Attachment 9
Fish and Wildlife Discipline Report

CAPITOL LAKE – DESCHUTES ESTUARY

Long-Term Management Project Environmental Impact Statement

Fish and Wildlife Discipline Report

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Executive Summary

This Fish and Wildlife Discipline Report describes the potential impacts of the Capitol Lake – Deschutes Estuary Long-Term Management Project on fish and wildlife and their habitats. The Capitol Lake – Deschutes Estuary includes the 260-acre Capitol Lake Basin, located on the Washington State Capitol Campus, in Olympia, Washington. Long-term management strategies and actions are needed to address issues in the Capitol Lake – Deschutes Estuary project area. An Environmental Impact Statement (EIS) is being prepared to document the potential environmental impacts of various alternatives and determine how these alternatives meet the long-term management objectives identified for the watershed.

The primary study area for fish and wildlife includes both the area where construction would occur under each alternative, as well as the remaining project area that supports species that could be affected by the project. The southern boundary is generally the base of Tumwater Falls, and the northern limit is the northern end of West Bay.

Potential impacts were determined by evaluating known occurrences of species, or species groups and indicator species in the study area, life history requirements, and the potential changes in habitat condition, extent, and availability under each alternative. For fish, the analysis considered changes in wetted area, bathymetry, salinity, tidal inundation, freshwater inputs, water quality, and sediment distribution. For wildlife, the analysis also considers changes in the availability of cover, food, predator-prey relationships, and breeding sites.

Construction impacts were analyzed based on the known relationships between construction elements (e.g., turbidity and construction noise) and the effects on fish and wildlife (e.g., avoidance, decreased foraging activity). The analysis considered construction timing, duration, methods, and BMPs and their relative implication for species and habitats under each alternative. Construction impacts were estimated based on the conceptual design for each alternative.

Operational impacts were analyzed by considering the projected outcome of each alternative and the changes to habitat and the corresponding effects to fish and wildlife species. Both long-term adverse impacts and beneficial effects associated with fish and wildlife are evaluated based on expected changes in ecological functions and processes within the study area.

The analysis examines the No Action Alternative, as well as three action Alternatives (Managed Lake, Estuary, and Hybrid).

The No Action Alternative would not result in construction impacts on fish and wildlife because the project would not be built. In the long term, the dam would remain in-place and minimal submerged aquatic vegetation removal would occur (consistent with current management practices). The lack of active lake management to remove sediment and aquatic vegetation could continue to affect habitat quality and habitat use by some fish or other aquatic species. In general, impacts on fish and aquatic habitat related to habitat changes from the lack of active lake management in Capitol Lake would be **less-than-significant** because the changes would occur incrementally and use of the basin by these species would still persist. Yuma and little brown myotis bats from the Woodard Bay colony regularly use the lake for foraging. The transition of the lake to a vegetated wetland would substantially reduce the ability of the area to support bats. Because of the size of the bat colony and its regional importance, and the dependence of the colony on Capitol Lake for foraging, the loss of foraging habitat from the transition of open water to wetland over time is considered a **significant impact** on this species group even though most of those impacts would be realized beyond the 30-year time horizon of the project.

Under all action alternatives, potential construction impacts on fish and wildlife are associated primarily with initial dredging and creation of habitat areas, as well as the construction of new in-water/overwater structures. Impacts on fish and aquatic habitat would be **less-than-significant**, including impacts associated with fish entrainment and direct mortality, water quality, turbidity and sedimentation, and noise and vibration. Although individual fish or wildlife could be affected, these impacts are small and would not measurably affect their local populations. Impacts would be minimized through adherence to the agency-approved in-water work period and implementation of standard overwater and in-water construction BMPs in accordance with environmental regulatory permit requirements.

For the Managed Lake Alternative, construction of the dam overhaul repairs would have **less-than-significant impacts** on fish and wildlife based on the temporary nature of the repairs, and minimal in-water work required. For the Estuary Alternative, construction related to 5th Ave dam removal, Deschutes Parkway realignment and 5th Avenue Bridge demolition and construction, slope stabilization, and other activities, would involve longer duration disturbances and additional in-water activities. For the Hybrid Alternative, construction impacts and the duration of impacts would be the same as those described under the Estuary Alternative, but would also include installation of a barrier wall to create the new, smaller reflecting pool. With adherence to approved in-water work windows and standard construction BMPs, impacts on fish and wildlife from both alternatives would also be **less-than-significant.**

With all action alternatives, the conversion of some areas of deepwater to wetland habitat areas would provide a **minor beneficial effect** for some species, such as raptors and passerines.

Under the Managed Lake Alternative, habitat zones would change as sediment fills in the Middle and South basins, and as the result of the creation of habitat areas in the Middle Basin resulting in impacts that range from **minor beneficial effects** to **less-than-significant impacts**, depending on the species. General fish and wildlife distribution and use patterns would be similar to existing conditions. Potential adverse impacts of new overwater and in-water structures on habitat would be minor and **less-than-significant**.

Under the Estuary and Hybrid alternatives, impacts on fish and wildlife would range from **beneficial** to **less-than-significant** to **significant**, depending on the species. The estuary conditions created under the Estuary Alternative would result in **substantial beneficial effects** for salmon, other anadromous species, and marine fishes, including protected species within these groups. Under the Hybrid Alternative, the full range of estuarine functions would not develop over the entire North Basin area, resulting in somewhat reduced benefits. The physical footprint of the dam removal would have **moderate beneficial effects** on salmon and other fish species expected to use the estuary. Conversely, the brackish water in the North and Middle Basins, and to a lesser degree in the South Basin, would not be suitable for freshwater fish species, resulting in mortality to these species and constituting a **significant impact** on this species group. For wildlife species, the change to an estuarine environment under the Estuary and Hybrid alternatives would be a **significant impact** on bats because of the size of the colony, their dependence on the freshwater environment of the Capitol Lake Basin emergent insects, and the elimination of this foraging base. Conversely, there would be **substantial beneficial effects** for shorebirds and wading birds related to the conversion of freshwater to estuarine habitat because of an increase in suitable habitat and changes in the types of prey available for this species group.

All action alternatives could directly or indirectly affect tribal resources. As summarized above, this discipline report identifies significant adverse impacts on fish and wildlife species and aquatic habitat, as well as anticipated beneficial effects. These impacts/effects could impact or beneficially affect tribal resources, including fish, wildlife, and vegetation available for harvest and use by potentially affected tribes, including the Squaxin Island Tribe, Nisqually Indian Tribe, and Confederated Tribes of the Chehalis Reservation. Under the No Action Alternative, continuation of current, limited management practices would not benefit species of importance to the tribes, specifically salmon and shellfish. The impacts on salmon related to habitat changes from continued deposition of sediment in Capitol Lake would likely not measurably affect fish available for harvest. Under the Managed Lake Alternative, maintaining a freshwater lake system would not substantially benefit species of importance to the tribes. Impacts on salmon related to habitat changes from continued deposition of sediment in Capitol Lake would likely not measurably affect fish available for harvest.

Under the Estuary and Hybrid Alternatives, reintroducing tidal hydrology to the Capitol Lake Basin would benefit many of the species of importance to the tribes, specifically salmon and shellfish, and potentially other fish and wildlife, as well as plants. Compared to the Estuary Alternative, the Hybrid Alternative would have less of an overall increase in habitat availability and access due to the reflecting pool. Maintenance dredging could result in impacts on tribal resources by causing physical or behavioral responses, or by affecting aquatic habitat, and potentially affecting access to fishing areas within West Bay during maintenance dredging cycles.

Making a determination of significance related to treaty-reserved rights is not part of this discipline report. Mitigation associated with potential impacts on tribal resources would be addressed directly with the affected tribes during government-to-government consultations as part of the permitting, regulatory, and consultation processes for the selected alternative.

Construction and operation impacts of the No Action and action alternatives are summarized in Tables ES.1 and ES.2.

