# 3.0 Existing Conditions & Affected Environment

This chapter provides an overview of existing conditions within the project area. It describes the natural and built environment that would be changed (impacted or improved) by the project alternatives. There are 14 sections to the chapter; each section describes a separate environmental discipline that was analyzed as part of this EIS. This information is summarized from the full description of existing conditions included in Attachments 5 through 18. Although the environmental disciplines are described separately, they are interrelated and together comprise the Capitol Lake – Deschutes Estuary.

## 3.1 HYDRODYNAMICS & SEDIMENT TRANSPORT

Hydrodynamics refers to the movement of surface water (rivers, streams, and estuaries) within a system. The Deschutes River and other smaller streams deliver freshwater from the surrounding watersheds to Capitol Lake. These flows are temporarily stored in Capitol Lake before discharging into West Bay (part of Budd Inlet and Puget Sound) via the 5th Avenue Dam. The 5th Avenue Dam controls when, and at what rate, water can exit the lake, depending on water levels in the lake and tide elevations in Budd Inlet.

Sediment transport refers to the movement of sediment within a system. Sediments are transported from the adjacent watershed to Capitol Lake by the Deschutes River and other smaller streams. The movement of sediments to West Bay (and the greater Puget Sound) is interrupted by the 5th Avenue Dam, causing large volumes of sediment to settle within the Capitol Lake Basin. Some of the sediment, particularly fine sediment, that is transported from the upper watershed is suspended in the water and discharged into West Bay, through the 5th Avenue Dam. Periodically, high currents in the lake can redistribute sediments and flush even more sediment into West Bay.

### What are the issues associated with sediment accumulation?

Excessive sediment accumulation can influence water quality, visual resources, aquatic habitat, and recreational use in Capitol Lake by reducing lake depth.

The analysis of hydrodynamics and sediment transport are closely related because sediment is primarily moved by flowing surface water.

Changes in hydrodynamics and sediment transport affect the many resources addressed in this EIS, such as fish and wildlife, land use, and navigation. The daily and seasonal fluctuations in water levels and currents influence what types of aquatic plants and animals can occupy Capitol Lake. Water levels during storm events determine the extent of lowland flooding around the lake, and the movement and deposition of sediment in West Bay affects navigation for vessels using the Port of Olympia and nearby marinas.

The study area for hydrodynamics and sediment transport includes the waters and low-lying land of the Capitol Lake Basin and West Bay. The Deschutes River, Percival Creek, and Puget Sound influence hydrodynamics in Capitol Lake and were considered as part of the extended study area.

***Exhibit 3.24 Hydrodynamics and Sediment Transport study area***

## Methods for Studying Hydrodynamics & Sediment Transport

A state-of-the-art and process-based three-dimensional computer model, Delft3D, was used to predict the movement of water and sediment in the study area under different project alternatives. The numerical model uses complex systems of physics-based equations to calculate how water and sediment move in response to tides, river inflow, the lake bed, and the sediment load input. The model predicted variations among the project alternatives using the same hydrologic and tidal inputs but varying project geometries. For each alternative, two storm events were modeled: an extreme +100-year river flow event and a 100-year tide event. These events were selected as the "extreme" events for purposes of the model because riverine and tidal floods have both been documented to cause flooding in the basin under existing conditions, and the 100-year storm is the standard flood level studied in floodplain assessments.

Data used as inputs to the model include bathymetry that was collected in 2020 for the project, streamflow records, tide records, current speed measurements, water levels upstream of the dam, records of dam opening and operational rules, meteorological data, flood mapping, and climate change predictions. Historical surveys of the lake bed were also used to determine past and current sedimentation rates and patterns. Physical measurements of sediment properties were also collected. Previous studies measured incoming sediment loads carried by the Deschutes River and other tributaries to quantify the rate at which sediment enters the Capitol Lake Basin from the upper watershed.

**These data sources are fully described in the Hydrodynamics and Sediment Transport Discipline Report (Attachment 5).**

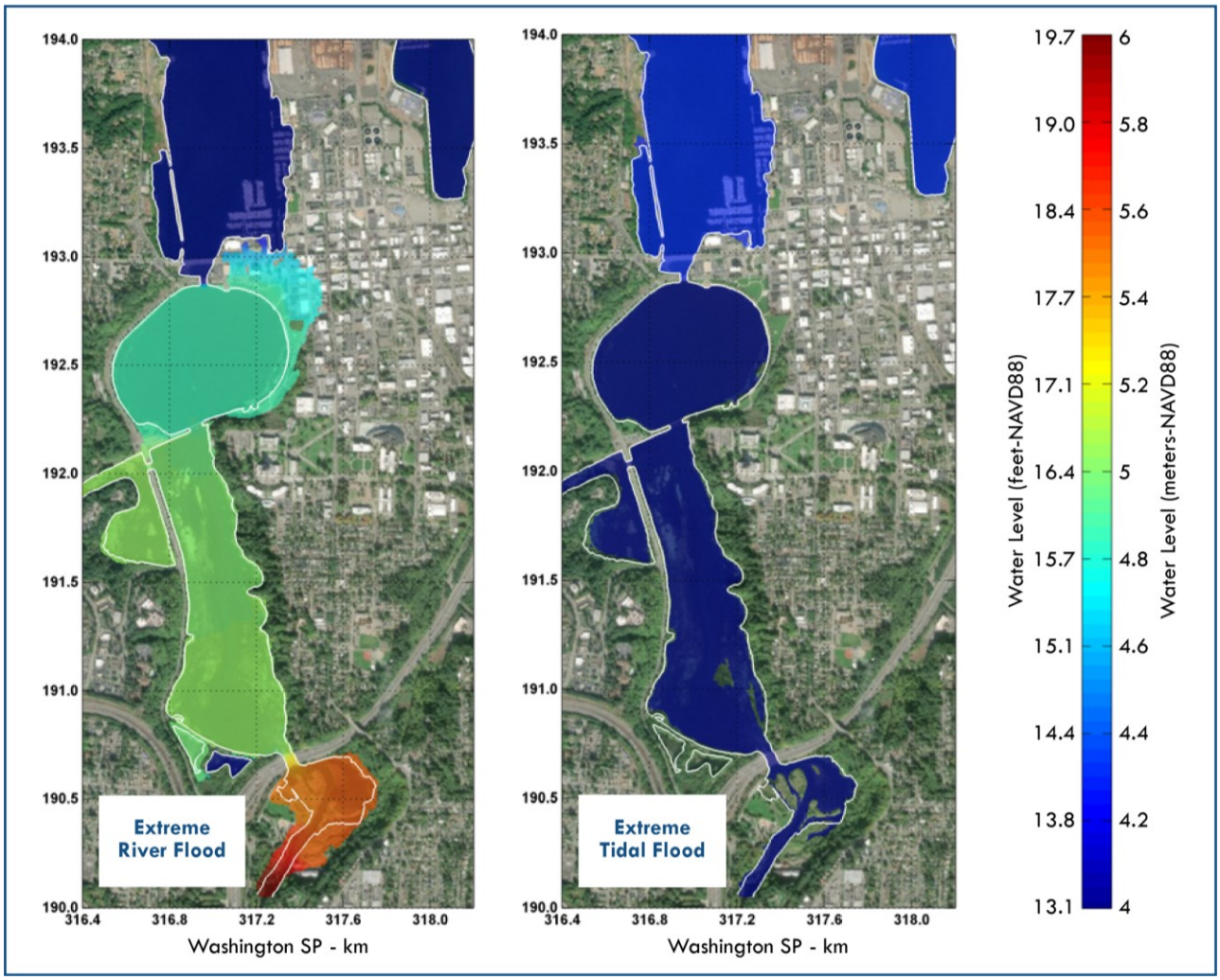
### 3.1.1 What are the existing water levels in Capitol Lake?

Under normal conditions, daily and seasonal water levels are relatively steady, and water current speeds are low. However, during storm events, water levels (and current speeds) in Capitol Lake Basin can be elevated. Enterprise Services adjusts discharge at the dam to generally maintain a summer lake level and a winter lake level (a foot lower than the summer lake level). Figure 3.1.1 shows modeled existing water levels during an extreme river flow event and extreme tidal event. Riverine floods result in the highest current speeds and water levels under existing conditions. Water levels are presented in meters NAVD 88.

**NAVD 88**

The North American Vertical Datum of 1988 (NAVD 88) is a vertical reference system used to measure elevations relative to the Earth's surface. In the U.S., NAVD 88 is the current official vertical datum.

## Figure 3.1.1 Water Levels during Extreme River & Tidal Floods under Existing Conditions



### 3.1.2 Where does freshwater enter Capitol Lake?

The Deschutes River flows into Capitol Lake at Tumwater Falls in the South Basin. This river is the main source of freshwater to the Capitol Lake Basin. Typical annual peak flow rates in the Deschutes River are approximately 3,800 cubic feet (110 cubic meters) each second. Other smaller tributary streams also flow into Capitol Lake. Percival Creek, which enters the Middle Basin at Percival Cove, is the largest of these streams. Typical annual peak flow rates in Percival Creek are much lower than the Deschutes River at around 150 cubic feet (4.2 cubic meters) each second. These freshwater inflows influence currents within Capitol Lake and, during high river flow events, can cause elevated water levels and flooding within the basin.

### 3.1.3 How does the 5th Avenue Dam work?

The 5th Avenue Dam was completed in 1951 to create Capitol Lake. The dam forms the existing northern boundary of Capitol Lake, and acts as a primary control on water levels and currents in the lake. The dam operation generally blocks movement of saltwater from Budd Inlet upstream and minimizes mixing with freshwater in the basin. The dam consists of a rock and earth embankment, a fish ladder, and two gates that can be raised and lowered to control the water level within Capitol Lake. The east and west gates are 24 and 36 feet (7.3 and 11 meters) wide, respectively, with a maximum opening height of 11.9 feet (3.6 meters).

*Exhibit 3.25 View of the 5th Avenue Dam from the North Basin*

The dam gates are lowered to block incoming tidal waters when the water level in Budd Inlet is greater than the lake level. Depending on the tide level, the gates will also close when lake water levels drop below a minimum elevation, or open when the lake levels exceed a maximum elevation.

### 3.1.4 What is the existing sediment composition within Capitol Lake?

Within the lake, sediments are primarily composed of silt and sand. These types of sediments are typical of low-energy waterbodies such as lakes and tidal estuaries. Sediment composition is variable throughout the basin; sediments in areas of higher current speeds tend to be slightly coarser, such as near the 5th Avenue Dam and the BNSF Railway Trestle. For information on sediment characteristics and quality, see Section 3.11, Environmental Health.

### 3.1.5 How much sediment enters Capitol Lake each year?

The Deschutes River and Percival Creek carry the majority of sediment that reaches Capitol Lake. The estimated annual sediment load from the Deschutes River into the lake is between 29,000 and 55,000 cubic yards (22,000 and 42,000 cubic meters) each year. Percival Creek delivers approximately 1,400 cubic yards (1,100 cubic meters) of sediment each year. The annual sediment load from these rivers varies significantly from year to year. The rate of sediment input is directly related to stream flows, where greater flow rates contribute greater amounts of sediment.

### 3.1.6 How much sediment has accumulated since the 5th Avenue Dam was constructed?

Construction of the 5th Avenue Dam affected the rate and amount of sediment deposition throughout the basins that compose Capitol Lake. The method used to estimate the sediment deposition rates and spatial pattern was based on a comparison of a series of past bathymetric surveys. Although erosion occurs in isolated areas, most of the lake bed has accumulated between 0 and 6 feet (0 and 1.8 meters) in sediment thickness since the dam was constructed in 1951. The North and Middle Basins have experienced the highest rates of sediment deposition, as shown in Table 3.1.1 and Figure 3.1.2. There have been two dredge events in Capitol Lake since 1951 (in 1978 and 1986), with a total combined sediment removal of approximately 300,000 cubic yards (230,000 cubic meters).

Surveys are also periodically conducted in Budd Inlet in the federal navigation channel and ship turning basin. Surveys dating back to 1998 show that the navigation channel and turning basin have accumulated between 0.1 and 1.2 inches (0.3 to 3 centimeters) of sediment each year.

#### Bathymetric Survey

Bathymetric surveys allow the depth of a waterbody to be mapped and illustrate the surface of the land that lies underwater. In survey results, variations in depth are shown by color and contour lines.

Bathymetric surveys are usually conducted using a multibeam echo sounder attached to a boat. The sounder sends out beams across the floor of the waterbody. When the beams bounce back, the data are collected and processed.

**Table 3.1.1 Annual Volume of Sediment Accumulation in Capitol Lake**

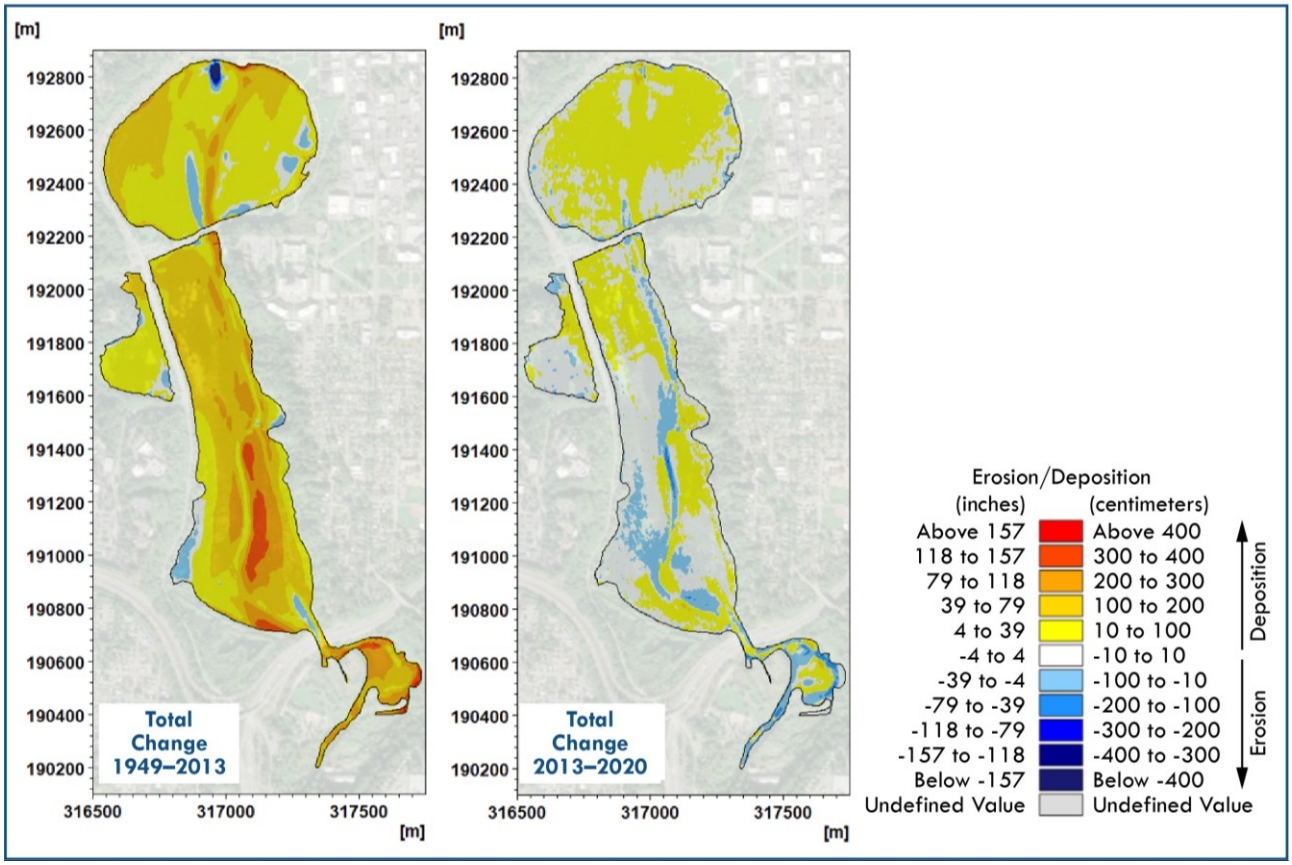
| | South Basin (cy/yr *(m³/yr)*) | Middle Basin (cy/yr *(m³/yr)*) | North Basin (cy/yr *(m³/yr)*) | Percival Cove (cy/yr *(m³/yr)*) |
|---|---|---|---|---|
| 1949–2013 | 3,150 *(2,408)* | 18,391 *(14,061)* | 6,133 *(4,869)* | 639 *(489)* |
| 2013–2020 | -1,265 *(-967)* (1) | 3,586 *(2,741)* | 11,005 *(8,414)* | 668 *(511)* |

Note:

1. Negative values indicate areas of net erosion, rather than of net accumulation over time.

Abbreviations: cy/yr = Cubic yards each year; m³/yr = Cubic meters each year

## Figure 3.1.2 Total Sediment Erosion & Deposition




### 3.1.7 How does climate change affect Capitol Lake?

The hydrodynamic and sediment transport numerical model-simulated alternatives incorporated relative sea level rise (RSLR) projections. RSLR is the sea level observed using a land-based reference frame. The numerical model used projections consistent with those used in the Olympia Sea Level Rise Response Plan developed by the City of Olympia, Port of Olympia, and LOTT Clean Water Alliance (LOTT). The Sea Level Rise Response Plan outlines how downtown Olympia can adapt to rising seas, using projections based on data from the Washington Coastal Resilience Project. Scenarios modeled for the hydrodynamic assessment of this project include 2 feet (0.61 meters) of RSLR, which is projected to occur in Olympia between 2050 and 2080, according to the Sea Level Rise Response Plan.

Climate change will also affect rainfall patterns and river flow rates. Climate models predict that the Deschutes Watershed may experience a 10% to 30% increase in extreme 24-hour rainfall by mid-century. Similarly, future peak flow rates in the Deschutes River may increase; however, flow rate change projections are uncertain. Increased peak

#### Relative Sea Level Rise Projections

The EIS Project Team evaluated the best available science on RSLR, including the Olympia Sea Level Rise Response Plan as well as the latest projections developed for the State of Washington to define the "future condition" to include 2 feet (0.61 meters) of RSLR.

flow rates have the potential to cause more frequent and substantial flooding in the Capitol Lake Basin. Increased peak flow rates will also mobilize more sediment, which may lead to higher rates of lake bed elevation change.

## 3.2 NAVIGATION

Navigation refers to the movement of commercial and recreational watercraft. The study area for navigation includes West Bay, with the southern boundary at the 5th Avenue Dam and the northern boundary at the end of the peninsula between West and East Bay. This is the area in which commercial and recreational navigation could be affected by changes in sediment deposition from the project alternatives. Results of the numerical model showed that changes in sediment deposition, outside of the Capitol Lake Basin, would be limited to West Bay.

Navigational resources and facilities in West Bay include the southern portion of the existing U.S. Army Corps of Engineers (USACE) federal navigation channel (FNC) and adjacent turning basin, the Port of Olympia's three marine terminal berths, private marinas along the eastern shoreline of West Bay (Fiddlehead Marina, Martin Marina, and Olympia Yacht Club), and other public moorage facilities (Figure 3.2.1).

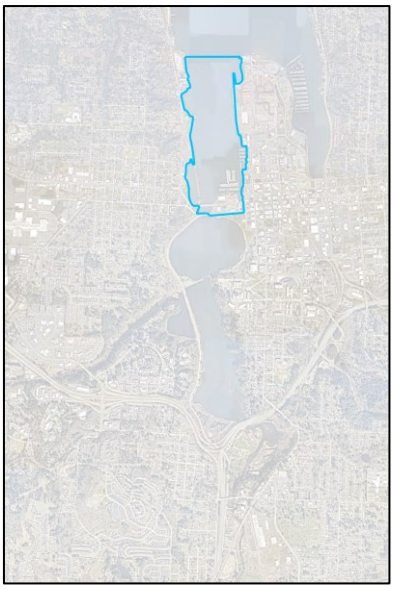


*Exhibit 3.26 Navigation study area*

### Methods for Studying Navigation Analysis

Data sources used for navigation analysis included existing navigation patterns for the study area, vessel use, depth, hydrodynamics, sediment erosion/deposition rates for the study area, and existing maintenance dredging data from the Port of Olympia, USACE, and several private marinas located in West Bay.

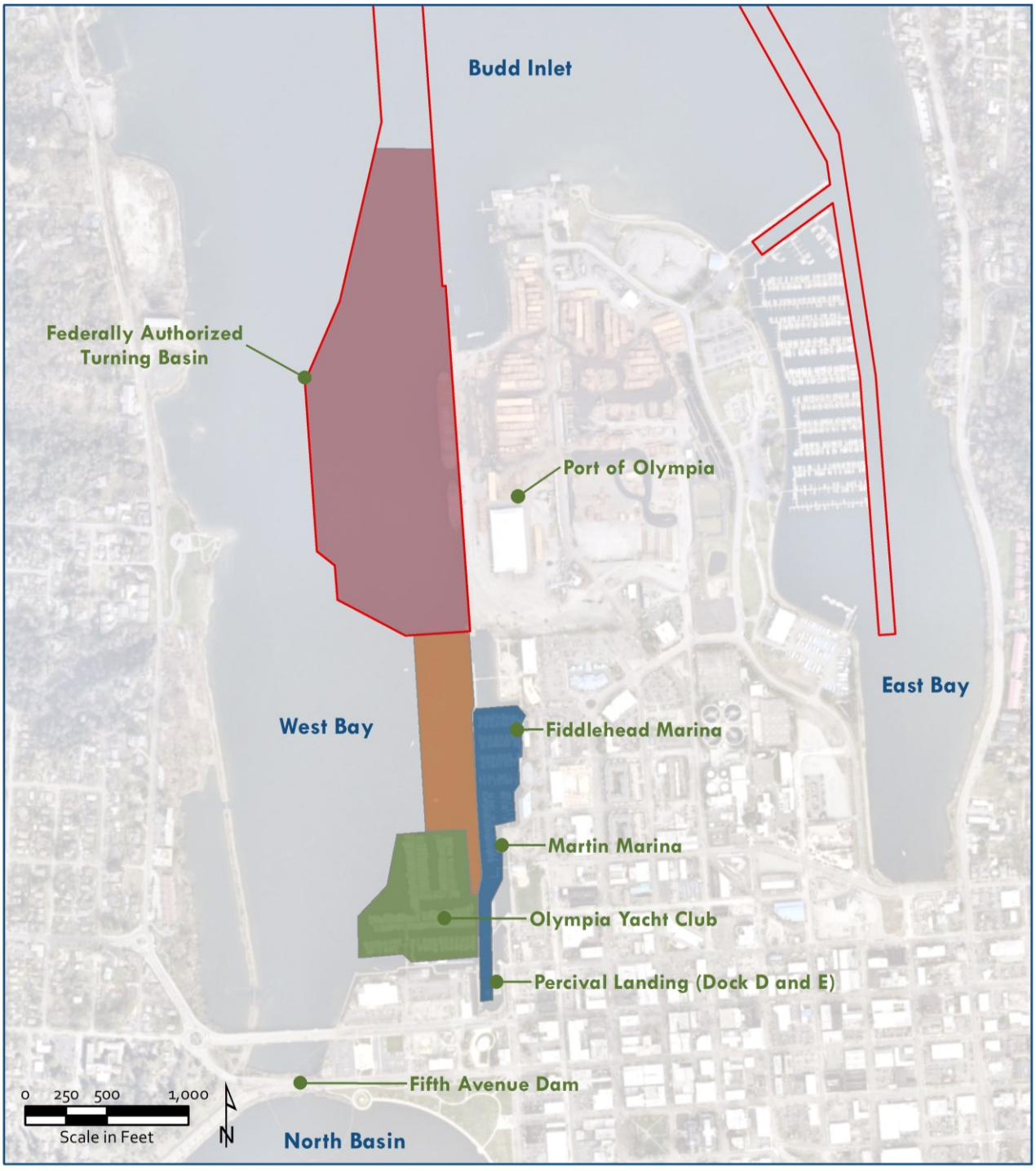
**Navigation Patterns.** Information about existing vessel navigation patterns was obtained from shipborne Automatic Identification Systems, which is a real-time network of transmitters and receivers that broadcast, track, and record vessel movement. These data were used to establish and evaluate the movement of larger vessels that use the FNC to access the Port of Olympia.

**Sediment Deposition Rates.** Past and present bathymetric condition surveys and hydrodynamic and sediment transport numerical modeling were compared to determine sediment deposition rates for West Bay.

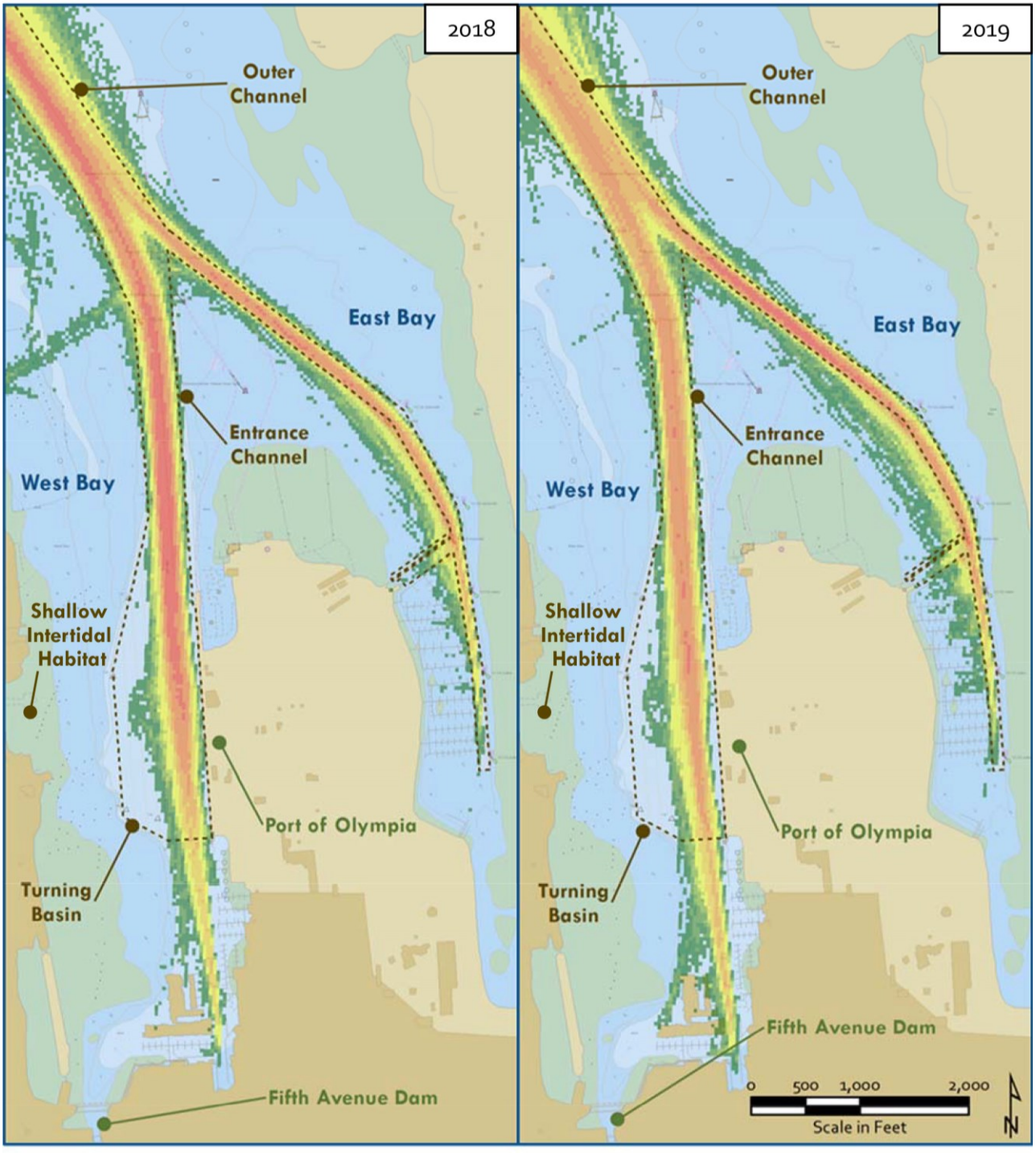
**Existing Maintenance Dredging.** Information on the types of vessels, incidents of vessel grounding or light-loading, operations, navigational constraints, sediment deposition, and long-term plans for accommodating different types of vessels was obtained from stakeholders. It was determined that maintenance dredging is expected to occur at most facilities within the next 10 years, prior to, or concurrent with the implementation of, any of the action alternatives.

**Additional information on navigation is presented in the Navigation Discipline Report (Attachment 6).**

## Figure 3.2.1 Navigational Resources in West Bay



# Figure 3.2.2 Budd Inlet Vessel Traffic Patterns




## Legend

Number of Vessel Passes (Annual)

| | | |
|---|---|---|
| 6 - 10 | 21 - 25 | 76 - 100 |
| 11 - 15 | 16 - 50 | 101 - 150 |
| 16 - 20 | 51 - 75 | 151 - 200 |

------ Limit of Federal Channel

Notes:
- AIS data was obtained from the US Coast Guard.
- Areas with 5 or fewer vessel passes per year are not shaded.
- Background nautical chart is ENC US5WA23M (April 30, 2020).

### 3.2.1 What are the general navigation patterns in West Bay?

Figure 3.2.2 provides a summary representation of vessel use from Budd Inlet into West Bay. The patterns reflect areas where vessel traffic generally occurs. This is known by vessel tracking beacons that are located on larger commercial vessels and some recreational vessels. Note that areas not shaded may still have occasional transit because smaller recreational vessels are not universally equipped with tracking beacons.

Vessel navigation was observed to be highest within the authorized FNC and turning basin and throughout the east side of West Bay closest to the Port of Olympia, local private marinas, and marina access areas along the east shore. This also corresponds to the area of the greatest water depth.

Typical vessels calling at the Port of Olympia include bulk cargo ships about 600 feet (180 meters) long and 100 feet (30 meters) wide. Typical vessels calling at West Bay marinas include recreational powerboats and sailboats, with an average draft between 2 and 7 feet (0.61 and 2.1 meters).

### 3.2.2 How were sediment deposition and erosion rates evaluated within the study area?

Commercial and recreational navigation within West Bay occurs along the eastern shoreline, in areas of sufficient water depth. When sediment is deposited in these areas, it incrementally reduces the depth of water. When sediment continues to accumulate and is not removed by dredging, commercial and recreational navigation is adversely impacted.

For this analysis, historical patterns and rates of sediment erosion and deposition within West Bay are evaluated by comparing available bathymetric surveys dating back to 1998. This provides the existing annual rate of sediment deposition that occurs within the study area (and has impacted navigation over time). Patterns and rates of sediment deposition that may occur in the future, after project construction, are evaluated with a numerical model that was built for this project. The predicted rates of sediment deposited throughout the study area each year indicate how quickly commercial and recreational navigation could be impacted. Understanding the potential sediment deposition rates informs the impact analysis and the frequency of maintenance dredging that would be needed to avoid or minimize impacts. The observed and

#### Three-Dimensional Modeling Study

The EIS Project Team selected the Delft 3D modeling software because this state-of-the-art three-dimensional model is one of the best numerical models widely used across the world to capture sediment dynamics of estuarine systems. The numerical model was built to a very high resolution, with greater coverage than other common model configurations.

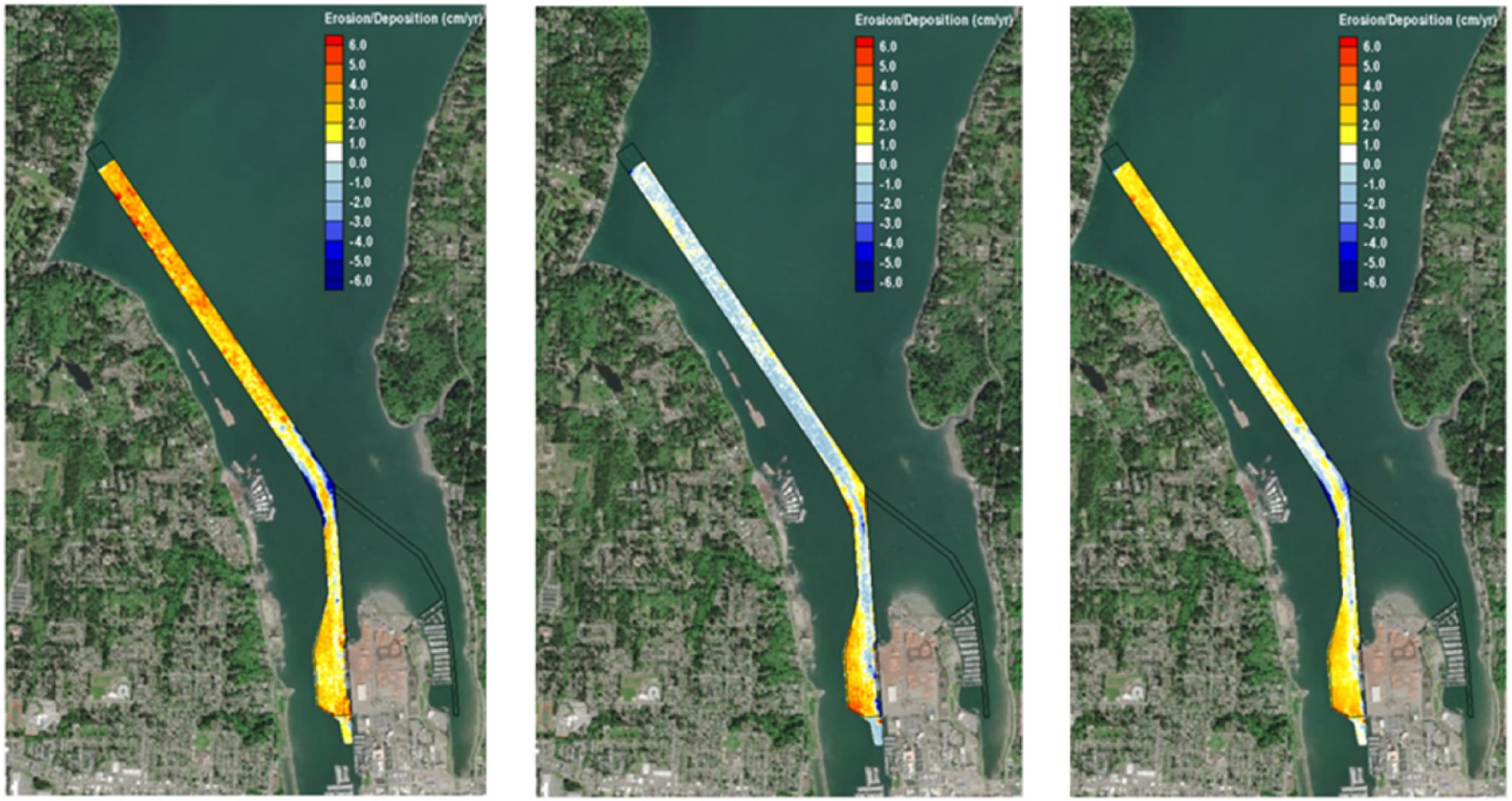
projected total and annual rates of erosion/deposition in the study area are described below.

#### 3.2.2.1 Federal Navigation Channel, Turning Basin and the Port of Olympia

The USACE conducts periodic bathymetric surveys of the FNC and turning basin to monitor changes in sediment deposition and erosion. Survey comparisons show that average observed rates of sediment deposition throughout the majority of the FNC ranged from 0.79 to 1.2 inches (2 to 3 centimeters each year between 1998 and 2020, although some erosion has been observed over the past 9 years. Sediment deposition within the adjacent turning basin is similar to the FNC, with an average observed rate of approximately 1.2 inches (3 centimeters) each year between 2011 and 2020.

Other sedimentation rate studies have been conducted at the Port of Olympia, and these suggest an annual deposition rate in the Port of Olympia vessel berths of approximately 0.047 to 0.43 inches (0.12 to 1.1 centimeters) each year. Considering the range of available data, the average annual rate of sediment deposition within the FNC, turning basin, and Port of Olympia vessel berths is estimated between -0.39 and +1.6 inches (-1 and +4 centimeters) each year, but varies over time and by area. Figure 3.2.3 provides details on average annual sediment erosion and deposition rates.

## Figure 3.2.3 Estimated Existing Average Annual Sediment Erosion/Deposition Rates (cm/yr)



### 3.2.2.2 West Bay Marinas

Existing bathymetry at West Bay marinas is limited and therefore deposition rates could not be determined with observed data. However, the marina owners have reported isolated areas of sediment accumulation. In the absence of data, average annual sediment erosion and deposition rates for the Olympia Yacht Club and other West Bay marinas were estimated based on the numerical model.

### 3.2.2.3 Sediment Deposition Pattern Summary for West Bay

The existing sediment deposition rates were used to calibrate and validate the sediment transport numerical model. This process confirmed that the model results were in alignment with the historical bathymetric survey, which means that the numerical model was accurately capturing the Project Area functions. After calibrating and validating the numerical model against existing conditions, it was used to simulate sediment transport for the project alternatives.

The modeled sediment deposition rates for existing conditions are summarized in Table 3.2.1. Table 3.2.1 shows that the highest sediment deposition rate occurs closest to the 5th Avenue Dam (near the Olympia Yacht Club) and decreases with distance away from the 5th Avenue Dam, northward into West Bay and Budd Inlet. The numerical model evaluated two storm events—without and with RSLR. The deposition rates were higher without RSLR and lower with RSLR. This is likely due to the higher water levels in the Capitol Lake Basin associated with RSLR, which would reduce current velocities and would reduce erosion of sediments in the Middle Basin. For this reason, later sections describing the analysis of impacts focus on numerical model results without RSLR, because impacts are greater under this scenario.

**Relative Sea Level Rise**

RSLR is the rise in sea level observed using a land-based reference frame. A 2-foot (0.61-meter) RSLR was implemented in the numerical modeling study to represent future increase in the sea level due to climate change. Conditions are applied as relative (i.e., a local, upward shift in offshore water levels).

Importantly, annual sediment deposition rates in West Bay are highly dependent on river flow events with more extreme flow events depositing more sediments. Additionally, sediment deposition rates are higher on the east side of West Bay because of an area of shallow intertidal habitat along the west side of West Bay, which directs sediment eastward.

**Table 3.2.1 Average Annual Sediment Deposition in West Bay for Existing Conditions, Predicted by Numerical Model**

| Location | Average Annual Sediment Deposition Without RSLR (inches each year *(centimeters each year)*) | Average Annual Sediment Deposition With RSLR (inches each year *(centimeters each year)*) |
|---|---|---|
| Olympia Yacht Club | 1.7 *(4.3)* | 1.3 *(3.4)* |
| Other West Bay Marinas and Marina Access | 0.83 *(2.1)* | 0.67 *(1.7)* |
| Port of Olympia/Turning Basin | 0.87 *(2.2)* | 0.63 *(1.6)* |
| FNC (excluding Turning Basin) | 0.039 *(0.1)* | 0.039 *(0.1)* |
| Rest of Budd Inlet (not within study area) | 0.039 *(0.1)* | 0.039 *(0.1)* |

### 3.2.3 What maintenance dredging is currently performed in West Bay?

The USACE is responsible for maintaining authorized water depths within the FNC and turning basin through maintenance dredging. The existing authorized depth within these channels is -30 feet (-9.1 meters) MLLW. The USACE last dredged the FNC in 2007.

The Port of Olympia is responsible for maintaining authorized water depths within their vessel berths. The average elevation within these vessel berths is -39 feet (-2.7 meters) MLLW. The Port of Olympia last dredged its vessel berths in 2014.

These two dredging events are the most recent maintenance dredging to occur within these navigational facilities within the last 40 years. Maintenance dredging is currently needed within the FNC and turning basin but it has been delayed due to the chemical quality of the sediment, which is impacted and being evaluated by Ecology.

