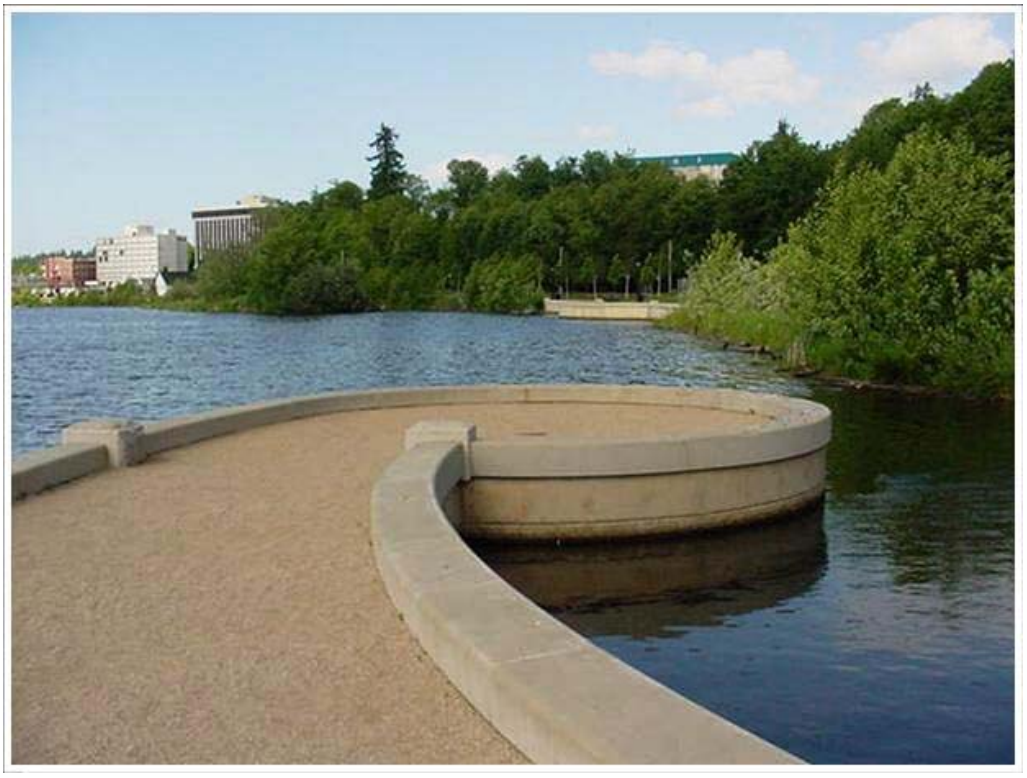
CAPITOL LAKE ALTERNATIVES ANALYSIS – FINAL REPORT

Prepared for

Washington Department of General Administration &
Capitol Lake Adaptive Management Plan Steering Committee



July 2009

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SECTION 1

Introduction and Description of Alternatives

1.0 Introduction

1.1 Background

The area that is now Capitol Lake was once an integral part of Budd Inlet, consisting of intertidal mudflats that typically form at the mouths of estuaries (like Budd Inlet). The idea to create a lake on the State's Capitol campus came from the 1911 Wilder and White campus plan. After reviewing different concepts, designers settled on a plan to dam the lower Deschutes River and create a lake as a reflecting pool for the Capitol building. An earthen dam, concrete spillway, and bridge were constructed in 1951, blocking the tidal exchange with Budd Inlet and flooding the mudflats to form Capitol Lake.

Capitol Lake and its surrounding shoreline, trails, and parks are a vital part of the local area. Not only is the lake an important recreational hub and a valued amenity for downtown Olympia, it also holds historical and personal significance for many people. However, it has also created multiple management issues for the State Department of General Administration (GA), which is responsible for managing the lake.

Arguably, the most pressing issue facing Capitol Lake is sedimentation. Sediment transported by the Deschutes River is gradually filling in the lake. Sedimentation, water quality problems, and invasive species issues have combined to challenge the lake's uses and values and have been the impetus for considering alternative management strategies. The lake also influences Budd Inlet, another important consideration when evaluating management options. In response to these issues, in 1997 the GA organized what became the Capitol Lake Adaptive Management Plan (CLAMP) Steering Committee. The committee has met monthly since then, with the public invited to attend. Steering committee membership is shown in Table 1-1.

Table 1-1. CLAMP Membership.

City of Olympia
City of Tumwater
Washington Department of Ecology (Ecology)
Washington Department of Fish and Wildlife (WDFW)
Washington Department of General Administration (GA)
Washington Department of Natural Resources (WDNR)
Squaxin Island Tribe
Thurston County
Port of Olympia

One of the committee's first steps was to create a vision for management of the system. The CLAMP 'Vision for the Next Ten Years' was completed in 2002. It outlined 14 major

management objectives for Capitol Lake, including a commitment to adaptive management and transparency. Key goals of the vision include:

- Study estuary restoration feasibility
- Develop a sediment management plan
- Rehabilitate the fish ladder at the Capitol Lake dam
- Relocate the Percival Cove fish-rearing operation
- Improve Capitol Lake water quality to meet State standards
- Eliminate noxious weeds
- Control populations of Canada geese

The CLAMP plan also called for restoration of infrastructure damaged in the Nisqually earthquake, completion of Heritage Park, and increased public use of public lands.

The goals associated with conducting estuary feasibility studies, developing a sediment management plan, and improving Capitol Lake water quality, lead to development of a range of long-term management options for the lake basins. Eventually, four management alternatives were selected for consideration. Several rigorous scientific studies have been conducted to evaluate and compare the four alternatives. The purpose of this document is to collect the technical findings into one document and to provide a simplified comparison of the management alternatives.

1.2 Purpose and Approach

While studies of Capitol Lake have spanned more than three decades, this alternatives analysis focuses on those completed in recent years in support of Capitol Lake Adaptive Management Plan (CLAMP) objectives. The goal of this report is to summarize the key findings of these technical reports to facilitate selection of a long term management strategy. It is not the purpose of this report to provide a technical review of the reports or to further analyze the information presented in them. The background reports themselves were not prepared to address all issues facing this management decision, but to provide a framework for what is considered the most crucial of these issues. Depending upon the alternative selected, a more comprehensive environmental review (e.g., an Environmental Impact Statement (EIS) will be prepared.

The CLAMP Steering Committee originally selected 15 categories as a framework for analyzing the four Capitol Lake management alternatives. The analysis categories were taken from the CLAMP 10-Year Plan, the Capitol Campus Master Plan, estuary study technical reports, and public comments. During development of this report, these 15 categories were organized into 3 major groups (Environment, Economy, and People) and combined where appropriate to create 8 technical analysis topics, summarized in Table 1-2. One of the categories, Ecosystem Health, was not included in the analysis because it was believed to be encapsulated within the three issues described as part of the Environment group, shown in Table 1-2.


N
Budd Inlet
Capitol Lake - North Basin
Capitol Lake - Middle Basin
Percival Cove
Marathon Park
Sylvester Park
Heritage Park
Centennial Park
Maple Park
OLYMPIA
TUMWATER
Interpretation Center
Capitol Lake South Basin
Deschutes Parkway
Olympic Way
Garfield Ave.
Harrison Ave.
4th Ave.
5th Ave.
Thurston Ave.
Olympia Ave.
State Ave.
Legion Way
7th Ave.
8th Ave.
9th Ave.
10th Ave.
Union Ave.
11th Ave.
12th Ave.
13th Ave.
14th Ave.
15th Ave.
16th Ave.
17th Ave.
18th Ave.
19th Ave.
20th Ave.
21st Ave.
22nd Ave.
23rd Ave.
24th Ave.
Columbia St.
Capitol Way S
Washington St.
Franklin St.
Adams St.
Jefferson St.
Cherry St.
Chestnut St.
Plum St.
Water St.
Capitol Blvd
101
5
Map M-2
Washington State Capitol and Capitol Parks
East Campus
West Campus
Capitol Park Lands
Other State Property
June 2006

Table 1-2. Technical analysis topics evaluated for the four Capitol Lake management alternatives.

ENVIRONMENT
Sediment Management
Plants and Animals
Water Quality
ECONOMY
Infrastructure
Downtown Flood Risk
Long Term Cost
PEOPLE
Public Recreation
Cultural and Spiritual Resources

Section 2 of this report, the *Comparison of Alternatives*, is organized around these 8 technical topics; each topic having its own section within Section 2. Each section provides an overview of the topic, and a summary of impacts associated with each management alternative. For the Status Quo Alternative, the lake basin will change significantly over the years. Therefore, the impacts from this alternative are described for two time scales; the near-term which covers approximately the next 50 years and the long-term which addresses the period after that. For all alternatives, the impacts are described and formatted as a series of summary statements. Where appropriate, these statements have supporting 'end notes' to point readers to the specific document and page where information can be found. Finally, each technical section ends with a brief comparison of alternatives that emphasizes the most significant differences.

All of the technical analysis topics sections in Section 2 of this report have been reviewed and discussed by members of the CLAMP Steering Committee. Section 3 of this report summarizes the key findings of the Steering Committee.

1.3 Description of Alternatives

1.3.1 Status Quo

The Status Quo Lake alternative describes the lake if present conditions and management actions were extended into the future. This alternative is the baseline condition for the other three alternatives.

Artist's concept of Status Quo Alternative

Under this alternative, ongoing CLAMP management actions would continue. These actions include; managing the lake elevation to avoid flooding of adjacent properties, removal of noxious weeds along the shoreline and milfoil from the lake, and control of the resident Canada geese population.

This alternative assumes that the Capitol Lake dam would remain and be maintained in good working order. New construction may include building a pedestrian bypass around the dam and other design elements during the final phases of Heritage Park construction. There would be no changes to the adjacent roadway system with this alternative.

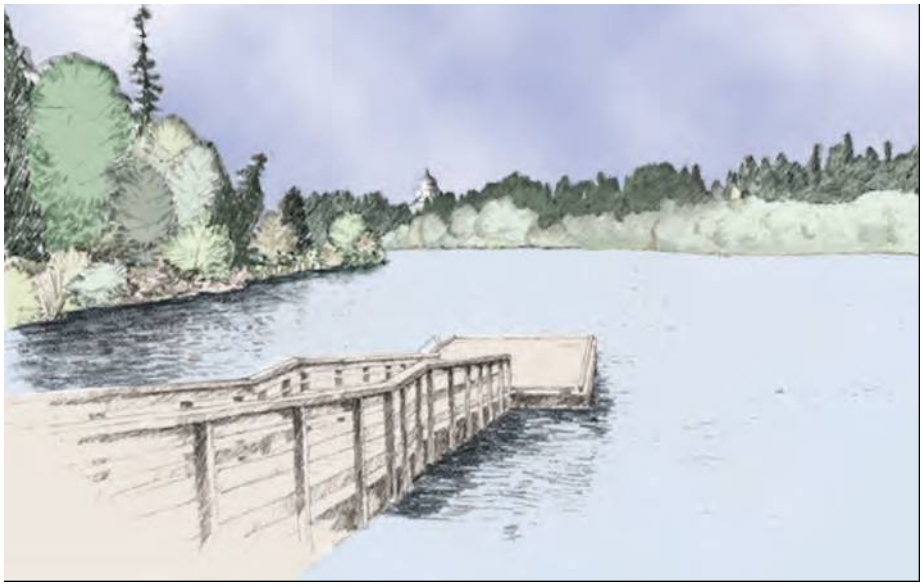
This alternative also assumes that no dredging would occur within the basin. Without dredging, sediment from the Deschutes River and Percival Creek would continue to fill-in the open water areas of the lake. The transition from open water to sand bars, to marshes, then to riparian vegetation would be similar to the south basin (located south of Interstate 5). It would take several decades for the lake to fully transition into the large wetland and river system that defines the long-term condition for this alternative. Because the transition period is predicted to be beyond the planning horizon for this project, both near-term (i.e., the next 50 years) and long-term (i.e., beyond 50 years) conditions are addressed in this analysis.

The historical sediment rate for the lake is about 35,000 cubic yards per year. Over time, Percival Cove, the middle basin, and then the north basin would be filled-in. Then, sediment would pass through the lake and into lower Budd Inlet.

The community's use of roads, parks, and sidewalks adjacent to the lake would change little with this alternative. Summer weed growth in open-water areas is expected to continue, and water depth in all basins would become shallower. Over time, the lake will become too shallow and weedy for motor boats, and the public boat launch in the south basin would be abandoned.

1.3.2 Managed Lake

The Managed Lake alternative describes basin conditions if a freshwater lake continues into the future. Capitol Lake has been managed as a freshwater lake since the 5th Avenue Dam was constructed in 1951.



Artist's concept of Managed Lake Alternative

Under this alternative, ongoing CLAMP management actions would continue. These would include; managing the lake elevation to avoid flooding of adjacent properties, removal of noxious weeds along the shoreline and milfoil from the lake, and control of the resident Canada geese population.

This alternative assumes that the Capitol Lake dam would remain and be maintained in good working order. New construction would include building a pedestrian bypass around the dam and development of the final phase of Heritage Park. There would be no changes to the adjacent roadway system with this alternative.

This alternative also assumes that the north and middle basins of Capitol Lake would be dredged. Both basins are visually important to the lake, and lie adjacent to Heritage Park and the West Capitol Campus. In those basins, no dredging would occur within 100 feet of the shoreline. No dredging is planned for Percival Cove and the south basin, except near the public boat launch.

The target water depth would be about 13 feet in the summer. This would increase opportunities for boating and water-based recreation within the basins. (This target water depth is the maximum that is feasible based on the design of the current dam.) Saltwater currently lies within depressions in the lake deeper than the dam, and so an existing depression in the north basin would be filled-in during dredging.

Several scenarios were created to compare various dredging methods and disposal techniques. A medium cost approach was chosen for the Managed Lake alternative. This would require initial dredging and removal of approximately 875,000 cubic yards of sediment, which would be disposed of in an approved marine location. Dredging within the lake would be limited by a summer fish window, and the amount of dredging needed would require two summers to complete.

About 220,000 cubic yards of sediment would need to be routinely dredged every 8 to 9 years, based on the historic sedimentation rate in the lake. Each maintenance dredging operation would be completed within a single summer fish window. Materials from these later dredge operations would be reused as construction fill and/or disposed at an approved marine location.

The community's use of the roads, parks, and sidewalks adjacent to the lake would not change under this alternative. Additional water depth would discourage aquatic plant growth within the dredged basins. A swimming beach is not proposed as a part of this alternative.

1.3.3 Estuary

The Estuary alternative describes basin conditions if tides were reintroduced into the Capitol Lake basin. This would resemble conditions prior to the construction of the Capitol Lake dam.

Artist's concept of Estuary Alternative

Under this alternative, ongoing CLAMP management actions would continue until the dam is removed. This would include; managing the lake elevation to avoid flooding of adjacent properties, removal of noxious weeds, and control of the resident Canada geese population.

A feasibility study evaluated various estuary options. The selected design for this alternative (labeled as "Option A" in the *2008 Estuary Feasibility Study*) would remove the Capitol Lake dam. This would create a tidal opening of about 500 feet that would be similar to the existing opening under the 4th Avenue bridge. A new 5th Avenue bridge would be constructed over the opening. A new intersection of Deschutes Parkway and 5th Avenue would be constructed to the west of the new bridge, connecting to the 4th Avenue roundabout.

The Estuary alternative would require protecting the foundation of Deschutes Parkway. A blanket of large rocks would be laid along the lake side of the roadway and keyed into the base of the shoreline. This rock buttress would be constructed along the western shore of the existing lake and along the Percival Cove causeway.

Prior to removing the dam, an initial dredge of approximately 395,000 cubic yards would occur in the main channel of the existing lake. This would reduce the amount of lake sediment which would otherwise flow into the navigation channel, Percival Landing marinas, and the Port of Olympia. This lake sediment would be used to cover the rock buttress along Deschutes Parkway and to reshape the shoreline to support intertidal, saltmarsh habitat. After the dam is removed, the navigation channel, slips at the Percival Landing marinas, and berths at the Port of Olympia would need to be dredged more frequently than in the past.

This alternative would also require minor restoration around the existing lake basin. Rock would be added for scour protection at the base of the BNSF Railroad Bridge and the adjacent pedestrian bridge. The trails at Tumwater Historical and Interpretative Site and the Arc of Statehood bulkhead at Heritage Park would also require some repair or replacement.

Community use of the roads, parks, and sidewalks adjacent to the estuary would change slightly due to the revised road alignment. Piers and docks around the estuary would not be accessible to boaters during periods of low tide. It is assumed that the shift to tidal conditions would eliminate the growth of freshwater invasive aquatic weeds.

1.3.4 Dual-Basin Estuary

The Dual-Basin Estuary alternative describes basin conditions with tidal influence and a reflecting pool adjacent to Heritage Park. This alternative is the same as the Estuary alternative, except for the reflecting pool. The ongoing CLAMP management actions of flood protection, removal of noxious weeds, and control of the Canada geese population would continue.

Artist's concept of Dual Basin Alternative

Splitting the north basin to create a reflecting pool is a design promoted by the Olmsted Brothers in 1912 as one of the alternatives considered by the Wilder and White design team. The design for the Dual-Basin Estuary was one of the scenarios (Option D) evaluated by the 2008 estuary feasibility study.

