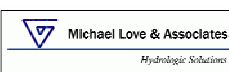


# Salmon Creek Estuary Enhancement Project

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Engineering - Hydrology - Stream Restoration



## HISTORIC SALTMARSH

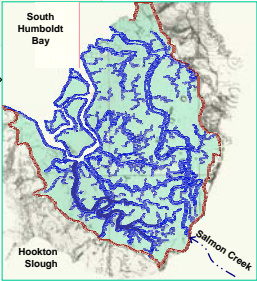


**Humboldt Bay** has four large tributaries that support viable runs of anadromous salmonid:

- Jacoby Creek
- Freshwater Creek
- Elk River
- Salmon Creek

**Salmon Creek** flows from the Headwaters preserve to the USFWS Humboldt Bay National Wildlife Refuge.

- 18 mi<sup>2</sup> drainage area
- 40-65 in. rainfall annually
- Coho, chinook, steelhead, and cutthroat trout present



## EXISTING CONDITIONS

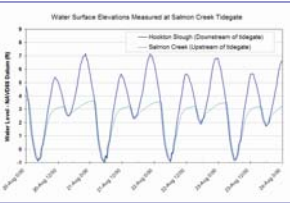


**Salmonid Usage of Tidal Estuaries**  
Until recently, use of estuaries by juvenile salmonids received little attention. As research focuses on the role of the intertidal estuary in the lifecycle of anadromous salmonids, we are beginning to understand the importance of this habitat type.

One of the most comprehensive research studies to date was performed by Miller and Sadro (2000). They investigated juvenile coho usage of the estuarine portion of Winchester Creek, a tributary to South Slough, Coos Bay, Oregon. During a 16-month period they found at least three different life cycles of juvenile coho using the estuary: fry entering in spring, pre-smolts entering in fall and winter, and smolts entering in spring. The estuary environment proved to be excellent foraging habitat, resulting in surprisingly high growth rates.

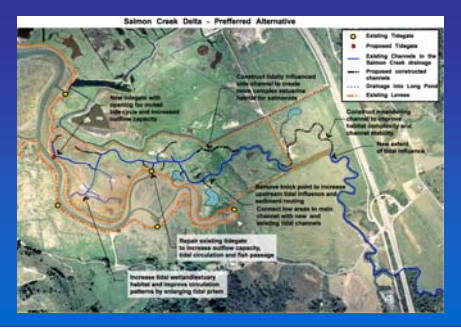


Assistance with field work by AmeriCorps Watershed Stewards Projects

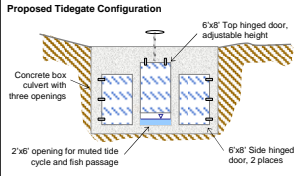


The existing 1.5'x3' fish door within the tidegates produces a "muted tidal cycle" inside the levees.

## PREFERRED ALTERNATIVES



New tidegate technologies can be used to fine tune or seasonally adjust artificial tidal regimes.



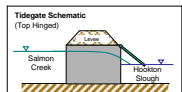
## MUTED TIDE CYCLE

A **muted tide** cycle is a means of introducing or reintroducing a tidal cycle into an area that has either been diked and drained, subsided, or where upstream flood constraints limit the volume of tidal flux (tidal prism) that can inundate an area.

The rate of **tidal flux** in diked areas can be increased by designing the size and elevation of drainage structures to allow the ebb and flow of bay water into and out of a site.

The muted tide concept can be used in the lower Salmon Creek project area to restore tidal estuary habitat without extensive construction of new levees and without further impacting upstream flood conditions.

## TIDEGATE MODELING

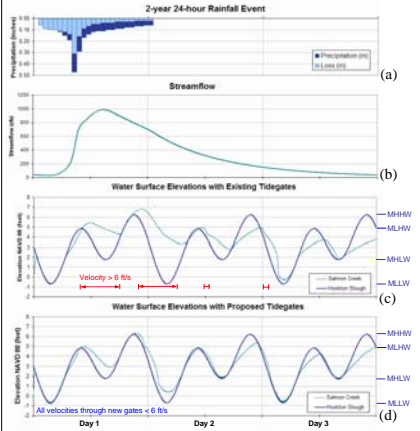


The flap on a tidegate closes when the tide is higher than the upstream water surface, thus limiting upstream tidal inundation



Side hinged tidegate at Rocky Gulch

**Hydraulic modeling** was used to determine existing conditions and develop appropriately sized new tidegates for improved fish passage and outflow capacity.



- (a) 2-year 24-hour rainfall event (3.01 inches) distributed using an SCS Type IA design storm.
- (b) Resulting streamflow hydrograph generated from HEC-HMS hydrologic model of Salmon Creek watershed.
- (c) Existing tidegates modeled using inflow from hydrograph and design tidal cycle. Velocities exceed 6 ft/s (maximum allowed for upstream passage of adult salmon and steelhead) for more than 16.5 hours. The gates lack sufficient capacity to drain peak storm flows during ebb tides.
- (d) Proposed tidegates modeled under same conditions as existing. Velocities remain suitable for adult fish passage throughout the period, and the tidegates have sufficient capacity to drain peak storm flows as the tide ebbs.

## PROJECT ACTIVITIES

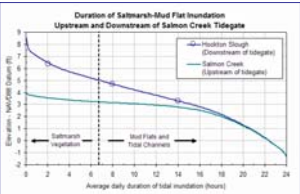
- Planning (Completed 2003)**
- Develop restoration plan
  - Monitor tidal characteristics
  - Water quality sampling
  - Topographic mapping
  - Identify existing limiting factors
  - Develop restoration alternatives
- Implementation (Ongoing)**
- Implement restoration measures
  - Connect off channel wetlands and ponds
  - Increase tidal flux upstream of tidegates
  - Improve fish passage at tidegates
  - Increase salt-fresh water interface
  - Improve flood routing
  - Increase sediment routing

## INUNDATION LEVELS

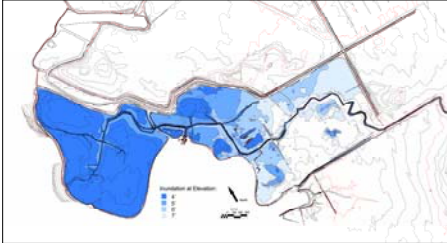
**Saltmarsh** locations are determined determined by the amount of time time land is inundated by saltwater. saltwater.

In **Humboldt Bay**, mudflats transition to saltmarsh at approximately 5 feet elevation, which is inundated an average of 6.8 hours/day.

The existing **muted tidal cycle** in Salmon Creek allows saltmarsh to form between 3.2 and 4.0 feet.



The inundation map shows that increasing the muted high tide to 5-feet will connect currently isolated off-channel wetlands.



## PARTNERS

- Project Proponents**
- Pacific Coast Fish, Wildlife & Wetlands Restoration Association (PCFWRA)
  - USFWS Humboldt Bay National Wildlife Refuge
- Funding**
- CA Dept. Fish and Game
  - Coastal Conservancy
- Design**
- Michael Love & Associates
  - Jeff Anderson & Associates
  - Nehalem Marine



**References**

Barnhart, Roger A. Miller J. Body, and John E. Pappas. 1992. The ecology of Humboldt Bay, California: an extensive profile. USFWS Biological Report 1. January 1992. 123 pp.

Miller, Bruce A. and Steve Sadro. 2000. Residence time, habitat utilization and growth of juvenile coho salmon. Preliminary Report of Findings. 19 pp.