2.0 Project Alternatives & Construction Approach

Development of alternatives is an important step in the SEPA process. Alternatives are developed to identify and analyze different ways to achieve the project purpose and goals. Each of the alternatives analyzed should be reasonable, must feasibly attain project goals, and must represent a clear choice for the decision-maker. Therefore, as outlined within this chapter, considerable effort was taken in the development of alternatives that would best achieve project goals. The No Action Alternative, which proposes no changes in the current management of the Project Area, serves as a baseline to which all other action alternatives are compared, and describes the most likely outcome in the absence of the long-term management project.

There are five sections in this chapter. Section 2.1 includes a description of how the project alternatives were developed. The project alternatives are summarized in Section 2.2, and the components of each alternative are discussed in more detail in Section 2.3. Section 2.4 provides an overview of the conceptual construction schedule, and the means and methods that may be used to construct the primary components of the alternatives. Long-term maintenance dredging for each project alternative is described in Section 2.5. Once a Preferred Alternative has been selected (refer to Section 1.8, What is the Project Purpose, as Established in Phase 1?), and design and permitting are underway following a Final EIS (Phase 3 of long-term management planning), the construction means and methods, and the specific approach to adaptive maintenance for that alternative, will be refined.

2.1 HOW WERE THE ALTERNATIVES DEVELOPED?

There are two general approaches for management of the Capitol Lake – Deschutes Estuary: keep the 5th Avenue Dam in place and maintain a freshwater lake, or remove the 5th Avenue Dam and restore tidal estuarine conditions.

Three long-term management alternatives emerge from the two approaches: a Managed Lake Alternative (keep the dam), an Estuary Alternative (remove the dam), and a Hybrid Alternative (remove the dam but retain a smaller lake impoundment in the Project Area). These are the primary alternatives that have been the subject of past planning processes, as described in Chapter 1.0, Introduction, Project Background, and History. Strategies to better manage environmental conditions within the Project Area are also included in the long-term management alternatives.

Governmental and agency partners and the community have provided a range of recommendations on elements within the long-term management alternatives.

A Measurable Evaluation Process was developed for this project to evaluate the range of discrete concepts and alternative variations that have been proposed through past planning processes and through the scoping period at the beginning of the EIS. The Measurable Evaluation Process helped Enterprise Services develop the Managed Lake, Estuary, and Hybrid Alternatives for evaluation in this EIS. Enterprise Services sought to optimize the alternatives by screening the range of concepts to identify those that would best achieve project goals.

Exhibit 2.4 Project goals

In coordination with Enterprise Services, the known range of concepts were screened by the EIS Project Team composed of civil engineers, environmental engineers, coastal engineers, geomorphologists, water quality specialists, biologists, limnologists, economists, and planners. Screening the concepts in Step 1 of the Measurable Evaluation Process provided the following benefits:

- It provided an opportunity to screen components of an alternative without eliminating an entire alternative variation because one or more of its components were not feasible or sustainable.
- It allowed concepts to be eliminated early if they did not have technical or regulatory feasibility, or were not

environmentally and economically sustainable, which are key elements of the project purpose statement.

- It compared concepts that could be implemented to meet project goals and developed optimized versions of the Managed Lake, Estuary, and Hybrid Alternatives from those concepts found to best meet project goals.
- It ensured responsible expenditure of project funding by limiting the detailed technical analyses to the optimized alternatives. This is especially appropriate because the alternative variations did not vary significantly enough to result in substantial differences in the technical analyses, or in the differentiation among the alternatives that supports decision-making.

Table 2.1.1 provides the objective criteria that were used in this screening process. A depiction of the complete Measurable Evaluation Process is provided in Figure 2.1.1.

Management Concepts from Past Processes

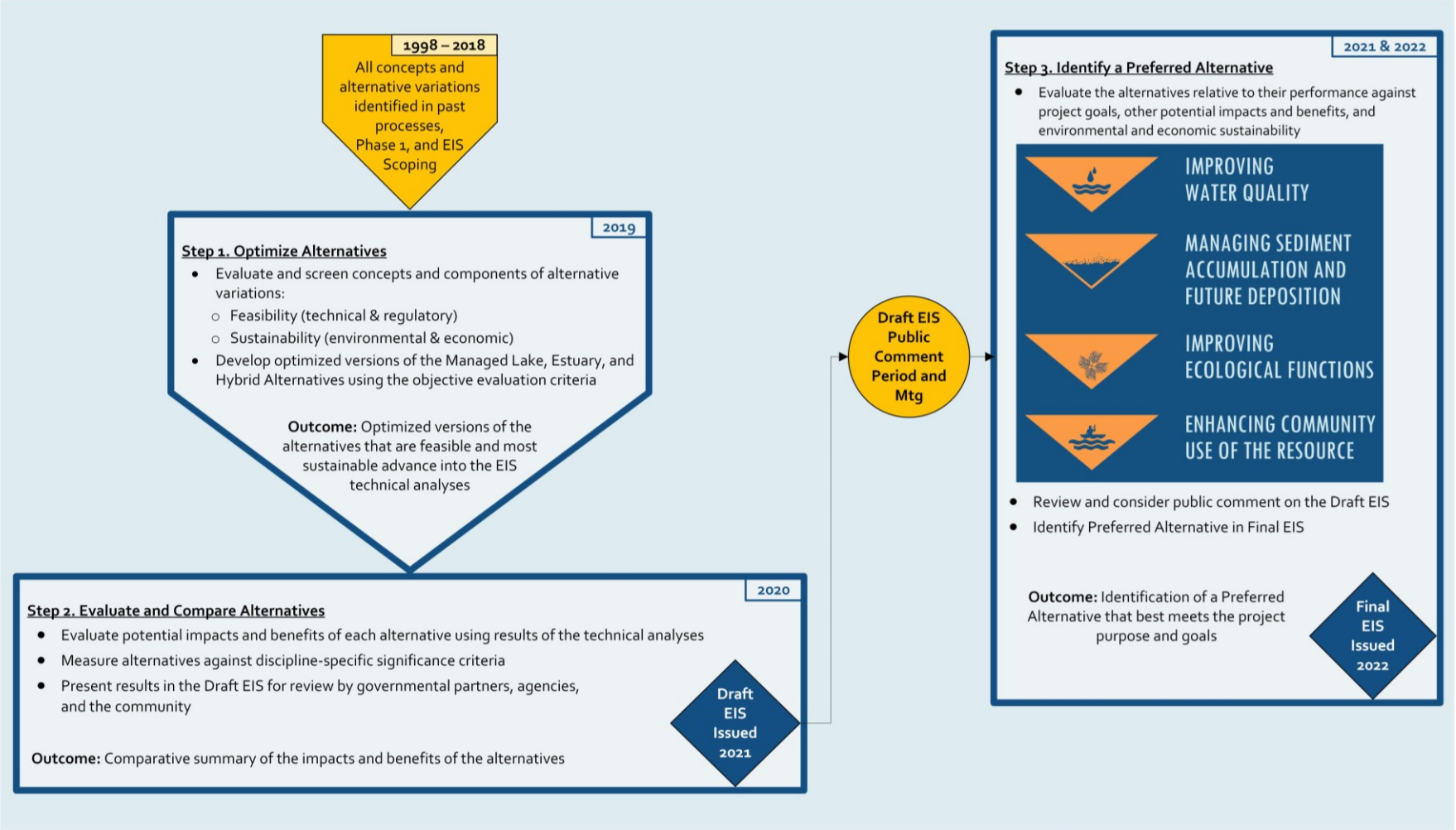
Concepts and alternative variations were sourced from:

- The 1998–1999 EIS for Capitol Lake Adaptive Management
- The 2007 Deschutes Estuary Feasibility
- The 2009 Alternatives Analysis for Capitol Lake Adaptive Management
- The 2016 Phase 1 process
- The 2018 scoping comments for this EIS

Table 2.1.1 Objective Criteria Used in the Measurable Evaluation Process

Screening Criteria	Rating Scale	Notes
Technical Feasibility	High Medium Low	A component was considered technically feasible if (1) there were no apparent technical or logistical obstacles that would prevent the component from being constructed and maintained, and (2) there was technical uncertainty, and that uncertainty was at an acceptable level based on current, standard engineering practices.
Regulatory Feasibility	High Medium Low	A component was considered to have regulatory feasibility if (1) permits and approvals could be secured within the project schedule and budget, and (2) the component was within Enterprise Services' jurisdiction to implement and there were no legal protections on land, or other similar restrictions that could affect the feasibility.
Environmental Sustainability	High Medium Low Unknown	A component would support an environmentally sustainable outcome if it would provide net environmental benefits over a 30-year horizon, considering relative contribution to project goals.
Economic Sustainability	High Medium Low Unknown	A component would support an economically sustainable outcome if it would be cost-effective in meeting the project goal. A proposed approach was considered cost-effective if its present value life-cycle costs over a 30-year horizon were low relative to other proposed approaches within the same project component.

Figure 2.1.1 Measurable Evaluation Process for the Environmental Impact Statement



Optimized versions of the Managed Lake, Estuary, and Hybrid Alternatives that emerged from the Step 1 screening process are discussed in more detail throughout this chapter and are evaluated in this Draft EIS. The concepts that were eliminated from further review as a result of this screening are briefly described in Concepts Screened through the Measurable Evaluation Process (Attachment 19).

2.2 WHAT ARE THE PROJECT ALTERNATIVES?

2.2.1 Managed Lake Alternative

The Managed Lake Alternative would retain the 5th Avenue Dam in its existing configuration. The 5th Avenue Dam would be overhauled to significantly extend the serviceable life of the structure. The reflecting pool within the North Basin would be maintained, and active recreational use would be restored in this area. Sediment would be managed through initial construction dredging and recurring maintenance dredging in the North Basin only. Sediment from construction dredging would be used to create habitat areas in the Middle Basin to support improved ecological function, habitat complexity, and diversity. Sediment would continue to accumulate and over time would promote a transition to freshwater wetlands in the South and Middle Basins. Boardwalks, a 5th Avenue Pedestrian Bridge, a dock, and a boat launch would be constructed for community use.

If selected as the Preferred Alternative, adaptive management plans would be developed during the design and permitting process to maintain water quality, improve ecological functions, and manage invasive species. See Figures 2.2.1 and 2.2.2 for a graphical summary of the key alternative components and a visual simulation of the North Basin under a Managed Lake Alternative.

What is an adaptive management plan?

An adaptive management plan outlines specific management objectives and the recommended management strategies that would be implemented to meet those objectives. With an adaptive management approach, a site is monitored to ensure that the management objectives and performance measures are met. If the site is not meeting objectives, the management strategies are adapted for better performance. This approach recognizes the dynamic nature of these systems, and that adjustments may be needed over time.

Condition of the 5th Avenue Dam

Enterprise Services inspected the 5th Avenue Dam in 2016 to document the current condition and prioritize repair recommendations. The structural components of the dam, and its mechanical and electrical components, were found to be in **fair condition**. Fair condition means that minor to moderate deterioration was observed. The durability assessment noted increasing corrosion, and the geotechnical evaluation recommended stabilization to improve subsurface soils that are susceptible to liquefaction.

Figure 2.2.1 Managed Lake Alternative Overview

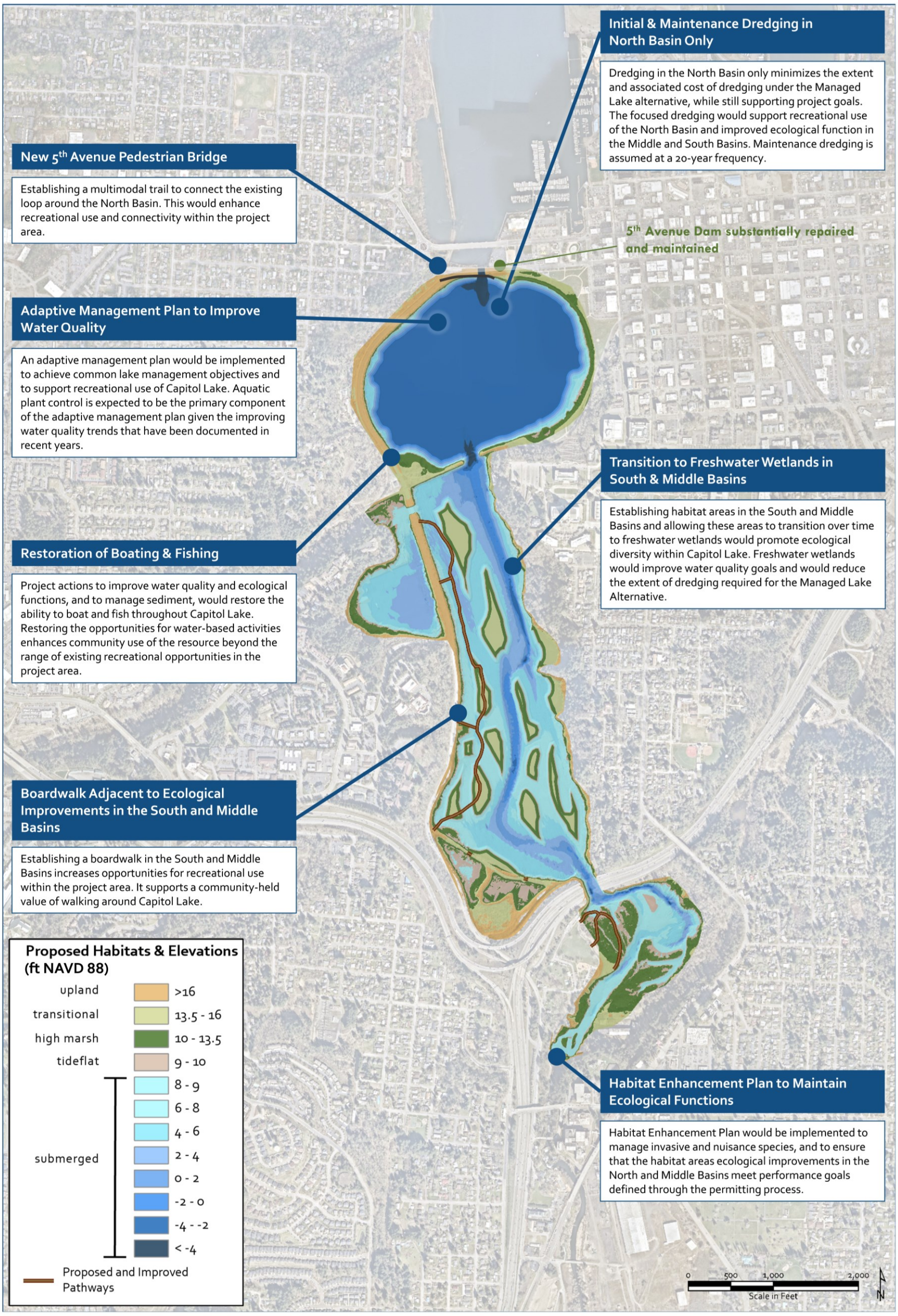


Figure 2.2.2 Managed Lake Alternative Visual Simulation

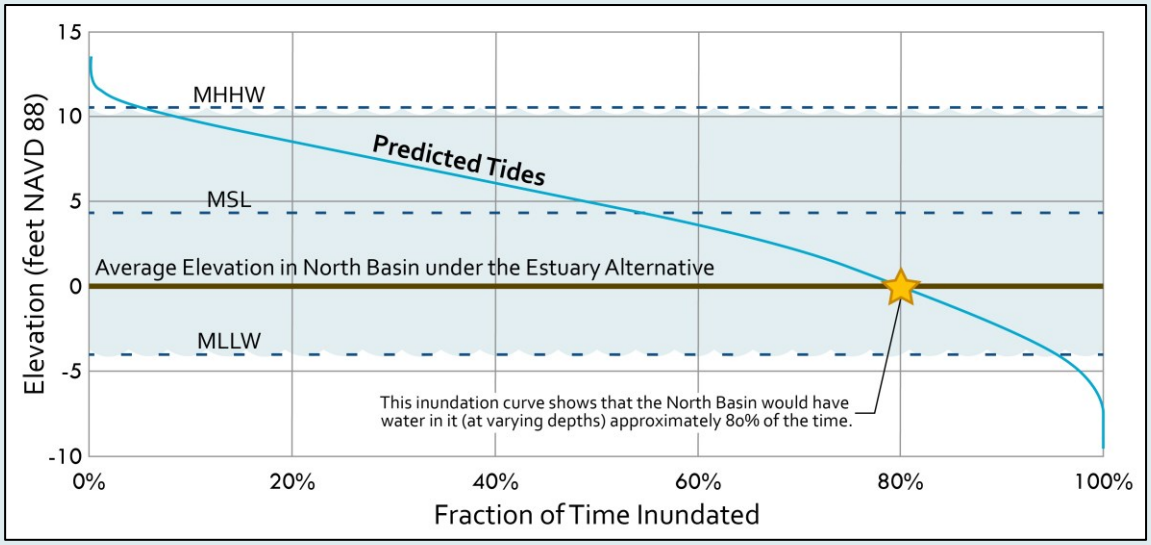
2.2.2 Estuary Alternative

Under the Estuary Alternative, the 5th Avenue Dam would be removed, and an approximately 500-foot-wide (150-meter-wide) opening would be established in its place. This would reintroduce tidal hydrology to the Capitol Lake Basin, returning the area to estuarine conditions where saltwater from Budd Inlet would mix with freshwater from the Deschutes River. Sediment would be managed through initial construction dredging in the Capitol Lake Basin and recurring maintenance dredging within West Bay. Dredged materials from construction dredging would be used to create habitat areas in the Middle and North Basins to promote ecological diversity, though tideflats would be the predominant habitat type. Boardwalks, a 5th Avenue Pedestrian Bridge, a dock, and a boat launch would be constructed for community use. This alternative also includes stabilization along the entire length of Deschutes Parkway to avoid undercutting or destabilization from the tidal flow. Existing utilities and other infrastructure would be upgraded and/or protected from reintroduced tidal hydrology and saltwater conditions.