Vessel navigation is currently impacted due to the accumulated sediment; cargo vessels typically sail on rising high tides or lighten their loads because the increasingly shallow water is not sufficient for a fully loaded vessel. There is active coordination between USACE and the Port of Olympia regarding these conditions. It is expected that maintenance dredging will be conducted by the USACE in the FNC and turning basin and by the Port of Olympia in their berths within the next 10 years to reestablish authorized water depths.

Maintaining navigational water depth at the marinas is the responsibility of the marina owners. Water depth at the marinas in West Bay is estimated to average about -7 feet (-2.1 meters) MLLW. The minimum

water depth of -5 to -7 feet (-1.5 to -2.1 meters) MLLW is stipulated in environmental regulations and aquatic land leases, helping to avoid vessel contact with the underlying sediment.

The Olympia Yacht Club last completed maintenance dredging within specific shallow portions of their marina in 2014; prior to this, maintenance dredging was completed in 1987. Maintenance dredging at the Martin Marina last occurred in the 1980s.

All three West Bay marinas experience shoaling and/or sediment accumulation to some extent and have either conducted maintenance dredging recently or plan to complete maintenance dredging within the next 10 years to maintain navigation, to comply with lease requirements, and/or in parallel with dock upgrades and/or reconfiguration. Maintenance dredging is often planned around other necessary marina upgrades focused on key areas that experience shoaling.

## 3.3 WATER QUALITY

For the EIS water quality analysis, the study area includes Capitol Lake and its major inflow sources of the Deschutes River and Percival Creek, as well as West Bay and East Bay of Budd Inlet. These areas are included because they would be impacted (beneficially or adversely) by the project alternatives. Upstream areas in the Deschutes River and Percival Creek are not part of the study area because these areas would not be impacted by the project alternatives.

Several federal, state, and local government policies, regulations, and ordinances protect water quality in the Deschutes River, Capitol Lake, and Budd Inlet. Ecology has been delegated authority by the U.S. Environmental Protection Agency (USEPA) to implement the federal Clean Water Act in Washington by establishing water quality standards, identifying impaired waterbodies, conducting TMDL studies, and issuing water quality permits. In July 2020, USEPA approved a TMDL for the Deschutes River. A TMDL is currently being prepared for Budd Inlet. Numerous discharges to the watershed are regulated through the National Pollutant Discharge Elimination System (NPDES).

*Exhibit 3.27 Water Quality study area*

**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.

## Methods for Studying Water Quality

Previous studies, historical monitoring data, and recent data collected for this analysis were used to characterize the conditions in both Capitol Lake and Budd Inlet. For Capitol Lake, the first step was to evaluate whether any trends in water quality should be considered to ensure that the data used for the analysis are representative of existing conditions. The water quality was then compared to applicable water quality standards and thresholds, and to conditions in nearby lakes. Existing conditions within Budd Inlet were also characterized by comparing existing water quality to applicable state criteria.

**The data sources used in the analysis are fully described in the Water Quality Discipline Report (Attachment 7).**

### 3.3.1 What past work has been conducted to assess water quality?

Over the decades, government agencies and others have evaluated water quality conditions in Capitol Lake in response to visual and chemical changes. Water quality has changed within the project area because of 5th Avenue Dam construction and the impoundment of Deschutes River water, inputs to the river and lake from various sources, lake treatments, accidental spills, and a range of other factors. As a result, Capitol Lake historically experienced various water quality problems including aquatic weed infestations, algal blooms, and high bacteria concentrations that resulted in closure of the swimming area and restrictions on boating and other beneficial uses. Capitol Lake has been listed on Ecology's 303(d) list for impaired waters due to bacteria and total phosphorus since 1996.

A number of factors affect the water quality and overall aquatic health of the aquatic ecosystem in Capitol Lake. Within this context, it is important to note that "water quality" is more than just chemicals in the water.

Capitol Lake is profoundly affected by a complex and continually changing interaction between physical (e.g., temperature, river flow and tides, erosion, and sedimentation), chemical (e.g., nutrients, dissolved oxygen, pH), and biological (e.g., algae, bacteria, and aquatic plants and animals) characteristics. The Deschutes River, which is the predominant inflow source, flows through Capitol Lake at a rate that keeps the water well circulated compared to other lakes in the region, most of which become stratified in the summer with a warm layer at the surface and colder water below.

Water quality standards are only occasionally exceeded in Capitol Lake, primarily for temperature and dissolved oxygen. A water quality trend

## Improving Water Quality Trends in Capitol Lake

Because of the river's influence, the water in Capitol Lake is rapidly replaced, and water quality conditions commonly associated with stratification (e.g., high temperatures in shallow waters, oxygen depletion in deeper waters, widely fluctuating pH, toxic algal blooms) are not problematic. Despite a perception of worsening conditions, monitoring data (from 2004 to 2014, as well as in 2019) indicate that water quality conditions have actually been improving in Capitol Lake.

analysis conducted for this EIS used data that were not available to Enterprise Services or the general public during preparation of the Capitol Lake Adaptive Management Plan (CLAMP) in 1999.

Perceptions of poor water quality and worsening conditions in Capitol Lake are likely based on the impaired aesthetics from aquatic plant growth and the ongoing restrictions on recreational use, rather than water chemistry. However, recent monitoring data indicate that water quality in Capitol Lake is relatively good. The interrelationship between the various factors affecting the aquatic ecosystem in Capitol Lake are important to consider in evaluating the water resources throughout the ecosystem.

Low dissolved oxygen in Budd Inlet during the summer has also been a long-term water quality concern, leading to extensive modeling efforts to better understand the contributing factors to dissolved oxygen depletion. Recent water quality monitoring has provided further insights into the nutrient dynamics and loading from the Deschutes River and Capitol Lake inflows that contribute to marine algae productivity and oxygen depletion in Budd Inlet. Deschutes River and Capitol Lake water quality and flow inputs have historically affected Budd Inlet, along with important and substantial inputs from the greater Puget Sound.

### 3.3.2 What methods were used for studying existing water quality?

Previous studies, historical monitoring data, and recent data collected for this analysis were used to characterize the conditions in both Capitol Lake and Budd Inlet. The primary studies used, which are fully referenced in the Water Quality Discipline Report (Attachment 7), include:

- *Capitol Lake Restoration Analysis* (Entranco 1984): Preliminary study conducted to characterize the water quality conditions in Capitol Lake.
- *Budd Inlet Scientific Study Final Report* (LOTT 1998): Analyzed field data to quantify circulation patterns and nutrient loading to Budd Inlet.
- *Deschutes River, Capitol Lake, and Budd Inlet Temperature, Fecal Coliform Bacteria, Dissolved Oxygen, pH, and Fine Sediment Total Maximum Daily Load Technical Report*: Water Quality Study Findings (Ecology 2012): Reported data and modeling results for Capitol Lake and the Deschutes River using historical data from Budd Inlet and Capitol Lake.

#### Algae and Aquatic Plants

This document addresses algae (in this case, phytoplankton including cyanobacteria) separate from other aquatic plants. Algae growth is fueled by nutrients in the water and energy from sunlight, and while algae contain chlorophyll like most aquatic plants, they do not have true stems, roots, leaves, and flowers. Algae types include both freshwater algae that are found in Capitol Lake and marine algae that are present in Budd Inlet and other estuaries. Many rooted aquatic plants take nutrients from the bottom sediments that may have accumulated over many years, and some species present in Capitol Lake (e.g., coontail) are floating plants that take nutrients from the water. While there are some kelp and other aquatic plants in Budd Inlet, they have not reached nuisance levels like the dense freshwater aquatic plant growth in Capitol Lake. During their life cycles, algae and other aquatic plants can each have profound effects on physical and chemical characteristics of water quality.

*Exhibit 3.28 Coontail (a native floating plant) in Capitol Lake*

- *South Puget Sound Dissolved Oxygen Study: Water Quality Model Calibration and Scenarios* (Ecology 2014): Identified anthropogenic causes of dissolved oxygen depletion in South Puget Sound, providing an overview of the conditions between inlets.
- *Deschutes River, Capitol Lake, and Budd Inlet Total Maximum Daily Load Study Supplemental Modeling Scenarios* (Ecology 2015b): Used historical data to model scenarios that predict causes of poor water quality in Budd Inlet.
- *Total Maximum Daily Loads (TMDLs) for the Deschutes River and its Tributaries* (USEPA 2020): Provided TMDLs for sediment, bacteria, dissolved oxygen, pH, and temperature in the Deschutes River and its tributaries.

Ecology is currently developing a TMDL for Budd Inlet. This report and its findings were not available for this EIS.

Historical monitoring data used include:

- Deschutes River and Capitol Lake:
  - Stream Flow 2004–2014 (United States Geological Survey [USGS]): These data were used to develop water and phosphorus budgets for Capitol Lake.
  - Water Quality 2004 (Ecology): These data were used to augment 2019 data collected for this EIS.
  - Water Quality 2004–2014 (Thurston County): This dataset was used to identify long-term trends and to develop the phosphorus budget and support the alternatives analysis.
- Budd Inlet:
  - Water Quality 2000–2020 (Ecology): These data were used to compare the observed water quality conditions to surface water quality standards.

For this assessment, the first step was to evaluate whether any trends in water quality should be considered to ensure that the data used for the analyses are representative of existing conditions. The water quality of Capitol Lake was then compared to surface water quality standards to evaluate existing conditions, and also compared to the total phosphorus action threshold for Puget Sound lowland lakes. Conditions in Capitol Lake were compared to nearby lakes to provide a perspective for water quality conditions in the region. Previous studies and data were

supplemented with additional data collected in 2019. These data and a water and phosphorus budget provide further insight into the current interactions between the Deschutes River and Capitol Lake.

Analyzing potential trends in water quality and selecting data that represent existing conditions involved examining the monitoring results from the past two decades to identify data most appropriate for this analysis. Water quality data for Capitol Lake collected by Thurston County from 2004 through 2014 were used for the trend analysis. The presence of strong trends for key parameters indicates that data from the earlier years in the data record are not appropriate to use in characterizing existing conditions. Therefore, only the most recent 5-year period (2010 to 2014) was used to evaluate water quality criteria, trophic status, and comparisons to nearby lakes. For the water and phosphorus budgets, data from hydrologic water years 2008 to 2012 (e.g., water year 2011 is from October 2010 through September 2011) were analyzed because this was the most recent 5-year period that contained flow, storage, and phosphorus data for the Deschutes River, Capitol Lake, and Percival Creek. Having five consecutive years of data provides an understanding of both average water quality conditions and year-to-year variability.

Similar to Capitol Lake, existing conditions for Budd Inlet were assessed based on available data. Current conditions within Budd Inlet were characterized by comparing existing water quality to applicable state criteria. Sediment quality was also analyzed, largely referencing the findings from the Sediment Quality Discipline Report (Attachment 15). Several studies and modeling efforts conducted in Budd Inlet were used to compare the waterbody to other inlets in South Puget Sound.

Multiple previous water quality studies in the project area were supplemented by additional data collected by the EIS Project Team in 2019 and 2020 to characterize existing conditions.

Key studies reviewed include a 2012 Ecology study with modeling results, Ecology TMDL studies, Thurston County water quality monitoring in the Deschutes River and Capitol Lake, and Ecology water quality monitoring in Budd Inlet. The full description of methodology and information sources is presented in the Water Quality Discipline Report (Attachment 7).

### 2019 Water Quality Sampling

The EIS Project Team collected water quality samples in Capitol Lake to compare current and historical conditions to determine if current conditions are within the range of previous observations. Samples were collected from May through October to be consistent with past Thurston County-collected data. See Section 3.2.3 of the Water Quality Discipline Report (Attachment 7) for more information.

## 3.3.3 What are the existing water quality conditions?

This section summarizes the information on existing water quality and forms the baseline for evaluating potential adverse impacts or beneficial

effects of the project alternatives. A more detailed description of water quality is provided in the Water Quality Discipline Report (Attachment 7).

Information on dissolved oxygen and nutrients is emphasized in this EIS analysis because low dissolved oxygen concentrations have been a long-term problem in Budd Inlet, and these parameters have been the focus of water quality improvement planning efforts.

**Dissolved Oxygen**

Dissolved oxygen is a measure of how much oxygen is dissolved in the water. The amount of dissolved oxygen in a stream or lake can provide information about the waterbody's water quality. Adequate dissolved oxygen concentrations are important to aquatic habitat, particularly for cold water fish, such as salmon.

Ecology has previously modeled the lake's influence on dissolved oxygen in Budd Inlet. Ecology's model focused on: (1) nitrogen, because it typically drives algae production in marine waters, and the seasonal die-off and decomposition of algae consumes (or reduces) dissolved oxygen concentrations; and (2) total organic carbon (TOC) as an indicator of organic matter that, when decomposing, contributes to dissolved oxygen depletion. Other key parameters that influence dissolved oxygen conditions in Budd Inlet are phosphorus and biochemical oxygen demand (BOD). Other existing water quality conditions (e.g., temperature, pH, bacteria) and sediment quality were also considered in this analysis, but with less detail.

### 3.3.3.1 Capitol Lake

Construction of the 5th Avenue Dam in 1951 transformed the Deschutes Estuary into a freshwater waterbody now known as Capitol Lake. Prior to that time, the Deschutes River flowed to Budd Inlet, with the current-day Capitol Lake Basin consisting of estuary habitat and tideflats. The Deschutes River, which is the predominant inflow source to the lake, now flows through the lake at a rate that replaces the water within about 1 week and keeps the water well mixed. The rapid replacement of lake water results in Capitol Lake being regulated as a surface waterbody where water quality standards for lakes are not specifically applicable. However, this EIS provides comparisons to other lakes in the region and anticipates that a lake management plan for Capitol Lake would be developed and implemented under the Managed Lake Alternative, and potentially the Hybrid Alternative.

**Trophic State Definitions for Lakes**

**Oligotrophic:** Nutrient-poor waters with minimal algal and/or plant productivity.

**Mesotrophic:** Moderately nutrient-enriched waters with intermediate levels of algal and/or plant productivity.

**Eutrophic:** Nutrient-enriched waters with high levels of algal and/or plant productivity.

**Hypereutrophic:** Extremely nutrient-enriched waters with very high levels of algal and/or plant productivity.

The existing conditions for water quality in Capitol Lake are presented in the following subsections by:

- Assessing water quality trends in Capitol Lake and Deschutes River.
- Comparing water quality monitoring data to regulatory standards and indicators of trophic state (biological productivity).

- Evaluating water quality and algae monitoring data from 2019.
- Comparing Capitol Lake to other lakes in Thurston County.
- Comparing water quality in the Capitol Lake Basin to water quality entering from the Deschutes River.
- Summarizing information on lake sediment quality.
- Evaluating water and phosphorus budgets for Capitol Lake.
- Summarizing water quality modeling studies from the Deschutes River TMDL.

## Water Quality Trends in Capitol Lake

Thurston County collected water quality data in Capitol Lake and other area surface waters, including the Deschutes River, for several decades until 2014 as part of an ambient water quality monitoring program. The most recent water quality data collected by Thurston County from 2004 through 2014 for Capitol Lake and the Deschutes River, the period since brewery discharges ceased, were compiled to evaluate existing conditions. The data were used to assess trends in annual and summer conditions to ensure that the data used in the analysis reflect existing conditions. During these years, the Deschutes River was monitored year-round, whereas Capitol Lake was monitored only during May through October. Trends in the Deschutes River were therefore evaluated for both full years and the May through October periods. Trends in Capitol Lake were evaluated using all the available data (May through October) as well as by separating data into seasons: spring (May through June), summer (July through August), and fall (September through October). Lake monitoring was performed at two depths: near surface and near bottom.

### Key Water Quality Terms

**Chlorophyll-*a* and pheophytin-*a*:** Pigments analyzed to indicate algae productivity.

**Dissolved oxygen:** An important requirement for fish life.

**Fecal coliform:** An indicator of the potential presence of bacterial pathogens.

**pH:** A measure of acidity.

**Secchi depth:** A measure of water transparency that is sometimes decreased by algae in the water.

The following significant trends were observed in Capitol Lake during the summer over the years from 2004 through 2014:

- Improvement was observed with lower algal productivity indicated by surface pH, surface total phosphorus chlorophyll-*a*, pheophytin-*a*, and Secchi depth. Increasing surface and bottom conductivity indicated saltwater intrusion through the dam.
- During the spring, total phosphorous and chlorophyll-*a* exhibited improving water quality.
- Surface temperature and pH both indicated improving water quality. Increasing surface conductivity indicated the influence of saltwater intrusion.

- Total phosphorous, chlorophyll-*a*, and pheophytin-*a* all had improving water quality trends in the fall. Surface results for dissolved oxygen exhibited a worsening trend, potentially due to a decrease in oxygen production from algae or aquatic plants, which is consistent with the improving trends of lower chlorophyll-*a*, pheophytin-*a*, and pH. A significantly increasing trend in surface conductivity again indicated saltwater intrusion.

The following significant trends were also observed in Deschutes River water quality over the same period:

- Using year-round data, pH improved, indicating lower algal productivity.
- Using May through October data, fecal coliform bacteria and pH both exhibited improvements.

The trend analysis results indicate that Capitol Lake exhibited improving water quality from 2004 to 2014 based on significant improvement in temperature, total phosphorous, chlorophyll-*a*, Secchi depth, and fecal coliform bacteria. These trends appear to be most evident in the fall and spring. Because of the observed trends, evaluations of existing water quality data were limited to the most recent 5-year period (2010 through 2014) to better reflect current conditions in the lake and river.

The improvements summarized here and measured in other studies indicate that watershed improvement activities carried out over the past 25 years, including removal of the brewery discharge, have been effective at improving overall water quality in the lower Deschutes River and Capitol Lake.

## Applicable Water Quality Standards and Existing Water Quality in Capitol Lake

Capitol Lake water quality is regulated using water quality standards and criteria for fresh waters of the state. Capitol Lake has an average detention time (i.e., the time it takes for inflows to replace the lake's water volume) of less than the 15-day mean detention time used by the state (WAC 173-201a-020) to define a lake. For this reason, Capitol Lake is classified as a river and regulatory requirements for water quality in Washington lakes (WAC 173-201a-230) do not apply. Information on existing conditions for nutrients and trophic state indicators is included in this EIS because it is relevant to future lake management under the Managed Lake and Hybrid Alternatives.

### Trend Analysis

Overall, the trend analyses over a 10-year period (2004–2014) indicated that water quality in Capitol Lake was improving based on temperature, total phosphorus, chlorophyll-*a*, Secchi depth, and fecal coliform bacteria data.

### What water quality standards apply to Capitol Lake?

Capitol Lake is strongly influenced by its major inflow source, the Deschutes River. Because of river inputs, the lake has an average detention time of 14 days or less. From regulatory and functional perspectives, Capitol Lake is a very wide and slow reach of the Deschutes River. Detention time was also calculated during development of the water budget for this study (Section 4.1.3). The calculation was aimed at average conditions rather than low flow and therefore calculated detention times were much lower: ranging from 0.6 to 7.9 days. The storage estimate was based on 2013 lake bathymetry data. The lake will have filled in some since 2013; therefore, the detention time may be slightly lower than calculated.

Comparing water quality data from 2010 through 2014 with state surface water quality standards (WAC 173-201A-602) indicates that the lake occasionally does not meet standards for temperature, dissolved oxygen, total dissolved gas, and pH (Table 3.3.1).

If lake water quality standards were applied at Capitol Lake, it would continually exceed the Action Level for total phosphorous (>20 micrograms per liter [µg/L]) in lowland lakes of the Puget Sound region. The standards recommend that lakes that exceed the Action Level for total phosphorous develop specific management plans and actions to reduce algae productivity and improve water quality. By definition, all eutrophic lakes in Washington exceed the Action Level for total phosphorous, including most lowland lakes in the Puget Sound region.

### Table 3.3.1 Comparison of Capitol Lake Data to Washington State Surface Water Quality Standards [1]

| Parameter | Mean | Median | Min. | Max. | Surface Water Quality Standard/Action Level |
|---|---|---|---|---|---|
| Temperature (˚C) (Surface) | 16.5 | 17.1 | 9.3 | **21.1** | 17.5 [2] |
| Temperature (˚C) (Bottom) | 16.2 | 16.9 | 9.7 | **20.1** | 17.5 [2] |
| Dissolved oxygen (mg/L) (Surface) | 12.2 | 12.2 | 9.2 | 16.3 | 8.0 [2] |
| Dissolved oxygen (mg/L) (Bottom) | 10.7 | 10.6 | **7.7** | 13.1 | 8.0 [2] |
| Total dissolved gas (%) (Surface) | **124.8** | **124.8** | 95.3 | **168.5** | 110.0 [3] |
| Total dissolved gas (%) (Bottom) | 108.1 | 109.8 | 83.0 | **133.3** | 110.0 [3] |
| pH (Surface) | 8.2 | 8.2 | 7.4 | **9.2** | 6.5–8.5 [2] |
| pH (Bottom) | 7.7 | 7.7 | 6.6 | **8.8** | 6.5–8.5 [2] |
| Total phosphorous (µg/L) (Surface) | **32.3** | **32.0** | **22.0** | **59.0** | 20.0 [4] |

Notes:

Data are from monthly summer (May through October) grab samples collected by Thurston County.

Bold and shaded values indicate problematic excursions from the standard or Action Level.

1. Based on 2010–2014 data from the North Basin.
2. Washington State Surface Water Quality Standards (WAC 173-201A: Salmonid Spawning, Rearing, and Migration) for freshwater.
3. WAC 173-201A standard for total dissolved gas.
4. Action Level listed in WAC 173-201A-230.

As presented in greater detail in the Water Quality Discipline Report (Attachment 7), very similar results for temperature and dissolved oxygen from near the surface and near the bottom show that water in Capitol Lake is well mixed, unlike many regional lakes that become thermally stratified in the summer with warmer water near the surface and cooler water at depth.

Water temperature frequently exceeds the 17.5 °C maximum criterion both near the surface and near the bottom in Capitol Lake.

Because the temperature criterion is also exceeded in the main incoming water sources (Deschutes River and Percival Creek), maximum temperatures in the lake can be attributed to both the incoming water and warming in the lake basin where there is less shade and more solar exposure.

The 8.5 maximum pH criterion is also exceeded during periods of high algae and aquatic plant growth and daytime photosynthesis, particularly in the near-surface waters of Capitol Lake (see Table 3.3.1.).

Table 3.3.2 compares conditions in Capitol Lake to thresholds commonly used for assigning a trophic state to lakes. Based on total phosphorous, chlorophyll-*a*, and Secchi depth, Capitol Lake would be classified as eutrophic (i.e., enriched with nutrients and productive for algae) even after the improving trends in these parameters observed in recent years. The Action Level for total phosphorous for Washington lakes (>20 µg/L) does not apply to Capitol Lake because of its regulatory status due to its rapid flushing rate. WAC 173-201A-230 recommends for lakes that a study be initiated to develop a lake-specific standard for total phosphorous where the Action Level is exceeded. The summer mean total phosphorous concentration in Capitol Lake (32.3 mg/L) is much greater than the Action Level. Although not a regulatory requirement, this information is included because it is anticipated that a lake management plan would be developed and implemented under the Managed Lake Alternative and potentially the Hybrid Alternative.

## Vertical Mixing

Vertical mixing is important in moderating water quality conditions in Capitol Lake and preventing oxygen depletion in the deeper waters. As a result, dissolved oxygen concentrations only infrequently drop below the 8.0 milligrams per liter (mg/L) minimum standard near the lake bottom, and Capitol Lake remains well oxygenated through most of the summer.

## Temperature Criterion

Compared to other regional lakes, temperature criterion exceedances near the surface in Capitol Lake are moderate and less frequent.

### Table 3.3.2 Comparison of Capitol Lake Data & Trophic State Thresholds for Lakes

| Trophic State | Secchi Depth [1] (m) | Chlorophyll-*a* [1] (µg/L) | Total Phosphorus [1] (µg/L) | Total Nitrogen [1] (mg/L) |
|---|---|---|---|---|
| Capitol Lake Data | 1.8 | 12.3 | 32.3 | 0.60 |
| Oligotrophic | >4 | <2.6 | <12 | <0.35 |
| Mesotrophic | 2–4 | 2.6–7.2 | 12–24 | **0.35–0.65** |
| Eutrophic | **1–2** | **7.1–20.1** | **24–48** | 0.65–1.2 |
| Hypereutrophic | <0.5 | >56 | >96 | >1.2 |

Notes:

**Bold/shaded text** shows how levels in Capitol Lake would be characterized.

1 Summer mean value for surface water measurements taken between 2010 and 2014.

An Ecology modeling study of Budd Inlet indicated that the largest human-caused contributor to low dissolved oxygen problems in Budd Inlet was loading of nutrients and TOC from Capitol Lake. For the parameters of most interest (e.g., biological indicators such as TOC and dissolved organic carbon [DOC]), the Ecology modeling study was based on data collected in Capitol Lake in 2003 and 2004. To provide more recent data and to augment the historical dataset, limited additional monitoring was conducted in Capitol Lake from May through October 2019 as part of the EIS evaluation. The routine monitoring of the Deschutes River performed by Thurston County was also expanded to include some key analytes. More details on the monitoring results are included in the Water Quality Discipline Report (Attachment 7) and summarized below.

Importantly, three events occurred in 2019 that may have influenced water quality results. The first event occurred on February 25, 2019, when there was a large spill of transformer oil, just downriver of Tumwater Falls. The oil entered the Deschutes River from several storm drains and flowed into Capitol Lake. Ecology immediately launched an extensive cleanup that involved removing oil from the system by skimming the surface, cleaning the shoreline vegetation, and vacuuming contaminated sediment. The cleanup efforts occurred from March through July 2019. Water quality may have been affected by both the transformer oil and the site disturbances from cleanup operations. The remaining two events were associated with large sewage spills on Percival Creek in early February 2019 and near the end of May 2019.

Because of concerns that the spills described above may have impacted water quality results intended for characterizing existing conditions, 2019 data were not used in long-term trend analyses but were compared

#### 2019 Events Affecting Water Quality

Three events in 2019 may have affected water quality results: a spill of transformer oil in the lower Deschutes River and subsequent cleanup efforts, and two sewage spills in Percival Creek.

***Exhibit 3.29 Responders gather contaminated vegetation along the Capitol Lake shoreline (Source: Washington State Department of Ecology https://ecology.wa.gov/About-us/Get-to-know-us/News/2021/Feb-11-Olympia-Brewery-Spill-to-Capitol-Lake)***

with those from previous years (2010 to 2014), as summarized in Table 3.3.3. Phosphorus data from 2019 were suspected to be influenced by spill cleanup and were thus not used in the analysis; however, data for other water quality parameters collected in 2019 were generally within the expected range of historically observed values and accepted for analyses.

### Table 3.3.3 Comparison of 2019 Capitol Lake Water Quality Data to 2010–2014 Data

| Parameter | North Basin: 2010–2014 Average | North Basin: 2019 Average | Middle Basin: 2010–2014 Average | Middle Basin: 2019 Average |
|---|---|---|---|---|
| Total nitrogen (mg/L) (Surface) | 0.60 | 0.49 | 0.69 | 0.65 |
| Total phosphorous (mg/L) (Surface) | 0.032 | 0.069 | 0.032 | 0.22 |
| Soluble reactive phosphorous [1] (mg/L) (Surface) | 0.010 [1] | 0.024 | 0.014 [1] | 0.115 |
| Chlorophyll -*a* (µg/L) (Surface) | 12.3 | 14.1 | 5.2 | 3.8 |
| Pheophytin-*a* (µg/L) (Surface) | 3.0 | 3.3 | 3.1 | 1.7 |
| Secchi Depth (m) | 1.8 | 1.6 | 2.4 | 1.9 |

Note:

1. These values are based on the 2004 dataset because SRP was not measured from 2010 to 2014.

Overall, the monitoring data (2010 to 2014, and 2019) indicate that Capitol Lake currently has relatively good water quality in terms of physical and chemical characteristics important to aquatic life; water quality standards (such as for temperature and dissolved oxygen) are occasionally exceeded, but these are tempered by the Deschutes River. Chlorophyll-*a* concentrations are also relatively low, especially given the lake's eutrophic condition, indicating that algal productivity is generally not excessive. Public perceptions of degraded water quality in Capitol Lake may be linked to aesthetic impacts of the extensive and dense aquatic plant population that becomes more exposed during summer low river flows. Monitoring data indicate that, with the exception of phosphorus, water quality in Capitol Lake in 2019 was generally consistent with results for 2010 to 2014 and characteristic of good water quality in terms of physical and chemical properties important to aquatic life.

Table 3.3.4 provides a summary of bacteria data from the 2019 field study. Overall, bacteria concentrations were low and geometric mean (an average used where values may be widely variable) values were much less than the standard for *Escherichia coli* (*E. coli*). One sample from the North Basin (from May 28, 2019) exceeded the maximum standard due to a large sewage spill in Percival Creek on the same day that resulted in very high bacteria concentrations in Percival Creek. With the exception of the monitoring event during the spill that impacted the North Basin only, the Middle and North Basin stations had similar concentrations and geometric mean values. The station near the eastern shoreline of the North Basin had elevated bacteria concentrations compared to the other lake stations, but still met water quality standards.

## Key Water Quality Terms

**Total nitrogen:** A critical nutrient for algae and plant growth, particularly in marine waters.

**Soluble reactive phosphorous:** A critical nutrient for algae and plant growth, particularly in freshwater lakes.

### Table 3.3.4 Comparison of 2019 Bacteria Concentrations in Capitol Lake to Washington State Surface Water Quality Standards

| Sample Date | Middle Basin: Fecal Coliform Bacteria (CFU/100 mL) [1] | Middle Basin: E. Coli (CFU/ 100 mL) | North Basin: Center: Fecal Coliform Bacteria (CFU/100 mL) [1] | North Basin: Center: E. Coli (CFU/ 100 mL) | North Basin: Shore: Fecal Coliform Bacteria (CFU/100 mL) [1] | North Basin: Shore: E. Coli (CFU/ 100 mL) |
|---|---|---|---|---|---|---|
| 5/28/2019 | 16 | 11 | **540** | **335** | 115 | 68 |
| 6/26/2019 | <10 [2] | <10 [2] | <2 [2] | <2 [2] | – | – |
| 7/24/2019 | 2 | 2 | <2 [2] | <2 [2] | – | – |
| 8/22/2019 | <2 [2] | <2 [2] | 4 | 4 | 78 | 66 |
| 9/24/2019 | 64 | 54 | 7 | 7 | 9 | 4 |
| 10/22/2019 | 171 | 171 | 35 | 35 | 44 | 44 |
| Geometric Mean | 14 | 13 | 11 | 10 | 43 | 30 |
| Geometric Mean Standard [3] | 100 | 100 | 100 | 100 | 100 | 100 |
| Maximum Standard [3] | 200 | 320 | 200 | 320 | 200 | 320 |

Notes:

**Bold and shaded values** indicate problematic excursions from the standard or Action Level.

1. Until recently, the state water quality standards for lakes and rivers (WAC 173-201A-200) used fecal coliform bacteria and *E. coli* as alternative indicators of bacterial contamination. Both were measured during the 2019 monitoring to evaluate lake conditions. As of this year (2021), only *E. coli* bacteria will be used to determine compliance.

2. Values with a < indicate that the sample concentration was less than the detection limit.

3. WAC 173-201A-200: Table 200 (2)(b) Criteria based on datasets where there are fewer than 10 sample points.

Abbreviation CFU = Colony forming unit

Another potentially important biological component of water quality is algae. As previously described, algae consumes oxygen in the water column during respiration and decomposition. One type of algae (cyanobacteria, or blue-green algae) can cause toxic algal blooms that can result in illness and death in animals and humans if consumed. Monitoring in 2019 indicated that blue-green algae, when present in samples, represented only 5% to 10% of the total algae community. The predominant algae in 2019 were diatoms (not a toxin-producing algae), representing 70% to 95% of the total algae population. In 2004, the lake algae population included one blue-green algal bloom, which occurred in August.

## Water Quality in Capitol Lake Compared to Other Local Lakes

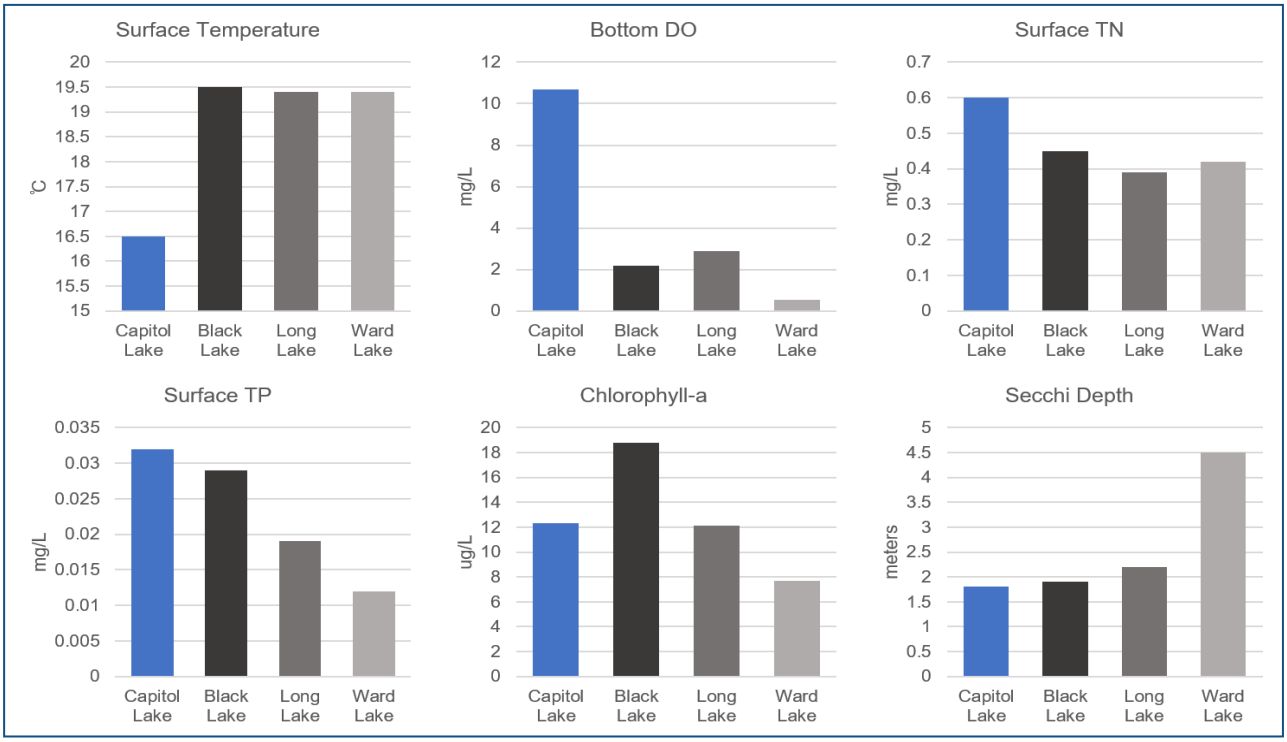
Figure 3.3.1 compares average measured conditions in Capitol Lake to other lakes in Thurston County using data from 2010 to 2014. Better water quality is indicated by cooler surface temperatures and higher dissolved oxygen near the lake bottom, while greater algal productivity is indicated by higher total nitrogen and total phosphorous, higher chlorophyll-*a* concentrations, and lower Secchi depths.

Nearby lakes, Black Lake and Long Lake are similarly eutrophic (i.e., nutrient enriched), while Ward Lake is likely mesotrophic (i.e., moderately nutrient enriched). As shown, Capitol Lake is cooler and has more oxygen than the other lakes. It has higher concentrations of both total phosphorous and total nitrogen; however, other measures indicate there is less algal productivity compared to the other lakes. These differences are likely due to the different hydrodynamics of Capitol Lake: the large inflow from the river and low residence time (i.e., the time it takes to replace the water volume). Capitol Lake is typically well mixed and therefore does not stratify into layers with warm, oxygenated water near the surface and cooler, oxygen-depleted waters at depth as is common in most Puget Sound lowland lakes.

### Capitol Lake Water Quality

Overall, Capitol Lake exhibits relatively good water quality when compared to other lakes in the area. Ecologically, the low temperatures and high dissolved oxygen are more supportive of cold water fish than other local lakes.

# Figure 3.3.1 Comparison of Capitol Lake to Other Thurston County Lakes Using Summer 2010 to 2014 Data




## Water Quality in Capitol Lake Compared to the Deschutes River

One of the main objectives of the 2019 data collection effort was to compare BOD, total nitrogen, and TOC between the lake and river to evaluate the extent to which Capitol Lake, rather than the river, primarily: (1) contributes to the delivery of these materials into Budd Inlet, and (2) is a principal contributor to low dissolved oxygen conditions in Budd Inlet. Before this comparison could be made, it was necessary to evaluate the extent to which the 2019 transformer oil spill and/or spill-related activities may have resulted in increases in BOD, total nitrogen, or TOC due directly to the release or movement of additional organic matter that would increase carbon, or due indirectly to increased algae. Based on comparisons between the 2010 to 2014 data and 2019 data, the spills did not appear to have substantial effects on BOD, total nitrogen, and TOC; therefore, the datasets were considered representative for comparisons between Capitol Lake and the inflowing Deschutes River.

Table 3.3.5 compares Deschutes River and Capitol Lake water quality data from monitoring in 2019. As summarized in the table, there was a small decrease in average total nitrogen between the river and lake as

### Key Water Quality Terms

**Dissolved inorganic nitrogen:** The nitrate, nitrite, and ammonium forms of nitrogen most readily available to algae growth.

**Total organic carbon:** A measure of the organic material primarily from decomposing algae and plants.

**Dissolved organic carbon:** The organic material that is dissolved in water.

**Biochemical oxygen demand:** A measure of oxygen consumption needs.

**Total suspended solids:** A measure of the particles suspended in water.

well as decreases in dissolved inorganic nitrogen (DIN). The data also indicate small increases in BOD, total suspended solids (TSS), and TOC between the river and lake but these were generally small in relation to the overall low concentrations measured. Chlorophyll-*a* was not measured in the river, but a comparison between the Middle and North Basin results indicates that chlorophyll-*a* increases as the water moves from the river through the lake. Thus, the increases in BOD, TSS, and TOC are likely due in part to increased algae growth.

## Nutrients and the Low Dissolved Oxygen in Budd Inlet

Ecology studies and modeling have shown the primary contributing role of nutrients in the depletion of oxygen in Budd Inlet. Phosphorus and nitrogen fuel the growth of algae and aquatic plants (sources of TOC) in Capitol Lake, which consume oxygen when they are decomposed in the lake or in Budd Inlet. The Deschutes River and Capitol Lake are sources of nutrients to Budd Inlet along with other sources and can therefore help to fuel the growth of marine algae that also contributes to oxygen depletion.

### Table 3.3.5 Average Summer Water Quality Conditions in the Deschutes River & Capitol Lake in 2019

| Parameter | Deschutes River | Middle Basin Surface | North Basin Surface | North Basin Bottom |
|---|---|---|---|---|
| Total phosphorous (mg/L) | 0.033 | 0.031 (1) | 0.032 (1) | – |
| Soluble reactive phosphorous (mg/L) | 0.017 | 0.014 (1) | 0.010 (1) | ND (2) |
| Total nitrogen (mg/L) | 0.79 | 0.65 | 0.49 (1) | 0.51 |
| Ammonia (mg/L) | – | 0.075 | <0.055 (2) | <0.030 (2) |
| Nitrogen dioxide + nitrate (mg/L) | – | 0.42 | <0.20 (2) | 0.22 |
| Chlorophyll-*a* (µg/L) | – | 3.83 | 14.1 | 10.1 |
| Pheophytin-*a* (µg/L) | – | 1.7 | 3.3 | 3.0 |
| TSS (mg/L) | 1.70 | 1.81 | 2.63 | 2.83 |
| TOC (mg/L) | 1.83 | 2.22 | 2.55 | 2.94 |
| DOC (mg/L) | – | 2.00 | 2.44 | 2.10 |
| BOD (mg/L) | <2.00 (2) | <2.06 (2) | <2.25 (2) | <2.08 (2) |

Notes:

1 For these parameters, 2019 data were likely influenced by unusual events and considered unrepresentative of average conditions. In these cases, average values from 2010 to 2014 are shown.

