedimentation was included. The increase in marsh elevation due to sediment trapping by vegetation and organic deposition was not included. These processes will become important as the marsh develops. • Sea level rise was assumed to be 0.0036 m/yr, the same as used in the Napa Salt Pond Feasibility Study. • An average elevation, derived from the topographic survey, for each pond was used as the initial elevation. No additional fill in the ponds was considered. • Only existing internal pond dimensions were considered. Internal pond levees and ecotone areas to be constructed are not included in the analysis.

Results

Acres of vegetated marsh (elevation between MSL and MHW)

Alternative 1	Alternative 2	Alternative 3
At 10 years: 900	**At 10 years:** 850	**At 10 years:** 770
At 25 years: 1150	**At 25 years**: 1000	**At 25 years:** 920
At 50 years: 1150	**At 50 years:** 1000	**At 50 years:** 920
See Figure 1-8	See Figure 1-8	See Figure 1-8

Discussion

The results of the marsh evolution for the three alternatives are shown in Figure 1-8. The rate of marsh plain accretion starts out high because the duration of flooding is high. As the wetland increases in elevation the duration of flooding decreases so the rate of marsh plain growth also decreases. It was assumed that vegetation would start to colonize the ponds when the pond bottom elevation approaches sea level. For all the alternatives the elevation of the ponds will start to reach sea level starting in about years 3 to 5, and would continue for about another 10 years, by which time all the ponds should be at sea level or higher. Mature marsh was assumed to start developing when the pond bottom elevation is equal to Mean High Water (MHW). It is expected to take 50 years or more for tidal areas in all alternatives to develop into high marsh (Figure 1-8). However, variations in topography and depositional patterns will cause this to occur sooner in some locations.

Objective 1.I. Maximize synergy with existing habitat (e.g., Fagan Marsh and isolated wetlands/drainages adjacent to eastern perimeter)

Criterion Yes/No

Methods and Assumptions None

Results

Alternative 1	Alternative 2	Alternative 3
Yes, has largest area directly connected to the Napa River.	Yes, has less area directly connected to the River but managed ponds will provide habitat for water birds, thereby 'connecting' it to other areas.	Same as alternative 2. Playa, while not hydraulically connected to the river will be connected via the water birds and wild life that use it.

Discussion

There are numerous opportunities for synergy with adjacent habitats: the Napa River, Fagan Marsh, and the small patches of wetland to the east of the site. The largest opportunity for synergy with adjacent habitats is reconnecting ponds 9 and 10 to Fagan Marsh, located to the north of ponds 9 and 10. This opportunity is the same for all three alternatives. The levee separating ponds 9 and 10 from Fagan Marsh and Fagan Slough will be graded to approximately mean high water and a 200-foot wide levee breach excavated. A starter channel would be excavated along the approximate alignment of the historic channel. This would literally allow flow of organisms and nutrients between the two areas and

the Napa River.

Project design elements on the eastern edge of ponds B-1, B-2, and B-3 will complement the adjacent off-site habitats. For example, ecotone and refugia will be placed opposite the vineyard and grassland, whereas wetland will come to the toe of the levee adjacent to the two low-lying wetlands.

The connection with the Napa River affords opportunities for myriad synergistic exchanges with the multiple intertidal habitats created at the project site, e.g.: foraging and roosting habitat for water birds, nursery habitat for fish and crabs, production and discharge of organic detritus etc.

Green Island is a natural topographic high. This is an uncommon occurrence in vast expanses of tidal marsh plain. The design will capitalize on this condition, creating ecotones or smooth transitions from aquatic habitat to upland.

The alternatives do not preclude future opportunities to hydraulically connect to the State Lands Commission Pond and or the muted tidal wetland located at the end of Eucalyptus Drive and owned by the City of American Canyon. Tidal flow to the wetland at the end of Eucalyptus Drive currently originates south of the closed landfill and passes through culverts under Eucalyptus Drive. Connecting this wetland to the Napa River via the channel adjacent to Pond B-3 would provide more direct tidal action, resulting in a larger tidal amplitude on this wetland. Increasing the tidal action on the site would likely change the vegetation cover and composition.

Objective 1.J. Minimize potential for bird strikes (same as 5.E)

Criteria Area and duration of standing water on site at time zero, at year 10 and year 50

Methods and Assumptions The area of inundation and duration of flooding was based upon the marsh evolution results described in Objective 1.H. The elevations of a "typical" tide (i.e., tidal datum estimates for the project site) were compared to the estimated elevations of the pond bottoms. Percent time of inundation was calculated as the fraction of the time the tide exceeded the pond bottom elevation. The following was assumed:

- The wetland drains and fills completely. If a large breach but no channels are constructed initially, then portions of the ponds could remain flooded continuously until channels develop. This could take several years.
- Each pond accretes evenly. This results in no decrease in the area of inundation over time until the entire pond is above MHHW, only a decrease in the duration of inundation.

Results

Alternative 1	Alternative 2	Alternative 3

At 0 years: On average, tidal areas are inundated 60% of the time. **At 10 years:** On average, tidal areas are inundated approximately 40% of the time **At 50 years:** On average, tidal areas are inundated approximately 10% of the time **See Figure 2-1**	Inundation of tidal areas is similar to Alternative 1 Managed ponds may be inundated from 60 to 100% of the time, depending on the season and management regime	Inundation of tidal and managed areas is similar to Alternative 2 Playa may be inundated 60 to 75% of the time, depending on climate and management regime

Discussion

Predictions for duration of inundation in tidal areas are shown on Figure 2-1. At the time of breaching the inundation period is estimated to range from 40% in B1-B3 to 75% in CB 1-9. Since these estimates are based on a "typical tide" there may be diurnal variation that would fall outside the prediction. As the marsh plain accretes over time the duration of inundation will decrease (Figure 2-1). By year 50 the marsh plain is only inundated 10 to 15% of the time. These predictions are roughly equivalent for all alternatives.

The duration of standing water in managed ponds and playa will depend on management regime and climate. In general, managed ponds would be shallowly flooded in late summer and then to maximum depths between late-fall through winter months to manage for waterfowl. In the spring the ponds could be drawn down for shorebird nesting. The managed ponds may dry completely by the late summer. Typically, playa will be inundated by precipitation from November through June or July.