This alternative would require all of the major construction required for the Estuary alternative. This includes removing the Capitol Lake Dam, constructing a new 5th Avenue Bridge, creating a new intersection for Deschutes Parkway and 5th Avenue, installing a rock buttress along Deschutes Parkway, dredging the lake prior to removing the dam, and placing lake sediments along the roadway to create intertidal habitat.

This alternative would also require the construction of a 1,900 foot long barrier built of sheet pile and topped with a pedestrian walkway. It would connect to the existing shoreline east of the current dam and east of the BNSF Railroad trestle.

The western side of the north basin would be an estuary of about 61 acres, with the eastern side being a reflecting pool of about 39 acres. Baffles constructed in the barrier would keep the pool water at a desired level during low tide. They would also help to circulate salt water inside the reflecting pool and lessen water quality concerns. A design to use fresh water in the pool was found to be infeasible.

This alternative would increase the amount of sediment discharging into Budd Inlet and increase the need to dredge the navigation channel, Percival Landing marinas, and the Port of Olympia.

Community use of the roads, parks, and sidewalks adjacent to the lake would change slightly due to the revised road alignment. Piers and docks around the lake would only be accessible during periods of high tide. It is assumed that the shift to tidal conditions would (temporarily, at least) eliminate the growth of freshwater invasive aquatic weeds.

1.4 Next Steps

The CLAMP Steering Committee members will use this report and the detailed studies it previously commissioned to make recommendations to the GA Director on long-term management of the Capitol Lake basin. The GA director will review these recommendations and materials and make a recommendation to the State Capitol Committee (SCC). The SCC consists of the Governor, Lieutenant Governor, Secretary of State, and the Commissioner of Public Lands. Finally, the SCC will then present their final recommendations which would be brought to the State Legislature for possible funding and action.

SECTION 2

Comparison of Alternatives

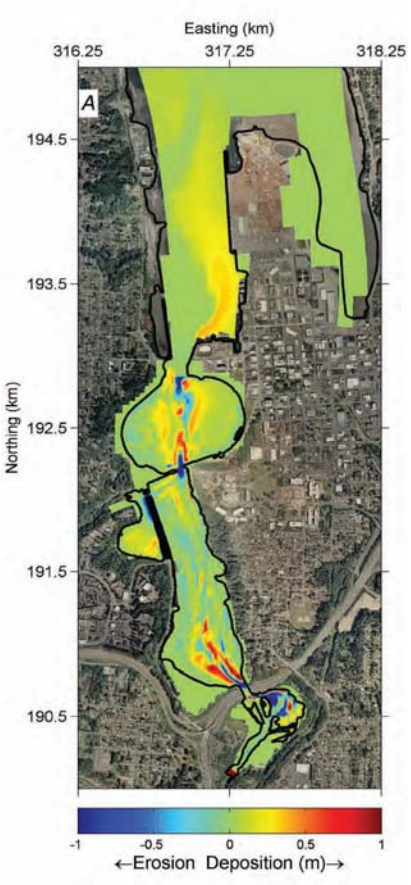
Part 1 – Environment

2.1 Sediment Management

2.1.1 Overview

This section summarizes the impacts of the four Capitol Lake management alternatives on sediment management, including dredging, disposal needs, and impacts to lower Budd Inlet.

Information used to summarize the impacts of each alternative included two modeling studies conducted by the U.S. Geological Survey (USGS): a dredging and disposal analysis, and an addendum to that analysis.[1] [2] [3] [4] In the first USGS study, sediment characteristics, river inputs, and tidal frequencies were used to model sediment transport and deposition under the different estuary alternatives. In the second study, the model was refined to reduce uncertainty and simulations were run for the Estuary and Dual-Basin Estuary alternatives. These simulations also included sediment accumulation volumes and patterns that would result from limited lake basin dredging before removing the Capitol Lake dam. Results of the second study were used to estimate the required dredging quantities from the Port and marina under both of the estuary alternatives and to evaluate options for dredging and disposal of the dredge spoils. (In this report, the term "marinas" is used to denote the Olympia Yacht Club, Percival Landing, Martin Marina, One Tree Island Marina, and Fiddlehead Marina. The Port of Olympia area is referred to as the "Port" in this report. When describing general impacts to the lower end of Budd Inlet, the area is referred to as "the Inlet" or "lower Inlet".)



Sediment Transport Model – showing erosion and deposition of sediment with dam removal (no prior dredging)

Sediment management is the most complex issue in comparing management alternatives, and includes many variables (e.g., type of dredging, character of the dredged sediment, frequency of dredging, and disposal alternatives). All of these variables rely on a number of assumptions and the related cost estimates vary widely. The following background information is provided as a framework for the comparisons that follow.

2.1.1.1 Dredging Needs

Dredging needs are described in two categories: initial dredging and maintenance dredging. Initial dredging refers to the removal of existing sediments that have accumulated in the Capitol

Lake basins during the past 30 years or longer. All management alternatives except the Status Quo Alternative would require some initial dredging. However, for the Estuary Alternatives, sediments removed during initial dredging would be less than half of those of the Managed Lake Alternative. In addition, under the Estuary Alternative all (or a large portion) of the removed sediment would be reused within the lake basin by placing it along the Deschutes Parkway for stabilization and habitat creation.

Maintenance dredging refers to the long-term need for dredging, and would be required for the Managed Lake as well as both Estuary Alternatives. For the Managed Lake Alternative, maintenance dredging would occur in the lake. It was predicted that 350,000 cubic yards (cy) of material would need to be removed at ten-year intervals.[5] For the Estuary Alternative, maintenance dredging would occur in the lower Inlet. It was predicted that once equilibrium was reached, dredging would need to occur at about a 5 year frequency resulting in removal of 246,000 cy over a 10-year period.[6] The large difference between the amount required for maintenance dredging of the lake as compared to the estuary was predicted by recent modeling that indicated that under estuary conditions approximately 30 percent of the material that enters lower Budd Inlet will bypass the marinas and Port facilities and move north into Budd Inlet.

2.1.1.2 Disposal Considerations

The primary purpose of the dredging and disposal technical reports was to evaluate the many alternatives for dredging and disposal of the dredge spoils. A wide range of disposal options was evaluated, including open-water disposal, landfilling, and beneficial reuse for a variety of purposes such as habitat restoration, site restoration, site reclamation, beach nourishment, landfill cover, fill material, and construction material.

Certain sediment characteristics limit the disposal options. First, all of the sediments, whether they are existing accumulated sediments or future sediments associated with maintenance dredging, and whether they are deposited in the lake or in the lower Inlet, have a similar physical structure that limits their beneficial reuse for purposes such as landfill cover, fill, and construction material. In this respect, there are no differences between the alternatives. The one exception is the sediments that would collect in sediment traps in the lake under the Managed Lake Alternative, which should be coarser and therefore, may be appropriate for construction material. Another limiting factor is the presence of toxic contaminants, most notably furan and dioxin, in the existing marine sediments. Depending upon the degree of contamination, this could preclude the use of open-water disposal options for at least a portion of the existing marine sediments and in some cases limit their use for habitat restoration. Finally, there is a concern regarding the presence of seeds from purple loosestrife, an invasive weed species, in the existing lake and marine sediments. The presence of purple loosestrife seeds would preclude the use of at least one open-water disposal site for these sediments. While disposal options are similar between the alternatives, there are important differences in the cost of their implementation. Generally, open-water disposal is more expensive for the lake sediments because of the cost of moving the material around the dam.[7]

For the lake sediments, the low-cost estimate included the assumption that the sediments would be used for nearshore restoration or over the long-term be placed at the Anderson-Ketron Island disposal site (the lowest cost open-water disposal site). The medium cost scenario assumed placement at an upland reclamation site and the highest cost scenario, considered very unlikely, was transport to an upland landfill site.

As described above, there are both toxic contaminant and purple loosestrife seed issues associated with the estuary sediments. Because it is unknown when or whether these contaminant issues will be resolved, a range of disposal scenarios was developed and rated by cost. Under the low-cost case, assuming sediment contaminant problems are eliminated, the sediments could be used for local restoration or open-water disposal.[8] Under medium cost scenarios, it was assumed that some portion of the sediment would need to be landfilled due to toxicants but that most could be used for reclamation. Under the highest cost scenario, which was considered very unlikely, all of the material would require disposal in an upland landfill.

The following summary of disposal options was taken directly from the most recent dredge and disposal analysis report:[9]

> "The disposal sites have the most significant impacts to the project cost. Disposal sites also affect construction methods; mechanical dredging is generally most cost-effective for upland disposal or beneficial reuse, while hydraulic dredging is often more cost-effective for offshore disposal. The most cost-effective option for material transported off-site—open-water disposal at Anderson-Ketron Island—is available only for clean material, and may not be available for the Capitol Lake sediments because of presence of purple loosestrife seeds. Anderson-Ketron Island is particularly sensitive to purple loosestrife because of the near proximity of the Nisqually National Wildlife Refuge. The most expensive option –upland disposal at a landfill site—is certain to be available for all but the most contaminated sediments, which are not believed to be present in Capitol Lake or in Budd Inlet. Intermediate options include the following:
>
> - Open-water disposal at Commencement Bay. This site is more distant than Anderson-Ketron Island but it may accept materials containing purple loosestrife seeds.
>
> - Beneficial reuse for mine reclamation at the Lakeside Industries Central Aggregate Pit and the TransAlta mine, both near Centralia. At either site, it would be necessary to construct a new rail spur for efficient off-loading; this is included in the costs presented.
>
> - Beneficial reuse for shoreline or nearshore restoration in lower Budd Inlet. While purple loosestrife would be an issue, it could be managed in the relatively urbanized environment. The quantity of dredged material may be greater than lower Budd Inlet projects could accept, so other options would also be needed.

- Beneficial reuse as construction fill. This would only be available for a subset of the dredged material."

Another possibility mentioned in the report is to establish an open water or confined aquatic disposal site in Budd Inlet. However, due to the unknowns associated with this possibility, this disposal option was not considered in the disposal study.

2.1.2 Impacts of Alternatives

2.1.2.1 Status Quo Alternative

Near-Term Status Quo Condition

In the near-term (next 50 years), no sediment management activities would occur; none of the sediment that has accumulated in the lake basins would be removed, and none would be removed over the long term. It has been assumed that during the near-term period, the Deschutes River would continue to deliver the same volume of sediment each year and that most of it would settle in the existing lake basins, gradually filling the basins from south to north until the system reaches equilibrium with the sediment load.

Dredging Needs

- No initial dredging would occur in either the lake basins or the Inlet area.
- No maintenance dredging would occur in either the lake basins or Inlet area other than what is currently planned or anticipated by the Port and marinas.

Sediment Disposal

- No sediment disposal would be required for lake sediments.
- No sediment disposal would be required for inlet sediments other than what is currently planned or anticipated by the Port.

Impacts to the Port of Olympia

- The export of sediment to the Port would be similar to what has occurred in recent years and therefore the frequency of dredging would be similar to what has been needed recently.

Impacts to Marinas and Yacht Club

- The export of sediment to the marina area would be similar to what has occurred in recent years and therefore the frequency of dredging would be similar.

Long-Term Status Quo Condition

In the long-term (beyond 50 years), it is expected that the lake would have reached its full sediment storage capacity and be fairly well filled-in. Once the capacity is reached, much of the lake would support wetland vegetation while the remaining open water would appear as a river channel. At that time, it can also be assumed that the entire annual sediment load associated with the Deschutes River would be transported to Budd Inlet. However, it was assumed for the Estuary Alternative that only 70 percent of this would be deposited in lower Budd Inlet.[10] The remaining 30 percent was predicted to bypass the lower inlet and settle north of the Port and marina area. This same assumption can be applied to the Long-Term Status Quo condition.

Dredging Needs

- No initial dredging would be required in either the lake or lower Inlet.
- No maintenance dredging would occur in the lake basins. Eventually (>50 years), sediment removal would be required in the lower Inlet to compensate for the sediment load contributed by the Deschutes River that was previously deposited in the lake basins.

Sediment Disposal

- No initial dredging would be required and therefore no sediment disposal would be necessary for these materials.
- It is difficult to predict the quality of the sediments or what disposal option(s) might be available for the sediments that will eventually need to be removed from the lower Inlet. It is assumed the sediment quality will be similar to that described for the post-50 year condition for the Estuary Alternative. The medium cost assumption for the Estuary Alternative at 45 to 50 years was that most of the removed sediment would be disposed of at nearby restoration sites and some would be landfilled.[11]

Impacts to the Port of Olympia

- Seventy percent (70%) of the annual sediment load associated with the Deschutes River would be transported to lower Budd Inlet. This would result in accelerated filling of the Inlet and the need for more frequent sediment removal in the Port area than under current conditions. A dredging quantity of 73,500 cy and a frequency of every 5 years was assumed for long term maintenance.

Impacts to Marinas and Yacht Club

- Seventy percent (70%) of the annual sediment load associated with the Deschutes River would largely be transported to lower Budd Inlet. This would result in accelerated filling of the Inlet and the need for more frequent sediment removal in the marina area than under current

conditions. A dredging quantity of 50,000 cy and a frequency of about 5 years was assumed for long-term maintenance at the marinas and yacht club.

2.1.2.2 Managed Lake Alternative

Under the Managed Lake Alternative, most of the sediments that have accumulated behind the dam would be removed from the lake basins. The lake would continue to act as a large settling basin, and would be dredged at 10-year intervals to maintain its sediment storage capacity. This would reduce long term sediment loading to the port and marina areas. The Managed Lake Alternative would not involve any dredging within 100 feet of the shoreline. The target summer water depth would be 13 feet. The system would appear similar (in terms of size, shape, and character of the shoreline) to what has existed for the past 50 years.

Dredging Needs

- A large volume of sediments (875,000 cy) would be removed initially to regain much of the water volume lost over the half-century since construction of the dam. [12] Existing sediment traps in the south and middle basins could be re-excavated to improve settling and dredging efficiency.

- It was estimated that on a 10-year frequency, 350,000 cy would be removed from the lake basins.[13] The lake would continue to act as a sedimentation basin and therefore dredging needs in the lower Inlet would be similar to existing requirements.

Sediment Disposal

- Options for disposal of initial dredge material included a combination of nearshore restoration and reclamation site (low cost option); to all sediment disposed of at a reclamation site (medium cost); to a combination of open-water disposal in Commencement Bay with some upland landfill (high cost); to all upland landfill (worse case).[14]

- Long-term sediment disposal options varied from placement at a nearby restoration site (lowest cost option); to placement at a reclamation site (medium cost option); to placement at the Commencement Bay open-water disposal site (high cost option); to disposal at a landfill site (worst case).

Impacts to the Port of Olympia

- After the lake is dredged, there may be some improvement in its ability to trap and remove sediments brought in by the Deschutes River. If trapping efficiency of the lake basins increases, the export of sediment to the lower

Inlet would be expected to be lower than what has occurred recently. Therefore, the frequency of dredging in the Port area would be expected to be equal to or lower than the frequency in recent years.

Impacts to Marinas and Yacht Club

- If trapping efficiency of the lake basins increases, the export of sediment to the lower Inlet would be expected to be lower than what has occurred recently. Therefore, the frequency of dredging in the marinas and yacht club area would be expected to be equal to or lower than the frequency in recent years.

2.1.2.3 Estuary Alternative

Under the Estuary Alternative, approximately 394,000 cy of the sediments that have accumulated behind the dam would be removed during initial dredging to create an estuary main channel. After dredging, the dam would be removed and the existing lake would be opened to the influence of the tides and marine water. The initial dredging would reduce sedimentation in the Port and marina areas. Different scenarios for disposal of the material dredged from the lake have been considered for the Estuary Alternative. In one scenario, all of this material (394,000 cy) would be used within the lake basin to stabilize the Deschutes Parkway and to form intertidal habitat. In a second scenario, a smaller quantity (176,000 cy) would be retained in the lake basin; that used to stabilize the Parkway and the rest would be moved offsite. There was little cost difference associated with these scenarios.[15] It has been assumed that much of the remaining accumulated lake sediments would remain in the lake basin in depositional areas along the eastern portion of the north basin.

Under the Estuary Alternative, the existing lake would go through a period of transition in which sediment accumulation patterns would be defined by tidal actions, and sediment would build up in the north and middle basins. The lake basins would no longer act as settling basins and the majority of the sediment discharged by the Deschutes River would settle in lower Budd Inlet.

Dredging Needs

- Approximately 394,000 cy of sediments would be removed initially to create the main estuary channel but most or all will be placed along the Deschutes Parkway to provide intertidal habitat and to decrease the quantity of material that would otherwise be released to Budd Inlet.[16]

- After equilibrium is reached (which was defined as after about 25 years), it was estimated that approximately 123,000 cy of material would be removed on a 5-year frequency from the lower Inlet.[17]

Disposal Needs

- Under one scenario, no initial dredge material will be produced because all of the material will be re-used within the existing lake basins to stabilize the Deschutes Parkway or to create tidal mud-flats. Under a second scenario more than half of the dredged material (218,000 cy) would be moved off-site.[18] The disposal options for this material included; disposal at a reclamation site (low and medium cost options); to a combination of disposal at a reclamation site and upland landfill (high cost option); to all upland landfill disposal (worse case).

