

## Elkhorn Slough National Estuarine Research Reserve

# Tidal Marsh Restoration using Sediment Addition

### An Overview and Frequently Asked Questions

Updated: 5/31/12

#### **Background**

Elkhorn Slough is an extraordinary coastal environment located in central California, in northern Monterey County. Elkhorn Slough is one of only 28 sites in the country designated a National Estuarine Research Reserve. The slough's tidal waters are part of the Monterey Bay National Marine Sanctuary and it supports remarkable biological diversity and harbors a dozen rare, threatened or endangered species, as well as the largest tracts of tidal marsh on the West Coast, south of San Francisco Bay. Elkhorn Slough hosts world class wildlife viewing opportunities, attracting 40,000 recreational visitors each year.

#### **Historic Marsh Loss**

About half (1,000 acres) of the historic tidal marsh in Elkhorn Slough has been lost since 1870, largely due to diking and draining, with 150 acres dying over the past 60 years because of excess inundation. Tidal marsh dieback is anticipated to accelerate with sea level rise and without action an estimated 500 more acres are predicted to disappear in the next 50 years.

This project addresses these issues by restoring formerly diked and drained wetlands. These restored habitats will provide an array of benefits to people and wildlife, such as removing pathogens and excess nitrogen from the water column, providing reproductive habitat for fish and birds, and sequestering carbon in the soil.

#### **Restoring Subsidized Landscapes**

One hundred years ago, extensive tidal marsh occurred on the shores of Elkhorn Slough. By the 1930s and 40s much of the salt marsh on the southern and eastern shores had been diked and drained. Decades later, these dikes began to fail, reintroducing tidal waters to the reclaimed lands. However, while the wetlands were drained, the soils consolidated and decomposed and the land subsided. The land surface dropped by up to several feet. This made the soil too low and wet to support salt marsh when the tides returned. This extra room (accommodation space) also contributes to a shortage of sediment in the slough that affects the viability of tidal marsh elsewhere.

This project will add sediment to these former marshes, returning the land to the elevation necessary for marsh plants to thrive. If fully successful, the healthy plants will create and capture sediment in the future, jumpstarting the process that sustains healthy tidal marsh habitats as sea level rises.

The sediment addition will also reduce Elkhorn Slough's tidal prism, the volume of water that flows in and out of the slough each tidal cycle. The tidal prism today is larger than it was historically, and the additional flowing water has eroded banks and soft mud habitats.

## **Project Goals**

Goal 1: Increase the extent of tidal marsh in Elkhorn Slough.

*Objective 1.1:* Restore salt marsh ecosystem to historically diked and drained areas through adding sediment.

Goal 2: Reduce tidal scour in Elkhorn Slough.

*Objective 2.1:* Reduce tidal scour through adding sediment to historically diked and drained areas

Goal 3: Protect and improve surface water quality in Elkhorn Slough.

*Objective 3.1:* Protect and improve surface water quality through establishing tidal marsh buffer

Goal 4: Provide resilience to climate change to Estuarine ecosystems in Elkhorn Slough

*Objective 4.1:* Increase the extent of tidal marsh of sufficient elevation to be resilient to moderate sea level rise

Goal 5: Increase understanding of how best to create salt marsh

*Objective 5.1:* Conduct a well-designed and monitored project so that lessons learned can inform future salt marsh restoration projects in the estuary.

## **Why sediment addition?**

Adding sediment produces marshes that are fully integrated into the cycles of the estuary: the exchange of water, minerals, nutrients and organisms. It restores marshes and reduces tidal prism without structures, such as culverts, which can impair water quality, impede wildlife movement and be expensive to maintain.

## **Where will the sediment come from?**

Sediment is likely to be obtained from flood control projects along the Pajaro River led by Santa Cruz County Department of Public Works and the Monterey County Water Resources Agency. It may also be obtained from the dredging of Moss Landing Harbor, from the Graniterock, Inc. quarry in Aromas, and other suitable sources.

## **Has this been done before?**

While innovative on the Central Coast, the beneficial re-use of sediment to restore tidal marshes is well established in San Francisco Bay, where hundreds of acres of tidal marsh restoration projects have been implemented using this approach.

### **Why these sites?**

The sites selected for several reasons. They require only a moderate amount of sediment to restore the marshes, they have good access for construction equipment, and they have uplands or remnant levees nearby to help contain the sediment if needed. This makes them the most cost effective sites to restore in terms of dollars per acre of tidal marsh.