Objective 1.K. Minimize off-site erosion of existing marshes and unintended levee breaching that may result from increases in tidal prism from successive opening of restoration projects throughout the area

Criteria

a) Estimate changes to Fagan Slough cross section and Fagan Marsh

b) Estimate erosion potential by Edgerley Island docks

Methods and Assumptions

Methods to quantify the evaluation of this objective are being developed. However, the changes to Fagan slough cross-section will be the same for each alternative since Ponds 9 and 10 will be restored to tidal for all alternatives.

Results

Alternative 1	**Alternative 2**	**Alternative 3**
Not likely to vary among alternatives		

Discussion

There will be an increase in the diurnal tidal prism of about 600 acre-feet

as a result of the increased tidal prism due to opening Ponds 9 and 10. Details on the changes will be included in the EIR; however, the increased tidal prism is expected to increase the cross-sectional area of the channel by several hundred square feet.

Objective 1.L. Minimize loss of mudflat from breaching levees in CB 8 and Pond B-3.

Criterion Estimate new channel area across mudflat

Methods and Assumptions This objective was evaluated by measuring the width of the historic channel (USCS 1856) that crossed the mudflat south of CB 8. Qualitative comparisons to the historic channel top width are made for the evaluation of the alternatives. Mudflat erosion associated with the Pond B-3 drainage channel is assumed to be similar to the breach width.

Results

	Alternative 1	**Alternative 2**	**Alternative 3**
Estimated channel scour in the mudflat outboard of levee breach	South of breach at CB 8: Greater than historic condition at time 0, and greater than historic condition at dynamic equilibrium	South of breach at CB 8: Greater than historic condition at time 0, and approximately equal to historic condition at dynamic equilibrium	Same as Alternative 2

Discussion The historic channel that crossed the mudflat directly south of CB 8 had a top width that ranged from 130 to 600 feet, with an average width of approximately 250 feet. This channel had a drainage area of approximately 750 acres. This drainage area is similar to the area proposed for the main channel in Alternative 2 (approximately 740 acres), but less that the drainage area of the main channel in Alternative 1 (approximately 880 acres). In addition, because the marsh area has subsided, the tidal prism at the time of breaching (time 0) will be larger than the historic condition. Therefore, when the levee is breached near CB 8 the channel that will form in the outboard mudflat would presumably be larger than the historic condition for all Alternatives. For Alternative 1 the channel in the mudflat would remain larger than the historic condition because of the larger drainage area. For Alternatives 2 and 3 the channel would presumably be similar in cross-section to the historic condition because of the similar drainage area. At this stage of analysis it is difficult to assess whether additional scour of the outboard mudflat will occur outside of the channel footprint.

Goal 2 Identify areas to be operated as managed ponds (and/or playa).

Objective 2.A. Create conditions that will provide habitat for migratory water birds (shorebirds/waterfowl)

Criterion Acres of managed ponds and playa

Methods and Assumptions This objective was evaluated calculating the acres of proposed managed pond and playa for each alternative

Results

Alternative 1	Alternative 2	Alternative 3
0 acres of managed ponds	175 acres of managed ponds	175 acres of managed ponds and 94 acres of Playa

Discussion All alternatives will improve habitat for migratory birds such as waterfowl and shorebirds in the years following implementation of the project. Developing tidal marsh will provide foraging and roosting areas for various bird guilds. However, Alternatives 2 and 3 would have water features that are specifically designed and managed for the benefit of shorebirds and waterfowl. Water quality and water depth will influence habitat quality and type and are controlled by site management.

Objective 2.B. Create structural complexity for water-related birds

Criteria a) Acres of islands

b) Acres available for topographic variation

Methods and Assumptions Acres of protected nesting habitat includes constructed refugia in managed ponds. Acres available for topographic variation includes the total area of managed ponds and playa.

Results

Alternative 1	Alternative 2	Alternative 3
None	16 acres of refugia; 175 acres available for topographic variation (managed ponds)	16 acres of refugia; 269 acres available for topographic variation (managed ponds plus playa)

Discussion Developing protected nesting areas in the tidal portions of the project is not considered feasible because of the dynamic nature of the landscape. Therefore, Alternative 1 has no protected nesting or topographic variation as components of the design.

Approximately 16 acres of protected nesting (i.e., islands within the managed ponds) are proposed as part of the conceptual design. This will be refined in later stages of the design process.

Objective 2.C. Select areas that facilitate maintenance access

Criterion Yes/No

Methods and Assumptions None

Results

Alternative 1	Alternative 2	Alternative 3
Not Applicable	Yes	Yes

Discussion	Water control structures for managed ponds will be located on the perimeter levee, and will be easily accessible by motorized vehicles. Alternative 1 is not applicable because no maintenance is anticipated.

Objective 2.D.	Minimize potential adverse water quality conditions
Criteria	a) Temperature b) Dissolved oxygen (DO) c) pH d) Salinity
Methods and Assumptions	**Methods** Much of the evaluation for this objective is based on the water quality analyses conducted for the NSMR on the west side of the Napa River and on observations from introducing tidal action to the South Bay Salt Ponds. **Assumptions** <u>Temperature:</u> • Ponds which are opened to tidal influence will be less likely to exhibit temperature deviations from ambient because of the continual exchange of water with Napa River; • Managed Ponds will have less tidal exchange than breached tidal ponds; • Playa ponds will have less tidal exchange than managed ponds <u>Dissolved Oxygen:</u> • Tidal areas are not likely to have DO concentrations below 5 mg/l because there is low potential for algal blooms and upper sediments remain oxygenated due to cyclical exposure to the atmosphere and wave induced turbulence. • Percent saturation of oxygen in water tends to decrease as the temperature increases, the negative impact anticipated is depression of dissolved oxygen, and this depression of DO will be most pronounced in ponds with the highest temperature. DO can also be reduced by biotic respiration, e.g., by algae at night or by microbial metabolism. <u>pH:</u> • The evolution of pH patterns in the Napa Plant site will be similar to that observed at the Napa-Sonoma Marshes Restoration site on the west side of the Napa River. • pH may increase in association with algal blooms and decrease due to contact with peat soils <u>Salinity:</u>

- The ponds will be dry when the levees are breached and tidal exchange is initiated with the receiving water
- Managed Ponds will have less tidal exchange than breached tidal ponds;
- Playa ponds will have less tidal exchange than managed ponds

Results

Alternative 1	Alternative 2	Alternative 3
Temperature: Very low potential for sustained high temperatures **DO:** Very low potential for DO <5 mg/l **pH:** Very low potential for pH extremes **Salinity:** No potential for adverse conditions after initial equilibration	**Temperature:** Managed ponds have the potential for increased temperatures **DO:** Managed ponds have potential for DO <5 mg/l at times **pH:** Managed ponds have potential for periodic pH extremes **Salinity:** low potential for adverse conditions	**Temperature:** Managed ponds and playa have seasonal potential for increased temperatures **DO:** Managed ponds and playa have potential for DO <5 mg/l at times **pH:** Managed ponds and playa have potential for periodic pH extremes at times **Salinity:** Low potential for adverse conditions

Discussion

Temperature

Temperature in tidal areas will be moderated by the continuous tidal exchange. Seasonal temperature increases are likely in managed ponds and playa.