- Under the low-cost case, assuming sediment contaminant problems are eliminated, the sediments could be used for local restoration or open-water disposal. Under medium and high cost scenarios, it was assumed that some portion of the sediment would need to be landfilled due to toxicants but that most could be used for reclamation and, under the worst cost scenario, it would all require upland landfill.

Impacts to the Port of Olympia

- Dredging needs would increase over existing conditions. After equilibrium is reached, (which was defined as after about 25 years) it was estimated that 73,000 cy of material would need to be removed at a frequency of once every 5 years.[19]

Impacts to Marinas and Yacht Club

- Dredging needs would increase over existing conditions. After equilibrium is reached (which was defined as after about 25 years), it was estimated that 50,000 cy of material would need to be removed at a frequency of once every 5 years.[20]

2.1.2.4 Dual-Basin Estuary Alternative

In general, the lower Inlet would undergo more sedimentation under the Dual-Basin Alternative, because the available sediment storage in the eastern part of the North basin of the lake would be lost. However, the modeled differences in sedimentation rates between the two estuary alternatives were considered to be within the range of model uncertainty.[21] Therefore, the summary of dredge and disposal needs provided above for the Estuary Alternative, also applies to the Dual-Basin Estuary Alternative.

2.1.3 Comparison of Alternatives

The long term sediment management implications of the four alternatives are presented in Table 2-1.

Table 2-1. Comparison of alternatives in relation to sediment management issues.

	Status Quo [a]	Managed Lake	Estuary	Dual-Basin Estuary
Dredging Needs				
Initial	0 cy	875,000 cy	394,000 cy	394,000 cy
Maintenance	0 cy	350,000 cy (every 10 years)	246,000 cy (every 10 years) [c]	246,000 cy (every 10 years) [c]
Disposal Options [b]				
Initial	NA	Upland Reclamation Site	No off-site disposal required	No off-site disposal required
Maintenance	NA	Upland Reclamation Site	5 – 10% to landfill, 90 – 95% to upland reclamation	5 – 10% to landfill, 90 – 95% to upland reclamation
Impact to Port	Similar to existing conditions	Dredging requirements equal to or less than existing conditions	Dredging requirements should be higher than existing conditions (73,500 cy every 5 years)	Dredging requirements should be higher than existing conditions (73,500 cy every 5 years)
Impact to Marinas	Similar to existing conditions	Dredging requirements equal to or less than existing conditions	Dredging requirements should be higher than existing conditions (50,000 cy every 5 years)	Dredging requirements should be higher than existing conditions (50,000 cy every 5 years)

NA: Not applicable

[a] This table reflects near-term conditions (over the next 50 years) for this alternative.

[b] Disposal options summarized here reflect only the medium case cost option for comparison purposes.

[c] The actual recommended dredging frequency was 123,000 cy every 5 years.[22] This has been presented as a volume over 10 years to allow direct comparison to the Managed Lake Alternative.

According to the technical study results, the Managed Lake Alternative would require that a far greater volume of sediments be dredged and disposed of than for the estuary alternatives. This is true for both the initial dredging and long term maintenance dredging. This, and logistical differences such as the type of dredging equipment needed and transport needs between lake dredging and disposal and inlet dredging and disposal, further drive up cost differences.

There are more disposal concerns associated with dredging in the Inlet due to the presence of toxic contaminants. This may require that some of the sediments are disposed of at an upland landfill site; which is a more costly disposal option. However, the additional cost associated with this did not offset the more significant difference between the volume of sediments that must be handled.

The estuary alternatives would result in a greater impact to the Port and Marina areas due to a need for increased frequency of dredging. The dredging frequency estimate for these areas is once every 5 years.

The following summary statements were excerpted from the most recent dredge and disposal technical report:[23]

The costs for the estuary alternatives are lower than the corresponding cases for the Lake Alternative. This is partly because some of the potential unit costs for dredging are lower for the estuary alternatives. Initial dredging for the Estuary Alternative, with placement alongside Deschutes Parkway, is very cost-effective: so is dredging from the Port facilities with open-water disposal. Because dredging in the lake is confined by the Capitol Lake dam, equipment size is limited which in turn decreases possible production rates and increases costs.

Second, even where unit costs are similar or higher for the estuary alternatives – e.g., with placement in a landfill or reclamation site—the absolute quantity of material to be dredged long term is smaller for the estuary alternatives. Modeling shows that in the long term, approximately 30 percent of material that enters lower Budd Inlet bypasses the marinas and Port facilities and moves north into Budd Inlet.

The non-construction related costs associated with maintenance dredging in the marina and the Port facilities were not included in the overall project costs.

2.2 Plants and Animals

2.2.1 Overview

This section summarizes the impacts of management alternatives on plants and animals, including species on the Washington Department of Fish and Wildlife (WDFW) Priority Habitat and Species list, exotic or invasive species, and other species that would tend to favor or disfavor the various alternatives. The WDFW report *Implications of Capitol Lake Management for Fish and Wildlife*[24] provided the primary basis for this summary. The report provides a detailed description of life histories and likely responses for a range of species in the context of the four identified management alternatives. For this Comparative Summary, this information has been pared down to provide summary statements of their findings. Their findings are grouped into three categories: fish and wildlife habitat, fish migration, and exotic and invasive species.

Great Blue Heron

WDFW did two types of analyses, one based on a comparison of species among alternatives, which is the focus of this Alternatives Analysis

and another based on comparisons of ecosystem extent among alternatives. With regard to the latter comparison, WDFW noted that estuary ecosystems are one of the most imperiled ecosystems worldwide. In Washington State, the area of estuaries has declined over 80 percent since European settlement, whereas the area of freshwater lakes has increased over 370 percent, largely due to the increase in reservoirs associated with hydroelectric projects. Both of the estuary based alternatives (Estuary and Dual Basin Alternatives) are anticipated to increase the area, and enhance functions and processes associated with an ecosystem type at high risk in the Puget Sound Ecoregion (i.e., estuarine wetlands), whereas the lake alternatives (Status Quo and Managed Lake) would support a freshwater lake ecosystem.

2.2.1.1 Fish and Wildlife Habitat

The differences between alternatives are described in terms of potential habitat impacts to anadromous fish, freshwater fish, and marine fish as well as the different types of birds, mammals, and invertebrates that use or potentially would use the project area. In addition to marine fish that use Budd Inlet, there are seven species of anadromous fish that use Capitol Lake to access the Deschutes River and Percival Creek.[25] Five are salmonid fish of economic, commercial, or cultural importance.[26] There are also 16 freshwater fish species that use Capitol Lake[27]; six of which are introduced species.[28] There is also a wide range in bats and birds; shorebirds, aerial foragers, surface eaters, divers and others to consider. Last, there are 16 species with special designations[29] (such as federal or state listed, and included on the WDFW Priority Habitat and Species) identified in the project area, and the number of these that would benefit from the various alternatives are summarized.

2.2.1.2 Fish Migration

The differences associated with the Capitol Lake dam and water quality are the primary factors that affect fish migration. Under existing conditions, the Capitol Lake dam provides a physical barrier where anadromous fish concentrate, which increases predation. Further, the dam results in slower moving, deeper water that is associated with lakes and reservoirs. These changes can cause a direct adverse affect on migration as a result of higher water temperatures and by promoting aquatic plant growth which can become a physical barrier. Reduced tidal mixing, poor water quality, and extensive aquatic plant beds also impact migration either because conditions are not healthy or because they provide physical barriers to movement. Increased temperature and aquatic plant growth can also reduce dissolved oxygen which may further affect migration.

2.2.1.3 Exotic and Invasive Species

There are seven non-native fish and animal species that favor freshwater conditions that exist in Capitol Lake. These include American bullfrog, common carp, brown bullhead, smallmouth bass, largemouth bass, yellow perch, and nutria; all accidentally or intentionally introduced into Capitol Lake. Non-native species are considered threatening to native species because they may feed on them, use up available habitat, decrease the value of existing habitat, and introduce diseases or parasites. There are also two non-native clam species, submerged exotic plants such

as Eurasian watermilfoil, and riparian zone aquatic plants such as purple loosestrife and cordgrass, that are considered under the exotic species discussions.

2.2.2 Impact of Alternatives

2.2.2.1 Status Quo Alternative

Over the near-term (the next 50 years) the lake basins would reflect the conditions that currently exist, that is, a shallow, freshwater lake. The already extensive beds of submerged aquatic plants would continue to expand and water quality would likely deteriorate further. However, over the long-term (beyond 50 years), the lake basins would fill-in and the area would essentially be occupied by a stream channel flowing through a large, freshwater wetland system. Submerged aquatic plant beds would be gone or greatly reduced and water quality would be much improved and essentially reflect the quality of the river.

The WDFW report that provides the basis for this analysis defined the Status Quo Alternative as the existing condition. Therefore, their findings provide the basis for the description of the Near-Term Status Quo Condition with regard to animals and plants. To address the long-term condition, statements have been included that reflect a general sense of the changes that would accrue as a result of the transition to a wetland.

Near-Term Status Quo Condition

Tidal mixing would be limited due to the presence of the Capitol Lake dam. Water quality would continue to deteriorate in terms of dissolved oxygen and temperature, and aquatic plant beds would expand.

Fish and Wildlife Habitat

- Production of flying insects which are an important food source for aerial foraging birds and bats would be encouraged.[30]
- Several species of waterfowl that feed on aquatic plants and invertebrates would be supported.[31]
- Habitat use by freshwater diving birds would progressively be discouraged as result of expanding aquatic plant beds.
- Seven species of anadromous fish would continue to use Capitol Lake. However, the deterioration in water quality and increase in aquatic plant beds would represent poorer habitat conditions for these fish.[32]
- Suitable habitat would exist for all 16 freshwater fish species (Table 2-2). However, many of these species too, would eventually be negatively impacted by the poorer habitat conditions.[33]

- Marine fish might experience minor negative effects to the extent that poorer water quality in the lake basins results in incremental deterioration in Budd Inlet.

- Suitable habitat would exist for aquatic and semi-aquatic mammals that require freshwater as well as those that use both estuarine and freshwater habitats.[34]

- The habitat would be favored by 4 of the 16 species with special designations (Table 2-3). The four species that would favor the habitat conditions include largemouth bass and smallmouth bass (both of which are considered exotic introductions to Capitol Lake), purple martin, and Vaux's swift.[35]

Table 2-2. Freshwater fish species in Capitol Lake.

Species (common name)	Species (scientific name)	Native/Exotic	Special Designation [a]
Cutthroat trout	*Oncorhynchus clarki*	Native	No
Rainbow trout	*Oncorhynchus mykiss*	Native	No
Common carp	*Cyprinus carpio*	Exotic	No
Peamouth	*Mylocheilus caurinus*	Native	No
Northern pikeminnow	*Ptychocheilus oregonensis*	Native	No
Speckled dace	*Rhinichthys osculus*	Native	No
Redside shiner	*Richardsonius balteatus*	Native	No
Largescale sucker	*Catostomus macrocheilus*	Native	No
Brown bullhead	*Ameiurus nebulosus*	Exotic	No
Three-spined stickleback	*Gasterosteus aculeatus*	Native	No
Smallmouth bass	*Micropterus dolomieu*	Exotic	Yes
Largemouth bass	*Micropterus salmoides*	Exotic	Yes
Yellow perch	*Perca falvescens*	Exotic	No
Prickly sculpin	*Cottus asper*	Native	No
Riffle sculpin	*Cottus gulosus*	Native	No
Western brook lamprey	*Lampetra richardsoni*	Native	No

[a] Special Designation indicates whether the species is included on the Washington Department of Fish and Wildlife Priority Habitat and Species (PHS) list as summarized in Table 2-3.

Table 2-3. Species with special designations.

Species (common name) [a]	Species (scientific name)	PHS Status [b]
Chinook (Puget Sound ESU)	*Oncorhynchus tshawytscha*	1, 2, 3
Chum (Puget Sound/Strait of Georgia ESU)	*Oncorhynchus keta*	1, 2, 3
Coho (Puget Sound/Strait of Georgia ESU)	*Oncorhynchus kisutch*	2, 1
Steelhead (Puget Sound DPS)	*Oncorhynchus mykiss*	1, 1
Largemouth bass	*Micropterus salmoides*	3
Smallmouth bass	*Micropterus dolomieu*	3
Bald eagle	*Haliaeetus leucocephalus*	1
Barrow's goldeneye	*Bucephala islandica*	3
Bufflehead	*Bucephala albeola*	3
Common goldeneye	*Bucephala clangula*	3
Hooded merganser	*Lophodytes cucullatus*	3
Purple martin	*Progne subis*	1
Vaux's swift	*Chaetura vauxi*	1
Humpy shrimp	*Pandalus goniurus*	2, 3
Butter clam	*Saxidomus giganteus*	2, 3
Native littleneck clam	*Protothaca staminea*	2, 3

[a] ESU = Evolutionarily Significant Unit, DPS = Distinct Population Segment

[b] PHS status refers to the Washington Department of Fish and Wildlife Priority Habitat and Species list where: 1 = State-listed or Candidate species, 2 = Vulnerable aggregations, 3 = Species of recreational, commercial, and/or tribal importance that are vulnerable.

Fish Migration

- A bottleneck and concentration point that allows for increased predation on migrating fish would remain at the Capitol Lake dam.[36]
- Anadromous fish migration would be impaired due to deteriorating water quality and increased aquatic plant beds that can be a physical barrier to migration.[37]
- Habitat would support warm water fish and therefore, result in increased predation on migrating fish.[38]

Exotic and Invasive Species

- Habitat would continue to be suitable for seven non-native fish, mammal, and amphibian species that currently exist in Capitol Lake.[39]
- Conditions would continue to provide habitat for the invasive submerged plant Eurasian watermilfoil as well as providing potential habitat for other invasive plants commonly found near the water's edge (e.g., reed canarygrass, purple loosestrife, Japanese knotweed, etc.).[40]

Long-Term Status Quo Condition

Over the long-term (beyond 50 years), the open water of the lake would be lost and largely replaced by wetland. Water quality would improve over the long-term because the remaining open water would essentially become an extension of the Deschutes River. By restoring a functional riparian zone dissolved oxygen and temperature would be expected to improve and submerged aquatic plant beds would be greatly reduced and replaced by emergent vegetation.

Fish and Wildlife Habitat

- Fairly extensive wetland habitat would exist.
- The general reduction in quiescent open water habitat would negatively affect some shorebirds, several species of waterfowl that feed on aquatic plants and invertebrates, and diving birds that require lake-like conditions.
- Production of flying insects, which are an important food source for aerial foraging birds and bats, would be encouraged.[41]
- Use by many of the 16 freshwater fish species that currently use Capitol Lake would be reduced or potentially eliminated due to loss of suitable habitat (Table 2-2).
- Marine fish habitat could improve to the extent that Budd Inlet water quality improves.
- Suitable habitat conditions would be present for aquatic and semi-aquatic native mammals that require freshwater.

Fish Migration

- Capitol Lake dam would remain a bottleneck and concentration point for migrating fish that allows for increased predation.
- Anadromous fish migration would improve due to the loss of the aquatic plant beds that can be a physical barrier to migration.

Exotic and Invasive Species

- Habitat for the invasive, submerged, aquatic plant, Eurasian watermilfoil would be reduced.
- Potential habitat would exist for invasive plant species that use wetland and river channel habitat (e.g., reed canarygrass, purple loosestrife, Japanese knotweed, etc.).
- Exotic amphibians and mammals (i.e., American bullfrog and nutria) that currently exist in the system would continue to be supported.

- Elimination of the lake ecosystem would reduce habitat suitable for non-native freshwater fish, but those species would potentially continue to use suitable in-stream habitat.

2.2.2.2 Managed Lake Alternative

In the Managed Lake Alternative, the habitat would reflect the conditions that currently exist, i.e., habitat suited to freshwater-dependent species. In general, the Managed Lake Alternative would result in the following conditions.

