SOUTH BAY SALT POND LONG-TERM RESTORATION PLAN

GUIDING PRINCIPLES, OBJECTIVES,

AND CONCEPTUAL MODEL

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Mission: To prepare a scientifically sound and publicly supportable restoration and public access plan that can begin to be implemented within five years

The overarching goal of the Long-Term Restoration Plan is the restoration and enhancement of wetlands in the South San Francisco Bay while providing for flood management and wildlife-oriented public access and recreation.

Guiding Principles for the South Bay Salt Pond Long-Term Restoration Plan

1. The Long-Term Restoration Plan is based on the best available science, and independent scientific review is an integral part of its development and implementation.
2. The Long-Term Restoration Plan is developed through an inclusive and open process that engages all stakeholders and interest groups.
3. Numerous federal, state and local agencies are partners in the Long-Term Restoration Plan and their views are considered fully.
4. The Long-Term Restoration Plan is a flexible plan that is based on the concept of adaptive management - recognizing that information gathering is part of implementation and that modifications will be made in the future based on that information.
5. The Long-Term Restoration Plan is implemented in phases, including achieving early, visible successes.
6. The Long-Term Restoration Plan emphasizes naturally sustaining systems and integrates habitat development actions at the landscape scale to provide South Bay ecosystem-level benefits.
7. Development of the Long-Term Restoration Plan will consider costs of implementation and monitoring so that planned activities can be effectively executed with available funding.

South Bay Salt Pond Habitat Long-Term Restoration Project Objectives

1. Create or enhance habitats of sufficient size and appropriate structure to promote restoration of native special status species that depend on South San Francisco Bay habitat for all or part of their life cycles.

2. Create or enhance habitats of sufficient size and appropriate structure to maintain current migratory bird species that utilize existing salt ponds and associated structures such as levees.
3. Create habitats of sufficient size, structure, function and diversity to support increased abundance and diversity of native species in various South San Francisco Bay aquatic and terrestrial ecosystem components, including plants, invertebrates, fish, mammals, birds, reptiles and amphibians.
4. Maintain or improve existing levels of flood protection in the South Bay area.
5. Provide public access and recreational opportunities compatible with wildlife and habitat goals.
6. Maintain or improve existing levels of water quality in the South Bay, and minimize adverse effects caused by habitat conversion activities.
7. Implement design and management measures to maintain or improve current levels of vector management, control predation on special status species, and manage the spread of non-native invasive species.
8. Protect existing infrastructure.

CONCEPTUAL MODEL

Purpose of the Model

An estimated 85% of the historic tidal marshes in the Bay have been filled or significantly altered. The loss of tidal marsh has had negative effects on the physical, chemical, and biological health of the Bay, including (*Goals Report):*

- Declines in fish and wildlife populations, leading to economic losses through declines in sport and commercial hunting and fishing, and the listing of numerous species under the federal and state endangered species acts;
- Loss of tidal prism causing tidal channels to become more narrow and shallow, significantly decreasing the capacity of local rivers and streams and increasing the local hazards of flooding and need for dredging;
- Decreased water quality and increased turbidity within the Estuary; and
- Curtailment of the influence of tidal marshes on sediment transport leading to the accumulation of sediments from watersheds at the mouths of streams.

Based upon past experiences with tidal marsh restoration in the Bay, linkages can be described between physical inputs and processes, habitat evolution, and biological responses (sustainable populations of resident and migratory native species and complex food webs).

The conceptual model is not intended or designed to represent a comprehensive analysis of all the interactions of physical, chemical, and biological conditions that operate within the San Francisco Bay and its associated habitats (together represented by the term “Bay” in this discussion). Rather, the conceptual model is designed as a tool to help clarify the mechanisms and relationships that must be considered in assessing the effects of potential changes in the physical and chemical conditions of the Bay and surrounding habitats that may result from restoration actions at the South Bay Salt Ponds. The model is intended

to identify key relationships between the controlling factors, physical and chemical conditions likely to be affected, and biological communities of concern. The model should be used to ensure that the analyses performed provided a sound scientific basis for assessing the potential effects and benefits of various restoration design alternatives.