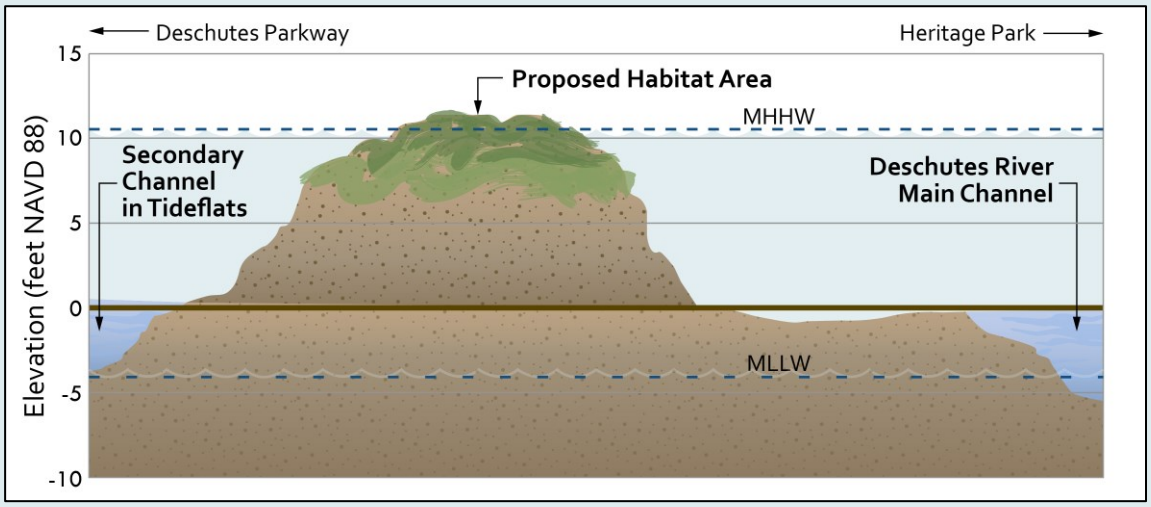
If selected as the Preferred Alternative, adaptive management plans would be developed during the design and permitting process to improve ecological functions and manage invasive species. See Figures 2.2.3 and 2.2.4 for a graphical summary of the key alternative components and a visual simulation of the North Basin under the Estuary Alternative.

Tidal Conditions under the Estuary & Hybrid Alternatives

Tidal conditions in the Capitol Lake Basin, under the Estuary and Hybrid Alternatives, would be similar to Budd Inlet. To determine the amount of time that the North Basin would be filled with water, an inundation curve was developed. The inundation curve represents a statistical analysis of predicted tides in Budd Inlet. The point at which the inundation curve and the average elevation in the North Basin meet is the amount of time that the North Basin would be inundated, or covered by water. (In this case, inundation does not mean flooding.) This inundation curve shows that the North Basin would have water in it (at varying depths) approximately 80% of the time. The amount of time that any other elevation would be inundated is the nexus, or point, at which the inundation curve and that elevation meet on this graph.



This cross section shows the average range of water elevations that would occur in the North Basin under the Estuary Alternative. Deschutes Parkway is off to the left and a proposed habitat area is shown between Deschutes Parkway and the main channel of the Deschutes River, which would flow through the middle of the North Basin. Secondary channels that would form across the tidal flats are also shown.



Abbreviations: MHHW = The average elevation of the higher high tide each day; MSL = The mean elevation of the tide each day; MLLW = The average elevation of the lower low tide each day.

Tide Variations

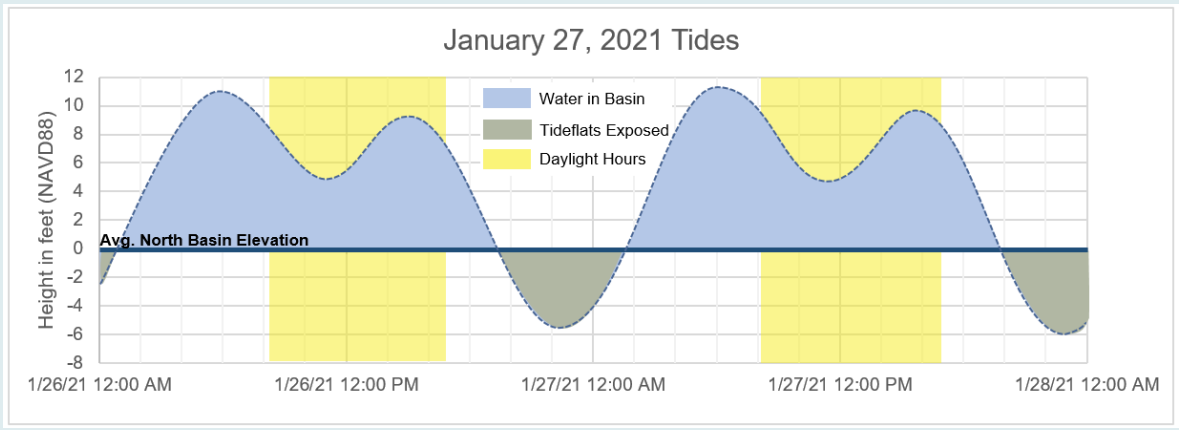
The graphics at right show the tide variation on representative days throughout the year, including three summer days (in June and July) and a winter, spring, and fall day. All days shown are spring tides—when higher high tides and lower low tides occur—except for the June tide chart, which shows a neap tide (moderate tide). These days are representative only, as tides are variable and change daily, and from one week or season to another. The yellow shade on the tide charts indicates approximate daylight hours, adjusted seasonally. The blue shade on the charts indicate when water would be present in the North Basin and the changes in water elevation. The gray shade indicates when tideflats would be exposed. As shown, the largest period of daylight hours with low tide (and exposed tideflat) is during the summer. The tide water elevation shown comes from the tide charts for Budd Inlet (NOAA Station #9446969).

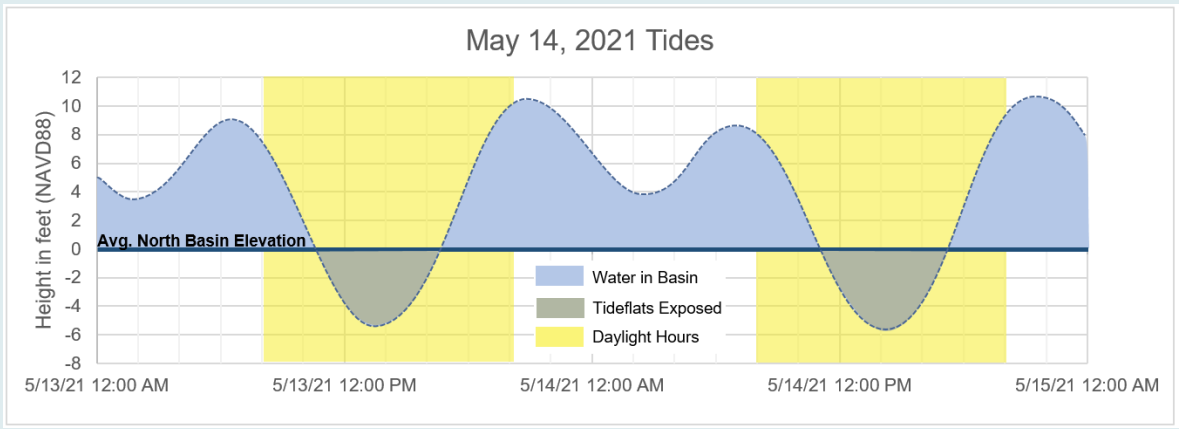
Spring Tide

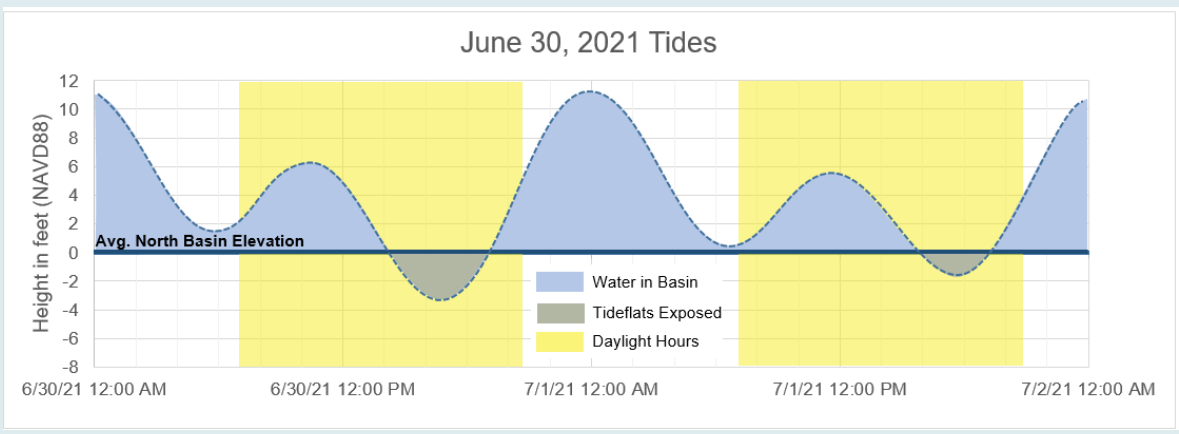
A spring tide, known also as a "King Tide" refers to the slightly larger tides (higher high and lower low tides than normal) that occur during new and full moons.

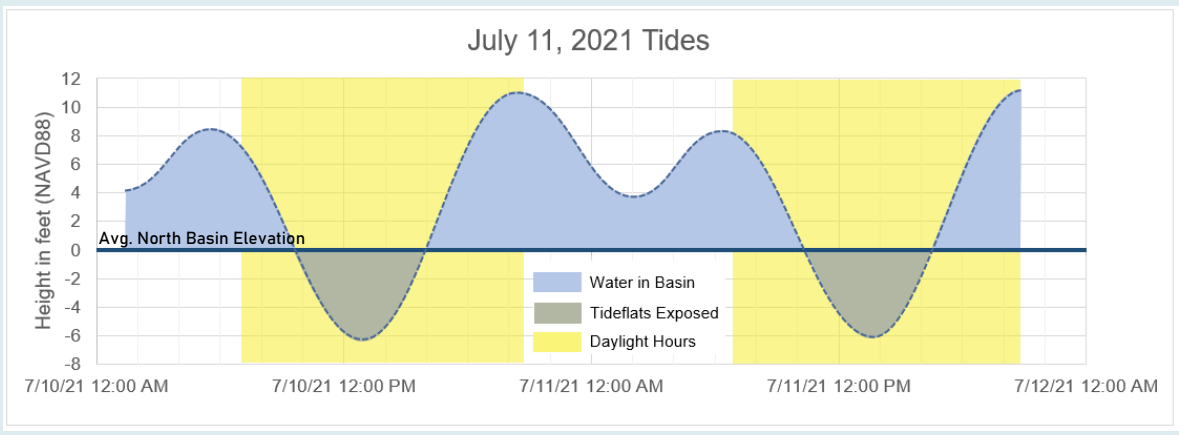
Neap Tide

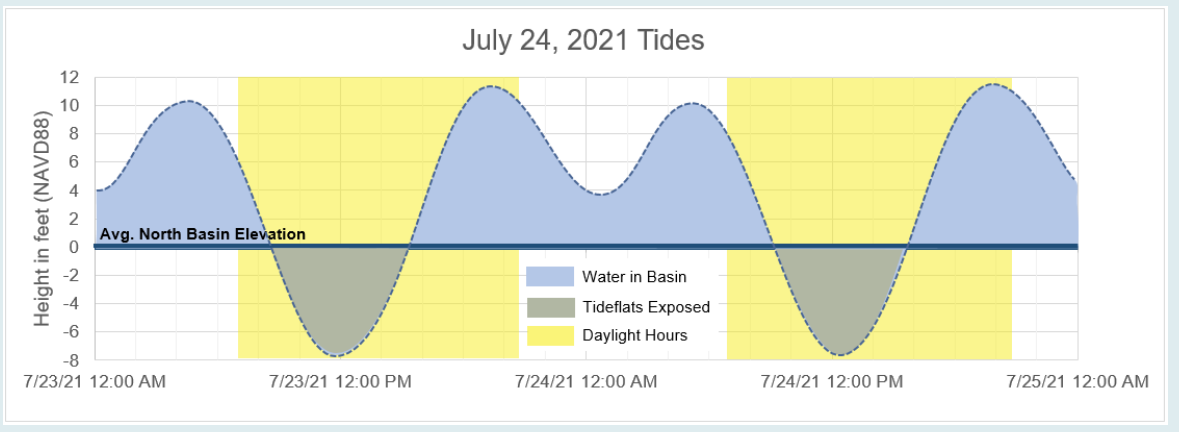
A neap tide occurs 7 days after a spring tide. It refers to a period of moderate tides (lower high tides and higher low tides).