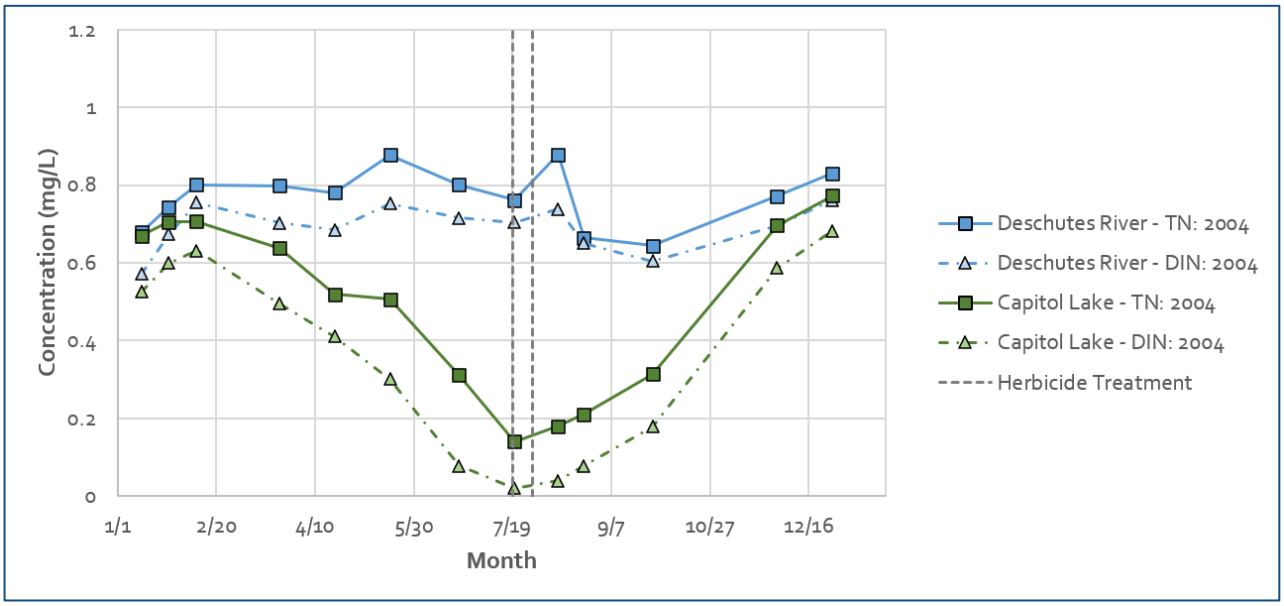
2 SRP data that were collected in 2019 did not represent typical conditions due to extensive spill cleanup efforts.

3 Values with a < indicate the sample set had at least one sample at concentrations less than the detection limit: BOD = 2 mg/L; TSS = 0.5 mg/L; ammonia = 0.01 mg/L; nitrogen dioxide + nitrate = 0.01 mg/L.

Abbreviation: ND = No data

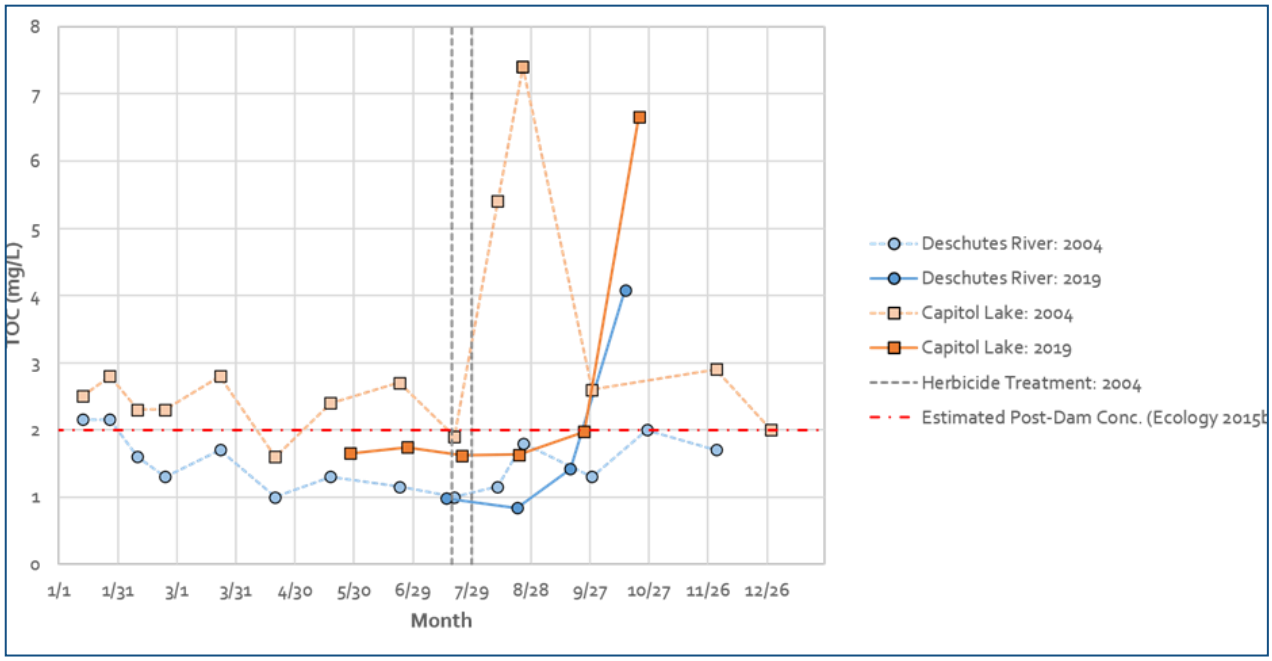
Previous Ecology modeling studies concluded that Capitol Lake increased the load of TOC and decreased the DIN load to Budd Inlet as compared to the river, and these findings are supported by monitoring data. Figure 3.3.2 compares the total nitrogen and DIN concentrations in the river and lake. As shown, the concentrations are consistently lower in the lake during the growing season, and they steadily decrease relative to the river as the growing season progresses. The decrease in DIN over the growing season has been attributed to uptake by plants and algae in the lake.

## Figure 3.3.2 2004 Total Nitrogen and DIN Concentrations in the Deschutes River near Tumwater Falls & the North Basin of Capitol Lake




The conversion of DIN into algae and aquatic plants in the lake corresponds to higher TOC concentrations in the lake relative to the river (Figure 3.3.3). During each monitoring year, the notable peaks in TOC in late summer (2004) or fall (2019) were attributed to aquatic plant die-off; 2004 was not a typical year for plant die-off because of two herbicide applications in the summer to kill aquatic plants. The herbicide applications resulted in nearly immediate die-off of most of the plants, resulting in a large release of TOC in a short period of time in mid-summer (Figure 3.3.3). Under natural conditions, aquatic plants would die off slowly over an extended period in late summer and fall, similar to the timing of increased TOC as observed in 2019 (Figure 3.3.3).

## Figure 3.3.3 Deschutes River & Capitol Lake TOC Concentrations from 2004 and 2019




Note:

The red line indicates the approximate total organic carbon under the Estuary Alternative, reflective of modeled conditions without the 5th Avenue Dam in place during summer months in 1997. This corresponds to the modeled estimate of 5 mg/L of total organic carbon with the 5th Avenue Dam in place.

These monitoring results and previous studies indicate that Capitol Lake may increase the load of TOC to Budd Inlet, but decrease the load of total nitrogen and DIN when compared to the Deschutes River input without the lake. While the differences in nitrogen between the river and lake are clear, there is less distinction in TOC concentrations. While TOC in the lake is consistently higher than the river through most of the summer, they are both generally low overall (below 3 mg/L), with the important exception of the peak that occurs in the lake during late summer or early fall due to plant die-off.

Although an increase in TOC was noted in the lake, there were no concurrent increases in BOD. As described in Section 4.1.1.4 of the Water Quality Discipline Report (Attachment 7), BOD concentrations measured in 2019 were quite low in comparison to TOC concentrations in both the lake and the river; therefore, the TOC is largely made up of organic matter that is resistant to rapid decomposition. This observation implies that the decomposition of organic matter likely occurs very slowly in Budd Inlet, and it may not be contributing much to summer oxygen depletion. In summary, while Capitol Lake results in a modest increase in TOC to Budd Inlet, this TOC may not be exerting an

immediate or substantial oxygen demand in the inlet during the critical summer months.

## Sediment Quality in Capitol Lake

In some lakes, sediments are a major source of nutrients for aquatic plants or algae. Sediments may also contain toxic constituents accumulated over many years that can be harmful to aquatic life. When sediments are disturbed by dredging or other activities, nutrients and chemicals may reenter the water and stimulate algal blooms or cause harm to fish and plankton.

Sediment samples were collected from the Middle and North Basins of Capitol Lake by the EIS Project Team in March 2020 and analyzed for multiple chemicals of potential concern, including metals, organic chemicals (e.g., petroleum hydrocarbons), and phosphorous. Samples were collected from near the sediment surface, from the depth ranges proposed for dredging, and from deeper sediments that would become the new sediment surface after dredging. Sediment quality was found to be generally good with low chemical concentrations in all three layers of both sampled lake basins. No organic chemicals were found to exceed sediment management standards. Except for lead, metals were generally either not detected or detected at low concentrations. The only criterion exceeded was the freshwater Cleanup Screening Level (CSL) for total sulfides protective of benthic invertebrates. High sulfide concentrations are common in lake sediments due to microbial decay of natural organic matter present in algae and aquatic plants.

The amount of bioavailable phosphorus for potential release and algal uptake in the lake is higher in surface sediments in the North Basin than the Middle Basin and much lower in buried sediments that could become exposed by dredging. See Section 3.11.2 for more information on existing sediment quality.

## Capitol Lake Water and Phosphorus Budgets

Water and total phosphorous budgets were developed to quantify sources of total phosphorous to the lake. The budgets were developed using data from water years 2008 to 2012, as this was the most recent 5-year period containing data for all major sources (e.g., both rivers and lake). A water budget is necessary to develop a budget for phosphorus, an important nutrient that can control algae productivity in Capitol Lake, which in turn contributes to the TOC that is part of the oxygen depletion process in Budd Inlet.

### Water and Phosphorous Budgets

A water budget is an accounting of all the water that flows into and out of a Project Area. A phosphorus budget is an accounting of the sources and amounts of phosphorus entering and leaving the lake.

The results of both the water and total phosphorous budgets are described in Section 4.1.3 of the Water Quality Discipline Report (Attachment 7). In many lakes, internal loading of phosphorus from sediments is a substantial source of summer total phosphorous. In Capitol Lake, the high dissolved oxygen and relatively low phosphorus concentrations measured in the bottom waters indicate that loading from sediments is negligible, which is also a finding of the phosphorus budget. Total phosphorous discharged over the dam represents a large portion of the total phosphorous loss during summer. Sedimentation (i.e., loss) of total phosphorous in Capitol Lake appears to be largely a function of the load of phosphorus entering the lake from the Deschutes River.

In summary, the total phosphorus budget found that 96% of the phosphorus entering Capitol Lake during the summer growing season comes from the Deschutes River and Percival Creek, and 79% of phosphorus exits the lake via the tide gate outlet while 21% is retained in lake sediments. Water and sediment budgets support the notion that the Deschutes River strongly influences Capitol Lake physically and ecologically.

### 3.3.4 What modeling studies have been performed in the study area?

There have been several modeling studies of the Deschutes River over the past 10 to 15 years. Although they have primarily focused on the river and its watershed, each has predictions and assumptions that help with understanding existing conditions in Capitol Lake and Budd Inlet. The findings and model predictions related to both Capitol Lake and Budd Inlet are described further in Section 3.3.1.2 of the Water Quality Discipline Report (Attachment 7). A TMDL is currently being prepared for Budd Inlet that will address loadings and allocations associated with Capitol Lake and will likely supersede some of the findings from the studies summarized here; however, the date of issuance for the Budd Inlet TMDL is unknown but anticipated in mid-2022.

#### *3.3.4.1 What were the findings of the Deschutes River TMDL Water Quality Study?*

In 2012, Ecology issued a Deschutes River, Capitol Lake, and Budd Inlet Temperature, Fecal Coliform Bacteria, Dissolved Oxygen, pH, and Fine Sediment Total Maximum Daily Load Technical Report: Water Quality Study Findings Report. The primary goal of the study was to provide the technical basis to support development of Deschutes River TMDL allocations designed to move the river toward compliance with water

quality standards. The water quality analytes addressed by the TMDL include fecal coliform bacteria, temperature, dissolved oxygen, pH, and fine sediment. The study used historical data, as well as supplemental data collected from July 2003 to December 2004, to develop an analytical model of river water quality.

The supplemental data collected represent the only recent comprehensive dataset for some of the analytes such as TOC, BOD, and DIN that are critical to model predictions. As documented in the study, an herbicide treatment was performed in the summer of 2004 to eliminate Eurasian watermilfoil. This treatment resulted in an immediate die-off of a large stand of the Eurasian watermilfoil as well as other aquatic plants. The resultant decomposition would have increased TOC and nutrients and produced immediate algae growth in the lake, as was noted by the researchers. Nutrient and TOC concentrations were likely affected throughout the summer. As documented in the same study, the aquatic plant biomass grew back entirely over the summer and therefore was present to decompose in the fall, and again result in TOC release from the lake. Thus, the magnitude and seasonal relationships for nutrient and TOC discharges to Budd Inlet in 2004 were not representative of a typical year.

The TMDL Water Quality Study Findings served as a precursor to future studies because it calibrated and validated the water quality model for the mainstream Deschutes River as well as a model applied to Capitol Lake. Although the focus of the TMDL was the Deschutes River, Capitol Lake and Budd Inlet were also modeled under current conditions and with removal of the dam.

The TMDL Water Quality Study Findings Report concluded that the combined effects of nonpoint and point sources of pollutant loads from the Deschutes River Watershed exceed the pollutant loading capacity of Budd Inlet and Capitol Lake for nutrients, and reductions in pollutant load were required to meet water quality standards for dissolved oxygen in Budd Inlet.

### *3.3.4.2 Deschutes River TMDL*

Following Ecology's development of a TMDL for multiple water quality indicators in the Deschutes River and other Budd Inlet tributaries, USEPA revised and reissued the TMDL in 2020. These documents and supplemental water quality modeling by Ecology provide information that informs our understanding of existing conditions in Capitol Lake and Budd Inlet.

In 2015, Ecology released the Deschutes River, Percival Creek, and Budd Inlet Tributaries TMDL. The parameters assessed in the TMDL included fine sediment, bacteria, dissolved oxygen, pH, and temperature. In 2018, the USEPA disapproved some portions of the TMDL and then released a revised version in 2020; the revised version from USEPA is the source of information provided in this section unless otherwise indicated.

For this assessment, the TMDL results are primarily of interest for characterizing the quality of water entering Capitol Lake. The TMDL also identifies upstream sources of pollutants that need to be controlled to improve water quality downstream in Capitol Lake and Budd Inlet (e.g., municipal stormwater, hatchery effluent, industrial and construction stormwater, sand and gravel operations). To improve dissolved oxygen levels, the TMDL set allocation targets for total nitrogen and total phosphorous.

The Deschutes River and Percival Creek currently comprise 86% and 9% of the summer total phosphorous load to Capitol Lake, respectively. By replacing the existing concentrations of total phosphorous in these streams with the target concentrations recommended by the TMDL, the summer load of total phosphorous from these sources would decrease by over 30%. If achieved, this decrease would result in significant changes in water quality in Capitol Lake. Based on limited summer 2019 monitoring, average total nitrogen concentrations in the Deschutes River are already very near the target set by the TMDL. Implementation of the TMDL is predicted to contribute to the continuation of declines in phosphorus in the lake and an improvement in lake water quality conditions in the future.

#### 3.3.4.3 Supplemental Scenarios for the Deschutes River TMDL

Ecology performed additional modeling to evaluate 15 different management scenarios for Budd Inlet. The model focused on nitrogen because it typically drives algae production in marine waters, and algae production and decomposition in Budd Inlet is believed to be the major driver of low dissolved oxygen there. The model also focused on TOC as an indicator of organic matter that, when decomposed, contributes to dissolved oxygen depletion.

Relevant to understanding existing conditions, the model attributed dissolved oxygen depletion in Budd Inlet to the 5$^{th}$ Avenue Dam due to a combination of factors:

- The 5th Avenue Dam creates a pulsed flow that alters circulation in southern Budd Inlet.
- The 5th Avenue Dam and Capitol Lake alter concentrations and loads of carbon.
- The 5th Avenue Dam and Capitol Lake alter concentrations and loads of nitrogen. The assimilation of inorganic nitrogen by freshwater plants (e.g., phytoplankton) in Capitol Lake, with resultant production of TOC, alters discharges to Budd Inlet.

The model assumes that much of the DIN is converted to organic nitrogen in plants and algae as the water moves through Capitol Lake. The model predictions for the DIN load to Capitol Lake and impacts on Budd Inlet are supported by 2 years of monitoring data collected by Ecology (2003 and 2004). Figure 3.3.2 shows concentrations of total nitrogen and DIN in the Deschutes River and Capitol Lake as measured in 2004. Generally, the concentrations of nitrogen were higher in the Deschutes River than in Capitol Lake. Similarly, in 2019 (Table 3.3.5), the mean total nitrogen concentration in Capitol Lake was only 62% of what was measured in the Deschutes River.

Monitoring data and model results both support a conclusion that Capitol Lake decreases the total nitrogen and DIN load to Budd Inlet during the summer; therefore, removal of the dam would increase the total nitrogen and DIN load to Budd Inlet. Increased DIN load would supply additional nutrients for algal production in Budd Inlet.

### *3.3.1.2 Budd Inlet*

The hydrodynamics of Budd Inlet are dominated by tidal exchange but are also influenced by inflow from the Deschutes River and Capitol Lake. In Budd Inlet, 75% of the water originates from Puget Sound, and the remaining 25% is from freshwater sources. Budd Inlet has a relatively short residence time (the average time dissolved or suspended matter resides in an estuary), ranging from 8 to 12 days. The rate of discharge over the 5th Avenue Dam is highly variable and depends on Deschutes River discharge. On some days, no water is released; on other days, high volumes of water are released for several hours. The combination of tides and Capitol Lake inflow support a counterclockwise circulation pattern within Budd Inlet.

Water circulation and water quality in Budd Inlet have been altered by the filling of much of the historic estuary (the Port of Olympia peninsula and much of downtown Olympia are part of the historic estuary), the

5th Avenue Dam, Puget Sound conditions, point and nonpoint sources of pollution, and watershed modifications. Studies over the past 20 years or more have focused on the relative importance of many of these factors and how they influence the low dissolved oxygen problems in much of Budd Inlet.

Information on existing conditions in Budd Inlet relevant to evaluating potential project effects include data from water quality monitoring and sediment quality studies, and water quality modeling used to predict dissolved oxygen conditions under different scenarios with or without the 5th Avenue Dam.

### 3.3.5 How is existing water quality in Budd Inlet evaluated?

Existing water quality in Budd Inlet is characterized by comparing monitoring data to water quality standards, comparing water quality conditions in Budd Inlet to other inlets and embayments in Puget Sound, and summarizing nutrient loading information from a previous study.

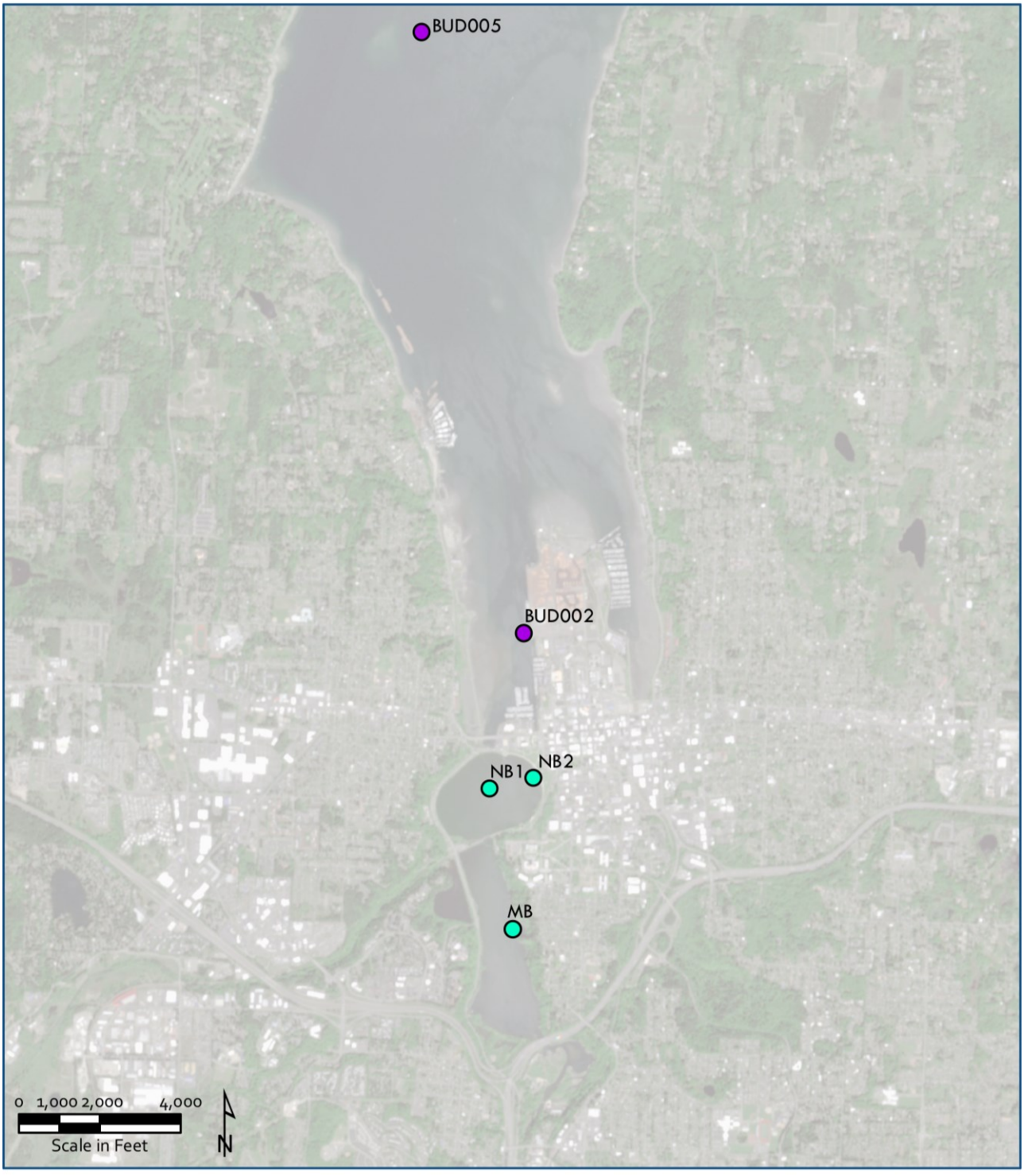
#### *3.3.5.1 How does the water quality compare to water quality standards?*

The current conditions of Budd Inlet were evaluated using data collected from Ecology's Marine Waters Monitoring program at two stations in Budd Inlet: BUD005 (outer inlet) and BUD002 (inner inlet) (Figure 3.3.4).

The water quality standards designate two categories for protection of aquatic life in Budd Inlet. Inner Budd Inlet (south of Priest Point) is categorized as "good quality," whereas waters north of Priest Point are categorized as "excellent quality," with each category having different water quality standards. For dissolved oxygen, there are two parts to the standards: the first are 1-day minimum dissolved oxygen criteria that apply to most marine waters (5.0 mg/L minimum in inner Budd Inlet and 6.0 mg/L minimum in outer Budd Inlet). However, the developers of the state standards recognized that many marine waters, including the long narrow inlets that comprise much of South Puget Sound, have naturally low dissolved oxygen concentrations that are all below the criteria. For these areas, a second part to the standard was developed to limit the amount of decrease in dissolved oxygen that could be caused by human activity. In both parts of Budd Inlet, water quality standards apply that limit human-caused dissolved oxygen depletion to no more than 0.2 mg/L.

For consistency with the evaluation of existing conditions presented for Capitol Lake (Section 3.3.3.1), water quality characteristics from the same period (May through October from 2010 to 2014) are presented for Budd Inlet (Table 3.3.6). Temperature, dissolved oxygen, and pH are typically the worst in summer to early fall, making it an important period for evaluation. For this date range, only data collected in 2014 were available for the BUD002 site.

## Figure 3.3.4 Areas of Interest to Water Quality Discipline Study




**Legend**

- Freshwater monitoring station
- Marine monitoring station

Both Ecology monitoring stations exceeded (did not comply with) the water quality standards for temperature and dissolved oxygen, and the Outer Budd Inlet site (BUD005) also exceeded the pH standard (Table 3.3.6). Inner Budd Inlet experiences consistently lower dissolved oxygen than outer Budd Inlet.

### Table 3.3.6 Comparison of Budd Inlet Water Quality with Applicable Standards (May through October)

| Station | Parameter | Mean | Median | Min | Max | Standard [1] |
|---|---|---|---|---|---|---|
| BUD002 Inner Budd Inlet (2014) | Temp. (˚C) | 13.97 | 13.47 | 10.94 | **19.64** | 19 |
| BUD002 Inner Budd Inlet (2014) | Top dissolved oxygen (mg/L) [2] | 7.21 | 6.10 | **1.97** | 13.54 | 5.0 |
| BUD002 Inner Budd Inlet (2014) | Bot. dissolved oxygen (mg/L) [2] | 6.55 | 5.82 | **3.05** | 10.66 | 5.0 |
| BUD002 Inner Budd Inlet (2014) | pH | 7.55 | 7.53 | 7.21 | 8.04 | 7.0–8.5 |
| BUD005 Outer Budd Inlet (2010–2014) | Temp. (˚C) | 13.37 | 13.56 | 9.00 | **19.36** | 16 |
| BUD005 Outer Budd Inlet (2010–2014) | Top dissolved oxygen (mg/L) [2] | 10.23 | 9.95 | **5.10** | 18.08 | 6.0 |
| BUD005 Outer Budd Inlet (2010–2014) | Bot. dissolved oxygen (mg/L) [2] | 7.49 | 6.99 | **4.83** | 12.80 | 6.0 |
| BUD005 Outer Budd Inlet (2010–2014) | pH | 7.83 | 7.82 | 7.14 | **8.87** | 7.0–8.5 |

Notes:

Bold and shaded values indicate problematic excursions from the standard or Action Level.

1. WAC 173-201A-210 for "excellent" and "good" water quality criteria for BUD005 and BUD002, respectively.
2. Top: 0.0–6.0 m depth; Bottom: 6.5–12 m depth.

Based on mean concentrations, results from the Budd Inlet monitoring stations indicate that surface dissolved oxygen concentrations were more than 3 mg/L lower in inner Budd Inlet than in the outer inlet.

Dissolved oxygen problems normally occur late summer to early fall at both stations.

At the outer station (BUD005), dissolved oxygen appears to be plentiful in the upper portions of the water column most of the time, although the minimum value measured (5.1 mg/L dissolved oxygen) was less than the 6.0 mg/L criterion. In the lower portion of the water column, concentrations were also less than the criterion starting in July and lasting through November. At the inner station (BUD002), dissolved oxygen concentrations were much lower. The period of low dissolved oxygen in the deeper waters below the minimum dissolved oxygen criterion of 5.0 mg/L is shorter than at the outer station, but this difference is primarily a function of the lower dissolved oxygen criterion that applies in inner Budd Inlet (see Figure 4.15 in Water Quality Discipline Report).

Nutrient and chlorophyll-*a* data from Ecology's ambient monitoring for the Budd Inlet sites, summarized in the Water Quality Discipline Report (Attachment 7), indicate that the two stations have similar nutrient concentrations that do not vary substantially between depths, indicating well-mixed conditions. Chlorophyll-*a* concentrations appear to be higher at the outer station (BUD005) based on average values, and the outer station experiences substantially higher maximum concentrations.

#### *3.3.5.2 How does Budd Inlet compare to other South Puget Sound inlets?*

Figure 3.3.5 provides context for dissolved oxygen conditions in Budd Inlet relative to other inlets and embayments in Puget Sound, as predicted by Ecology's Salish Sea model. The figure shows the predicted number of days and areas in Puget Sound that would not meet dissolved oxygen water quality standards during 2006, 2008, and 2014. Budd Inlet, along with most inlets in South Puget Sound, frequently violate the water quality standard for dissolved oxygen. The model shows that Budd Inlet has a relatively high maximum daily depletion of dissolved oxygen due to anthropogenic sources when compared to other South Puget Sound inlets. These model results also indicate that the low dissolved oxygen issues of Budd Inlet are not atypical for inlets in South Puget Sound and they also emphasize the importance of the Deschutes River in moderating dissolved oxygen conditions in Budd Inlet.

**Figure 3.3.5 Ecology-Modeling of Dissolved Oxygen Depletion Resulting in Water Quality Violations**

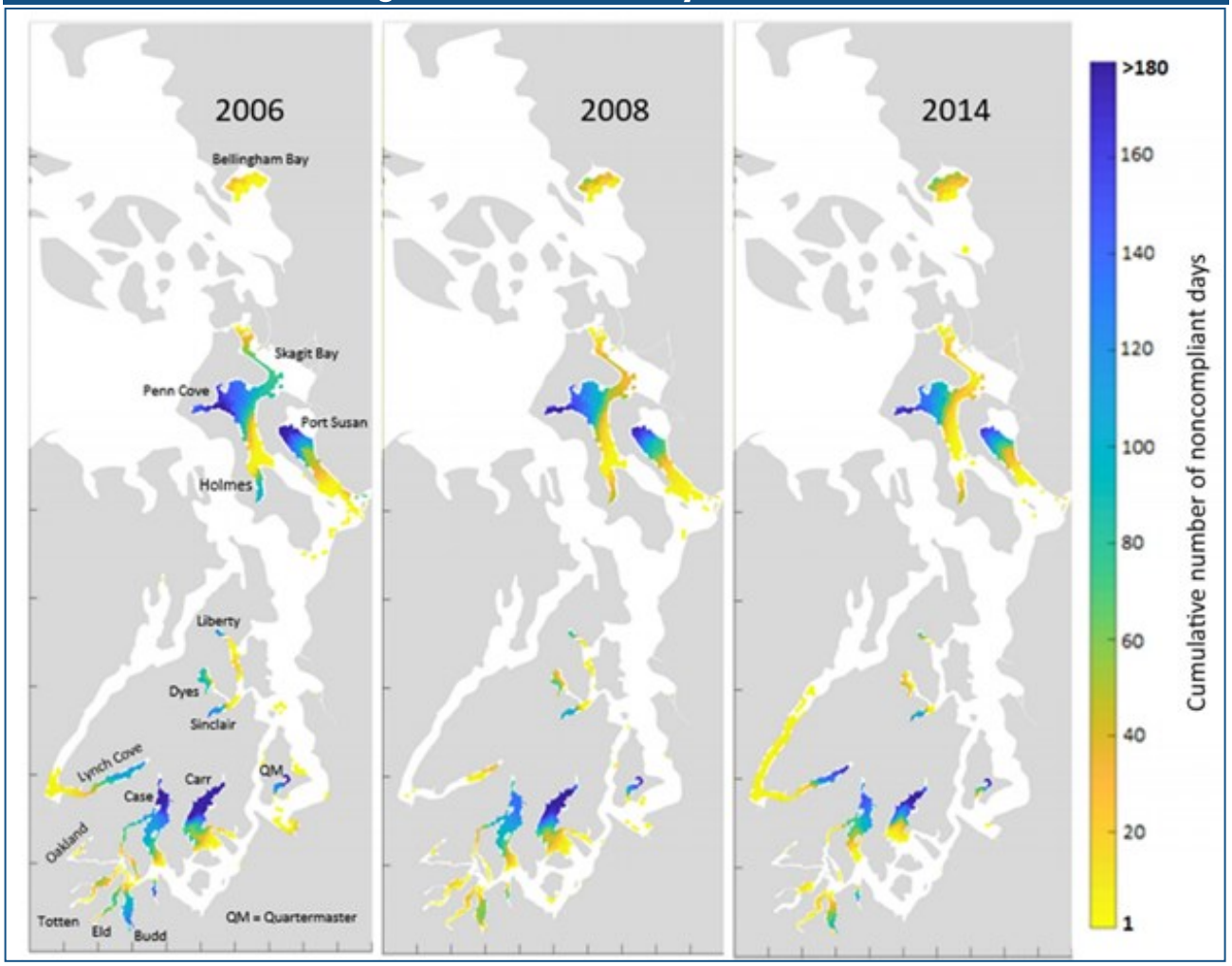



Figure 3.3.5 was generated by Ecology's Salish Sea model, and the predicted dissolved oxygen depletions are less than those predicted by Ecology's Budd Inlet model. Ecology considers the Budd Inlet model to be more accurate for predicting conditions in Budd Inlet. However, the relationships among inlets are assumed to be similar even if the values shown for Budd Inlet are not directly comparable between the models.

### *3.3.5.3 Nutrient Loading to Budd Inlet*

Nutrient loading to Budd Inlet was documented by LOTT in 1998. DIN was specifically analyzed because it fuels algae growth and subsequently results in decreased dissolved oxygen concentrations as the algae die and decompose. Sources of DIN calculated in the LOTT study are summarized in Table 3.3.7. Focusing on the summer months, which is the period of concern for low dissolved oxygen, nutrient loading

estimates show that Puget Sound was by far the largest contributor of DIN to Budd Inlet and that the load from sediments was the next largest source. Combined, these two major sources were predicted to contribute all but 3% to 14% of the summer DIN load to Budd Inlet. Both Capitol Lake and LOTT are predicted to have a larger influence in inner Budd Inlet compared to the entire inlet, where combined they were predicted to contribute 5% to 22% of the summer DIN load.

### Table 3.3.7 Percent of Total DIN Loading to Budd Inlet by Source & Season

| Source | Whole Inlet: Winter | Whole Inlet: Summer | Inner Inlet: Winter | Inner Inlet: Summer |
|---|---|---|---|---|
| Puget Sound | 78–83% | 60–84% | 73–78% | 47–82% |
| Sediments | 2–11% | 6–34% | 0.4–6.0% | 0.7–37% |
| Capitol Lake | 7–11% | 1–8% | 12–17% | 3–14% |
| LOTT | 2–5% | 1–3% | 3–7% | 2–8% |
| Other Inputs | 1–2% | 1–3% | 1–2% | 1–5% |

Winter: November–January; Summer: July–September.

## 3.3.6 What is the sediment quality in Budd Inlet?

Sediments can release nutrients and other chemicals into the water column, affecting water quality. Sediment quality criteria include thresholds for effects on benthic (i.e., bottom-dwelling) marine life and criteria to protect human and ecological health from harmful exposures to bioaccumulative chemicals (e.g., dioxins and carcinogenic hydrocarbon chemicals that become more concentrated moving up the food chain). Based on recent studies, sediment chemical concentrations generally do not exceed Sediment Management Standards (SMS) and DMMP criteria for marine benthic toxicity in West Bay of Budd Inlet except for a few chemicals in some samples collected near stormwater outfalls in marinas and at the Port of Olympia along the eastern shoreline of West Bay. Additional information can be found in Section 3.1, Hydrodynamics and Sediment Transport, Section 3.11, Environmental Health, and the Sediment Quality Discipline Report (Attachment 15). In general, lower concentrations of organic chemicals and metals were found in the central and southwest areas of West Bay. Generally, sediment quality in Budd Inlet has not met human and ecological health criteria for bioaccumulative chemicals in West Bay. Some carcinogenic hydrocarbons slightly exceed regional background levels and may increase risks to wildlife and people.

The benthic invertebrate community in West Bay is currently impacted from the high organic matter content of surface sediments, not the low

chemical concentrations. The average TOC concentration in Budd Inlet sediments is 3.7%, which slightly exceeds the typical range of 0.5% to 3.5% for Puget Sound.

### 3.3.7 How were potential human-caused impacts to water quality in Budd Inlet evaluated?

The most detailed information on existing conditions in Budd Inlet relevant to the project is from Ecology's Deschutes River, Capitol Lake, and Budd Inlet TMDL Study (2015). This Ecology model was used to predict current and natural conditions in Budd Inlet and evaluate various scenarios to quantify the effects of different anthropogenic sources on dissolved oxygen in Budd Inlet. The results focused largely on predicting the magnitude of human-caused dissolved oxygen depletion in comparison to the modeled natural conditions. Model outcomes for both the cumulative effects of all human-caused influences and for effects attributed solely to the presence of the 5$^{th}$ Avenue Dam are described under the evaluation of long-term water quality impacts (see Section 4.3, Water Quality).

### 3.3.8 How would existing water quality in the Project Area be summarized?

Capitol Lake is a small, eutrophic (i.e., biologically productive) waterbody that experiences dense aquatic plant growth and algal blooms typical of many lowland lakes in Puget Sound. Conditions in Capitol Lake are strongly influenced by inflows from the Deschutes River, which result in rapid flushing of the lake and well-mixed water. Monitoring indicates improving trends in water quality in the Deschutes River and Capitol Lake. Capitol Lake does not meet all applicable water quality standards; relative to other lakes in the region, however, Capitol Lake exhibits comparable or better water quality (based on temperature, dissolved oxygen, and chlorophyll-*a* levels).

Budd Inlet is also a productive system that supports extensive algal blooms. Dissolved oxygen is routinely less than the numeric minimum criteria (primarily in the bottom waters) at both the outer and inner Budd Inlet monitoring stations in the summer and early fall. To a large extent, the low dissolved oxygen is a natural condition that occurs in other inlets and embayments in South Puget Sound. The water quality standards acknowledge that dissolved oxygen concentrations may be naturally low, and in those cases the water quality standards are aimed at limiting human-induced sources of dissolved oxygen depletion. The standards allow for a human-induced dissolved oxygen depletion of no more than 0.2 mg/L. Ecology modeling has indicated that human-

induced sources in Budd Inlet are responsible for up to 3.1 mg/L of dissolved oxygen depletion (based on worst-case in East Bay), and therefore Budd Inlet does not meet the applicable water quality standard.

Recent modeling by Ecology has indicated that Capitol Lake and the 5th Avenue Dam are the primary cause of human-induced depletion of dissolved oxygen in Budd Inlet, and that they may account for up to 1.8 mg/L of depletion (based on the worst-case location in East Bay from Ecology's model). The Ecology model attributes dissolved oxygen depletion from Capitol Lake to altered circulation caused by operations of the 5th Avenue Dam but more so due to loading of carbon from Capitol Lake. For Capitol Lake, Ecology's model results indicated that "the production and decomposition of organic carbon is the process that is most responsible for depletion of dissolved oxygen in Budd Inlet."

Monitoring data summarized above and Ecology's model both indicate that DIN is higher in the Deschutes River compared to Capitol Lake. Conversely, the data and model also indicate that TOC is lower in the Deschutes River compared to Capitol Lake. This relationship is likely a result of the uptake of inorganic nitrogen by algae growth in Capitol Lake that then increases TOC, which is eventually discharged to Budd Inlet. Ecology's model predictions for scenarios looking at removal of the 5th Avenue Dam are described in the section evaluating long-term water quality impacts of alternatives (see Section 4.3, Water Quality).

## 3.4 AQUATIC INVASIVE SPECIES

Aquatic invasive species (AIS) are non-native plants and animals that rely on the aquatic environment for a portion of their life cycle and can spread to new aquatic areas, causing economic or environmental harm.