Table ES.1 Summary of Construction Impacts and Mitigation Measures

	Impact Finding	Minimization and Other Mitigation Measures	Significant and Unavoidable Adverse Impact
Managed Lake Alternative			
Fish – Impacts on fish species, or species group, or aquatic habitat	Less-than-significant Impact	BMPs and other measures to avoid and minimize impacts in Section 5.7	No
Wildlife – Impacts on wildlife species or wildlife habitat	Less-than-significant Impact	BMPs and other measures to avoid and minimize impacts in Section 5.7	No
Estuary Alternative			
Fish – Impacts on fish species, or species group, or aquatic habitat	Less-than-significant Impact	BMPs and other measures to avoid and minimize impacts in Section 5.7	No
Wildlife – Impacts on wildlife species or wildlife habitat	Less-than-significant Impact	BMPs and other measures to avoid and minimize impacts in Section 5.7	No
Hybrid Alternative			
Fish – Impacts on fish species, or species group, or aquatic habitat	Less-than-significant Impact	BMPs and other measures to avoid and minimize impacts in Section 5.7	No
Wildlife – Impacts on wildlife species or wildlife habitat	Less-than-significant Impact	BMPs and other measures to avoid and minimize impacts in Section 5.7	No

Table ES.2 Summary of Operations Impacts (including Benefits) and Mitigation Measures

Impact Summary by Alternative	Impact Finding	Minimization and Other Mitigation Measures	Significant and Unavoidable Adverse Impact
No Action Alternative			
Fish – Impacts on fish species, species group, or aquatic habitat	Less-than-significant Impact	N/A	N/A
Wildlife – Habitat alterations (impact on bats)	**Significant Impact**	N/A.	N/A
Managed Lake Alternative			
Fish – Impacts on fish species, species group, or aquatic habitat associated with additional permanent overwater and in-water structures and artificial lighting elements	Less-than-significant Impact	BMPs and other measures to avoid and minimize impacts in Section 5.7	No
Fish – Alterations in lake bathymetry and water depths in the lake associated with dredging, for both the anadromous and freshwater species groups	Minor Beneficial Effect	N/A	N/A
Fish – Alterations in sediment function associated with dam overhaul repairs, including the buttressing berm in Budd Inlet (for the marine species group)	Less-than-significant Impact	BMPs and other measures to avoid and minimize impacts (see Section 4.5.8)	No
Wildlife – Conversion of deepwater habitat to wetland habitat areas for some species that utilize open water habitat, such as diving/dabbling ducks, bats, and Insectivorous birds	Less-than-significant Impact	BMPs and other measures to avoid and minimize impacts in Section 5.7	No

Impact Summary by Alternative	Impact Finding	Minimization and Other Mitigation Measures	Significant and Unavoidable Adverse Impact
Wildlife – Alterations in lake bathymetry and water depths in the lake associated with maintenance dredging	Less than significant impact	BMPs and other measures to avoid and minimize impacts (See Section 4.5.8)	No
Wildlife – Conversion of deep-water habitat to wetland habitat areas for some species that utilize wetland habitats for habitat or prey, such as raptors and passerines	Minor Beneficial Effect	N/A	N/A
Estuary Alternative			
Fish – Aquatic habitat alterations related to dam removal (reduction in habitat for native freshwater fish due to transition from freshwater to brackish water in basin)	**Significant Impact**	None	Yes
Fish – Conversion of freshwater lake habitat to a tidally influenced brackish estuary, specifically benefitting anadromous fish and marine fish, potentially including ESA-listed Chinook salmon and steelhead trout	**Substantial Beneficial Effect**	N/A	N/A
Fish – Increase in available in-water habitat that would result from dam removal, specifically for anadromous fish and marine fish species, potentially including ESA-listed Chinook salmon and steelhead trout	Moderate Beneficial Effect	N/A	N/A
Wildlife – Habitat alteration (impacts on bats)	**Significant Impact**	None	Yes

Impact Summary by Alternative	Impact Finding	Minimization and Other Mitigation Measures	Significant and Unavoidable Adverse Impact
Wildlife – Increase in suitable habitat and changes in the types of prey available for shorebirds and wading birds from conversion to estuarine habitat	**Substantial Beneficial Effect**	N/A	N/A
Wildlife – Large expansion of suitable habitat within the estuary for shellfish	Moderate Beneficial Effect	N/A	N/A
Wildlife – Increased habitat available for raptors and passerines	Minor Beneficial Effect	N/A	N/A
Wildlife – Potential for increased salmon prey base for ESA-listed orcas	Minor Beneficial Effect	N/A	N/A
Hybrid Alternative			
Fish – Aquatic habitat alterations related to dam removal (reduction in habitat for native freshwater fish due to transition from freshwater to brackish water in basin)	**Significant Impact**	None	Yes
Fish – Conversion of freshwater lake habitat to a tidally influenced brackish estuary, benefitting anadromous fish and marine fish, potentially including ESA-listed Chinook salmon and steelhead trout	Moderate Beneficial Effects	N/A	N/A
Fish – Increase in available in-water habitat that would result from dam removal, specifically for anadromous fish and marine fish species	Moderate Beneficial Effects	N/A	N/A

Impact Summary by Alternative	Impact Finding	Minimization and Other Mitigation Measures	Significant and Unavoidable Adverse Impact
Wildlife – Habitat alteration from loss of a freshwater lake that supports bat forage on the regional bat population	**Significant Impact**	None	Yes
Wildlife – Increase in suitable habitat and changes in the types of prey available for shorebirds and wading birds from conversion to estuarine habitat	Moderate Beneficial Effects	N/A	N/A
Wildlife – Large expansion of suitable habitat within the estuary for shellfish	Moderate Beneficial Effects	N/A	N/A
Wildlife – Reflecting pool would offer some resting deepwater habitat for diving and dabbling ducks when the estuary portion of the project is at low tide	Minor Beneficial Effects	N/A	N/A
Wildlife – Increased habitat available for raptors and passerines	Minor Beneficial Effects	N/A	N/A
Wildlife – Potential for increased salmon prey base for ESA-listed orcas	Minor Beneficial Effects	N/A	N/A

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List of Acronyms and Abbreviations

Acronyms/ Abbreviations	Definition
BMP	best management practice
BOD	biological oxygen demand
C-CAP	Coastal Change Analysis Program
cfs	cubic feet per second
CMP	corrugated metal pipe
CY	cubic yards
dB	decibel
DNR	Washington Department of Natural Resources
DO	dissolved oxygen
DPS	distinct population segment
Ecology	Washington Department of Ecology
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
Enterprise Services	Washington State Department of Enterprise Services
ESA	Endangered Species Act
ESU	evolutionarily significant unit
g	grams
GIS	geographic information system
GMA	Growth Management Act
HDPE	High Density Polyethylene
HPA	Hydraulic Project Approval
MHHW	mean higher high water
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NAVD	North American Vertical Datum
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWIFC	Washington Department of Fish and Wildlife and Northwest Indian Fisheries Commission
OMC	City of Olympia Municipal Code
OWS	overwater structure
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PHS	Priority Habitats and Species
ppt	parts per thousand

Acronyms/ Abbreviations	Definition
RCW	Revised Code of Washington
RMS	root mean square
SEL	sound exposure level
SEPA	State Environmental Policy Act
SF	square foot/feet
SMP	Shoreline Master Program
SPL	sound pressure level
SPSSRG	South Puget Sound Salmon Recovery Group
SWIFD	Statewide Integrated Fish Distribution
TMC	Tumwater Municipal Code
TMDL	Total Maximum Daily Load
TRPC	Thurston Regional Planning Council
U&A	Usual and Accustomed
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WRIA	water resource inventory area
WSDOT	Washington State Department of Transportation
WWTIT	Washington Department of Fish and Wildlife and Western Washington Treaty Indian Tribes

1.0 Introduction and Project Description

1.1 PROJECT DESCRIPTION

The Capitol Lake – Deschutes Estuary includes the 260-acre Capitol Lake Basin, located on the Washington State Capitol Campus, in Olympia, Washington. The waterbody has long been a valued community amenity. Capitol Lake was formed in 1951 following construction of a dam and provided an important recreational resource. Historically, the Deschutes Estuary was used by local tribes for subsistence and ceremonial purposes. Today, the expansive waterbody is closed to active public use. There are a number of environmental issues including the presence of invasive species, exceedances of water quality (WQ) standards, and inadequate sediment management.

The Washington State Department of Enterprise Services (Enterprise Services) is responsible for the stewardship, preservation, operation, and maintenance of the Capitol Lake Basin. The 260-acre Capitol Lake Basin is maintained by Enterprise Services under long-term lease agreement from the Washington Department of Natural Resources.

In 2016, as part of Phase 1 of long-term planning, a diverse group of stakeholders, in collaboration with the state, identified shared goals for long-term management and agreed an Environmental Impact Statement (EIS) was needed to evaluate a range of alternatives and identify a preferred alternative. In 2018, the state began the EIS process. The EIS evaluates four alternatives, including a Managed Lake, Estuary, Hybrid, and a No Action Alternative.

The long-term management alternatives are evaluated against the shared project goals of: improving water quality; managing sediment accumulation and future deposition; improving ecological functions; and enhancing community use of the resource. Refer to Figure 1.1 for the project area for long-term management. The Final EIS will identify a preferred environmentally and economically sustainable long-term management alternative for the Capitol Lake – Deschutes Estuary.

The EIS process maintains engagement with the existing Work Groups, which include the local governments, resource agencies, and tribe. It also provides for expanded engagement opportunities for the public, such as a community sounding board.

Figure 1.1 Project Area

1.2 SUMMARY OF PROJECT ALTERNATIVES

1.2.1 Managed Lake Alternative

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

If selected as the Preferred Alternative, adaptive management plans would be developed to maintain water quality, improve ecological functions, and manage invasive species during the design and permitting process.