### **Are the sites protected?**

The sites are part of the Elkhorn Slough National Estuarine Research Reserve, which is owned by the California Department of Fish and Game (CDFG) and managed in partnership with the National Oceanic and Atmospheric Administration (NOAA). The land is managed to prevent future impacts associated with development.

### **What will the sediment criteria be?**

An important part of the planning process is defining the criteria that sediment must meet to be used for the project. We will adapt a framework for the beneficial reuse of sediment for wetland restoration has been developed for San Francisco Bay by the US EPA and the Army Corps of Engineers. The process will define the acceptable concentrations of pollutants and the required testing. A key component is a risk assessment, which considers the fate and impacts of potential pollutants in the environment for vulnerable species, such as predatory birds. Sediment that could worsen conditions in the slough will not be imported.

### **Is importing invasive species a problem?**

It is important to ensure that the project does not import invasive species into the slough. Managing this risk is an important part of the project. A multi-tier process will be developed and implemented to minimize the risk of importing species that could impact Elkhorn Slough. Examples of actions include inspecting sediment sources and rejecting material with invasive species that could survive transport and placement in salt water habitats.

### **How will the sediment be imported?**

The planning process is evaluating options including trucking, rail transport and slurry pipeline. The best option depends on the sediment sources. For the Pajaro River source, trucking is the approach with the lowest cost and CO<sub>2</sub> emissions. The likely route would be on Highway 1 and Dolan Road. For material imported from Moss Landing Harbor the best option would be a dredge slurry pipeline.

### **How will the sediment be placed? Will containment berms be used?**

Various options will be evaluated in terms of costs, benefits and impacts. Factors to consider include the disturbance of existing habitat and the potential for sediment to move off the restoration site. For example, sediment delivered in a slurry will require containment berms so settling can occur. Sediment delivered by truck and placed with heavy machinery may not require containment berms depending on the potential for sediment to migrate off the site, and its potential impacts in other parts of the slough.

**Elkhorn Slough tidal marshes have been dying back. Tidal channels have undergone extensive erosion. Will the restored marsh die back? Will the added sediment wash away?**

Marsh has died back in many parts of the slough, and channel erosion has been extensive, but recent research has found differences in which areas are eroding and which are accumulating sediment. Four years of monitoring by ESNERR scientists (Eric Van Dyke and Beth Watson) found sediment accumulation in all areas with healthy marsh vegetation. A separate study from Cal State Monterey Bay (Spear and others 2010) also indicates that healthy marsh did not erode, although nearby channels did.

Site selection and design will play an important role in protecting placed sediment from erosion and ensuring the establishment of robust marsh plants. The project will establish tidal marsh at an elevation in the tidal frame that will optimize the growth rate of the plants. This is anticipated to result in dense vegetation that traps sediment and accumulates organic material. Sacrificial wave breaks, embankments and existing berms may be used as needed to facilitate vegetation establishment. However, this project provides a good opportunity to test our understanding of the factors that are driving marsh dieback and tidal scour in the slough.

**Will the marsh be planted?**

Past observations in Elkhorn Slough have shown that pickleweed and other marsh plants readily colonize bare soil at the right elevation over one to three years, making it not cost effective – or necessary - to do large scale planting. Marsh vegetation disturbed during the project may be re-used. The ecotone, the habitat between the marsh and adjacent grasslands, will be planted with a variety of species propagated from local stock, as necessary to achieve targets for diversity and representative species, which will be developed.

**Is climate change a problem? Will the restored marshes drown?**

There is a risk that the restored marshes will drown as sea level rises at rates accelerated by climate change, but projects like this one increase the chances that marshes in the estuary will survive a changing climate. Adding sediment to subsided marshes is a strategy for making Elkhorn Slough more resilient in the face of accelerating sea level rise: the restored marshes will be better able to rise with sea level and buffer uplands from waves and currents. The California State Coastal Conservancy encourages the “beneficial reuse of dredge materials to enable tidal wetlands and other shoreline habitats to keep pace with sea-level rise”. In addition to adaptation, the project provides mitigation to climate change: In less than 10 years, the restored tidal marsh is anticipated to capture and sequester CO<sub>2</sub> in quantities that offset the greenhouse gasses generated by construction.