DO

The Basin Plan minimum DO criterion for tidal waters downstream from the Carquinez Bridge is 5.0 mg/L. It should be expected that water impounded without tidal circulation will demonstrate depressed DO levels as the water heats up in the late summer and the water depth decreases.

pH

The water quality objective in the San Francisco Bay Basin Plan is 6.5 to 8.5 (San Francisco RWQCB, 1995). The pH of the water in the Napa River was measured to be 7.7 during the site characterization performed for the Napa-Sonoma Marshes Restoration project in 2001. At the same time, pH in Pond 2A, which was opened to tidal action in 1995 by DFG, was measured to be 7.9.

The pH measured in the concentrator ponds on the west side of the Napa River averaged 8.4 in 2001. Four of these ponds had pH over 8.5 in the October 2001 sampling event.

Napa River water should have a fairly high pH buffering capacity. Therefore except where water is detained, as in the managed ponds, interaction of waters with the peat should not result in decreased pH. Water in tidal areas should be expected to demonstrate approximately the same pH as water in the Napa River. Impounded water in managed

ponds or playa ponds will likely trend slightly higher in pH, similar to concentrator ponds on the west side the River. Increases in pH above the upper Basin Plan water quality objective of 8.5 are considered to be a possibility within the managed ponds; however, increases in the Napa River above 8.5 pH due to seasonal releases from the managed ponds are considered unlikely.

Salinity

The San Francisco Region Basin Plan establishes narrative water quality objectives for salinity in the Napa River and Fagan Slough. The water quality objective is to avoid increasing salinity to the point where an adverse effect on beneficial uses, particularly fish migration and estuarine habitat, is created. Causing or contributing to an adverse effect due to high salinity is considered significant. Breaching the ponds in the dry should result in a lower salinity discharge because the salinity will be equivalent to the amount of salt that can dissolve into the incoming river water during a single tide. Conversely, if the ponds were breached when full of water the concentration would be supersaturated because of the pond's historic and current use i.e. pickle ponds and crystallizer beds.

Salinity in managed and playa ponds will vary seasonally and will be a function of the management regime. High salinity conditions may be favorable for some species of wildlife. Extensive modeling of the Napa Marshes suggests that carefully managed discharge of elevated salinity water from managed ponds, if timed to coincide with high flow wet season flow regimes in the Napa River, will not produce negative impacts as they are defined in the Basin Plan.

Goal 3. Maintain levels of flood protection provided by existing levees on project site.

Objective 3.A.	Study and adopt design that will minimize need for new flood protection levees		
Criteria	a) Linear feet of improved Flood Control levee required b) Linear feet of improved internal levee required		
Methods and Assumptions	A flood control levee will be provided to ensure flood protection for adjacent properties. The length of improved flood control levee was determined by analyzing the length of existing levee below the proposed flood protection elevation of 10.0 feet (NAVD88), selected by CDFG. Internal levee improvement will be provided in Alternatives 2 and 3 for the managed ponds. It is assumed at this time that the managed pond levee will be raised from existing elevations to MHW.		
Results	**Alternative 1**	**Alternative 2**	**Alternative 3**

	13,520 linear feet 0 linear feet	13,520 linear feet 5,300 linear feet	12,900 linear feet 5,300 linear feet
Discussion	In order to provide adequate flood protection from Napa River flood events for areas east of the project site, it will be necessary to improve the flood control levee along Ponds 9 and 10 from Napa River to the northeast corner of Pond 10, and along the southern ponds from the northwest corner of Pond W-1 at Napa River along the eastern boundary of the site to the southwest corner of pond B-3 at the Napa River. The extent of the flood control will remain consistent for all alternatives. Internal Levee improvement around CB1, 2, and 3 will be required for Alternatives 2 and 3, in order to protect the managed ponds from certain tidal events.		

Objective 3.B.	If new or improved flood protection levees are required to protect adjacent properties, design to maintain existing level of flood protection		
Criterion	Levee crest elevation		
Methods and Assumptions	A top of levee elevation of 10.0 feet (NAVD88) was chosen to provide protection for adjacent properties to the project. This elevation was chosen since the majority of the existing outboard flood protection levee along the Napa River is near an elevation of 10.0 feet. Further analysis is needed to determine the final proposed levee height that will provide similar flood protection to existing conditions.		
Results	**Alternative 1**	**Alternative 2**	**Alternative 3**
	10.0 feet (NAVD88)	10.0 feet (NAVD88)	10.0 feet (NAVD88)
Discussion	The flood protection elevation remains constant for all alternatives.		

Objective 3.C.	Maintain existing flood protection/drainage in the Napa County Airport area		
Criterion	Does alternative change existing drainage positively or negatively? (Yes/No)		
Methods and Assumptions	The proposed design for the selected alternative will ensure that the existing drainage associated with the Napa County Airport will not be negatively affected.		
Results	**Alternative 1**	**Alternative 2**	**Alternative 3**
	No	No	No
Discussion	Currently, discharge from No Name Creek and stormwater from the western end of the airport drain through a culvert to a tributary of Fagan Slough. Modeling of Fagan Slough predicts that the project will not increase tidal or flood elevations in Fagan Slough (URS 2005b).		

Objective 3.D. Maintain upstream flood control

Criterion Effects on flood elevations upstream of project area

Methods and Assumptions Evaluation of results from 1-D hydraulic model.

Results

Alternative 1	Alternative 2	Alternative 3
No effect	No effect	No effect

Discussion Hydraulic Modeling has shown that the project will have a negligible effect on upstream flood elevations. Refer to Draft Modeling Tech Memo #1B, Napa Plant Site Restoration Project (URS 2005b)

Goal 4. Implement design and management measures to maintain current levels of vector management.