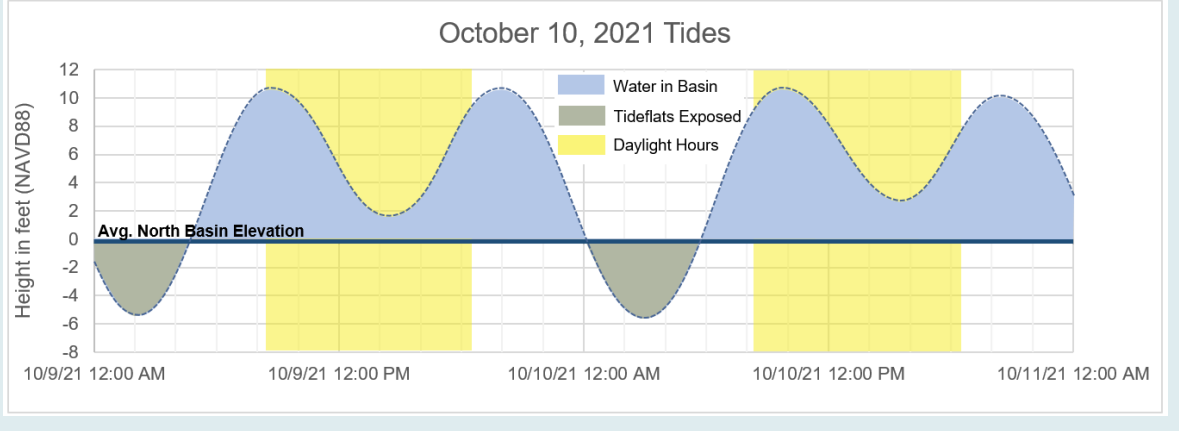


Figure 2.2.3 Estuary Alternative Overview

Figure 2.2.4 Estuary Alternative Visual Simulation at Mean Tide

2.2.3 Hybrid Alternative

Under the Hybrid Alternative, the 5th Avenue Dam would be removed, and an approximately 500-foot-wide (150-meter-wide) opening would be established in its place. Tidal hydrology would be reintroduced to the western portion of the North Basin and to the Middle and South Basins. Within the North Basin, a curved and approximately 2,600-foot-long (790-meter-long) barrier wall with a walkway would be constructed to create an approximately 45-acre saltwater reflecting pool adjacent to Heritage Park. A freshwater (groundwater-fed) reflecting pool was also evaluated for this EIS (refer to Attachment E of the Water Quality Discipline Report [Attachment 7]). Construction and maintenance of this smaller reflecting pool, in addition to restored estuarine conditions in part of the Capitol Lake Basin, gives this alternative its classification as a hybrid. Sediment would be managed through initial construction dredging in the Capitol Lake Basin and recurring maintenance dredging within West Bay. In the Middle and North Basins, constructed habitat areas would promote ecological diversity, though tideflats would be the predominant habitat type. Boardwalks, a 5th Avenue Pedestrian Bridge, a dock, and a boat launch would be constructed for community use. This alternative also includes stabilization along the entire length of Deschutes Parkway to avoid undercutting or destabilization from tidal flow. Existing utilities and other infrastructure would be upgraded and/or protected from reintroduced tidal hydrology and saltwater conditions.

If selected as the Preferred Alternative, adaptive management plans would be developed during the design and permitting process before operation of the alternative to improve ecological functions and manage invasive species. Adaptive management would also be needed for a freshwater reflecting pool, but not for a saltwater reflecting pool. See Figures 2.2.5 and 2.2.6 for a graphical summary of the key alternative components and a visual simulation of the North Basin under the Hybrid Alternative.

Would the Capitol Campus Powerhouse be affected by the project?

No. Although the Capitol Campus Powerhouse is located on the shoreline of the Middle Basin, it does not use water from Capitol Lake to generate steam or hot water it provides to the Capitol Campus. So, transitioning the Middle Basin to freshwater wetlands under the Managed Lake, or tideflats during some portion of the tidal cycle under an Estuary or Hybrid Alternative, would not impact the ability of the Capitol Campus Powerhouse to provide power and steam.

How would the water elevation change due to 5th Avenue Dam removal in the Hybrid Alternative?

The tidal portion of the North Basin would be filled with water most of the time under the Hybrid Alternative, similar to the Estuary Alternative. An average water depth of approximately 6 to 8 feet (1.8 to 2.4 meters) would be maintained in the reflecting pool.

Figure 2.2.5 Hybrid Alternative Overview

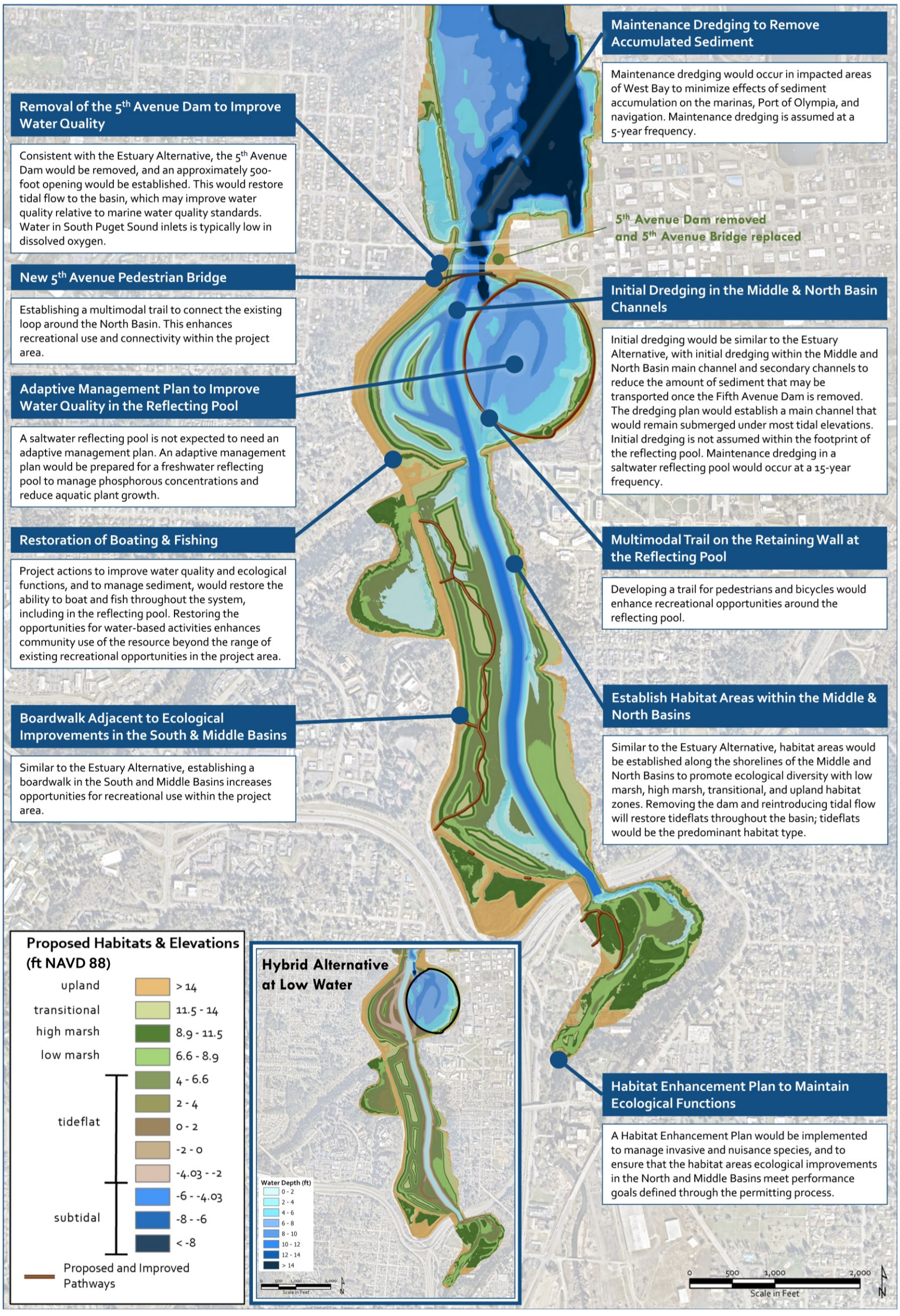


Figure 2.2.6 Hybrid Alternative Visual Simulation

2.2.4 No Action Alternative

The No Action Alternative represents the most likely future expected in the absence of implementing a long-term management project. The No Action Alternative would persist if a Preferred Alternative is not identified and/or if funding is not acquired to implement the Preferred Alternative. A No Action Alternative is a required element in a SEPA EIS and provides a baseline against which the impacts of the action alternatives (Managed Lake, Estuary, Hybrid) can be evaluated and compared.

The No Action Alternative would retain the 5th Avenue Dam in its current configuration, with limited repair and maintenance activities, consistent with the scope and scale of those that have received funding and environmental approvals over the past 30 years. In the last 30 years, the repair and maintenance activities have been limited to emergency or high-priority actions, which occur sporadically as a result of need and funding appropriations.

Although Enterprise Services would not implement a long-term management project, current management activities and ongoing projects in the Capital Lake Basin would continue. Enterprise Services would continue to implement limited nuisance and invasive species management strategies.

In the absence of a long-term management project, it is very unlikely that Enterprise Services would be able to procure funding and approvals to manage sediment, improve water quality, improve ecological functions, or enhance community use. **The No Action Alternative does not achieve the project goals.**

What is the current depth of the lake?

Average existing water depth in the North Basin of Capitol Lake is approximately 6 feet. Water depths in the Middle and South Basins are shallower, on average. Water depths continue to shallow as approximately 35,000 cubic yards of sediment are deposited within the Capitol Lake Basin annually.

2.3 WHAT ARE THE PRIMARY COMPONENTS COMMON TO ALL ACTION ALTERNATIVES?

All action alternatives include actions to meet project goals of improving water quality, managing sediment, improving ecological functions, and enhancing community use within the Capitol Lake – Deschutes Estuary. The primary components that are common to the long-term management alternatives are described in this section.

2.3.1 Sediment Management

2.3.1.1 Dredging in Capitol Lake Basin during Construction

All action alternatives include initial dredging during construction to remove sediment that has accumulated within the Capitol Lake Basin over time. An estimated 35,000 cubic yards of sediment from the Deschutes River and Percival Creek settle in the Project Area each year. This amounts to almost 2.5 million cubic yards (1.9 million cubic meters) of sediment accumulation since construction of the 5th Avenue Dam in 1951. There have only been two dredge events since that time to manage sediment—removing an estimated total of 300,000 cubic yards (230,000 cubic meters) of accumulated material. This sediment accumulation has resulted in increasingly shallow conditions throughout the Capitol Lake Basin over time.

If the Capitol Lake Basin was not dredged, it would continue to fill with sediment, developing more wetland type conditions and reducing open water habitat. Submerged aquatic plants would dominate the waterbody, and there would be a slow transition to emergent wetlands. The capacity of the Capitol Lake Basin to store sediments would eventually be lost and at that time, the sediment load would pass directly to West Bay. As the Capitol Lake Basin shallowed, water temperatures would rise, and this would increase algal blooms and change water chemistry. (Within the 30-year project time horizon, the Capitol Lake Basin would still provide flood storage capacity, given project rates of sediment deposition and because flood storage capacity is largely controlled by early release of lake water through the 5th Avenue Dam.)

Action Alternatives

The Managed Lake, Estuary, and Hybrid Alternatives are considered "action alternatives" because action would be taken during construction and operation to improve existing conditions. This contrasts with the No Action Alternative, where no action would be taken—this is sometimes referred to as a "do nothing" approach.

Variation Across Action Alternatives for Dredging during Construction

Managed Lake Alternative

Under the Managed Lake Alternative, only the North Basin would be dredged during construction. Dredging would remove approximately 6 feet (1.8 meters) of sediment across the North Basin to obtain an average water depth of approximately 13 feet (4.0 meters) (a bottom elevation of approximately -3 feet [-0.9 meters] North American Vertical Datum of 1988 [NAVD 88]). Approximately 350,000 cubic yards (270,000 cubic meters) of sediment would be removed. This dredging would support recreational use of the Managed Lake after construction.

Estuary Alternative

Under the Estuary Alternative, dredging would occur in the Middle and North Basins in the area that would transition to the main channel of the estuary. This dredging design is intended to minimize the amount of sediment that would otherwise be transported by the main channel into West Bay after the 5th Avenue Dam is removed. The main channel would be dredged to a bottom elevation of -6 feet (-1.8 meters) NAVD 88, which would provide a submerged main channel under most tidal elevations. The average channel width would be 100 feet (30 meters) throughout the Middle and North Basins. Smaller secondary channels would also be established in the North Basin. These channels would be designed to mimic conditions of the historic estuary and would increase habitat complexity and diversity. These channels would be shallower than the main channel, at a bottom elevation of -4 feet (-1.2 meters) NAVD 88. In total, approximately 525,000 cubic yards (400,000 cubic meters) of sediment would be dredged from the Capitol Lake Basin during construction.

Hybrid Alternative

Dredging under the Hybrid Alternative would be consistent with the Estuary Alternative, except secondary channels would not be established on the east side of the North Basin given the smaller reflecting pool proposed for that area. Existing average water depths in that area are approximately 9.5 to 10.5 feet (2.9 to 3.2 meters) and would support recreation. Therefore, dredging is not proposed within the reflecting pool during construction. In total, approximately

How are tidal elevations determined?

North American Vertical Datum of 1988 (NAVD 88) is the vertical datum established for vertical control surveying in the U.S.

Mean Higher High Water (MHHW) is the average height of the daily high tides at a nearby tide station.

Mean Lower Low Water (MLLW) is the average height of the daily low tides at a nearby tide station.

Plus (+) indicates above the NAVD 88 vertical datum. Minus (-) indicates below the NAVD 88 vertical datum.

Reference water levels in the Project Area in feet NAVD 88 *(meters NAVD 88)*:

West Bay
MHHW = +10.5 *(+3.2)*
MLLW = -4 *(-1.2)*

Lake Levels
Winter = +8.5 *(+2.6)*
Summer = +9.5 *(+2.9)*

500,000 cubic yards (380,000 cubic meters) of sediment would be dredged from the Capitol Lake Basin during construction.

Disposal of Dredged Material

The presence of invasive species within Capitol Lake, particularly the purple loosestrife and New Zealand mudsnail, limit disposal options for the material dredged during construction. In 2000, the Dredged Material Management Program (DMMP) agencies prohibited the disposal of dredged sediments from Capitol Lake at the Anderson-Ketron Island Disposal Site (or any open-water disposal site in Puget Sound) due to the presence and potential spread of purple loosestrife. The Anderson-Ketron Island Disposal Site is close to the Nisqually River Delta, and the restriction by the DMMP agencies recognized that purple loosestrife seeds can remain viable in saltwater for several weeks and can germinate if they reach lower salinity waters, such as those at the protected Billy Frank Jr. Nisqually National Wildlife Refuge. After the New Zealand mudsnail was discovered in Capitol Lake, the DMMP agencies also prohibited disposal of Capitol Lake dredged material because of the uncertainty and risk associated with the release of New Zealand mudsnails into other waterbodies.

The DMMP agencies have stated that dredged material from Capitol Lake can be beneficially reused within Capitol Lake because such reuse would not increase populations or the extent of the purple loosestrife, New Zealand mudsnail, or other aquatic invasive species. Beneficial reuse is a key component of all action alternatives and is discussed in more detail in Section 2.3.2.1, Constructed Habitat Areas.

What is the DMMP?

The DMMP is an interagency approach to managing dredged material. The U.S. Army Corps of Engineers is the lead agency, working in coordination with the U.S. Environmental Protection Agency, Ecology, and the Washington State Department of Natural Resources. These agencies evaluate the suitability of dredged material to be placed at open-water disposal sites in Puget Sound, and authorization must be obtained from the DMMP agencies prior to any in-water placement of dredged material. Primary factors in a suitability determination include chemical quality of the dredged material, potential presence of invasive species, and sediment characteristics (i.e., grain size).

Comparison of Action Alternatives for Dredging during Construction

A comparison of the proposed location, volume, and depth is provided in Table 2.3.1.