Design of the Model

Introduction

A graphic representation of the conceptual model is presented in Figure 1. As described above, the conceptual model presented in this report is focused on those physical, chemical, and biological conditions that should be considered when assessing potential changes caused by project design and management alternatives. A number of other physical and chemical conditions are important to the overall functioning of the Bay, but would not be affected by project activities. The external factors and inputs shown at the bottom of Figure 1 represent some of the important factors that control or modify the physical, chemical, and biological conditions in the vicinity of the proposed project. However, none of these would be affected by the proposed project.

An underlying assumption of the model is that a number of key physical drivers control the physical and chemical environment of the Bay. The physical drivers control a set of physical and chemical conditions (biological drivers) that in turn control the biological communities that exist in the Bay – in concert with a variety of biological factors. There are a wide variety of global, regional, and Bay-wide biological processes that do or may affect the same biological communities that may be affected by the biological drivers under study – the effects of which may be far greater than potential project-related effects. An additional assumption of this model is that the restoration actions in the Salt Ponds would result in changes to the physical structure of, and chemical input to, the Bay, which then would result in changes in the physical and chemical conditions, which would in turn result in changes in biological communities in the Bay.

Five general sets of physical drivers have been defined for the model:

- Constituents in water and sediments - including salt, contaminants, nutrients, and other organic and inorganic compounds
- Hydrodynamics - including circulation, waves, and water levels in the Bay
- Bathymetry and Topography- the basic existing shape of the Bay and surrounding habitats
- Physical characteristics of Bay sediments - primarily geologic characteristics
- Other physical conditions - such as noise and human disturbance

These physical drivers work in combination to create or control the physical and chemical conditions that are biological drivers. The hydraulic drivers (circulation, waves, and water levels in the Bay) combined with the physical bathymetry of the Bay determine sediment transport in the Bay. Constituent input to the Bay, Bay circulation, and sediment characteristics determine water quality in the Bay. The bathymetry and structure of the

Bay controls the extent of various habitat types within the Bay, but habitat is also influenced by sediment characteristics and water circulation. Basic sediment properties combined with constituent input, water circulation and habitat determine sediment quality in the Bay.

The model also recognizes that a number of parameters are important to aquatic biological communities that are not directly related to the physical and chemical processes. The levels of noise and human disturbance may affect biological communities in the Bay separately from water circulation and water chemistry influences.

Biological Drivers and Relationship to Biological Communities

Four types of physical and chemical conditions have been identified as "biological drivers" in the model, all are physical parameters or conditions that often are measured to indicate the condition of the Bay. These parameters include:

- Water quality - including both chemical composition and physical properties of Bay waters
- Sediment transport - including erosion, deposition, and resuspension of sediments
- Sediment quality - including both the physical and chemical composition of sediments
- Other forms of disturbance - such as noise and human disturbance

These conditions lead to the formation of specific habitat structure and type (such as marshes, mud flats, and open water), and play significant roles in the existence of biological communities in the Bay. Benthic biotic communities are largely controlled by sediment quality, water quality, sediment transport, and habitat area, as well as by interaction with other biological communities. Water quality, hydrodynamics, habitat volume, and various types of disturbance control pelagic communities, along with interaction with other biological communities. The avian and mammal communities are controlled by habitat area, various forms of disturbance, by the availability of various food source communities (such as the benthic community) that are more directly controlled by physical parameters such as water and sediment quality, and potentially be toxic effects of bioaccumulative compounds transported from sediment and water through plant and prey tissue.