Objective 4.A. Work with Napa County Mosquito Abatement District (NCMAD) during design development

Criteria There are no evaluation criteria for this objective

Methods and Assumptions

Results

Alternative 1	Alternative 2	Alternative 3
Not applicable	Not applicable	Not applicable

Discussion CDFG and the design team are actively coordinating with the Napa County Mosquito Abatement District. A meeting was held at their offices in August 2005 to inform them about the project and solicit their initial feedback.

Objective 4.B. Provide access for vector management

Criteria Is access included in design? Yes/No

Methods and Assumptions

Results

Alternative 1	Alternative 2	Alternative 3
Yes	Yes	Yes

Discussion The perimeter levee surface elevation, width, and composition will facilitate access for maintenance vehicles and boats to site interior.

Objective 4.C.	Avoid hydrologically isolated depressions with emergent vegetation
Criteria	a) Acres with once daily tidal action b) Acres of poorly drained habitat
Methods and Assumptions	1) Emergent vegetation is not planned for the managed ponds or playa, so evaluation is applicable to the tidal areas in each alternative. 2) Modeling showed that the addition of channels improves site drainage. 3) All of the tidal surfaces are above MLLW and have the potential to drain, on average, once per day. Figure 2-1 was created to estimate the percent time of inundation of the tidal areas.

Results

Alternative 1	Alternative 2	Alternative 3

Discussion Predictions for duration of inundation and conversely draining in tidal areas are shown on Figure 2-1. At the time of breaching the drained period is estimated to range from 60% in B1-B3 to 25% in CB 1-9. Since these estimates are based on a "typical tide" there may be diurnal variation that would fall outside the prediction. As the marsh plain accretes over time the duration of drained time decreases. By year 50 the marsh plain is only inundated 85-90% of the time. These predictions are roughly equivalent for all alternatives.

Goal 5. Promote environmental benefit and reduce impacts.

Objective 5.A.	Identify and preserve cultural resources in the project area, including important archaeological and historical sites
Criterion	Are important archaeological and historical sites avoided? Yes/No
Methods and Assumptions	This objective was evaluated by reviewing the cultural resource documentation developed for the project.

Results

Alternative 1	Alternative 2	Alternative 3
Yes	Yes	Yes

Discussion All Alternatives avoid impacts to known archaeological and historic sites.

Objective 5.B.	Coordinate with Native Americans significant cultural resources are identified
Criterion	Coordination is occurring, no evaluation criteria are considered
Discussion	The Native American Heritage Commission reviewed its 'Sacred Lands File' on May 20, 2005 for the entire project vicinity. No sacred lands were identified in the area. They provided a list of groups and individuals to inform of the project and solicit additional information. These groups and individuals were contacted via letter on June 1, 2005. The Suscol Intertribal Council responded on June 4, 2005 stating that no known

archaeological sites are within the project area, but they encouraged due diligence during construction to ensure that unknown archaeological sites are avoided or treated appropriately.

Objective 5.C. Design restoration to rely on natural processes and topographic features to minimize construction activities

Criteria

a) Linear feet of channel excavation

b) Linear feet of new flood control levees and berms

c) Total excavation volume

d) Total placement volume

Methods and Assumptions

Channel and levee lengths were measured using selected alignments based on existing levees and historic channels. Excavation and placement (fill) volumes were calculated by constructing digital terrain models of existing and proposed surfaces in Autocad LDD, and then utilizing a Grid Volume estimation method to calculate cut and fill volumes. Total excavation volumes include channel excavation, internal levee lowering, internal and external breach excavation, and dredge stockpile excavation. Total placement or fill volumes include flood control levee fill, internal (managed pond) levee fill, erosion control and habitat benches along flood control levees, and fill placed to enhance drainage within the proposed tidal ponds. It is important to note that while the total excavation volume (c) includes the channel excavation material to be sidecast, the total placement volume (d) does not include this sidecast material.

Results

	Alternative 1	**Alternative 2**	**Alternative 3**
a) Linear feet of channel excavation	a) 22,072 feet	a) 22,072 feet	a) 22,072 feet
b) Linear feet of new flood control levees and berms	b) 13,520 feet	b) 13,520feet	b) 12,900 feet
c) Total excavation volume	c) 744,150 CY	c) 741,650 CY	c) 731,967CY
d) Total placement volume	d) 336,445 CY	d) 333,945 CY	d) 324,267 CY

Discussion

As mentioned previously, the lengths of proposed tidal channels and proposed flood control levees are constant for all alternatives. Excavation volumes are reduced from Alternative 1 to Alternative 2 since the existing levees within and around CB 1, 2 and 3 will not be lowered or breached in Alternative 2. Excavation volumes are reduced from Alternative 2 to Alternative 3 since the existing levees within and around the wash ponds will not be lowered or breached in Alternative 3.

Placed (fill) volumes are increased from Alternative 1 to Alternatives 2 and 3 since the managed pond levee will require improvement from the current condition.

Objective 5.D. Promote compatibility with surrounding land uses

Criterion Yes/No

Methods and Assumptions This objective was evaluated by reviewing existing land use documents, as described in Section 3.8, "Land Use and Planning" of the Existing Conditions Memorandum, to determine the surrounding land uses.

Assumptions:

- Open water, managed open water are attractive habitat for waterfowl.
- Waterfowl and geese are considered hazardous wildlife by the Federal Aviation Administration.
- Fully vegetated tidal marsh is not preferred habitat for waterfowl and geese.
- Salt spray could occur from the tidal marshes to adjacent areas (including sensitive agricultural areas).

Results

Alternative 1	Alternative 2	Alternative 3
• North- Yes • East- No • West- Yes • South- Yes	• North- Yes • East- No • West- Yes • South- Yes	• North- Yes • East- No • West- Yes • South- Yes

Discussion The land uses to the north, south, and west of the plant site are generally wetland, open water, and open space. All of the proposed alternatives would be compatible with these land uses and would therefore promote compatibility with these land uses, especially at locations where wetlands are also being restored, such as along the western boundary of the City of American Canyon. All three alternatives would equally promote compatibility with the residential and industrial land uses to the east of the project site. Salt spray to upland areas that could occur under all three alternatives would promote incompatibility with adjacent agricultural land uses to the east of the project site, such as the Green Island Vineyard.