Table 2.3.1 Comparison of Dredging during Construction

Dredging Design	Managed Lake Alternative	Estuary Alternative	Hybrid Alternative
Dredging Location during Construction	North Basin	Middle and North Basin Main Channel North Basin Secondary Channels	Same as Estuary Alternative, except no secondary channels in the east side of the North Basin
Dredge Volume (cubic yards *(cubic meters)*)	350,000 *(270,000)*	525,000 *(400,000)*	500,000 *(380,000)*
Dredge bottom elevation (feet NAVD 88 *(meters NAVD 88)*)	-3 *(-0.9)*	Middle and North Basin Main Channel: -6 *(-1.8)* North Basin Secondary Channels: -4 *(-1.2)*	Same as Estuary Alternative, except no dredging in the east side of the North Basin

2.3.1.2 Recurring Maintenance Dredging during Long-Term Management

Recurring maintenance dredging would occur as part of all action alternatives to manage sediment over time. The design and frequency of recurring maintenance dredging would vary across the alternatives, focusing dredging in impacted areas only and to support project goals, including enhanced community use of the resource and improved ecological functions. The frequency and volume of maintenance dredging are estimated based on predicted rates of sediment deposition and numerical modeling conducted for this project. The actual rate of sediment deposition is highly dependent on naturally fluctuating annual river flows and maximum storm events—more sediment is transported through the system in years with large storm events, and less is transported in smaller storm years.

Variation Across Action Alternatives for Recurring Maintenance Dredging

Managed Lake Alternative

Under the Managed Lake Alternative, maintenance dredging would occur in the North Basin to support continued recreational use. The North Basin would be dredged approximately every 20 years, providing capacity for sediment accumulation over time without impacting recreation, which would require a minimum average water depth of 6 feet (1.8 meters). Approximately 470,000 cubic yards

(360,000 cubic meters) of sediment is expected to be removed during the first maintenance dredging event, 20 years following construction. During later maintenance dredging events, the total volume of sediment removal would increase because sediment would no longer be settling in the South and Middle Basins. Those basins would have reached sediment equilibrium, and more sediment would pass through to the North Basin. With more sediment settling in the North Basin, dredging would have to occur more frequently than the initial 20-year frequency and an increased volume would be removed during each dredge event.

Estuary Alternative

Under the Estuary Alternative, maintenance dredging would occur within impacted areas of West Bay. Maintenance dredging would not occur in the Capitol Lake Basin in order to support estuary restoration in this area.

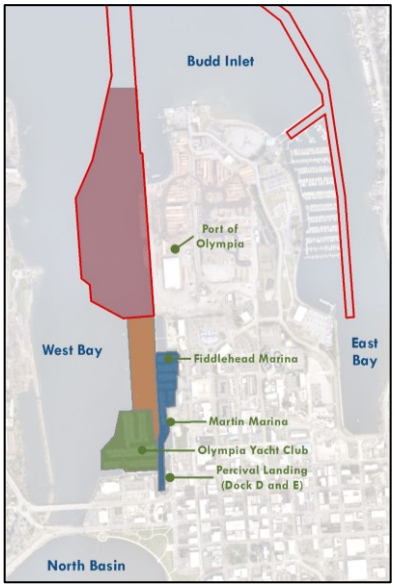


Exhibit 2.5 Long-term maintenance dredging under the Estuary and Hybrid Alternatives

Within West Bay, the average annual sediment deposition rate is predicted to range from approximately 6 inches (15 centimeters) each year at the Olympia Yacht Club to less than one-half inch (1.3 centimeters) each year within the Federal Navigation Channel at the northern point of the Project Area. Maintenance dredging would occur at the Olympia Yacht Club, private marinas, the Port of Olympia, and in the Federal Navigation Channel and other access areas along the eastern shoreline of West Bay to support continued navigation. Maintenance dredging is expected to occur every 6 years, as shown in Table 2.3.2, with approximately 700,000 cubic yards (540,000 cubic meters) of sediment removed over a 30-year period.

Table 2.3.2 Expected Maintenance Dredging Schedule & Locations under the Estuary Alternative

Year Following Construction	Location
6	Olympia Yacht Club
12	Olympia Yacht Club, private marinas, Port of Olympia, and Federal Navigation Channel
18	Olympia Yacht Club
24	Olympia Yacht Club, private marinas, Port of Olympia, Federal Navigation Channel, and other access areas along the eastern shoreline
30	Olympia Yacht Club

A sediment monitoring plan is proposed to record annual sediment deposition changes allowing for maintenance dredging events to be scheduled before these West Bay facilities are significantly impacted.

Maintenance dredging would not occur in areas of West Bay where navigation is not adversely impacted by sediment accumulation, such as the western shoreline, where sediment accumulation would be an ecological benefit.

Hybrid Alternative

Recurring maintenance dredging under the Hybrid Alternative would occur within impacted areas of West Bay, consistent with the Estuary Alternative, but every 5 years (see Table 2.3.3). The frequency increases under the Hybrid Alternative because there is less area in the North Basin for sediment deposition given the barrier wall, and consequently, more sediment is transported and deposited downstream. Approximately 985,000 cubic yards (750,000 cubic meters) of sediment is expected to be removed over a 30-year period. A sediment monitoring plan is also proposed under the Hybrid Alternative.

Table 2.3.3 Expected Maintenance Dredging Schedule & Locations under the Hybrid Alternative

Year Following Construction	Location
5	Olympia Yacht Club
10	Olympia Yacht Club, private marinas, Port of Olympia, and Federal Navigation Channel
15	Olympia Yacht Club
20	Olympia Yacht Club, private marinas, Port of Olympia, Federal Navigation Channel, and other access areas along the eastern shoreline
25	Olympia Yacht Club
30	Olympia Yacht Club, private marinas, Port of Olympia, and Federal Navigation Channel

Disposal of Dredged Material

Sediment dredged from the Managed Lake Alternative during recurring maintenance dredging is expected to be disposed of upland because the purple loosestrife and New Zealand mudsnail will persist

in the freshwater environment, at populations similar to existing conditions. The DMMP agencies will not authorize in-water placement of dredged material affected by these invasive species.

Sediment dredged from West Bay during the recurring maintenance dredging events under the Estuary and Hybrid Alternatives is expected to be suitable for disposal at an in-water location. New Zealand mudsnails and purple loosestrife are saltwater tolerant but do not thrive in saltwater environments. Although a small population of New Zealand mudsnail may establish in West Bay, high densities are not anticipated because of the salinity levels. New Zealand mudsnails prefer shallow waters and areas with lower salinity; also, dredging would occur in deeper water that is maintained for navigation. Additionally, the sediment to be dredged would primarily be recent deposits from the Deschutes River. The Deschutes River does not have an established population of New Zealand mudsnails and would not likely carry the purple loosestrife that may persist along the shorelines closer to Tumwater Falls.

Sediment dredged from West Bay under the Estuary and Hybrid Alternatives is also expected to have good chemical quality, because it would be the clean sediment deposited from the Deschutes River, rather than the existing West Bay sediment.

Sediment would be sampled prior to disposal to confirm suitability for in-water placement.

Comparison of Action Alternatives for Recurring Maintenance Dredging

As described above, there is variation in the location, estimated frequency, and approximate volume of sediment removed during recurring maintenance dredging under the three action alternatives. A comparison is outlined in Table 2.3.4.

Table 2.3.4 Comparison of Recurring Dredging

Maintenance Dredging Design	Managed Lake Alternative	Estuary Alternative	Hybrid Alternative: West Bay
Dredging Location	North Basin	West Bay (impacted areas only)	Same as Estuary Alternative
Estimated Dredging Frequency	~20 years	~6 years (frequency confirmed through monitoring)	~5 years (frequency confirmed through monitoring)

Maintenance Dredging Design	Managed Lake Alternative	Estuary Alternative	Hybrid Alternative: West Bay
Approximate Recurring Dredge Quantity (cubic yards *(cubic meters)*)	~470,000 *(360,000)* (first event) >470,000 *(360,000)* [1] (thereafter)	~700,000 *(540,000)* [2]	~985,000 *(750,000)* [3]
Disposal Options for Dredged Sediments	Upland disposal	In-water disposal is assumed; upland disposal is an option	In-water disposal is assumed; upland disposal is an option

Notes:

1. With a reduced area for sediment to settle in the Middle Basin due to constructed habitat areas, the Middle Basin will eventually reach sediment equilibrium. This means that sediment accumulating in the Middle Basin would instead be deposited into the North Basin, increasing sedimentation rates there. Once the Middle Basin reaches sediment equilibrium, the majority of sediment would accumulate in the North Basin, and maintenance dredging needs would increase during future maintenance dredging events beyond the 30-year project time horizon. Over time, the amount of dredged material removed under the Managed Lake would be comparable to the projected removal under the other alternatives.
2. The volume of sediment dredged under the Estuary Alternative is greater than the Managed Lake during the 30-year project time horizon because it is assumed that the main channel of the estuary and higher current velocities will move sediment into West Bay, rather than allowing it to settle out in the Middle Basin, as would occur under the Managed Lake. Additionally, the depth of dredging in West Bay is restricted by federal and state regulations, so less capacity can be provided, compared to a dredge event in the North Basin of the Managed Lake, where several feet of accumulated sediment could be removed.
3. The volume of sediment dredged under the Hybrid Alternative is greater than the Estuary Alternative because there would be very limited settling area near the shorelines in the North Basin due to the reflecting pool. This would result in more sediment being transported out of Capitol Lake Basin and into West Bay.

2.3.2 Ecological Functions

2.3.2.1 Constructed Habitat Areas

Habitat areas would be constructed within the Capitol Lake Basin under all action alternatives to improve ecological function within the Project Area. The habitat areas would be constructed using sediment dredged from the Capitol Lake Basin during construction. Beneficially reusing the material on-site to develop habitat results in a significant cost savings for the project—it avoids or minimizes costs associated with hauling the material off-site and disposing it in at an upland landfill. Beneficially reusing the material in the Capitol Lake Basin also reduces the need to import soil amendments because the sediment that would be reused has a high nutrient content and is expected to support plant growth. This beneficial reuse is similar to the wetland habitat development after the historical dredge events in 1978 and 1986, in which dredged material was placed in the

Beneficial Reuse

Beneficial reuse is often described as turning "would-be" waste products, or material that would go to a landfill, into a valuable commodity. This project would use sediment dredged during construction to create habitat, instead of sending this material to the landfill. This is an example of beneficial reuse.

southwest corner of the Middle Basin (the area that is now referred to as Interpretive Center).

Importantly, agencies with jurisdiction have determined that the material dredged during construction cannot be beneficially reused outside of the Project Area or placed at an open water disposal site due to the presence of invasive species that exist in Capitol Lake today, and would exist during construction of any of the alternatives. However, reusing within the Project Area is considered acceptable because the sediment would remain within the same system that it currently exists, and not be spread to new aquatic sites.

The habitat areas would be planted with different assemblages of native species depending on their location, the quantity and type of water, elevation relative to the surrounding water, and other factors.

During design and permitting, concepts for the habitat areas would be advanced and included in a Habitat Enhancement Plan. The Habitat Enhancement Plan would describe the specific treatments to be applied in each of the upland, riparian, wetland, and aquatic habitat areas. Treatments include grading, planting, weed management, installation of habitat features, and similar treatments. The Habitat Enhancement Plan would define specific performance standards for the habitat areas to measure the success of these areas. Typical performance standards would define thresholds for wetland saturation; cover, density, and diversity of native plants; and other habitat attributes. Some level of adaptive management is assumed to ensure that the performance standards are met. For example, if after construction, the native plant assemblages are not establishing as designed, the adaptive management actions could include additional planting, soil amendment, modification of topography, weed control, or other corrective measures. The approach to meeting performance goals and the frequency of active management required to meet the performance goals for the habitat enhancements would vary across the alternatives. This would be further defined in the permitting process.

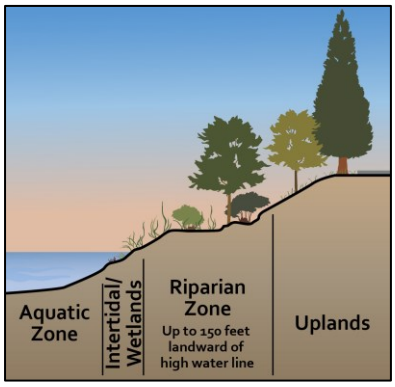


Exhibit 2.6 Habitat areas

Performance standards would also address invasive species presence. The Habitat Enhancement Plan would include measures to address nuisance and invasive species within the Project Area. Potential approaches to managing aquatic invasive species are discussed in Sections 4.4 and 5.4, and would include hand-maintenance (i.e., pulling or seed head removal), use of bottom barriers and screens to limit growth, and potentially, herbicide application, if approved by project stakeholders.

Variation Across Action Alternatives for Constructed Habitat Areas

Managed Lake Alternative

Under the Managed Lake Alternative, approximately 210 acres of wetland, riparian, and upland habitat would be established as a result of constructed habitat areas and the natural ecological transition along the east and west shorelines of the Middle Basin. Freshwater wetlands would be established at lower elevations; riparian and upland habitats would be established at higher elevations. The constructed freshwater wetlands and riparian and upland habitat would be designed to mimic existing conditions of the South Basin or other appropriate reference sites in Puget Sound. This mix of habitat would increase ecological diversity within the Capitol Lake Basin. Habitat enhancements are not planned for the South and North Basins. The South Basin would continue to transition to vegetated freshwater wetlands, and the North Basin would be maintained as an open reflecting pool and for recreational use.

Exhibit 2.7 Freshwater wetlands in the South Basin, Tumwater Historical Park

Estuary Alternative

Under the Estuary Alternative, approximately 140 acres of salt marsh and upland habitat would be established as a result of constructed habitat areas and natural ecological transition along the east and west shorelines of the Middle and North Basin. The constructed habitat areas would consist of low marsh, high marsh, transitional, and upland habitat zones. The habitats would be designed to mimic local salt marsh reference sites within South Puget Sound. Salt-tolerant species would be planted or seeded at lower elevations, and woody riparian species would be planted in areas above tidal influence. These enhancement measures would increase ecological diversity. Restored tideflats would be the predominant habitat type.

Exhibit 2.8 Salt marsh habitat in the Billy Frank Jr. Nisqually National Wildlife Refuge

Plant species within the existing freshwater wetlands in the South Basin may transition naturally as salinity increases with restored tidal flow, but habitat areas would not be constructed.

Hybrid Alternative

Habitat enhancements for the Hybrid Alternative would be similar to the Estuary Alternative, but habitat areas would not be constructed along the east shoreline of the North Basin. Approximately 130 acres of marsh and upland habitat would be established under the Hybrid Alternative, including low marsh, high marsh, transitional, and upland habitat.

Comparison of Action Alternatives for Constructed Habitat Areas

As described above, there is variation in the habitat types constructed under the three action alternatives. A comparison is provided in Table 2.3.5.

Table 2.3.5 Total Area of Habitat Types in Middle & North Basins after Construction

Habitat Design [1, 2]	Existing Conditions	Managed Lake Alternative	Estuary Alternative	Hybrid Alternative
Deepwater Habitat – Freshwater	240 acres	107 acres	-	-
Deepwater Habitat – Estuarine [1]	-	-	37 acres	75 acres
River Channel – Freshwater	25 acres	5 acres	5 acres	5 acres
Vegetated Freshwater Wetlands	51 acres	210 acres	7 acres	7 acres
Tideflat	-	-	151 acres	118 acres
Low Marsh – Estuarine	-	-	39 acres	37 acres
High Marsh – Estuarine	-	-	46 acres	45 acres
Vegetated Wetland Transitional [3]	-	-	31 acres	29 acres
Upland	19 acres	14 acres	21 acres	22 acres
Total	**336 acres**	**336 acres**	**338 acres**	**338 acres**

Notes:

1. This table does not reflect habitat in West Bay, because that habitat would not change as a result of the project.
2. The areas provided within this table are estimated based on modeled future conditions and rounded to the nearest acre.
3. Transitional is defined as the area between freshwater and estuarine habitats.