The study area for AIS includes the Capitol Lake Basin, Percival Creek up to US Highway 101, the Deschutes River upstream of Tumwater Falls, and West Bay extending north from the 5th Avenue Dam to the southern end of Priest Point Park near the mouth of Mission Creek (47 07'N). This area is based on the local aquatic resources where AIS could be directly affected by the project and does not include distant waterbodies where AIS potentially could be transported to by project-related activities.

Capitol Lake has a well-documented presence of AIS including plants, invertebrates, fish, waterfowl, and aquatic mammal species. The presence of AIS has resulted in closure of Capitol Lake to all water-based use.

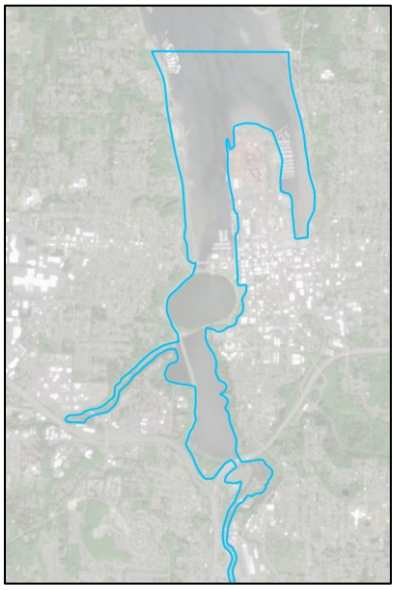


*Exhibit 3.30 Aquatic Invasive Species study area*

## Methods for Studying Aquatic Invasive Species

An extensive literature review was conducted to evaluate AIS in the study area. Information was derived from existing management plans (e.g., vegetation management, annual reports of aquatic weed treatments, and recommendations for invasive species treatments), surveys that have been conducted to monitor the presence and distribution of AIS in Capitol Lake, databases on invasive species, and research papers and studies that focused on detection, species biology, population fluctuations, transport and spread, and treatment options and effectiveness.

**For further information on data sources, see the Aquatic Invasive Species Discipline Report (Attachment 8).**

### 3.4.1 What AIS species are discussed in the EIS?

Although there are numerous species of plant and animal AIS in Capitol Lake and within the study area, the EIS focuses on the four high-priority AIS in the Capitol Lake Basin: purple loosestrife, Eurasian watermilfoil, New Zealand mudsnail, and nutria (refer to Table 3.4.1). This section provides a summary of their documented presence in the study area, the ecological impact of their presence, and previous and current management efforts to control their presence and spread. For more detailed information on the full analysis of the high-priority AIS, including additional tables and figures, refer to the Aquatic Invasive Species Discipline Report, provided as Attachment 8.

For a brief summary of the non-high priority AIS within the study area, which include plants, invertebrates, fish, waterfowl, and aquatic mammal species, refer to Section 3.4.3. These species are discussed in full detail in the Aquatic Invasive Species Discipline Report (Attachment 8).

## How many AIS exist in Capitol Lake?

Fifteen different AIS have been documented in Capitol Lake in recent survey efforts.

These include:

- 3 emergent plant species
- 1 floating leaved plant
- 2 submersed plant species
- 3 invertebrates
- 4 fish species
- 1 waterfowl
- 1 mammal

**Table 3.4.1 High Priority Aquatic Invasive Species Observed in the Study Area**

| Scientific/ Common Name | State Status [1] | Waterbody | Relative Abundance |
|---|---|---|---|
| Aquatic Invasive Plant: *Lythrum salicaria* Purple loosestrife | Class B High Priority | Capitol Lake, Deschutes River, Budd Inlet | High in the South Basin and Percival Cove; low in the Middle and North Basins |
| Aquatic Invasive Plant: *Myriophyllum spicatum* Eurasian watermilfoil | Class B High Priority | Capitol Lake | Moderate in South Basin, Middle Basin, and Percival Cove; low in North Basin |
| Aquatic Invasive Animal: *Potamopyrgus antipodarum* New Zealand mudsnail | Prohibited High Priority | Capitol Lake | 20,000 snails per square meter in limited areas of the North Basin |
| Aquatic Invasive Animal: *Myocastor coypus* Nutria | Prohibited High Priority | Capitol Lake | Fewer than 25 animals |

Note:

1 Washington State Noxious Weed Class (WNWCB 2020) or High Priority Invasive Species (WISC 2020c).

## 3.4.2 What are the high-priority invasive plants in the study area?

### *3.4.2.1 Purple Loosestrife*

Purple loosestrife (*L. salicaria*) is a non-native emergent species typically found in freshwater and brackish wetlands, along streams, and in other wet areas. It has narrow, lance-shaped leaves; showy purple flowers that occur in erect spikes at the top of stems from late June through October; and a rhizomatous growth pattern.

*Exhibit 3.31 Purple Loosestrife (Source: gailhampshire https://creativecommons.org/licenses/by/2.0/deed.en)*

The plant is a vigorous grower that spreads by rhizomes or by seed. Purple loosestrife forms dense colonies that outcompete native plant species and provide minimal wildlife habitat. These dense colonies can also be detrimental to aesthetics and inhibit access to shorelines for recreation. Management of purple loosestrife is a costly effort requiring repeated monitoring and removal efforts to prevent its spread. The seeds can be viable for several years.

#### Current Distribution of Purple Loosestrife within the Study Area

Purple loosestrife was first discovered in Capitol Lake in 1986. Figure 3.4.1 presents the most current map of purple loosestrife distribution in the study area, as of 2018. Observation points and areas

where purple loosestrife was observed are colored in purple. Purple loosestrife was most abundant in the South Basin but was present along the shorelines of all three basins, at the Interpretive Center wetland areas, and Percival Cove. Only one plant was observed in the North Basin, and no plants were observed along the east shoreline of the Middle Basin.

Although purple loosestrife is a high-priority species based on its aggressive growth and potential impacts on native species, it is not likely significantly impacting native wildlife or recreation in and around the Capitol Lake Basin based on its current abundance and the emergent plant diversity.

### Management of Purple Loosestrife

Over the years, the Thurston County Noxious Weed Control Board and the Washington State Department of General Administration (GA; now Enterprise Services) have employed numerous mitigation efforts to decrease the spread of purple loosestrife in Capitol Lake.

Starting in 1989, removal techniques such as flowerhead removal, aquatic herbicide treatment, impacted soil removal, and beetle application were conducted. In general, although the presence of purple loosestrife would sometime decrease after treatment, the lack of continuity in treatments from year to year and the lack of monitoring after control efforts were implemented limited the understanding of the efficacy of management actions.

In 2001, under direction from the CLAMP Steering Committee, the Capitol Lake Integrated Purple Loosestrife Management Plan was adopted, which established the goal to eradicate purple loosestrife from Capitol Lake and adjacent areas. In this plan, a combination of monitoring, public education, chemical control with glyphosate spot-treatment, biological controls (insect introductions), and manual removal were recommended.

Since 2001, the primary methods to remove purple loosestrife have been through the application of glyphosate and later, application of the herbicide imazapyr and seed head removal. The populations and densities of purple loosestrife have decreased and increased throughout Capital Lake since 2001. In 2019, continued use of surveys, seed head removal, and imazapyr treatments was recommended for future years because purple loosestrife has continued to persist throughout the basin. Surveys conducted in 2016, 2017, and 2018 indicate density and numbers of purple loosestrife have stabilized.

## Purple Loosestrife

Purple loosestrife is a wetland plant native to Europe and Asia that was brought to North America in the early 19th century. This highly invasive plant was likely introduced when its seeds were included in soil used as ballast in European sailing ships and discarded in North America.

It reproduces primarily by seed. Each plant may produce up to 2.7 million seeds annually. It can also spread through stem cuttings and root fragmentation.

The seeds can be viable for several years, but because the seeds are small and carry little food reserves, germination must occur when photosynthesis can occur immediately.

## Figure 3.4.1 Purple Loosestrife Distribution in Capitol Lake in 2018

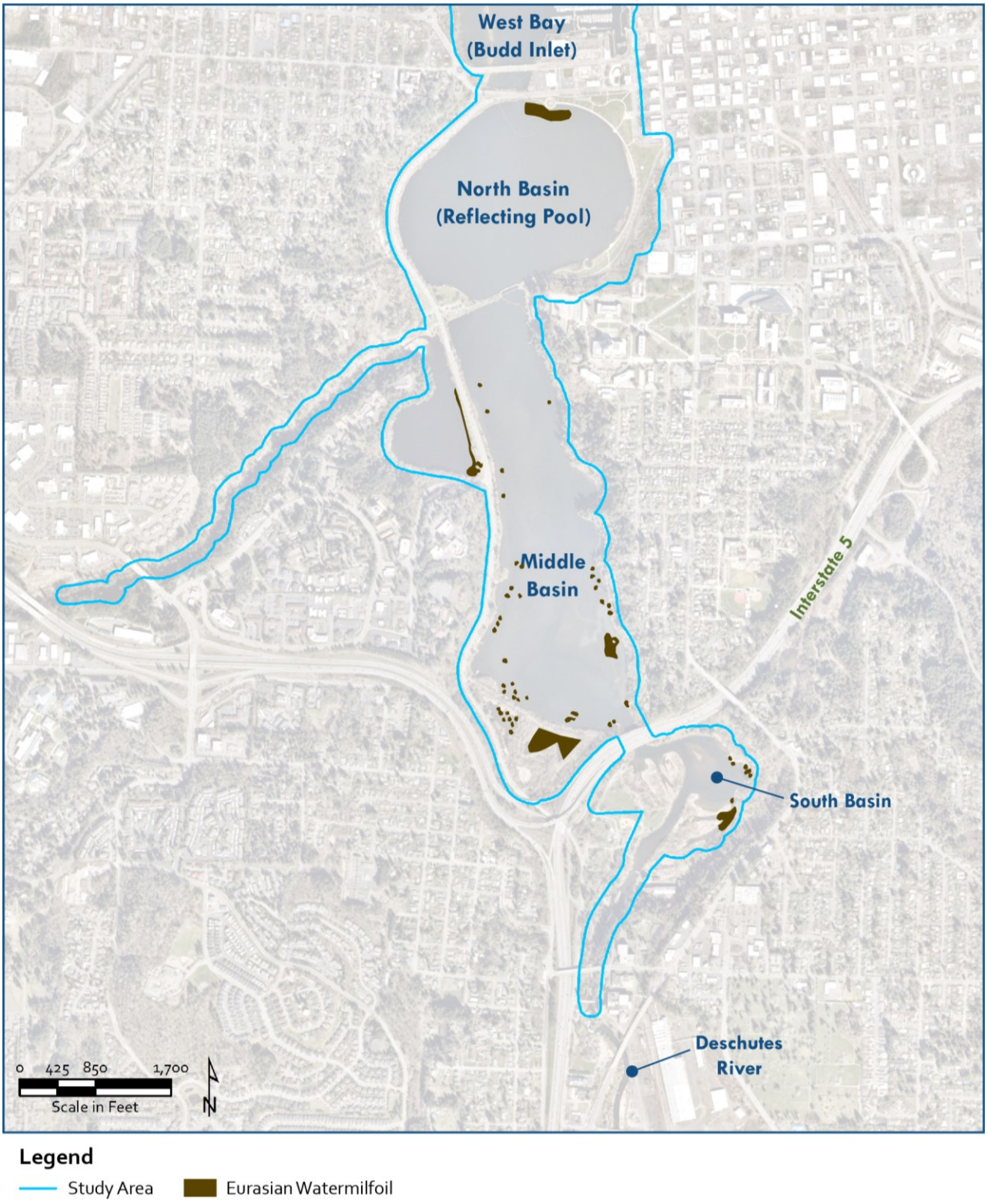
### 3.4.2.2 Eurasian Watermilfoil

Eurasian watermilfoil (*M. spicatum*) grows submersed below water surfaces. The plant has feather-like underwater leaves, emergent flower spikes, and many fibrous roots. Roots may form on broken plant fragments, enabling the plant to spread by plant fragments in addition to spreading by rhizomes. The abundance of viable plant fragments allows this plant to rapidly spread and colonize new areas and it commonly forms dense, thick mats early in the growing season due to its rapid growth rate of up to 1 foot per week. These mats reduce sunlight and oxygen in underlying waters, which degrade water quality, outcompete native vegetation, decrease habitat quality for native fish species, and inhibit recreational activities. Management of Eurasian watermilfoil is costly, requiring repeated monitoring and removal efforts to prevent its spread.

#### Current Distribution of Eurasian Watermilfoil within the Study Area

The Eurasian watermilfoil was first reported in Capitol Lake in September 2001. Figure 3.4.2 presents the most current map of Eurasian watermilfoil distribution in the study area, as of 2018. Observation points and areas where Eurasian watermilfoil was observed are colored in brown. Individual plants and patches of plants were observed in all three basins, the Interpretive Center wetland areas, and Percival Cove. The large patch observed in the North Basin adjacent to the 5$^{th}$ Avenue Dam had not been observed in previous surveys. Although Eurasian watermilfoil is a high-priority species based on its aggressive growth and potential impact on native species, it is likely not significantly impacting native wildlife or recreation in and around the Capitol Lake Basin based on its current abundance and the aquatic plant habitat diversity.

## Figure 3.4.2 Eurasian Watermilfoil Distribution in Capitol Lake in 2018



Native submersed plants currently impact the ability of maintenance vessels to navigate within Capitol Lake in summer, because they grow up to the water surface over most of the lake area. This dense vegetation is coontail *(Ceratophyllum demersum)* not Eurasian watermilfoil.

***Exhibit 3.32 Coontail as seen from survey vessel***

## Management of Eurasian Watermilfoil

Similar to the purple loosestrife, numerous management efforts have been employed to decrease the spread of Eurasian watermilfoil in the study area.

Shortly after Eurasian watermilfoil was discovered in Capitol Lake, the CLAMP Steering Committee adopted an Invasive Aquatic Vegetation Management Plan in 2002 that included application of an herbicide triclopyr and subsequent monitoring to determine whether it was successful.

In 2004, triclopyr was applied to Eurasian watermilfoil throughout the study area. The Washington State Department of Agriculture monitored the application process and noted that triclopyr was effective in killing Eurasian watermilfoil, and it dissipated quickly, and did not harm native aquatic vegetation.

In 2005, the GA would periodically monitor and remove observed plants manually using contracted divers, equipped with a water vacuum to capture any floating fragments.

From 2007 to 2018, Eurasian watermilfoil was surveyed annually and removed manually by a boat and/or snorkel team. In 2007, 1,386 plants were removed from the South and Middle Basins. The number of plants removed from these basins decreased annually thereafter, with only six plants requiring removal in 2013 and 2014. However, the number of plants removed then increased each year up until 2018 when 105 plants required removal.

Other control strategies were employed throughout the study area, such as biocontrol (i.e., through application of the watermilfoil weevil) and installation of bottom barriers. However, neither method was very successful in controlling the spread of the Eurasian watermilfoil over time. Barriers installed on the lake bed were initially thought to be effective but require ongoing maintenance because they are susceptible to displacement, degradation, and sediment accumulation.

### How pervasive can Eurasian watermilfoil be in the environment?

In 2009, only one Eurasian watermilfoil plant was reported in Capitol Lake (in Percival Cove). Between 2012 and 2013, approximately 4,820 pounds of Eurasian watermilfoil were removed by divers, indicative of the fast rate of spread for Eurasian watermilfoil.

***Exhibit 3.33 Example of Eurasian watermilfoil removal by hand at Green Lake in Seattle, Washington***

## 3.4.3 What are the high-priority invasive animals in the study area?

### *3.4.3.1 New Zealand Mudsnail*

The New Zealand mudsnail (*P. antipodarum*) is an invertebrate AIS. It is a very small (4 to 6 millimeters [mm]) freshwater snail with an elongated shell. The opening of the shell has an operculum, which is a retractable lid that can seal the shell. The operculum allows the mudsnail to protect itself from short-term exposure to chemicals and allows them to survive outside water for long periods of time (i.e., up to several months).

The New Zealand mudsnail is self-cloning and one female is enough to initiate a new population. New Zealand mudsnails are found in shallow freshwater and brackish water ecosystems. Due to their ability to survive outside the aquatic environment for several weeks to months, new populations can be established through inadvertent transport on boots, gear, and equipment.

In addition to outcompeting native species for natural resources, their ability to withstand highly variable environmental conditions allows New Zealand mudsnails to take advantage of changing environmental conditions, including climate change, to further spread and outcompete native species. By outcompeting native species, the New Zealand mudsnail reduces prey species for native fish, resulting in reduced body weight and health of native salmonids.

Biofouling is the major economic impact associated with the introduction of New Zealand mudsnails, as they can pass through water pipes and emerge from domestic taps, and can ultimately block pipes and meters.

#### Current Distribution of New Zealand Mudsnail within the Study Area

New Zealand mudsnails were first observed in Capitol Lake in 2009. Multiple surveys over the years have shown them to be present throughout the study area, including the North Basin, Middle Basin, and the Deschutes River, but they have not been found extending into nearby creeks and tributaries.

In 2015, a survey did not find any New Zealand mudsnails in the five new sites in streams and lakes that were surveyed within a 5-mile radius of Capitol Lake, including Percival Creek. Since the 2015 survey, there have been no reported sightings of the New Zealand mudsnail in Percival

*Exhibit 3.35 New Zealand mudsnail distribution in Capitol Lake in 2013 (red points positive, black points negative) (Source Pleus 2016)*

Creek or other nearby waters, suggesting that the spread of mudsnails from the lake has been very limited over the past 10 years. The New Zealand mudsnail has effectively been contained within the Capitol Lake Basin by prohibiting public access to the lake.

New Zealand mudsnails are currently affecting recreational opportunities in the project area because active use of the Capitol Lake Basin was prohibited as a result of their presence. The impact of New Zealand mudsnails on native wildlife is unclear. Several native species of snails are also abundant in Capitol Lake, and the New Zealand mudsnail population has not overtaken the benthic community in the lake as was expected.

### Management of New Zealand Mudsnails

Given the persistence of the New Zealand mudsnail, avoiding or minimizing further spread relies heavily on public outreach and education. Other potentially effective management approaches were identified through literature review, preliminary testing, past experience within Capitol Lake, and professional judgement. The management approaches are described in this section.

#### *Freezing*

Freezing has increased the mortality of the New Zealand mudsnail when the lake bed has been drained and exposed to hard freezing weather conditions for a few consecutive days. However, this is highly dependent upon the weather being cold and dry without insulating snow, which is an unusual combination of conditions for the Capitol Lake area.

In December 2016, Enterprise Services lowered the level of Capitol Lake as a management approach. The New Zealand mudsnail mortality varied depending on location. For example, mortality near Marathon Park was approximately 50%, while mortality along Powerhouse Road SW was approximately 90%. These differences were attributed to the proportion of the survey areas exposed to freezing conditions, where less mortality was observed when more area was below ice cover.

#### *Heat and Desiccation*

Heat and desiccation through local weather conditions is more frequently achieved than dry and freezing conditions. However, this seasonally dependent action requires several consecutive hot-dry days and has been shown in productive lakes to cause nuisance odors from decaying algae and aquatic plants and animals. Both the freezing and heat factors are limited in Capitol Lake by the mild climate and constant inflow from the Deschutes River.

### New Zealand Mudsnail

There are several factors that contribute to the difficulty in controlling New Zealand mudsnail.

Per WDFW, a single female self-clones at a rate that results in a colony of 40 million snails over the course of one year. Mudsnails are often found in densities up to 500,000 snails per square meter and can travel at a rate of up to 10 feet per hour.

The New Zealand mudsnail can completely seal its shell, which allows the snail to survive out of water for several weeks in cool, damp conditions.

### *Saltwater Backflush*

In 2010, an experiment was done in Capitol Lake to see if increased salinity would cause mortality of the New Zealand mudsnail. The lake was backflushed with water from West Bay to test the tolerance of the New Zealand mudsnail to higher salinities and thermal shock. Researchers found the snails had significantly higher mortality at higher salinities that increased with higher temperatures. While increasing the salinity may increase mortality, the experimental backflush resulted in a reduction of the entire macroinvertebrate community and was subsequently discontinued as a management approach. Researchers also speculated that after the lake returned to normal freshwater conditions, the backflush could result in a larger mudsnail population as a product of rapid reproduction and newly available resources that are no longer consumed by competing species.

#### Are New Zealand mudsnails tolerant to salinity?

A 50% mortality rate for New Zealand mudsnails from a freshwater environment begins at 22 parts per thousand salinity (ppt or practical salinity unit); whereas the 50% mortality rate of New Zealand mudsnails from estuary environments averages at 38 ppt salinity.

Salinity levels in West Bay are observed at 26 to 30 ppt.

The New Zealand mudsnail's salinity tolerance has been shown to increase with marine water exposure.

### *Chemical Agents*

Two chemical agents have been examined for use in Capitol Lake (1) Bayluscide (with niclosamide as the active ingredient) and (2) sodium chloride. Bayluscide acts quickly, killing the New Zealand mudsnail before they have a chance to respond or find protection. Sodium chloride is much slower, allowing the snail to close its operculum and wait for the toxic level of the introduced agent to dissipate. However, further study is needed to better understand how it might perform in a field application.

Neither chemical is currently allowed for aquatic use under the Aquatic Invasive Species Management Permit, but application of either chemical may be allowed by an experimental use permit or addition of the chemical to the existing permit as part of its 5-year update, which is next due in 2021, then 2026, and so on.

In addition to treatment efforts to control the New Zealand mudsnail population growth and spread, public outreach and education can help to prevent the spread by human activity. Existing signage warns recreational users at Marathon Park of New Zealand mudsnail infestations. Although educational outreach is a helpful approach to encourage public awareness and control, signs alone are not effective to prevent the spread of invasive species.

## *3.4.3.2 Nutria*

Nutria (*M. coypus*) is a mammal AIS. Nutria are semiaquatic rodents native to South America. Adults are approximately 2 feet long with dark

brown fur and large orange teeth. Although they are often mistaken for beavers, nutria have a thin tail. Nutria breed year-round and can produce up to three litters a year, with a litter size ranging from 2 to 9 young. In their introduced range, nutria have few natural predators.

*Exhibit 3.36 Nutria (Source: WDFW)*

Although they are well adapted for movement on land, nutria are more at home in the water and prefer slow-flowing streams, lakes, and freshwater marshes as well as brackish and saltwater habitats. Nutria are herbivores and feed mostly on wetland plants, targeting the base of plant stems, and they dig for roots and rhizomes in the winter. They often construct circular platforms of compacted, coarse emergent vegetation for use during feeding, birthing, resting, and grooming. They also construct burrows in levees, dikes, and embankments.

Nutria negatively impact invaded ecosystems. Their feeding activity destroys marsh vegetation, transforming marsh areas into open water, displacing native species; their burrows undermine water-management infrastructure and destabilize banks, increasing erosion along shorelines; and they host infectious diseases that affect humans, livestock, and wildlife.

## Current Distribution of Nutria within the Study Area

In 1935, nutria were brought to Washington for use in the fur industry. It is unknown whether they escaped or were intentionally released when fur farming was no longer profitable; however, they spread rapidly throughout western Washington. Nutria observations in Capitol Lake were first recorded in 1975.

Although nutria are a high-priority species based on their potential impacts, they are not likely significantly impacting water quality or native plants and wildlife in the Capitol Lake Basin based on the current abundance.

## Management of Nutria

Typically, feral populations of nutria are managed by shooting and trapping. Eradication is preferable for small- to medium-sized populations, but some level of control is essential in most cases if eradication is not feasible. Fences, walls, and other structures can reduce nutria damage, but high costs usually limit their use. No chemical repellents for nutria are currently registered. Other rodent repellents (such as Thiram) may repel nutria, but their effectiveness has not been evaluated.

The U.S. Department of Agriculture Wildlife Service was under contract with Enterprise Services from 2014 to 2019 to manually control the population in and around Capitol Lake. In 2017, they conducted a survey for areas of fresh nutria activity and removed one nutria. No nutria were observed during night survey efforts, and an estimated number of nutria in the basin was not determined.

### 3.4.4 What other aquatic invasive plants and animals are in the study area?

Although the EIS focuses on the four high-priority AIS in the Capitol Lake Basin, Capitol Lake has a well-documented presence of other non-high priority AIS that include plants, invertebrates, fish, waterfowl, and aquatic mammal species.

Table 3.4.2 provides a summary of their classification status, abundance in the study area, and previous and current management efforts to control their presence and spread. For more detailed information on the remaining AIS in the study area, including additional tables and figures, refer to the Aquatic Invasive Species Discipline Report (Attachment 8).

**Table 3.4.2 Non-High Priority Aquatic Invasive Species Observed in the Study Area**

| Scientific/Common Name/State Status | Relative or Estimated Abundance | Previous Management Techniques | Current Management Techniques |
|---|---|---|---|
| Plants:<br>*Iris pseudacorus*/<br>Yellow flag iris/<br>Class C | High in the South and Middle Basins; moderate in Percival Cove; low in the North Basin | Annual surveys<br>Treatment with 3% solution of glyphosate | Annual surveys<br>Treatment with 1.5% solution of imazapyr<br>Seed removal from plants |
| Plants:<br>*Phalaris arundinacea*<br>Reed canary grass/<br>Class C | Present at unknown locations in 2006 | No management or monitoring efforts have been conducted | No management or monitoring efforts have been conducted |
| Plants:<br>*Nymphaea odorata*/<br>Fragrant waterlily/<br>Class C | Moderate in the North Basin and Percival Cove; low to zero in the Middle and South Basins | Annual surveys<br>Cutting of leaves and tops of stems to stress the plants | Annual surveys<br>Cutting of leaves and tops of stems to stress the plants |
| Plants:<br>*Potamogeton crispus*/<br>Curlyleaf pondweed/<br>Class C | Present at unknown locations in 2006 and primarily in the south end of lake in 2004 | Low abundance; no management or monitoring efforts have been conducted | Low abundance; no management or monitoring efforts have been conducted |
| Invertebrates:<br>*Corbicula fluminea*<br>Asiatic clam/<br>Not listed | Present in 2003 along the west shoreline of the North Basin | Low abundance; no management or monitoring efforts have been conducted | Low abundance; no management or monitoring efforts have been conducted |

| Scientific/Common Name/State Status | Relative or Estimated Abundance | Previous Management Techniques | Current Management Techniques |
|---|---|---|---|
| Invertebrates: *Radix auricularia*/ European ear snail/ Not listed | Present in 2003 in Capitol Lake | Low abundance; no management or monitoring efforts have been conducted | Low abundance; no management or monitoring efforts have been conducted |
| Fish: *Cyprinus carpio*/ Common carp/ Regulated | Fewer than 200 fish | No management or monitoring efforts have been conducted | No management or monitoring efforts have been conducted |
| Fish: *Ameiurus nebulosus*/ Brown bullhead/ Not listed | Fewer than 50 fish | Enhancing native predation | Physical removal and chemical agents (but can affect native species) |
| Fish: *Micropterus salmoides* Largemouth bass/ Not listed | Fewer than 200 fish | Low abundance; no management or monitoring efforts have been conducted | Low abundance; no management or monitoring efforts have been conducted |
| Fish: *Perca flavescens*/ Yellow perch/ Not listed | Fewer than 50 fish | Low abundance; no management or monitoring efforts have been conducted | Low abundance; no management or monitoring efforts have been conducted |
| Waterfowl: *Branta canadensis*/ Canada goose/ Not listed | 142 birds | Surveys<br>Addling eggs in nests and good removal | Surveys<br>Addling eggs in nests and good removal |

## 3.5 FISH & WILDLIFE

Aquatic and terrestrial habitats in the Capitol Lake Basin support a variety of native and non-native fish and wildlife species, including aquatic invasive species. The presence, abundance, and distribution of these species reflect the current habitat conditions, which differ from historical conditions because of the construction of the 5th Avenue Dam in 1951, and other development actions.

The study area for fish and wildlife includes the Capitol Lake Basin from Tumwater Falls to West Bay and the marine waters of West Bay, including associated riparian, wetland, and upland terrestrial habitats. The study area also encompasses Percival Cove and Percival Creek to where changes could occur as a result of the action alternatives.

*Exhibit 3.37 Fish and Wildlife study area*

Fish, wildlife, and the habitats on which they depend are protected by various federal, state, and local laws and regulations. These include

(among others) the federal Endangered Species Act (ESA), Magnuson–Stevens Fishery Conservation and Management Act, the Migratory Bird Treaty Act, the Washington State Hydraulic Code, and local critical area regulations.

Additional information on the regulatory context for fish and wildlife resources is presented in the Fish and Wildlife Discipline Report (Attachment 9).

## Methods for Studying Fish & Wildlife

Information on fish and wildlife species in the study area was derived from available scientific literature, technical reports, and data from various federal, tribal, state, and local agencies. The analysis focuses on specific species groups for fish (based on similar habitat preferences) or indicator species for wildlife (specifically selected for this project) whose response to impacts is representative of a larger group of species.

**For further information on data sources, see the Fish and Wildlife Discipline Report (Attachment 9).**

## 3.5.1 Fish

### *3.5.1.1 What are current aquatic habitat conditions in the study area?*

The construction of the 5th Avenue Dam in 1951 changed the Capitol Lake Basin from an estuary to a freshwater impoundment. Prior to that time, the Deschutes River flowed to Budd Inlet, with the current-day Capitol Lake Basin consisting of estuary habitat and substantial tideflats (also called mudflats). Construction of the 5th Avenue Dam limited anadromous fish passage, created a barrier to tidal exchange, and altered natural hydrological and sediment transport processes. The study area now includes riverine, lacustrine (lake), and estuarine fish habitat. Each of these habitats provides important ecological functions that support a variety of freshwater and marine fish.

Sediment deposition in Capitol Lake has promoted the development of freshwater wetland habitat, especially along the margins of the basins. These changes, in combination with nutrient sources from the Deschutes River, contributed to phosphorus levels and caused an increase in algae and plant growth, which can alter water quality and freshwater habitat conditions, potentially affecting freshwater fish species. Development in the basin altered habitat conditions and have also contributed to the proliferation of both invasive and nuisance

## Aquatic Invasive Species in Capitol Lake

Capitol Lake has well-documented presence of invasive species including plants, invertebrates, amphibians, fish, waterfowl, and aquatic mammal species. Their presence has ecological effects and has resulted in closure of Capitol Lake to all public use. Information on aquatic invasive species in Capitol Lake is included in Section 3.4, Aquatic Invasive Species, and the Aquatic Invasive Species Discipline Report (Attachment 8).

species in the study area, especially Eurasian watermilfoil, purple loosestrife, New Zealand mudsnail, and Canada geese.

Development in the watershed has also degraded water quality and altered the marine habitat conditions in the study area. Within West Bay, dredge and fill activities and the presence of the 5th Avenue Dam have reduced habitat for important juvenile salmonid food sources and Olympia oysters. Fill placed between the East and West Bays of Budd Inlet and associated bulkheads and overwater structures have displaced tideflat habitat and degraded intertidal habitat. Dissolved oxygen is routinely at levels less than the numeric minimum criteria (primarily in the bottom waters) in the summer and early fall. While dissolved oxygen levels are naturally low in many inlets and embayments in South Puget Sound, oxygen depletion can be harmful for fish and other aquatic species.

### *3.5.1.2 How are fish using the study area?*

West Bay and Capitol Lake, as well as the riverine habitats of the Deschutes River and Percival Creek, support a diverse group of native and non-native fish species, including several species and stocks of native salmon and trout (Table 3.5.1). Many of these species, particularly salmon, have significant ecological, cultural, economic, and recreational value in Washington. Capitol Lake is located within the traditional territory of the Southern Coast Salish and Southwestern Coast Salish cultural groups, which includes, but is not limited, to the Steh-chass, Nusehchatl, Squaxin, Nisqually, and the Chehalis.

**Table 3.5.1 Fish Species Potentially Present in the Study Area**

| Species Sub-Group | Species / Status |
|---|---|
| Anadromous Fish: Hatchery-origin and ESA-Listed Salmonids | Hatchery-origin Chinook salmon, native population Chinook salmon (FT, SC), steelhead trout (FT), bull trout (FT) |
| Anadromous Fish: Other Salmonids | Coho salmon, chum salmon, sea-run cutthroat trout, sockeye salmon |
| Anadromous Fish: Non-Salmonids | Starry flounder, three-spined stickleback |
| Freshwater Fish: Native Fish (resident) | Resident cutthroat trout, rainbow trout, peamouth, Northern pikeminnow, speckled dace, redside shiner, largescale sucker, prickly sculpin, largescale sucker, prickly sculpin, riffle sculpin, Western brook lamprey |

| Species Sub-Group | Species / Status |
|---|---|
| Freshwater Fish: Exotic/Non-native | Common carp, brown bullhead, smallmouth bass, largemouth bass, yellow perch |
| Marine Fish: Native Fish | Pacific sand lance, shiner perch, surf smelt, arrow goby, pile perch, bay pipefish, staghorn sculpin, tidepool sculpin, sand sole, specked sand dab |

Abbreviations: FT= Federally Threatened, SC = State Candidate.

## Anadromous Fish

Seven anadromous (fish that migrate from freshwater to and from the ocean) salmonid species may occur in the Capitol Lake Basin or its vicinity at different stages of their life history. Historically, use of the project area by anadromous salmonids only extended to Tumwater Falls. No naturally reproducing native populations of Chinook salmon, steelhead, or bull trout are present within the Deschutes River because Tumwater Falls is a natural fish barrier.

### Salmonids

Salmonids are any fish that belong to the family Salmonidae, including salmon, trout, and char.

All anadromous salmonids produced in the Deschutes River watershed migrate through the fish ladders at the 5th Avenue Dam and at Tumwater Falls. Some juvenile rearing is assumed to occur in Capitol Lake during the spring outmigration and possibly extending into summer or later. Adult anadromous salmonids returning to the basin continue their upstream migration by moving into the Deschutes River or Percival Creek. The Chinook salmon returning to the Deschutes River and Percival Creek are fall-run Chinook salmon of hatchery origin. Very low numbers of steelhead are thought to return to the Deschutes River, and they are presumed to occur in Percival Creek. The steelhead returning to the Deschutes River are winter-run steelhead and are a distinct non-native stock.

*Exhibit 3.38 Fish ladder at Tumwater Falls near the Tumwater Hatchery*

In 1954, a fish ladder was constructed to allow anadromous salmonids to access habitats in the Deschutes River upstream of Tumwater Falls. WDFW operates a hatchery at Tumwater Falls with a production goal of 3.8 million juvenile Chinook salmon each year. These salmon are released into the Deschutes River. Chinook salmon from the Tumwater Falls Hatchery are not listed under ESA.

*Exhibit 3.39 Fish ladder at 5th Avenue Dam, at left*

Two species of anadromous non-salmonids occur in Capitol Lake: three-spined stickleback and starry flounder. Three-spined stickleback have both anadromous and resident life history forms. It is not known how much of the current population in Capitol Lake is the anadromous form.

Studies indicate that three-spined stickleback comprise an overwhelming majority of the fish population in Capitol Lake.

### Freshwater Fish

Limited information is available on the freshwater fish community of Capitol Lake, which includes both native and non-native (exotic) species. Table 3.5.1 lists the documented freshwater fish in Capitol Lake. Many of the freshwater species are either competitors of or prey on juvenile salmonids, and some provide prey for larger fish. Freshwater habitats include the lake basins created by the 5th Avenue Dam, as well as the riverine environments in Percival Creek and the Deschutes River.

### Marine Fish

West Bay and the lower portion of Budd Inlet provide marine water habitat for anadromous fish, forage fish, saltwater fish species, and shellfish. Like the freshwater species in the Capitol Lake Basin, some of the saltwater fish species found in Budd Inlet are either competitors of or prey on juvenile salmonids, and some provide an important prey base for salmonids.

Table 3.5.1 lists the documented marine species of West Bay. It should be noted that many more marine species inhabit Puget Sound than are listed below. For example, the marine waters of Puget Sound are home to dozens of species of bottomfish, including dogfish, skates, rockfish (at least 14 species), greenlings, sculpins, surfperches, and flatfish (sanddab, halibut, sole, and flounder). While any of these species may occasionally be present in the waters of West Bay, this analysis focuses on those marine fish that have been documented in the study area and are likely to occur.

*Exhibit 3.40 Chinook salmon in the fish ladder at the Hiram M. Chittenden Locks (Source: Josh Larios https://creativecommons.org/licenses/by-sa/2.0/deed.en)*

## How many Chinook salmon return to the Tumwater Falls Hatchery each year?

The number of Chinook salmon adults returning to the Tumwater Falls Hatchery between 2013 and 2018 is presented below.

- **2013** – 10,729
- **2014** – 3,084
- **2015** – 5,012
- **2016** – 13,890
- **2017** – 33,887
- **2018** – 12,412

## *3.5.1.3 What threatened or endangered fish species and habitats are present in the study area?*

Puget Sound Chinook salmon are listed as threatened under the ESA; however, this applies to native populations, which are not present in the Deschutes River or Percival Creek watersheds. The estuarine waters of Budd Inlet are designated as critical habitat for Chinook salmon.

Puget Sound steelhead are also listed as threatened under the ESA. Capitol Lake and the Deschutes River are designated as critical habitat for steelhead, although the steelhead returning to the Deschutes River are a distinct non-native stock.

Bull trout, listed as federally threatened, may occasionally be present in the marine waters of West Bay, but there is no bull trout habitat in Capitol Lake or its tributaries. No designated critical habitat for bull trout is present in the study area.

Two species of ESA-listed rockfish occur in Puget Sound. The bocaccio rockfish is listed as endangered while the yelloweye rockfish is listed as threatened under the ESA. Although larval and juvenile rockfish could occasionally be present in the study area, adults and juvenile rockfish are not likely to occur in the relatively shallow waters of West Bay.

**Endangered Species Act**

The ESA is an act of Congress passed in 1973 that governs how animal and plant species whose populations are dangerously in decline or close to extinction will be protected and recovered. The federal agencies with jurisdiction over endangered species in the Project Area are the National Oceanic and Atmospheric Administration (NOAA) Fisheries (responsible for protecting Chinook salmon and steelhead trout) and the U.S. Fish and Wildlife Service (responsible for protecting bull trout).

## 3.5.2 Wildlife

The study area contains a mix of terrestrial and aquatic habitats important for numerous wildlife species.

### *3.5.2.1 What habitats can be found along the shoreline of Capitol Lake?*

As with the aquatic environment, development in the basin has substantially altered the habitats along the Capitol Lake shoreline compared to historical, natural conditions. Existing conditions include riparian, wetland, and contiguous terrestrial habitats along the shorelines, which now support shorebirds, waterbirds, raptors, songbirds, and terrestrial mammals that have adapted to these relatively disturbed habitation conditions. Human development has resulted in armored shorelines and decreased the quality and quantity of riparian vegetation, reducing the habitat value for native species.

Riparian conditions around Capitol Lake vary substantially. In the North Basin, the Arc of Statehood path and adjacent roadways are so close to the shore that there is only a narrow strip of riparian vegetation. Although some trees are present, these are generally ornamental like native deciduous trees, with few to no tall trees or coniferous trees. These provide less valuable riparian functions compared to what occurred before the lake was created. Although conditions on the west bank of the Middle Basin are similar, this area contains larger deciduous and some coniferous trees. In addition, the vast majority of the east bank of the Middle Basin provides a 300-foot-wide (91-meter-wide) riparian zone, consisting of mature mixed forest, including overhanging vegetation. The South Basin also has somewhat-more natural riparian conditions, consisting of emergent and scrub-shrub vegetation as well as some patches of deciduous trees.