The issue regarding land use compatibility with the Napa County Airport, located east of Ponds 9 and 10 is the potential for bird strikes. The whole project site is within 10,000 feet of the air operations area of the Napa County Airport and the Federal Aviation Administration (FAA) recommends a separation distance of 10,000 feet between an airport and any land use that would attract wildlife that is hazardous for aviation, such as waterfowl. FAA guidance also provides exceptions for wetlands that provide " unique ecological functions, such as critical habitat for threatened or endangered species." All three alternatives could attract waterfowl. Waterfowl would be most attracted to open ponded water within the project site, such as in the managed ponds and playa. Once vegetation has become established in the tidal marshes under each

alternative, Alternative 1 would have the least amount of open water and Alternative 3, during the rainy season, would have the most amount of open water. Therefore, Alternative 1 would be the most compatible with airport land uses and Alternative 3 would be the least compatible. See the analysis for Objective 1.J for further discussion.

Objective 5.E. Promote consistency with regional planning initiatives

Criterion Yes/No

Methods and Assumptions

Method: Review the applicable regional planning documents, which includes the Napa County General Plan, the BCDC Bay Plan and the Goals Project.

Assumption: Creating habitat for birds could be detrimental to the use of the Napa County Airport.

Results

Alternative 1	Alternative 2	Alternative 3
• Goal Project- Yes • Napa County General Plan- No • Bay Plan- No	• Goal Project- Yes • Napa County General Plan- No • Bay Plan- No	• Goal Project- Yes • Napa County General Plan- No • Bay Plan- No

Discussion

In general, all three alternatives would be consistent with the restoration planning recommendations outlined in the Baylands Ecosystem Habitat Goals (Goals Project 1999) because they will restore large areas of tidal marsh. Alternative 3 is the most consistent because the Goals Project calls for management of open water habitat and seasonal wetlands on both sides of the Napa River.

The Napa County General Plan designates the use of the project site for the protection of agriculture, watersheds, and floodplain but without being detrimental to the intended uses of the Napa County Airport. All three alternatives create habitat utilized by birds that are considered hazardous wildlife by the Federal Aviation Administration. The presence of hazardous wildlife at the project site could be detrimental to the use of the airport. Therefore, the three alternatives would not be consistent with the county General Plan. Alternative 3 would create the most suitable habitat for hazardous bird species, while Alternative 1 would create the least amount of suitable habitat.

None of the three alternatives would be consistent with the Bay Plan. The Bay Plan identifies the project site as being useful for a possible shallow-draft port and a regional dredged material rehandling facility.

Objective 5.F. Provide safe, convenient access to the project area

Criterion Yes/No

Methods and Assumptions Evaluation of road alignment

Results

Alternative 1	Alternative 2	Alternative 3
Yes	Yes	Yes

Discussion Access would be provided for Alternatives 1 and 2 through a proposed levee improvement and road adjacent and south of W-3. Access for Alternative 3 would occur on the existing road between W-1 and W-2. Site access design will be further developed when the preferred alternative is selected.

Objective 5.G. Protect existing or provide alternate maintenance access for existing infrastructure, including the railroad tracks

Criteria Does design meet this objective? Yes/No

Methods and Assumptions None

Results

Alternative 1	Alternative 2	Alternative 3
Yes	Yes	Yes

Discussion The railroad tracks will continue to be accessible via Green Island Road. Project levees will maintain the current level of flood protection to the railroad right-of –way.

Objective 5.H. Identify appropriate areas for agency facilities

Criteria Do agency facility locations avoid sensitive cultural resources? Yes/No

Methods and Assumptions It has been assumed that the locations of sensitive cultural resources have been identified.

Results

Alternative 1	Alternative 2	Alternative 3
Yes	Yes	Yes

Discussion Existing buildings will be used to house agency offices and as a residence for a site caretaker. No ground disturbing activities will occur on Green Island where cultural resources have been identified. Due diligence during construction will be practiced to ensure that unknown archaeological sites are avoided or treated appropriately.

Goal 6. Provide wildlife compatible recreational opportunities consistent with CDFG policies and regulations.

Note: The public access and recreation components for the project will be the same for all three alternatives and will not be used to differentiate among the alternatives.

Objective 6.A.	Coordinate pedestrian and bicycle trail development with the Bay Trail, Napa County, and City of American Canyon as appropriate.
Criterion	Linear feet of pedestrian trail and bicycle trail.
Discussion	The project will include development of over 34,000 linear feet (6.5 miles) of pedestrian and bicycle trails. Approximately 11,600 linear feet (2.2 miles) of the trail system will be located directly adjacent to the Napa River. Providing for these improvements will meet the trail system plans, guidelines and recommendations in place by the City of American Canyon, County of Napa and Bay Trail. There can be connections from the end of Eucalyptus Road and Green Island Road.

Objective 6.B.	Create access facilities in close proximity to existing access points, such as Green Island Road.
Criterion	Yes/No (number of staging or access points)
Discussion	The project will include development of 1 significant and 1 or 2 smaller staging areas. Two of the staging areas are adjacent to and within 0.5 miles of Green Island Road. The third staging area would be located approximately 1.7 miles south of Green Island Road, in closer proximity to "central" American Canyon at Eucalyptus Road.

Objective 6.C.	Provide opportunities for hand launched watercraft, e.g. kayaks and canoes.
Criterion	Yes/No (number of launch points)
Discussion	Hand launching of non-motorized watercraft such as kayaks and canoes will be available at the northeast end of the existing barge channel where the larger staging area is proposed. An expansive flat area for vehicle parking, existing boat dock and accessible ramping exist at this location.

Objective 6.D.	Create interpretive panels(s) for public outreach and education.
Criterion	Yes/No
Discussion	Interpretive panels and signage will be included throughout the project site. Informative panels will be associated with staging areas; more detailed natural and culturally related information could be displayed at a potential future interpretive center; and pedestrian-scale signage will be located along the trail system. Panels and signage will follow the "Guidelines for Preparing an Interpretive Prospectus" prepared by the California Department of Parks and Recreation Office of Interpretive Services, October 1985.

Objective 6.E.	Create angling access points.
Criterion	Yes/No (number of angling access points)
Discussion	Angling access will be available at the Green Island Road and main (barge channel) staging areas, as well as several points along the western-most project trails located adjacent to the Napa River.

Goal 7. Minimize ecological risks from restoration (Which Alternative provides opportunity for phasing?)