2.3.3 Water Quality

The approach to improving water quality would vary across the action alternatives. For all alternatives, actions to improve water quality would occur within the Project Area only. It is also recognized that the watershed is part of an interconnected hydrologic system. Actions implemented by other agencies upstream of the Project Area, such as those prescribed under the Water Quality Improvement Plan issued by the U.S. Environmental Protection Agency and Ecology for the Deschutes River, are expected to result in an improvement to existing conditions. Conversely, development actions in the watershed could degrade existing water quality conditions.

2.3.3.1 Water Quality Improvements

Variation Across Action Alternatives for Water Quality Improvements

Managed Lake Alternative

The Managed Lake Alternative would include an adaptive management approach to meet established lake management objectives.

Recent data indicate that water quality conditions in Capitol Lake have been improving over time. Overall, Capitol Lake now exhibits relatively good water quality when compared to other lakes in the area. There are only occasional violations of state water quality standards (for temperature, pH, dissolved oxygen (DO), and total dissolved gas). Capitol Lake does exceed the trophic-state Action Level for total phosphorus for Puget Sound lowland lakes, indicating that it is productive for algae and aquatic plant growth. The total phosphorous levels have resulted in dense aquatic vegetation in the lake. The presence of that aquatic vegetation alone does not indicate that water quality is bad, but, left unmanaged, it would have continued impacts to visual quality and water-based recreation. Management actions under a Managed Lake Alternative may be relatively limited and largely focused on aquatic plant management, given the significant improving trends.

Management approaches, such as mechanical plant harvesting, would support a healthy aquatic plant community and would avoid significant impacts to recreation, aesthetics, and aquatic life uses from dense plant communities. The adaptive management plan would specify water quality, aquatic plant, and aquatic invasive species monitoring procedures for evaluating whether the objectives are being met or need to be modified based on changes in environmental conditions and uses.

An adaptive management plan would be developed during the permitting phase of the project if the Managed Lake Alternative is implemented. Implementing an adaptive management plan may have positive effects on West Bay. No active management strategies are assumed outside of Capitol Lake.

Lake Management Objectives for Water Quality

- Meet applicable water quality standards
- Control nuisance or toxic algal blooms, including an action threshold for total phosphorous
- Control invasive species and enhance ecological value
- Control aquatic plants to improve aesthetics, boating access, and reduce fall/winter nutrient release to West Bay
- Support ongoing work to reduce nutrients and contaminants

Estuary Alternative

Management actions to improve water quality are not included as part of the Estuary Alternative. However, watershed-based

management activities are being implemented as a result of the ongoing Total Maximum Daily Load (TMDL) processes and are expected to improve the quality of water that inflows from the tributaries to Capitol Lake.

Total Maximum Daily Load (TMDL)

A TMDL is a formal plan that outlines discharge limits of problematic pollutants to improve water quality in an impaired waterbody.

Water quality under the Estuary Alternative would be similar to other inlets in South Puget Sound and would reflect typical estuary conditions, with periodically low dissolved oxygen concentrations. The Estuary Alternative supports the water quality goal by restoring historical estuarine beneficial uses within the waterbody, including enhanced habitat for aquatic life, and reduced aquatic plants. The Estuary Alternative would result in minor to moderate improvement to dissolved oxygen concentrations within Budd Inlet.

Hybrid Alternative

Management actions to improve water quality are not included as part of the Hybrid Alternative within the area of restored tidal flow.

If a freshwater reflecting pool is selected as part of this alternative, an adaptive management plan would be implemented to improve water quality. The groundwater-fed reflecting pool would be expected to have high phosphorus concentrations, which would need to be treated to prevent severe algal blooms in the summer and to achieve lake management objectives. Management actions such as stormwater treatment and phosphorous inactivation are anticipated. The adaptive management plan would be developed during the permitting phase if the Hybrid Alternative is implemented.

Management actions to improve water quality within a saltwater reflecting pool would not be needed because of tidal flushing. To avoid stagnant conditions, tide gates would be installed within the barrier wall between the reflecting pool and the estuary. During an incoming tide, the tide gates would open to allow water to enter the reflecting pool. The tide gates would close when water within the reflecting pool reached a specified elevation. During an outgoing tide, the tide gates would open again to allow water to exit the reflecting pool. The tide gates would close when water within the reflecting pool was between approximately +8 and +6 feet (+2.4 and +1.8 meters) NAVD 88. For comparison, the average existing water elevation in Capitol Lake varies between approximately +10 and +8 feet (+3.0 and +2.4 meters) NAVD 88.

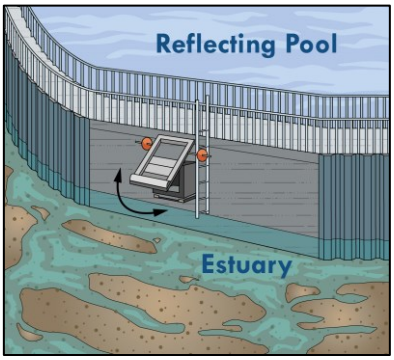


Exhibit 2.9 Example tide gate

Comparison of Action Alternatives for Water Quality Improvements

As described above, there is variation in the approach to maintain water quality and the level of active management required under the three action alternatives. A comparison is provided in Table 2.3.6.

Table 2.3.6 Comparison of the Water Quality Approach Across Action Alternatives

	Managed Lake Alternative	Estuary Alternative	Hybrid Alternative: Capitol Lake Basin	Hybrid Alternative: Reflecting Pool
Approach to Maintain Water Quality	Adaptive management plan with strategies to maintain water quality	No active management by the project (separate actions under the TMDL would still be implemented)	No active management by the project (separate actions under the TMDL would still be implemented)	If freshwater: adaptive management plan If saltwater: tidal flushing only

2.3.4 Community Use

New recreational amenities are proposed to improve community use of the resource. The approach to restoring recreation is similar across all of the long-term management alternatives.

2.3.4.1 Boardwalks Adjacent to Habitat Areas in South and Middle Basins

In all three action alternatives, elevated boardwalks would be constructed along the west shoreline of the South and Middle Basins. The boardwalks would support walking and public gathering and would provide seating. Design would be similar to the boardwalks at the nearby Billy Frank Jr. Nisqually National Wildlife Refuge. The approximately 8-foot-wide (2.4-meter-wide) boardwalks would also support nature and wildlife viewing opportunities within the Project Area given their proximity to the shoreline habitat.

Exhibit 2.10 Boardwalks at the Billy Frank Jr. Nisqually National Wildlife Refuge

In the South Basin, an approximately quarter-mile (0.4 km) boardwalk would extend waterward from the existing walking paths within the Tumwater Historical Park. An approximately three-quarter mile (1.2 km) boardwalk in the Middle Basin would also provide two connections to the existing walking path on Deschutes Parkway, in addition to the entries at the north and south end of the Middle Basin.

These boardwalks are a project component consistent across all action alternatives.

2.3.4.2 Restoration of Boating and Fishing

Project actions to improve water quality and ecological function, including actions to control invasive species, would restore the ability to boat and fish throughout the Capitol Lake Basin. Under all long-term management alternatives, the existing dock at the southern point of the Capitol Lake Interpretive Center would be rebuilt to like-kind conditions. The existing dock is a timber pile-supported structure, extending approximately 100 feet (30 meters) into the Middle Basin from the adjacent trail. An approximately 5-foot-wide (1.5-meter-wide) timber pier leads to the dock, which is approximately 50 feet by 15 feet (15 meters by 4.6 meters). Once rebuilt, this dock would support fishing within the Capitol Lake Basin.

Exhibit 2.11 View of dock at the southern point of the Interpretive Center

The existing dock at the northern point of the Interpretive Center would be demolished given its proximity to the boardwalk that would be constructed in the Middle Basin.

A nonmotorized boat launch would be established at Marathon Park. The area would be maintained for entry and exit of nonmotorized boats. The slope along an approximately 50-foot (15-meter) section of the southern shoreline of Marathon Park would be regraded and the substrate in this area would be supplemented to support nonmotorized boating.

To prevent the spread of aquatic invasive species from reintroduced recreational use, educational signage would be posted throughout the Capitol Lake Basin. All watercraft would be required to be inspected before and after recreational use of the waterbody. Decontamination stations would be installed and operated at the new boat launch at Marathon Park, at the existing boat launch at Tumwater Historical Park, and at the Interpretive Center for decontaminating footwear and fishing gear. Outside of the Project Area, a decontamination station may also be installed in West Bay.

What is a decontamination station?

Decontamination stations typically include a trailer-mounted hot water pressure washer with a containment area to collect the water that has been used.

The boat launch and dock are project components consistent across all long-term management alternatives.

2.3.4.3 5th Avenue Pedestrian Bridge

Pedestrian access would be improved along the existing loop around the North Basin. An approximately 14-foot-wide (4.3-meter-wide)

elevated bridge would be constructed south of the 5th Avenue corridor. This would provide a connection between the existing pathways at Heritage Park to existing pathways along Deschutes Parkway. It would support the frequently used walking path and would improve circulation for bicycles through the Project Area.

Variation Across Action Alternatives for Recreational Features that Support Community Use

Hybrid Alternative

In the Hybrid Alternative, an additional pathway would be constructed atop the barrier wall that would separate the reflecting pool and the estuary in the North Basin. This pathway would accommodate both pedestrians and bicycles, with a design width of approximately 14 feet (4.3 meters). When combined with the existing walking path along the North Basin in Heritage Park, it would create an approximately 1-mile (1.6-km) loop around the reflecting pool.

2.3.5 Summary of Primary Project Components

Tables 2.3.7 through 2.3.11 provide the primary components of the long-term management alternatives, including sediment management (during construction and long-term after construction); ecological functions, water quality, and community use.

Is swimming proposed?

Formal public swimming facilities are not included as part of the action alternatives. However, the action alternatives would not include measures to prevent swimming.

Formal public swimming facilities could be constructed and operated within the North Basin, or elsewhere within the Project Area, in the future, following separate environmental review. A governmental or agency partner could negotiate a lease for public swimming facilities. Hosting formal public swimming facilities is not within the scope of services or agency mission of Enterprise Services. The historic swimming beach within Capitol Lake was run by the City of Olympia Parks Department.

Table 2.3.7 Initial Sediment Management (dredging during construction)

Construction Dredging	No Action	Managed Lake	Estuary	Hybrid
Dredging Location	No dredging	North Basin	Middle and North Basins	Middle and North Basins
Dredge Volume (cubic yards)	N/A	350,000	525,000	500,000
Disposal Location	N/A	Beneficially reused to construct habitat in Project Area	Beneficially reused to construct habitat in Project Area and to stabilize Deschutes Parkway Approximately 13,000 cubic yards hauled for off-site disposal	Beneficially reused to construct habitat in Project Area and to stabilize Deschutes Parkway Approximately 100,000 cubic yards hauled for off-site disposal

Table 2.3.8 Long-Term Sediment Management (projected over a 30-year time horizon)

Ongoing Maintenance Dredging	No Action	Managed Lake	Estuary	Hybrid
Purpose	To support navigation in West Bay (dredging conducted by others)	To support recreational use of the North Basin	To avoid impacts to commercial and recreational navigation in West Bay	To avoid impacts to commercial and recreational navigation in West Bay To support recreational use of the reflecting pool
Location	Port of Olympia, navigation channel, marinas	North Basin	Impacted areas of West Bay	Impacted areas of West Bay Reflecting pool
Frequency	~20 years (dredging conducted by others)	~20 years	~6 years (1)	~5 years (1)
Anticipated Dredge Volume (cubic yards)	Unknown	~470,000	~700,000	~985,000 ~200,000 (1)
Disposal Location	Unknown	Upland	In-water (3)	In-water (2) Upland

Notes:

1. Frequency of maintenance dredging would be confirmed through a sediment monitoring program.
2. It is assumed that sediments removed from West Bay during maintenance dredging in the Estuary and Hybrid Alternatives would be disposed of in-water given the good chemical quality of sediments in the Deschutes River, and low potential for invasive species persistence in the saltwater environment. If material is determined not suitable for disposal at an allowable location in Puget Sound, it would be hauled by truck to an upload disposal location.

Table 2.3.9 Ecological Functions

Management Strategies	No Action	Long-Term Management Alternatives
Actions Taken to Improve Ecological Functions	Limited maintenance and monitoring of invasive species	Habitat areas constructed in Capitol Lake Basin to improve ecological function and increase ecological diversity in the Project Area. Monitoring and maintenance of habitat areas to ensure plantings meet performance goals. Monitoring to assess aquatic invasive species populations and to ensure decontamination effectiveness

Table 2.3.10 Water Quality

Adaptative Management Plan	No Action	Managed Lake	Estuary	Hybrid
Purpose	No current management actions for water quality	To maintain water quality standards and beneficial uses	N/A	To maintain water quality standards and beneficial uses in the reflecting pool (1)
Potential Management Options	No management actions for water quality	Mechanical harvesting of aquatic plants, herbicide treatment, etc.	N/A	Stormwater treatment and phosphorous inactivation, etc. (1)

Note:

1. An adaptive management plan would only be needed for a freshwater reflecting pool; adaptive management is not needed for a saltwater reflecting pool.

Table 2.3.11 Recreational Use

Active Recreation	No Action	Long-Term Management Alternatives
Amenities to Enhance Community Use	N/A	New boardwalks constructed in the Middle and South Basins 5th Avenue Pedestrian Bridge (1) Existing dock restored in the Middle Basin for fishing New hand-carried boat launch established in North Basin for nonmotorized boating Decontamination stations and educational signage installed in Marathon Park, Tumwater Historical Park, the Interpretive Center, and potentially at West Bay Park

Note:

1. The Hybrid Alternative would also provide a new pedestrian pathway atop the barrier wall constructed in the North Basin.

2.4 WHAT CONSTRUCTION ACTIVITIES WILL TAKE PLACE IN THE ACTION ALTERNATIVES?

2.4.1 Construction Schedule

Following selection of an alternative for implementation, the Capitol Lake – Deschutes Estuary Long-Term Management Project will transition to Phase 3. Phase 3 consists of design and permitting. Consistent with other regional projects of a similar magnitude, this process is expected to take approximately 3 to 5 years. If funding were immediately available to transition from this EIS into Phase 3,

and Phase 3 design and permitting progressed as planned, construction could begin as early as 2028.

The most significant construction activities will occur in-water. In-water work is closely regulated by environmental agencies and is confined to an "in-water work window" in order to avoid or minimize potential impacts to migrating juvenile salmonids and returning adults. Within Capitol Lake, the in-water work window also protects WDFW's hatchery production program. In coordination with the Technical Work Group as part of the EIS process, the conceptual construction schedules assume an extended in-water work window from June 1 to August 15 and November 15 to February 15 each year, rather than the prescriptive in-water work window from July 1 to August 15. The adjusted in-water work window is similar to the prescriptive in-water work window of the adjacent marine water, which extends from July 16 through February 15 each year. This extended in-water work window will be further reviewed by the permitting agencies during the design and permitting phase to ensure that construction during this time would not impact sensitive aquatic species.

Adjustments to a prescriptive in-water work window can be granted if a need is demonstrated, and also if BMPs are implemented to avoid or minimize impacts to aquatic species. An adjustment to the in-water work window is needed for this project because significant progress could not be made during construction within the existing in-water work window.