*Exhibit 3.41 Riparian vegetation along the Arc of Statehood in the North Basin*

The area, including Capitol Lake, Percival Cove, and the riparian corridor associated with Percival Creek, is considered a biodiversity area (native habitat within an Urban Growth Area) by WDFW Priority Habitats and Species (PHS) mapping because of its terrestrial habitat and remnant wooded shoreline, which provide nesting and foraging habitat for wildlife.

*Exhibit 3.42 Riparian vegetation in the South Basin*

Wetland areas are important for many wildlife species. As described in Section 3.6, Wetlands, wetland types in the study area include freshwater wetlands and estuarine wetlands.

Wildlife habitat types in the study area are shown in Figures 3.5.1A and 3.5.1B.

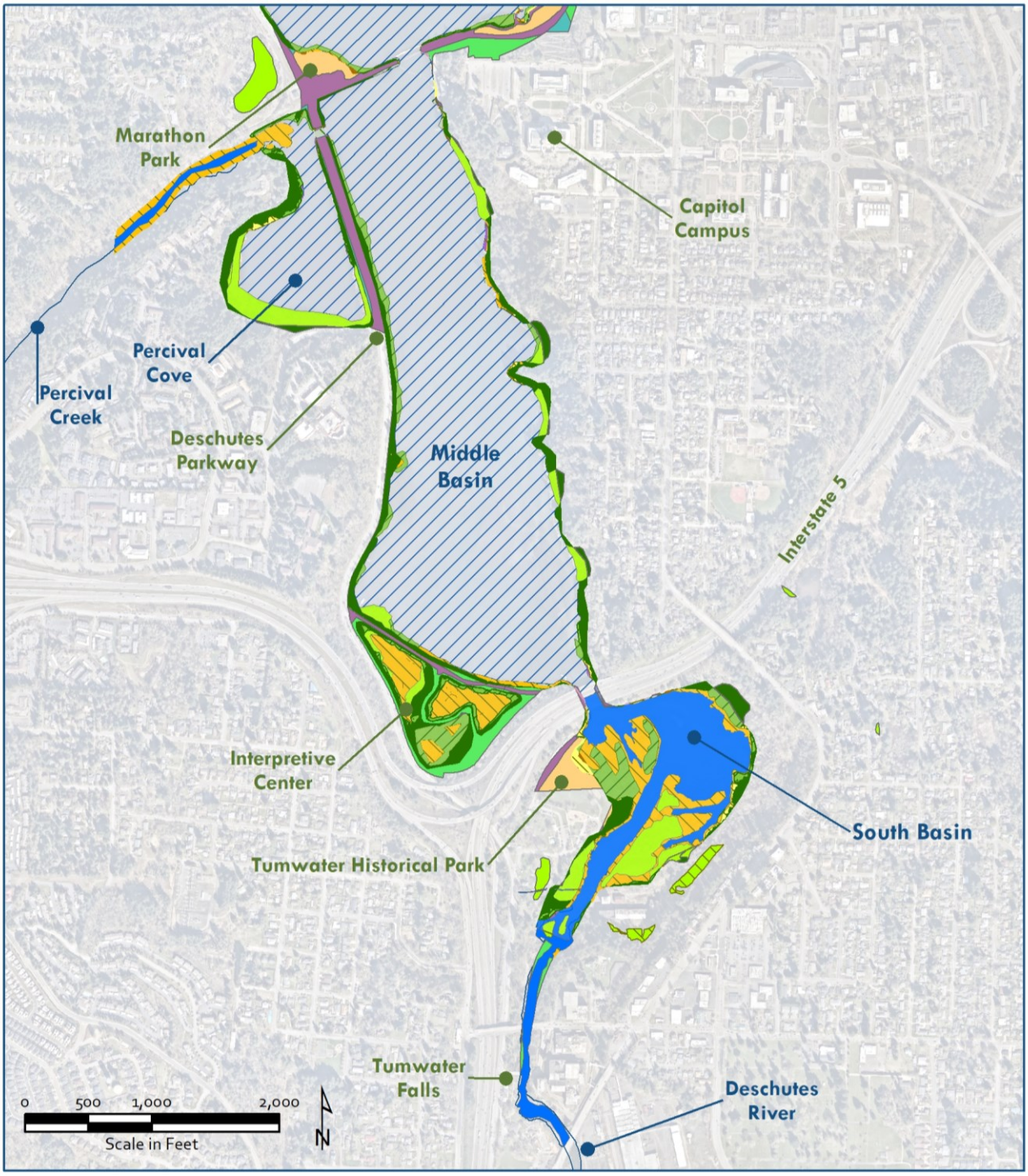
# Figure 3.5.1A Wildlife Habitats - North


**Legend**

**Wetland Habitats**
- Deepwater habitat - estuarine
- Deepwater habitat - freshwater
- Tideflat
- River channel
- Vegetated wetland - freshwater (PEM)
- Vegetated wetland - freshwater (PFO)
- Vegetated wetland - freshwater (PSS)
- Vegetated wetland - estuarine (high marsh)
- Upland

**Upland Habitats**
- Developed
- Grassland
- Mixed forest
- Shrub

# Figure 3.5.1B Wildlife Habitats - South



### 3.5.2.2 What birds can be found in the study area?

Birds in the study area can be described in five groups: shorebirds/ wading birds, diving/dabbling ducks, insectivorous birds, raptors, and passerine birds (Table 3.5.2). Numerous species in each group use the study area year-round or seasonally for breeding or wintering.

**Table 3.5.2 Bird Species & Species Groups Present in the Study Area**

| Species Group | Habitat Association and Use |
|---|---|
| **Shorebirds / Wading Birds** (e.g., western sandpiper, great blue heron) | Forage on small invertebrates in shallow water or exposed substrates during low tide; use Capitol Lake only during drawdowns or summer low flows that expose foraging substrates; herons forage on fish, amphibians, and invertebrates; most shorebirds are migratory and only seasonally present, while herons are year-round residents. |
| **Diving / Dabbling Ducks** (e.g., common goldeneye, American wigeon) | Forage on aquatic plants in fresh and saltwater, plant seeds and tubers, weeds, aquatic invertebrates (insects, crustaceans, and mollusks); use freshwater and riparian habitats for roosting and breeding. |
| **Insectivorous Birds** (e.g., violet-green swallow) | Seasonal (spring and summer); forage on flying insects; Capitol Lake is important source for insect production and emerging prey. |
| **Raptors** (e.g., bald eagle) | Year-round and seasonal use of Capitol Lake and shoreline habitats; prey on shorebirds and ducks (peregrine falcon), small shorebirds (merlin), fish (osprey), and birds and fish (bald eagle). |
| **Passerine Birds** (e.g., yellow warbler) | Use a wide variety of terrestrial and wetland habitats (freshwater and nearshore) to forage, breed, and over-winter; many permanent residents with some seasonal migrants using habitats for breeding (e.g., warblers, thrushes). |

### 3.5.2.3 What bats can be found in the study area?

Capitol Lake is an important source of emerging flying insects that are prey for multiple species of bats. Capitol Lake appears to be an important feeding area for two bat species in particular, little brown bat and Yuma myotis. Both species have been radio-tagged from large breeding colonies located at Woodard Bay in Henderson Inlet and at the Evergreen State College. An estimated 3,000 bats occupy the Woodard Bay colony, located approximately 7 miles (11 km) from Capitol Lake, but the proportion of the colony that forages at the Capitol Lake is not known. These bats use Capitol Lake to forage and do not appear to use other smaller lakes and ponds closer to their colonies.

*Exhibit 3.43 Little Brown Bat (Source: WDFW)*

### 3.5.2.4 What other mammals can be found in the study area?

Apart from bats, most mammals that use the study area are aquatic or semiaquatic and primarily visit the area to find prey or forage. WDFW noted 11 species of freshwater aquatic and marine mammals that have been recorded in the Capitol Lake area; no formal surveys have been conducted and all records are anecdotal. Table 3.5.3 summarizes the species and species groups of mammals.

**Table 3.5.3 Mammal Species & Species Groups Present in the Study Area**

| Species Group | Habitat Association & Use |
|---|---|
| **Freshwater Aquatic Mammals:** (e.g., nutria [1], muskrat, beaver, northern river otter, mink, raccoon) | Some forage on aquatic plants and emergent vegetation of wetlands and generally use freshwater wetlands and streams (nutria, beaver, raccoon); some use estuarine and nearshore habitats to prey on aquatic birds, crayfish, fish, and amphibians (otter, mink). |
| **Marine Mammals [2]:** (e.g., orca [3], harbor seal, California sea lion) | Seasonal and migratory use of marine waters to prey on salmon and other fish species during seasonal runs. |

Notes:

1. Nutria are considered an aquatic invasive species in Washington State.
2. All marine mammals are protected under the federal Marine Mammal Protection Act.
3. Southern resident orca are listed as Endangered under the federal ESA.

### 3.5.2.5 Are there threatened, endangered, or sensitive wildlife species and habitats in the Capitol Lake Basin?

The Southern resident orca population is listed as endangered under the federal ESA, and critical habitat is currently designated for inland waters of Washington State including Budd Inlet. Washington State, under the direction of Governor Inslee, recently completed a final report and recommendations for ensuring the survival of orcas in Puget Sound. The Southern Resident Killer Whale Recovery Task Force led this work, which was completed in 2019, some of which became legislation.

Little brown bat and Yuma myotis are not listed as threatened, endangered, or candidate species by the state. However, myotis roosting concentrations are listed as a Priority Habitat. Townsend's big-eared bat, a state candidate species, has been detected in the South Basin area through acoustical detection. No information is available about the specific habitats used by the species or its frequency of occurrence.

#### Orcas (Killer Whales)

A priority focus of the **Southern Resident Killer Whale Recovery Task Force** is to increase Chinook salmon abundance through habitat protection and restoration, and increased hatchery production, while minimizing competition with wild stocks and decreased predation.

### 3.5.3 Tribal Resources

Capitol Lake is located within the ancestral lands of the Southern Coast Salish and Southwestern Coast Salish cultural groups, which include, but are not limited to, the Steh-chass, Nusehchatl, Squaxin, Nisqually, and the Chehalis. These groups have used the area since time immemorial for various levels of habitation, ceremony, and resource gathering. Descendants of these people are members of today's federally recognized Squaxin Island Tribe, Nisqually Indian Tribe, and Confederated Tribes of the Chehalis Reservation.

Many of the fish, shellfish, and wildlife species in the study area (particularly the salmonids) have significant cultural and economic value to area tribes. The traditional diet of the Southern Coast Salish and Southwester Coast Salish relies heavily upon salmon, but also includes other important saltwater, freshwater, and terrestrial resources. Historically, the inlets surrounding the southernmost portion of Puget Sound provided abundant resources.

West Bay provides fish harvesting opportunities for some tribes, which are protected treaty rights under the Medicine Creek Treaty of 1859. These rights for Indigenous people in the South Puget Sound region were affirmed in a landmark court case decided by Judge Boldt and upheld by the U.S. Supreme Court in 1979. Capitol Lake is closed to all active use, including tribal fishing.

## 3.6 WETLANDS

Wetlands are important natural resources that perform vital ecological functions and provide many societal benefits and ecosystem services, such as water storage and flood protection, groundwater recharge, water quality improvements, sediment retention, habitat for fish and wildlife, recreation, and others. Wetlands are protected by a variety of federal, state, and local laws, plans, and policies. These laws, plans, and policies have different, but overlapping, requirements to protect and maintain these habitats and their functions. The Clean Water Act (CWA) is the primary federal law protecting wetland resources; the CWA regulates the discharge of dredge and fill materials into wetlands and other waters of the U.S. The CWA is administered by the U.S. Army Corps of Engineers (USACE), with support in Washington State from Ecology. Project proponents are required to avoid and minimize impacts on wetlands and must compensate for any unavoidable impacts. Additional information on the regulatory context for wetland resources is presented in the Wetlands Discipline Report (Attachment 10).

**Regulatory Wetland**

As defined by both federal and state laws, wetlands are "areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."

The wetlands study area includes the Capitol Lake Basin and associated wetland from Tumwater Falls to West Bay. The study area also encompasses Percival Cove and Percival Creek and associated wetlands to where changes could occur as a result of the action alternatives.

## Methods for Studying Wetlands

Existing conditions in the study area were determined based on the available geographic information system (GIS) data, aerial imagery, critical area and shoreline maps, the bathymetric survey, and previous readily accessible wetland studies applicable to the study area. This information was used to estimate the presence, extent, and type of wetlands, deep water habitats, and tideflats in the study area. This planning-level analysis was supplemented with a site reconnaissance to the Project Area in the summer of 2019, but wetlands were not delineated, rated, surveyed, or sampled for the EIS analysis.

**For further information on wetlands, see the Wetlands Discipline Report (Attachment 10).**

### 3.6.1 What types of wetlands are present in the study area?

#### *3.6.1.1 Historical Conditions*

Historically, the Deschutes River formed a broad estuary as it flowed into Budd Inlet in the area that is now Capitol Lake (Figure 3.6.1). The historic delta consisted of river deposits, with braided channels and scattered tidal marshes.

Construction of the 5th Avenue Dam in 1951 blocked the tidal exchange between the Deschutes River and Budd Inlet. It also altered the morphology and ecology of the lower river system. Other development throughout the basin (e.g., construction of I-5, development of Olympia and Tumwater, port-related facilities) have similarly altered wetland conditions in the study area. Although different from their historic condition, Capitol Lake Basin and West Bay include wetlands that provide habitat for a range of birds, fish, bats, aquatic and semiaquatic mammals, and invertebrates.

## Figure 3.6.1 Historic Condition of Capitol Lake Basin

1873 1941

### 3.6.1.2 Wetland Types in the Study Area

For this EIS analysis, the term "wetland" encompasses five broad types to characterize both the freshwater and estuarine habitats present in the Capitol Lake Basin and West Bay:

- Vegetated wetlands – freshwater
- Vegetated wetlands – estuarine
- Tideflats
- Deepwater habitats – freshwater (i.e., Capitol Lake)
- Deepwater habitats – estuarine (i.e., West Bay)

Tideflats and deepwater areas are not technically considered "wetlands" but are protected and regulated by multiple federal, state, and local laws

as waters of the U.S., waters of the state, and/or critical areas. Streams and rivers, such as the Deschutes River and Percival Creek, are also waters of the U.S., waters of the state, and critical areas (see Section 3.3, Water Quality, and Section 3.5, Fish and Wildlife, for more information on these waters).

The wetland types present in the study area are defined and described in this section. Wetland acreage is summarized by type in Table 3.6.1, and Figures 3.6.2A and 3.6.2B show the location of these wetland types in the basin. More information is presented on the location of these types by basin in the Wetlands Discipline Report (Attachment 10).

### Table 3.6.1 Wetland & Other Habitat Types in the Study Area under Existing Conditions

| Wetland Types | Location | Estimated Acreage[1] |
|---|---|---|
| Deepwater Habitat – Estuarine | West Bay | 208 |
| Tideflat | West Bay | <1 |
| Vegetated Wetland – Estuarine (High Marsh) | West Bay | 3 |
| Deepwater Habitat – Freshwater | North and Middle Basins | 240 |
| Vegetated Wetland Freshwater (emergent) | North, Middle, and South Basins | 19 |
| Vegetated Wetland Freshwater (scrub-shrub) | North, Middle, and South Basins | 16 |
| Vegetated Wetland Freshwater (forested) | North, Middle, and South Basins | 18 |
| River Channel – Freshwater | Middle and South Basins | 25 |
| Upland | North, Middle, and South Basins | 19 |
| **Total** | | **549** |

Note:

1. Areas are approximate, based on National Wetlands Inventory data and a high-level reconnaissance investigation. All numbers are rounded to the nearest acre.

# Figure 3.6.2A Existing Wetland Types – North

# Figure 3.6.2B Existing Wetland Types – South


Legend

- Deepwater Habitat - Estuarine
- Tideflat
- Deepwater Habitat - Freshwater
- Vegetated Wetland - Freshwater (emergent)
- Vegetated Wetland - Freshwater (scrub-shrub)
- Vegetated Wetland - Freshwater (forested)
- River Channel
- Upland

## Vegetated Wetlands – Freshwater

These wetlands are dominated by trees, such as willow, red alder, and Western red cedar; shrubs such as spirea, twinberry, and dogwood); and/or emergent vegetation, such as slough sedge, soft rush, and piggyback plant. They are fed by surface or groundwater and occur on the edges of lakes or rivers, on slopes, or in shallow depressions. Vegetated freshwater wetlands may or may not have standing water, and when they do, it is typically shallow. Vegetated freshwater wetland types include forested, scrub-shrub, and emergent wetlands.

*Exhibit 3.44 Vegetated freshwater wetlands (emergent and scrub-shrub) in the North Basin*

Vegetated freshwater wetlands make up about 10% of the wetland acreage in the study area and are scattered throughout all of the basins. Within the North Basin, emergent and scrub-shrub wetlands occur along Heritage Park on the east and Marathon Park in the southwest, and a few fringes along Deschutes Parkway. Within the Middle Basin, the western shoreline is dominated by fringes of emergent and scrub-shrub wetlands with areas of forested wetland being common along the eastern shoreline. The hydrology of the South Basin is dominated by the Deschutes River and side-slope seeps, with vegetated freshwater wetlands forming a complex of emergent, scrub-shrub, and forested wetlands.

*Exhibit 3.45 Vegetated freshwater wetlands (emergent and scrub-shrub) in the South Basin*

## Vegetated Wetlands – Estuarine

These wetlands occur in the zone where freshwater and saltwater meet and are referred to as low marsh and high marsh. These wetlands have salinity levels greater than 0.5 ppt and are usually influenced by tides. Vegetated estuarine wetlands are characterized based on their elevation levels within the intertidal zone and dominant vegetation form. High marsh wetlands occur in the upper intertidal zone and are infrequently inundated with water. Typical vegetation species include tufted hair grass and arrow grass. Low marsh wetlands occur at lower elevations and are typically characterized by the presence of pickleweed, arrow grass, Lyngbye's sedge, and saltgrass.

### Intertidal Zone

The intertidal zone is the area along the shoreline that is either covered with water, or not, depending on the tidal cycle. It is within the area of tidal fluctuation.

Very little (~3 acres) of this wetland type occurs in the study area, all in the form of high marsh along the southwest shoreline of West Bay.

*Exhibit 3.46 Estuarine and tideflats along the western shoreline of West Bay*

## Tideflats

These wetlands are broad, flat areas in the intertidal zone that are exposed at low tides and inundated at high tides. The substrate is mostly clay and silt-sized (i.e., very small) particles as well as organic material. They are either unvegetated or vegetated only by algal mats or annual

plants such as sea lettuce. Eelgrass can be present at lower elevations if tidal currents, sediment deposition, and water quality create appropriate growing conditions.

Although prevalent before the 5th Avenue Dam was constructed, very little (<1 acre) of this wetland type now occurs in the study area. Shallow water tideflats are found along the western shoreline of West Bay.

*Exhibit 3.47 Deepwater (freshwater) habitat in the North Basin*

### Deepwater Habitats – Freshwater and Estuarine

These include areas where surface water is permanent and deep, such that water is the principal medium within which the dominant organisms live. Deepwater habitats can be freshwater or estuarine. If present, vegetation is aquatic bed vegetation that is usually visible above the water surface. The boundary between wetlands and deepwater habitats in an estuarine system is the elevation of the extreme low water. The boundary between wetlands and deepwater habitat in the freshwater environment is a depth of 8.2 feet (2.5 meters) or the edge of emergent vegetation, shrubs, or trees.

Deepwater habitats make up the vast majority (~82%) of existing wetland types in the study area. The existing estuarine deepwater areas are all in West Bay, and the freshwater deepwater areas are in the North and Middle Basins. The estuarine and freshwater areas are divided by the 5th Avenue Dam.

## 3.7 AIR QUALITY & ODOR

Air quality refers to the condition of the breathable air with respect to the presence of pollutants identified by the USEPA and Ecology as pervasive in urban environments, and for which state and federal health-based ambient air quality standards have been established. The air quality analysis addresses pollutants, which can have negative effects on human health and the environment. It also addresses greenhouse gases (GHGs), which can contribute to climate change.

Odor is a commonly experienced human sensation. The olfactory sense can detect and discriminate thousands of odors. The presence of an odor is the product of small quantities of certain chemicals, or mixtures of chemicals, in the air we breathe.

### Odor Characteristics

Important characteristics of odors at specific locations are described below.

- **Intensity.** Perceived strength of odor. It is subjective and important in characterizing the odor environment.
- **Duration.** The length of time an odor persisted at a location.
- **Frequency.** How often an odor was present at a location.
- **Offensiveness (or Hedonic Tone).** Scientifically developed scale for the pleasantness or unpleasantness of the nature of the odor.

## Methods for Studying Air Quality & Odor

Data sources used for the air quality analysis include relevant USEPA reports and standard computer tools, as well as odor studies, particularly those concerning hydrogen sulfide ($H_2S$), an odorous gas that can be naturally produced from tideflats. Available literature on odor-producing emissions of tideflats was also reviewed.

**For further information on data sources, see the Air Quality and Odor Discipline Report (Attachment 11).**

For assessing air quality and odor associated with the project, the study area is the project area and the surrounding ambient air that has the potential to be influenced by the project, based on the scope and nature of the construction and post-construction air emissions, as well as the nature of the topography and meteorological conditions in the area. Based on the nature and quantities of the air pollutant emissions and potential odors generated by the action alternatives, the impacted area is not expected to extend far from the project area.

### 3.7.1 What is the existing odor environment at Capitol Lake?

Existing potential sources of odor in the vicinity of the project area include the existing tideflats along the East and West Bay. Odors produced by tideflats have not been studied in depth, and the literature on associated quantitative odor-producing emissions is sparse. Most of the available literature focuses on sulfur compound emissions, which have been quantified per unit of tide-influenced area. These emissions are often driven by hydrogen sulfide ($H_2S$), a gas that has a characteristic odor of rotten eggs and an odor detection limit with a range that spans from 0.5 to 300 parts per billion depending on the studies considered. Ambient $H_2S$ air concentrations in the Olympia area are not readily available to characterize existing odor conditions. However, the Olympic Region Clean Air Agency (ORCAA) logs odor complaints received from the public.

## Did the historic estuary smell bad?

Historical anecdotal evidence of odors within the estuary are not reliable because they cannot be attributed to specific odor sources. There have been many changes in sewage management, industrial activities and related discharges, and other unknown contributors in the Project Area since that time.

During a 5-year period (March 2015 through March 2020), the primary sources of odor complaints in the region were burning garbage, as well as smoke from woodstoves and burn piles, all of which accounted for approximately 86% of the total odor complaints. Other recurring sources of odor complaints received by ORCAA were from a hot-mix asphalt plant, a mushroom farm, and a packaging facility. A summary of odor complaints is provided in the Air Quality and Odor Discipline Report (Attachment 11). There were no odor complaints associated with

tide fluctuations or associated natural odor-producing sources, and there were no odor complaints during a 2016 drawdown of Capitol Lake.

### 3.7.2 What is the existing air quality environment in the Project Area?

Washington is subject to air quality regulations issued by USEPA, Ecology, and local air agencies such as ORCAA. These agencies have established National Ambient Air Quality Standards (NAAQS).

Concentration levels of the criteria pollutants must not exceed the NAAQS over specified time periods. Ecology and ORCAA monitor air quality in the region to compare the levels of criteria pollutants found in the atmosphere with the NAAQS. Areas that meet the limits set by the NAAQS are referred to as "attainment areas," and areas that exceed the limits for one or more pollutants are referred to as "nonattainment areas." When an area is designated as nonattainment, measures must be taken to bring the area back into compliance; after a nonattainment area achieves compliance, it becomes a "maintenance" area. This designation requires that Ecology, in coordination with ORCAA, develop an attainment plan to demonstrate how the area will come back into compliance with the standard.

**National Ambient Air Quality Standards (NAAQS)**

The Clean Air Act establishes emissions standards for criteria pollutants. These standards are known as NAAQS. The NAAQS set limits for criteria pollutants, including:

- Carbon monoxide
- Nitrogen dioxide
- Sulfur dioxide
- Particulate Matter (two different sizes, 2.5 micrometers and less than 10 micrometers)
- Ozone

Existing sources of air pollution in the vicinity of the project include industrial-zoned areas and transportation corridors, including marine diesel-fueled vessels and both diesel and gas vehicles on the nearby roadways.

Criteria air pollutants of primary concern are nitrogen dioxide, Particulate Matter$_{10}$, and Particulate Matter$_{2.5}$. Other pollutants include ozone precursors (i.e., hydrocarbons and nitrogen oxides), sulfur dioxide, ozone, and carbon monoxide. Given the setting, industrial and transportation sources likely comprise the largest contributors to ambient pollutant concentrations in the vicinity of the project. Smoke from residential wood combustion, one of the main sources of air pollution in Washington State, may also be a significant contributor to ambient particulate matter concentrations during winter months.

The area was designated as nonattainment during the period of 1992 to 1999 due to exceedances of the particulate matter of 10 micrometers or less ($PM_{10}$) 24-hour standard, primarily caused by smoke from woodstoves and fireplaces. In 2000, local monitoring indicated that the air quality had improved, and the area implemented a 20-year maintenance plan that concluded on December 4, 2020. The area

continues to be in attainment for $PM_{10}$ and is no longer required to adhere to the maintenance plan.

### 3.7.3 How are greenhouse gases assessed?

An executive order issued by Governor Christine Gregoire in February 2007 (Executive Order No. 07-02) established goals for Washington for reducing GHG emissions as follows:

- To reach 1990 levels of GHG emissions by 2020
- To reach 25% below 1990 emission levels by 2035
- To reach 50% below 1990 emission levels by 2050

On April 30, 2020, Ecology announced the beginning of the rulemaking process create a new rule, Chapter 173-445 WAC, Greenhouse Gas Assessment for Project, which will help address analysis and mitigation of GHG emissions for environmental assessments of certain projects. The new rule is slated to be completed by spring 2021. As new rulemaking is under development, this EIS considers previous Ecology guidance as adopted in Chapter 173-441 WAC – Reporting of Emission of Greenhouse Gases. This rule aligned the state's GHG reporting requirements with USEPA regulations, and required facilities that directly emit 10,000 metric tons of carbon dioxide ($CO_2$) equivalents ($MTCO_2e$) or more each year, as well as fuel suppliers that supply fuels in the state that would result in 10,000 $MTCO_2e$ when combusted, to report their GHG emissions to Ecology.

**Which greenhouse gases are addressed in this report?**

The following, most commonly emitted GHGs, are addressed in this EIS:

- Carbon Dioxide ($CO_2$)
- Nitrous Oxide ($N_2O$)
- Methane ($CH_4$)

**$MTCO_2e$**

$MTCO_2e$ (metric tons of carbon dioxide equivalent) is the unit of measurement for GHGs. It is used to compare the emissions from different GHGs based on their global warming potential.

Ecology estimated state-wide annual GHG emissions in 2015 at approximately 97 million $MTCO_2e$, and annual worldwide GHG emissions for 2010 were estimated by the World Resources Institute to be approximately 46 billion $MTCO_2e$. The state is seeking to reduce its GHG footprint to 45% and 95% of 1990 emissions by 2030 and 2050, respectively.

In addition to GHG emissions created during construction and operation of the project, this EIS considers the carbon sequestration or emissions potential of the wetlands established under the project alternatives. Coastal wetland environments remove $CO_2$—a GHG—from the atmosphere and sequester the carbon as biomass, dead organic matter, and soil carbon. The environmental service of wetland carbon sequestration is often referred to as "blue carbon."

**Carbon Sequestration**

Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide.

While carbon is typically sequestered in wetland environments, methane ($CH_4$) emissions occur in marshes when anaerobic (i.e., oxygen-starved) conditions allow microbes to decompose organic matter and produce

$CH_4$. The effect of wetlands on GHGs can vary widely from a net negative to a net positive, depending on the salinity and biomass in the system. The relative GHG sequestration or emission expected under the alternatives are described in Section 4.7, Air Quality and Odor.

In 2018, the Thurston Regional Planning Council adopted the Thurston Climate Adaptation Plan (TCAP) to guide Thurston County and the broad South Puget Sound region in developing strategies for adaptation and response to climate change. This 22-member intergovernmental board has a mission to provide visionary leadership on regional plans, policies, and issues. The TCAP includes a number of Guiding Principles, including a goal relating to GHG emissions.

The Guiding Principles support increased resiliency through achievable, flexible, and, where possible, measurable and replicable climate adaptation strategies. Relating to GHG emissions, the Guiding Principle states: "Identify and leverage climate change adaptation strategies and actions with mitigation co-benefits, such as reducing, capturing, and storing greenhouse gas emissions."

In 2021, collaborating jurisdictions adopted the Thurston Climate Mitigation Plan (TCMP) to address local contributions to the causes of climate change. The plan includes an emissions reduction target of reducing net communitywide GHG emissions 45% below 2015 levels by 2030 and 85% below 2015 levels by 2050. The TCAP and TCMP together form a comprehensive Climate Action Plan for the Thurston Region.

## 3.8 LAND USE, SHORELINES, & RECREATION

Land use refers to how land is developed and managed for various human uses. It also refers to the preservation or protection of land as a natural resource. Shorelines refers to land along a waterbody, which can also be developed for human purposes or preserved as a natural resource, subject to regulations specifically for shorelines. Recreation refers to opportunities for people to engage with and enjoy the natural and built environment. These three resources are combined in this analysis.

The study area for land use, shorelines, and recreation includes the Capitol Lake Basin that Enterprise Services manages, and encompasses areas within 1,000 feet (300 meters) where shoreline use or recreation activities could change, or the alternatives could influence adjacent land uses. The study also includes areas within and adjacent to West Bay where shoreline uses such as recreational marinas or shipping could be affected by changes in sediment movement.

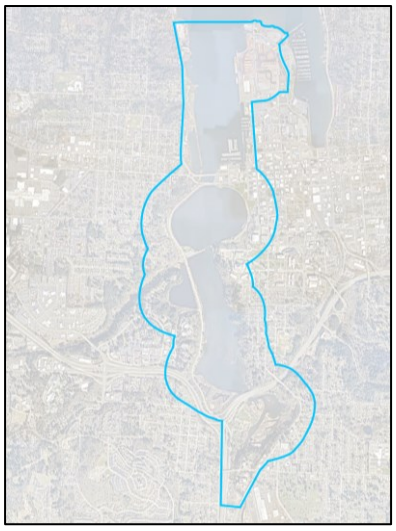


*Exhibit 3.48 Land Use, Shorelines, and Recreation study area*

## Methods for Studying Land Use, Shorelines, & Recreation

Data sources used include relevant zoning and parcel information in GIS format, policy and planning documents, and land and shoreline use regulations applicable to the study area. The study also included input from the Community Sounding Board and Work Groups and data from a recreational user survey. Park users were surveyed at parks adjacent to Capitol Lake during high usage periods in the summer of 2019, including during Capital Lakefair.

**The Land Use, Shorelines, and Recreation Discipline Report (Attachment 12) contains the full list of data sources used for the evaluation.**

### 3.8.1 What is the existing land use, planning, and zoning in the study area?

The study area includes a range of uses, from open space used for wildlife habitat and recreation to intensively-used commercial and industrial areas. Figure 3.8.1 shows the existing land uses in the study area.

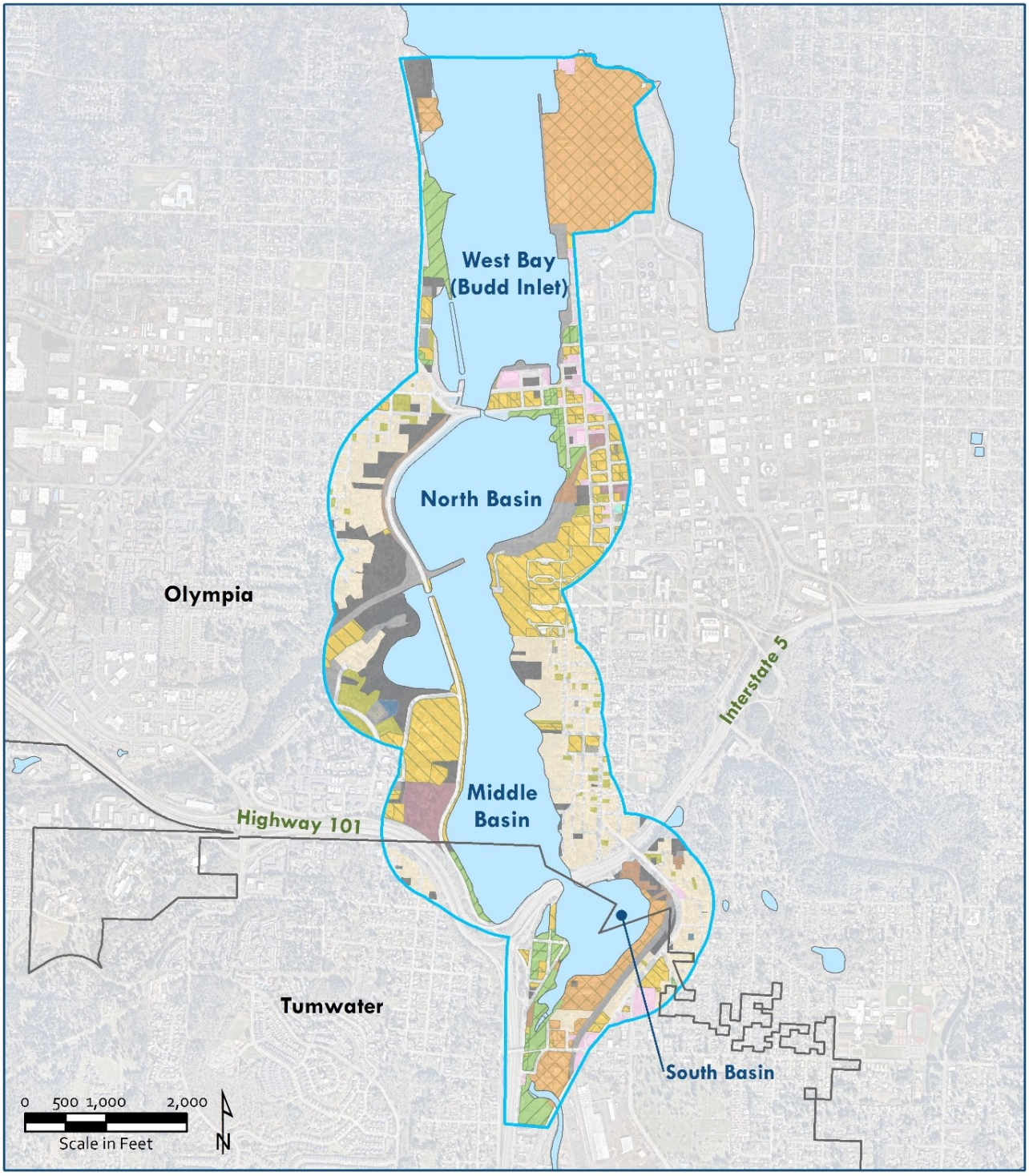
Most land uses abutting Capitol Lake are various forms of open space. Capitol Lake is itself considered open space. Surrounding open space includes portions of the Capitol Campus, parks, habitat areas, and undeveloped portions of large single-family lots.

Transportation is also a notable land use surrounding Capitol Lake. The I-5 highway crosses between the South and Middle Basins. The BNSF Railway Trestle crosses between the Middle and North Basins. Deschutes Parkway extends the entire length of the west side of Capitol Lake, and 5$^{th}$ Avenue crosses the water between the North Basin and West Bay.

Around the North Basin, in addition to the open space described above, single-family development dominates the uses to the west, and a mixture of office, retail, and government uses are adjacent to the east.

Around the Middle Basin, in addition to the open space described above, uses are predominantly single-family residences and state capitol offices to the east. To the west, office and commercial uses front Lakeridge Way SW, including the Thurston County Courthouse. A steam plant (the Capitol Campus Powerhouse) occupies the shoreline at the northeast edge of the Middle Basin.

# Figure 3.8.1 Map of Existing Land Uses




**Legend**

City Boundary
Study Area

**Land Use Type**

Cultural
Hotel-Motel
Manufacturing
Parks and Open Space
Public Assemby
Recreation
Residential Multi-Family
Residential Single-Family
Retail
Service
Other
Transportation
Undeveloped Land
Utilities
Water

Around the South Basin, single-family development is also predominant to the east. The South Basin abuts the New Market District and Brewery District in Tumwater, two commercial districts that surround and include the former Olympia Brewery.

West Bay is surrounded by parks, private recreational marinas, the Port of Olympia, commercial offices, a large sawmill, and a small number of townhouse residences.

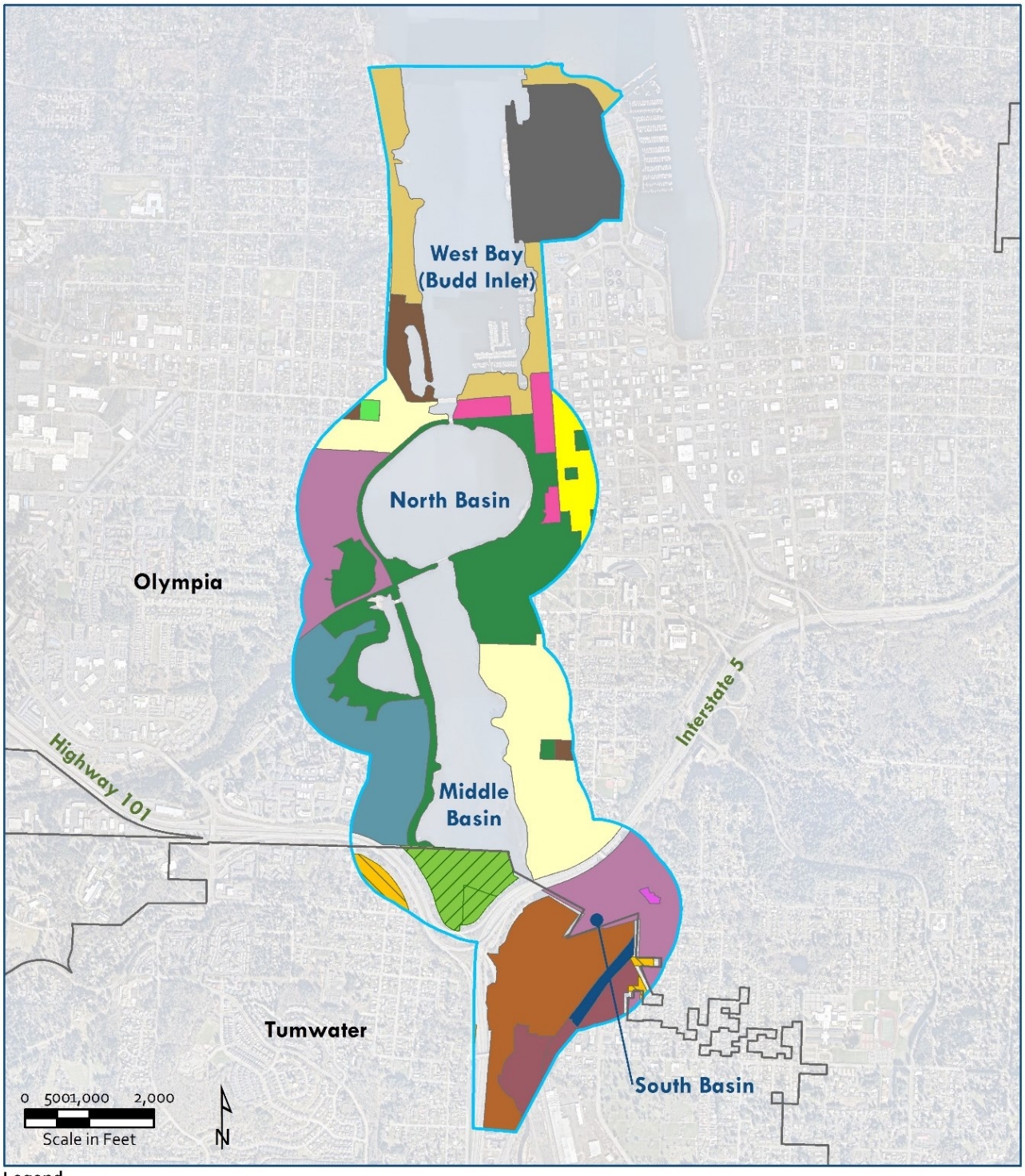
*Exhibit 3.49 Port of Olympia facilities*

The study area lies within the city limits of Olympia and Tumwater. The city limits and zoning designations within the study area are shown in Figure 3.8.2.

