

Reference Estuary Study

continued

The salinity values from the reference estuaries ranged from 1 to 28 (psu). The predicted range of salinity within Capitol Lake as modeled by USGS was 1 to 30 parts per thousand (ppt). Estuarine conditions are usually considered to occur at 0.5 ppt and salinity in southern Puget Sound is as high as 32 ppt.

Sediment

The predicted sediment textures for a restored Deschutes estuary (Capitol Lake) were similar to those sampled within the reference estuaries. Sediment samples were collected from each of the 90 reference sites.

Silt loam was the most common sediment texture with both the reference estuaries and the modeled Deschutes estuary. Sandy loam sediments was the second most common sediment texture in the five reference estuaries and would be abundant within the modeled Capitol Lake. Silt and silty clay loam were predicted to be common in a restored Deschutes estuary but were found only at 2 of 90 sampling sites. The silt loam sediments will be an important factor in the formation of the estuarine communities within a restored estuary.



Vegetation

The majority of sampled sites were unvegetated flats of either sand, mud, or mixed sand and mud. Several plots contained a layer of diatoms (microscopic, one-celled algae) or algal mats on the surface.

Sites with salt marsh vegetation were very limited. A majority of the marsh vegetation was found at only 12 of the 90 reference sites. The vegetation and plant species identified at the reference estuary sites are characteristic of those typically found in estuarine, intertidal and salt marsh community types within Puget Sound.

Shells and Invertebrate Collection

Shells were collected which were on top of the sediment at the sampling sites. The following organisms were found at the five reference estuary sampling sites:

barnacles	<i>Mytilus trossulus</i> ,
butter clam	<i>Saxidomus giganteus</i>
Japanese littleneck clam	<i>Tapes japonica</i>
native littleneck clam	<i>Protothaca staminea</i>
soft-shelled clam	<i>Mya arenaria</i>
bent-nosed macoma	<i>Macoma spp.</i> ,
Nuttall's cockle	<i>Clinocardium nuttallii</i>
unknown species of cockles	
moon snail	<i>Polynices lewisii</i>
slipper snail	<i>Crepidula fornicata</i>

CAPITOL LAKE

Adaptive Management Plan

Reference Estuary Study and Biological Conditions Report

Fall 2006

Study Background

This Fact Sheet is a summary of major findings from the Deschutes Estuary Feasibility Study. It presents information from the 1st in a series of technical reports. The Deschutes River Estuary Restoration Study and Biological Conditions Report was prepared by the Earth Design Consultants, Inc. (Corvallis, Oregon).

The full report can be downloaded from the Washington Dept. of General Administration website at: www.ga.wa.gov/CLAMP/EstuaryStudy.htm

This report describes the results of two separate feasibility study tasks. First is the Reference Estuary Study, and the second is the Biological Conditions Report. Both tasks will help evaluate the feasibility of restoring Capitol Lake to an estuary of the Deschutes River. Capitol Lake is part of the Washington State Capitol Campus and is located in Olympia and Tumwater, Washington.

When designing the Deschutes Estuary Feasibility Study (DEFS), one important question was ... **"If we build it, will they come?"** This study would help answer the

Southern Puget Sound

The Biological Conditions Report describes what habitats would be expected in a restored Deschutes estuary. Capitol Lake used to be part of southern Budd Inlet. Today, Budd Inlet is seven miles long, one mile wide at its mouth, and two miles wide near its center. At the south are East and West Bays which are divided by the Port of Olympia peninsula. West Bay is the mouth of the Deschutes River Estuary.

Budd Inlet and southern Puget Sound estuaries are characterized by:

- Shallow depths,
- Soft, and silty sediments,
- Slow flushing times,
- "Layering" of freshwater on top of saltwater,
- Warmer summer surface water,



Field data collection. Ellis Cove in Priest Point Park. August 2005

question when considering whether or not to restore the estuary. It was to predict what types of habitat communities a restored Deschutes estuary might support. To do this, the study used the anticipated physical conditions of the restored estuary which were a part of the Hydrodynamics and Sediment Transport Modeling report (see Fact Sheet #4).

- Complexity in shape,
- Limited water exchange with other parts of the Puget Sound,
- Tide ranges of 13 to 15 feet between high and low tides,
- Limited dilution of nutrients, and
- Lower oxygen concentrations.

These physical conditions lead to some differences between the flora and fauna of southern Puget Sound as compared with other estuaries in Puget Sound. For example, some species assemblages such as kelp and other algae and invertebrate species are not as diverse as other parts of Puget Sound. Eelgrass, a key habitat of juvenile salmon, is also not found south of the Nisqually Delta.