Objective 7.A. Phase project to restore tidal circulation as Cargill completes harvest operations and consistent with regulatory requirements

Criterion Yes/No

Methods and Assumptions This analysis assumes that the phase-out agreement between Cargill and CDFG is on schedule and no significant delays will occur.

Results

Alternative 1	Alternative 2	Alternative 3
Yes, in the all tidal scenario, tidal action could be restored to ponds 9 and 10 in Phase 1 (2007) and the remainder of the ponds would be restored to tidal action in Phase 2.	Yes, same phasing opportunities as described for Alternative 1. Managed ponds would be constructed in Phase 2.	Yes, Phase 1 in this alternative could include both restoration of tidal action to Ponds 9 and 10, and allow most of the wash ponds to function as Playa.

Discussion Cargill is harvesting as much salt as possible from the ponds, given salinity management and topographic constraints. Ponds 9, 10, W1, W2, and W3 may be ready for restoration in 2007. The remainder of the ponds will be ready at a later date. The alternatives are equivalent with respect to construction phasing. Phasing opportunities are based on Cargill's salinity reduction schedule and spatial considerations related to implementing restoration. The only other potential for phasing in the southern ponds could be to construct the managed pond separately from the tidal area. It is unlikely that this would be cost effective, however,

because of mobilization/demobilization costs relative to the total amount of work to be accomplished.

Although salt reduction activities will be completed in the wash ponds (W1, W2, and W3) in 2005, Cargill would like to use the southern portion of W1 as a dredged material storage area for dredging of the barge channel. This would preclude tidal restoration to the wash ponds in the near term because the dredge material storage area is in the location of the breach for the tidal channel. Moreover, restoring tidal action to these ponds as prescribed in Alternatives 1 and 2, would be problematic while Cargill is still working at the plant site. This is because restoration of tidal action to the wash ponds would periodically flood the access road to the plant site. Alternatives 1 and 2 propose relocating the access road to reduce habitat fragmentation in wash ponds and eliminate the need to raise the access road above the flood elevations. Portions of W1 and all of W2 and W3 may be able to be managed as playa in the interim.

Objective 7.B. Minimize mobilization of contaminants present in sediments, to the extent possible

Criteria Mobilization Potential

- within the site and;
- to receiving waters

Methods and Assumptions The analysis assumes:

- The ponds will be dry when the levees are breached and tidal exchange is initiated to the river
- Managed Ponds will have less tidal exchange than breached tidal ponds;
- Playa ponds will have less tidal exchange than managed ponds

Results	**Alternative 1**	**Alternative 2**	**Alternative 3**
	Moderate potential for mobilization of legacy soil-borne constituents within the site and to receiving waters	Less potential than Alternative 1	Least potential of all alternatives

Discussion Re-distribution of sediments, both within the ponds in the tidal portion of the project area is anticipated as the historical slough channels re-establish. This may also result in discharge of sediment to receiving waters. However, large amounts of sediment discharge to receiving waters is not likely because the site will be a long-term (50 to 100 years) sediment sink. Managed ponds pose less potential than tidal areas for impacts because (1) releases are limited, (2) velocities are low and (3) when releases occur there is control over the timing and magnitude of the discharge. Playa ponds would hold limited potential for impacts because few discharges are anticipated.

Goal 8. Design restoration implementation, management, and monitoring that can be effectively executed with minimal cost. Phase construction to meet funding availability.

Objective 8.A. Adopt design that will be self-sustaining and minimize operations and maintenance as much as possible

Criterion Operation and Maintenance Cost Effort

Methods and Assumptions Operation and Maintenance (O&M) Cost information for Managed Ponds and Playa areas is being compiled. Relative O&M effort will be categorized as either low, moderate, or high.

Results

Alternative 1	Alternative 2	Alternative 3
Low	Moderate	High

Discussion O&M effort will increase with the area of managed ponds and playa. Managed ponds and playa areas will have water control structures that will require significant operation and maintenance. Alternative 2 will have at least one control structure for the managed ponds, while Alternative 3 will have an additional control structure for the Playa areas.

Objective 8.B. Manage construction costs to achieve project goals and objectives with available funding

Criteria Conceptual level Capital Cost

Methods and Assumptions Quantities were measured and/or calculated based on standard engineering methods and procedures. Unit cost information was gathered from various sources including, but not limited to, vendor/supplier quotes, the California Department of Transportation (Caltrans) Contract Cost Data summary, RSMeans Cost Data Book (latest edition) and previous project/bid experience. A Contractor mark-up of 15% and a Contingency of 30% was used for this estimate.

Results

Alternative 1	Alternative 2	Alternative 3
$18,222,032	$20,473,278	$19,861,180

Discussion The preliminary budget estimate for Alternative 2 is approximately 10% higher than for Alternative 1. This is driven by the following additional cost items associated with Alternative 2: water control structure for the managed ponds, internal grading for managed ponds, internal levee construction around the managed ponds, along with associated contractor mark-up and contingency on these items. The preliminary budget estimate for Alternative 3 is approximately 3 % lower than for Alternative 2. This is driven by the reduction in length of flood control levee construction (reduced along wash ponds), the reduction of internal levee grading and breaching in the wash ponds, the deletion of the new access road, and the deletion of the wash pond levee breach for Alternative 3..

Objective 8.C.	Limit costs associated with delay
Criteria	Not Applicable to Alternatives Evaluation

Objective 8.D.	Form partnerships and alliances to develop and institute a long-term viable funding strategy
Criteria	Not Applicable to Alternatives Evaluation

3.1 RATIONALE FOR AND IDENTIFICATION OF A PREFERRED ALTERNATIVE

All of the restoration alternatives will provide extensive habitat for aquatic and terrestrial native species. Alternative 1 will have the greatest extent of tidal marsh habitat, which is important for many species, but will lack the heterogeneity of Alternatives 2 and 3. Alternative 3, with managed ponds and playa habitat, provides the greatest opportunity to manage the project area for a diverse assemblage of wildlife species.

CDFG has selected Alternative 2 as the preferred alternative because it provides:

1) habitat diversity (i.e., managed pond and tidal areas) that will benefit a broad range of wildlife species in the long-term,
2) diverse opportunities for educational outreach, and
3) high-quality public access and wildlife-oriented recreation opportunities.

