Parsons Slough Sill Project
Phase 1: 30% Design

Preliminary Project Description
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Submitted by

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1.0 PROJECT LOCATION

The Parson Slough Sill Project is located at the mouth of Parsons Slough in Monterey County, California (Figure 1-1). The proposed location of the sill and adjustable weir is just downstream of UPPR Bridge MP 103.27 Coast Subdivision.

2.0 PROJECT PURPOSE AND OBJECTIVES

2.1 Project Background and Purpose

Project Background

The Parsons Slough Marsh Complex is located on the southeast side of Elkhorn Slough and consists of the 254-acre Parsons Slough (including the “Five Fingers” area) and the 161-acre South Marsh area. The complex was historically dominated by tidal salt marsh and tidal creeks. In 1872, a railroad was built along the western side of this area and this railroad embankment blocked off the connections of about half a dozen tidal creeks. By 1913, a number of large, artificial freshwater ponds for waterfowl hunting were created by the construction of earthen levees around marsh areas to block tidal exchange. The entirety of Parsons Slough was removed from tidal exchange by 1956 and large areas were cleared, leveled, and drained for pastureland. The draining of the tidal marsh areas in Parsons Slough caused the marsh sediments to dry out, compact, decompose, and subside by several feet. During winter of 1982-1983, a levee breached near the mouth of Parsons Slough during a storm event allowing tidal waters to enter Parsons Slough (including South Marsh). The levee to South Marsh was temporarily rebuilt, water was pumped out to finish the creation of habitat islands and tidal channels for the South Marsh restoration project, and then the levee was intentionally breached restoring full tidal exchange to the complex in the fall of 1983. This restoration project took place soon after the Elkhorn Slough Reserve was designated and obtained ownership of these wetlands. Today, due to the increased tidal energy in the system, even these recently restored marsh habitat islands are deteriorating. The Parsons Slough complex now accounts for approximately 30% of the tidal prism in Elkhorn Slough. The increase in Elkhorn Slough’s tidal prism has accelerated tidal marsh loss and habitat degradation throughout the system from tidal erosion of the channel, creeks, mudflats, and marsh banks and tidal flooding of interior marsh areas. A more detailed management history and photos of the Parsons Slough Marsh Complex can be found at http://www.elkhornslough.org/tidalwetland/twmap06.htm.

In 2004, ESNERR initiated a planning effort to evaluate the tidal erosion issues at Elkhorn Slough and develop restoration and management strategies. Through the Elkhorn Slough Tidal Wetland Project (TWP) planning process, experts from multiple disciplines agreed that without intervention, excessive erosion will continue widening the tidal channels and converting salt marsh to mudflat. This will result in a significant loss of habitat function and decrease in estuarine biodiversity. Several projects to address the problem were identified. Restoration of Parsons Slough was selected as the highest priority project because significant habitat improvements can be achieved within the complex, while also potentially achieving system-wide benefits. Additional information about the TWP can be found at http://www.elkhornslough.org/tidalwetlandplan.htm.
A Draft Restoration Plan for Parsons Slough was completed in 2008. Consideration of multiple factors led to the conclusion that the project most able to advance the goals of the Tidal Wetland Project Strategic Plan and the Parsons Slough Restoration Plan is the construction of an adjustable submerged tidal barrier (a sill) at the mouth of Parsons Slough.

**Project Purpose**

The purpose of the adjustable sill is to provide a moderate reduction in energy compared to the existing tidal regime, while maintaining sufficient tidal exchange and flushing to provide acceptable water quality.

**2.2 Project Objectives**

The objective of the project is to construct a structure that would be adjustable over a range of conditions to enable optimization among the following multiple management objectives.

- Decrease the tidal prism to between 60% and 80% of current conditions and ensure that water quality and biodiversity can be protected by allowing reversibility in tidal prism, to 95% of current conditions.

- Operate the sill structure such no more than 65% of the Parsons area (excluding Whistlestop) should consist of subtidal habitat (no more than 283 acres of the 440 acre total), no less than 40% of the habitat area should consist of intertidal mudflat (no less than 174.4 acres), and no less than 5.2% should consist of salt marsh (no less than 22 acres). These goals were chosen so that there would be no net loss of salt marsh, and no more than a 50% loss of intertidal mudflats important for shorebirds.

- Design the sill structure so that at the most restrictive setting there is no more than 50% reduction in existing tidal range due to the structure alone and at the most open setting, there is no more than 5% reduction in existing tidal range due to the structure alone. These goals in boundaries on tidal range reduction are to minimize risk to water quality with an emphasis on dissolved oxygen or hypoxia (<2.3 mg/L) events, which are currently <5% of the time. ESNERR wants to ensure that tidal range is never artificially restricted far beyond what was natural at Elkhorn or is typical at other similar California estuaries, and aims to support estuarine diversity which has been shown to require substantial tidal range.

- Design and operate the sill structure such that the maximum velocities within the Parsons complex and the exit channel range from 10-15 feet/second and that water crosses the sill structure without creating plunging flows that could trap or injure fish and wildlife.