1.2.2 Estuary Alternative

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

If selected as the Preferred Alternative, adaptive management plans would be developed to improve ecological functions and manage invasive species during the design and permitting process.

1.2.3 Hybrid Alternative

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

If selected as the Preferred Alternative, adaptive management plans would be developed before operation of the alternative to improve ecological functions and manage invasive species during the design and permitting process. Adaptive management would also be needed for a freshwater reflecting pool, but not for a saltwater reflecting pool.

1.2.4 No Action Alternative

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

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

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

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

1.3 CONSTRUCTION METHODS FOR THE ACTION ALTERNATIVES

This impact analysis relies on the construction method and anticipated duration for the action alternatives, which are described in detail in Chapter 2 of the EIS.

2.0 Regulatory Context

2.1 RESOURCE DESCRIPTION

This discipline report describes the following important ecosystem resources— fish and wildlife, and their habitats. An ecosystem is a biological community interacting with its physical and chemical environment as an integrated, dynamic unit. Ecosystems are made up of living organisms, including humans, and the environment they inhabit. Understanding this relationship is integral to the environmental review process. Various federal, state, and local regulations, including the Washington State Environmental Policy Act (SEPA), require that the effects of a proposed project on ecosystem structure, function, and process be evaluated in an EIS. This report is organized into two sections by ecosystem resource: (1) fish and fish habitat, and (2) wildlife and wildlife habitat. The three major groups of fish species evaluated, based on species life history, include anadromous fish, freshwater fish, and marine fish. Anadromous fish include those listed under the Endangered Species Act (ESA), other salmonids, and non-salmonid anadromous fish. Freshwater fish include both native fish and those that are exotic or non-native. Wildlife species addressed in this report include shellfish, birds, bats, and mammals (freshwater aquatic and marine).

This report also provides a discussion of tribal resources. Additional information on tribal resources is included in Section 4.3 of the *Cultural Resources Discipline Report* (ESA and NW Vernacular 2021) and in the *Economics Discipline Report* (ECONorthwest 2021), where ecosystem services are discussed. For the purposes of this Draft EIS, the term tribal resources refers to tribal fishing and gathering practices and treaty rights, specifically, the collective rights and access to traditional areas associated with a tribe's sovereignty or formal treaty rights. These resources may include fish, wildlife or plants used for commercial, subsistence, and ceremonial purposes.

2.2 RELEVANT LAWS, PLANS, AND POLICIES

Fish and wildlife and their habitats are protected by a variety of federal and state laws, plans, and policies (Section 2.2.1) and local plans and policies (Section 2.2.2).

2.2.1 Federal and State

Several federal and state regulations, plans, and policies influence planning, land use, and management activities that can impact fish and wildlife species and their habitats within the study area. Tables 2.1 and 2.2 summarize applicable federal and state regulations and policies.

Table 2.1 Federal Laws, Plans, and Policies

Regulatory Program or Policies	Lead Agency	Description
Medicine Creek Treaty of 1854	U.S. Government & Native American groups	Treaty between U.S. Government and certain Native American groups with 13 articles. Articles include, but are not limited to, defining lands ceded by signatories to the U.S. Government, securing the rights of signatories for taking fish at usual and accustomed grounds and stations, and creating reservations.
Federal Endangered Species Act (ESA)	National Marine Fisheries Service (NMFS); U.S. Fish and Wildlife Service (USFWS)	Provides for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The ESA prohibits importing, exporting, taking, possessing, selling, and transporting endangered and threatened species (with certain exceptions). It also provides for the designation of critical habitat and prohibits the destruction of that habitat. All projects that require federal permits, federal funding or federal land must comply with the ESA. The ESA pertains to all federally listed threatened and endangered species and critical habitats.
Magnuson-Stevens Fishery Conservation and Management Act (MSA) - Public Law 104-297, October 11, 1996, as amended	NMFS	Requires federal agencies to consult with NMFS on activities that may adversely affect Essential Fish Habitat (EFH). The EFH designation for the Pacific salmon fishery (Chinook, coho, and pink salmon) includes all those streams, lakes, ponds, wetlands, and other waterbodies, currently or historically accessible to salmon in Washington, except above identified impassable barriers. In addition to Pacific salmon, EFH has been designated for groundfish and coastal pelagic species.
Marine Mammal Protection Act	NMFS; USFWS	Protects all marine mammals and prohibits, with certain exceptions, the take of marine mammals in U.S. waters.
Fish and Wildlife Coordination Act	NMFS; USFWS; Washington Department of	Requires that federal agencies consult with the USFWS, NMFS, and state wildlife agencies for activities that affect, control, or modify waters of

Regulatory Program or Policies	Lead Agency	Description
	Fish and Wildlife (WDFW)	any stream or bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat.
Recovery Plan for Southern Resident Killer Whales	NMFS	This plan identifies a range of actions that will contribute to recovery of Southern Resident killer whales. The plan includes efforts on the local, state and regional levels to address recovery of other species (particularly salmon), cleanup of Puget Sound and management of local resources.
Bald and Golden Eagle Protection Act	USFWS	Protects bald and golden eagles from the unauthorized capture, purchase, or transportation of the birds, their nets, or their eggs.
Coastal Zone Management Act (CZMA)	Administered by Washington Department of Ecology (Ecology)	Voluntary state–federal partnership that encourages states to adopt management programs to meet the federal goals of protection, restoration, and appropriate development of coastal zone resources. In Washington, primarily implemented through the Clean Water Act process (discussed under *State* below). Includes the "federal consistency" provision, which gives states a strong voice in federal agency decision-making and guidelines.
Executive Order 12962 (Recreational Fisheries)	USFWS	Mandates federal agencies, to the extent permitted by law and where practical, to improve the "quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing opportunities."
Migratory Bird Treaty Act	USFWS	Protects migratory birds by prohibiting private parties (and federal agencies in certain judicial circuits) from intentionally taking, selling, or conducting other activities that would harm migratory birds, their eggs, or nests (such as the removal of an active nest or nest tree), unless the Secretary of the Interior authorizes such activities under a special permit.

Table 2.2 State Laws, Plans, and Policies

Regulatory Program or Policies	Lead Agency	Description
Washington State Endangered Species Act	WDFW	Oversees the listing and recovery of those species in danger of being lost in the state. Pertains to all state-listed threatened and endangered species.
State Hydraulic Code (Washington Administrative Code [WAC] 220-660)	WDFW	Regulates hydraulic projects (construction or performance of work that will use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state) by requiring a Hydraulic Project Approval (HPA) for all such projects. The purpose of the HPA is to ensure that construction or performance of work is done in a manner that protects fish life.
Shoreline Management Act	Ecology	Requires local jurisdictions to implement shoreline master programs to "prevent the inherent harm in an uncoordinated and piecemeal development of the state's shorelines." Shorelines are defined as marine waters, streams, and rivers with greater than 20 cubic feet per second (cfs) mean annual flow; lakes 20 acres or larger; upland areas called shorelands that extend 200 feet landward from the edge of these waters; biological wetlands and river deltas connected to these waterbodies; and some or all of the 100-year floodplain, including all wetlands. Implemented via the local Shoreline Master Programs (SMPs).
Growth Management Act (Revised Code of Washington [RCW], Chapter 36.70A)	Department of Commerce	The Growth Management Act (GMA) requires local jurisdictions to designate and protect critical areas, including fish and wildlife habitat conservation areas, are critical areas, in order to wisely use and protect the state's resources, including aquatic resources. See Critical Areas References in Table 2.3 for more detail.

2.2.2 Local

The study area includes lands located in the cities of Olympia and Tumwater. These municipalities have developed comprehensive plans, zoning, shoreline management plans, and ordinances for environmentally critical areas to direct growth and development within their jurisdictions, and have codified regulations in their respective municipal codes. Table 2.3 presents a summary of applicable local laws, plans, and policies.