Relationships Between Biological Communities

As indicated on Figure 1, complex biological relationships influence the individual biological communities concurrent with the influence of physical and chemical conditions. Figure 1 is not intended to indicate all of these relationships. To do so would make the model so complex that it would be reduced in value. Rather, the model is intended to illustrate general relationships of biological communities, such as the dependence of bird populations on the availability of food sources represented by the benthic and pelagic communities.

Results of Salt Ponds Restoration Projects

The thought process behind the development of this conceptual model should guide the development of the methodologies used in the assessment of restoration design and management alternatives. The model can be used to identify key relationships between the controlling factors, physical and chemical conditions likely to be affected, and biological communities of concern. The model should be used to insure that the analyses performed provided a sound scientific basis for assessing the potential effects and benefits of various restoration design alternatives.

Restoration activities implemented in existing salt ponds are intended to improve the regional ecosystem habitat, support increased populations of key species and communities, and provide recreational opportunities for humans. As described in the project objectives, other considerations include goals such as flood management and vector management. These endpoints, or results are represented as boxes in the top layer of the conceptual model (Figure 1).

Some of the project components that have the potential to affect these endpoints are shown above the external factors and inputs in Figure 1, and include trails (providing public access but potentially disturbing some ecosystem components), constituents in salt ponds (these may affect water quality in the Bay as a result of increase hydrological connectivity), and structural and hydraulic changes (these may affect processes such as circulation patterns and sediment transport).

While the restoration project is intended to result in beneficial effects for both the ecosystem and human population, it is important to recognize that unintended adverse effects may also occur. For example, creation of tidal marsh habitat may change sediment transport patterns in ways that affect adjacent habitats. Tidal marshes may also increase production of methylmercury, the most toxic and bioavailable form of mercury. The conceptual model should be used to anticipate and minimize these types of potential adverse effects.

Interactions between Associated Habitats

A mixture of different habitat types will be created or enhanced in these areas, although locations and sizes of specific habitats have not yet been determined. Potential habitat types include tidal marsh, mud flats, managed ponds, sloughs and channels, and open bay. Figure 2 shows three example cross-sections of habitat associations that are likely to occur. The conceptual model discussed above applies to each type of habitat, but some processes are likely to be more important in certain habitat types than others. For example, significant sediment transport is more likely to occur in an open system such as a tidal marsh than in a managed pond. The processes and factors shown in Figure 1 occur both internally within each habitat system, and externally between associated habitat systems.

Underlying External Inputs, Physical Drivers, and Relationship to Biological Drivers

The external inputs as shown on Figure 1 may affect biological components directly or indirectly through interactions with physical components. However, in neither case would the external inputs be affected by potential project activities. Physical/chemical conditions that contribute to an overall functioning of the Bay and must be considered in project design and operation, but that would not be affected by project activities include:

- *Ocean-water levels.* The ocean-water levels are governed by differences in the attractive forces of celestial bodies (sun, moon, and others to a lesser extent) upon different parts of the rotating earth. None of these parameters will be affected by the restoration activities.
- *Freshwater inputs.* Restoration activities will not affect the amount of freshwater that enters the Bay.
- *Meteorology.* The overall wind and meteorological parameters that govern Bay Area weather are driven by high and low pressure systems that develop over the Pacific Ocean.
- *Sediment load from Bay tributaries.* The sediment load to the Bay is primarily from the Delta. However, and particularly in the South Bay, sediment also enters via local tributaries. None of these sources of sediment will be affected by restoration activities, although transport of sediments may change.
- *Sunlight*. The amount of sunlight reaching the Bay is not expected to change due to restoration activities.
- *Precipitation and evaporation*. Restoration activities are not expected to change precipitation or evaporation in the Bay area.
- *Nutrient input.* Nutrient inputs to the South Bay (nitrogen, phosphorous) are primarily derived from discharges of treated sewage from wastewater treatment plants. Additional sources of nutrients include tributary inputs from major creeks, ocean water, Delta water, releases from previously deposited sediments, and atmospheric deposition. Restoration activities are not expected to measurably alter the major nutrient inputs to the South Bay, although nutrient inputs may change locally.
- *Water temperature.* Water temperature is primarily governed by solar radiation or sunlight. Surface waters that are exposed to sunlight are traditionally warmer than bottom waters that receive less sunlight. Given that sunlight will not be affected by restoration activities, the temperature of the Bay will not be affected. It should be noted that in areas where depth increases or decreases, the local water temperature may change.
- *Salinity.* The salinity of the Bay is governed by freshwater inputs and the salinity of the ocean. Neither of these is affected by restoration activities. Therefore, the overall salinity (i.e., the amount of salt in the Bay) will not be affected. However, this is not to say that local salinity conditions due to Salt Ponds restoration activities will not change, or that the vertical stratification or horizontal distribution of salinity will not be affected.