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For additional questions, please contact:

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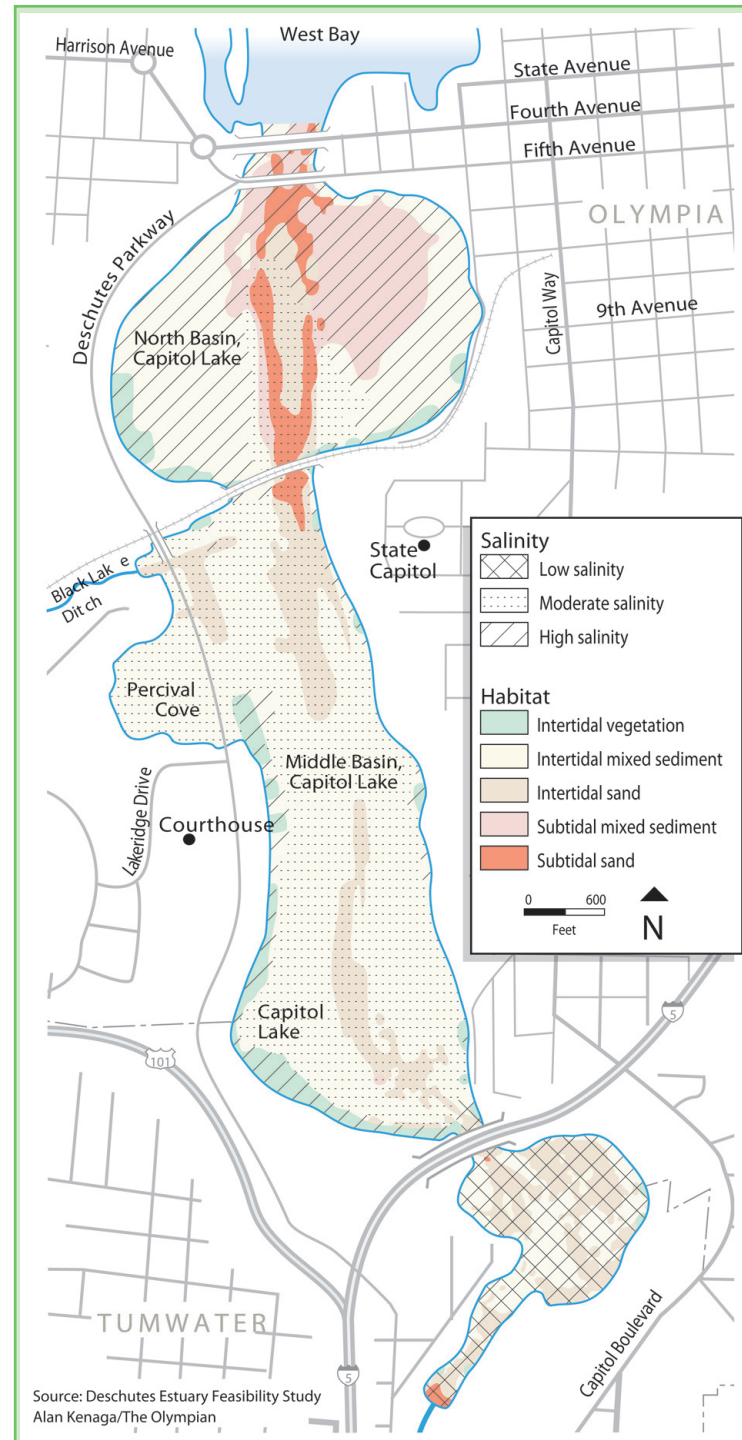
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Biological Conditions Report

The Biological Conditions Report combined the field data, scientific literature, and statistical modeling. It identifies what sort of estuarine communities might recolonize a restored Deschutes estuary.