Table 2.3 Local Laws, Plans, and Policies

Regulatory Program or Policies	Lead Agency	Description
Deschutes River Coho Salmon Biological Recovery Plan	Squaxin Island Tribe	Provides an analysis and recommendations for the priority reaches in the watershed and priority types of restoration and protection actions to implement.
City of Olympia Municipal Code (OMC) 18.32 - Environmentally Critical Areas Code (2016)	City of Olympia	OMC 18.32 governs areas of Olympia that provide critical environmental functions and values including critical aquifer recharge areas (drinking water protection areas), fish and wildlife species, streams and riparian areas, wetlands, floodplains, and geologic hazard areas (i.e., landslides, erosion hazards).
OMC 16.70 Flood Damage Prevention (2019)	City of Olympia	OMC 16.70 promotes public health, safety, and general welfare through regulating activities within flood hazard areas.
OMC 16.60 Tree, Soil, and Native Vegetation Protection and Replacement	City of Olympia	Regulates tree, soil, and native vegetation removal and protection.
Shoreline Master Program (SMP) (2015)	City of Olympia	The SMP provides goals, policies, and regulations for shoreline use and protection, and establishes a permit system for administering the program. The goals, policies, and regulations are tailored to the specific geographic, economic, and environmental needs of the City of Olympia and its varied shorelines.
Shoreline Master Program (2014, last updated 2019)	City of Tumwater	The SMP provides goals, policies, and regulations for shoreline use and protection, and establishes a permit system for administering the program. The goals, policies, and regulations are tailored to the specific geographic, economic, and environmental needs of the City of Tumwater and its varied shorelines.
Tumwater Municipal Code (TMC) 16.04, 16.12-16.32 Environment	City of Tumwater	TMC 16 governs areas of Tumwater that provide critical environmental functions including wetlands, fish and wildlife habitat areas, geologic hazard areas (i.e., erosion hazards), floodplains, and wellhead protection areas.
TMC 16.08 Protection of Trees and Vegetation	City of Tumwater	Regulates the removal and protection of trees and native vegetation.
2016–2036 Comprehensive Plan (2016)	City of Tumwater	The Comprehensive Plan describes the community's long-term vision and goals, including its vision for the natural environment, future land use, recreation, and other infrastructure.

3.0 Methodology

3.1 SELECTION OF THE STUDY AREA

The primary study area for fish and wildlife and their habitats is shown in Figure 3.1. The primary study area is based on the area where fish and wildlife species or habitats could be most directly affected by the construction or operation of the project alternatives. The study area includes both the area where construction would occur under each alternative, as well as the areas that support species that could be affected by the project, defined as the Capitol Lake Basin (including Percival Cove), Deschutes River up to the base of the Tumwater Falls, West Bay of Budd Inlet, and Percival Creek upstream to where modeling indicates that geomorphic changes or tidal influence could occur. The study area also includes riparian, wetland, and contiguous terrestrial habitats along the shorelines of the Capitol Lake Basin and West Bay. The southern boundary is generally the base of Tumwater Falls, and the northern limit is the northern end of West Bay. Although the project could have minor effects on hydrology and water quality north of West Bay, in the greater Budd Inlet, and into East Bay, the nature and magnitude of any such changes are not expected to adversely impact fish and wildlife species and habitats. See the *Water Quality Discipline Report* (Herrera 2021a).

Figure 3.1 Study Area for Fish and Wildlife

Legend

Project Area

3.2 DATA SOURCES AND COLLECTION

Data sources used for the fish and wildlife analysis include available scientific literature, technical reports, and data from various federal, tribal, state, and local agencies. These sources were used to identify fish and wildlife species in the study area and to assess potential effects of the proposed project on species presence, distribution, abundance, and habitat conditions. The assessment is based on peer-reviewed literature and other documents identified as "best available science" during the Phase 1 process (2016), including but not limited to the sources listed below.

- NOAA (National Oceanic and Atmospheric Administration) C-CAP Land Cover Atlas (2016)
- USFWS (U.S. Fish and Wildlife Service) National Wetlands Inventory, Wetlands Mapper (2019)
- WDFW 2017-18 Final Hatchery Escapement Report (2020b)
- WDFW Forage Fish Spawning Online Mapper (2020c)
- WDFW SalmonScape Database (2020d)
- WDFW Priority Habitats and Species (PHS) database (2020e)
- Tumwater Falls Hatchery Genetics Management Plans (WDFW 2005a, b)
- Implications of Capitol Lake Management for Fish and Wildlife (Hayes et al. 2008)
- Washington Department of Natural Resources (DNR) Natural Heritage Program (2020)
- Ecology Coastal Atlas Map and Database (2020b)
- Statewide Integrated Fish Distribution
- Statewide Integrated Fish Distribution (SWIFD) (NWIFC 2020b)
- Capitol Lake Bathymetric Survey (eTrac 2020)
- Salmon Habitat Protection and Restoration Plan for Water Resource Inventory Area 13, Deschutes (TCDLE 2004)
- City of Olympia Storm and Surface Water Plan (2018)
- City of Olympia Critical Area and Shoreline GIS data (2019)
- City of Olympia West Bay Environmental Restoration Assessment (Coast and Harbor Engineering (2016)
- City of Tumwater Draft Urban Forestry Management Plan (March 2020)
- Lacey, Olympia, and Tumwater Shoreline Analysis & Characterization Report (ESA Adolfson 2008)
- Thurston County Natural Resources geographic information system (GIS) data layers (2019)
- Thurston County Regional Planning Council (TRPC) Shoreline Inventory (2008)

- Salmon and Steelhead Habitat Limiting Factors reports for Water Resource Inventory Area 13 (Haring and Konovsky 1999)
- Deschutes River Coho Salmon Biological Recovery Plan (Confluence 2015)
- Percival Creek Comprehensive Drainage Basin Plan (Olympia 1993)

3.3 ANALYSIS OF IMPACTS

A large number and variety of fish and wildlife species utilize the aquatic and terrestrial habitats within the study area. Potential impacts from the project alternatives include both short- and long-term impacts on these species, as well as their habitats. Negative impacts on fish and wildlife species due to temporary construction or loss of suitable or key habitats for a fish (species groups) and wildlife species (indicator species) are considered adverse impacts. The relative magnitude of adverse impacts is categorized as "**less-than-significant**" or "**significant**." Conversely, substantial increases in the quality and/or quantity of suitable or key habitats for a fish (species group) and wildlife species (indicator species) are considered beneficial effects of an alternative. While the primary focus of the SEPA analysis is the identification of adverse impacts, the analysis also evaluated the potential magnitude of beneficial effects. Long-term beneficial effects were considered minor, moderate, or substantial incorporating both quantitative and qualitative factors as well as best professional judgment.

Detailed information on the presence, distribution, and abundance of individual fish and wildlife species in the study area is variable, and lacking for some species. In addition, there are a large number of species in the study area, making it difficult to analyze project effects on each individual species. Therefore, it is useful to focus on specific species groups (based on similar habitat preferences) or indicator species (specifically selected for this project) whose response to impacts is representative of a larger group of species. Potential impacts on fish species and habitat were generally evaluated by species groups, while the potential impacts on wildlife species and habitat were based more on indicator species. Note that some individual species have more intrinsic and societal value than other species. For example, adverse impacts and beneficial effects to ESA-listed species are given the most consideration, followed by other non-ESA listed native species. A species-specific evaluation for ESA-listed species, state priority species, and species of local concern would occur during permitting of the selected alternative.

Impacts on fish species groups and wildlife indicator species are based on known occurrences in the study area, life history requirements, and the potential changes in habitat condition, extent, and availability under each alternative. For fish, the analysis considered changes in wetted area, bathymetry, salinity, tidal inundation, freshwater inputs, water quality, and sediment distribution. For wildlife, the analysis also considered changes in the availability of cover, food, predator-prey relationships, and breeding sites.

3.3.1 Identification of Construction Impacts

Construction impacts are the temporary effects related to construction disturbance. Potential long-term impacts on fish and wildlife from permanent habitat changes and recurring maintenance dredging are addressed under *Operational Impacts*.

Project construction is anticipated to last 4 to 8 years, depending on the alternative, and would entail multiple in-water work seasons. Pursuant to federal, state and local laws, the project must include best management practices (BMPs) to avoid and minimize construction impacts. The affected habitats generally would revert to their pre-construction condition following completion of the project either through natural processes, active restoration, or some combination; however, the time-frame (temporal aspect) of recovery following construction is also considered in the impact analysis.

The primary construction elements that could affect fish and wildlife include the following:

- Activities related to initial dredging and creation of habitat areas in the Capitol Lake Basin.
- In-water construction (e.g., 5th Avenue Dam repair or removal, new 5th Avenue Pedestrian Bridge, new 5th Avenue Bridge (vehicular) boardwalks, dock, boat launch.
- Construction activities that include noise generating activities (e.g., pile driving) and/or that create visual disturbances.

Impacts are analyzed based on the known relationships between construction elements (e.g., turbidity and construction noise) and the effects on fish and wildlife (e.g., avoidance, decreased foraging activity). As described previously, the analysis focuses on the effects of project construction on representative fish and wildlife species groups and indicator species. The analysis considered construction timing, duration, methods, and BMPs and their relative implication for species and habitats under each alternative. Construction impacts were estimated based on the conceptual design for each alternative.

For the fish and wildlife analysis, the magnitude of short-term (construction) impacts is considered significant or less-than-significant, as follows.