**Why is it good to bring in sediment in trucks, but undesirable for sediment to wash in from the watershed during the winter rains?**

The Elkhorn Slough watershed is steep and the soils are highly erosive. The Natural Resources Conservation Service identified these lands as the most erosive farmland in the western U.S. Extensive efforts have been undertaken during the past 30 years to reduce the amount of

erosion in the watershed with considerable success. This erosion does not benefit the Elkhorn Slough ecosystem or economy. While farmland erosion in the watershed provides a potential source of sediment to the tidal marshes in the slough, most of the soil is sandy and does not reach the marshes. Erosion causes considerable damage to other ecosystems, such as the burial of freshwater ponds and marshes with sand, and the incision of gullies through wet meadow, oak woodland and maritime chaparral communities. Erosion compromises soil fertility and farmland sustainability. The sediment may be enriched in undesirable compounds such as nutrients and pesticides. Finally, there is no empirical evidence that such sediment is suitable for sustaining the marshes: the areas of the Elkhorn Slough tidal marsh that receive the largest amounts of sediment from eroding farmlands are also the ones undergoing the most extensive dieback of marsh vegetation.

### **Won't there be a lot of traffic?**

The project is anticipated to generate a large amount of truck traffic. For example, the Phase 1 restoration of 18 acres requires the transport of about 30,000 cubic yards of sediment, which will be delivered by approximately 1500 to 2500 dump truck roundtrips.

### **Will existing habitats and species be impacted?**

The project will be designed to minimize impacts to the many species that use the slough and existing high quality habitat. Some of the strategies to be developed include the timing of construction, the choice of equipment and the degree of future disturbance required to ensure establishment of the marsh.

### **Are the mudflats important to preserve?**

Mudflats in Elkhorn Slough are highly productive and provide valuable habitat for a wide array of invertebrates and key foraging habitat for shorebirds and many fish species. The mudflats at the sites do not appear to serve the same valuable ecologic function of other mudflats in the estuary: investigations to date indicate they lack the abundance and diversity of invertebrates, particularly shellfish, of nearby native mudflats. This appears to be related to their relatively high elevation.

### **How will the project be monitored?**

A comprehensive monitoring plan will be developed and implemented as part of the project to verify achievement of project goals and to increase understanding of ecosystem processes. Some elements will include: The establishment of tidal marsh will be monitored through the interpretation of aerial photography. Ecotone establishment will be assessed using quantitative field methods, such as transects. The displacement of tidal prism will be assessed using LiDAR topographic measurements. Reference sites in nearby Yampah Island and in other parts of the slough will be used to define success criteria.

## **What permits are required?**

The following compliance documents have been identified as likely to be required by the agencies in the development of the project.

### **Environmental Compliance**

- California Environmental Quality Act Compliance (Mitigated Negative Declaration or EIR anticipated, California Department of Fish and Game as lead agency)
- National Environmental Policy Act Compliance (EA anticipated, US Army Corps of Engineers as lead agency)

### **Federal Agency Authorizations and Permits**

- Army Corps of Engineers (Section 404(b)(1) compliance anticipated)
- Monterey Bay National Marine Sanctuary (permit anticipated)
- US Fish and Wildlife Service (Biological Opinion, Incidental Harassment Authorization: Endangered Species Act)
- National Marine Fisheries Service (Incidental Harassment Authorization: Marine Mammal Protection Act)
- National Marine Fisheries Service (Endangered Species Act consultation as part of the Environmental Assessment pertaining to potential impacts to the green sturgeon and Cojo salmon).

### **State Agency Authorizations and Permits**

- Regional Water Quality Control Board (401 Water Quality Certification/WDR/ NPDES anticipated)
- California Department of Fish and Game (LSA/Section 1602 Agreement)
- Coastal Commission (Coastal Development Permit)