Residential zones comprise 33% of the study area, with the majority of that in single-family zoning. Green Belt and Open Space zoning comprises only 4% of the land within the study area, but much of the Capitol Campus could also be categorized as open space, especially areas adjacent to Capitol Lake.

A major portion of the land abutting Capitol Lake is designated Capitol Campus on the City of Olympia zoning map. The Capitol Campus includes the main upper campus, Heritage Park, Deschutes Parkway, and the land surrounding Percival Cove in the Middle Basin, plus a few scattered parcels.

# Figure 3.8.2 Map of Existing Zoning



### 3.8.2 Which areas of the study area have shoreline environment designations?

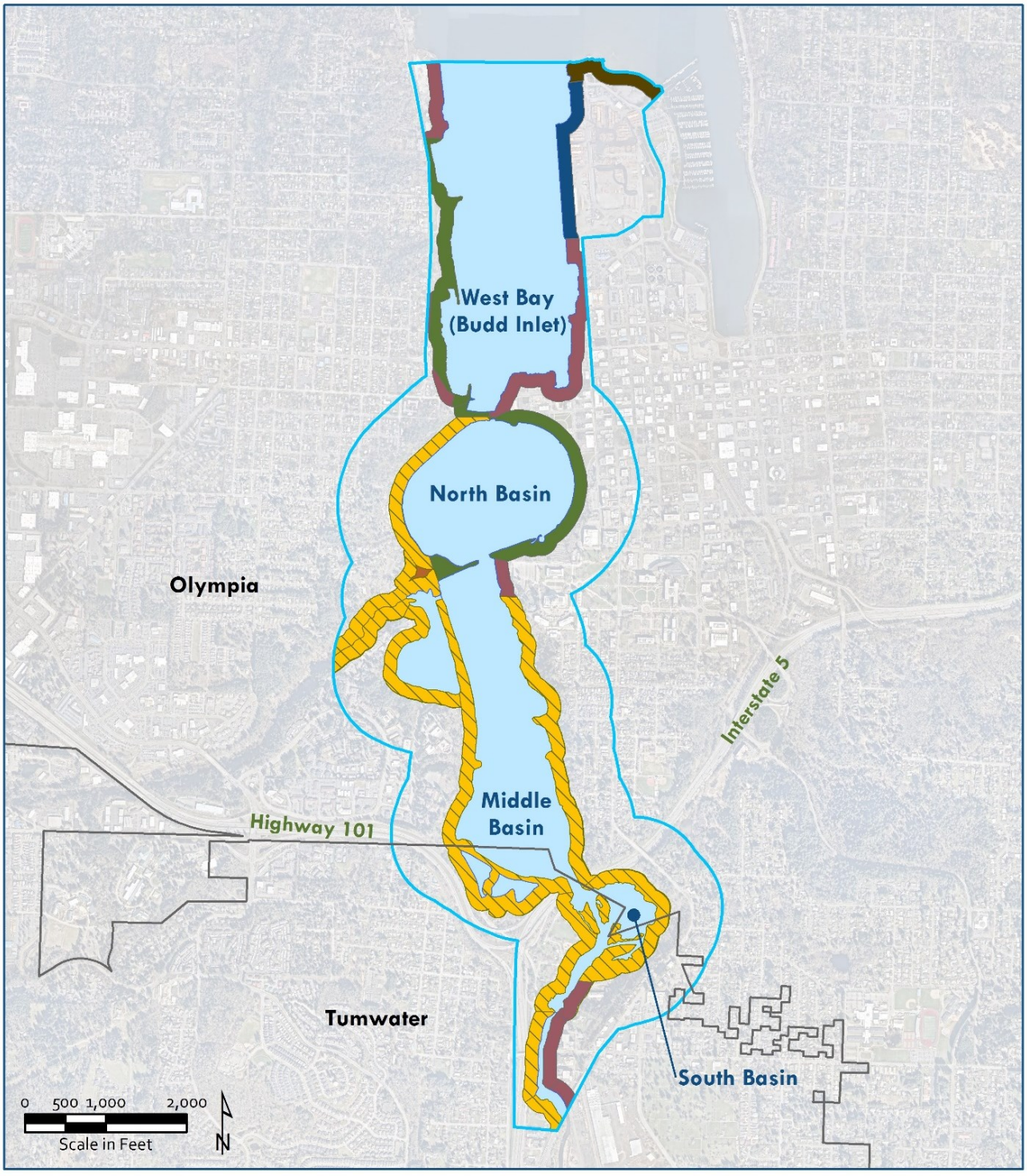
Shoreline designations are overlay zones authorized under the Shoreline Management Act and are shown on Figure 3.8.3. A large majority of the shoreline of Capitol Lake is designated Urban Conservancy, reflecting the goals of Olympia and Tumwater to support water-related and water-enjoyment uses while protecting and restoring ecological functions of these shorelines. The east side of the South Basin is designated Urban Intensity in recognition of the historic high-intensity uses associated with the brewery, and allowing commercial and recreational uses that are compatible with shoreline protection. The eastern and southern shores of the North Basin are designated Waterfront Recreation. This designation is applied to areas to be used for recreation or habitat conservation, and allows for low-intensity recreational use of the shorelines. A small portion of the Middle Basin is designated Urban Intensity in recognition of the historic Capitol Campus Powerhouse.

Along West Bay within Budd Inlet, designations of Waterfront Recreation and Urban Intensity predominate. A designation of Port Marine Industrial applies to the log shipping terminal in West Bay. This designation prioritizes and supports water-dependent industrial uses. Adjacent to and north of the shipping terminal, the shorelines are designated Marine Recreation, supporting public access and intensive recreational use such as the existing public dock and boat launch.

#### Shoreline Management Act

Under the state's Shoreline Management Act (SMA), each city and county that abuts a shoreline of statewide significance adopts a Shoreline Master Program (SMP) that applies to those waters and the adjacent land. Each SMP is based on SMA goals to protect the public trust by ensuring public access, protecting shoreline ecology, and accommodating water-dependent uses. This is accomplished through regulations in the SMP that establish shoreline environment designations, and corresponding use and development standards.

# Figure 3.8.3 Map of Existing Shoreline Designations




**Legend**

City Boundary
Study Area

**Shoreline Type**

Aquatic
Island
Marine Recreation
Natural
Port Marine Industrial
Shoreline Residential
Urban Conservancy
Urban Intensity
Waterfront Recreation

### 3.8.3 What are current recreation sites and their uses?

Several parks provide both local and regional benefits. Brewery Park at Tumwater Falls and Tumwater Historical Park are tourist attractions on the shore of the South Basin, and provide facilities for picnicking, wildlife viewing, and other activities. Heritage Park, on the eastern shore of the North Basin, hosts major community gatherings and provides trails and other recreation facilities for the broader Olympia-Tumwater area and tourists visiting the capitol. Marathon Park, on the southwest shore of the North Basin, and Interpretive Center, on the southwest shore of the Middle Basin, both provide active recreation, wildlife viewing, and other recreational opportunities serving the broader Olympia-Tumwater area. All of these parks are linked by a series of trails extending around the North Basin and along the west shore of the Middle Basin and South Basin. Figure 3.8.4 shows the recreation sites within the study area.

Recreation sites around Capitol Lake and West Bay attract hikers, runners, walkers, bicyclists, tourists, and other visitors to the Capitol Campus, downtown Tumwater, and downtown Olympia. Many community-supported events occur around the lake, including Capital Lakefair, Festival of the Steh-chass, Olympia Harbor Days, Olympia Wooden Boat Fair, and Capital City Marathon. Capital Lakefair, the largest recreational event that occurs in the Capitol Lake area, began in the 1950s, after construction of Capitol Lake and before the creation of Heritage Park. Capital Lakefair is an annual community festival at Heritage Park in the third week of July with an attendance of approximately 200,000. Despite current restrictions on water-oriented activities, shoreside activities remain as part of the current Capital Lakefair festival. For a list of events held in the Capitol Lake area see Table 4.3 in the Land Use, Shorelines, and Recreation Discipline Report (Attachment 12).

#### History of Recreational Use on Capitol Lake

Capitol Lake has been used formally for recreation since its creation in 1951. From 1964 to 1985, the City of Olympia operated a swimming area in the North Basin. Poor water quality forced the closure of the swimming area. Both recreational and organized boating took place on the lake from the early 1950s through 2009. In 2009, because of the presence of invasive New Zealand mudsnails, Capitol Lake was closed to all public water-oriented uses, including boating and fishing.

## Figure 3.8.4 Map of Recreation Sites


**Legend**

- Public Trail
- Public Park
- Study Area

### 3.8.4 Does the EIS consider input from area recreationists?

Information on recreational use of the surrounding open space resources was gathered through surveys conducted during the summer of 2019 at locations around the Capitol Lake Basin, and at a Community Sounding Board meeting. Capitol Lake and nearby Budd Inlet shorelines are important places for many types of recreation, especially walking, attending events, and family time. Diverse activities continue around the lake despite restrictions on in-water uses. Many people indicated they would use the area more if uses like boating, fishing, swimming, and wading were restored. Enterprise Services will consider this information during the decision-making process for this project. For additional information, see the Land Use, Shorelines, and Recreation Discipline Report (Attachment 12).

## 3.9 CULTURAL RESOURCES

Cultural resources include archaeological and historic built environment resources as well as traditional cultural properties.

Archaeological resources are places where past human activity has left physical traces. These traces include artifacts, deposits of debris, food remains (shells and bones), ruins of dwellings and other structures, and human remains and cemeteries. Historic built environment resources (historic resources) include buildings, structures, and landscape features built by people, and which remain in a functional state or operational readiness. Built environment resources typically must be at least 50 years old to be considered historic. Traditional cultural properties, sometimes referred to as areas of traditional cultural concern, are properties associated with cultural practices, beliefs, the sense of purpose, or existence of a living community that is rooted in that community's history or is important in maintaining its cultural identity and development as an ethnically distinctive people.

Certain cultural resources are protected under various federal, state, and local historic registers. These include districts, sites, buildings, structures, or objects that are already included in, or may be eligible for listing, in the National Register of Historic Places (NRHP), Washington Heritage Register, City of Olympia Heritage Register, or City of Tumwater Register of Historic Places.

The federal Section 106 process under the National Historic Preservation Act (NHPA) is used to consider how cultural and historic resources would be affected by an undertaking. As part of this process,

**NRHP**

The National Register of Historic Places (NRHP) is the official list of cultural resources that have been deemed worthy of preservation under the National Historic Preservation Act of 1966. Properties listed in the NRHP include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archaeology, engineering, and culture. NRHP properties are distinguished by having been documented and determined eligible according to uniform standards (Criteria A–D, known as the Criteria for Evaluation).

resources first are evaluated regarding their eligibility for listing in the NRHP. If they are eligible, then the process determines if the impacts are adverse or not, and whether mitigation is needed to offset adverse impacts. The USACE will be the lead agency for the Section 106 review for this project, and the review process is expected to include the Squaxin Island Tribe, Nisqually Indian Tribe, Confederated Tribes of the Chehalis Reservation, and DAHP. The Section 106 process will start once the SEPA EIS process concludes, a Preferred Alternative is selected, and the design and permitting process begins. Additional information on the regulatory context for cultural resources is presented in the Cultural Resources Discipline Report (Attachment 13).

The study area for archaeological resources is defined as a 0.25-mile (0.40-kilometer) buffer east, south, and west of the project area; the northern boundary is the extent of anticipated sediment deposition and dredging that would occur within West Bay under the Estuary and Hybrid Alternatives. The study area for the historic built environment consists of areas that could be directly or indirectly impacted by construction or operation of the project and is larger than the project area. At the south end, the boundary extends to the top edge of the steep bluffs around the South Basin, I-5, and US Highway 101; the eastern boundary encompasses the South Capitol Neighborhood, West Capitol Campus, Downtown Olympia historic districts, and Capitol Way S; and the western boundary is the upland edge of the project area; finally, the northern boundary is defined by a direct line from the north end of the Port of Olympia harbor west to the shore.

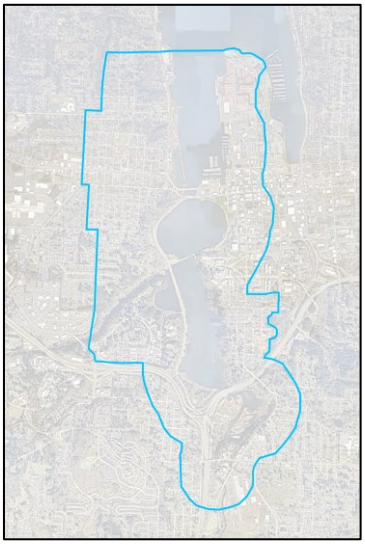


*Exhibit 3.50 Cultural resources study area*

## Methods for Studying Cultural Resources

The review of archaeological and historic built environment resources included both desktop analysis and a field inventory for historic resources. The desktop analysis of existing conditions and context for cultural resources was conducted using previous studies, database searches, historical maps, and historical registers. A field inventory and completion of historic property inventory (HPI) forms were completed for historic resources that would be directly or indirectly impacted by one or more of the action alternatives. The completed HPI forms and survey information will help support future Section 106 consultation as part of permit evaluations for the selected alternative, and may be supplemented at that time with additional survey work.

**The full list of studies, reports, and other data sources is presented in the Cultural Resources Discipline Report (Attachment 13).** Given the large volume of publicly available information on historic development context and history of the Capitol Lake area, there is a larger volume of information presented in this EIS and in the Cultural Resources Discipline Report (Attachment 13) on the historic built environment relative to archaeological resources.

## 3.9.1 What archaeological resources can be found in the study area?

### *3.9.1.1 Indigenous Context of the Study Area*

The Capitol Lake – Deschutes Estuary is located within the ancestral lands of the Southern Coast Salish and Southwestern Coast Salish cultural groups, which includes, but is not limited, to the Steh-chass, Nusehchatl, Squaxin (people of the water), Nisqually (people of the river, people of the grass), and the Chehalis. The Southern Coast Salish and Southwestern Coast Salish have used the area since time immemorial for various levels of habitation and resource gathering. Descendants of these people are members of today's federally recognized Squaxin Island Tribe, Nisqually Indian Tribe, and Confederated Tribes of the Chehalis Reservation.

The natural waterways of the study area, including the Deschutes River and Percival Creek, along with other nearby rivers, lakes, and forests provided fishing and hunting opportunities for resources such as salmon, beaver, waterfowl, deer, elk, bear, and other animals. The ethnographic record and oral tradition speak to the importance of the land, its resources, and fishing among indigenous groups throughout the region. This includes ceremonies and rites related to the resources and their procurement, including the First Salmon Ceremony. This ceremony celebrates the first catch of the season and ensures the fish return and remain an abundant resource for future seasons and generations.

The Southern Coast Salish groups in this area were signatories of the 1854 Medicine Creek Treaty. Under this treaty, ratified in 1859, lands in the South Puget Sound stretching from the Cascades to the Black Hills were ceded to the U.S. Government by the treaty signatories. This area includes the ancestral lands of the Squaxin Island Tribe, Nisqually Indian Tribe, and Confederated Tribes of the Chehalis Reservation. This treaty was the first negotiated between the U.S. Government and indigenous groups in the Washington Territory and established certain rights, amongst them fishing rights in all "usual and accustomed grounds and stations." This right was later upheld by the Boldt decision in 1974.

### *3.9.1.2 Recorded Archaeological Resources*

Given the shoreline setting of the Project Area and its proximity to water, the Project Area is classified as Very High to High Risk for presence of precontact-era archaeological resources. Upland areas adjacent to the North and South Basins contain recorded precontact-era archaeological sites, and it is likely that further as-yet-undiscovered sites

are present in the uplands adjacent to all three basins. It is also possible that some upland sites could extend downslope into the basins.

Landforms in the vicinity of 5th Avenue Dam are more notable for recorded historic-era archaeological sites rather than precontact-era sites. Recorded resources include "Heritage Park Bottle Dump" associated with the Olympia Brewing Company Bottle Works Plant Site in the North Basin, as well as refuse dumps and structural ruins. Also, the "Roadbed of the Olympia and Chehalis Valley Railroad" is situated along the western shoreline of the Middle Basin.

For a listing of previously recorded archaeological sites in the Project Area and their register status, see Table 4.3 in the Cultural Resources Discipline Report (Attachment 13).

### Precontact/Historic Era

Archaeological resources are commonly classified by whether they date to the period before contact between Indigenous and non-Indigenous people ("precontact era") or after contact ("historic era").

*Exhibit 3.51 Black and white aerial view of Capitol Buildings and Deschutes Estuary in Olympia facing north, circa 1927 (Source: unknown)*

## 3.9.2 What historic built environment resources can be found in the study area?

### *3.9.2.1 Historic Setting of the Study Area*

The Capitol Lake Basin began as a natural feature, part of the estuary transitioning between the freshwater Deschutes River and the saltwater tides of Budd Inlet. Over time, several events have changed the character of the Capitol Lake Basin: the establishment of Tumwater and Olympia; the growth of the west side of Olympia; the crossing of multiple railroad lines; and the evolution of the Capitol Campus, which includes the addition of the Des Chutes Basin Project (Capitol Lake).

In 1889, Washington became a state and Olympia the state capital. The state legislature selected New York architect Ernest Flagg to design the capitol building. Flagg's proposal oriented the capitol building to the south, and had it fronting a plaza with a reflecting pool and formal plantings. Twenty years later, the State Capitol Commission selected the architects Wilder & White to develop a master plan for the Capitol Campus. In their design, Wilder & White identified the capitol building site's height above the surrounding water (Middle and North Basins) and the city as key to conveying its monumental significance. The State Capitol Commission also hired the Olmsted Brothers to develop a preliminary plan for the general layout based on an earlier design by Wilder & White.

In 1912, the Olmsted Brothers worked with the State Capitol Commission and Wilder & White, showing their vision for reorganization of the land at the base of the bluff (Figure 3.9.1). The Olmsted Brothers' proposal for the estuary included creating a saltwater pond, selective

infilling of the tideflats, relocating the Northern Pacific Railway alignment, and capitalizing on the Capitol Waterway's alignment with the proposed location of the Legislative Building to extend a park along the infilled former waterway alignment to end at a railroad depot.

The saltwater pond was proposed to be created through a low retaining berm with a road along the top and an inlet and outlet to exchange water during tidal fluctuations. Ultimately, Wilder & White's design of the capitol group was selected by the State Capitol Commission and construction commenced. In 1927, the now State Capitol Committee (SCC) retained the Olmsted Brothers to design the campus landscape and approaches.

Much of the present-day configuration of the Capitol Lake Basin was established as part of the Des Chutes Basin Project, initiated by the State Legislature in 1937 through House Bill 530 authorizing work on the Des Chutes Basin Project in part "to be in keeping with and become a part of the capitol building and grounds; […]." This work included clearing development from the shoreline of the Capitol Lake Basin, buying back tidelands, and developing the 5th Avenue Dam, the 5th Avenue Bridge, and Deschutes Parkway. The SCC retained James W. Carey & Associates to develop the overall design, which ultimately included selecting an earth fill dam for the 5th Avenue Dam as the best suited and most economical design approach. The 800-foot-long and 80-foot-wide (at the top) dam was built as three units and completed in 1951. Fill for the dam was pulled from the nearby Percival Creek borrow pit.

*Exhibit 3.52 Deschutes Dam construction, April 8, 1950 (Source: The Susan Parish Collection of Photography, Washington State Archives)*

For additional information on the historic setting, see the Cultural Resources Discipline Report (Attachment 13). This includes further information on the historic development context and themes applicable to the history of the Capitol Lake area, such as early European settlement, land development, State Capitol development and design, commercial development, transportation, and neighborhood development.

# Figure 3.9.1 Flagg & Wilder & White Visions


Ca. 1893 view of architect Ernest Flagg's design for the State Capitol Building.

Courtesy Washington State Archives.


Ca. 1911 Bird's Eye View prepared by architects Wilder & White showing their vision for the capitol grounds.

Courtesy of the National Park Service, Frederick Law Olmsted National Historic Site. File No. 5350-32.

### 3.9.2.2 Listed and Potentially Eligible Historic Built Environment Resources

Historic built environment resources in the study area include historic districts and individually designated resources, both listed and those recommended as eligible for listing in the NRHP and other historic registers.

To determine potential impacts, the EIS analysis considered both listed historic resources and historic resources that the EIS Project Team evaluated and recommends as eligible for listing, as well as currently unlisted and unevaluated resources that may be eligible for listing in the NRHP and other historic registers. Potentially affected resources would be evaluated for eligibility as part of the Section 106 process during permitting for the selected alternative. During the Section 106 process, the lead federal agency will make a determination of eligibility for the identified resources, and forward that determination to DAHP in a letter with a request for concurrence on the determination(s).

The field inventory results were combined with information from previous historic resources investigations to create a comprehensive summary of the historic built environment of the study area. The comprehensive inventory includes both listed and potentially eligible resources as well as those that have not been reviewed for eligibility. A total of 103 historic resources were identified in the historic built environment study area, along with five existing historic districts. This evaluation also recommended a potential new historic district: the Des Chutes Basin Project. Figure 3.9.2 shows the location of the historic districts, as well as the individually listed and designated resources. For more information on the individual resources, see Cultural Resources Discipline Report (Attachment 13).

Many of the individually eligible resources are within one of the historic districts described below:

- **Des Chutes Basin Project Historic District (Recommended)**. The 1937 Des Chutes Basin Project is recommended by the EIS Project Team as a historic district due to its influence on and interconnectedness with the development and visual character of Tumwater, Olympia, and the Capitol Campus. Based on the results of this analysis, the following individual resources within the district are also recommended as eligible for certain federal, state,

#### Is the Capitol Lake – Deschutes Estuary listed in the NRHP?

The **Capitol Lake – Deschutes Estuary** is recommended as eligible for listing in the NRHP as a contributing resource within a historic district encompassing the **Des Chutes Basin Project**. The resource has historic significance for its association with the Des Chutes Basin Project and its impact on the community planning and development of Olympia and Tumwater.

and local historic registers: the Capitol Lake – Deschutes Estuary itself, 5th Avenue Dam, 5th Avenue Bridge, and Olympic Street W Bridge. The recommended historic district is within both the Cities of Tumwater and Olympia and within the Project Area, with most features within the Olympia city limits. This potential historic district possesses a significant concentration of associated structures, open space, and sites that present a unified entity and are historically interrelated and aesthetically mutually dependent.

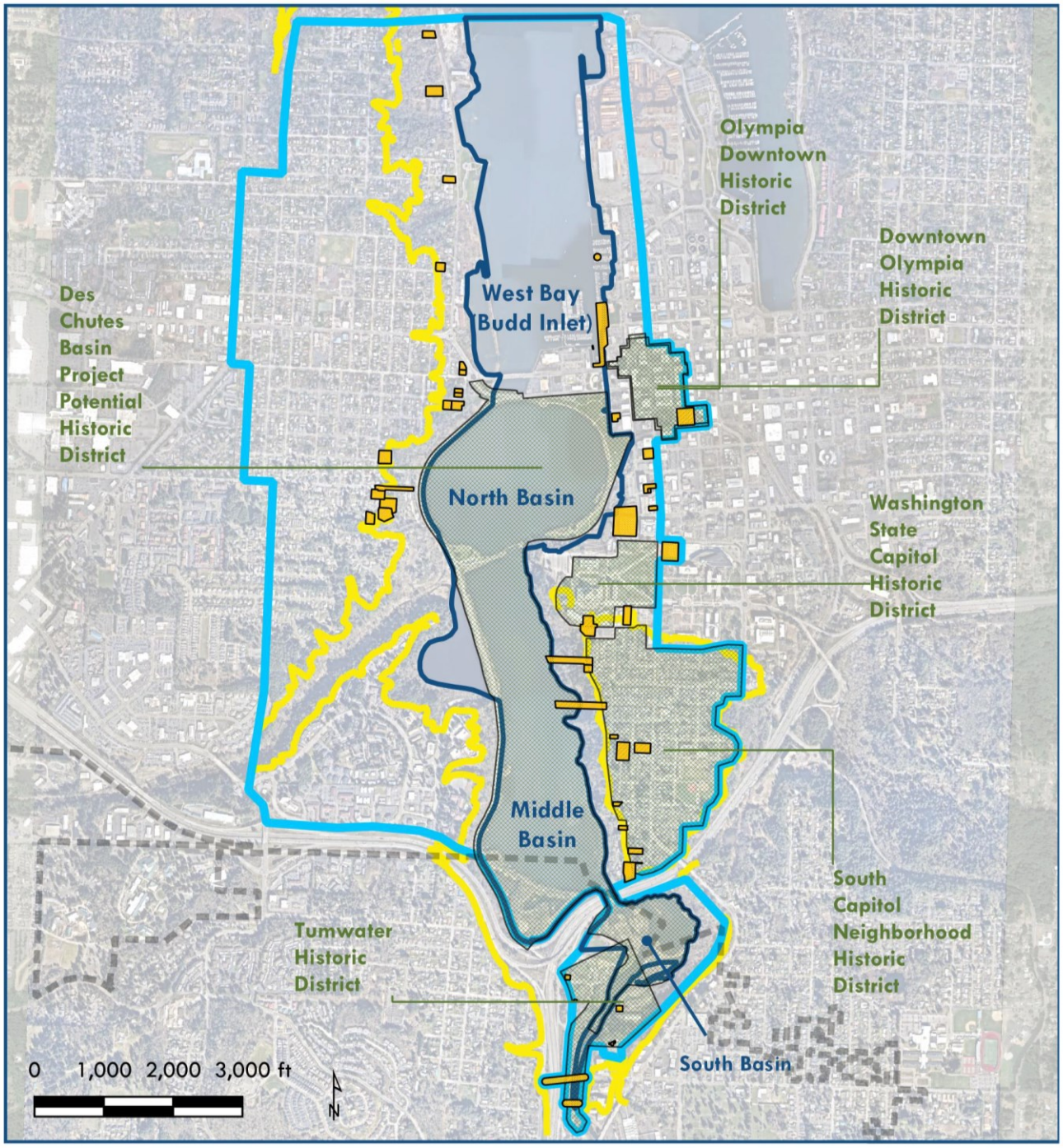
- **Tumwater Historic District (Listed)**. The Tumwater Historic District, located within the Project Area in the South Basin, is listed on both the NRHP and the Washington Heritage Register. The historic district encompasses most features remaining from Tumwater's early development and includes the 1906 Brewery Building, Crosby house (built ca. 1860), and Henderson house (built ca. 1905). Tumwater Historical Park is also within the district.
- **Olympia Downtown Historic District (Listed).** The Olympia Downtown Historic District is listed in both the NRHP and the Washington Heritage Register. The district is adjacent to the Project Area in the North Basin and West Bay.
- **Downtown Olympia Historic District (Listed).** The Downtown Olympia Historic District is listed in the Olympia Heritage Register. The district is adjacent to the Project Area in the North Basin and West Bay.
- **Washington State Capitol Historic District (Listed).** The Washington State Capitol Historic District is listed in both the NRHP and Washington Heritage Register. The district is adjacent to the Project Area in the North and Middle Basins.
- **South Capitol Neighborhood Historic District (Listed)**. The South Capitol Neighborhood Historic District is listed in both the NRHP and Washington Heritage Register. The district is adjacent to the Project Area in the Middle Basin.

These eligible and listed resources are shown on Figure 3.9.2.

## Are the 5th Avenue Dam and 5th Avenue Bridge eligible for listing in the NRHP?

Both the 5th Avenue Dam and 5th Avenue Bridge are recommended as eligible for listing in the NRHP as a contributing resource within a historic district encompassing the Des Chutes Basin Project. These structures have historic significance for their association with the Des Chutes Basin Project and their impact on the community planning and development of Olympia. As individual structures, they are also recommended as individually eligible for listing in the NRHP due to their high level of architectural integrity.

## Figure 3.9.2 Historic Districts & Listed Historic Resources



### 3.9.3 Are there traditional cultural properties in the study area?

As part of an earlier planning effort for the Capitol Lake Basin, a study was conducted in 2009 of cultural and spiritual values associated with future alternatives for the Capitol Lake Basin (*Study of Cultural & Spiritual Values Associated with Future Alternatives for Capitol Lake Basin)*. The study was intended to identify the cultural and spiritual values associated with the Capitol Lake Basin held by a variety of stakeholders, and to assess potential impacts on those values from proposed alternatives for Capitol Lake Basin at that time.

Values were identified through document review and interviews with stakeholders, including representatives of:

- The Native American community (the Squaxin Island Tribe)
- The Olympia Chinese-American community

The 2009 report contains information regarding beliefs and experiences associated with the Capitol Lake Basin, which are summarized below. Stakeholder participants in the earlier study confirmed to the EIS Project Team that the 2009 report remains a valid representation; no new information on the communities' history and ties to the area were identified.

**Traditional Cultural Properties**

A desktop analysis of previously documented traditional cultural properties listed in the Washington Information System for Architectural and Archaeological Records Data (WISAARD) maintained by DAHP was conducted; none were identified within the study area.

#### *3.9.3.1 Squaxin Island Tribe*

The Deschutes Estuary is the ancestral home to many of the Squaxin Island Tribe's members. The Deschutes Estuary was originally inhabited by the Steh-chass people who occupied the area around Budd Inlet. The Deschutes watershed continues to be used for ceremonial, subsistence, and commercial harvesting of natural resources, and is a place of strong cultural and spiritual value. The tribe sees value and significance of the Capitol Lake – Deschutes Estuary area as a provider, educator, connection to ancestors, and source of meditative tranquility. In addition, the natural condition of the original river and estuary is valued for the sake of itself. In its natural state, the basin provided water and mud for spiritual cleansing rituals; fish, shellfish, birds, and eggs; medicinal plants; and materials for basket-weaving such as sweetgrass. The tribe considers that a reintroduced estuary could be an educational resource to teach people about nature, land, and ancestors, as the area was once an important regional hub of indigenous trade and transportation.

**Gwitsawdit**

A prominent tribal value linked to the basin is **Gwitsawdit**, which are sacred "teachings of the land" that describe the balance of life and value of nature, and emphasize the interconnectedness of all aspects of the environment—an interconnectedness that was disrupted by construction of the 5th Avenue Dam.

### 3.9.3.2 Chinese-American Community

The Chinese-American community is linked to the Deschutes Estuary through Olympia's historic Chinatown.

Chinese immigrants first arrived in Olympia during the mid-19th century. Many found employment as construction laborers, in lumber camps, harvesting shellfish, commerce, and domestic work. From its roots on 4th Avenue W at Columbia Street and Capitol Way, Chinatown moved progressively south and west to 5th Avenue SW and Water Street SW, and the waterfront district known as Little Hollywood.

During the economic depression of 1882 to 1885, Chinese residents in Seattle and Tacoma were forcibly removed, but this did not happen in Olympia. However, anti-Chinese immigration laws and sentiment eventually led to the abandonment of Olympia's Chinatown. In 1937, the SCC was authorized to develop and extend the State Capitol grounds, which involved purchasing or condemning basin and tidelands. Little Hollywood was razed in 1943, and remnants of Chinatown are now gone.

*Exhibit 3.53 Black and white photograph of the City of Olympia from the west side of the Deschutes Estuary, looking east toward Mt. Rainier, 1942. Includes Governor Hotel, Little Hollywood*

The Chinese-American community values the area as an embodiment of the American Dream. Capitol Lake Basin represents a first immigrant home in the U.S., and it was a starting point for establishing Olympia's Chinese-American community. This experience is commemorated in a historic marker at Heritage Park Fountain, the site of the former Chinatown. The dedication of the Olympia Dragon Mural at the corner of 5th Avenue SW and Columbia Street SE in 2019 to commemorate the Chinese-American business community that was located along Columbia Street underscores the continued connection of this community with the area.

## 3.10 VISUAL RESOURCES

Visual resources are natural and human landscapes that are valued for their views. However, the importance of, sensitivity to, and impacts from changes to views can vary greatly from person to person. Public preferences for certain views are expressed in several planning policies and regulations.

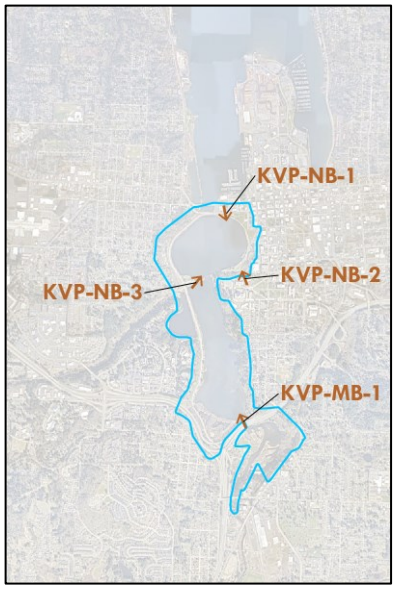



*Exhibit 3.54 Visual Resources study area and key view points (KVPs) used for visual simulations*

The study area for visual resources extends beyond the Project Area to the areas where the project would be visible. This includes public viewpoints, scenic routes and highways, and views from private properties. The study area includes Deschutes Parkway and the parks around the lake's north, west, and south shores; a portion of the Capitol Campus on the eastern shore; and the shorelines lining the southeast

shore of the lake. Images in this section were taken from photo points, as shown on Figure 3.10.1.

## Methods for Studying Visual Resources

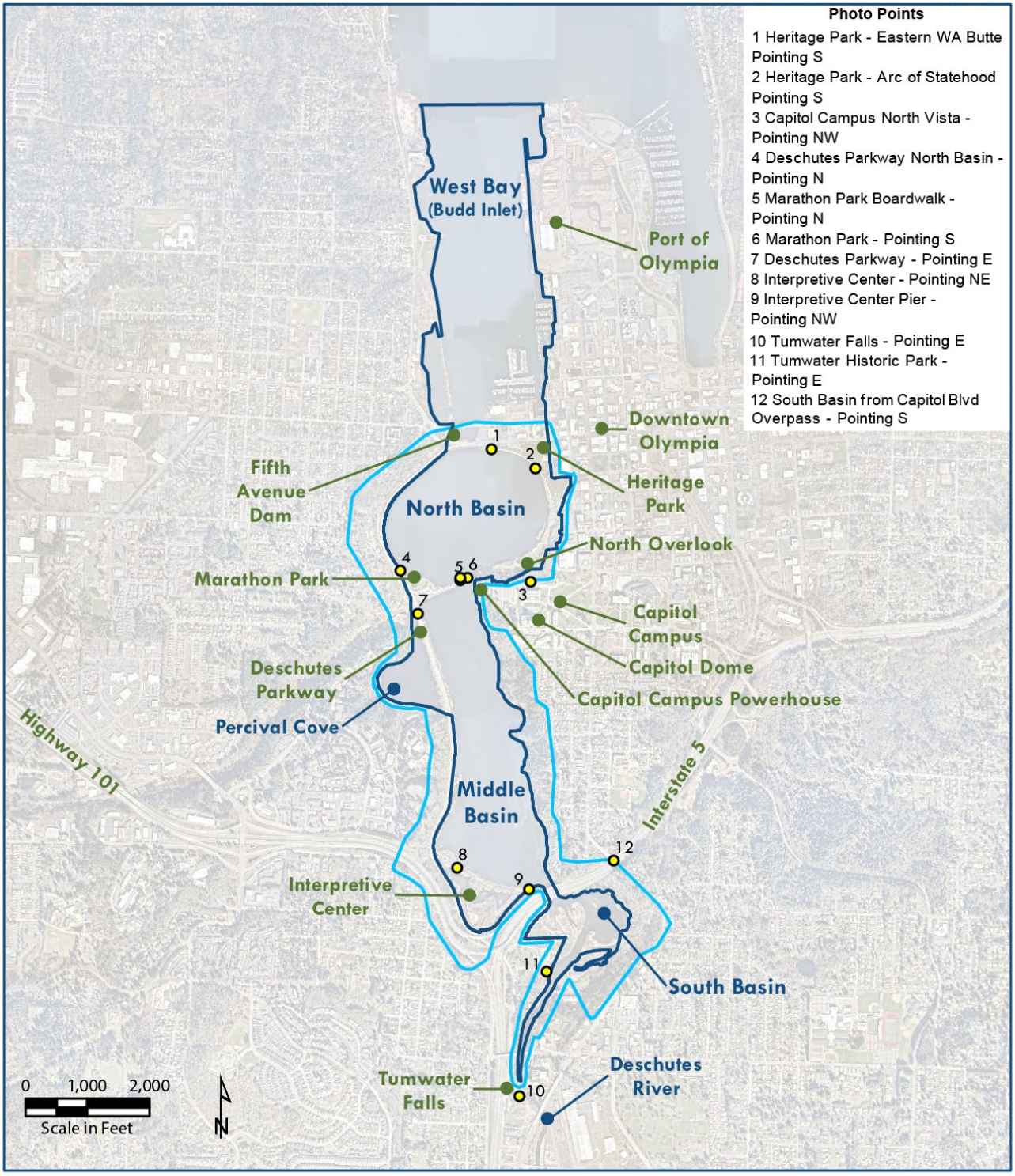
The affected environment was evaluated based on a review of the study area landscape and its uniqueness within the regional landscape, with reliance on agency policies to determine specific features that are valued. Data sources used for the analysis include aerial and terrestrial photography; GIS data including terrain, vegetative cover, and 3D modeling of structures and vegetation; relevant policy and planning documents; and land and shoreline use regulations applicable to the study area.

**The full list of data sources is presented in the Visual Resources Discipline Report (Attachment 14).**

### 3.10.1 What is the relevant context and regulatory landscape for this viewshed?

Capitol Lake is a large waterbody and a highly valued visual resource. Capitol Lake and the adjoining parks define edges of downtown Tumwater and Olympia, and contribute to the setting for the Washington State Capitol. The design of the Capitol Campus takes advantage of views of the water as a connection with the larger landscape setting that includes Puget Sound and the Olympic Mountains. While the state has adopted regulations regarding the use of Capitol Lake, no state regulation specifically directs the management of views or visual quality. Master Plans for the Capitol Campus do include goals relating to the views of the water and Olympic Mountains from the North Overlook. At a local level, the Cities of Tumwater and Olympia have policy guidance related to a general preference for protecting public views of the water, water's edge, and surrounding mountain views, and for naturalistic design treatments, but do not call out specific views that must be preserved (aside from views of the Capitol Dome).

# Figure 3.10.1 Visual Resource Photo Locations



## 3.10.2 What are the existing views within the North Basin?

The North Basin includes Heritage Park, Deschutes Parkway, and Marathon Park. The North Basin is noted for views of the Capitol Dome, which are available around much of the east, north, and west perimeter of Capitol Lake. The North Basin can also be seen from the Capitol Campus, particularly from the North Overlook. The North Basin is also a defining visual feature at the southwest edge of downtown Olympia. Views from taller buildings in downtown Olympia include the basin. The North Basin consists of four Landscape Similarity Zones, described in the following sections.

**Landscape Similarity Zones**

Landscape Similarity Zones are areas that have similar views and types of viewers within the basins.

### *3.10.2.1 Heritage Park*

The area east of the 5th Avenue Dam is dominated by Heritage Park, a highly visited public park that is an extension of the Washington State Capitol Campus. The park comprises the east shoreline of the North Basin and is generally flat. At the northern edge of Heritage Park, a mound known as the Eastern Washington Butte offers views across the North Basin toward the Capitol (see Exhibit 3.32). The southeast portion of the North Basin also provides views of the Capitol Dome and large areas of water (see Exhibit 3.33).