Impacts are considered significant if they:

- Result in large-scale take (mortality, injury, or deleterious behavioral changes on more than a few individual organisms) on fish and wildlife species listed under the federal Endangered Species Act (Threatened or Endangered) or similar effects on those species under the Washington State Endangered Species Act (Threatened, Endangered, Sensitive, or Candidate); or
- Eliminates, or makes non-viable, a species group or species of regional importance within the Capitol Lake Basins or West Bay through the loss of suitable habitat; or
- Substantially impact the movement of native resident or migratory fish or wildlife species or impair the use of fish spawning or wildlife breeding areas, through large-scale activities

that either precludes access to such for more than 2 years or directly eliminates those habitats that support spawning and breeding for a species group.

Impacts are considered less-than-significant if they:

- Do not result in large-scale take (mortality, injury, or deleterious behavioral changes on more than a few individuals) on fish and wildlife species listed under the federal Endangered Species Act (Threatened or Endangered) or similar effects on those species under the Washington State Endangered Species Act (Threatened, Endangered, Sensitive, or Candidate) and where the nature, magnitude, and duration of the effect are limited to a small number of individual organisms of a given fish and wildlife species, but do not substantially affect the reproduction, growth, or persistence of a species; or
- Have a short-term (less than 2 years) impact on the movement of native resident or migratory fish or wildlife species, or their use of fish spawning areas or wildlife breeding areas, but do not substantially affect the reproduction, growth, or persistence of a species.

3.3.2 Identification of Operational Impacts

Operational impacts are the long-term or permanent effects related to the operation of the project. Operational effects analyze the projected outcome of each alternative and the changes to habitat and the corresponding effects to fish and wildlife species. Both long-term adverse impacts and beneficial effects associated with fish and wildlife are evaluated based on expected changes in ecological functions and processes within the study area. The primary elements of the alternatives that would have the most effect on fish and wildlife include the following:

- 5th Avenue Dam repair or removal (e.g., freshwater or estuarine system)
- Impacts of new in-water and overwater structures (e.g., boardwalks, dock, boat launch, 5th Avenue Pedestrian Bridge)
- Recurring disturbance related to maintenance dredging

Assessments of potential adverse impacts and beneficial effects to fish and wildlife and their habitats are based on many factors including:

- The type, extent, and magnitude of habitat change relative to existing conditions, including temporal effects (e.g., how long would it take for each habitat to reach some level of relative stability).
- Changes in hydrology and sediment transport as indicated based on modeling of the alternatives and their specific design components.
- Expected changes in salinity and habitat type.
- Expected changes in water quality and aquatic vegetation, including during maintenance dredging.

The potential impacts and benefits of the alternatives on fish and wildlife are described by estimating the type, extent, and magnitude of habitat changes relative to existing conditions, and correlating those changes to the species groups and indicator species that occupy or are associated with each habitat type; no species-specific models were developed. The potential changes to vegetation in the study area are also explained and where possible, quantified. Changes in vegetation, water flow, salinity, and tidal fluctuation have a corresponding effect on species occurrence and densities, and affect wildlife use of those habitats. There is always uncertainty in predicting outcomes of effects to complex ecological systems, so the relative uncertainty is also acknowledged.

For the fish and wildlife analysis, the magnitude of long-term (operational) impacts is considered significant or less-than-significant, as follows.

Impacts are considered significant if they:

- Result in large-scale take (mortality, injury, or deleterious behavioral changes on more than a few individual organisms) on fish and wildlife species listed under the federal Endangered Species Act (Threatened or Endangered) or similar effects on those species under the Washington State Endangered Species Act (Threatened, Endangered, Sensitive, or Candidate); or
- Eliminates, or makes non-viable, a species group or species of regional importance within the Capitol Lake Basins or West Bay through the loss of suitable habitat, including habitat that supports reproduction, growth and feeding, or migration; or
- Conflict with the provisions of an approved local, regional, or state habitat conservation plan and/or regional salmon recovery plan.

Impacts are considered less-than-significant if they:

- Do not result in large-scale take (mortality, injury, or deleterious behavioral changes on more than a few individuals) on fish and wildlife species listed under the federal Endangered Species Act (Threatened or Endangered) or similar effects on those species under the Washington State Endangered Species Act (Threatened, Endangered, Sensitive, or Candidate) and where the nature, magnitude, and duration of the effect are limited to a small number of individual organisms of a given fish and wildlife species, but do not substantially affect the reproduction, growth, or persistence of a species; or
- Have minor long-term alterations in the environment that do not reduce the habitat quality or quantity of a fish and wildlife species group or indicator species to the point where the species or species group is extirpated from the study area.

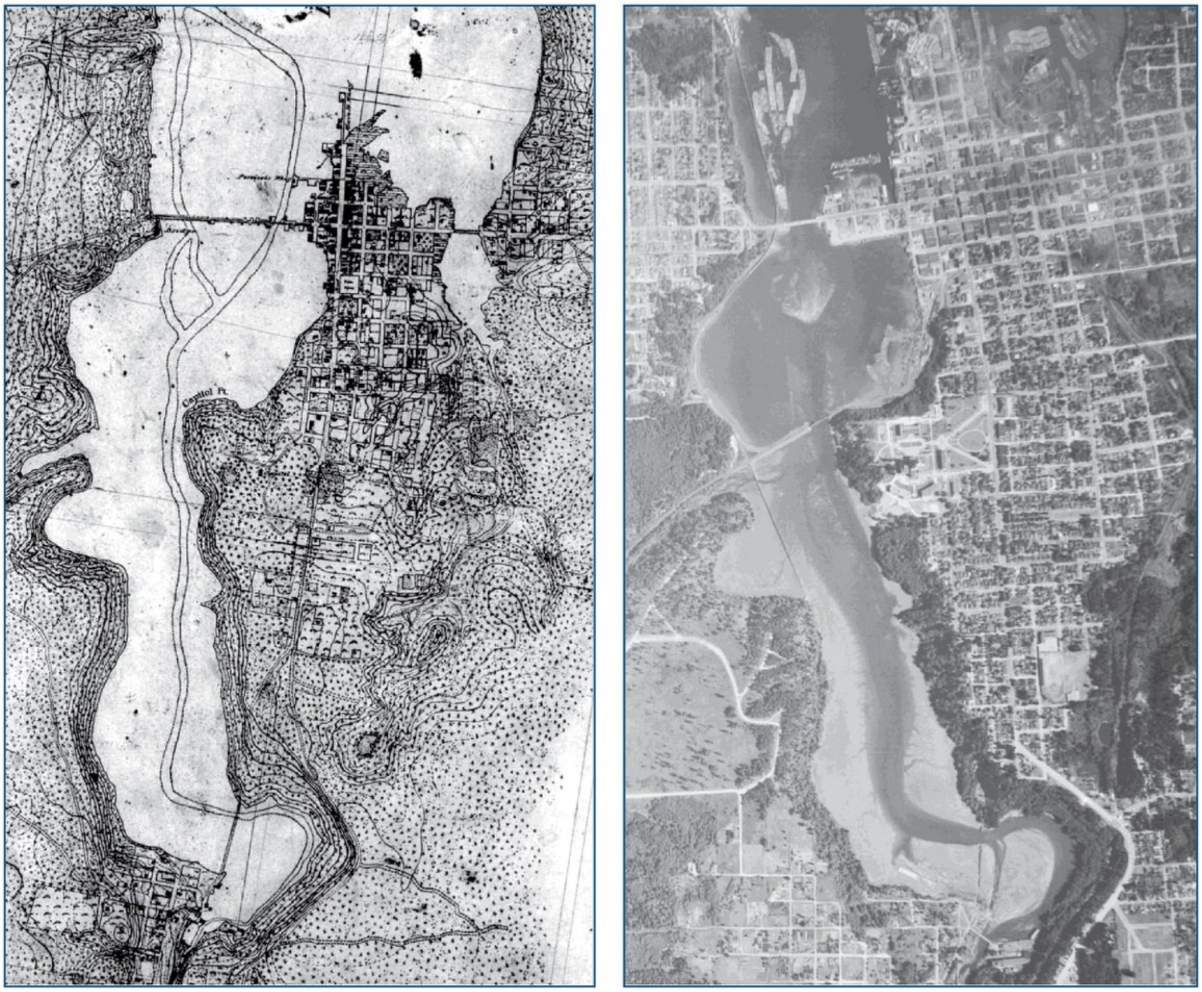
4.0 Affected Environment

4.1 FISH AND AQUATIC HABITAT

Capitol Lake was transformed into a fresh waterbody in 1951 when a dam and associated tide gate were constructed at the mouth of the Deschutes River to form a reflecting pool for the Capitol Building. Prior to this time, the Deschutes River flowed to Budd Inlet, with the current-day Capitol Lake Basin consisting of estuary habitat, including substantial tideflats (Figure 4.1). Prior to the dam construction and until 1954, anadromous fish were able to travel upstream from Budd Inlet up to Tumwater Falls, a natural fish passage barrier that historically restricted the distribution of anadromous fish to the lower 2 miles of the Deschutes River. Much of this length was the river's estuary with a short stretch of river below the falls. In addition to using the lower Deschutes River for spawning and rearing, a number of salmon species spawned in Percival Creek and used the estuary for a gradual transition from freshwater to saltwater. Sediment from the Deschutes River, and to a lesser extent Percival Creek, was transported into Puget Sound, and natural tidal exchanges supported water quality. The marine shoreline of West Bay provided tideflats and productive habitat for macroinvertebrates and forage fish, both important to the diets of salmon.