- Operate the sill structure such that marsh habitat is regularly inundated at a frequency and duration typical for representative estuarine plants and animals, somewhere between 2-13% of the time.
• Operate the sill structure to avoid creating a tidal regime that results in periodic large shifts in mean water level (>10 cm) which may last for weeks at a time. Tidal regimes with large changes in mean water levels such as observed at North Marsh have been associated with mosquito breeding events and die-offs in the estuarine benthos, including native oyster populations.

3.0 EXISTING CONDITIONS

3.1 General

The proposed location for the sill and adjustable weir is just downstream of UPPR Bridge MP 103.27 Coast Subdivision, which was replaced in 2003. The bridge is a 165-foot-long concrete slab girder bridge with new concrete abutments that were set just inboard of the previous abutments, which are still present, so as to not widen the existing channel. Sheetpiles were driven between the old and new abutments. The bridge is supported on ten bents each having three 24-inch-diameter concrete filled pipe piles that extend down approximately 100 feet below the rail line (Moffat and Nichol, 2008). The bents are spaced at distances of 9 to 14 feet apart. The rail line embankment has a crest elevation of about 8 feet\(^1\) in the vicinity of the bridge based on LIDAR data. A fiber optic cable line is buried along the east side of the rail line within the UPRR rail corridor right of way (Moffat and Nichol, 2008). The channel invert ranges between elevations -10 to -14 feet in the area downstream of the bridge. Rip-rap has been placed below the UPRR bridge for scour protection, however, the extent of the rip-rap is unknown (Kleinfelder, 2002). Based on Kleinfelder (2002), the rip-rap was had a maximum size of 3 feet in diameter and was delivered in forty 50-cubic yard capacity rail cars.

3.2 Geotechnical Conditions

The geotechnical conditions in the vicinity of the proposed sill base structure are based on two borings drilled in September 2001 for the replacement of UPRR Bridge MP 103.27 Coast Subdivision (Kleinfelder, 2002). The two borings, which are located approximately 40 feet downstream of the bridge were drilled to depths of 89 and 99 feet below the channel invert. The subsurface conditions found in both borings were approximately 62 feet of soft clayey silt underlain by very dense sandy soils.

3.3 Hydraulic Conditions

Tides at the UPRR bridge and within the Parsons Complex are approximately the same as that of the ocean with a mean tide range of 5.6 feet (Moffat and Nichol, 2008). The spring tide range in January 2007 was 8.25 feet from about 6.8 feet to -1.5 feet (Moffat and Nichol, 2008).

The velocity of tidal flows at the UPRR bridge are high enough to erode the soft clayey silts in which the channel is formed. Tidal velocities measured in 2002 were 5.6 feet per second during ebbing tides and 4.9 feet per second during flooding tides (Moffat and Nichol, 2008).

\(^1\) The elevation datum used in this technical memorandum is NAVD 88.
4.0 PROPOSED PROJECT ELEMENTS

The proposed sill structure consists of two distinct elements, a base structure and an adjustable weir. The base structure provides a foundation for the adjustable weir that would also prevent head-cutting and scour in Elkhorn Slough from migrating upstream into Parsons Slough as well as retain sediment that acretes within Parsons Slough. The adjustable weir would sit on top of or immediately adjacent to the base structure and be used to control the tidal prism entering Parsons Slough. The structure would span mouth of Parsons Slough and tie into the UPPR embankment on either side of the slough.

The intent of the design is to create as passive a structure as practicable with manipulation of the adjustable weir being required no more than two times per year in response to seasonal changes. The structure will be designed with the following design criteria:

- 50-year life span with consideration for its earlier removal if conditions dictate such action.
- Allow for combined settlement and sea level rise during the project life of up to 2 meters.
- Allow for modification in the future such that the structure could be altered to provide the historical cross-sectional area of Parsons Slough.

4.1 Base Structure

Three alternatives are being evaluated for the base structure. These alternatives are briefly described below:

Alternative 1 is a rockfill structure of approximately 6,500 CY of earth and rockfill (Figure 4-1). The structure would have upstream and downstream slopes of 2H:1V resulting in a maximum base width along the channel invert of approximately 90 feet. The central portion of the structure would be 100 feet wide and would have a top elevation of -2 feet. Earth and rockfill would be placed on the left and right sides of a 100-foot central area the structure to a top elevation 8 feet and would tie into the rail line embankment north and south of the UPPR bridge. Alternative 1 would have a total disturbance area of about 1 acre.

Alternative 2 is a sheetpile wall structure that would extend 270 feet across the channel (Figure 4-2). The central 100 feet of the sheetpile wall would have a top elevation of -2 feet and the sheetpile to the left and right side of the center section would have a top elevation 8 feet. The sheetpile would be capped to provide a platform for attachment of the adjustable weir. Short embankments that wrap around the ends of the sheetpile would be used to tie-in the base structure to the rail line embankment. Other alternative tie-ins include extending the sheetpile into the rail line embankments or using a helical anchored system similar to that used for the water control structure at North Azevedo Pond. A rockfill buttress would be placed on both sides of the sheetpile wall extending from elevation -2 feet to the channel invert with a slope of 2H:1V. The rockfill buttress would provide the following:

- Guide fish and marine animals moving from the channel invert over the sill and back down to the channel invert;
Prevent vortex flows that could trap marine life that might occur at the base of the sheetpile as tidal water flows over the sill invert; and

Provide additional lateral support for the sheetpile wall.