Fish and Wildlife Habitat

- Production of flying insects which are an important food source for aerial foraging birds and bats would be supported.[42]
- Habitat would support several species of waterfowl that feed on aquatic plants, fish, and invertebrates.[43]
- Favorable conditions would exist for diving birds that prefer freshwater.[44]
- Seven anadromous fish species would continue to use Capitol Lake. Managed lake conditions may also support predators and increase the residence time for rearing salmonids, possibly increasing the potential for predation.[45]
- Suitable habitat would exist for all 16 freshwater fish species. These species too, would benefit from improved habitat conditions (Table 2-2).[46]
- Habitat would be favored by 4 of the 16 species with special designations that exist in the project area (Table 2-3). The four species that would favor the habitat conditions include largemouth bass and smallmouth bass (both of which are considered exotic introductions to Capitol Lake), purple martin, and Vaux's swift. [47]
- Suitable conditions would continue to exist for aquatic and semi-aquatic mammals that require freshwater as well as those that use both estuarine and freshwater habitats.[48]

Fish Migration

- Fish migration would continue to be inhibited by limiting factors associated with the shallow lake environment in combination with limited saltwater intrusion and mixing.[49]
- The extent to which migration or rearing of juvenile salmon would improve over current conditions is unclear, and could be offset by

increased predation by warm-water fish species and lake-dependent birds.[50]

- Capitol Lake dam would remain a concentration point for migrating salmon that increases risk of predation.[51]

Exotic and Invasive Species

- Habitat would be favored by the seven non-native fish, mammal, and amphibian species that currently exist in Capitol Lake including; common carp, brown bullhead, smallmouth bass, largemouth bass, yellow perch, nutria, and American bullfrog.[52]

- Habitat would be suitable for the invasive submerged plant Eurasian watermilfoil as well as for other invasive plants commonly found near the water's edge (e.g., reed canarygrass, purple loosestrife, Japanese knotweed, etc.). However, routine dredging would also limit the extent of Eurasian watermilfoil and other submerged aquatic plants.[53]

- American bullfrog survival could be reduced compared to current conditions because greater water depth and limited emergent vegetation could increase the effectiveness of predators.[54]

2.2.2.3 Estuary Alternative

Under the Estuary Alternative, removal of the Capitol Lake dam and return of tidal influence to the lake basins would result in the development of habitat primarily comprised of intertidal mud-flats with a narrow fringe of vegetated marsh, and subtidal sandy channel connecting the Deschutes River to Budd Inlet. The hydrology, salinity, and topography within the estuary would fall within the range of those occurring within nearby estuaries; Woodard Bay, Ellis Cove, Mud Bay, Kennedy Creek, and Little Skookum Bay.[55]

Fish and Wildlife Habitat

- Habitat would be more suited to saltwater-dependent species as opposed to freshwater species.

- Production of flying insects, which are an important food source for aerial foraging birds and bats, would be reduced due to increase salinity.[56]

- Shorebirds, wading birds, and probing forager species that commonly require either extremely shallow water or fine-grained substrates that become exposed during tide changes would benefit due to the increased foraging opportunities. Depending upon the degree of use by shorebirds, this would also represent an attractive food source for raptors such as merlin and the peregrine falcon, which feed on the small birds.[57]

- Waterfowl that feed on bivalves, crustaceans, and mollusks would benefit from increased foraging opportunities. Waterfowl that prefer freshwater habitat and feed on aquatic plants, seeds, and freshwater invertebrates would be limited.[58]

- Favorable habitat would exist for diving birds that prefer shallow, estuarine conditions. The extent of this benefit is unknown due to the inability to predict how the habitat would be used by prey fish species.[59]

- Anadromous fish habitat, including salmonid habitat, would improve primarily due to:

  - Increased availability of intertidal estuarine habitat[60]

  - A reduction in predation by freshwater-dependent fish, birds, and mammals that use the lake, and by marine species that use the congregation point at the Capitol Lake dam.[61] However, this reduction in predation may be partly offset by an increase in predation by other marine-based predators.

  - Increased tidal flushing and improved water quality[62]

  - Reductions in aquatic plant beds and improved foraging conditions[63]

- Potential for all 16 lake-dependent freshwater fish to use the habitat would be significantly reduced and in some cases eliminated (Table 2-2).[64]

- Quality and quantity of habitat for marine fish species would improve.[65] There are nine marine fish species that would likely benefit from additional estuarine habitat in the vicinity of Budd Inlet.[66] For marine fish, improved water exchange that occurs as a result of dam removal would contribute to improved mobility and reduced predation. Accessibility to food would also increase due to the constant redistribution of particulates and small organisms.[67]

- Habitat would be favored by 10 of the 16 species with special designations that exist in the project area (Table 2-3). The 10 species for which habitat would be improved include; Puget Sound Chinook, chum salmon, coho salmon, Puget Sound steelhead, bufflehead, common goldeneye, hooded merganser, humpy shrimp, butter clam, and native littleneck clam.[68]

- Conditions would not support amphibian use as amphibians cannot tolerate brackish water.[69]

- Available habitat for aquatic mammals associated with freshwater (muskrat and nutria) would be limited. The Estuary Alternative would continue to provide suitable habitat for other aquatic mammal species including mink, raccoon, and river otter that are capable of using various habitat types.[70]

Fish Migration

- Fish migration would improve due to increasing the freshwater-saltwater mixing which indirectly improves habitat conditions (e.g., due to loss of the submerged aquatic plant beds that may provide a physical barrier to movement, reduce predation, and improve water quality).[71]

- Capitol Lake dam would be removed, thereby eliminating one concentration point that increases fish vulnerability to predators. Removal of the dam will also move the primary concentration point for migrating salmon further upstream to the fish ladder at Tumwater Falls and to a lesser extent the mouth of Percival Creek, thereby reducing the potential for predation by marine mammals, and increasing the potential for successful migration.[72]

Exotic and Invasive Species

- Habitat use by all freshwater species including exotic or invasive species such as American bullfrog, common carp, brown bullhead, smallmouth bass, largemouth bass, yellow perch, and nutria would be reduced or eliminated.[73]

- Conditions would increase the availability of habitat favored by soft-shelled clam and manila littleneck clam, both of which were introduced into Puget Sound are used as food, and are not known to negatively affect native species.[74]

- Suitable habitat for the invasive submerged plant Eurasian watermilfoil would be significantly reduced or eliminated. Potential habitat for other invasive plants commonly found near the freshwaters edge (e.g., reed canarygrass, purple loosestrife, Japanese knotweed etc) would be reduced.[75]

- Habitat suitable to other exotic species associated with estuaries and marine water; including smooth cordgrass, Chinese mitten crab, and European green crab would be increased. However, these species do not currently occur in Budd Inlet.[76]

2.2.2.4 Dual-Basin Estuary Alternative

The Dual-Basin Alternative would generally exhibit the same conditions for *Fish and Wildlife Habitat*, *Fish Migration*, and *Exotic and Invasive Species* as described for the Estuary Alternative. Water quality could be somewhat reduced within the saltwater reflection pool as a result of lower tidal exchange. Habitat availability could also be limited for shorebirds[77] and aquatic species that could not access the reflection pool.[78] The extent of these impacts would likely depend on final design and specific aspects of management.[79]

2.2.3 Comparison of Alternatives

Essentially there are three habitat types occurring across the four alternatives; a freshwater wetland, a freshwater lake system and saltwater estuarine habitat. Habitat of the Status Quo and Managed Lake Alternatives would be characterized by freshwater while the habitat of Estuary and Dual-Basin Alternatives would be characterized by an intertidal saltwater environment. While both the Status Quo and Managed Lake Alternatives would reflect freshwater conditions, over time, the differences between them would be significant. Most open water habitat would be eliminated under the Status Quo Alternative, a change that would be expected to negatively impact habitat for many warm-water fish and foraging habitat for many freshwater associated waterfowl. The Status Quo Alternative would improve habitat for stream and wetland associated species. The differences between Estuary and Dual-Basin Alternatives would be minor in this context.

Table 2-4 summarizes qualitatively the relative impacts for the alternatives on fish, plants, and wildlife. Changes to habitat relative to current conditions are described as similar (=), improvement over existing conditions (+ or ++), or decline over existing conditions (- or --). Higher degrees of positive (++) or negative (--) change are used to distinguish relative differences between the management alternatives. This information is shown in a similar fashion as presented in the WDFW report but incorporates the current definition of the long-term (beyond 50 years) Status Quo Alternative and summarizes information provided in the report for individual species.

In terms of birds and waterfowl, differences between the alternatives are primarily related to the differences in preferential use of freshwater and estuarine habitat by the various species and their dietary preferences. The loss of open water in the Status Quo Alternative and replacement with wetland would represent some significant changes in the type of habitat lost and formed and therefore impact species composition. Freshwater fish and invertebrate species would be favored by the Managed Lake Alternative. Because many of the freshwater fish species are non-native and prey on anadromous fish that are native and economically valuable, this is generally considered a negative impact of the Managed Lake Alternative.

Table 2-4. Comparison of alternatives in relation to plant and animal issues.

	Status Quo	Managed Lake	Estuary	Dual-Basin Estuary
Aerial Foragers	-	=	-	-
Diving birds and waterfowl (freshwater)	-	+	--	--
Diving birds and waterfowl (marine)	-	=	+	+
Shorebirds, probing foragers, raptors, wading birds	-	=	++	+
Anadromous Fish	--	=	++	+
Freshwater Fish	-	+	--	--
Marine Fish	=	=	+	+
Priority Habitat and Species	=	=	++	++
Fish Migration	+	=	+	+
Exotic species (freshwater)	=	=	--	--
Exotic species (marine)	-	-	+	+

= Similar to existing conditions

+ or ++ Improvement over existing conditions

- or -- Decline over existing conditions

Although the Managed Lake Alternative would result in an improvement in habitat conditions for anadromous fish, both anadromous and marine fish would be most favored by the estuary alternatives. This would result due to improvements in water quality, increased habitat, and fewer predators (i.e., warm-water fish).

The estuary alternatives provide habitat for a greater number of species with special designations than the freshwater alternatives.

On an ecosystem scale, the estuary alternatives would lend to the restoration of an ecosystem type that is considered more imperiled or at higher risk in the Puget Sound EcoRegion.

Over the long-term, fish migration conditions would be improved by all alternatives; however, the estuary alternatives provide the most significant improvement in conditions.

There are exotic species associated with both freshwater and estuarine habitats. Clearly, those associated with freshwater would be favored by the Status Quo and Managed Lake Alternatives, and those associated with estuarine conditions would be favored by the Estuary and Dual-Basin Alternatives. Under current conditions, more exotic species that are associated with freshwater environments have been identified in the project area than species associated with an estuarine environment, and therefore there is more concern about these. However, there are new exotic species being introduced each year to both types of environments; therefore over the long-term it cannot be predicted which type of environment is likely to attract the most problematic exotic species.

2.3 Water Quality

2.3.1 Overview

This section examines the impacts of the four management alternatives on water quality in Capitol Lake and Budd Inlet. The primary report used to prepare this section was the *Deschutes River, Capitol Lake, and Budd Inlet Temperature, Fecal Coliform Bacteria, Dissolved Oxygen, pH, and Fine Sediment Water Quality Study Findings*[80]. Other resources include *Potential Water Quality Conditions Associated with a Dredged Lake Alternative*[81] and *Deschutes Estuary Feasibility Study: Hydrodynamics and Sediment Transport Modeling.*[82]

Capitol Lake is on the Washington State Department of Ecology (Ecology) list of impaired surface waters (i.e., 303(d) list) for total phosphorus and fecal coliform bacteria, and Budd Inlet is listed for dissolved oxygen. The Deschutes River is listed for dissolved oxygen, temperature, pH, and fine sediment.

Sampling South Sound Estuaries

As a first step in developing a water quality improvement plan, Ecology performed a water quality study and developed a predictive model to evaluate point and nonpoint pollutant sources in the Deschutes watershed. All of the water quality issues described above were addressed in Ecology's study. However, because the management alternatives for the Capitol Lake basin are not expected to significantly improve temperature, pH, and fine sediment issues in the Deschutes River, this summary is limited to impacts on dissolved oxygen, total phosphorus, and fecal coliform bacteria in the Capitol Lake basin and Budd Inlet.

An over-arching finding of Ecology's report is the strong link between upper watershed conditions, the lake, and the Inlet. Water quality in the Deschutes River impacts the quality of the lake, which in turn impacts the Inlet. Further, there are strong relationships between such things as temperature and nutrients (such as phosphorus) and dissolved oxygen. Therefore, to substantially improve water quality conditions in the lake and/or estuary requires improvements in water quality in the river. For example, to improve dissolved oxygen conditions in Capitol Lake would require that nutrients and other pollutants in the Deschutes watershed be controlled.

Ecology's next step in development of a strategy for improving water quality conditions in the Deschutes watershed will be to develop a Water Quality Improvement Report that provides pollutant load reductions required to achieve water quality compliance in the river, lake, and estuary.

2.3.1.1 Dissolved Oxygen

The concentration of dissolved oxygen in Capitol Lake is primarily a result of the lakes' natural quiescent condition and oxygen demand from aquatic plants, algae, and sediments that are part of the lake environment. Most of the Middle and North basins were shown to violate dissolved oxygen standards for 60 days or more during the summer (July 15 through September 15) period.[83] Nonpoint sources (i.e., Deschutes River) were identified as a primary cause of these violations.[84]

As with Capitol Lake, Budd Inlet does not meet water quality standards for dissolved oxygen. The areal extent of low dissolved oxygen includes most of the inner inlet, extending past Priest Point Park on the east, and almost to Butler Cove on the west side of the Inlet.[85] The typical duration of low dissolved oxygen conditions in Budd Inlet was estimated at 1 to 2 days, although a few areas near the tip of the Olympia peninsula are predicted to experience 7 to 14 day-long violations.[vi] Low dissolved oxygen conditions coincide with the most stagnant water conditions, particularly immediately following neap tides when there is less water exchange.[86] The combined effects of point and nonpoint source pollution are the primary cause of dissolved oxygen violations.[vi]

2.3.1.2 Total Phosphorus

Total phosphorus concentrations in Capitol Lake are affected by input from the Deschutes River and sediments and aquatic plants in the lake. Phosphorus concentration is important to a lake environment because it directly affects algae levels. High productivity within Capitol Lake is partially caused by high nutrient loads from tributaries to the lake which result in algae blooms during the late summer.[87] According to modeling results, the majority of phosphorus entering Capitol Lake comes directly from the Deschutes River.[88] High nutrient loads and productivity also lead to decreased dissolved oxygen concentrations in the deeper portions of the lake. Dissolved oxygen concentrations in the estuary also are influenced by nutrient loads from the Deschutes River and other tributaries.[89] In Budd Inlet, nitrogen plays the critical role of influencing algae growth and driving oxygen levels. Therefore, phosphorus concentrations are not a priority concern for water quality in the Inlet.

2.3.1.3 Fecal Coliform Bacteria

Based on monitoring data collected for Ecology's study, fecal coliform bacteria concentrations do not meet the water quality standards in the summer or the winter.[90] More locations violate the water quality standards during the summer than the winter and small tributaries to Budd Inlet will require the greatest fecal coliform bacteria reductions.[91] If Capitol Lake reverts to an estuary, it would be subject to the marine water quality standards, which use enterococcus as the indicator bacteria for secondary contact recreation instead of fecal coliform bacteria.[92] The likely sources of bacteria are stormwater and wastewater treatment plant effluent and these will not be directly impacted by the management alternative selected. Therefore, no further discussion of fecal coliform bacteria is provided in the following summaries.

2.3.2 Impacts of Alternatives

2.3.2.1 Status Quo Alternative

Near-Term Status Quo Condition

In the near-term (i.e., the next 50 years), water quality would be similar to existing conditions. Through time, the lake basin would become shallower and water quality could deteriorate further. For example, aquatic plant beds could become more extensive and contribute to lower dissolved oxygen concentrations. Or, increased phosphorus cycling could lead to an increased frequency or magnitude of algae blooms in the lake. In the immediate future, the near-term scenario would result in the following water quality impacts:

Dissolved Oxygen

- Under existing conditions, modeling shows that existing pollutant loading leads to violations of dissolved oxygen standards throughout the summer (i.e., July through September) in the North, Middle, and South Basins of Capitol Lake.[93]

- In the North and Middle Basins, dissolved oxygen violations were predicted to last for over 60 days while, for most of the South Basin, violations were predicted to last up to 15 days.[94]

- Budd Inlet currently violates water quality standards for dissolved oxygen. The areal extent of low dissolved oxygen includes most of the inner inlet and extends past Priest Point Park on the east and almost to Butler Cove on the west side of the Inlet.[vi]

- The duration of the low dissolved oxygen conditions in Budd Inlet was typically estimated at 1 to 2 days, although there are a few areas near the tip of the Olympia peninsula where 7 to 14 day violations were predicted to occur.[vi]

Total Phosphorus

- Total phosphorus concentrations measured in the lake are high and indicate that the lake is nutrient rich (i.e., eutrophic).[95]

- The largest source of phosphorus to the lake is the Deschutes River (approximately two-thirds of the annual load) while internal sources (sediments) are estimated to contribute the remaining one-third.

Long-Term Status Quo Condition

In the long-term, (i.e., beyond 50 years), the lake would fill with sediment and convert to a wetland system. Water quality could improve over the long-term since the remaining open water would essentially become an extension of the Deschutes River. The quiescent lake conditions

and internal sources of phosphorus and oxygen demand that define a lake environment would be eliminated. Specifically, the long-term condition could result in the following water quality impacts:

Dissolved Oxygen

- Violations would continue to occur in Budd Inlet, though there may be some improvement in concentrations in the west bay due to improved flushing or circulation.[96]

- Concentrations in the remaining channel of the old lake basins would reflect Deschutes River conditions.

Total Phosphorus

- Conditions would directly reflect those in the Deschutes River; internal sources of phosphorus associated with the lake would largely be eliminated.

2.3.2.2 Managed Lake Alternative

Under this alternative, the North and Middle Basins of Capitol Lake would be dredged to remove existing sediments and routinely dredged in the future to maintain open-water conditions in the lake. No dredging would occur within 100 feet of the shoreline or in the South Basin, except near the public boat launch. Specifically, the Managed Lake Alternative would result in the following water quality effects:

Dissolved Oxygen

- Little change to dissolved oxygen within Capitol Lake or within Budd Inlet was predicted as a result of dredging.[97] Therefore, the oxygen conditions were predicted to be the same as what currently exists.