Construction of the 5th Avenue Dam limited anadromous fish passage, created a barrier to tidal exchange, and altered natural hydrological and sediment transport processes. For anadromous fish outmigrating from freshwater as juveniles or returning to freshwater as adults, the dam includes two flood control discharge channels and a fishway channel to provide suitable water depth, velocity, and jump conditions. When originally constructed, the tide gate and fishway could potentially delay the upstream migration of adult salmonids during low tides (Haring and Konovsky 1999) and restrict the movement of smaller fish (i.e., less than 6 inches long). This occurred when the lower lake levels in winter and the relatively high elevation of the fish ladder limited movement into and out of the lake to times when the tide gate was open and flow conditions were sufficient to allow these relatively weak-swimming fish to move freely. In 2002, the fishway was retrofitted to meet WDFW fish passage criteria and is considered 100% passable (WDFW Site ID: 970005).

Figure 4.1 Historical Condition of Capitol Lake Basin



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The alteration of natural hydrological and sediment transport processes following dam construction resulted in substantial filling of the lake basin with fine sediment from upstream reaches of the Deschutes River and created a shallow freshwater lake. These changes in the basin, in combination with nutrient sources from the Deschutes River, contributed to excess accumulations of phosphorus (contributing to increased algae and invasive plant growth) in the basin, although more recent water quality data indicate an improving trend in phosphorous loading (see the *Water Quality Discipline Report* [Herrera 2021a]). Recent water quality trends (2004 through 2014) show reductions in surface total phosphorus and chlorophyll, as well as improvement in water clarity (Secchi depth). The lake is well mixed with little difference in water temperature or dissolved oxygen (DO) through the entire water column. Both surface and bottom DO measurements are well above water quality standards and well within the range required by salmon and other fish. Likewise, although the basin demonstrates water temperatures in excess of riverine water quality standards, from a lake perspective, these water temperatures are low when compared to other lakes in the region. The elimination of brackish water and transition to saltwater have also created habitat for non-native fish species (e.g., bass) and harmful and invasive aquatic invertebrates (such as the New Zealand mud snail). However, recent lake data (2010–2014 and 2019) indicate that Capitol Lake currently has good water quality in terms of physical characteristics important to aquatic life, such as temperature and DO, as well as in terms of chlorophyll concentrations and algae blooms, especially in light of its eutrophic condition. The extensive aquatic plant community remains a concern.

While DO is naturally low in many inlets and embayments in South Puget Sound, the presence of the dam has contributed to poor water quality in the marine portions of the study area, shown by the Budd Inlet modeling study (Ecology 2015b). The study found the largest human-caused contributor to low DO problems in Budd Inlet was loading of nutrients, particularly nitrogen and algae production and decomposition in Budd Inlet and total organic carbon, which primarily originates from Capitol Lake. Decreases in available DO in Budd Inlet can be potentially harmful to salmon and other fish.

The overall density and distribution of aquatic vegetation, including invasive species, became more prevalent as the lake filled in with sediment, limiting habitat quality. Human development along the lake resulted in armored shorelines and decreased the quality and quantity of riparian vegetation, thus reducing the habitat value for native species. In addition, anadromous fish migrating to Puget Sound face physiological challenges from the abrupt transition from freshwater to saltwater. Although the study area still supports a variety of fish, including salmon and steelhead, the geomorphic and ecological conditions of the Lower Deschutes aquatic system are dramatically changed from their historical state, a condition which likely limits some historic fish populations.

4.1.1 Fish Use in Study Area

Many native and nonnative fish species inhabit the freshwater and estuarine habitats of the study area. A variety of fish species utilize the freshwater habitats of the North, Middle, and South Basins, as well as the riverine habitats of the Deschutes River and Percival Creek. Likewise, many fish species use the estuarine habitats of West Bay. Table 4.1 below provides information on the most common of these species (those that are expected to occur in the study area at least occasionally). These are grouped into assemblages (species groups), including anadromous fish (salmonid and non-salmonid), other freshwater fish, and marine fish (Table 4.1). WDFW (Hayes et al. 2008) conducted a thorough review of available data on fish presence and distribution in Capitol Lake and Budd Inlet, based on an extensive search of peer-reviewed and gray literature (information produced by government agencies, academic institutions, and also the for-profit sector that is not typically made available by commercial publishers), and interviews with species and habitat experts. As this work represents the most complete and comprehensive study to-date on this subject, this analysis utilized used similar species groups to characterize fish resources in Capitol Lake.

Table 4.1 Fish Species Potentially Present in the Study Area

Species Group	Species Sub-Group	Species / Status	Scientific Name
Anadromous Fish	**ESA-Listed Species**	Chinook Salmon (FT, SC)[a]	*Oncorhynchus tshawytscha*
		Steelhead Trout (FT)[a]	*O. mykiss*
		Bull Trout (FT)[a]	*Salvelinus confluentus*
	Other Salmonids	Coho Salmon	*O. kisutch*
		Chum Salmon	*O. keta*
		Sea-run Cutthroat Trout	*O. clarkii*
		Sockeye Salmon	*O. nerka*
	Non-salmonids	Starry Flounder	*Platichthys stellatus*
		Three-spined Stickleback	*Gasterosteus aculeatus*
Freshwater Fish (resident)	Native Fish	Resident Cutthroat Trout	*O. clarkii*
		Rainbow Trout	*O. mykiss*
		Peamouth	*Mylocheilus caurinus*
		Northern Pikeminnow	*Ptychocheilus oregonensis*
		Speckled Dace	*Rhinichthys osculus*
		Redside Shiner	*Richardsonius balteatus*
		Largescale Sucker	*Catostomus macrocheilus*
		Prickly Sculpin	*Cottus asper*
		Riffle Sculpin	*Cottus gulosus*
		Western Brook Lamprey	*Lampetra richardsoni*
	Exotic/non-native Fish	Common Carp	*Cyprinus carpio*
		Brown Bullhead (E)	*Ameiurus nebulosus*
		Smallmouth Bass (E)	*Micropterus dolomieu*
		Largemouth Bass (E)	*Micropterus salmoides*
		Yellow Perch (E)	*Perca falvescens*
Marine Fish		Pacific Sand Lance	*Ammodytes hexapterus*
		Shiner Perch	*Cymatogaster aggregata*
		Surf Smelt	*Hypomesus pretiosus*
		Arrow Goby	*Clevelandia ios*
		Pile Perch	*Rhacochilus vacca*

Species Group	Species Sub-Group	Species / Status	Scientific Name
		Bay Pipefish	*Syngnathus griseolineatus*
		Staghorn Sculpin	*Leptocottus armatus*
		Tidepool Sculpin	*Oligocottus maculosus*
		Sand Sole	*Psettichthys melanostictus*
		Speckled Sand Dab	*Citharichthys stigmaeus*

FT= Federally Threatened, SC = State Candidate, E = Exotic.
[a] No naturally reproducing native populations of Chinook salmon, steelhead, or bull trout are present within the Deschutes River Basin or Percival Creek, although use of the study area by these species may occur. Chinook salmon from the Tumwater Falls Hatchery are not listed under ESA.
Sources: Hayes et al. (2008), USFWS (2009), and WDFW (2020d).

4.1.1.1 Anadromous Fish

Nine anadromous fish species, including seven salmonid species, may occur in the Capitol Lake Basin or its immediate vicinity at different stages of their life history. The timing of salmonid presence in the Capitol Lake Basin is presented in Table 4.2. Two non-salmonids (three-spined stickleback and starry flounder) may also occur in the lake.

These species, particularly the salmon, have significant cultural and economic value to area tribes. Capitol Lake is located within the traditional territory of the Southern Coast Salish cultural group, which includes but is not limited to the Steh-chass, Nusehchatl, Squaxin, and Nisqually, and provide fish harvesting opportunities for some tribes (see the *Cultural Resources Discipline Report* for more information [ESA and NW Vernacular 2021]).

Adult anadromous salmonids returning to the Capitol Lake Basin can continue their upstream migration by moving into the Deschutes River, which flows into the lake from the south, or Percival Creek, which enters the Middle Basin from the west. When draining into the lake, Percival Creek drains into a cove, called Percival Cove, which is partially separated from the rest of the Middle Basin by the Deschutes Parkway SW.