*Exhibit 3.55 Photo Point 1: Heritage Park Eastern Washington Butte looking south toward the Capitol Dome*

*Exhibit 3.56 Photo Point 2: Heritage Park Arc of Statehood shoreline looking south toward the Capitol Dome*

The views from Heritage Park extend to Marathon Park and Deschutes Parkway. Views do not extend to the Middle Basin because of the BNSF Railway Trestle, which marks the division between the basins. The views looking south toward the Capitol Campus are highly unified, with the formal tree plantings along the shorelines leading to the forested hillside

topped by the Capitol Dome. There are some private views of Heritage Park from taller buildings downtown.

### 3.10.2.2 Capitol Campus North Overlook

The North Overlook, located on the Capitol Campus atop a steep hillside, offers views of Capitol Lake, downtown Olympia, Budd Inlet, Puget Sound, and the Olympic Mountains beyond (see Exhibit 3.34). Heritage Park stands in the foreground and the marinas and buildings of downtown Olympia form the middle ground of the view. The 5th Avenue Dam is visible on the far shore of Capitol Lake, but it is not prominent.

The view from the North Overlook provides a strong sense of place for viewers visiting the Capitol Campus.

*Exhibit 3.57 Photo Point 3: Capitol Campus North Vista looking northwest*

### 3.10.2.3 Deschutes Parkway

Deschutes Parkway extends west of the 5th Avenue Dam and continues south, along the west shore of the North Basin. Views from Deschutes Parkway are primarily open water (see Exhibit 3.35). The far shoreline is Heritage Park, which appears as a line of trees along the shore, with a low urban skyline behind it. The 5th Avenue Dam is visible but not prominent. Overall, the view is highly unified, like the view from Heritage Park. For a person traveling on the roadway, views of the water are intermittent, interrupted by parked vehicles as well as the street trees and in some areas, low shoreline vegetation. A few houses uphill and west of the parkway have views across the North Basin.

*Exhibit 3.58 Photo Point 4: Deschutes Parkway looking east toward downtown Olympia*

### 3.10.2.4 Marathon Park

Marathon Park is a large open space in the southwest portion of the North Basin. Views from this park are similar to those from Deschutes Parkway. Marathon Park has an east-west oriented pedestrian boardwalk that crosses the channel between the North Basin and the Middle Basin. The views from this vantage point looking northeast across the North Basin afford the only experience of being over the water on the North Basin (see Exhibit 3.36). The views to the south from the Marathon Park boardwalk have a railroad bridge in the foreground (see Exhibit 3.37).

*Exhibit 3.59 Photo Point 5: Marathon Park boardwalk looking northeast toward downtown Olympia*

*Exhibit 3.60 Photo Point 6: Marathon Park boardwalk looking south toward Middle Basin*

## 3.10.3 What are the existing views within the Middle Basin?

The Middle Basin is bounded on the north by the BNSF Railway Trestle and on the south by the I-5 bridge. Viewed from a distance, both the eastern and western shores of the Middle Basin appear heavily vegetated and form a naturalistic frame for the open water of the basin. Except when standing near them, the built elements (the bridges and the Capitol Campus Powerhouse) are not dominant features in this landscape. Like the North Basin, the Middle Basin as a waterbody is predominantly open water. There are overwater views of the Capitol Dome from viewpoints on the south and west sides of the basin. Trails at Percival Cove and the Interpretive Center provide very different visual experiences where vegetation varies in height from very low to well overhead. The Middle Basin consists of three Landscape Similarity Zones described in the following sections.

### *3.10.3.1 Deschutes Parkway*

The west shore of the Middle Basin is a continuation of Deschutes Parkway. The Middle Basin also includes Percival Cove, a largely natural area that is separated from the main basin by a causeway and bridge, which Deschutes Parkway traverses. Views are similar to those in the North Basin except that the roadway has open water on both sides. The Capital Dome can also be seen along much of the corridor.

### *3.10.3.2 Interpretive Center*

The Interpretive Center, at the southwest edge of the Middle Basin near the I-5 bridge, is made up of wetlands and paths, and has two small piers that provide close visual access to the water. The pathways afford views across the wetlands in the park as well as views north along the long sweep of the Middle Basin. From the shoreline path, open water and tree-lined shores dominate the view. In places, the Capitol Dome can be viewed (see Exhibit 3.38). Along other pathways, views are obscured by shrubby shoreline vegetation, but there are also openings where the entire basin can be observed.

This zone includes portions of I-5 and US Highway 101, as well as a small area upslope from US Highway 101. Only fleeting views of the Middle Basin are available from these highways.

*Exhibit 3.61 Photo Point 8: Interpretive Center looking northeast toward the Capitol Dome*

### 3.10.3.3 East Shore

There are no public view locations along the waterfront of the east shore. The area is mostly privately owned and has an extensive tree canopy on the steep slopes that line the shore and block views from the streets. The east shore of the Middle Basin is composed of steep slopes rising approximately 100 feet (30 meters) above the water level, forested with a mix of deciduous and coniferous trees (see Exhibit 3.39).

At the northeast end of the Middle Basin is the Capitol Campus Powerhouse, a historic industrial building nestled in the slope that provides steam heat to the Capitol Campus (see Exhibit 3.40). Viewed from Deschutes Parkway or the Interpretive Center, the eastern shore appears as a unified landscape of forest greenbelt, with the Capitol Dome and the I-5 bridge to the south being the only built features of any prominence.

*Exhibit 3.62 Photo Point 9: Interpretive Center pier looking northwest*

*Exhibit 3.63 Photo Point 7: View from Deschutes Parkway looking east across Middle Basin to the Capitol Campus Powerhouse*

### 3.10.4 What are the existing views within the South Basin?

The South Basin is bounded on the north by the I-5 bridge and on the south by Tumwater Falls. The falls form a natural and dramatic visual terminus (see Exhibit 3.41). The South Basin is the smallest of the basins and is dominated by views of riparian wetlands and forest, with the river channel and a small area of open water as a central spine. The South Basin is considered one Landscape Similarity Zone because views of it are similar from most angles, and views from within it, although varied, contain similar visual elements.

The features of the South Basin form a popular tourist attraction, and thousands of visitors come to the area every year to see the river, the fish hatchery, and the historic brewery and other buildings in the area. Therefore, most viewers see this zone from within one of the two parks that form the shorelines of this basin. Tumwater Historical Park has open areas with trails leading to the water's edge (see Exhibit 3.42). Brewery Park at Tumwater Falls also has trails and a pedestrian bridge over the river that allow users to see the river up close.

The visual character is largely unified, even in areas where built elements are close to the water. The main exception is the area near the I-5 bridge, where the massive overhead stricture contrasts sharply with rest of the basin.

*Exhibit 3.64 Photo Point 10: Tumwater Falls looking east*

*Exhibit 3.65 Photo Point 11: Tumwater Historical Park looking south toward Brewery Park*

## 3.11 ENVIRONMENTAL HEALTH

Environmental health addresses the physical, chemical, and biological factors that could affect human health. For this project, the chemical quality of sediment was evaluated as the primary potential change to environmental health. Additional information on sediment quality, including data collected for this project, is presented in the Sediment Quality Discipline Report (Attachment 15). Other aspects of environmental health that were evaluated in this EIS include the potential increase or decrease of mosquitos and toxic algae based on changing water quality conditions.

The study area for environmental health consists of areas that could be directly or indirectly affected by construction or operation of the action alternatives. This includes the North and Middle Basins within the Capitol Lake Basin, and West Bay, which could be affected by sediment transport from the Capitol Lake Basin, depending on the long-term management alternative. In this area, sediment quality could change as a result of the project.

## Methods for Studying Environmental Health

Sediment quality data collected by the EIS Project Team in Capitol Lake, and those data publicly available in West Bay, are compared against regulatory criteria to determine if the sediment poses a risk to the environment. For this study, sediment quality data were compared to the following criteria:

**Washington State Sediment Management Standards (SMS)** freshwater and marine chemical criteria that are protective of the benthic community and human health in freshwater and marine sediment. SMS sediment cleanup standards chemical criteria include the Sediment Cleanup Objective (SCO) and CSL.

**Dredged Material Management Program (DMMP)** marine sediment screening levels (SLs) are applicable for any future dredging project in West Bay that would dispose of dredged sediments within the waters of the U.S.

**Model Toxics Control Act (MTCA)** Method A soil cleanup levels for unrestricted land use are used to evaluate options for the beneficial reuse of the sediments at a non-landfill upland location.

**The Sediment Quality Discipline Report (Attachment 15) contains the full list of data sources used for the evaluation.**

### 3.11.1 How was existing sediment quality evaluated?

Information about the existing sediment quality conditions in Capitol Lake was obtained during a March 2020 sediment sampling event, as described in Section 3.11.2. Information about sediment quality for West Bay was evaluated using historical data available in Ecology's Environmental Information Management (EIM) online database and existing reports, as described in Section 3.11.3.

To evaluate sediment quality, chemical concentrations in surface sediments were compared to criteria for protecting benthic invertebrates (bottom-sediment dwelling organisms), wildlife, and human health in fresh and marine waters, as well as criteria for allowing potential disposal of sediments removed from the project site to an open-water disposal site in Puget Sound or an upland location.

### 3.11.2 What is the existing sediment quality in Capitol Lake?

In March 2020, a sediment sampling event was conducted in the North and Middle Basins to support the EIS analysis (Figure 3.10.1). The goal of this sediment sampling was to characterize the physical and chemical quality of sediments within the Capitol Lake Basin to evaluate existing conditions. This information was important for analyzing potential impacts to environmental health during construction and operation of each project alternative.

# Figure 3.11.1 Sediment Sample Locations


**Legend**

- Sampling Station

Surface, dredge layer, and Z layer sediment samples were collected in the North and Middle Basins in order to understand the quality of sediment that would be dredged and the sediment that would remain. Surface grab samples were collected from the top 3.9 inches (10 centimeters) of the sediment to characterize surface sediment quality. Subsurface sediment cores were collected to characterize the deeper layers. Samples were analyzed for the chemicals listed below. These chemicals were selected for analysis primarily because they are the chemicals that are regulated under SMS. Dioxins/furans do not have similar regulatory criteria under SMS, but have DMMP criteria to inform disposal options.

- Ammonia and sulfides
- Metals
- Butyltins
- Semivolatile organic compounds (SVOCs). For example, polycyclic aromatic hydrocarbons (PAHs), phthalates, and phenols.
- Polychlorinated biphenyls (PCBs)
- Organochlorine pesticides
- Total petroleum hydrocarbons (TPH)
- Dioxins/furans

The data indicated that, overall, Capitol Lake has high quality (good) sediment, meeting nearly all applicable sediment criteria. Refer to the Sediment Quality Discipline Report for detailed data table and analysis (Attachment 15). Sediment chemical concentrations were low in all three layers of both basins. The only criterion exceeded was the freshwater CSL for total sulfides protective of benthic invertebrates. High sulfide concentrations are common in lake sediments due to microbial decay of natural organic matter present in algae and aquatic plants.

Average concentrations of total sulfides exceeded the freshwater CSL in the surface and dredge layer in both basins, but not in the Z layer of either basin. This is because there is typically a low amount of organic matter in the deeper sediment. Organisms present in the surface layer are likely impacted by the high concentrations of total sulfides (and associated low dissolved oxygen), but not by anthropogenic chemicals.

## Three Layers of Sediment Evaluated

**Surface layer** sediments in many areas would be left undisturbed during and following construction. These are areas that would not be dredged.

**Dredge layer** sediments may be used to create habitat areas or be removed for off-site disposal or upland reuse (if treated for invasive species).

**Z layer** sediments are in dredge areas that would become exposed after dredging, but would remain.

## Potential Toxic Effects of Total Sulfides

### Risk to Benthic Organisms

Sulfides in sediment are naturally occurring. Elevated sulfide levels indicate the sediment may have low oxygen. Sometimes, the elevated sulfides in sediment can be toxic to benthic invertebrates or cause them to avoid the surrounding environment.

### No Risks to Human Health

The sulfides that are present in Capitol Lake do not pose a health risk to humans during recreational activities such as boating or swimming.

Although there were detections of other chemicals, none of the observed metals or organic chemicals concentrations would trigger sediment cleanup, as the detected concentrations were less than the CSL and are common in urban areas. Concentrations of dioxins/furans would not trigger sediment cleanup but may not allow for open-water disposal, depending on the volume-weighted average concentration in all dredged sediments. However, in-water disposal of sediments dredged during construction is not anticipated. Based on the chemical quality, there would be no restrictions for reuse or placement of sediments dredged from Capitol Lake at an upland location based on chemical concentrations.

Overall, the data were consistent with past historical studies from Capitol Lake, which have always shown the sediment in Capitol Lake to be of good quality.

### 3.11.3 What is the existing sediment quality in West Bay?

Sediment quality in West Bay was evaluated for this project because of the potential for characteristics to change if the 5th Avenue Dam was removed and sediment was deposited in West Bay from the Capitol Lake Basin; and to evaluate the potential impacts to sediment quality if sediment was transported from West Bay into the Capitol Lake Basin during flooding/incoming tides.

Sediment quality has been evaluated in West Bay in four studies conducted between 2008 and 2019. Sediment sampling locations are shown on Figure 3.11.2. In general, sediment quality in West Bay has not met sediment quality criteria based on data provided in these historical studies. Contaminants of primary concern include carcinogenic PAHs and dioxins/furans, which affect human and ecological health, and are located throughout West Bay, while localized exceedances of benthic criteria, which protect biological organisms in the sediment, occur near stormwater outfalls. Results from the studies are summarized below, and the sediment data from all the studies are available in Ecology's EIM database.

Sediment chemical concentrations in West Bay only exceed SMS and DMMP criteria for select chemicals. The exceedances occur near the stormwater outfalls in the Fiddlehead Marina and the Port of Olympia along the eastern shoreline of West Bay. Chemicals that exceed SMS criteria included organic compounds (phthalates, benzoic acid, benzyl alcohol, acenaphthene [a PAH]) and mercury. In general, lower

#### Summary of Sediment Sampling in West Bay

- **2008:** A characterization study of existing sediment data was conducted by Ecology. As part of this study, all sediment data available in the EIM database for Budd Inlet were evaluated for exceedances of cleanup criteria.
- **2011 and 2018:** Sediment monitoring was conducted by Ecology's Marine Sediment Monitoring Team as part of the Puget Sound Sediment Monitoring Program.
- **2013:** Extensive sediment monitoring was conducted by the Port of Olympia in the vicinity of the Port of Olympia peninsula for developing a conceptual site model, sediment cleanup criteria, and remedial alternatives for the study area.
- **2019:** Historical data review and sediment sampling was conducted on behalf of the LOTT Budd Inlet Treatment Plant as part of evaluating compliance with their stormwater discharge permit.

Refer to the Sediment Quality Discipline Report for detailed data tables and analysis (Attachment 15).

concentrations of chemicals were found in the central and southwest areas of West Bay.

Average concentrations of dioxins/furans and carcinogenic PAHs in West Bay were calculated for comparison to their respective regional background concentrations that are protective of ecological and human health. The average dioxin/furan concentration for West Bay did not exceed regional background but did exceed the DMMP SL for disposal sites, indicating that these sediments, if dredged, cannot be disposed of in open water disposal sites. The average carcinogenic PAHs concentration for West Bay exceeded regional background, indicating potential impacts to ecological and human health.

### Regional Background

Regional background is the concentration of a chemical in the environment that exists from both natural sources and from man-made diffuse sources not associated with a specific cleanup site, such as traffic and other widespread impacts from urban environments.

For chemical concentrations less than regional background concentrations, cleanup is not required.

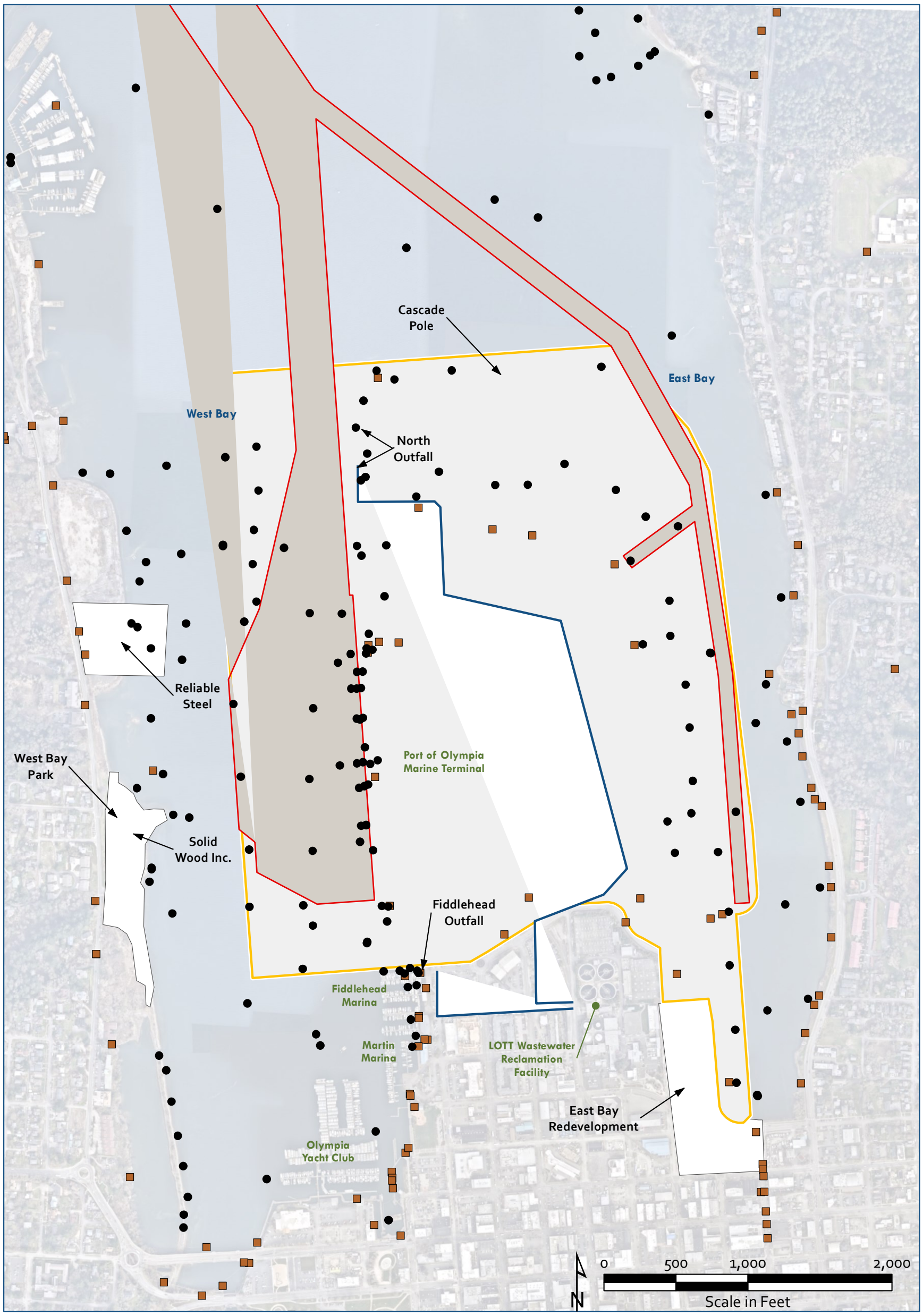
Ecology has identified four sites around Budd Inlet that will require future cleanups based on existing chemical concentrations in sediments or in the uplands (soil and groundwater). These cleanup sites are presented in Figure 3.11.2 and described below.

- **Port of Olympia Peninsula Investigation.** The Port of Olympia has investigated contamination of the peninsula located between and including part of East Bay and West Bay and is currently evaluating possible cleanup actions for an interim cleanup action plan with Ecology. Ecology has not provided a timeline for that cleanup, but it is a foreseeable future action.
- **Reliable Steel.** A draft cleanup plan was prepared in 2014 but cleanup has not yet occurred. Contaminants found at concentrations greater than sediment cleanup levels include metals, PAHs, and phthalates.
- **Solid Wood Inc.** Initial investigations found levels of metals, TPH, and PAHs that exceeded MTCA criteria for soil or groundwater. An interim cleanup was conducted in 2009 for soil and groundwater contamination and a remedial investigation is currently underway.
- **Cascade Pole.** The Port of Olympia has been working on cleaning up the Cascade Pole site from creosote contamination for many years. The most recent sediment monitoring in 2012 and 2013 showed decreasing dioxin/furan concentrations and no exceedances of CSLs protective of benthic invertebrates.

### What is the sediment quality in the Project Area?

The sediment in Capitol Lake is high quality. The sediments in West Bay are impacted by carcinogenic polycyclic aromatic hydrocarbons (cPAHs) and dioxins/furans and future cleanups are planned to address the contamination.

## Figure 3.11.2 Surface Sediment Sample, Outfall, & Cleanup Site Locations in West Bay




**Legend**

- Cleanup Site
- Federal Navigation Channel
- Port of Olympia Peninsula Investigation
- LOTT Outfall
- Stormwater Outfall
- Historical Surface Sediment Sample Location

### 3.11.4 How are mosquitoes relevant to environmental health?

Within the state of Washington there are 52 species of mosquitoes, of which 26 have been identified in Thurston County. Mosquitoes are known vectors capable of spreading disease-causing agents to humans. In 2008 the Washington State Department of Health (WDOH) reported that 12 species of mosquitos found in Thurston County were West Nile Virus (WNV) positive. However, detection or isolation of WNV viral RNA in a species of mosquito does not indicate that the species is a competent vector for the disease, but is an indication that the species has come into contact with the WNV transmission cycle. Two species of mosquito, *Culex pipiens* and *Culex tarsalis*, are considered the state's primary vectors of WNV, both of which are known to occur within Thurston County. Other mosquito-borne illnesses include Western Equine Encephalitis and St. Louis Encephalitis. The Centers for Disease Control reported that in 2018 there were a total of 56 mosquito-borne disease cases within Washington State.

Mosquitoes lay their eggs in standing water and moist soil and have adapted to a wide variety of habitats including ponds and marshes. Larvae are rarely found in deep water lakes and ponds or in flowing water such as streams or rivers.

A study conducted on the salinity tolerance of six different species of mosquitoes found that 100% mortality occurred with salinity levels between 10.2 and 17 ppt (30% to 50% saltwater). Of the six species *C. pipiens* was found to be the least salinity-tolerant species. A different study found that *C. tarsalis* had a higher salinity tolerance, up to 70% saltwater. These findings are applied to the analysis of potential changes in mosquito presence under the project alternatives.

### 3.11.5 Why is toxic algae considered as part of the environmental health analysis?

**Cyanobacteria**

Cyanobacteria, also called blue-green algae, are a group of algae primarily found in inland waters that can have major effects on water quality.

Capitol Lake experiences summer-time algal blooms. The algae community within the lake is primarily dominated by diatoms and cyanobacteria (blue-green algae). As described in Section 3.3, Water Quality, the lake experienced one blue-green algal bloom, which occurred in August 2004. People are typically exposed to toxic algae through contact with skin, inhalation of aerosols, or by consuming toxins via contaminated shellfish or water. Exposure can be linked to recreational activities associated with swimming, boating, and fishing. Symptoms of exposure to a toxic algae generally depend on the length

and type of exposure, but include irritation to the skin, eyes, nose, throat, and respiratory system. Some forms of cyanobacteria create toxins called cyanotoxins, which can impact the nervous system, liver, skin, stomach, and intestines.

In the past, Budd Inlet has been closed to shellfishing due to the presence of Diarrhetic Shellfish Poison (DSP). DSP is a biotoxin produced by a microscopic algae, *Dinophysis*, which is dinoflagellate. If ingested, symptoms of DSP include abdominal pain, vomiting, nausea, and diarrhea. Domoic acid is another biotoxin produced by a microscopic diatom belonging to the genus *Pseudo-nitzchia* that can accumulate in shellfish and cause Amnesic Shellfish Poisoning. Symptoms of Amnesic Shellfish Poisoning include gastrointestinal and neurological disorders and can be life-threatening. In 2008 domoic acid was detected in blue mussels in Budd Inlet.

### Dinoflagellate

Dinoflagellate are a widespread group of primarily marine algae known for toxic algal blooms.

### Diatom

Diatom are a major group of algae found in marine water, freshwater, and soil.

## Reference Materials for Section 3.11 (beyond those used in the sediment quality analysis)

CDC. 2017. Harmful Algal Bloom (HAB)-Associated Illness.

CDC. 2020. Washington: Vector-borne diseases Profile (2004-2018).

Essington, T., et al. The Biophysical Condition of the Puget Sound: Chemistry, Section 3. Harmful Algal Blooms. Encyclopedia of Puget Sound.

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WDOH. 2019. Distribution of Mosquitoes in Washington State, Western Washington Mosquito Species by County.

WDOH. 2020. Diarrhetic Shellfish Poisoning (DSP).

Kengne, P., et al. 2019. "Tolerance of disease-vector mosquitoes to brackish water and their osmoregulatory ability." *Ecosphere*, 10(10):e02783. 10.1002/ecs2.2783

Bradley, T. and Majorie P. 2000. "The Physiology of Salinity Tolerance in Larvae of two Species of Culex Mosquitoes: The Role of Compatible Solutes." *The Journal of Experimental Biology*, 203 821-830 (2000).

## 3.12 TRANSPORTATION

The transportation analysis includes the following elements: vehicle traffic on the street system, transit, nonmotorized travel (walking, bicycling), freight service (by rail and truck), and parking.

The study area for transportation includes all roadways, nonmotorized facilities, transit, and rail facilities located within and adjacent to the Project Area, streets that could carry truck trips hauling materials to and from the site during construction, and streets that could experience additional traffic generated by construction of the action alternatives. The study area is adjacent to and just north of the intersection of I-5 and US Highway 101. Deschutes Parkway is a major collector running along the western shore of the Capitol Lake Basin. Both 4th Avenue W and 5th Avenue SW are roadways and bridges that cross the basin between West Bay and the North Basin. The information presented in this section is summarized from the Transportation Discipline Report (Attachment 16).

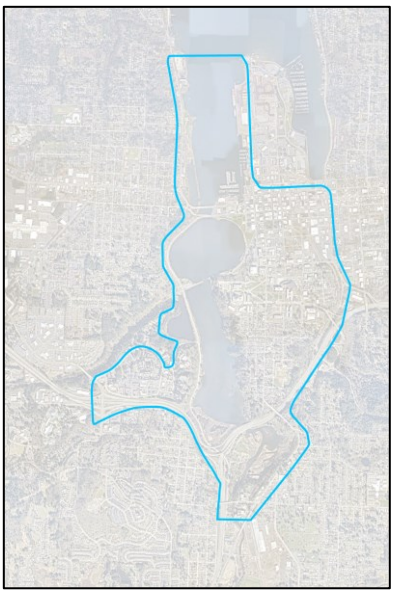


*Exhibit 3.66 Transportation study area*

### Methods for Studying Affected Environment

Data sources used for studying the affected environment for the transportation analysis include inventories of street, sidewalk, bike, and rail facilities in GIS format, as well as transportation planning and policy documents for the jurisdictions in which the facilities are located. Adherence to applicable engineering design and construction standards adopted at the federal, state, and local levels were also taken into account. Sources used in the transportation analysis include (among others) the City of Olympia Comprehensive Plan and Engineering Design and Development Standards; the City of Tumwater Transportation Master Plan; Thurston County GIS data; and the Washington State Department of Transportation (WSDOT) Design Manual and Standard Specifications for Road, Bridge, and Municipal Construction.

**The full list of data sources is presented in the Transportation Discipline Report (Attachment 16).**

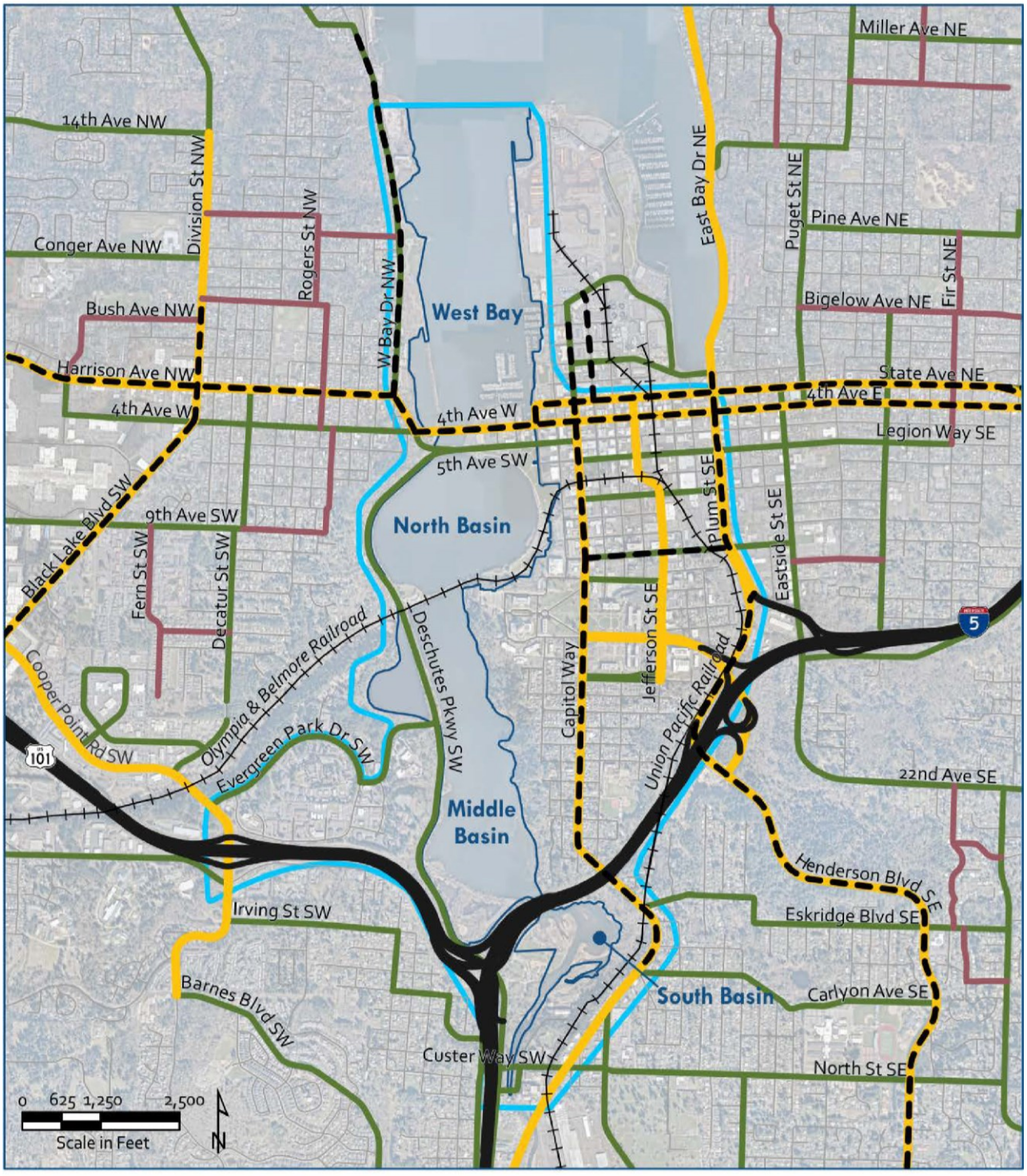
### 3.12.1 What is the existing street network in the study area?

Figure 3.12.1 shows the street network in the Project Area and study area. Average daily traffic volumes are listed in Table 3.12.1.

**Table 3.12.1 Streets & Corresponding Average Daily Trips in the Transportation Study Area**

| Street | Average Daily Traffic (vehicles each day) |
|---|---|
| 4th Avenue W (across bridge) | 22,000 |
| 5th Avenue SW (across bridge) | 17,000 |
| Deschutes Parkway | 5,000 – 7,000 |
| Capitol Way S / Capitol Boulevard SE | 7,000 – 12,000 |
| State Avenue NE | 12,000 |

# Figure 3.12.1 Street & Freight Network




**Legend**

- Interstate/Freeway
- Arterial
- Major Collector
- Neighborhood Collector
- Local Access
- Designated Truck Route
- Project Area
- Study Area

### 3.12.2 What are the existing traffic operations in the study area?

Traffic operations were evaluated based on level-of-service (LOS). The transportation analysis examined existing peak hour LOS at key intersections within the transportation study area, based on the most recent available information from the Cities of Olympia and Tumwater. For most intersections within the study area, LOS E is the locally adopted standard that applies. All study area intersections within Olympia are operating at LOS C or better during all times of day, with most operating at LOS A or B, and the study area intersections within Tumwater are operating at LOS D or better. These operations are well within the cities' adopted standard of LOS E for these intersections.

**Level of Service (LOS)**

LOS is a qualitative measure used to characterize intersection operating conditions. Six letter designations, "A" through "F," are used to define LOS. LOS A is the best and represents good traffic operations with little or no delay to motorists. LOS F is the worst and indicates poor traffic operations with long delays. The Cities of Olympia and Tumwater have adopted LOS standards that are applicable to streets within the study area.

### 3.12.3 What is the existing parking available in the study area?

On-street parking in the transportation study area includes both unrestricted and time-restricted parking facilities. Most of the streets in Downtown Olympia have time-limited parking restrictions, many with parking meters. Unrestricted on-street parking is available on Deschutes Parkway, and also along West Bay Drive NW and in the residential neighborhoods to the west of the Project Area. Parking is also available in the public parks in the study area, including Marathon Park and Heritage Park.

### 3.12.4 What is the existing transit network in the study area?

Bus service is provided in the study area by Intercity Transit. The Olympia Transit Center is located at State Avenue NE / Washington Street NE in downtown Olympia, and serves as the start and end point for all bus routes that travel through the transportation study area. Bus routes that serve the transportation study area, either via 4$^{th}$ Avenue W or 5$^{th}$ Avenue SW, include routes 41, 45, 47, and 48 (4$^{th}$ Avenue routes) and 12 and 42 (5$^{th}$ Avenue routes); most routes provide either daily or weekday service about every 30 minutes.

### 3.12.5 What is the existing freight network in the study area?

Freight movement within the transportation study area includes truck and rail movement to and from the Port of Olympia, located in West Bay at the south end of Budd Inlet, and also local truck deliveries. The City of

Olympia has designated certain streets as truck routes (as shown on Figure 3.12.1). Trucks are restricted to these streets for all freight movement, except for local deliveries. The route between the Project Area and the regional highway system using designated streets would utilize 4th Avenue E, State Avenue NE, and Plum Street SE.

One railroad mainline crosses the Project Area, shown on Figure 3.12.1. These tracks are part of the Olympia & Belmore Railroad, Inc., owned and operated by Genesee & Wyoming. The Olympia & Belmore Railroad, Inc., also provides a link between the Port of Olympia and the national rail freight network (BNSF Railway and Union Pacific Railroad lines). This line serves about three trains each week.

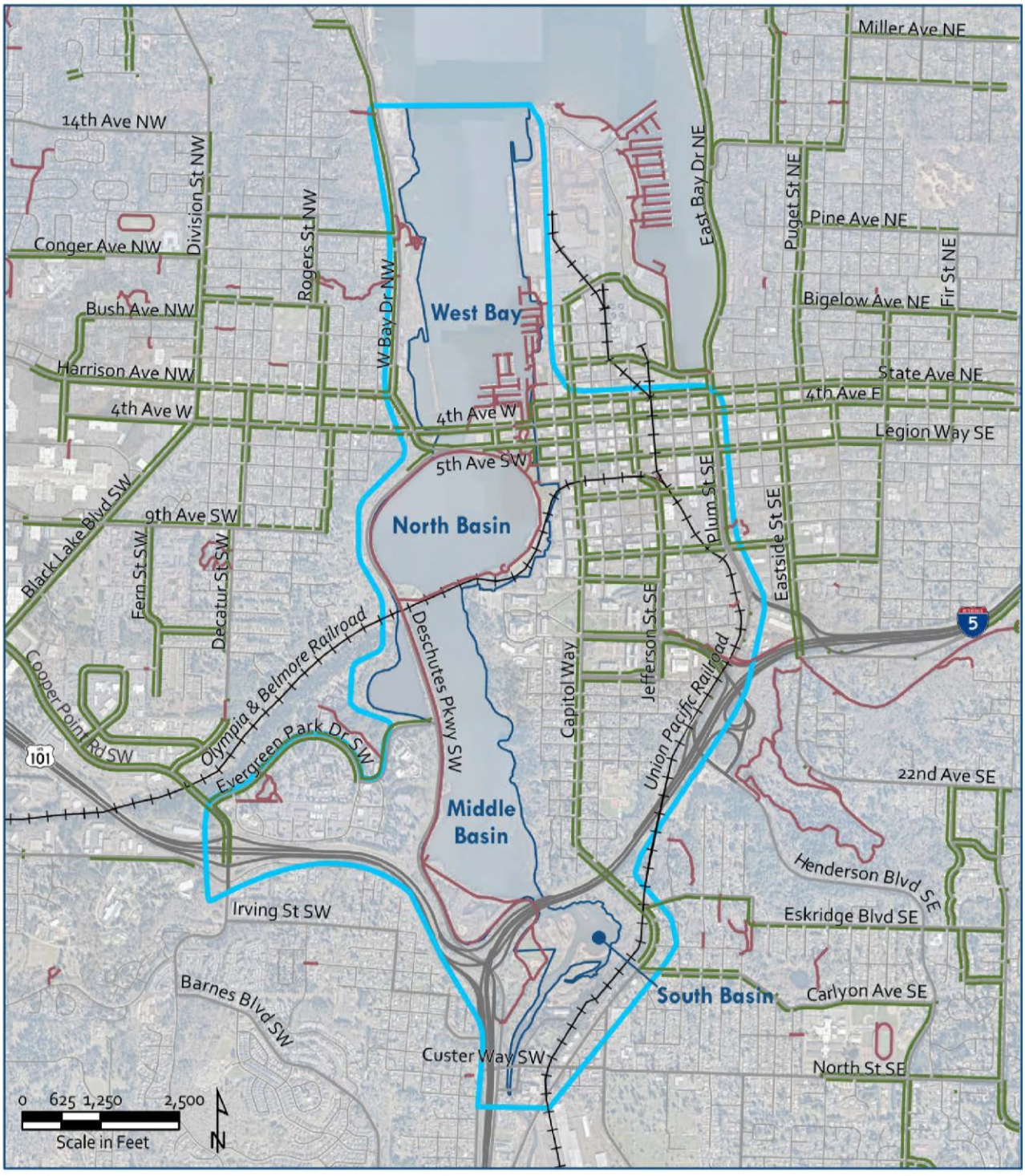
### 3.12.6 What is the existing pedestrian and bicycle network in the study area?

The City of Olympia's walking and bicycling infrastructure supports nonmotorized travel to employment centers, commercial districts, transit stops, schools and major institutions, and recreational destinations. There are several trails near the Project Area, many traversing the parks along the water. The docks located in the waterways are also considered public trails. Deschutes Parkway, West Bay Drive NW, 4th Avenue W, and 5th Avenue SW are all part of the pedestrian and bicycle network within the study area (see Figures 3.12.2 and 3.12.3).

*Exhibit 3.67 View of trail linking Marathon Park to east side of Capitol Lake near the Olympia & Belmore Railroad, Inc., railway*

The bicycle network includes facilities that are designated as Multi-Use Paths, Bike Lanes, and Bike Streets. These designations are consistent with the City of Olympia's designations of Class I Bike Path, Class II Bike Lane, and Class III Bike Route, respectively.