Total Phosphorus

- Dredging would remove some of the sediments that have accumulated in the lake, thus removing some of the sources linked with internal phosphorus loading and thereby potentially reducing in-lake concentrations. However, the majority of the phosphorus would still be generated by watershed sources. Therefore, no measurable improvement in water quality was predicted.[98]

- After dredging, the lake will remain eutrophic according to estimated annual and summer total phosphorous loading rates after dredging.[99]

2.3.2.3 Estuary Alternative

Under the Estuary Alternative, the Capitol Lake dam would be removed and the existing lake basins would become an extension of Budd Inlet, thus reflecting the existing water quality in the lower Inlet. The Estuary Alternative would result in the following water quality effects:

Dissolved Oxygen

- Budd Inlet would continue to violate water quality standards for dissolved oxygen. However, the areal extent of low dissolved oxygen (based on current nonpoint and point source loads) would be reduced; the West Bay area extending out to Butler Cove, as well as the existing lake basin area would no longer exhibit significant dissolved oxygen violations. The area associated with East Bay and the Olympia peninsula would continue to exhibit violations.[vi]

- The improvement to dissolved oxygen conditions in the West Bay area was attributed to increased circulation and possible changes in algal growth dynamics in response to circulation changes.[100]

- The duration of the low dissolved oxygen conditions in those areas of Budd Inlet which are still in violation was typically estimated at 1 to 2 days, although there are a few areas near the tip of the Olympia peninsula where 7 to 14 day violations were predicted to occur.[vi]

Total Phosphorus

- Conditions are not expected to change. Nitrogen concentrations will become the major nutrient influencing algal growth and overall productivity in the estuarine system.

2.3.2.4 Dual-Basin Estuary Alternative

No water quality modeling was performed for the Dual-Basin Estuary Alternative; however, the Dual-Basin and Estuary Alternatives share similar velocity structures, salinities, and inundation frequencies.[101] The saltwater reflecting pool in the North Basin would be designed for flushing during each tidal cycle, maintaining a relatively low hydraulic residence time. Thus, it can be assumed that the water quality implications of the Dual-Basin Estuary Alternative would be similar to those of the Estuary Alternative for the main basin.

2.3.3 Comparison of Alternatives

Dissolved oxygen violations will continue to occur in much of lower Budd Inlet and the lake, regardless of which alternative is selected. Dissolved oxygen violations in Budd Inlet are primarily caused by the combined effect of point source and nonpoint source discharges to the Inlet, and only somewhat related to management of the lake basins. Similarly, phosphorus

concentrations are primarily caused by upstream sources in the Deschutes River and are not predicted to be substantially influenced by the management alternatives.

Estuary alternatives were predicted to result in a smaller areal extent of dissolved oxygen violations than the lake alternatives, largely due to improved flushing. This improvement primarily affects the West Bay portion of the Inlet, an area critical to salmon migration.[102]

Little change to dissolved oxygen, temperature, or pH within Capitol Lake or Budd Inlet was anticipated as a result of dredging under the Managed Lake Alternative.[103] Under the Near-Term Status Quo Conditions and Managed Lake Alternative, the lake will remain eutrophic according to current annual and summer total phosphorous loading rates.[104] Under the Long-Term Status Quo Condition, total phosphorus would become less of a concern due to the shift to a river or wetland system. However, temperature, pH, and fine sediment may become a concern, all of which are currently on the 303(d) list for the Deschutes River.

Total phosphorus would become less of a concern in the Estuary and Dual-Basin Estuary Alternatives. Nitrogen is the primary concern in marine systems. No evaluation of nitrogen was performed; however, nitrogen loading to the system is not expected to change significantly as a result of which management alternative is selected.

Part 2 – Economy

2.4 Infrastructure

2.4.1 Overview

This section examines impacts of the management alternatives on infrastructure in the vicinity of Capitol Lake. These impacts are grouped into three categories: *Utilities*, *Public Roadways and Transportation Connections*, and *Other Infrastructure*. This section is based primarily on three reports. The *Deschutes Estuary Feasibility Study – Engineering and Cost Estimates Phase 3* report[105] examines traffic lanes, revisions, and roadway stabilization. The *Capitol Lake Alternatives Analysis Low-Lying Infrastructure* report[106] focuses on sea level rise and possible flooding effects in downtown Olympia. *Dam Condition Assessment and Life Expectancy*[107] evaluates the current condition of the Capitol Lake dam.

Olympia-Yashiro Friendship Bridge at 4th Avenue

This section addresses both the direct impacts (requiring upgrading or replacement) and indirect impacts (increasing vulnerability to flooding) of the alternatives. Impacts based on predictions of sea level rise are not addressed. In the estuary alternatives, sea level rise would accelerate flooding when compared to the lake alternatives; however, differences between these alternatives were found to be minor when compared to the overall flooding expected and the necessary mitigation measures.

2.4.1.1 Utilities

The project area includes sanitary sewer, stormwater, electrical, water, and reclaimed water lines. All were considered in the original technical studies. However, most electrical lines in the project area are aboveground and therefore are not addressed in this summary.[108] Utilities associated with the Capitol Lake dam, the pedestrian bridge adjacent to the BNSF Railroad Trestle, and those along Deschutes Parkway are the primary areas of concern. Since these utilities are tied to affected transportation structures, they may need to be replaced or upgraded to withstand flooding or saltwater exposure, depending on the chosen alternative.

2.4.1.2 Public Roadways and Transportation Connections

Roadways and bridges in the area are included in this category. The two primary transportation corridors affected are the Deschutes Parkway and the Capitol Lake dam. Specific bridges include the pedestrian bridge near the railroad trestle, the BNSF railroad line, Percival Cove Bridge, the 5th Avenue bridge, and the I-5 Bridge. These bridges may need to be replaced or upgraded or may be more vulnerable to flooding under the different alternatives.

2.4.1.3 Other Infrastructure

The Capitol Lake dam **(**also known as the 5th Avenue dam), the Arc of Statehood, the Old Brewery, and low-lying trail and park areas are all also considered here.

Changes to the stormwater conveyance system (e.g., installation of a new pump station and associated infrastructure) are needed to reduce existing flooding in downtown Olympia. However, because this condition requires upgrades regardless of the management alternative selected, it is not a project-related impact and is not discussed further in this summary.

2.4.2 Impacts of Alternatives

2.4.2.1 Status Quo Alternative

Near-Term Status Quo Condition

In the near-term (the next 50 years), there would be no new or rebuilt infrastructure. Flooding scenarios would be consistent with the present day flooding events. This does not imply that some infrastructure would not need replacement or improvement within the 50-year planning horizon, but this would not be a direct result of the selection of this alternative. The Near-Term Status Quo Condition is the best reflection of existing conditions.

Utilities

- The sanitary sewer line that runs underneath the pedestrian bridge and adjacent to the railroad trestle would not be replaced or upgraded.
- The sanitary sewer along Deschutes Parkway would not be replaced or upgraded and would not be vulnerable to flooding even during large, infrequent (100-year) flood events.
- No changes or upgrades would be required for other water and sewer lines in the project area.
- The structure that encases the utility lines north of 5th Avenue, at the spillway is cracked and sagging. If the dam is retained, then within the next 25 years this will need to be addressed.

Public Roadways and Transportation Connections

- No rebuilding or upgrading of 5th Avenue, the Deschutes Parkway, or other bridges will occur. The Percival Cove Bridge would continue to flood occasionally (i.e., during 25-year or higher flood events).

- No upgrades would be required for existing bridges.

Other Infrastructure

- The Capitol Lake dam is expected to remain functional over the next 50 years, assuming that an appropriate program of inspection and repair is followed.[109] This should include an initial set of concrete repairs, including epoxy-injecting cracks and patching spalls. Annual, Special (once every 5 years), and Post-Event Inspections should all be carried out.

- The tide-gate machinery on the Capitol Lake dam will most likely need replacement within the next 50 years.[110]

- The Arc of Statehood would not be impacted.

- No infrastructure changes are required for existing recreational facilities. Some low-lying trails and park areas are vulnerable to flooding under existing conditions, and this would continue.

- The Old Brewhouse is currently vulnerable to flooding during large, infrequent (100-year) flood events.

Long-Term Status Quo Condition

In the long-term (beyond 50 years), no new or rebuilt infrastructure would be required. Routine maintenance needs would continue and some infrastructure identified in this summary may require replacement, but these maintenance and replacement needs would not be related to the selection of this alternative. Because the shift of the ecosystem to a river/wetland system has no bearing on infrastructure, it would remain primarily the same as under the near-term conditions.

Utilities

- Impacts are the same as those described for the Near-Term Status Quo Condition.

Public Roadways and Transportation Connections

- Impacts are the same as those described for the Near-Term Status Quo Condition.

Other Infrastructure

- As the lake fills with sediment, its capacity to reduce flooding will decrease and modifications to the dam may be necessary.

2.4.2.2 Managed Lake Alternative

In this alternative, the north and middle basins of Capitol Lake would be dredged initially to remove existing sediment and routinely dredged in the future to maintain the Managed Lake condition. There would be no planned changes to the existing infrastructure.

Utilities

- Impacts are the same as those described for the Near-Term Status Quo Condition.

Public Roadways and Transportation Connections

- Impacts are the same as those described for the Near-Term Status Quo Condition.

Other Infrastructure

- No new infrastructure will be required.

- The Old Brewhouse is currently vulnerable to flooding, during large, infrequent (100-year) flood events.

2.4.2.3 Estuary Alternative

In this alternative, the Capitol Lake dam would be removed, and Capitol Lake would return to tidally-driven estuary conditions. The primary concerns arise from the presence of saltwater and tidal action coming into contact with the infrastructure.

Utilities

- Stormwater outfalls along Deschutes Parkway would be replaced as part of the Deschutes Parkway stabilization work.[111] Other metal stormwater outfalls around Capitol Lake would need to be replaced due to their inability to withstand the corrosive effects of salt water.[112]

- Generally, water lines and sanitary lines in the area that are made of ductile iron could be adversely affected by salinity in the groundwater or in the estuary and would require upgrading.[113]

- The existing sanitary sewer line that runs under the pedestrian bridge adjacent to the BNSF railroad trestle would be flooded at intertidal frequencies.[114] Continual exposure of this line to saltwater and the increased lateral loads on the pipe would require that this line be modified or replaced.

- Water and sanitary sewer lines associated with the existing dam would be installed on the new bridge structure.

- Sanitary sewer along Deschutes Parkway would be replaced during reinforcement of the parkway.

Public Roadways and Transportation Connections

- A new 5th Avenue bridge would be constructed with four traffic lanes and bike and pedestrian lanes on each side.[115]

- A new intersection of Deschutes Parkway and 5th Avenue would be constructed and would connect with the 4th Avenue roundabout.[116]

- The Deschutes Parkway will require stabilization due to tidal incursion.[117] A rock buttress will be constructed and filled with dredged materials in order to provide intertidal habitat.[118]

- The soffits of the Percival Cove Bridge would flood frequently (2-year event) and be within the splash zone for high spring tides.[119] This would require that the bridge superstructure be protected from salt water exposure.

- The existing bridges have not been designed for the higher velocity currents associated with tidal flows. It will be necessary to provide scour protection for these structures. This includes the I-5, 4th Avenue, and BNSF Railroad bridges.[120]

Other Infrastructure

- The Capitol Lake dam would be removed and no maintenance activities would be required.

- The Arc of Statehood may need upgrades to withstand continued saltwater exposure.[121]

- Upgrades or replacements could be necessary for some components of the existing recreational facilities.[122] For example, some trail areas in Tumwater Historical Park may need to be replaced with elevated

boardwalk, culverts located in the wetland area of Capitol Lake Interpretive Park may need to be replaced with bridges and some of the trails may need to be raised, and boat launch modifications would be necessary.

- The Old Brewhouse would flood infrequently (100-year events).

2.4.2.4 Dual-Basin Estuary Alternative

The Dual-Basin Estuary Alternative would require construction and other changes similar to the Estuary Alternative.

Utilities

- Impacts are the same as those described for the Estuary Alternative.

Public Roadways and Transportation Connections

- Impacts are the same as those described for the Estuary Alternative.

Other Infrastructure

- A new barrier would be constructed across the north basin of Capitol Lake to create a reflecting pool.

- All other infrastructure impacts are the same as those described for the Estuary Alternative.

2.4.3 Comparison of Alternatives

Impacts of the alternatives on infrastructure in downtown Olympia are summarized in Table 2-5. For the Status Quo Alternative, only the long-term (beyond 50 years) condition is shown, to reflect only potential differences within the 50-year planning horizon of the project.

The Status Quo and Managed Lake Alternatives are the most similar to present day conditions. Neither require infrastructure changes—only routine maintenance and upgrades to all infrastructure components.

The Estuary and Dual-Basin Alternatives would require removal, construction, or retrofitting of some major existing infrastructure components, including the Deschutes Parkway, 5th Avenue near the dam, and the dam itself. Smaller infrastructure components would also be impacted, some ductile stormwater and sewer lines would need replacement or protection, and some structures exposed to saltwater will need a protective coating. Increased velocities during tidal exchange would require protecting bridge footings and pilings. None of these infrastructure

changes would adversely impact the function of utilities, transportation corridors, or other infrastructure; for example, changes to the Capitol Lake dam would improve traffic patterns.

Table 2-5. Comparison of alternatives in relation to infrastructure issues.

	Status Quo	Managed Lake	Estuary	Dual-Basin Estuary
Utilities				
Capitol Lake Outfalls	No change	No change	Replaced	Replaced
Pedestrian bridge sewer line	No change	No change	Upgraded or Replaced	Upgraded or Replaced
General sewer and water lines	No change	No change	Some will need replacement	Some will need replacement
Public Roadways & Transportation Connections				
Deschutes Parkway	No change	No change	Stabilization required	Stabilization required
5th Avenue	No change	No change	New bridge constructed	New bridge constructed
Percival Cove Bridge	No change	No change	Upgrade or retrofit	Upgrade or retrofit
I-5 Bridge	No change	No change	Minor scour work	Minor scour work
4th Avenue Bridge	No change	No change	Reinforcement Required	Reinforcement Required
BNSF Bridge	No change	No change	Minor scour work	Minor scour work
Other Infrastructure				
Capitol Lake dam	Remains. Eventually requires maintenance & mechanical replacement	Remains. Eventually requires maintenance & mechanical replacement	Removed	Removed
Concrete spillway	Remains. Requires major maintenance	Remains. Requires major maintenance	Removed	Removed
Arc of Statehood	No change	No change	May require upgrade	May require upgrade
Recreational Trails	No change	No change	Consider elevated boardwalks	Consider elevated boardwalks
Culverts in Interpretive Park	No change	No change	Consider replacing with bridges	Consider replacing with bridges
Recreational Launches	No change	No change	Consider rebuilding	Consider rebuilding
Old Brewhouse	Flood occasionally	Flood occasionally	Flood occasionally	Flood occasionally

2.5 Downtown Flood Risk

2.5.1 Overview

This section examines effects of the four management alternatives on flood risk in downtown Olympia. Flooding impacts to other structures (e.g., utility lines and roadways) were described in Section 2.4. Two reports were reviewed to prepare this analysis. The *Capitol Lake Alternatives Analysis Low-Lying Infrastructure*[123] report focuses on sea level rise and possible flooding effects in downtown Olympia. The *Capitol Lake Alternatives Analysis Hydraulic Modeling*[124] report compares scenarios in which the Capitol Lake basin would start to flood under the various alternatives.

Flooding in Downtown Olympia, circa 1975

The descriptions of impacts focus on existing conditions in terms of sea level and sea level rise scenarios of 1 and 2 feet. The 2-year (frequent, smaller flood events) and 100-year (infrequent large events) are used to frame the analysis presented here.

To understand the potential for flooding in downtown Olympia it is important to first understand the existing condition. A significant portion of downtown Olympia lies below an elevation that under natural conditions would result in frequent flooding.[125] However, the existing stormwater conveyance system protects the downtown area from most of the flooding that would normally occur. Furthermore, there are a series of recommended changes to the stormwater conveyance system that would further reduce the flood risk. This situation is not related to how the Capitol Lake basin is ultimately managed. It is assumed that the infrastructure needed to control this flooding would be installed no matter which alternative is selected, and therefore the impacts of this flooding are not considered project related impacts and are not described or compared in this summary.

Another important element for protecting the downtown area from flooding is the berm that has been built within Heritage Park along the eastern shore of the north basin. This berm sets the effective flood elevation for downtown at 11.5 feet.[126] Therefore, in the following summaries, predicted changes in flood risk are not based on land or structure elevations, but on the berm elevation.