Best Management Practices

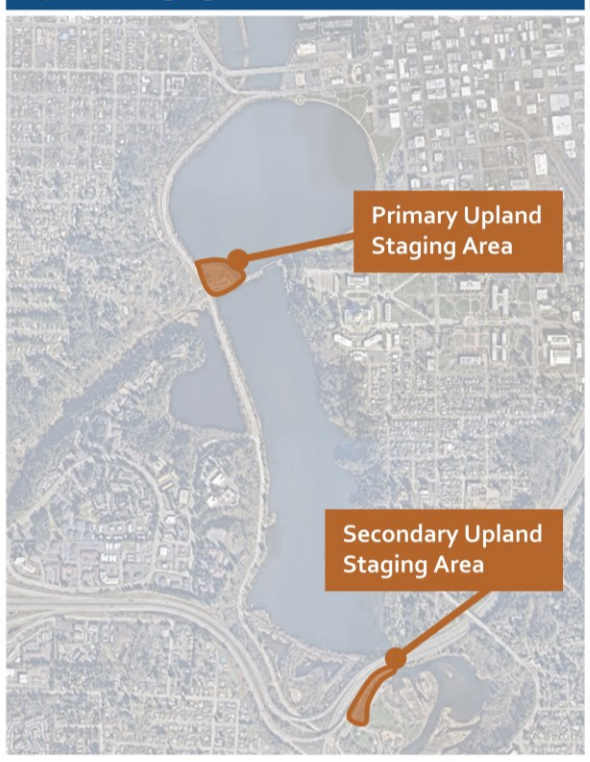
Best management practices are actions taken to protect the environment during work. The best management practices that would be implemented during in-water construction are described throughout the EIS.

Assuming the extended in-water work window, conceptual construction schedules provide a 4- to 5-year duration for construction of the Managed Lake Alternative, and a 7- to 8-year duration for construction of the Estuary and Hybrid Alternatives. It is assumed that construction would occur throughout the standard work week, with extended 12-hour days. The anticipated construction means and methods for the primary components of the action alternatives are described in the following sections. These construction means and methods will be refined as project design advances, as a result of input from the regulatory agencies during permitting, and after a contractor is selected to construct the project.

Figures 2.4.1 through 2.4.3 convey the anticipated sequence, schedule, location and equipment for the primary construction activities.

Figure 2.4.1 Location of Primary Construction Activities & Conceptual Schedule – Managed Lake Alternative

Upland Staging Areas

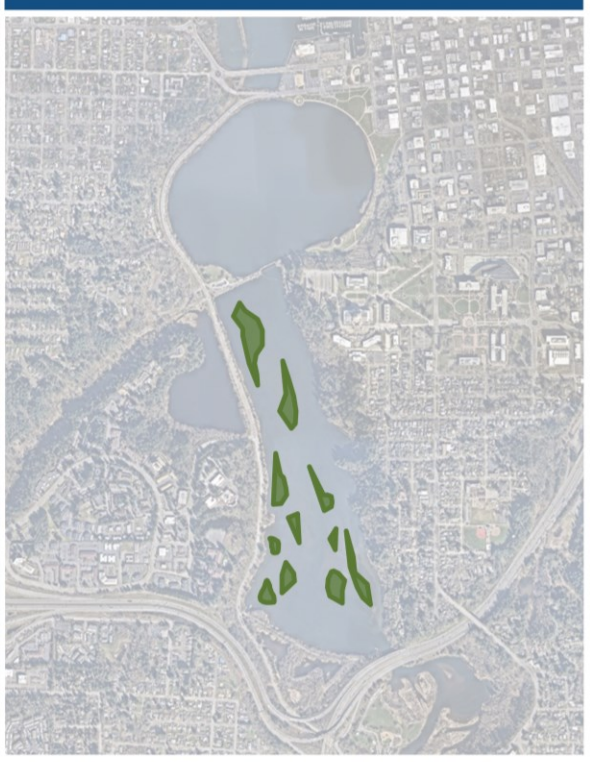


Location for construction equipment and materials storage, contractor work area, and other construction support tasks

In-Water Staging & Dredging

Primary Equipment: Portable barges and boats, hydraulic high-volume dredge, crane with pile driving equipment, forklift

Dredge Material Placement & Habitat Construction



Primary Equipment: Dozer, excavator, marsh buggy or similar

5th Avenue Dam Overhaul

Primary Equipment: Concrete and material trucks, concrete saw and excavator mounted jackhammer, blasting equipment, excavator, impact pile driving crane, barges

Pedestrian Bridge & Boardwalk & Dock Construction

Primary Equipment: Auger, concrete trucks

Anticipated Construction Schedule and Sequence for the Managed Lake Alternative

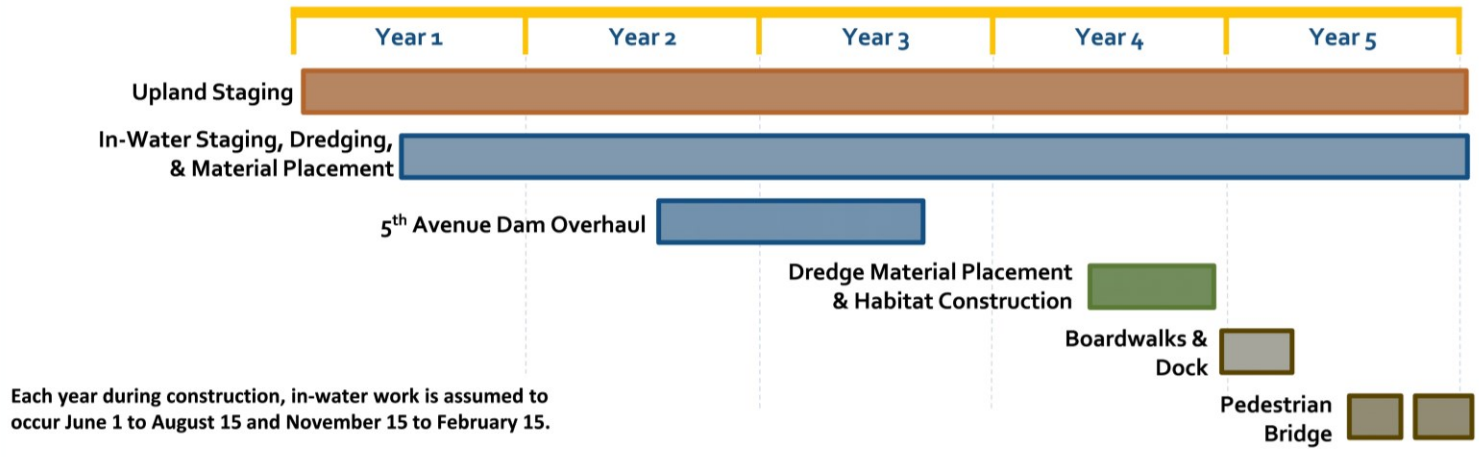
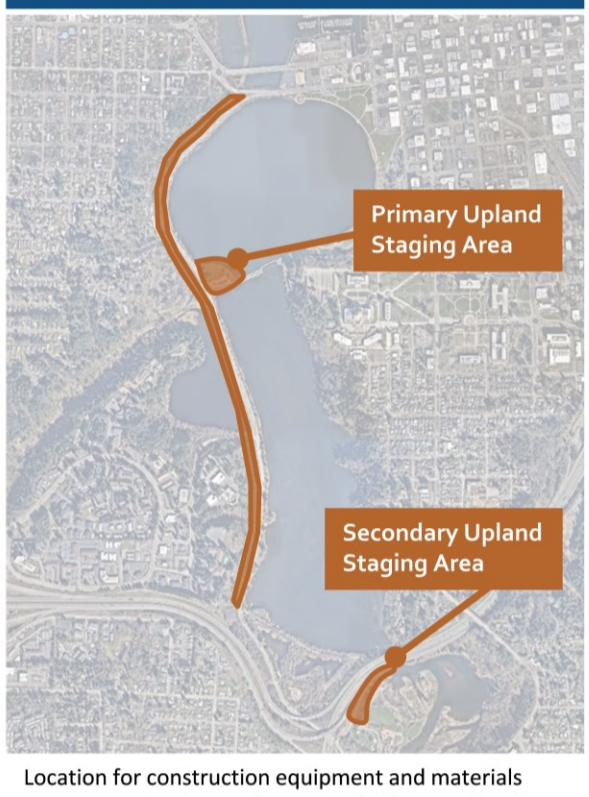


Figure 2.4.2 Location of Primary Construction Activities & Conceptual Schedule – Estuary Alternative

Upland Staging Areas

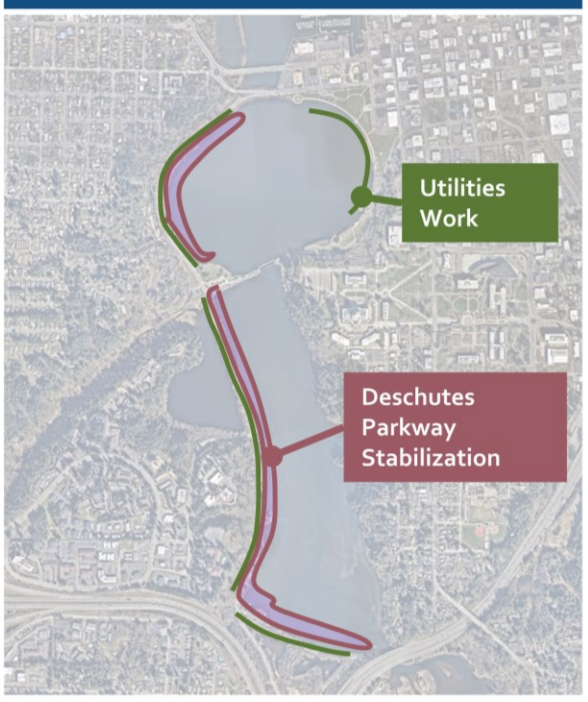


Location for construction equipment and materials storage, contractor work area, and other construction support tasks

In-Water Staging & Dredging

Primary Equipment: Portable barges and boats, hydraulic high-volume dredge, crane with pile driving equipment, forklift

Deschutes Parkway Stabilization & Utilities Work



Parkway Stabilization Primary Equipment: Concrete and material trucks, excavator, dozer, grader, paver, land-based crane, concrete saw and jackhammer
Utilities Work Primary Equipment: Excavator and loader, forklift

Dredged Material Placement & Habitat Construction

Primary Equipment: Dozer, excavator, marsh buggy or similar

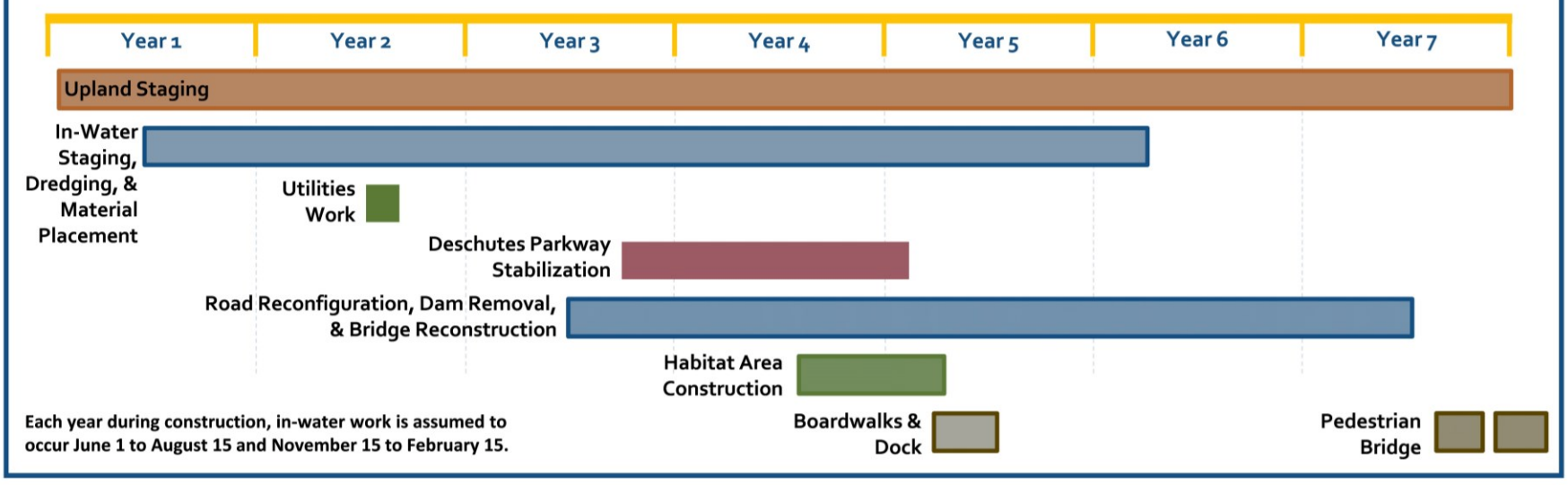
Road Reconfiguration, Dam Removal, & Bridge Reconstruction

Primary Equipment: Concrete and material trucks, concrete saw and excavator mounted jackhammer, blasting equipment, excavator, impact pile driving crane, barges

Pedestrian Bridge & Boardwalk & Dock Construction

Primary Equipment: Auger, concrete trucks

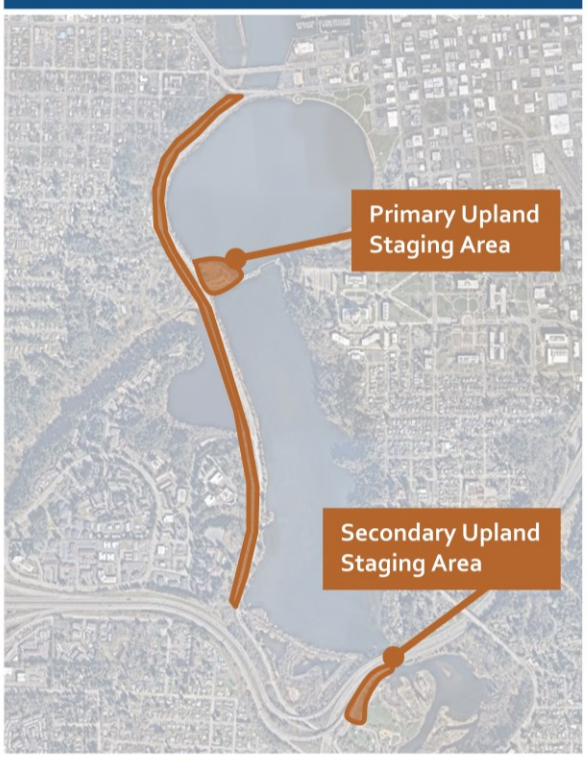
Anticipated Construction Schedule and Sequence for the Estuary Alternative



Each year during construction, in-water work is assumed to occur June 1 to August 15 and November 15 to February 15.