- *Urban Runoff.* Pollutant concentrations in urban runoff are governed by land use and management practices in the watersheds, and pollutant loads to the Bay are not expected to be affected by restoration activities. However, creation of some habitat types, such as tidal marshes, may improve water quality and ameliorate the effects of pollutants entering the Bay system.
- *Publicly Owned Treatment Works (POTWs).* Loads of pollutants and nutrients discharged by POTWs are not expected to change due to restoration activities.
- *Bay Water Exchange.* In general, exchange of constituents such as salinity, contaminants, and nutrients between various components of the Bay is not expected to change due to restoration activities. However, exchange on the local scale may change with increased or decreased hydraulic exchanges between habitats.
- *Surrounding Land Uses, Infrastructure Maintenance, Traffic, and Industry.* Land uses on surrounding properties not controlled by project sponsors are not expected to change due to restoration activities.

External Biological Factors

In addition, some biological communities within the Bay are strongly influenced by broader regional and global factors affecting specific species. For example, the local populations of migratory and pelagic species may be more influenced by factors such as conditions in breeding grounds outside the Bay, oceanic water temperatures, oceanic plankton blooms, etc. than by any conditions associated with restoration activities. Four broad categories of regional and global factors that comprise the background for interactions with physical and biological drives include the following:

Long-Term Regional Habitat Succession

Within the Bay, long-term changes in shoreline habitat, mudflats, tidal marsh have occurred and will continue to occur with or without the proposed project. Another example from a broader regional scale is nesting habitat for migrant birds that winter in the Bay. The nesting habitat for winter migrants is located well outside the limits of the Bay and, thus, habitat conditions and succession would not be affected by project activities.

Bioaccumulation

Many sources of contaminants within and outside the Bay control the existing background contaminant levels in biological communities, and these sources would not be affected by restoration activities. However, fate and transport of these contaminants may be affected.

Coastal/Regional Migration Behavior

Many fish (e.g., salmonids), mammals (gray whale), and birds (wintering waterfowl) exhibit migration patterns that are external to the Bay. These patterns would not be affected by restoration activities.

Population Dynamics

Several factors that are regional or global in scale may influence local Bay populations:

- Population changes influenced by global oceanic water temperature (e.g., El Niño events)
- Increases in the number of invasive species introduced to the Bay
- Cyclical predator/prey relationships
- Oceanic breeding and reproductive success
- Evolutionary/genetic changes

The regional and global factors are addressed here for three reasons:

- First, in many cases (e.g., oceanic breeding and reproductive success) these factors would not be affected by restoration activities in the South Bay Salt Ponds.
- Second, where interactions would occur between global/regional factors and project activities (e.g., regional Baywide shoreline changes interacting with local project-caused changes in deposition/erosion), the regional influence may be much larger than the influence from restoration activities.
- Third, in some cases (e.g., El Niño events that may affect pelagic fish populations and eventually Bay fish populations), the interactions between external inputs and local population effects cannot be evaluated because of the uncertainty regarding the global/regional factors.