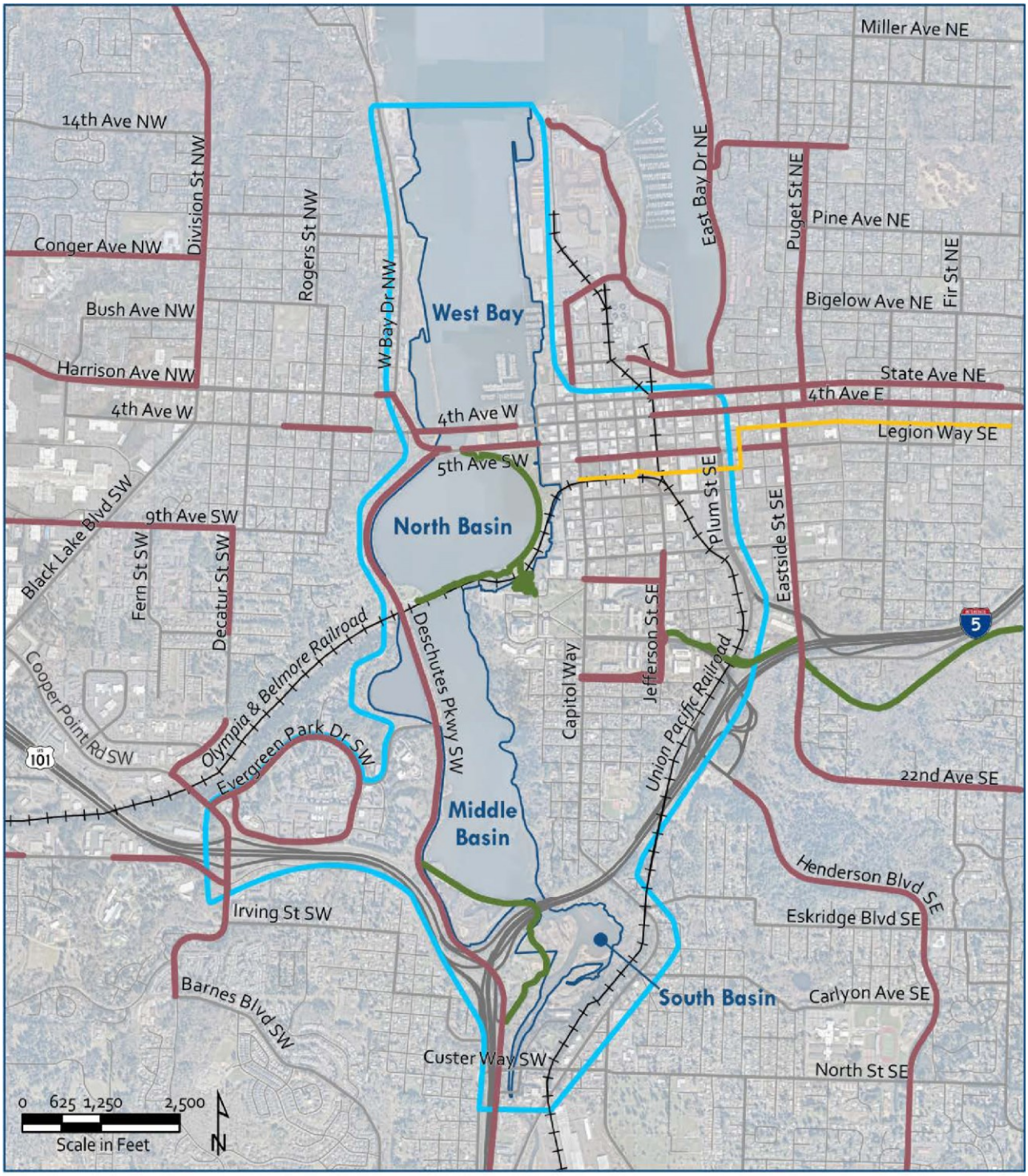
# Figure 3.12.2 Pedestrian Network




**Legend**

- Sidewalk
- Public Trail
- Project Area
- Study Area

# Figure 3.12.3 Bike Network




**Legend**

- Multi-Use Path
- Bike Lane
- Bike Street
- Project Area
- Study Area

## 3.13 PUBLIC SERVICES & UTILITIES

The public services and utilities considered in this analysis include the following:

- Fire and emergency response services
- Water, sewer, and stormwater utilities
- Electricity, natural gas, and telecommunications

The study area for the analysis includes the Project Area and adjacent areas where these services could be affected by either construction or operation of the project.

Information in the EIS is summarized from the Public Services and Utilities Discipline Report (Attachment 17), which includes more detailed information on public services and utilities in the study area, as well as information on the regulatory context.

### Methods for Studying Public Services and Utilities

Data and information sources used for the public services and utilities analysis include inventories of sewer and water lines, storm drains, underground gas lines, fiber-optic conduit, electrical transmission lines, and emergency services from local planning documents, as well as interviews with local jurisdictions.

**Additional information is presented in the Public Services and Utilities Discipline Report (Attachment 17).**

### 3.13.1 What fire and emergency response services are currently available in the study area?

The Olympia Fire Department and Tumwater Fire Department provide emergency fire and medical services to the study area. Most of the study area is located within Olympia Fire Districts 1 and 2, with a very small portion within District 3. Each district is served by a fire station. The southern portion of the study area is located within the service area of the City of Tumwater Fire Department. No fire stations are located within the study area; however, multiple stations are within 1 mile (1.6 km) of the study area, which ensures a timely response to incidents in the area. Average response times are about 7 minutes for Olympia Fire Districts and about 6 minutes for Tumwater Stations.

Four law enforcement agencies have jurisdictions that overlap the study area: the Olympia Police Department, Tumwater Police Department, Thurston County Sheriff, and Washington State Patrol. All stations and other facilities are located outside of the study area.

County sheriffs are responsible for maintaining the peace within their respective counties and filing complaints within their jurisdictions. Washington State Patrol has jurisdiction over state roadways (I-5 and US Highway 101) and the Capitol Campus.

No hospitals are located within the study area. The nearest hospital is Capital Medical Center, about 1.5 miles (2.4 km) west of the study area.

### 3.13.2 What water, sewer, and stormwater utilities are currently in the study area?

The water systems for both the Cities of Olympia and Tumwater include wells, reservoirs, pumps, and distribution lines to supply residents with water. Water lines within the study area include a potable water line that is routed across the 5th Avenue Bridge, an 8-inch-diameter (20-centimeter-diameter) line routed along Deschutes Parkway, and a 16-inch-diameter (41-centimeter-diameter) line that is routed under Marathon Park and suspended from the pedestrian bridge adjacent to the Olympia & Belmore Railroad, Inc., railroad.

*Exhibit 3.68 Utilities line routed along Deschutes Parkway. View from parkway of Percival Cove*

The wastewater systems for both the Cities of Olympia and Tumwater include gravity pipes, pressure pipes, and pump stations. The Olympia Wastewater Utility and Tumwater Water Resources Divisions are responsible for collecting and conveying wastewater flows to regional treatment facilities operated by LOTT. The main treatment facility for LOTT is the Budd Inlet Treatment Plant, which processes approximately 14 million gallons of wastewater on an average day. The Budd Inlet Treatment Plant, located between downtown Olympia and the Port of Olympia, discharges treated water through an outfall in West Bay, and also provides reclaimed water.

A LOTT reclaimed water force main is routed on the western side of the Middle Basin and around the North Basin crossing at the 5th Avenue Bridge and between the North and Middle Basins near Heritage Park. LOTT also owns and maintains a 12- to 18-inch -diameter (30- to 46-centimeter-diameter) reclaimed water distribution line that is routed along the eastern shoreline of the North Basin, crossing between the North and Middle Basins near Heritage Park along the pedestrian walkway bridge, and running along the western shoreline of the Middle Basin into the City of Tumwater.

The City of Olympia's sewer gravity mains range from 6 inches to 24 inches in diameter, with most pipelines located in the outer portions of the study area. Flow from West Olympia is conveyed across the 4th Avenue Bridge via an 18-inch-diameter sewer gravity main. Two

pump stations are located within the study area: one at the south end of Budd Inlet east of the 4th Avenue Bridge and the other (Percival Pump Station) near the southwestern portion of the North Basin. Sanitary sewer infrastructure within the study area includes a 22-inch-diameter high-density polypropylene gravity line to the west of the Middle Basin, a 20- to 24-inch-diameter force main routed to the west of the North Basin and across the 5th Avenue Dam, and a 24-inch-diameter ductile iron pipe under the pedestrian bridge adjacent to the BNSF Railway Trestle. In the City of Tumwater portion of the study area, a water treatment structure is located just south of the junction between I-5 and US Highway 101, adjacent to the east side of I-5. Most of the water lines and sewer lines within the study area are made of ductile iron.

The storm system for each city includes a system of catch basins, conveyance lines, and outfalls. Within the study area, there are approximately 74 corrugated metal (steel) pipe (CMP) stormwater outfall sites, of which 63 are located within the shoreline of Capitol Lake. In addition to outfalls within the City Olympia and City of Tumwater storm systems, state-owned and privately owned outfalls discharge to the lake. Figure 3.13.1 shows the type and location of each outfall.

Increased flooding from both extreme river flows and/or sea-level rise can damage utility infrastructure. A major concern in downtown Olympia is the impact of floodwaters on stormwater infrastructure. The City of Olympia has a combined sanitary sewer and stormwater system, which means that when floodwaters enter storm drains, generally the water is routed to the Budd Inlet Treatment Plant on the East Bay of Budd Inlet. Increased groundwater elevations due to sea-level rise can also cause excess infiltration into sanitary sewer mains.

Contributions of floodwater to the stormwater system impact the processing capacity of the Budd Inlet Treatment Plant and increase the likelihood of bypassing events, where untreated or partially treated wastewater is discharged directly to Budd Inlet. The overwhelmed sanitary-stormwater system can also back up sewer mains and potentially flood buildings and street drains with untreated sewage. This problem will become more frequent with sea-level rise.

## Olympia Sea Level Rise Response Plan

To address flooding vulnerabilities of downtown and the combined sewer system, the City of Olympia, LOTT, and the Port of Olympia prepared an Olympia Sea Level Response Plan. In the near term, flooding is managed through emergency response activities, installing backflow prevention on key stormwater outfalls and pipes, and landscaping of low spots to reduce flood impacts. Even with these actions, however, low-lying areas within and adjacent to Heritage Park will be vulnerable to flooding during infrequent, high-discharge flood events in the Deschutes Watershed.

Water quality is also an issue of concern for utility services in the study area. As described in Section 3.3.2, Ecology has identified Capitol Lake and the 5th Avenue Dam as the primary cause of human-induced depletion of dissolved oxygen in Budd Inlet (due to altered circulation caused by the 5th Avenue Dam, but more so due to loading of nutrients [carbon] from Capitol Lake. Other anthropogenic sources of nutrients identified include wastewater treatment plants (WWTP) that discharge directly to Budd Inlet (such as LOTT), WWTPs that discharge in Puget Sound north of Budd Inlet, and other non-point pollution sources.

### 3.13.3 What electricity, natural gas, and telecommunications services are currently in the study area?

Puget Sound Energy (PSE) is the primary electricity and natural gas service provider to the Cities of Olympia and Tumwater, and both electric lines and natural gas lines are located within the study area. Most of the electrical lines are located aboveground. PSE power lines cross the 5th Avenue Bridge and the southeastern portion of the South Basin. In the 5th Avenue Bridge vicinity, east-west aligned overhead powerlines cross over the 4th Avenue W bridge and the southerly end of West Bay before splitting to the northwest and southwest, just east of the Olympic Street W and Deschutes Parkway fork. Within the study area, natural gas lines are buried and strung under the 5th Avenue Bridge.

A steam plant occupies the shoreline at the northeast edge of the Middle Basin. Known as the Capitol Campus Powerhouse, the plant has produced steam since the 1920s serving east and west Capitol Campus with nearly 3 miles (4.8 km) of steam and condensation piping, providing steam to 12 of the 19 campus buildings.

*Exhibit 3.69 Steam plant on the northeast shore of the Middle Basin*

The primary provider of telecommunication services in the study area is Qwest Corporation, which does business as CenturyLink QC. A number of other private companies (e.g., AT&T, Verizon, Comcast, and Ziply) also maintain fiber optic cables and provide service throughout the area.

# Figure 3.13.1 Capitol Lake Stormwater Outfall Locations

## 3.14 ECONOMICS

SEPA does not require the economic analysis of a proposed action. As such, the statutes and regulations governing SEPA do not provide specific guidance for what methods to use to analyze economic effects in an EIS. For the Capitol Lake – Deschutes Estuary Long-Term Management Project, however, the Washington State Legislature and project stakeholders have stressed that an economic analysis is a critical component of the EIS and is needed to support the overall decision-making process. According to the Washington State Legislature in Engrossed Substitute Senate Bill 6095 (2018):

> *"The appropriation in this section is subject to the following conditions and limitations: … The environmental impact statement must also consider an expanded area around Capitol Lake and Budd Inlet including the Port of Olympia for the economic analysis. The environmental impact statement must consider the use of equal funding from nonstate entities including, but not limited to, local governments, special purpose districts, tribes, and not-for-profit organizations."*

The Funding and Governance Work Group is coordinating the approach to future funding and management of the resources associated with the Capitol Lake – Deschutes Estuary. The Funding and Governance Work Group includes representatives from Enterprise Services, Department of Natural Resources, the Squaxin Island Tribe, the Cities of Olympia and Tumwater, Thurston County, the Port of Olympia, and LOTT. The economic analysis presented in this Draft EIS will help inform the decision-making process.

In the absence of relevant laws, plans, and policies governing economic resources, the methodology followed for this EIS is consistent with professional standards of economic analysis, in the context of environmental impact review. It reflects federal guidance for using economic analysis in regulatory decision-making, water resource planning, and socioeconomic analysis under NEPA.

Based on scoping and early project coordination among the EIS Project Team, Enterprise Services, and stakeholders in the region, it was determined that the economic analysis for the EIS would focus on the following key topics:

- Downstream economic activity
- Development in downtown Olympia (both commercial and residential)

### Downstream Economic Activity

For this analysis, the term "downstream economic activity" is used to describe directly or indirectly affected economic activity surrounding Budd Inlet, within or near the Project Area—for example, impacts that primarily could affect businesses that are physically downstream of the project (at the Port of Olympia, marinas, and in downtown Olympia), but also throughout the county-wide study area.

- Demand for and value of recreation
- Demand for and value of ecosystem services

Economics also relates to equity and social justice, topics that are considered in this economic analysis. The subject of economics is interrelated with and linked to other resource topics addressed throughout the EIS, and the affected environments for the latter two topics (recreation and ecosystem services) are described in other sections of the EIS (in particular, Section 3.3, Water Quality, Section 3.6, Wetlands, Section 3.5, Fish and Wildlife, Section 3.7, Air Quality and Odor, Section 3.8, Land Use, Shorelines, and Recreation, and Section 3.9, Cultural Resources). The key factors of the affected environment that influence economic activity and development in the downtown area are summarized in this section, focusing on population, employment, income, and economic activity. The information presented in the EIS summarizes the baseline conditions that inform the analysis of potential long-term and short-term impacts. More details on the affected environment for economics, as well as broader information that provides valuable context, is presented in the Economics Discipline Report (Attachment 18).

### Equity and Social Justice

The distribution of economic resources has implications for equity and social justice. By examining who benefits, who experiences costs, and where, when, and how economic impacts materialize across different groups of people, the economic analysis brings into focus issues of fairness and consideration of people's different needs and values. For this project, key equity and social justice issues are related to tribal values for, and use of, natural resources.

### Methods for Studying the Affected Environment for Economics

The affected environment was evaluated based primarily on a literature review of publicly available demographic and economic data, data reported in past assessments of Capitol Lake – Deschutes Estuary long-term management planning, coordination with the Port of Olympia as a primary downstream resource, proprietary data from data service providers, and information generated from interviews and email correspondence conducted specifically for this project. The interviews were conducted by telephone with two groups: (1) planners and economic development officials (to capture the public sector perspective), and (2) private developers and real estate experts (to capture the private sector perspective). The EIS Project Team also conducted an on-site park user survey in the summer of 2019 to gather information about recreational use.

**For more information on the data sources and how they were used, see the Economics Discipline Report (Attachment 18).**

## 3.14.1 What are the regional population and economic conditions?

The economy in the study area is influenced by the current and expected future conditions related to population and economic resources in Thurston County and the Cities of Olympia and Tumwater. Background information on population, employment, and income for the study area is summarized in this section. It should be noted that the onset of the COVID-19 pandemic in early 2020 affected economic

conditions, resulting in uncertainties regarding future conditions. Existing conditions are described according to available information (most of which is pre-pandemic), and projections based on pre-pandemic conditions are subject to some level of uncertainty. For those conditions that have been described as affected by the COVID-19 pandemic, the data reflect conditions as recent as summer 2020 when the economic analysis was underway.

### *3.14.1.1 Population*

Similar to overall population increases throughout the Puget Sound region, the population in Thurston County increased by 9% between 2010 and 2018 (see Table 3.14.1). Much of that growth occurred in Lacey, which is adjacent to nearby military installations (e.g., Joint Base Lewis-McChord). Within Thurston County, the City of Tumwater has seen the largest rate of growth (30%) as the State of Washington recently opened new campuses to accommodate the state's public-sector workforce and housing remains relatively affordable.

**Table 3.14.1 Current Population & Population Change between 2010 and 2018**

| Geographic Area | 2010 | 2018 | Percentage Change |
|---|---|---|---|
| Thurston County | 252,264 | 274,684 | 9% |
| City of Olympia | 46,478 | 50,836 | 9% |
| City of Tumwater | 17,371 | 22,500 | 30% |

As it grows, Thurston County is becoming more ethnically and racially diverse. A quarter of Thurston County residents identify as non-white, followed by 23% of Olympia residents, and 18% of residents in the City of Tumwater. Those who identified as either Hispanic/Latino or Asian alone made up the largest share of non-white residents in the study area. Native American/Alaska Native populations comprised about 1% of the population in the study area.

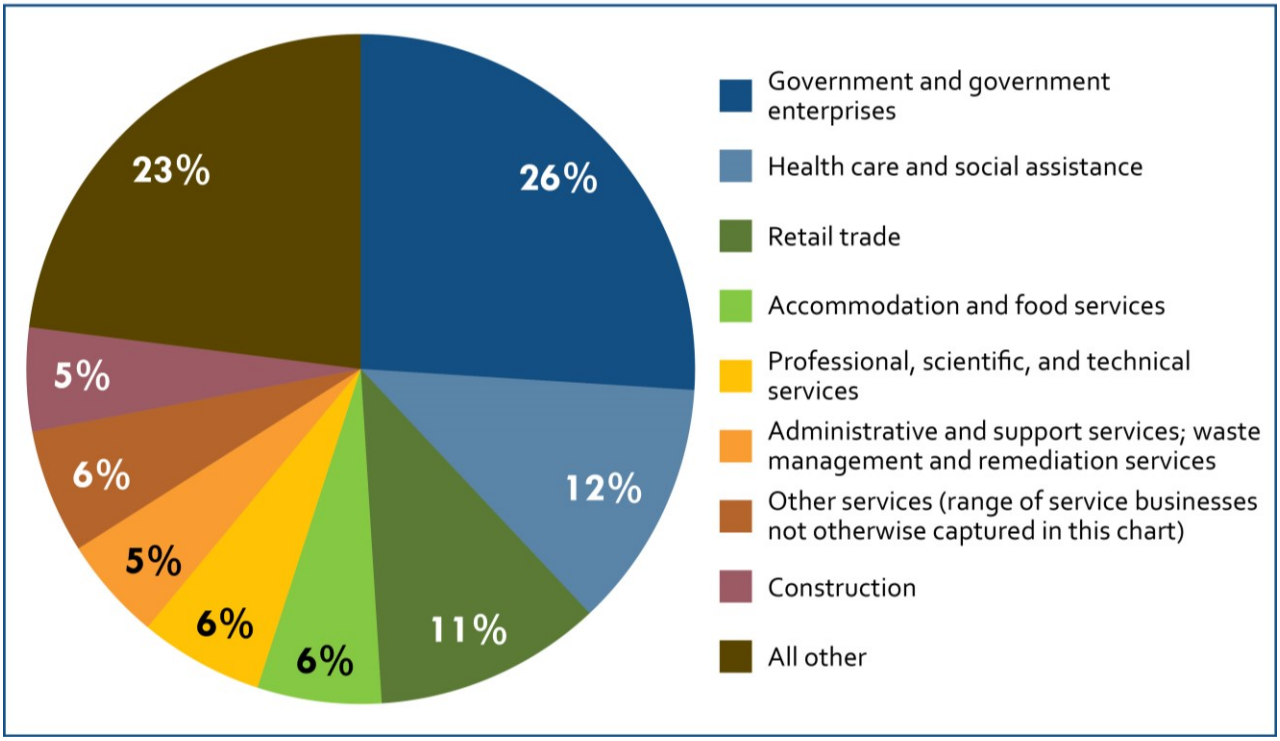
Looking ahead, the Washington State Office of Financial Management estimates that the population in Thurston County will continue to grow, increasing by 26% between 2020 and 2040, with an average annual growth rate of 1%.

### 3.14.1.2 Employment

Historically, natural resources played an important role in the local economy, with mining and lumber as the main industries in Thurston County through the 1920s. When Olympia was established as the state capitol in 1927, employment in the government sector grew, eventually outpacing the lumber industry in the 1950s. Decades later, the area's accommodation sectors and food services, as well as arts, entertainment, and recreation sectors grew with the passage of the Indian Gaming Regulatory Act (IGRA). Tribal casinos are now among Thurston County's top five employers.

Today, government at the local, state, and federal levels continues to be the county's largest employer. In 2018, about 154,500 people were employed (part-time and full-time) in Thurston County, with most employees (39,855) working in the government sector. The county's five largest private employers that year were Providence St. Peter Hospital, Safeway, Walmart, Nisqually Red Wind Casino, and Lucky Eagle Casino & Hotel. Figure 3.14.1 shows the major employment sectors in Thurston County. Aside from government, employment is heavily concentrated in health care and social assistance, retail, and accommodation and food services.

**Figure 3.14.1 Employment by Sector in Thurston County**



The employment forecast for Thurston County through 2045 suggests that government will remain the largest employment sector, followed by healthcare and social assistance, professional services, and retail trade (similar to today's conditions). The sector expected to grow the most between 2017 and 2045 is arts, entertainment, and recreation, which may more than double. Despite this expected growth, it will remain a small proportion of overall county employment. "Other services," which is a catch-all category that covers a wide range of service businesses, is also expected to grow substantially, likely in part driven by expected steady growth in residential populations and household income.

#### *3.14.1.3 Income*

Median household income (MHI) is calculated as the midpoint between the incomes for all households within a defined study area. The City of Tumwater and Thurston County have a higher MHI than Olympia, but the gap has narrowed in recent years. As Table 3.14.2 shows, MHI in both the City of Tumwater and Thurston County has decreased since 2010, while the City of Olympia's MHI has increased by 3% over the last decade.

**Table 3.14.2 Real Median Household Income (2018 Inflation-Adjusted Dollars)**

| Geographic Area | 2010 | 2018 | Percentage Change |
|---|---|---|---|
| Thurston County | $70,165 | $69,592 | -1% |
| City of Olympia | $56,958 | $58,606 | 3% |
| City of Tumwater | $69,768 | $65,167 | -7% |

### 3.14.2 What is economic activity and development like downstream of the 5th Avenue Dam?

The Port of Olympia has been an economic development resource for the surrounding local and regional economy for over 100 years, even before the 5th Avenue Dam was constructed. Funding for the Port of Olympia is mostly derived from operating revenue (e.g., cargo handling, leases). The Port of Olympia also receives financial support through a tax levy, which in recent years has generated over $6 million per year. In 2014, the Port of Olympia's marine terminal, marina, general aviation activity, and real estate tenants supported $106.1 million in direct wages and 2,400 jobs, with an average salary of

*Exhibit 3.7o Port of Olympia*

$44,204. Approximately 89% of the direct jobs were held by Thurston County residents. The Port of Olympia was also responsible for almost 1,200 induced jobs and $90.3 million in purchases of local supplies and services from firms providing direct services to the Port of Olympia.

In addition to the Port of Olympia, economic development adjacent to West Bay includes:

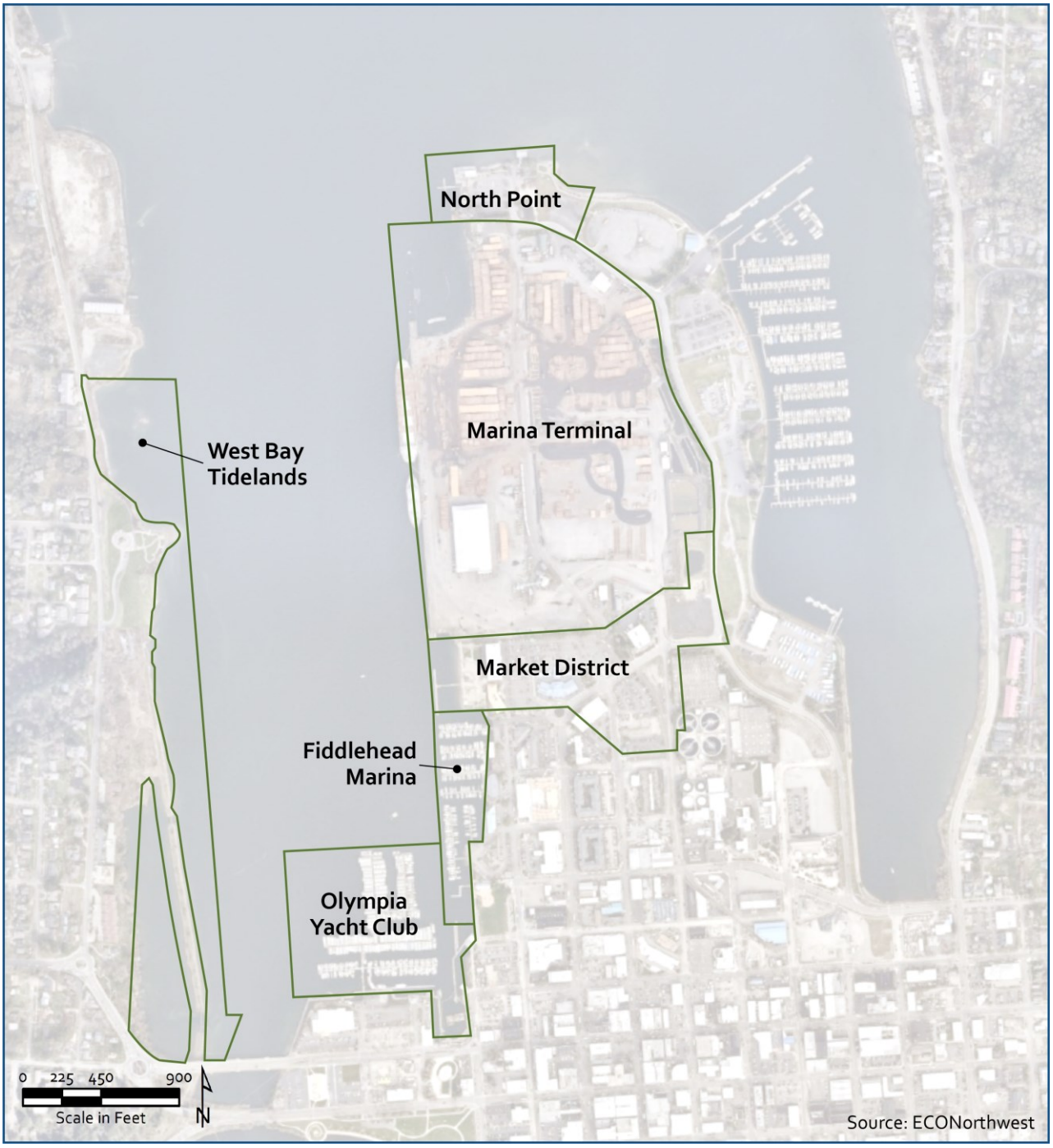
- **NorthPoint**, an area of restaurants and views of Puget Sound. Formerly an industrial site, the area was restored by the Port of Olympia and Ecology in 2006.
- **The Market District**, retail and commercial establishments, the centerpiece of which is the popular year-round Olympia Farmers Market.
- **Fiddlehead Marina**, a private marina on the eastern side of West Bay, directly south of the Port of Olympia. It consists of 75 boat slips and hosts family-owned and operated offices and docks.
- **The Olympia Yacht Club**, a private organization offering moorage opportunities to members, sailing education programs in partnership with Olympia Parks, Arts, and Recreation, and other activities.
- **West Bay Tidelands**, the western shoreline of West Bay, which is undeveloped and has been the subject of habitat restoration and recreational planning efforts over the past several years. The objective of the restoration is to improve the ecological functioning of West Bay by connecting restoration sites that promote natural coastal processes, while the recreational opportunities would support public use of the shoreline. Ongoing restoration and recreation development activities have the potential to generate employment opportunities and enhance recreational use and spending in the local area. See Figure 3.14.2.

*Exhibit 3.71 NorthPoint on the Port Peninsula*

*Exhibit 3.72 West Bay Tidelands*

*Exhibit 3.73 Market District on the Port Peninsula*

# Figure 3.14.2 Properties North of 5th Avenue Dam Considered in Downstream Economic Activity Analysis



## 3.14.3 What are the economic conditions in Downtown Olympia?

Downtown Olympia covers about a half of a square mile (1.3 square kilometers) to the east of the northernmost portion of Capitol Lake, and to West Bay, and is home to more than 450 local businesses and about 1,900 residents. Its main attractions include waterfront activities, a farmers market near the waterfront, various dining and retail establishments, a children's museum, multiple theaters, and a Creative District that supports artists and cultural venues. City planning efforts support future development in the downtown area. The 2017 Downtown Strategy calls for downtown to absorb 25%, or about 5,000 residents, of the City of Olympia's population growth over the next 20 years. The City of Olympia plans for a walkable, family-friendly neighborhood with a mix of urban housing options. In recent years, more than $180 million of public and private money has been invested in development and redevelopment in downtown Olympia.

Based on a synthesis of findings from the sources used to study the affected environment (key-informant interviews, market assessment, and literature review), the following conclusions are the most relevant for assessing the potential impact of the action alternatives on development in downtown Olympia:

- The appropriate study area for impacts to development in downtown Olympia is the Downtown Olympia Community Renewal Area, the relevant area defining downtown development in the City of Olympia.
- Population growth in the region is the primary driver of demand for development in downtown Olympia.
- A segment of the growing population is attracted to development similar to what is currently being developed in downtown Olympia: primarily smaller households, which are most often made up of younger and older people.
- Retail demand is currently driven by visitors, workers, and tourists, as well as a growing base of downtown residents. Increasing residential demand will drive new retail growth, which in turn attracts more residential development.
- Downtown Olympia will successfully attract demand for residential development based on two main factors: competitive rents compared to other locations, and the portfolio of amenities (including environmental amenities) that downtown has to offer.

### Downtown Olympia and Community Renewal Area

The Downtown Olympia Community Renewal Area boundary is the product of a recent community process to address blight, remove barriers to redevelopment, and initiate development partnerships with the Port of Olympia in downtown Olympia. Capitol Lake is listed as a potential amenity in the feasibility study for the Community Renewal Area, which supports the use of this boundary to investigate the potential impacts of changes in the amenity on downtown development.

- The downtown area has many amenities that differentiate it from other areas. These include the waterfront facing both sides of Budd Inlet, the Capitol Campus grounds, public attractions (museums and the farmers market), and Percival Landing.
- For Capitol Lake specifically, interviewees most frequently cited the surrounding walking trails as one of its most compelling features for downtown residents, followed by the views it provides. These features would continue to contribute to attracting residential demand to downtown to the extent they are maintained in future management alternatives.

Growth in downtown Olympia is driven in part by its amenities, including Capitol Lake. Existing and potential new residents will assess quality-of-life factors in their decision to live downtown. Visitors will come for work or to visit the capitol grounds and will return (or not) based on the quality of their experience. Retailers, restaurant owners, and service providers will respond to demand from residents and visitors and locate and invest accordingly. However, the largest influence on new development continues to be overall regional demand for housing among demographic segments that are more likely to prefer high amenity, urban environments.

### 3.14.4 What is the demand for and value of recreation?

Recreation resources, facilities, and opportunities in the Project Area include local parks, trails and paths, events, and water-based opportunities (as described in Section 3.8, Land Use, Shorelines, and Recreation). Heritage Park, Marathon Park, Tumwater Historical Park, the Interpretive Center, and Percival Landing Park are all particularly important recreation sites in the basin, and recreational use is popular with local residents and visitors. Throughout the county, there are a variety of publicly and privately owned and operated parks and natural areas. Recreational resources throughout the county provide opportunities similar to the features offered by recreational resources within the basin, meaning that opportunities are not limited to those within the Project Area. People who recreate within the basin may also visit these other areas throughout the county, or may choose to visit Capitol Lake.

Based on a synthesis of findings from the economic analysis in the Economics Discipline Report (Attachment 18), the following are key

conclusions relevant to the demand for and value of recreation in the Capitol Lake – Deschutes Estuary:

- Demand for the types of recreation provided by the Capitol Lake Basin is strong. Demand will likely increase in the future with regional population growth, local population growth supported by residential development in downtown Olympia, and increasing participation rates in many types of outdoor recreation supported by the Capitol Lake – Deschutes Estuary.
- The Capitol Lake Basin provides the types of recreation opportunities that Washington state and Thurston County residents demand the most: urban trails and paths for walking and biking; exploring waterways, coastlines, and natural spaces; and participating in outdoor events.
- Annual use of the parks and facilities surrounding Capitol Lake during formal events likely exceeds 200,000 people. Monthly use of Heritage Park during peak summer season likely exceeds 30,000 people. Recorded pedestrian use of paths throughout the Capitol Lake Basin varies from thousands of trips in some parts of the North Basin to hundreds of thousands of trips in parts of the South Basin per year. The path circumnavigating Capitol Lake is most popularly used by pedestrians. Recorded bicycle use is more concentrated along Deschutes Parkway, with an average of over 60,000 trips per year (primarily reflecting trips for commuting).
- Other similar opportunities for trail- and park-based recreation are available in the region, which can offset direct losses of economic value when recreation closures occur in the study area.
- Demand for some activities not currently available in the Capitol Lake Basin (such as nonmotorized boating, paddling, and fishing) is present and growing. Availability of substitutes for paddling opportunities in the downtown area is limited. The nearest access for small, hand-launched watercraft, such as canoes and kayaks, is in West Bay Park and the northern part of Budd Inlet.
- Recreation activity is economically important because it is something people value. Enhancements to recreation improve people's overall economic well-being, and may

lead to more people moving to the region in part because they value recreation amenities.

- Recreation activity is also important economically in the region because visitors coming into the study area to participate in recreation activities spend money that would not likely otherwise be spent in the region. Spending ranges from $8 per participant per day for local park use to over $80 per day for nonmotorized boat use. (Residents spend money on recreation too, but it is likely this money would have been spent locally whether they were recreating or doing something else.)
- The economic value people place on recreation experiences is influenced by the quality of the environmental setting where recreation takes place, and on their understanding of the cultural and symbolic meaning attached to place. People place higher values on visually interesting sites. Symbolic and cultural meaning cannot be quantified but is highly influential and varies from person to person.
- The alignment of preferences and economic value may bias toward maintaining status quo because people tend to value more highly what they know; and people who perceive they are giving something up that they care about may value the loss more highly than the value someone may place on gaining something new, a manifestation of the endowment effect.

In short, recreation in the Capitol Lake Basin is economically important, and changes in development patterns in downtown Olympia will likely increase the value of recreation opportunities in the future. Rising demand may also lead to more crowded recreation sites, further increasing the value of expanding recreation opportunities.

### 3.14.5 What is the demand for and value of ecosystem services?

Ecosystem services describe the capacity of an ecosystem to provide goods and services that people value. Increases in an ecosystem's ability to provide goods and services produce economic benefits, as they increase the value people derive from the ecosystem. Conversely, decreases in an ecosystem's ability to provide goods and services produce economic costs. These values may accrue as factors of production to industries and tribes (e.g., commercial fishing), recreational use values of the broader ecosystem (e.g., fishing or

birdwatching), or nonuse values related to the health and function of the ecosystem. Ecosystem goods and services typically are not traded in markets, so their value is inferred from nonmarket valuation techniques to assess changes in value. Ecosystem services addressed in this economic analysis include the following:

- **Habitat Provision:** Ecosystem services are largely determined by the type and quality of habitat available. The habitat types currently present in the Project Area include submerged/open water, river channel, freshwater wetlands, tideflat, low marsh, high marsh, transitional, and upland areas. These habitats provide benefits and functions for fish, wildlife, and plant species, which people value. The affected environment for the habitats that make up ecosystem services are described in detail in other sections of Chapter 3.0, Existing Conditions and Affected Environment (see Section 3.5, Fish and Wildlife, and Section 3.6, Wetlands).
- **Water Regulation:** Water regulation includes maintenance of water quality and flood regulation. Clean water—at the right place and right time—contributes to a variety of goods and services that people rely on. Clean water supports commercial livelihoods, subsistence, recreation, cultural meaning, and individual well-being, in part by supporting aquatic ecosystems that humans depend on and value (see Section 3.3, Water Quality). Flood regulation and management of wastewater and stormwater are crucial for maintaining infrastructure in the region (see Section 3.13, Public Services and Utilities).
- **Climate Regulation:** Another ecosystem service provided by the natural capital in the Capitol Lake – Deschutes Estuary is the ability to regulate climate through sequestering GHGs. GHGs in the basin are primarily sequestered in the vegetation and soil in and around the water. In contrast to sequestration, GHGs are released by decomposing organic matter, such as vegetation (see Section 3.7, Air Quality and Odor). The threats from climate change in Washington state include sea level rise, increased flooding, reduced snowpack, droughts, increased fire risk, ocean acidification, and others. Sea level rise is especially relevant for this project because downtown Olympia is vulnerable to flooding given the extensive shorelines, including Capitol Lake – Deschutes Estuary and West Bay,

and it is only 12 inches (30 centimeters) above sea level. All of these influence economic value in the study area.

- **Cultural, Heritage, Spiritual, Historical, and Education Values:** Cultural, heritage, spiritual, historical, and education values are a component of cultural services that represent the nonmaterial benefits that people obtain from ecosystems and environments. Three primary components to these values are associated with Capitol Lake – Deschutes Estuary. The first is the cultural, heritage, and spiritual values associated with the environment and natural resources used for ceremonial and subsistence purposes by tribes since time immemorial. The second is the historic value of Capitol Lake as a component of the Capitol Campus and the City of Olympia. The third is the potential for the ecosystem and ecosystem management activities to offer educational opportunities to the public, resource managers, and researchers. Studies of the area's ecology add to scientific knowledge of the region's ecosystems and how natural and human-influenced processes are affected by various management strategies. This research is ongoing and has the potential to evolve in different ways depending on future conditions.
- **Visual Aesthetics:** The visual aesthetic of the Capitol Lake – Deschutes Estuary creates value in two ways: by defining and enhancing public areas, such as parks, trails, and roads that are available to all; and by serving as a more distant backdrop to private properties with restricted access. Public views include all those around Capitol Lake – Deschutes Estuary, such as the view of the Capitol Dome from the reflecting pool in the North Basin, mountain views and views of downtown from the North Overlook, the waterfront views throughout the trails on the shoreline, and secluded views of vegetation that provide an immersive experience in the South Basin. Although the exact value of these public visual amenities is unknown, these visual amenities likely increase tourism, recreational use, and overall visitation to the area. Some private views of the water features in the basin are from residential properties in the sloped area above Deschutes Parkway and from taller buildings in downtown, particularly to the east and north of the lake. For more information on the affected environment for visual aesthetics, including public and private views, see Section 3.10, Visual Resources.