Capitol Lake is a migratory corridor for outmigrating salmonid smolts and returning adult salmonids (Hayes et al. 2008). Some juvenile rearing is assumed to occur in Capitol Lake during the spring outmigration and possibly extending into summer or later (Hayes et al. 2008). Steltzner (2007) reported that hatchery juvenile Chinook salmon released from the Tumwater Falls Hatchery appeared to rear in the lake for 6 to 10 days in the spring. This same residency is assumed for any Chinook salmon produced in Percival Creek. Freshwater fish species in Capitol Lake remain there throughout the year, except for those times when they may move into the lower portions of the Deschutes River or Percival Creek.

Table 4.2 Life History and Timing of Salmon Species in Capitol Lake

Salmon Species and Run	Life Stage	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Coho Salmon	Adult River Entry																		■	■	■	■			
	Juvenile Rearing and Outmigration					■	■	■	■	■	■	■	■												
Fall Chum Salmon	Adult River Entry	■																					■	■	■
	Juvenile Rearing and Outmigration				■	■	■	■	■																
Fall Chinook Salmon (hatchery origin)	Adult River Entry														■	■	■	■	■	■	■				
	Juvenile Rearing and Outmigration					■	■	■	■	■	■	■													
Winter Steelhead	Adult River Entry	■	■	■	■	■																■	■	■	■
	Juvenile Rearing and Outmigration					■	■	■	■	■	■	■	■	■	■										
Sea-run Coastal Cutthroat Trout	Adult River Entry	■	■	■	■	■	■														■	■	■	■	■
	Kelts (adults) Outmigration						■	■																	
	Juvenile Rearing and Outmigration								■	■	■	■													
Bull Trout	Adult/Sub-adult Foraging							■	■	■	■	■	■												
	Juvenile Rearing and Outmigration																								

■ present

Sources: Williams et al. (1975), WDFW and WWTIT (1994), WDFW (2000), TCDLE (2004).

Historically, anadromous salmonids could only access the Deschutes River to the upstream margin of the approximately 2-mile long estuary because of the natural barrier, Tumwater Falls, immediately upstream of the estuary. In 1954, a fish ladder was constructed that allowed anadromous salmonids to access habitats in the Deschutes River upstream of Tumwater Falls.

WDFW operates a hatchery at Tumwater Falls with a production goal is 3.8 million juvenile Chinook salmon per year that are released into the Deschutes River at the hatchery (WDFW 2020a). An adult collection pond at the top of the fish ladder system is used to capture hatchery-origin Chinook salmon for broodstock collection by the WDFW Tumwater Falls Hatchery. It also allows WDFW to control and count the number of adult salmonids allowed to migrate farther upstream in the Deschutes River. WDFW fish counts at the fishway and hatchery are the basis of the salmon numbers provided below.

As summarized by Hayes et al. (2008), hatchery Chinook salmon and Coho salmon were planted in the upper Deschutes River (above the falls) and Percival Creek at various times since 1953. Steelhead have also been planted in the upper Deschutes River. Such releases of juvenile salmonids to the Upper Deschutes River have not occurred in recent years, except for limited releases of Coho salmon which have not occurred since 2015 (Pilon, pers. comm.). Hatchery-origin fall Chinook salmon and some coho salmon were reared by WDFW in net-pens and open water in Percival Cove from the 1960s until ending in 2007 (Hayes et al. 2008).

ESA-Listed Anadromous Salmonids

Chinook Salmon

Chinook salmon are present throughout the study area, including the Capitol Lake Basin and West Bay. The Chinook salmon returning to the Deschutes River and Percival Creek are fall-run Chinook salmon of hatchery origin (Haring and Konovsky 1999). They are not part of the native PS population and therefore not listed as threatened.

The number of Chinook salmon adults returning to the Tumwater Falls Hatchery each year between 2013 and 2018 is presented in Table 4.3 (WDFW 2020b). While the vast majority are used for broodstock, a small number of Chinook salmon have been released upstream of the facility. Since 2019, no Chinook salmon adults are allowed upstream of the hatchery in order to avoid Chinook salmon interactions with native Coho salmon spawning (Pilon, pers. comm.). Between 2013 and 2018, some males and jacks were released upstream, but no females were released (Topping, pers. comm.). This was to prevent hatchery Chinook salmon spawning, while providing a recreational fishing opportunity and adding marine-derived nutrients to the Deschutes River watershed.

Table 4.3 Annual Number of Chinook Salmon Collected at Tumwater Falls Hatchery

Return Year	Adults	Jacks	Total
2013	10,157	572	10,729
2014	2,946	138	3,084
2015	3,747	1,265	5,012
2016	13,188	702	13,890
2017	30,081	3,806	33,887
2018	11,467	945	12,412

Adult fall Chinook salmon returning to spawn first appear at the 5th Avenue Dam fish ladder in late July and continue upstream migrations through October (Williams et al. 1975). Spawning generally occurs between late September through October (SPSSRG 2005). The fall-run Chinook salmon are considered "ocean type," such that they typically outmigrate to saltwater as smolts during their first spring or summer. Chinook salmon are the most dependent salmon species on estuaries as they outmigrate from rivers as juveniles (Healey 1982). In natural estuaries, the gradual transition from freshwater to saltwater supports the physiological transition the juvenile salmon must undergo (Fresh 2006). While rearing in estuaries, juvenile salmon utilize tidal channels, tideflats, and vegetated salt marsh habitats that provide abundant prey resources and support rapid growth (Simenstad et al. 1982).

Steelhead

Very low numbers of Steelhead are thought to return to the Deschutes River and Percival Creek (Pilon pers. comm.). The returning steelhead are winter-run steelhead and are a distinct non-native stock (Haring and Konovsky 1999). They spawn naturally in the Deschutes River upstream of Tumwater Falls. Adult steelhead return to rivers between November and mid-March, and spawn timing is from early January to early April (WDFW and WWTIT 1994). Steelhead typically remain in freshwater for two or three years before migrating out to the ocean (Thurston Conservation District Lead Entity 2005).

Data are not available on the number of steelhead returning to the Deschutes River because WDFW does not trap fish during the time of the year (December through February) that the adults would be returning to river. Past efforts by WDFW to trap returning steelhead in the early 2000s did not capture any. Based on the absence of steelhead during those sampling efforts, WDFW assumes that steelhead numbers returning to the Deschutes River are very low (Pilon pers. comm.).

Bull Trout

Bull trout do not reproduce in the freshwater portions of the study area due to the presence of the fish barrier at Tumwater Falls, and a lack of complex habitat, cold, clean water, and suitable spawning gravel in this area. However, bull trout may enter Capitol Lake on feeding forays, especially when hatchery-produced or naturally spawned juvenile salmon are outmigrating. Foraging or migrating adult bull trout may also be in the saltwater habitats of Budd Inlet, including West Bay. Bull trout exhibit multiple migratory strategies, commonly occupy patchy distributions, and are associated with cool water and complex habitats.

Other (non-ESA Listed) Anadromous Salmonids

Coho Salmon

Coho salmon are present throughout the study area, including the Capitol Lake Basin and West Bay. Coho salmon spawn and rear in both the Deschutes River and Percival Creek (WDFW and NWIFC 2020). Historically, Percival Creek likely supported a native Coho salmon run. Coho salmon in the Deschutes River are of non-native origin. The river was historically inaccessible to Coho salmon due to the natural barrier at Tumwater Falls. With the installation of a series of fish ladders that allow fish past Tumwater Falls and the release of hatchery-origin Coho salmon, a population was established in the Deschutes. Hatchery releases have occurred intermittently since the late 1940s, but no Coho salmon have been released since 2015 (Pilon, pers. comm.).

Coho salmon typically migrate to marine waters after spending 18 months in freshwater (Weitkamp et al. 1995). Adults return to the rivers in mid-September to mid-November and spawn between late October and early January (WDFW and WWTIT 1994). Fry emerge from the gravel in late winter and early spring. After 1 year rearing in the river, young Coho salmon outmigrate from the river in the spring. After leaving Capitol Lake and entering saltwater, Coho salmon migrate out of Puget Sound to the Pacific Ocean. Adult Coho salmon return in late summer and early fall of the following year.

Due to a consistent 3-year life cycle among Coho salmon (1.5 years in freshwater and 1.5 years in saltwater), there are generally three separate brood year lineages. Every 3 years, the strongest brood year lineage returns and tends to have more returning Coho than the 2 weaker brood year lineages. In the strongest of the three brood year lineages returning to the Deschutes River, the annual number of adults has ranged between 800 and 2,450 since 1991. However, the two other brood year lineages have had much lower numbers, including 100 or fewer adult Coho salmon returning in 9 of the last 14 years of returns for those lineages (Topping, pers. comm.)