- **Mud Flats** would dominate the restored estuary. They would be similar to those of Mud Bay in Eld Inlet. Mud flats are characterized predominantly by silt and clay sediments that are regularly flooded by high tides, drained and flooded by a diffuse pattern of channels. At high and low tides, mudflats can be a source of food for waterfowl and food and refuge for juvenile fishes. Organisms expected in mud flat habitats include burrowing crustaceans and polychaetes, mud shrimp, and clams. Diatoms and algal mats may be found where salinities are higher.
- **Mixed Sand and Mud Flats** would occur at varying elevations and salinities throughout a restored estuary. At higher elevations, these habitats form a transition zone up to high marsh areas and are populated with vascular plants and even some trees. At lower elevations and low salinities, plants such as bulrush and arrowgrass may also occur. In lower elevation/high salinity areas, microalgae, salt-tolerant plants such as pickleweed, and animals such as ghost shrimp will likely exist.
- **Sand Flats** would also be expected within the basin. Sand flats are found along exposed boundaries of mud flats in estuarine river deltas, adjacent to river channels. They typically occur in higher energy areas than mud flats where the substrate is predominantly sand and is exposed to sorting from wave and current action. Flooded by most high tides, sand flats are covered by scattered vegetation near the tidal edges, with more vegetation farther away from water. Clams, polychaetes, and young fish are typical animals that inhabit sand flats. In high salinity areas salt grass could be expected, while less salt-tolerant common three-square and Lyngbye's sedge would be expected closer to Percival Cove and Tumwater Falls.



A recreated Deschutes River estuary would feature mostly mud flats at low tide with a sandy river channel running through it and a thin perimeter of salt marsh plants in portions of the North and Middle Basins.

Biological Conditions Report

continued

- **Sand Channels** would form in the North and Middle Basins. The main channel would reform quickly after dam removal. It would be expected to be deeper and sandier than those found at Kennedy Creek. Sand channels generally occur in open, deeper areas where channels form. These open areas are typically inhabited by clams, polychaetes, young flat fish, salmon, and sand loving algae. They are also important for provision of refugia and food for anadromous, resident, and marine fishes and transport of sediments.
- **Vegetated marsh** would likely be limited to a band around the periphery of the basin (similar to Mud Bay). This area would support the type of salt marsh plants described for the mud and sand flats above. Higher elevations may also support trees and shrubs common to Puget Sound shorelines

The urban setting of Capitol Lake could pose some obstacles for reestablishing a restored Deschutes estuary. These challenges include: excess nutrients, altered hydrologic cycle, urban stormwater, invasive species, climate change, and other human disturbances. However, with realistic goals and an adaptive rehabilitation process, these uncertainties could be overcome and successful estuarine communities could be reestablished within the basin.

Reference Estuary Study

The Reference Estuary Study sampled five estuaries within southern Puget Sound. These including Woodard Bay, Ellis Cove, and Mud Bay in Thurston County; and Kennedy Creek and Little Skookum Inlet in Mason County. All are relatively close to Capitol Lake and were chosen to represent the range of conditions present in estuaries within Southern Puget Sound. While the reference estuaries were from smaller drainages (creeks rather than a river), each watershed had a similar diversity of land uses and forest cover as compared to the entire Deschutes River watershed.

Previous studies have shown that Elevation, Sediment Texture, and Salinity are the key physical parameters for predicting conditions within a restored Deschutes estuary (Capitol Lake).

At each estuary a total of 16 to 21 field sampling points were randomly located. There were a total of 90 sites across the five estuaries. Measurements were taken on the following: 1) Vegetation - percent cover; species, and type, 2) Sediment texture - sand, silt, and clay 3) Salinity, 4) Temperature, 5) Dissolved oxygen concentration, and 6) pH. The location and elevation of each sampling point were established using global positioning system (GPS). Sediment cores and empty or dead invertebrate (*insects and shellfish*) shells were collected for later lab analysis. The field work was undertaken during August and September 2005.

Elevation

Elevations at the reference estuary sites ranged from a low of -2.1 feet tidal elevation (Mean Lower Low Water - MLLW) at Ellis Cove in Priest Point Park, to a high of almost 16 feet MLLW in Mud Bay. The average elevation of sampled sites was 8.4 feet MLLW. The largest proportion of the sites fell near the median value of 8.6 feet MLLW, which is just above mean half tide. By comparison, the summer and winter levels of Capitol Lake would be 14.2 - 13.2 feet MLLW, if converted to tidal elevation datum.

The field team was unable to sample the lowest elevation at many of the estuary sites because of deep water. However, the sampling strategy adequately captured much of the range of physical conditions, and dominant plant and algal communities present in South Sound estuaries and those which could be expected within a restored Deschutes estuary.

Salinity

The salinity data collected at the reference estuary sites were measured in "pore water salinity" (psu). The USGS modeling output was called "near-bed salinity". While the two salinity data sets are not directly comparable, both include salinity ranges which are common to estuarine communities in Puget Sound according to other scientific studies.