For the Status Quo and Managed Lake Alternatives, flooding is caused by large rainfall events that cause the Deschutes River to flood. Flood levels in the lake basin can be affected somewhat by the management of the Capitol Lake dam;[127] lake levels can be lowered in anticipation of a storm event thereby creating more flood storage capacity. The dam was not designed as a flood control structure and therefore has limited value for alleviating flooding. In recent years dam operations have been optimized to reduce predicted flood events, but there are limits to its ability to store flood waters. In this comparative analysis, it is assumed that lake levels would continue to be manually lowered via dam operations, prior to major storm events. For the full range of modeled flood events (2-year through 100-year magnitudes) flooding for the Status Quo and Managed Lake Alternatives did not threaten downtown Olympia.

For the Estuary Alternatives, peak floods would be driven by tidal elevations. Tidally driven flood elevations are higher than flood elevations for the existing lake condition. It was estimated that under existing tidal conditions, a 2-year flood event will result in flood elevations that are 1.4 feet higher than with the dam and lake in place.[128] The impact of tides is muted for larger events, so that the difference in peak flood elevations for the 100-year event is only 0.4 feet higher under the Estuary Alternatives than what occurs now under current conditions.[129] For the full range of modeled flood events (2-year through 100-year magnitudes) flooding for the Estuary Alternatives did not threaten downtown Olympia.

A global rise in sea level would increase flood frequencies in the Estuary and Lake Alternatives. If climate change brings both sea level rise and increased peak flows in the Deschutes River, then the impacts to Olympia in terms of flood risk will increase substantially.[130]

2.5.2 Impacts of Alternatives

2.5.2.1 Status Quo Alternative

Near-Term Status-Quo Condition

In the near-term (the next 50 years), sediment would continue to accumulate in Capitol Lake, however, this would not be expected to result in significant flood storage loss. Flooding events would continue to be driven by inputs from the Deschutes River and Percival Creek. Lowering of water levels at Capitol Lake prior to major storm events through dam operations can reduce flooding, but only if Deschutes River flooding is limited to one or two tide cycles. In this analysis it is assumed that, as now, dam operations would be optimized to reduce flooding conditions.

- Peak flood elevations and therefore flood frequencies would be the same as under existing conditions.

- At existing sea levels, a peak flood during even a 100-year event would be at approximately 10.6 feet and therefore well below the elevation of the berm that protects the downtown area.[131] Consequently, flood risk in the downtown area would not be expected to notably increase.

- With a global sea level rise of 1 foot, the flood elevation during a 100-year event is estimated at 11.3 feet. This is still below the elevation of the protective berm and therefore would not result in flooding or the immediate need to raise the berm.[132]

Long-Term Status Quo Condition

Under the Status Quo Alternative, over the long-term (beyond 50 years), the lake would fill with sediment and convert to a wetland system. This conversion would remove much of the lake's water storage capacity and would result in a loss of flood control capacity that is currently provided by the operation of the dam. The peak elevation for the condition where 6 feet of sediment is allowed to build-up in the existing lake was evaluated in the hydraulic study.

- Peak flood elevations would be approximately 0.3 feet higher than under the current condition, for more frequent (2-year) events and for less frequent, larger floods (100-year events).[133]

- At existing sea levels, a peak flood event of 100 years would reach an elevation of approximately 10.7 feet,[134] below the elevation of the berm that protects the downtown area. Therefore, the flooding frequency in the downtown area would not increase notably.

- At a sea level rise of 1 foot, the peak flood elevation for a large, infrequent flood (100-year) is estimated at 11.6 feet and would result in flooding of downtown.[135] However, it is assumed that the protective berm would be raised prior to this sea-level rise to protect the downtown area.

2.5.2.2 Managed Lake Alternative

Under this alternative, the north and middle basins of Capitol Lake would be dredged to remove existing sediments and routinely dredged in the future to maintain the Managed Lake condition. As under the Status Quo Alternative, flooding events under the Managed Lake Alternative would be driven by inflow from the Deschutes River and Percival Creek. It was assumed that manual lowering of water levels at the Capitol Lake dam prior to major storm events would continue to be implemented. Modeling results indicate that dredging has no impact on flood elevations.[136] This is because the vast majority of the dredging occurs where the lake bed elevations are below the level that would provide an effective storage volume. Because the dredging would have little impact on ultimate flood elevations, the impacts for this alternative are considered to be essentially the same as for the Near-Term Status Quo Condition.

- Modeling results indicate that dam operations (i.e., lake lowering before a storm event) can be somewhat effective at decreasing the more frequent flood events (i.e., 2-year events), resulting in a decrease in peak flood elevations by as much as 0.6 feet,[137] depending upon how the dam is operated. At lower flood frequencies, (i.e., the 100-year event), lake

lowering has relatively little effect on flooding; peak flood elevations decrease by only 0.1 to 0.2 feet.[138] For more extreme events, when high flows in the Deschutes River span two or more tidal cycles, lowering lake levels is relatively ineffective after the first tide that coincides with high river flows.[139]

- At existing sea levels, a peak flood event of 100 years would reach an elevation of approximately 10.4 feet,[140] below the elevation of the berm that protects the downtown area. Therefore, the flooding frequency in the downtown area would not increase notably.

- At a sea level rise of 1 foot, the peak flood elevation for a large, infrequent flood (100-year) is estimated at 11.3 feet, just below the elevation of the protective berm and therefore would not immediately require raising the berm to protect downtown from flooding.[141]

2.5.2.3 Estuary Alternative

Under the Estuary Alternative, the Capitol Lake dam would be removed and Capitol Lake would return to tidally-driven estuary condition. Under the Estuary Alternative, the entire Capitol Lake basin would be open to tidal flushing and water levels would be primarily influenced and determined by the tides.

- Under existing sea levels and frequently occurring flood events (i.e., 2-year events), the flood elevations would be approximately 1.4 feet higher than under existing conditions.[142] At low frequency events (100-year) this difference is muted and the increase in peak flood elevations is predicted to be 0.4 feet higher than under the lake alternatives.[143] It is important to note that these predicted differences in peak flood elevations between lake and estuary conditions may be overestimated. Assumptions in the modeling may slightly increase the flood elevation for the lake conditions and slightly decrease the flood elevations for the estuary conditions.[144]

- At existing sea levels, the berm provides protection up to a flood elevation of 11.5 feet. With stormwater system controls in place, the downtown area would be protected from flooding up to the 100-year flood event.

- The Estuary Alternatives would respond directly with a global rise in sea level; increasing by 1 foot with every 1-foot rise in sea level. At a sea level rise of 1 foot, the peak flood elevation for a large, infrequent flood (100-year) is estimated at 12.0 feet, which is above the elevation of the protective berm.[145] However, as with the other alternatives, this flooding would be prevented through raising the height of and/or extending the berm that currently protects downtown Olympia.

2.5.2.4 Dual-Basin Estuary Alternative

Under the Dual-Basin Estuary Alternative, a barrier would be constructed in the north basin, creating a calm basin adjacent to Heritage Park. Saltwater in the eastern reflecting basin would fluctuate by a few feet with the tidal cycles. The analysis of future risk from flooding indicates that peak flood elevations are essentially the same for both the Estuary Alternative and Dual-Basin Estuary Alternative.[146]

2.5.3 Comparison of Alternatives

Under existing sea levels and commonly occurring flood events (i.e., 2-year events), estuary flood elevations are predicted to be up to 1.4 feet higher than under the lake conditions. However, downtown Olympia is protected from high river flows and tidally induced flooding by the constructed berm around Heritage Park.

The downtown area would become increasingly vulnerable to flooding with an increasing rise in sea level. While a sea level rise would increase peak flood elevations for all of the alternatives, the Estuary Alternatives would respond more directly, increasing by 1 foot with every 1-foot rise in sea level. For the lake alternatives, a sea level rise would be tempered slightly by the dam; a 1-foot rise in sea level would result in approximately a 0.75-foot flood elevation increase during commonly occurring flood events. The engineering study which predicted flood elevations for the alternatives suggests that the difference between lake and estuary alternatives may be slightly overestimated.

The existing berm that protects downtown would need to be raised sooner under the Estuary Alternatives than the Status Quo and Lake Alternatives. Using current tide levels and the 100-year flood event as an upper boundary, under the estuary conditions the flood elevation is predicted to be 0.5 feet below the berm height. However, under Estuary Alternatives, the downtown area would become vulnerable to flooding at lower increases in sea level. The berm would not need to be raised until a sea level rise of approximately 0.5 feet. Under the Status Quo and Lake Alternatives, the berm would need to be raised at a sea level rise of approximately 1.2 feet.

If climate change brings both sea level rise and increased peak flows in the Deschutes, then the impacts to Olympia in terms of flood risk will increase substantially.

2.6 Long-term Costs

2.6.1 Overview

This section identifies the long-term costs of implementing the different management alternatives. The primary document used to prepare this chapter was the *Community Economic Values for the Capitol Lake Basin*[147] report, which was developed using input from community stakeholders as well as economic information derived from earlier technical reports including the *Capitol Lake Dam Conditional Assessment and Life Expectancy* report and the *Engineering*

Design and Cost Estimates report. Information from the *Capitol Lake Alternatives Analysis Dredging and Disposal Addendum*[148] was also reviewed for this summary

The long-term cost analysis presented for each alternative focuses on the direct project costs of infrastructure investments and long-term maintenance. In this case, long-term maintenance is primarily associated with dredging. An assessment of regional economic effects, such as those that might be associated with changes in tourism, participation in community events, or downtown business were not fully considered in the economic study due to the lack of readily available data.[149] There may also be other hidden or indirect costs, such as those associated with resource damage or liability, which also have not been addressed. All of the costs are provided as a range of low to high, to account for the fact that these are planning level cost estimates that cover a wide range of possibilities. The wide range in cost is primarily driven by assumptions associated with the type of dredge equipment used and how dredge material is disposed. All cost estimates are in 2008 dollars to simplify the comparisons.

Open Water Dredging with Clamshell Crane

2.6.1.1 Infrastructure Costs

The primary infrastructure investments include the cost of initial dredging, the cost for dam maintenance or dam removal and 5th Avenue bridge construction as well as stabilization and upgrade of the Deschutes Parkway and replacement or upgrade of the many ductile stormwater outfalls that discharge to Capitol Lake.[150] The need for these infrastructure investments varies according to the alternative selected.

Additional infrastructure costs associated with sea-level rise and associated flooding were considered to be the same ($2 to $4 million) for all alternatives.[151] However, as described in the section on downtown flood risk (Section 3.5), these costs would accrue at an earlier time (i.e., lower sea level rise) for the estuary alternatives. Because costs associated with flood protection for sea-level rise are the same, this cost is not addressed in the description of the individual alternatives, but is included in the final cost estimates to maintain consistency with the economic report.

2.6.1.2 Maintenance Costs

The only long-term maintenance cost identified for this Alternatives Analysis is that associated with dredging. As detailed in the dredging studies, the dredging costs are highly variable. The

key drivers to the cost differences for dredging are the volume of material removed and the disposal option used for the dredged materials.

2.6.2 Impacts of Alternatives

2.6.2.1 Status Quo Alternative

Near-Term Status Quo Condition

Infrastructure Costs

Existing infrastructure associated with the Status Quo Alternative includes the Capitol Lake dam, bridges, parkways, walkways, and the parks and roads associated with the lake and Budd Inlet. The Capitol Lake dam would continue to operate. None of the existing sediments that have collected in the lake basins would be removed, and no other infrastructure changes or upgrades would be required. Therefore, the only cost associated with infrastructure investments are those associated with major maintenance of the dam structure. This cost has been estimated at between $2.0 and $4.0 million [152] (Table 2-6). (Clearly there will be routine upgrade and construction costs associated with the infrastructure that already exists in the area, however; these needs would not change as a result of the selection of this Alternative.)

Table 2-6. Cost comparison for each of the lake management alternatives. (All costs shown as a range of low to high cost estimates in millions of dollars.)

	Status Quo [a]	Managed Lake	Estuary	Dual-Basin Estuary
Infrastructure Costs				
Flood Mitigation	2 – 4	2 – 4	2 – 4	2 – 4
Initial Dredging	0	74 – 146	16 – 23	16 – 23
Dam Maintenance	2 – 4	2 – 4	0	0
Dual-basin barrier	0	0	0	28 – 29
Other Infrastructure	0	0	57 – 63	57 – 63
Total Infrastructure	4 – 8	78 – 154	75–90	103 – 119
Maintenance				
Dredging [b]	0	113 – 168	40 – 135 [c]	40 – 135 [c]
Total Maintenance	**0**	**113 – 168**	**40 – 135**	**50 – 135**
TOTAL [d]	**4 – 8**	**192 – 321**	**115 – 225**	**142 – 254**

[a] Costs are for the near-term (the next 50 years) condition for the Status Quo Alternative

[b] Maintenance costs are associated with long term dredging and based on 50 years of dredging needs.

[c] Dredging costs for the estuary alternatives include dredging in the lower inlet.

[d] Taken from the table on page 2 of the *Community Economic Values for the Capitol Lake Basin* report.

Maintenance Costs

No dredging would occur under the Near-Term Status Quo Condition. Therefore, no maintenance costs were identified for this Alternative.

Long-Term Status Quo Condition

Infrastructure Costs

As noted for the Near-Term Status Quo Condition, costs for maintaining the local infrastructure associated with the Capitol Lake dam would range between $2.0 and $4.0 million over the next 50 years. At some point over the long-term (beyond 50 years), replacement of the dam will be required. These costs have not been developed.

Maintenance Costs

Once the lake is filled in, it will lose capacity to store additional sediments. Eventually (>50 years), sediment removal needs in the lower Inlet would increase to compensate for the load contributed by the Deschutes River that previously was deposited in the lake basins. Although the cost of this was not considered in the background studies and is outside the planning horizon for this project, it can be assumed that the cost for this dredging would be similar to the long term cost for dredging associated with the estuary alternatives.

2.6.2.2 Managed Lake Alternative

Under this alternative, the North and Middle Basins of Capitol Lake would be dredged to remove existing sediments and routinely dredged in the future to maintain the desired conditions in the lake (maintenance dredging). Costs presented for this alternative represent expenditures expected to occur over the next 50 years for maintenance activities occurring only in Capitol Lake. No dredging costs are included here for Budd Inlet. This does not mean there would not be a need for dredging in the inlet. However, the need for dredging would not be expected to change significantly over the existing needs as a result of this alternative.

Infrastructure Costs

Infrastructure costs for the Managed Lake Alternative are identified in Table 2-6. Included in the range of costs are major dam maintenance and initial dredging costs. The cost for dam maintenance over the next 50 years has been estimated at between $2.0 and $4.0 million (Table 2-6). Initial dredging costs were estimated at $74.3 to $145.9 million based on 875,000 cubic yards of sediment removed.[153] The total estimated costs for infrastructure improvements including flood mitigation costs, range from $78.3 to $153.9 million.[154]

Maintenance Costs

Under the Managed Lake Alternative dredging will be required on a routine basis. It was assumed that approximately 350,000 cubic yards of sediment would be removed every 10 years to maintain the lake system.[155] Table 2-6 identifies the maintenance costs for dredging under the Managed Lake Alternative, based on a 50-year scenario. The estimated costs range from a low of $113.3 to a high of $167.5 million.[156]

2.6.2.3 Estuary Alternative

Under the Estuary Alternative, the Capitol Lake dam would be removed and the existing lake basins would become an extension of Budd Inlet. In addition to dam removal and building of a bridge, there are other infrastructure costs associated with stabilization and upgrades of the Deschutes Parkway.

Some of the sediment currently deposited in Capitol Lake would be transported into the inlet. The costs of additional dredging in Budd Inlet and the affected marinas are included in the maintenance costs, as noted below.

Infrastructure Costs

Initial dredging would be required to move existing sediment that is located in the middle and north basins of the lake and create a river channel. Most of this would be deposited along the Deschutes Parkway to stabilize the roadway and form tide flats, thereby reducing overall dredging costs. Initial dredging costs are expected to range from $15.7 to $22.9 million for this alternative.[157] These costs are based on dredging approximately 394,000 cubic yards of material which is disposed of within the lake basin resulting in minimal disposal costs.

The primary infrastructure change would be the removal of the Capitol Lake dam and replacement with a 5th Avenue bridge and related roadway work. Also included in the cost estimate is repair and upgrade work for the Deschutes Parkway. The construction costs associated with the development of the Estuary Alternative range from $57 to $63 million (Table 2-6). The total infrastructure costs are therefore estimated at $74.7 to $89.8 million.

Maintenance Costs

Maintenance costs associated with the Estuary Alternative include periodic maintenance dredging in Budd Inlet to manage the additional sediment that is anticipated to be introduced into the system from the Deschutes River. It was assumed that dredging would occur at 5-year intervals, and result in removal of 111,000 cubic yards of sediment in the lower Inlet, including the Port and marina areas. Maintenance dredging costs over a 50-year period are estimated to range from $39.8 to $134.7 million.

2.6.2.4 Dual-Basin Estuary Alternative

Under the Dual-Basin Estuary alternative, a barrier would be constructed in the North Basin of Capitol Lake, creating a quiet and still 40-acre basin that would reflect the image of the state Capitol buildings, thereby maintaining a primary planning goal of Heritage Park. Water in the eastern basin would not drain during low tides, although flushing would occur at higher tides. Other than this additional infrastructure cost, the costs for this alternative are the same as for the Estuary Alternative.