### **Local Agency Authorizations and Permits**

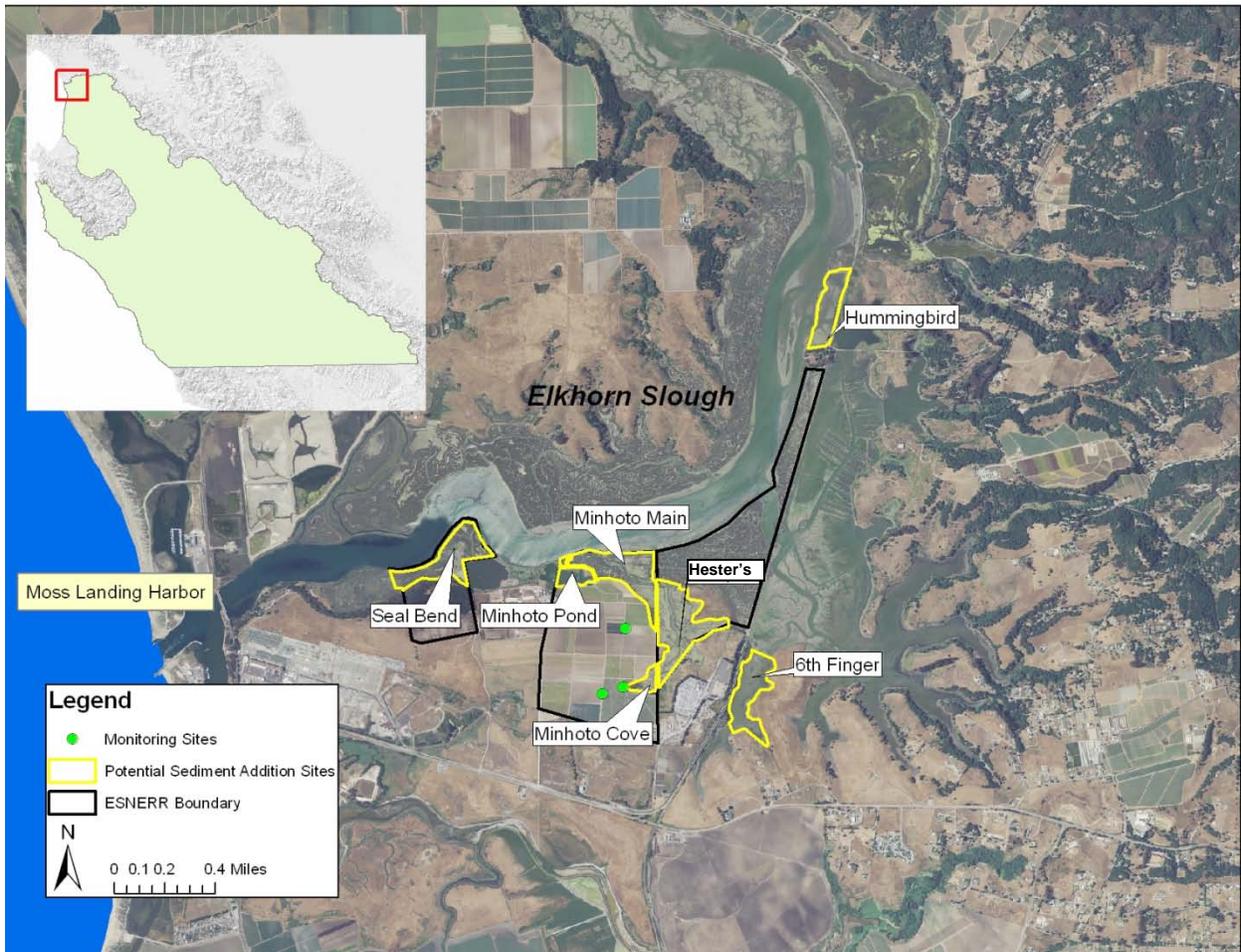
- Monterey County (Design Review, Grading Permit, Construction Permit)