South Bay Salt Ponds Restoration
Figure 1 Conceptual Model
Draft

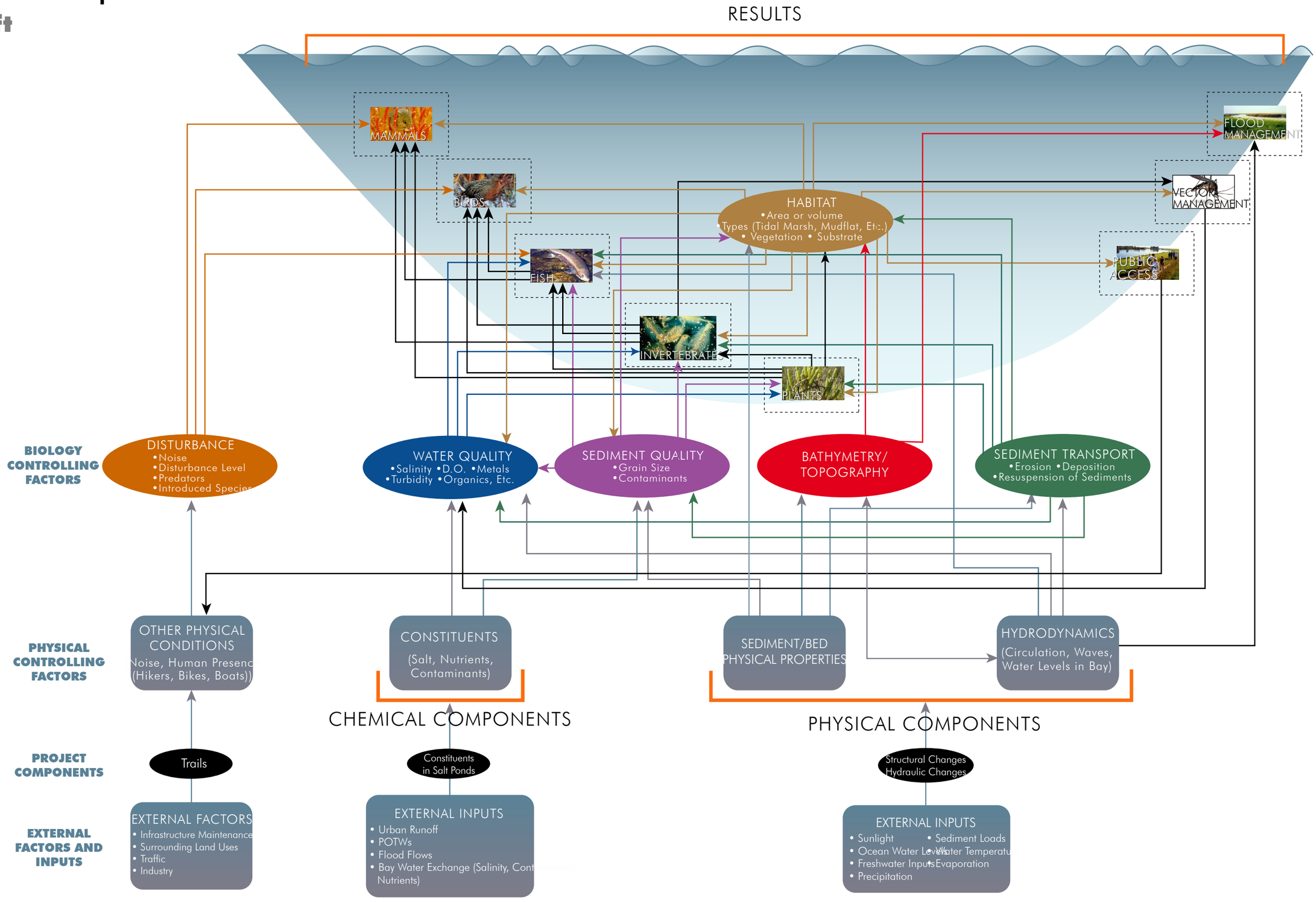

Figure 2 Associated Habitat Examples