Infrastructure Costs

The cost for construction of the new barrier to create the dual-basin has been estimated at $27.9 to $29.4 million. All of the other infrastructure and initial dredging costs would be similar to those estimated for the Estuary Alternative. Therefore, the total construction costs associated with development of the Dual-Basin Estuary Alternative range from $102.6 to $119.2 million (Table 2-6).

Maintenance Costs

The maintenance dredging costs identified for the Dual–Basin Estuary alternative are identical to those estimated for the Estuary Alternative (Table 2-6). These costs range from $39.8 to $134.7 million over the 50-year period of interest.

2.6.3 Comparison of Alternatives

The economic data and costs identified by the various CLAMP technical reports for the Capitol Lake management alternatives are presented in Table 2-6. As noted previously, these costs are associated with direct project costs and do not include indirect or hidden costs that may accrue.

The lowest cost alternative is the Status Quo Alternative. Other than dam maintenance and flood mitigation there are no initial costs. Several unquantified costs are projected to exist beyond the 50-year planning horizon. As the lake basin fills with sediment flood management becomes more difficult and eventually becomes ineffective. New deposits of river sediment pass through the area which is now the lake and are deposited in lower Budd Inlet. Also, on-going maintenance of the 5th Avenue Dam becomes too costly and the structure will need to be replaced. All of these impacts are expected to occur in the long term and therefore are not a part of the 50-year cost analysis.

By far the highest cost is associated with the Managed Lake Alternative. The total cost to implement this alternative, based on a comparison of the low cost estimates, is 70 percent higher than the Estuary Alternative. This difference is primarily driven by the volume of sediment removed and disposed of under the Managed Lake Alternative; twice as much sediment is removed during initial dredging, when compared to the Estuary Alternative. Further, all of this sediment is slated for disposal offsite. Initial dredging costs are 80 percent higher for the Managed Lake Alternative, and account for nearly $60 million of the difference between these alternatives. Similarly, over the long term, more sediment is removed during maintenance dredging under the Managed Lake Alternative and disposal costs are higher, thereby accounting for another $73.5 million.

Both of the estuary alternatives have higher infrastructure costs, but these are small in comparison to the costs associated with dredging. In these alternatives, the initial dredge volume is substantially smaller and dredge materials are deposited locally. Further, according to the most recent modeling results, a smaller quantity of new sediment will require active management

under the Estuary Alternatives than previously estimated. This is because a large portion was predicted to be deposited in areas of Budd Inlet where it creates no disturbance.

There is a nearly $30 million difference between the Estuary and Dual-Basin Estuary Alternatives. This is due to the added cost for construction of the barrier under the Dual-Basin Alternative.

Part 3 – People

2.7 Public Recreation

This section addresses the effects of the four Capitol Lake management alternatives on public recreation. There are three basic groups of activities described for each alternative: water-based recreational activities, park and trail system use, and community and social gatherings.

Bow of Dragon Boat with Capitol Buildings

This summary is based primarily on three reports. The *Deschutes Estuary Feasibility Study—Engineering and Cost Estimates*[158] discusses how existing trails, parks, and canoe launches could be affected by the alternatives. The *Deschutes Estuary Feasibility Study: Net Social and Economic Benefit Analysis*[159] includes information on the affected public use of Capitol Campus. *The Capitol Lake Alternatives Analysis Low-Lying Infrastructure*[160] focuses on sea level rise and potential flooding in the area.

2.7.1 Overview

Capitol Lake was created in 1951 as a reflecting pool for the State Capitol building. Over the years, it has become a landmark for the City of Olympia and is a critical part of the local region's amenities. There is no question that the area near and surrounding Capitol Lake is an important, well-used, regional hub for many types of recreation. Differences in the type of recreational activities, as were differences in timing and opportunity for those activities, were identified when comparing the four alternative lake management scenarios. Overall, recreational activities will be supported, and supported well, under all of the Management Alternatives.

The lake is surrounded by established recreational sites, including Heritage Park, Marathon Park, the Deschutes Parkway trail system, Capitol Lake Interpretive Center, and Tumwater Historical Park. Percival Landing and the marinas at the lower end of Budd Inlet function as an extension of the lake in terms of the overall recreational attributes of the project area. In fact, the Thurston

Regional Trails Plan indicates that Capitol Lake area serves as a critical node for the intersection of existing and planned trails and bike paths to serve the long term needs of the planning area.[161]

2.7.1.1 Water-Based Recreation

Water-based recreational activities primarily include non-motorized boating and fishing. Due to water quality concerns, swimming is no longer supported by the lake. The alternatives could also affect accessibility to open water from existing docks, although it has been assumed in this review that these docks would be modified to allow access during most periods.

2.7.1.2 Park and Trail System

Use of the park and trail system focuses on the above-mentioned parks and associated trail systems. The trails are used extensively for walking, jogging, bicycling, and wildlife viewing. The primary concerns in terms of park and trail use are related to the potential changes in the frequency of high water for low-lying trails and park areas.

2.7.1.3 Community Supported Events

Many community-supported events and social gatherings are centered in the Capitol Lake area. Major community events that occur near the project area include the Procession of Species, the Dragon Boat Festival, and Lake Fair (including the hydroplane races). Social gatherings, such as picnics, weddings, and family reunions also routinely occur in the project area. For these recreational groups, the difference between the alternatives is related to loss of open water and a change in the character of the area. The potential for higher water levels that may affect the green space and park areas is also a concern. It is important to note that high-water events are seasonal and do not generally coincide with the period when community events and social gatherings occur.

2.7.2 Impacts of Alternatives

2.7.2.1 Status Quo Alternative

The Status Quo Alternative would require little to no construction or immediate changes to the area. In the near-term (the next 50 years), the lake basins would reflect conditions that currently exist; although water quality would continue to deteriorate, and aquatic plant beds would expand. Over time, the lake basins would fill in, and the area would essentially be occupied by a stream channel flowing through a large, freshwater wetland system. The area of open water would be greatly reduced, and submerged aquatic plant beds would be replaced by emergent vegetation and other wetland vegetation types.

Near-Term Status Quo Condition

Water-Based Recreation

- Existing docks and floats would still provide access to open water.

- Canoeing, kayaking and fishing would continue, although boating activity would be limited by the aquatic plant beds and shallow nature of much of the lake.

- Marinas and boating use of lower Budd Inlet would continue to be supported at the current level.

Park and Trail System

- Low-lying portions of the park and trail system would continue to flood during wet weather periods.[162]

- Poor pedestrian and bicycle passage over the 5th Avenue bridge would not be expected to continue.

- Wildlife viewing opportunities would continue at the current level.

- Retain existing amenities for community and social events

Community Supported Events

- Events that require open water would be supported.

- Seasonal flooding of park and green space areas would occur.

Long-Term Status Quo Condition

Water-Based Recreation

- There would be eventual reduction or elimination of these activates.

- Existing docks and floats would become obsolete as areas of open water shrink.

- Opportunities for boating would decline as the aquatic plant beds expand, the basins become shallower, and open water area is reduced. Fishing opportunities would still exist; however, the catch would primarily be salmon, rather than the current mix of salmon and freshwater fish.

Park and Trail System

- Direct access to the water's edge would be reduced as marsh areas expand.

- Wildlife viewing opportunities would continue; the expanded wetland may attract different wildlife species.

- Poor pedestrian and bicycle passage over the 5th Avenue bridge would not be expected to continue.

Community Supported Events

- Retain existing amenities for community and social events
- Events that require open water, such as the Dragon Boat Festival and the Lake Fair hydroplane races, would be discontinued in the lake basin.
- Seasonal flooding of park and green space areas would still occur.
- The elimination of the reflecting pool for the Capitol buildings would eventually occur.

2.7.2.2 Managed Lake Alternative

Under the Managed Lake Alternative, recreational opportunities would be similar to those that currently exist. Although lake dredging and other management activities may improve water quality and reduce the extent of aquatic plant beds, they would also periodically disrupt and limit recreation.

Water-Based Activities

- Access to existing docks and floats would be available.
- Reduced aquatic plant beds would benefit boating and fishing.
- Boating in lower Budd Inlet would continue to be supported at the current level.
- Motorboats and waterskiing could be supported within the lake area.[163]

Park and Trail System

- All existing park and trail systems would be available and direct access to the water's edge would continue at its current level.
- Poor pedestrian and bicycle passage over the 5th Avenue bridge would not be expected to continue.
- Wildlife viewing opportunities would be similar to what currently exists.

Community Supported Events

- Retain existing amenities for community and social events.

- Events that require open water would still be supported.
- Seasonal flooding of park and green space areas would still occur.

2.7.2.3 Estuary Alternative

Under the Estuary Alternative, opportunities for recreation would be similar to those under existing conditions; however, there may be differences in the general nature of the activities or their extent. Connectivity between the lake area and Budd Inlet by water craft would enhance boating. The concurrent reintroduction of tidal influence within the lake area would alter accessibility for some recreational activities. Because this alternative would require reconstruction of the 5th Avenue bridge, it would likely result in the creation of new bicycle and pedestrian lanes at the bridge. Impacts on park and trail use and community or social events could be mixed.

Water-Based Activities

- There would be limit opportunities for water-based activities, such as canoeing and kayaking during low tides.[164]
- Existing docks and floats would need to be modified to adjust to the tides and tide flat buildup.
- There would be limited opportunities for canoeing or kayaking during low tides, however removal of the 5th Avenue dam would remove a current barrier and expand connectivity for small boats.
- Fishing opportunities would still exist; however, the catch would change. A mix of salmon, and marine species, such as starry flounder, and sand sole would be available, rather than the current mix of salmon and freshwater fish.[165]
- Assuming that sediment deposited in the lower inlet is removed regularly, boat moorage and boating events in Budd Inlet (e.g., Tugboat races at Harbor Days) would not be adversely affected.
- Motorboat and waterskiing would not be supported within the lake area. This would not be a change from current conditions.

Park and Trail System

- There would be support for the existing system.[166,167]
- Low-lying portions of trails would be moved or replaced with elevated boardwalks and park areas could experience seasonal flooding at high tide.

- If bicycle and pedestrian lanes are added on each side of the 5th Avenue Bridge, pedestrians and cyclists would benefit from safer conditions.[168]

- Wildlife viewing opportunities could expand through replacement of the existing freshwater wetlands with estuarine wetlands.

Community Supported Events

- Amenities for community and social events would still exist.

- An estuary would not likely support events that require open water such as the Dragon Boat Festival and the Lake Fair hydroplane races.

- An estuary would continue to support other community and social events.

2.7.2.4 Dual-Basin Estuary Alternative

The Dual-Basin Estuary Alternative would result in conditions similar to those for the Estuary Alternative. This alternative would restore tidal influence, while retaining the reflecting pool for the Capitol building. The additional pedestrian walkway would provide new access to recreational activities.

In addition to the long-term effects of the Estuary Alternative, the Dual-Basin Estuary Alternative would:

- Retain a reflecting pool for the Capitol building.

- Provide additional walking area with the newly constructed pedestrian barrier, which would separate the reflecting pool and the estuary area.

2.7.3 Comparison of Alternatives

The impacts of the alternatives on public recreation compared to existing conditions are qualitatively summarized in Table 2-7. For the Status Quo Alternative, only the long-term condition is included in the summary. On balance, recreational activities will be supported, and supported well, under all of the Management Alternatives.

There are differences between the alternatives but the overwhelming outcome of this evaluation is recognition of the value and importance of the lake area as a recreational asset for the local region. The following summation of differences is overshadowed by the continuing major role the lake basin will play under any of the four scenario as a recreational magnet and landmark for the community.

Both the estuary alternatives and the Status Quo Alternative would result in a more limited open-water area for boating and fishing compared to the Managed Lake Alternative. Under the

Estuary Alternatives low tides would affect boating in the lake area but new connectivity with the Inlet would be established. It is assumed that docks, ramps and other access points would be re-configured to allow use in a tidal environment.[169] Under the Status Quo Alternative a permanent loss of open water would significantly affect boating but new wildlife watching opportunities would likely be available. The Managed Lake Alternative could allow opportunities for motorized boating and waterskiing that are not currently available.[iii]

Table 2-7. Comparison of alternatives in relation to public recreation issues.

	Status Quo [a]	Managed Lake	Estuary	Dual-Basin Estuary
Water-Based Activities				
Boating access	-	+	+	+
Fishing opportunities	=	=	=	=
Motorboat and skiing opportunities	=	+	=	=
Budd Inlet boating and moorage [b]	=	=	=	=
Park and trail System				
Historical and Interpretive Park wetland trails	=	=	=	=
New recreational pathways	=	=	=	+
Overall flooding of area parks and trails	=	=	=	=
Wildlife viewing opportunities	=	=	=	=
Community Events and Social Gatherings				
Space to hold community events	=	=	=	=
Open-water lake-based events	-	=	-	-

Notes:

The symbol = represents conditions similar to existing conditions.

The symbol + represents an improvement over existing conditions.

The symbol - represents a decline from existing conditions.

[a] This addresses only the long-term Status Quo Condition.

[b] This assumes that routine dredging occurs in the lower inlet to maintain water depth.

The estuary alternatives could result in reduced use of the park and trail system due to increased flooding frequency. The low-lying areas of the park and trail system routinely flood during wet weather under existing conditions, under the estuary alternative they would flood at each high tide. However, it has been assumed that a raised boardwalk would be provided to mitigate for this flooding. The estuary alternatives would likely result in some overall improvement to pedestrian and bicycle trails because they would result in reconstruction of the 5th Avenue bridge, and pedestrian and bicycle passage would likely be part of the new design.

The Dual-Basin Estuary Alternative would result in an overall increase in the trail system because the barrier separating the basins would feature a pedestrian walkway.

Most community events and social gatherings would generally be unaffected by the selection of alternatives. There are at least two community events that specifically require open water: the

Dragon Boat Festival and the Lake Fair hydroplane races. These would need to be scheduled to occur during high tides or be relocated to Budd Inlet.

The Capitol Lake basin is a recreational gem. Any future condition of the lake will recognize the value of this resource to the community and to the Capitol Campus. All alternatives will include optimization of recreational opportunities.

2.8 Cultural and Spiritual Values

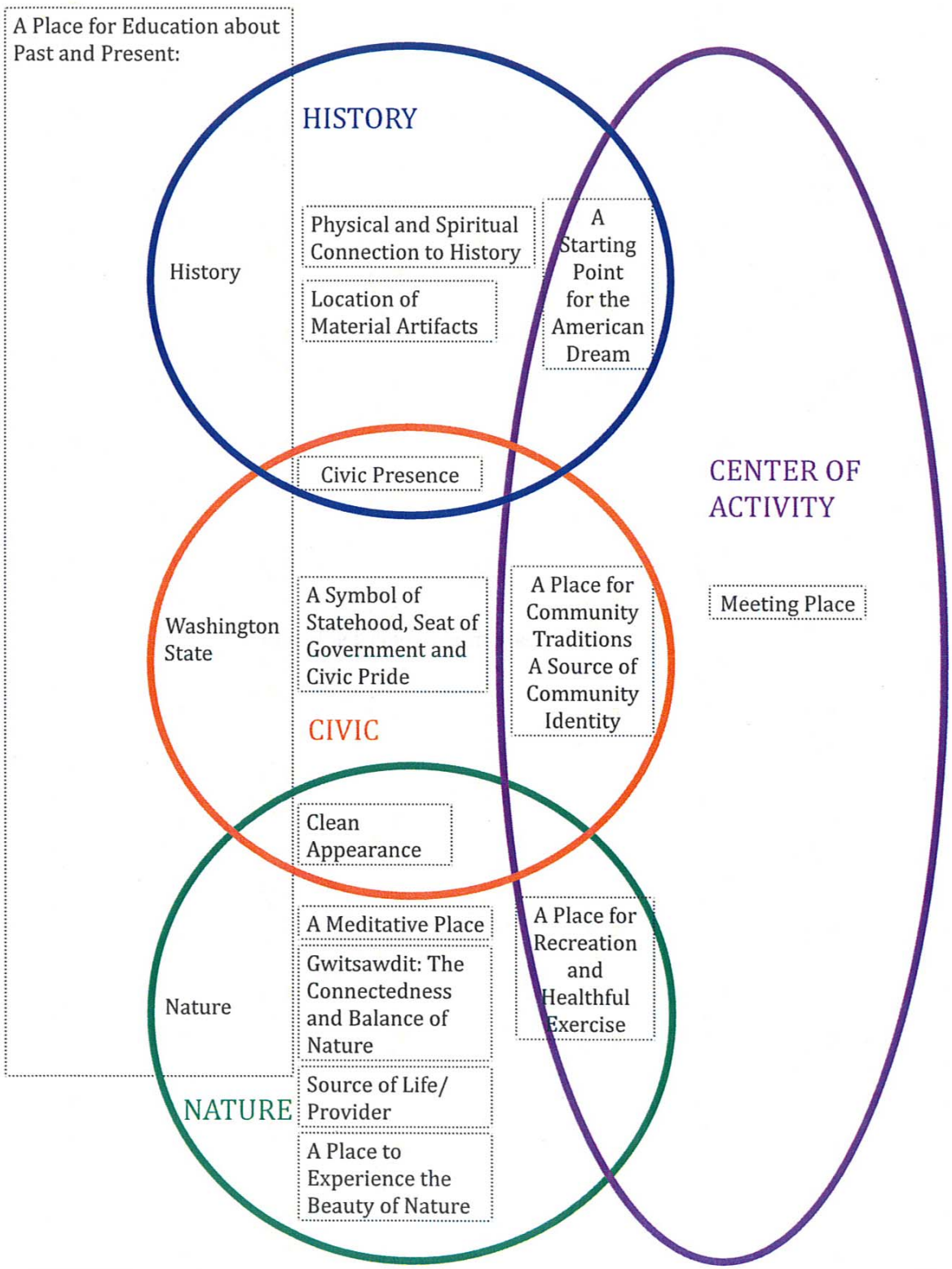
2.8.1 Overview

This section addresses the relationships between the four management alternatives and the cultural and spiritual values associated with the Deschutes River basin and Capitol Lake basin. These values are not scientific; they are feelings, beliefs, and intangible benefits currently associated with the area. These values are grouped into five categories, or cultural services, that the basin provides: Spiritual Values, Historical Importance, Civic Pride, Presence of Nature, and Community Identity.