The managed pond component of Alternative 2 is important because it will provide open water habitat to benefit waterfowl and shorebirds. This habitat would be available, and potentially more abundant in Alternative 3, but the trade-off would be that the barge channel would likely fill with sediment. This would limit the recreational opportunities at the site because the boat launch would have to be abandoned or moved to a less protected area along the Napa River. Having public access and the potential for a future educational center near the barge channel is desirable from a social perspective. In the long-term CDFG envisions the Napa Plant Site as a significant regional education and recreation resource.

While all alternatives would require maintenance, those that require operation of a managed pond (i.e., Alternative 2 and 3) will require a greater level of effort and capital resources. CDFG recognizes that Alternative 2 will require on-going maintenance and management. The managed pond will need to be operated so that water quality conditions do not deteriorate and fish entrapment is minimized. Over the long-term culverts and gates may need to be replaced. All levees will need to be inspected and maintained.

3.2 POTENTIAL RESTORATION PHASING

The purchase agreement between CDFG and Cargill included provisions for Cargill to harvest as much salt as possible from the site. Salt making uses the ponds in a sequential process and thus the salt is removed and the ponds are ready for restoration in series. This phase-out of salt harvesting operations is the primary determinant of the restoration phasing. The phase-out operation is described in detail in the Existing Conditions Memorandum (URS 2005c).

Wetlands restoration and site development is planned in two phases. The first phase is comprised of restoring tidal action to ponds 9 and 10 by breaching to Fagan Slough, as described above. Construction of the restoration features for the wash pond area would also be done in Phase 1, with the exception of breaching to the barge channel. Phase 1 is scheduled to commence in 2007. The second phase would be restoration of tidal action and all the associated construction elements for the southern pond group. The timing of Phase 2 construction is less certain because it depends on Cargill's phase-out progress and on obtaining construction funding. It is projected to occur between 2010 and 2012.

The majority of public access facilities will be constructed in Phase 2. During Phase 1 signage could be installed on Green Island Road and public access to the interior could be permitted on an individually permitted/arranged basis for special events.

CDFG. 2004. California Department of Fish and Game and Resources Legacy Fund. Request for Environmental and Engineering Services. Napa Plant Site Restoration Project. November 19, 2004.

Goals Project (San Francisco Bay Area Wetlands Ecosystem Goals Project). 1999. *Baylands ecosystem habitat goals.* A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco and Oakland, CA: U.S. Environmental Protection Agency and San Francisco Bay Regional Water Quality Control Board.

LandPeople, Chaudhary & Associates, Michael Kent & Associates, TOVA Applied Science & Technology. 2005. Airport Area Bicycle Route Study. Prepared for Napa County Department of Public Works. June 2005.

URS. 2005a. Napa Plant Site Restoration Project Modeling Tech Memo #1a. Prepared for California Department of Fish and Game. July 2005.

URS. 2005b. Napa Plant Site Restoration Project Modeling Tech Memo #1b. Prepared for California Department of Fish and Game. September 2005.

URS. 2005c. Napa Plant Site Restoration Project Existing Conditions Memorandum. Page 3-25. Prepared for California Department of Fish and Game. July 2005.

U.S. Army Corps of Engineers. 2004. Napa River Salt Marsh Restoration Project Final Feasibility Report. Appendix A of Appendix D. June 2004

U.S. Fish and Wildlife Service (USFWS). 2005. 2004 Annual Self Monitoring Program for Alviso Ponds within South San Francisco Bay Low Salinity Salt Ponds Alameda, Santa Clara, and San Mateo Counties. November 2005.

Williams, P.B., M.K. Orr, and N.J. Garrity. 2002 Hydraulic Geometry: A Geomorphic Design Tool for Tidal Marsh Channel Evolution in Wetland Restoration Projects. Restoration Ecology. Vol. 10 no.3, pp.577-590

Wyckoff, Larry. 2005. Personal communication. California Department of Fish and Game. Science team meeting September 22, 2005.

Appendix A
Opportunities and Constraints List

GOAL 1 CREATE CONDITIONS THAT WILL LEAD TO THE ESTABLISHMENT OF A FULL RANGE OF TIDAL HABITATS

Opportunities	Constraints
• Re-establish historic channels • Build transitions to existing/planned habitats • Provide hydrologic connection and continuity with American Canyon ponds • Use local dredge material (from river dredging and or from NSMRP construction activity or wash pond sediments to create topography conducive to restoration goals and objectives • Unrestricted breaches (no structures) have low operation and maintenance costs • Substantially increase spatial extent of sub-tidal and intertidal habitats in the project area • Restore, enhance or create tidal marsh-upland transitional ecotone habitats • Create habitat for tidal marsh and river dependent special status plants and animals • Regional coordination of habitat restoration goals with other Napa River estuary projects such as NSMRP and projects in American Canyon • Improved circulation may lead to improved water quality • Reduction in bird strike potential (in long-term as Ponds 9 and 10 become vegetated) • Easy access from River to ponds for restoration of tidal action and recreation • Can achieve full tidal action in ponds if desired • Increase area of tidal inundation upstream of existing culverts on east end of Pond 10 • Improve quality of non-point source flows discharging river • Fagan Marsh and Coon Island would be good reference sites	• Potential presence of listed plant species (e.g., at breach locations) • Potential tidal and storm water backwater flooding (e.g., airport) • Sufficient available volume of riverine sediment to create marsh plain elevation (gross availability) • Sediment captured in salt ponds restored by the NSMRP on the west side of the river reduces the sediment supply available to the project (cumulative reduction of supply) • Structural integrity of existing levees • Increased wave erosion on existing levees due to introduction of tidal action • Increased wave erosion, changes in velocity, or flow patterns on existing residential docks on west side of river • Contamination in State Lands Commission pond adjacent to landfill • Phasing associated with Cargill operations/closure (extending construction period increases cost) • Change in tidal prism in Fagan Slough (potential increase below breach and decrease above breach) • Erosion/sedimentation changes in Fagan Slough • Construction methods for channel construction • Seepage conditions near vineyards • Access roads to existing housing on site (need to be protected) • Increased bird strike potential at airport • Potential increase in mosquito breeding habitat • Invasive plant species colonization of site

• Maximize synergy with adjacent wetland projects; e.g. City of American Canyon tidal and treatment wetlands, NSMRP, and Cullinan Ranch	during vegetation establishment • Loss of habitat for salt pond dependent species • Predator access on levees • Short-term water quality impairment, high salinity discharge