Alternative 2 would require placement of about 1,500 CY of fill and would disturb about 0.6 acres.

Alternative 3 would be similar to Alternative 2, except that the sheetpile and pile cap structure would be supported on end bearing piles driven through the soft soils to the dense underlying sandy soils (Figure 4-3).

All of the alternatives requires fill being placed within the mouth of Parsons Slough and on the perimeter marsh adjacent to the railroad embankment. The volume of fill required would be up to 6,500 cubic yards with a disturbance area of up to 1 acre. The alternatives would be located between a small tidal channel on the southern side of Parsons Slough just downstream of the UPRR bridge and the bridge, and thus, impacts to the small channel would be avoided.

4.2 Adjustable Weir

Several options are being considered for the adjustable weir portion of the project. Some structures are passive while others require motorized mechanisms for adjustment. Structures being considered in the evaluation ranging from simple to complex include; flash board riser or stop log structures, tilting and overflow weirs and miter, radial, pneumatic and overshot gates. Corrosion and biofouling are of significant concern given the marine environment. Emphasis in the design will be placed on robust alternatives that allow adjustment after long periods of inactivity and that minimize required maintenance. In all cases, the adjustable weir must be compatible with the preferred base structure alternative.

5.0 PROJECT CONSTRUCTION

Construction of the Parsons Slough Sill Structure will be performed from barges possibly made up of flexi-floats assembled inside Elkhorn Slough. Potential staging areas along Elkhorn Slough include Moss Landing Harbor, Moss Landing Wildlife Area, Kirby Park Rookery Bridge and Parsons Overlook (Figure 5-1). Staging areas will be further evaluated during the 30 percent design. Specific improvements to the staging areas would be determined by the construction contractor but are anticipated to include the temporary driving of piles and installation of deadmen on the shore to anchor barges, a landing area where cranes and barges can be offloaded and assembled, space for equipment storage, parking and office facilities and a stockpile area for storing and transferring materials to the worksite. A crane or excavator would be set up to assist in loading materials on barges and loaders used to move materials around the staging area.

The size of the main barge used for the placement of fill materials could be on the order of 40-ft wide by 60 to 80-foot long, set up to support a 90-ton crane with 2 cubic yard (cy) bucket. These types of cranes can typically place material about 60 feet from center of pin, which would be around 50 feet from the edge of the barge. The barge would need about 3-4 feet of water depth to float. The same barge and crane set up could be used for driving sheetpiles or other types of piles. Sheetpile would be driven starting with a
vibratory hammer to set the sheets, but may require an impact hammer to complete driving. Barges used to haul earth and rockfill materials to the project site would be of a similar size.

Temporary impacts resulting from project construction would include impacts to the staging area where vehicles are parked and equipment and materials are loaded onto barges, the anchoring of barges containing equipment and materials at the construction site, and transportation of personnel and equipment between the staging area and worksite. Temporary disturbance of silt resulting from placement of fill within the channel and construction noise resulting from operation of the equipment including driving of piles with vibratory and impact hammers could impact wildlife.

The Project design and regulatory compliance process are proceeding in tandem. The goal for the project is to have the 30% design completed by the end of January 2010, with an ultimate goal of bidding the construction work in early summer of 2010 and completing construction by November 2010. The actual duration and dates will depend on the final design, acquisition of permits, issuance of Notice to Proceed to the contractor, as well as tidal, weather and other site constraints. It is anticipated that construction of the two sheetpile alternatives could be completed within one construction season. The rockfill alternative would require an additional construction season to preconsolidate the soft sediment to reduce settlements after installation of the adjustable weir, and as such, is likely to be dropped from consideration because the construction wouldn’t fit within the planned timeframe.

Development of a concept level construction cost estimate for the sill structure is currently in progress. However, the construction cost is estimated to be in the range of ___________. The construction cost will vary based on the final design and construction climate at the time of bid.

6.0 PROJECT OPERATION

The Parson Slough Sill Structure will become operational when construction is completed. Adjustments to its configuration are anticipated more frequently early in its design life and less frequently as its influence on tidal flows is learned. In the first years, planned adjustments might be made as frequently as every 6 months, and emergency adjustments (to stop hypoxia/fish kill events) might need to be made within weeks. After the optimal configuration has been determined, adjustments will likely rarely or never need to be made.

Maintenance activities are likely to primarily involve the removal of Mussels, barnacles, algae, sponges, tunicates, and bryozoans rapidly colonize submerged substrates so that the adjustable weir can be properly operated.

Access for operation and maintenance activities will be by boat.
7.0 References

Kleinfelder (2002). Geotechnical Engineering Investigation for Union Pacific Railroad Bridge (103.27 Coast) Replacement Project at Parsons Slough in Monterey County, California, January 23.