This section is based primarily on two studies. *The Study of Cultural and Spiritual Values Associated with Future Alternatives for Capitol Lake Basin* [170] uses personal interviews to identify cultural and spiritual values associated with the Lake basin, and to assess potential alternatives based on those values. The *Deschutes Estuary Feasibility Study: Net Social and Economic Benefit Analysis*[171] summarizes findings from public informational surveys and focus group sessions conducted on the Managed Lake versus the Estuary Alternatives.

The Deschutes River basin has long been a place where nearby residents connect with their community and nature. It has been a gathering place for Native Americans, a landmark for weary travelers, a site for a growing industry, a shanty town, and currently serves as a place of civic pride. To help understand these values, several individuals offered written and verbal input. Most contributors were representatives of the following groups:[172]

- The Native American community (Squaxin Island Tribe)
- The Olympia Chinese-American community
- The Heritage Park Development Association
- Events organized and held regularly that are an important part of the identity of the Olympia community
- Others knowledgeable in area history
- Community representatives who participated in the Capitol Lake planning stakeholder involvement process



Schematic Representation of Identified Values

Each of the five categories of values noted above, are presented here and described with regard to how they may or may not be supported by each of the potential alternatives. However, the overarching conclusion of the *Deschutes Estuary Feasibility Study: Net Social and Economic Benefit Analysis* report was that the variety of cultural and spiritual values the basin supports reflect personal and group preferences, which cannot be objectively compared to one another. It was not the goal of the above referenced report to complete an inventory, it does not fully document the impacts to physical resources, and does not provide an analysis of aesthetic impacts.[173]

2.8.1.1 Spiritual

Spiritual values include the those of Native American "Gwitsawdit[1,2] -The Connectedness and Balance of Nature," and "Source of Life/Provider." These are values also shared by non-Native American groups.[174] "A Meditative Place" and "Spiritual and Inspirational" values are identified as being "connected to something larger."[175] The key components of this value group are the natural cohesiveness and way in which spiritual needs are provided (or not provided)[176] for by the alternatives.

2.8.1.2 Historical

Values such as a "Physical and Spiritual Connection to History" and "A Place for Education about Past and Present" offer various historical education opportunities. "Location for Material Artifacts," "A Starting Point for the American Dream," and "Cultural Heritage" are also of significant ancestral importance for the Squaxin Island Tribe and for Chinese-Americans and other immigrants, whose families began in America while living in the basin's shanty town (known as "Little Hollywood").[177] In general, all of these values identify the basin as a place to reflect on all that came before the present day environment. Key components for this group are consideration for the connection to ancestry and educational opportunities present in this space.

2.8.1.3 Civic Pride

The values of civic pride include "Civic Presence," and "A Symbol of Statehood, Seat of Government and Civic Pride." These values relate to the City Beautiful Movement[3] and the sense of pride for Washington State that the images of this area create.[178] The key focus of this group is to maintain a reflecting pool for the Capitol Buildings, which is a source of civic pride.[179] [180] The area should also continue to represent the ideals of the City Beautiful Movement.[181]

[1] "Gwit-saw-dit" is a phonetic spelling of a word in the Lushootseed language. The actual spelling could not be verified for this report.

[2] This value represents nature as it is valued for its own sake. "Gwitsawdit" are sacred "teachings of the land" held by the Squaxin Island Tribe.

[3] City Beautiful Movement is a turn of the century architectural movement to beautify cities and promote harmonious social order.

2.8.1.4 Presence of Nature

Presence of Nature values include "Clean Appearance," "A Place to Experience the Beauty of Nature," and "Aesthetic Values." These are associated with an appreciation for the presence of water, wildlife and vegetation within the urban core of the city.[182,183] Components of this value group include the presence or absence of tidal mud-flats and the type of ecosystem created. This analysis focuses on the different values that will be supported or discouraged with various ecosystems, while the Plants and Animals section (Section 3.2) provides a more detailed discussion of actual environmental changes that would be expected to occur with the various alternatives.

2.8.1.5 Community Identity

Community Identity Values include "A source of Community Identity and Place for Community Traditions," "A Meeting Place," and "A Place for Recreation and Healthful Exercise." These values focus on the importance of having a place for the community to gather in both small and large groups.[184] Key components of the various community values include green space, trails, and the presence of open water.[185]

2.8.2 Impacts of Alternatives

2.8.2.1 Status Quo Alternative

Near-Term Status Quo Condition

Spiritual

- Spiritual values held by the Native American community, such as "Gwitsawdit" and "Source of Provider/Life" are not supported under existing conditions, and would continue to be unsupported.
- Meditative opportunities would remain unchanged.

Historical

- This alternative would continue to support the historical importance of the basin for a significant amount of time. It would continue to be a "Connection to History" and a place to remember that this is a "Starting Point for the American Dream" until sedimentation progresses to the point where the connection is broken.

Civic Pride

- The amount of support for "Civic Pride" in the area would slowly be reduced, as the reflecting pool becomes smaller and fills in.

Presence of Nature

- Conditions would slowly become altered as the water body establishes a new ecosystem.

Community Identity

- This would maintain a place for social and community events
- Green space areas would continue to be accessible.
- Open water boating activities would gradually become reduced or eliminated.

Long-Term Status Quo Condition

Spiritual

- The values held by the Native-American community identified as "Gwitsawdit" and "Source of Provider/Life" are not being supported under existing conditions, and would continue to be unsupported.
- In general, this alternative also reduces opportunities for a meditative and scenic area.

Historical

- The freshwater marsh has no association with ancestors or past eras, including Native-American, European-American, and Chinese-American heritage, therefore discouraging the "Connection to History" values.
- Lack of tidal action would continue the existing disconnect with the era prior to the creation of the lake; this lack would also fail to support values expressed as "Connection to History," and "A Place for Education Past and Present."

Civic Pride

- Civic pride would be reduced through elimination of the reflecting pool and the imagery it creates with the Capitol buildings.

Presence of Nature

- The presence of nature value would be altered due to a change in existing conditions. One consequence is that the habitat setting could become less clean for people who hold the "Clean Appearance" value.

Community Identity

- Reduce opportunities for social and community events:[186] Recreational boating would be eliminated, including boating activities valued as part of community events, including the Dragon Boat Festival and boating events associated with Lake Fair.

2.8.2.2 Managed Lake Alternative

Cultural and spiritual values supported by the Managed Lake Alternative would be similar to current conditions. Lake dredging and other management activities would improve water quality (as discussed in more detail in the Water Quality Section), and reduce the extent of aquatic plant beds. This alternative would continue to be unsupportive of some values, but would support many values that are currently being supported by the existing condition.[187]

Spiritual

- The values held by the Native-American community identified as "Gwitsawdit" and "Source of Life/Provider" are not supported under existing conditions and would continue to be unsupported.

- Reducing aquatic plant growth would improve the basin as a meditative place for some.

Historical

- Lack of tidal action would continue to disconnect the area from those eras existing prior to creation of the lake.

- Provide a better area to reflect on the "Starting Point of the American Dream". Many families, particularly the Chinese-American community, settled in America in the basin's shantytown. Water in the basin currently evokes sentimental and historical lessons for individuals whose families lived the "American Dream."

- Educational opportunities about past and present would continue to exist.

Civic Pride

- Overall this would reflect positively on civic pride in the downtown area.

- The continued presence of the reflecting pond would promote civic pride in the state Capitol, because people value the existence of Capitol Lake as a source of civic pride.

- The improved water quality would increase the "Civic Presence" value, due to a cleaner reflecting pool.

Presence of Nature

- Improve support due to an improved appearance and improved management of aquatic plants.

Community Identity

- Generally improve these values by maintaining green space and open water for non-motorized boating.

2.8.2.3 Estuary Alternative

The Estuary Alternative influences various components of several value groups. Many values are altered or changed, some are supported or diminished, and none are eliminated.[188]

Spiritual

- The natural estuary would restore Native Americans "teachings of the land" and support values such as "Gwitsawdit; balance of nature" and "Source of Life/Provider" values.

- Cause a shift in the surrounds for meditative activities; however, meditative space would still be present.

Historical Values

- It would provide an area where lessons could be learned from times before the lake was constructed, a "Place for Education Past and Present".

- This would 'actively' demonstrate conservation of natural heritage[189] and a "Connection to History".

Civic Pride

- This alternative would create a different vision for representations of the presence of Civic Pride in the downtown area.[190]

- Water in the estuary would not serve as a reflecting pool 100 percent of the time, therefore reducing pride often felt while in the basin area[191] and influencing the "Symbol of Statehood and Civic Pride".

- This alternative would have little effect on the local City Beautiful Movement, because the triggers for the original need (Little Hollywood shantytown, and sewage issues) no longer exist today.[192]

Presence of Nature

- The presence of nature would shift under this alternative, due to a saltwater ecosystem replacing the freshwater ecosystem.

Community Identity

- The most noticeable change manifested by this alternative would be the loss of continual water presence, which would affect the aesthetic of the space and therefore community identity.

- Non-motorized boat use in the basin would also be affected because of the tidal cycles. However, boat users would be able to schedule boating activities to fit within the tidal cycle.

- The presence of tidal mud-flats and other ecosystem changes would alter the identity of community events.

2.8.2.4 Dual-Basin Estuary Alternative

Implementing the Dual-Basin Estuary Alternative would result in some conditions similar to those of the Estuary Alternative. This alternative would restore tidal influence, while retaining the reflecting pool for the Capitol buildings.

Spiritual

- Impacts on spiritual values for this alternative would be consistent with the Estuary Alternative.

Historical

- A connection to history similar to that expressed in the Estuary Alternative would be maintained.

Civic Pride

- The key aspects associated with civic pride would also be maintained. The presence of the reflecting pool would remain, and the symbol of the state Capitol buildings reflecting in water would continue to exist.

Presence of Nature

- The presence of nature would shift to a saltwater ecosystem.

Community Identity

- This alternative will result in some changes for community identity and gatherings, somewhat consistent with those effects identified with the

Estuary Alternative. However, non-motorized boat users will likely be able to use the reflecting pool in addition to boating in the estuary areas during appropriate tidal cycles.

2.8.3 Comparison of Alternatives

The Status Quo Alternative is least supportive of area cultural and spiritual values. It would continue to eliminate some spiritual value components, and decrease connections to historical events. It would also diminish key components of Civic Pride with the eventual loss of the reflecting pool. Additionally, the meditative feeling and presence of nature in the area would change. The atmosphere would also be unfavorable for some community events.[193]

The Managed Lake Alternative would continue to support most identified values such as "A Place for Recreation and Healthful Exercise" and those values included in the Civic Pride group. However, it would continue to b unsupportive of the spiritual value held by Native Americans.

The Estuary Alternatives would also continue to support most identified cultural and spiritual values. However there would be several significant changes to various components of these values. These changes would be considered as positive by some citizens and negative by others.

The primary difference between the two estuary alternatives are the effects on "Civic Pride Values." The Estuary Alternative would reduce the period of time that the reflecting pool would be visible, while the Dual-Basin Estuary Alternative would continue to provide a reflecting surface 100 percent of the time. Other cultural and spiritual value groups such as "Historical Values", "Community Identity," and "Presence of Nature" would all continue to be upheld, although somewhat altered from present day conditions.

The main conclusion that can be drawn from this analysis is that while different groups and individuals hold different values. One set of values was not identified as more significant, more strongly held, or more reflective of the community. The commonality across all groups and individuals was the high value placed on waterfront.

SECTION 3

Summary

3.0 Summary

As described in the Introduction, the purpose of this report is not to provide a technical review of the background reports aimed at evaluating Capitol Lake management alternatives, or to further analyze the information presented in those reports. Instead, its purpose is to provide a concise summary of the information provided in the background reports, as it pertains to each of the selected topics. The text provided for each topic concludes with a brief comparative analysis of the key differences between alternatives. Therefore, the purpose of this Summary section is not to re-summarize all of the differences among the alternatives but to present the key findings for each topic as viewed by the CLAMP Steering Committee.

Although four alternatives were carried through this analysis, ultimately the differences to be considered are those between the Managed Lake and Estuary Alternatives. At the scale of analysis conducted here, there were no major differences between the Estuary and Dual-basin Estuary Alternative. Inclusion of the Status Quo Alternative was used to provide perspective and to more clearly document the impacts of choosing to do nothing, rather than to present an alternative to be seriously considered. Therefore, this summary is focused on the general comparison of a managed lake and an estuary condition.

The following briefly describes the general perspectives discussed during the CLAMP meetings for each of the eight topics.

Sediment: Due to the many uncertainties and the inherent complexity of the sediment management issue, the majority of the technical studies prepared to support the comparison of alternatives, focused on this topic. Regardless of which management alternative is selected, a long term program for sediment management that involves dredging and disposal will be required. However, in almost all aspects of sediment management, the Estuary Alternatives were considered to have less impact than the Managed Lake Alternative. There is less sediment removed (both initially and over the long term) and generally removal and disposal is less expensive under the Estuary Alternatives. The Estuary Alternatives will result in a greater accumulation of sediments in the Port of Olympia and the marinas located in the Percival Landing area. There were also predicted changes in dredging frequency. The long term dredging frequency was estimated at every 10 years for the Managed Lake Alternative and every 5 years for the Estuary Alternatives.

Plants and Animals: The plant, animal, and fish species supported will depend on whether the basin supports freshwater or marine water species. In general, the species supported or not supported by the alternatives are commonly occurring. CLAMP members agreed there appeared to be an advantage to salmon under the estuary alternatives, based on improved water quality and migration corridor improvements.

Water Quality: Water quality was the analysis topic that all CLAMP members agreed was a very high priority. In their discussion of this topic, the overarching message was that improving water quality to meet State standards would continue to be a focus no matter which management alternative is selected. The water quality variable most directly impacted by the selection of alternatives, was dissolved oxygen. Water quality violations related to dissolved oxygen are predicted to occur whether the system is managed as a lake or as an estuary. Under the estuary alternatives there would be an improvement in terms of the extent and duration of these violations. A large portion of the West Bay area extending out to Butler Cove, as well as the entire existing lake basin area would no longer exhibit significant dissolved oxygen water quality standards violations. The improvement to the West Bay area is especially important because this area is critical to salmon migration. To prevent dissolved oxygen violations in Southern Budd Inlet other initiatives must be taken in the upstream watershed and/or in the Inlet itself. A multi-organization group, the "Deschutes Water Clean-up Initiative" will be addressing this issue.

Infrastructure: There are no historic or highly valued structures affected by the different management alternatives, therefore, the most significant impact of infrastructure needs are related to cost. The Estuary Alternatives would require more infrastructure changes to protect structures from saltwater and tidal action, but the cost for this is secondary in comparison to sediment management costs associated with either the Lake or Estuary alternatives.

Downtown Flood-Risk: The differences in flood-risk between the lake and estuary management alternatives were not considered to be significant at existing sea levels. Limited flooding of areas outside of downtown Olympia would occur more frequently under the estuary alternatives, particularly as associated with predictions of sea level rise, However, at higher sea levels, the flood-risk to downtown associated with flooding from the Deschutes River or Capitol Lake are over-shadowed by predicted flooding from Budd Inlet.

Long-term Cost: There are high economic costs associated with implementing either a lake or the estuary alternatives. For the estuary alternatives there are infrastructure costs associated with removing the dam and re-building or stabilizing roadways that are not shared by the lake alternative. However, these costs are small in comparison to the costs associated with dredging. The total cost for implementing the Managed Lake Alternative was estimated to be nearly 70 percent higher than the cost for implementing the Estuary Alternatives.

Cultural and Spiritual Resources: There were different perspectives and values voiced among groups and individuals included in the surveys. Ultimately, one set of values is no more important, or most strongly held, or most reflective of the community. The common thread among the perspectives was that all groups and

individuals placed a high value on a landscape that included water. This shared value exists whether the water is a lake or an estuary.

Public Recreation: The area near and surrounding Capitol Lake is an important, well-used, regional, recreational hub. Differences in the specific type of recreational activities were identified, as were differences in timing and opportunity for those activities. Overall, recreational activities will be supported, and supported well, under all of the management alternatives.

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