GOAL 2 IDENTIFY AREAS TO BE OPERATED AS MANAGED PONDS

Opportunities	Constraints
• Easier to control conditions and make appropriate design changes if necessary (for managed ponds) • Enhance habitat for migratory shorebirds and waterfowl • Seasonally manage crystallizer beds as salt panne habitat • Ability to move water • Seasonal intake of saline water will facilitate vegetation management • Can create protected nesting islands	• Management of high salinity area(s) (may not be able to discharge) • Operation and maintenance needs • levee maintenance • water control structure management • micro-management of water depths for certain species • Ability to move water (introduce river water during neap tides) • Predator access via levees

GOAL 3 MAINTAIN EXISTING LEVELS OF FLOOD PROTECTION IN THE PROJECT REACH OF THE NAPA RIVER

Opportunities	Constraints
• Airport – possibility to attract funding for improving levees & changing structures • Improve levee • Restore historical hydrology to this Napa River reach • Once open to tidal action, ponds may provide off-line storage during high flow events • Cumulative affects of NPSR project and NSMRP on velocity/sedimentation in river • Napa River is large, therefore volume is available to fully flood ponds	• Cost of levee improvement/replacement • Levee maintenance near airport • Possible non-desired erosion in Napa River and marsh plain (loss of mudflat) • Adversely impact flow conditions on the West side of Napa River • Accommodation of potential sea level rise • Fagan Slough capacity could limit conveyance to and from Ponds 9 & 10 • Need to maintain River front levees if breaches are to be maintained on Fagan Slough • Need to avoid erosion or flooding impacts to residence at mouth of Fagan Slough • Entrance road and railroad need erosion and flood protection • Increased river velocities could scour Cuttings Wharf area docks • Cumulative flood capacity effects, when compounded with NSMRP on the west side of the river

GOAL 4 IMPLEMENT DESIGN AND MANAGEMENT MEASURES TO MAINTAIN CURRENT LEVELS OF VECTOR MANAGEMENT

Opportunities	Constraints
• Provide access for vector management • Work with Napa County Mosquito Abatement District during design	• Increased area of potential mosquito breeding habitat

GOAL 5 PROMOTE ENVIRONMENTAL BENEFIT AND REDUCE IMPACTS

Opportunities	Constraints
• Increasing vegetative cover may reduce bird strike potential • Improve water quality • Design a self maintaining ecosystem to reduce maintenance • Increase habitat diversity and complexity in Napa River estuary • Improve habitat over existing salt pond conditions • Cargill will remove most of salt from the system; reducing long-term risk from high-saline releases • Enhanced recreation (see Goal 6)	• Proximity to Napa County Airport • Federal Aviation Administration buffer • Bird strike zone • If the salt facility were found eligible for the National Register of Historic Places and if the project adversely affects portions of the resource (through removal, demolition, etc.); then the changes would be considered adverse effects to be mitigated • Excavation locations could be Native American resource sites • Breaching into Fagan Slough adds another body of water to consider for permitting, monitoring and modeling

GOAL 6. PROVIDE WILDLIFE COMPATIBLE RECREATIONAL OPPORTUNITIES CONSISTENT WITH CDFG POLICIES AND REGULATIONS.

Opportunities	Constraints
• Green Island Road for vehicular access, staging, picnicking and launching of non-motorized boats • Connection to Bay Trail and City of American Canyon trail system • Existing structures for adaptation to future facilities for public outreach, interpretive center/research for entire Napa River area • Partnership with other educational groups for on-going or special events such as the Friends of the Napa River, Audubon Society, etc. • Phasing (could allow time to identify funding sources) • American with Disabilities Act requirements • Passive environmental education	• Exposed riprap, rebar, concrete in existing levee riprap • Railroad tracks/train presence • Lack of potable water and sanitary/sewer system • Lack of electrical power outside of immediate plant area • Public access must be wildlife compatible access • Funding for construction, operation and maintenance • American with Disabilities Act requirements • Access to site through industrial area (public safety on narrow roads with truck traffic)

GOAL 7. MINIMIZE ECOLOGICAL RISKS FROM RESTORATION

Opportunities	Constraints
• Coordinate (data, sampling, analytical methods, typical permit requirements) with other Napa River and SBSP projects	• Creation of natural processes that produce methyl mercury

GOAL 8. DESIGN RESTORATION IMPLEMENTATION, MANAGEMENT, AND MONITORING THAT CAN BE EFFECTIVELY EXECUTED WITH MINIMAL COST. PHASE CONSTRUCTION TO MEET FUNDING AVAILABILITY.

Opportunities	Constraints
• Coordinate with ongoing region-wide SBSP and NSMRP restoration activities for both construction and monitoring • Take advantage of existing Napa County GIS system and WICC for data storage and dissemination • Coordination with construction of NSMRP sites could lead to reduced construction cost at NPSR project • Proximity to hydrologic source (Napa River) • Peripheral levees will help in construction phasing • Phasing construction will allow monitoring and design refinements for future phases of construction based on lessons learned • Phasing construction facilitates obtaining funding • Restoration not being forced by outside agency so no precise habitat endpoint must be met (e.g., no specific mitigation requirement) • Existing site elevations could rapidly lead to low-maintenance unrestricted tidal system • Site continuity – no culverts or structural connections needed in future tidal area • Combined region-wide monitoring program with NSMRP and SBSP restorations can minimize cost • Self sustaining system • Can avoid the use of structures • Surrounding land use is mostly compatible with wetland presence	• Time needed to take into account progress of Salt Pond region-wide effort and NSMRP effort. • Cargill production phasing lengthens construction schedule • Multi-phase construction approach may lead to increased cost in the long run • Time to secure permits (RWQCB, BCDC, USACE) • Need to provide site access – bay trails need some maintenance and supervision • Interpretative center operation and maintenance cost • Need to protect airport from flooding • Levee maintenance required along Green Island Road • High salinity discharge(s) may require NPDES permit [depending on concentration/duration/timing of discharge, and results of modeling]

• Ponds south of railroad grade can be hydraulically connected for sequential breaching such that discharge to the river reduces impacts and simplifies permitting • Work with Cargill now to provide guidance on what they can do to leave site in condition that will reduce maintenance • Breach quickly during high flows in winter using blasting (avoid using excavator in dry season) • Ability to learn from what is/isn't working on both sides of the river (comparison of habitat evolution, species use etc. leading to enhanced success of later project phases)	