Figure 2.4.3 Location of Primary Construction Activities & Conceptual Schedule – Hybrid Alternative

Upland Staging Areas

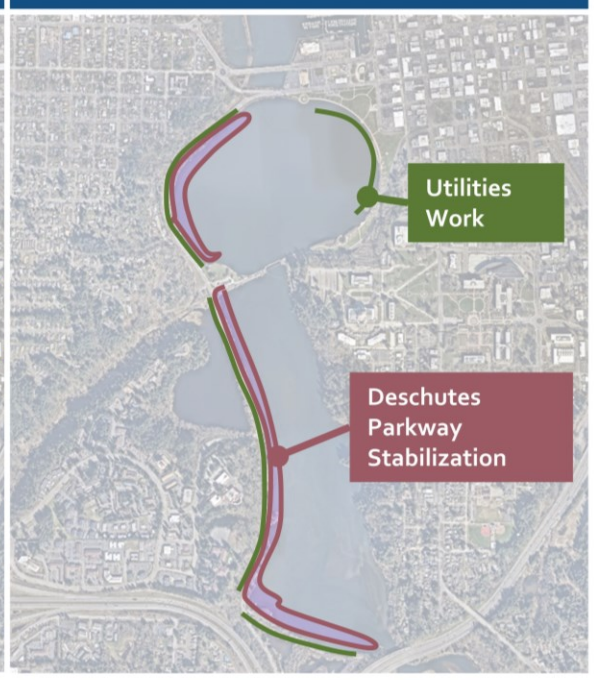


Location for construction equipment and materials storage, contractor work area, and other construction support tasks

In-Water Staging & Dredging

Primary Dredging Equipment: Portable barges and boats, hydraulic high-volume dredge, crane with pile driving equipment, forklift
Primary Wall Construction Equipment: Barges and small work boats, vibratory and impact pile driving hammer, crane barge rig

Deschutes Parkway Stabilization & Utilities Work



Parkway Stabilization Primary Equipment: Concrete and material trucks, excavator, dozer, grader, paver, land-based crane, concrete saw and jackhammer
Utilities Work Primary Equipment: Excavator and loader, forklift

Dredged Material Placement & Habitat Construction

Primary Equipment: Dozer, excavator, marsh buggy or similar

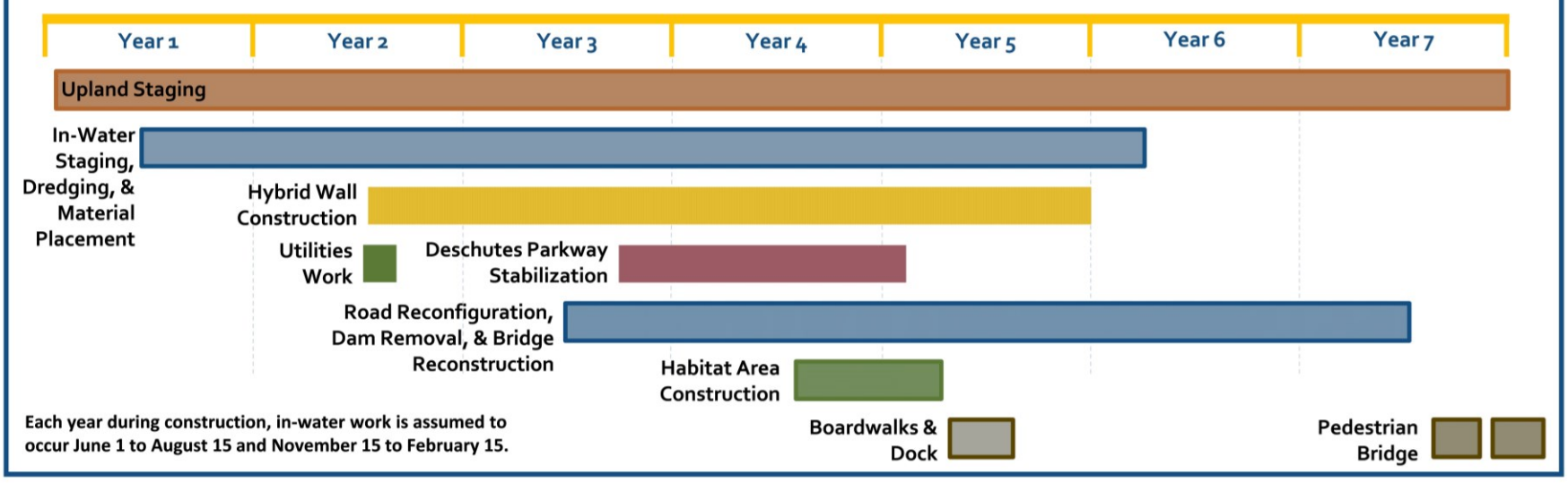
Road Reconfiguration, Dam Removal, & Bridge Reconstruction

Primary Equipment: Concrete and material trucks, concrete saw and excavator mounted jackhammer, blasting equipment, excavator, impact pile driving crane, barges

Pedestrian Bridge & Boardwalk & Dock Construction

Primary Equipment: Auger, concrete trucks

Anticipated Construction Schedule and Sequence for the Hybrid Alternative



Each year during construction, in-water work is assumed to occur June 1 to August 15 and November 15 to February 15.

2.4.2 Construction Staging and Access

Construction will primarily be staged from portable barges or on floats throughout the Capitol Lake Basin. Marathon Park will be used throughout construction as the primary upland staging area. Additional staging would occur temporarily in other adjoining parks and public spaces throughout construction.

In-water construction staging would move throughout Capitol Lake as construction progresses. To stabilize the portable barges and floats, spud piles or anchors may be used for mooring. The portable barges and floats would be outfitted with bin walls to contain construction equipment and stockpiled materials.

To establish upland construction staging areas, vegetation would be removed as needed and the staging area may be regraded. Primary utilities may be extended from the adjacent facilities to provide adequate electricity and water. The staging areas would be delineated with fencing and temporary erosion and sediment control measures to prevent runoff of sediment-laden or untreated stormwater. These upland staging areas may support smaller construction activities. They may also provide space for storage of construction equipment and material, construction offices, and parking. Following construction, these areas would be restored to preconstruction conditions or better, and public access would be restored.

2.4.3 Dredging

Dredging is one of the primary construction activities for all long-term management alternatives.

Before dredging begins, temporary sheetpile containment areas would be constructed in the North and/or Middle Basins in the locations where the dredged material will be placed to create new habitat areas, as described previously. Sheetpiles used to construct the containment areas would be installed with a vibratory pile driver, working from both land and water. The sheetpiles would be installed at a rate of up to 300 linear feet (90 linear meters) each day. To support this work, a temporary crane pad or work trestle would be installed from the shore and along the waterward edge of the sheetpile. A crane pad is constructed with a series of heavy timbers that are often up to 1 foot (0.3 meters) thick and 4 feet (1.2 meters) wide. When these timbers are rafted together and secured to crossbeams, they create a temporary pad upon which a crane can

Approach to Construction Dredging

Under the Estuary and Hybrid Alternatives, dredging would occur before the 5th Avenue Dam is removed. This would:

- Provide additional containment for sediment suspended during dredging.
- Maintain water levels for water-based equipment to move throughout the Capitol Lake Basin.
- Minimize the amount of sediment that is moved downstream after 5th Avenue Dam removal.

Exhibit 2.12 Sheetpile

traverse. A pile spacing of approximately 20 feet (6.1 meters) is assumed. The work trestle would be approximately 15 feet (4.6 meters) wide and would extend approximately 50 feet (15 meters) into the water.

Installation of the temporary sheetpile would take approximately 6 months for all action alternatives. Once installed, the containment areas would provide approximately 100 acres for material placement, across 20 discrete sheetpile containment cells. Silt curtains would be placed around the containment cells to contain turbidity from the subsequent activities.

Dredging would begin after the temporary containment cells were constructed. Dredging is expected to occur with a small hydraulic high-volume dredge on a portable barge. A hydraulic dredge works like a vacuum—sediment is sucked from the bottom of the lake with a cutter head and extendable pipe. Water is also captured with the sediment, and the material that is discharged is a slurry of the combined sediment and water. Hydraulic dredging is effective at removing silty and sandy materials, which is characteristic of the sediment that has accumulated throughout the Project Area. If needed, mechanical dredging could be used in areas with cobbles or coarser sediments.

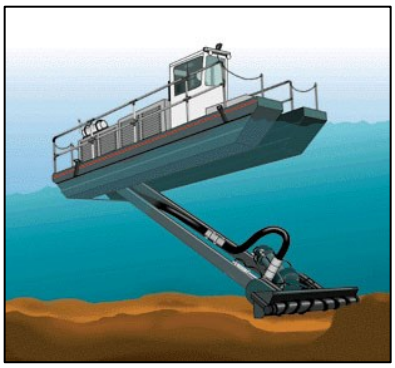


Exhibit 2.13 Hydraulic dredge

The cutter head of the hydraulic dredge, or the "vacuum," would be approximately 8 inches (20 centimeters) in diameter. A pipeline would be attached to the opposite end and would move slurry to the containment areas. The pipeline would float on the surface of the water and would be assisted by booster pumps, which would provide additional force to move the slurry. Slurry from this construction dredging would be pumped into the containment cells in a way that spreads the daily volume of material across the total placement area. Up to 7,500 cubic yards (5,700 cubic meters) of slurry would be moved to the placement areas each day, with up to 1,500 cubic yards (1,100 cubic meters) of sediment captured within the slurry.

Use of multiple containment cells would allow the slurry to settle, wherein the mix of sediment and water would begin to separate. As the water rises to the top, it would be pumped from the containment cells back into Capitol Lake.

Dredging would occur over 3 years, throughout the adjusted in-water work windows from June 1 to August 15 and November 15 to February 15 each year. Initial construction dredging would require approximately 12 months total for the Managed Lake Alternative,

and approximately 15 months total for the Estuary and Hybrid Alternatives.

2.4.4 Constructing and Planting Habitat Areas

As dredging is completed, marsh buggies or other similar equipment would be used to develop the slope of the consolidated sediment where habitat areas would be installed. The habitat areas may be developed at a rate of approximately 1 acre every 3 days. The habitat areas would be hand-planted with native species. The total duration to construct and plant the habitat areas would be approximately 8 months under all alternatives. Work to construct the habitat areas, within the containment cells, would not be confined to the in-water work window.

Exhibit 2.14 Marsh buggy excavator (Source: Peter S. Thabang https://creativecommons.org /licenses/by-sa/4.0/deed.en)

Following this work, the sheetpile containment walls would be removed. Sheetpile removal would occur with vibratory equipment, staged from land or water. As each containment cell is deconstructed and equipment moves closer to the shoreline, sections of the temporary crane pad or work trestle would also be removed. The total duration to remove the sheetpile would be approximately 6 months and would occur within the in-water work window.

2.4.5 Constructing Boardwalks and Docks

Following removal of the containment cells, boardwalks would be constructed in the South and Middle Basins. The boardwalks would be supported by wood posts or timber piles, with two piles per pile bent. A pile bent is a row of piles that work together to support a structure, such as a bridge or boardwalk. The pile bents would have a spacing of approximately 10 feet (3.0 meters).

Exhibit 2.15 Bridge pile bent (Source: Federal Highway Administration)

Each pile would be supported with a concrete foundation that would be installed in the sediment. The concrete foundations would be installed with an auger, which is a large drill that penetrates the lake bottom. As the auger is extracted, concrete would be pumped into the space that has been created. Reinforcing steel could be set into the wet concrete for additional strength. Once the concrete foundations have cured, the wood posts or timber piles would be fastened with brackets or a similar system. The approximately 8-foot-wide (2.4-meter-wide) timber deck and railing of the boardwalk would then be installed.

Dock construction would be consistent with the approach used to construct the boardwalks. The work would occur concurrent to boardwalk construction.

Construction of the boardwalks and docks is expected to occur over an approximately 4- to 6-month duration and would be staged from land or water. Activities to construct the concrete foundations and to set the wood posts or timber piles would occur within the in-water work window. However, water levels may be lowered in the lake to allow the work to occur in the dry.

2.4.6 Constructing the 5th Avenue Pedestrian Bridge

The new 5th Avenue Pedestrian Bridge would be 14 feet (4.3 meters) wide and up to 775 feet (240 meters) long. It would be supported by 24-inch-diameter (61-centimeter-diameter) steel pipe piles, with two piles per bent and a bent spacing of approximately 100 feet (30 meters). The steel piles would be installed with a vibratory pile driver and then finished with an impact pile driver, which uses a series of pulses or "hits" to advance the pile into the sediment. After the piles are installed, prefabricated concrete deck sections with guardrails would be placed to develop the superstructure. The bridge would be constructed with water-based equipment and would take approximately 4 to 5 months to construct. This work would be confined to the in-water work window.

Exhibit 2.16 Pile driver along Seattle's waterfront (Source: Washington State Department of Transportation https://creativecommons.org/licenses/by-nc-nd/2.0/)

2.4.7 Establishing a Nonmotorized Boat Launch at Marathon Park

The nonmotorized boat launch at Marathon Park would be a natural surface launch, using existing site characteristics to support this use. An excavator would develop a gradual slope within the 50-foot (15-meter) section of the southern shoreline of Marathon Park. Soil would be removed to develop a slope no greater than 8% and extending from shore by approximately 100 feet (30 meters). Gravel or other substrate would be placed along the shoreline and into the water to develop a natural ramp for hand-carried launching.

2.4.8 Variation Across Action Alternatives during Construction

2.4.8.1 Managed Lake Alternative

Repairing the Existing 5th Avenue Dam

The 5th Avenue Dam is aging and is in need of overhaul repairs. It is composed of two distinct parts: an 82-foot-wide (25-meter-wide) tide gate structure with a control house, two concrete spillways, and a fish ladder; and an earthen dam that extends up to 150 feet (46 meters) westward toward the shoreline. In 2016, the structural, mechanical, and electrical components of the 5th Avenue Dam were evaluated by a team of professional engineers. Following the evaluation, a suite of repairs were recommended to maintain a serviceable structure and to avoid a major failure event. This work would be performed as part of the Managed Lake Alternative. Work would occur in various places in and along the 5th Avenue Dam. This work would include the following:

- **Work within the control house.** Electrical components that control the tide gates would be replaced, including gears and gear boxes, controllers, electrical panels, and other appurtenances. The control house itself would also be repaired to ensure that it remains weather resistant.
- **Work on or from the 5th Avenue Bridge or existing adjacent pedestrian bridge.** The fish ladder would be repaired using a crane staged from the roadway. Work on the pedestrian bridge would focus on minor safety upgrades, such as replacing existing guardrails and ladders.
- **Work within the spillways.** Spillways are the structures that allow for controlled water release from Capitol Lake, into West Bay. When work occurs within a spillway, stoplogs would be used on the upstream and downstream ends of the spillway to restrict water flow, and the spillway would be dewatered. Components that control the tide gates would be replaced, the radial gates would be repaired, and a system would be installed to avoid corrosion of steel parts.
- **Work outside of the spillway, above water.** Damaged concrete outside of the spillway would be chipped out with a handheld hydraulic hammer and new concrete would be poured.

What is an earthen dam?

An earthen dam (or berm) is an area of compacted soil that is used to separate or stabilize an area. The earthen dam constructed in 1951 was used to separate Capitol Lake from West Bay and acts as part of the 5th Avenue Dam.

Exhibit 2.17 Existing tide gates at 5th Avenue Dam (Source: Moffatt& Nichol)

Exhibit 2.18 Earthen portion of 5th Avenue Dam

- **Work outside of the spillway, in-water.** The cutouts within the spillway would also be repaired. A small sheet pile cofferdam would be installed with a vibratory hammer to facilitate this work.

In addition to these repair and maintenance activities, work at the earthen dam is also needed because the subsurface soils are susceptible to liquefaction. The primary construction activities at the earthen dam would include:

- **Jet grouting to improve soil strength.** Jet grouting is a construction technique that mixes grout with soil to improve the soil strength. A drill pipe is inserted into the soil to the desired depth and, as it is raised back to the surface, it rotates and injects grout into the surrounding area. A mix of soil, grout, and water is also returned to the surface, having been displaced by the high-pressure placement of grout. Jet grout forms into columns as it is installed in the ground. The columns would be installed within the center of the earthen dam, creating a spine up to 100 feet (30 meters) wide and extending from below the ground surface to a depth of approximately 30 feet (9.1 meters). To install the jet grout columns, the westbound lanes of 5th Avenue SW and the eastbound lanes of Olympic Street W would be closed. The roadway would be demolished before jet grouting began and would be restored to preconstruction conditions once this work was finished. Installation of the jet grout columns would take approximately 3 months. During this time, a concrete batch plant would be mobilized to the work area and spoils would leave the area by truck for disposal at a landfill.
- **Installation of a buttressing berm.** The final protective measure would be construction of a buttressing berm to improve stability of the earthen dam. Up to 25,000 cubic yards (19,000 cubic meters) of aggregate and riprap would be placed along the shoreline and in-water on the downstream (Budd Inlet) side of the earthen dam. This work would be confined to the in-water work window and would take approximately 4 weeks to complete.