**For questions or comments contact:**

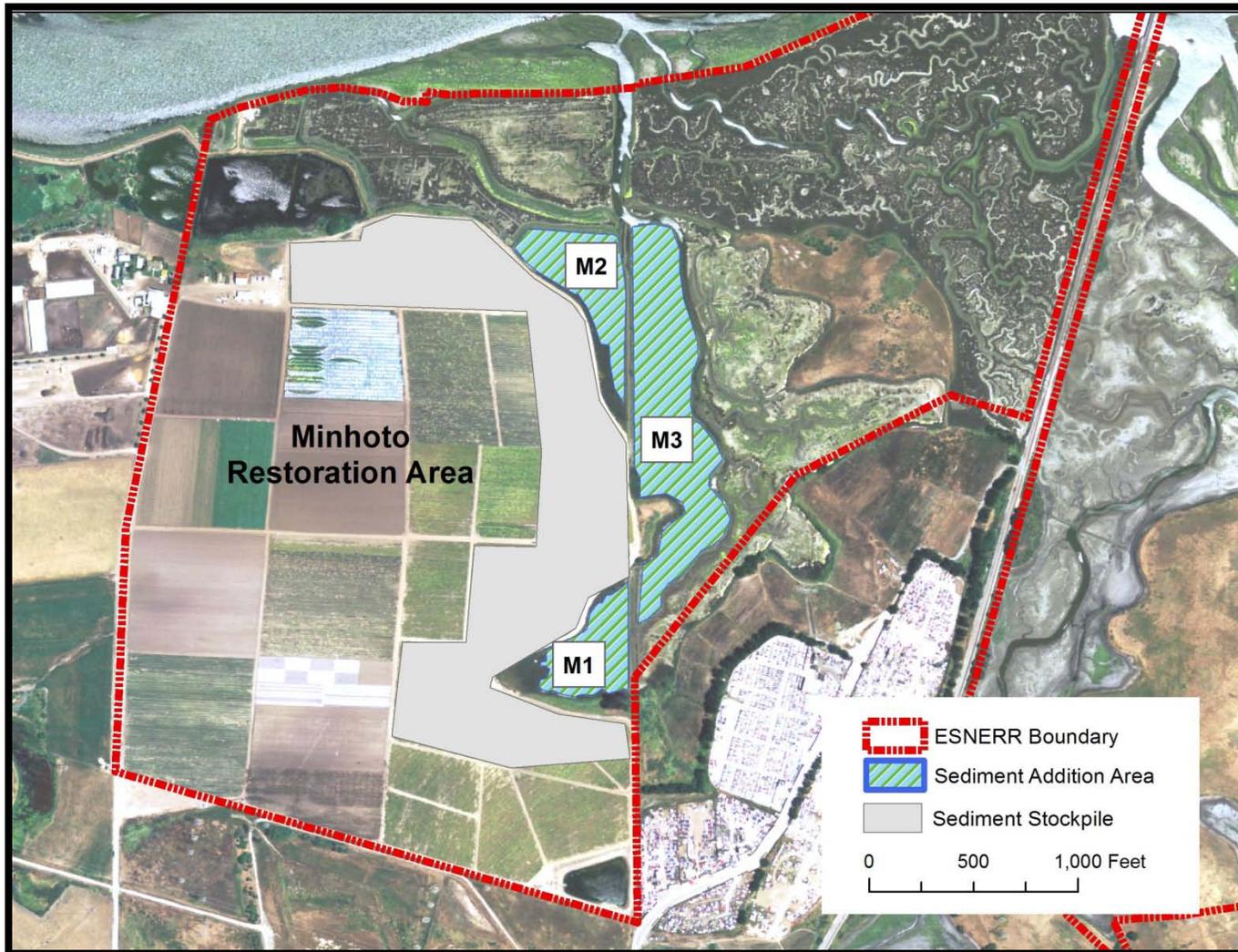
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**PROJECT SITE MAP 1:** Priority planning sites for tidal marsh restoration through sediment addition



**PROJECT SITE MAP 2:** Phase 1 Restoration site: Minhoto Ranch, Elkhorn Slough National Estuarine Research Reserve (Owned and managed by the California Department of Fish and Game)



**SITE PHOTOS**



**Sea otter on marsh near the Minhoto site.**



**View west across the Minhoto and Hester's Marsh sites to the Minhoto grass buffer.**



**Seal Bend restoration site S2 from the Moonglow Dairy levee. Trees in the background provide a rookery to herons, egrets and cormorants.**



**View of the Minhoto M2 restoration site from a remnant berm that will be used to contain added sediment.**

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### PROJECT SITE MAP 3: Pajaro River Sediment Sources

The map shows areas of the Pajaro River that are part of the Pajaro River Bench Excavation Project, an effort of the Santa Cruz County Department of Public Works and the Monterey County Water Resources Agency.

Extensive flooding in 1995 led to multiple efforts to reduce flooding on the Pajaro River, including watershed management process involving the four counties of the watershed, a levee re-evaluation process led by the Army Corps of Engineers, and the Bench Excavation project. The ‘benches’ are sediment deposits between the river levees that are higher than the floodplain. The plan is to lower the benches to the elevation of the 2-year floodplain, which will remove about 300,000 cubic yards of silt from the four mile reach of the river upstream of Highway 1. The project is in the planning process and is evaluating sediment placement areas in the region near Watsonville, including the county and city landfills, agricultural fields, wetland restoration sites and urban development sites.