What is a cofferdam?

For this project, cofferdams (or, coffercells) would be constructed of interlocking sheetpiles that would create a watertight enclosure. Water within the cofferdam would then be removed to provide a dry work area.

Exhibit 2.19 Cofferdam

Liquefaction

Liquefaction is when wet soil loses stability due to stress during a seismic event and begins to act like a liquid.

Exhibit 2.20 Jet grouting

Exhibit 2.21 Riprap along the shoreline near the existing 5th Avenue Bridge

2.4.8.2 Estuary and Hybrid Alternatives

Replacing Existing Outfall Pipes

There are approximately 50 existing outfalls that discharge stormwater into the Capitol Lake Basin. Many of these outfalls are made of corrugated metal that would deteriorate with exposure to saltwater. The metal pipes would be replaced with saltwater-resistant pipes. A trench would be excavated around the immediate area of the outfall and the metal pipes would be removed. New pipes would be laid inside the trench, and the area would be backfilled and compacted with stockpiled or imported material. In some areas, a splash pad of larger rock or riprap may be installed to help diffuse the discharge.

The total duration to replace the affected outfall pipes and restore the work areas to preconstruction conditions is estimated at up to 6 months total, some of which would be confined to the in-water work window.

Replacing Culverts at Capitol Lake Interpretive Center

The Interpretive Center is separated from the Middle Basin by an earthen containment berm, but is hydraulically connected by two arch culverts that measure 6 feet (1.8 meters) in diameter. These culverts flush water into the existing habitat area to sustain the freshwater wetlands. The Estuary and Hybrid Alternatives would replace the culverts with an open channel through the containment berm and provide a boardwalk structure over the opening to maintain the public path. The existing culverts and a portion of the berm above the culvert would be removed. A bridge or boardwalk would be constructed over the gap to maintain trail continuity. Size, configuration, and constructions methods for the boardwalk structure would be similar to the other boardwalks described above.

Removing the 5th Avenue Dam and Reconstructing 5th Avenue

The 5th Avenue Dam and the 5th Avenue Bridge above the dam would be removed in its entirety under the Estuary and Hybrid Alternatives. The construction activities to remove the 5th Avenue Dam and reconstruct a new 5th Avenue Bridge are summarized in the following sections and in Figure 2.4.4.

Figure 2.4.4 Deschutes Parkway Realignment & New 5th Avenue Bridge

The primary construction activities at the current 5th Avenue Dam location would include:

- **Construct a new roadway connection.** The first step in removal of the 5th Avenue Dam is to construct a roadway connection that allows continued movement of vehicles to and from Deschutes Parkway.

  Under existing conditions, Deschutes Parkway connects to 5th Avenue SW. A new connection would be constructed between Deschutes Parkway and the roundabout at 4th Avenue W. This connection would enable Deschutes Parkway to remain in service, and would allow vehicles to be rerouted from 5th Avenue SW.

  Access to the existing 5th Avenue Bridge would be maintained as this new connection is constructed. Lane width on Deschutes Parkway would be reduced and vehicular movement would be confined to movement between 5th Avenue W and Deschutes Parkway. Access between the existing 5th Avenue Bridge and the 4th Avenue W roundabout would be closed during this phase of construction, which is expected to last up to 6 months.

  The new roadway connection from Deschutes Parkway to the roundabout at 4th Avenue W would be constructed by installing a mechanically stabilized earth (MSE) retaining wall structure below the roadway and filling behind the wall face to develop the roadway grade. The MSE retaining wall is constructed by alternating layers of compacted backfill and soil reinforcements, such as steel reinforcing strips or grids to provide lateral stability for the filled area. The MSE wall would be installed west of the existing trail connection beneath the 5th Avenue Bridge. Constructing the retaining wall in this location would allow the trail connection to remain open after construction and would allow the estuary opening at 5th Avenue SW to be approximately 500 feet (150 meters) wide. Approximately 40,000 cubic yards (31,000 cubic meters) of imported geotechnically suitable fill would be placed behind the retaining wall.

  The new roadway connection would encroach on an undeveloped portion of two privately owned properties. A portion of a railroad right-of-way would also be needed for placement of fill to support the road connection. This

property, currently vacant since the tracks have been removed, is no longer used for rail transportation.

Once the new roadway connection is established, traffic would be shifted from the 5th Avenue Bridge to the 4th Avenue Bridge. Vehicles and pedestrians would be detoured around 5th Avenue SW to facilitate dam removal and construction within the 5th Avenue corridor.

- **Remove the 5th Avenue Dam and 5th Avenue Bridge.** Existing utility lines within the 5th Avenue SW roadway would be removed from the bridge and directionally drilled across the corridor. Directional drilling is a construction method that is commonly used to install utility lines underground. A directional drill would bore a horizontal hole between receiving pits established on the east and west shorelines, and a polyethylene pipe would be pulled through to establish a long-term conduit. Utility lines would be reconnected. This utility work would take up to 2 months.

  To demolish the existing 5th Avenue Dam and 5th Avenue Bridge, approximately 900 linear feet (270 linear meters) of sheetpile would be installed around the earthen dam to create a cofferdam. The sheetpiles would be installed with a vibratory hammer and the sheets would be sealed to maintain a dry work area. Installation of the cofferdam would occur from land-based equipment over approximately 4 months. The cofferdam would only enclose the earthen dam at this point, so water from Capitol Lake would continue to move to West Bay through the tide gates. Following installation of the cofferdam, earthmoving equipment would be mobilized to excavate material from within the cofferdam. Some of the removed earthen dam material would be recycled, some may be beneficially reused on site, and some would be taken to an appropriate upland disposal facility. In total, approximately 64,000 cubic yards (49,000 cubic meters) of material would be removed from an approximately 145,000 square foot (13,500 square meter) area. Excavation would last for up to approximately 2 months.

- **Construct a new 5th Avenue Bridge.** The new 5th Avenue Bridge would be constructed within the cofferdam. The bridge would be supported by reinforced concrete drilled

shafts and precast concrete columns. To construct the drilled shafts, a large casing would be advanced into the substrate with a vibratory pile driver to the desired depth. Sediment within the casing would be removed with an auger and reinforcing steel would be lowered into the excavated area. Concrete would be pumped into the casing to form the drilled shaft. During the concrete placement, the resultant water or slurry would be contained for treatment at an upland location or disposal.

After construction of the western portion of the bridge substructure, the cofferdam would be removed. This would partially reintroduce tidal flow to the basin, and water would flow through this opening as work transitioned to the tide gate structure. The sheetpile would be reinstalled around the tide gate structure. Removal, reinstallation, and sealing of the sheetpile would require approximately 4 to 5 months. The tide gate would then be demolished. Marine-based equipment would support demolition of the concrete structure. Smaller components of the tide gate structure would be saw cut and removed with demolition hammers. The thicker concrete sidewalls and bottom concrete slab would be drilled and micro-blasted in order to be removed. Removal of the tide gate structure would take approximately 6 months. The eastern portion of the bridge substructure would then be constructed within the cofferdam.

The cofferdam would be removed from the site after all site demolition and construction of the bridge superstructure was complete. The bridge superstructure would be built with precast bridge sections, forming a concrete girder bridge. The new 5th Avenue Bridge would be approximately 79 feet (24 meters) wide, with four lanes of traffic and a bicycle and pedestrian path with a guardrail system on either side. It would span the approximately 500-foot (150-meter) estuary opening and connect to the existing 5th Avenue SW roadway at the isthmus and the realigned Deschutes Parkway.

- **Restore Areas of Impact.** Given the reconfiguration of this area, a small portion of the roadway south of the new 5th Avenue Bridge and east of the new Deschutes Parkway would no longer be used. The roadway would be removed from this area and the shoreline would be

planted with native species, consistent with plantings at similar elevations in the constructed habitat areas (Figure 2.4.4). This work would take approximately 2 months.

Slope Stabilization Along Deschutes Parkway

The slope along Deschutes Parkway would be stabilized to minimize potential impacts associated with restored tidal flow. The placement of additional material would help to avoid undercutting or slope failure. Material excavated from the earthen dam could be beneficially reused for the slope stabilization if the quality were suitable for reuse in the Project Area. Imported material may also be used. The material would be placed along the shoreline with a long-arm excavator. This work would occur over approximately 4 weeks during the 5th Avenue Dam removal, before the reintroduction of tidal flow. Areas above the intertidal zone may be planted consistent with the habitat areas to enhance the aquatic and adjacent terrestrial habitats and in accordance with a habitat-enhancement plan. Areas within the intertidal zone would be tideflats.

Is stabilization needed anywhere else?

Riprap will be placed along critical infrastructure to avoid scour from restored tidal action. Up to 1,500 cubic yards of riprap may be placed in the following locations:

- Interstate 5 (I-5) Bridge (South Basin)
- BNSF Railway Trestle (North Basin)
- 4th Avenue Bridge (West Bay)

2.4.8.3 Estuary Alternative

Coating at the Seawall at Heritage Park

The existing seawall separating the North Basin from Heritage Park would be prone to deterioration in a saltwater environment. To provide additional protection, it would be treated with an epoxy coating. Before the epoxy coating could be applied, the surface would be cleaned and any visible damage to concrete areas would be repaired as needed. The epoxy coating would then be applied and given time to set.

This would occur when water levels in the lake were lowered, allowing the work to be conducted "in the dry." Crews would use hand-held equipment. Coating this seawall would take approximately 1 month. This activity would also occur if a saltwater reflecting pool were chosen as part of the Hybrid Alternative.

2.4.8.4 Hybrid Alternative

Construction of the Reflecting Pool Barrier Wall

Construction of the Hybrid Alternative would be similar to the Estuary Alternative, with the exception of the barrier wall that would be constructed in the North Basin to create a smaller reflecting pool.

The barrier wall would be constructed of coated sheetpile with concrete panels and would be curved to maintain aesthetic consistency with the seawall at Heritage Park. Approximately 2,600 linear feet (790 linear meters) of the sheetpile panels would be driven from a barge using a vibratory pile driver. An impact pile driver would be used to ensure the intended load-bearing capacity, or if hard subsurface layers are encountered. Shorter tail walls running perpendicular to the primary barrier wall would be installed to increase structural stability. These tail walls would be approximately 20 feet (6.1 meters) long and spaced approximately 20 feet (6.1 meters) apart. The tail walls would be short enough to remain submerged under most tidal elevations.

At the top elevation of the barrier wall, a cast-in-place concrete closure pour would affix the concrete sheetpile to its pile cap and to the pathway that would be installed atop the barrier wall. Sections of the approximately 14-foot-wide (4.3-meter-wide) precast concrete pathway and railing would be installed atop this barrier wall and a connection would be developed with the existing walking path in Heritage Park.

Cast-in-Place

Cast-in-place refers to a method of construction where raw concrete is brought to a construction site and a design element is specialty cast within formwork.

The barrier wall would be installed prior to removal of the 5th Avenue Dam to provide adequate water depth for the water-based equipment. Work to install the sheetpile panels would occur over approximately 3 months, at a rate of approximately 100 linear feet (30 linear meters) each day. Installation of the sheetpile panels would be confined to the in-water work window. The total duration to construct the barrier wall would be approximately 15 months over two or three in-water work windows.

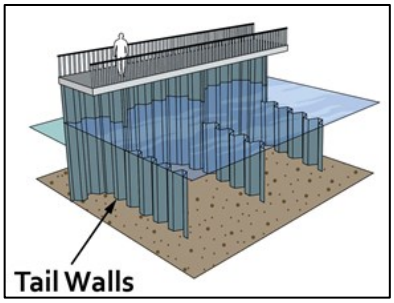


Exhibit 2.22 Example of a barrier wall

2.4.9 Typical Construction Equipment

Construction equipment that would commonly be used to complete the activities described within Chapter 2.0 are shown in Table 2.4.1:

Table 2.4.1 Commonly Used Construction Equipment

Equipment	Intended Use
Portable barge	Support water-based construction and staging
Small hydraulic high-volume dredge	Remove sediment from lake bottom
Booster pump	Move slurry to placement areas and water to shore
Crane with vibratory pile-driving hammer	Install and remove sheetpile
Impact pile driver	Install sheetpile panels

Equipment	Intended Use
Dozer, loader, and excavator	Support general construction activities
Marsh buggy	Develop slope of habitat areas
Forklift	Move materials within staging areas and construction site
Survey and assist boat	Move employees and support water-based construction
Haul truck and concrete truck	Import construction materials
Crane with drill auger	Install boardwalk foundations
Concrete saw and jackhammer	Remove existing concrete
Blasting equipment	Remove thick layers of concrete
Grader and paver	Support roadway construction

2.5 WHAT IS THE APPROACH TO LONG-TERM SEDIMENT MANAGEMENT?

2.5.1 Maintenance Dredging

Maintenance dredging is the primary maintenance activity for all the long-term management alternatives. Maintenance dredging would occur by mechanical means from a portable barge. Mechanical dredging is an approach that "digs" or "bites" the sediment from the bottom of the lake with a bucket similar to an excavator or a clamshell. After each pass of the bucket, the dredged sediment would be placed on a receiving barge. The receiving barge would be equipped with bin walls to contain the dredged material. The bin walls would likely have scupper drains that would allow for passive dewatering of the dredged material, and the scuppers could be outfitted with fabric or fencing to minimize the release of sediment during dewatering.

Exhibit 2.23 Images of a mechanical dredge

Under the Managed Lake Alternative, portable barges would be trucked to the site and launched into the lake to support a mechanical dredge on a barge, and others outfitted with hoppers to transport dredged material from the lake to a temporary handling facility established at Marathon Park. Depending on the rate of production, the dewatered dredged material could be temporarily stockpiled at Marathon Park. Dredged material would be transferred to trucks or railcars for disposal at an upland facility.

Dredging in Capitol Lake under the Managed Lake Alternative is expected to occur across three extended in-water work windows

(June 1 to August 15 and November 15 to February 15), for a total duration of approximately 18 months, if only a single dredge is used. Dredging operations are assumed to be 10 hours each day, 5 days each week.

Under the Estuary and Hybrid Alternatives, maintenance dredging in West Bay would occur within the prescriptive in-water work window, which extends from July 16 through February 15 each year. Depending on the dredge event, the total duration could be as short as 2 months, or up to 14 months across two in-water work windows. This assumes mobilization of a single dredge, and 10-hour workdays, 5 days each week.

Maintenance dredging at the Olympia Yacht Club or within private marinas may require piles or floats to be removed. Derrick barges, flat deck barges, and land-based equipment could be used to pull floats and piles from shoaled areas of the marinas if necessary. Boathouses located in shoaled areas may need to be temporarily relocated. Many dredge events at marinas within Puget Sound are able to complete maintenance dredging without removing piles or floats. Small hydraulic dredges provide flexibility while dredging around boathouses, or boathouses can be relocated temporarily within or near the marina.

Dredged material (accumulated sediment) removed from West Bay is expected to be suitable for disposal at the nearby Anderson-Ketron Island Disposal Site. Split hull receiving barges would be towed by barge to the disposal site, and the material would be released. Existing transload facilities would be used if the dredged material is not suitable for in-water disposal. Use of Port of Olympia facilities for transloading would require coordination with Port of Olympia operations.

2.5.2 Management Activities for Water Quality and Ecological Functions

Management activities to maintain water quality and ecological functions would be defined during permitting. The adaptive management plan and habitat enhancement plan would be developed in coordination with, and approved by, Ecology, WDFW, City of Olympia, City of Tumwater, other applicable local, state, and federal agencies, and tribes.