Chum Salmon

Low numbers of Chum salmon are present throughout the study area, including the Capitol Lake Basin and West Bay. Chum salmon are documented as spawning in Percival Creek (Hayes et al. 2008). These are fall Chum salmon (WDFW and NWIFC 2020) that are assumed to be strays from larger Chum salmon runs elsewhere in South Puget Sound (Hayes et al. 2008). Haring and Konovsky (1999) reported no Chum salmon in the Deschutes River.

When young, Chum salmon spend little time in freshwater. When fry emerge from the gravel, they immediately begin their migration downstream to estuarine/nearshore areas (Salo 1991). Outmigrating fry either rear for weeks in natal estuarine habitats or pass directly through into Puget Sound (Fresh 2006). Based on the timing of the nearby Eld Inlet fall Chum salmon stock, they return to rivers and spawn between mid-November and mid-January (WDFW and WWTIT 1994).

Sockeye Salmon

There is no sockeye salmon stock documented with distributions extending into Capitol Lake, Deschutes River, or Percival Creek (WDFW and WWTIT 1994). Haring and Konovsky (1999) reported isolated observations of sockeye salmon spawning in Percival Creek and annual observations of 10 or fewer adult sockeye salmon returning to the Deschutes River. Between 2008 and 2018, 15 total sockeye salmon were released upstream of Tumwater Falls with no more than five in any single year Topping (pers. comm.).

Sea-Run Coastal Cutthroat Trout

Sea-run coastal cutthroat trout are present throughout the study area, including the Capitol Lake Basin and West Bay. Coastal cutthroat trout are documented as having distributions that include the Deschutes River and Percival Creek. There is no information on the abundance of the population.

Sea-run coastal cutthroat trout typically spend between 2 and 4 years in freshwater before migrating to marine waters (Giger 1972, Lowery 1975). Coastal cutthroat trout outmigrate in the spring, with the fish tending to rear extensively in shallow intertidal areas, preying on forage fish (Mason Conservation District 2004). After feeding in saltwater and estuaries for several months, most anadromous coastal cutthroat trout return to freshwater to overwinter and spawn, although sexual maturity of returning fish varies by geography and sex (Fuss 1982, Tipping 1981). Like steelhead, anadromous coastal cutthroat trout are iteroparous and adults may spawn in multiple years (Trotter 1989). Sea-run coastal cutthroat trout enter rivers as adults between mid-October and the end of March, with spawning occurring between January and March (WDFW 2000).

Anadromous Non-Salmonids

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. Three-spined stickleback have been captured in sampling in lower Budd Inlet by Steltzner (2003) and are presumed to be the anadromous form (Hayes et al. 2008). It is not known how much of the current population in Capitol Lake is the anadromous form (Hayes et al. 2008). Hayes et al. (2008) cites several sources indicating that three-spined stickleback comprise an overwhelming majority of the fish population in Capitol Lake. The anadromous form spends most of its adult life in the marine environment feeding on plankton and returns to freshwater to breed (USGS 2020). Breeding occurs annually from late April to July in ponds, rivers, lakes, drainage canals, marshes, sloughs, tidal creeks, and sublittoral zones of the sea (Bell and Foster 1994, Mattern et al. 2007). Three-spined stickleback do not die after spawning and can breed more than once (Hayes et al. 2008). The eggs hatch 5 to 10 days after fertilization (Bell and Foster 1994). Individuals reach sexual maturity between 1 and 2 years of age. The average lifespan of this species is ranges is only about 1 to 3 years (Wootton 1976).

Starry flounder were documented in Capitol Lake during a drawdown in 1996 but were not found in 1997 (Hayes et al. 2008). Starry flounder are a bottom-dwelling flatfish. Starry flounder spawn at the freshwater interface in upper estuaries, often at or near the first riffles leading into estuaries (Orcutt

1950, Horton 1989). Starry flounder do not die after spawning and can breed more than once (Hayes et al. 2008). Hayes et al. (2008) notes that a lack of data prevents understanding the status of starry flounder in Capitol Lake.

4.1.1.2 Freshwater Fish

As noted by Hayes et al. (2008), limited information is available on the fish community of Capitol Lake. The following discussion of Capitol Lake's freshwater fish community is based on information from Hayes et al. (2008), unless otherwise referenced. It is known from the historic drawdowns of the lake that it supports several thousands of fish.

Table 4.4 lists the documented freshwater species of Capitol Lake, notes whether they are native or non-native, and describes their ecological role based on Wydoski and Whitney (2003). The ecological role is described as it relates to habitat use and potential for competition and predation with anadromous salmonids in the study area.

In addition to the species in Table 4.4, Olympic mudminnows (*Novumbra hubbsi*) are documented in the lower portion of the Deschutes River watershed (Mongillo and Hallock 1999). Hayes et al. (2008) did not include Olympic mudminnow in a Capitol Lake effects analysis noting "Capitol Lake is not preferred habitat"; therefore, this species was not included as a species occurring in Capitol Lake. Olympic mudminnows are typically found in slow-moving streams wetlands and ponds (Mongillo and Hallock 1999). In these habitats, they require a muddy bottom, little or no water flow, and abundant aquatic vegetation (Mongillo and Hallock 1999).

Table 4.4 Freshwater Fish Species Potentially Present in the Study Area

Species	Origin	Lake Habitats Occupied	Ecological Role
Three-spined Stickleback	native	littoral, limnetic, and benthic	Numerous, substrate-oriented, often near aquatic vegetation, provide prey for larger fish.
Coastal Cutthroat Trout	native	littoral and limnetic	Resident life history form competes with other salmonids for prey when young and is a major predator when larger.
Rainbow Trout	non-native	littoral and limnetic	Resident life history that is the same species as steelhead. Overlapping habitat with other salmonids; consume similar prey. Potential competitor and predator of young anadromous salmonids.
Peamouth	native	littoral	Occupies shallow benthic habitats in lakes and streams. Potential competitor of young anadromous salmonids.

Species	Origin	Lake Habitats Occupied	Ecological Role
Northern Pikeminnow	native	littoral and limnetic	Occupies lakes and slow-moving habitats in streams. Major fish predator that occupies salmonid fish habitat.
Speckled Dace	native	littoral and benthic	Occupies benthic habitats. Generally, found in shallow water less than 3 feet deep. Some prey overlap with young anadromous salmonids.
Redside Shiner	native	littoral, benthic, and sometimes limnetic	Uses shallow and deep habitats. Some prey overlap with young anadromous salmonids.
Largescale Sucker	native	littoral and benthic, except for brief period of limnetic	Occupies benthic habitats of lakes and streams. Young largescale sucker have some diet overlap with young anadromous salmonids.
Prickly Sculpin	native	littoral and benthic	Occupies shallow and deep benthic habitats. Potential competitor and predator of young anadromous salmonids.
Riffle Sculpin	native	littoral and benthic	Occupies shallow benthic habitat, generally sand or gravel. Potential competitor of young anadromous salmonids.
Western Brook Lamprey	native	littoral and benthic	Larval life stage occupies silty benthic habitats in quiet backwater areas. Juveniles and adults occupy gravel stream beds. Species is non-parasitic and does not harm other fish.
Common Carp	non-native	littoral and benthic	Occupies depths up to 100 feet in lakes and streams. Young carp are a potential competitor of young anadromous salmonids.
Brown Bullhead	non-native	littoral and benthic	Competitor with young salmonids for similar prey.
Smallmouth Bass	non-native	littoral and limnetic	Major fish predator that occupies salmonid habitat, resulting in some prey competition.
Largemouth Bass	non-native	littoral and limnetic	Major fish predator that occupies shoreline habitat. Young bass compete with young salmonids for some prey.
Yellow Perch	non-native	littoral and limnetic	Consumes similar prey as young salmonids. Potential competitor and predator of young anadromous salmonids.

4.1.1.3 Marine Fish

Table 4.5 lists the documented marine species of West Bay, notes whether they are native or non-native, and describes their ecological role based on Hayes et al. (2008). 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 (sandab, halibut, sole, and flounder). While any of these species may occasionally be present the waters of West Bay, this analysis focuses on those marine fish that have been documented in the study area and our likely to occur (Hayes et al. 2008). The ecological role of these species is described in Table 4.5 as it relates to habitat use and potential for interactions with anadromous salmonids in the study area.

Table 4.5 Marine Fish Present in Study Area and Lower Budd Inlet

Species	Origin	Ecological Role
Pacific Sand Lance	native	Beach-spawning fish that deposits eggs on sand in mid and upper intertidal zone. Schooling species. Important prey species in food web, including for salmonids.
Surf Smelt	native	Beach-spawning fish that deposits eggs on pea gravel and coarse sand in upper intertidal zone. Schooling species. Important prey species in food web, including for salmonids.
Shiner Perch	native	Schooling species. Common in nearshore, including fish surveys of Budd Inlet. Diet overlaps with young anadromous salmonids.
Pile Perch	native	Common in estuaries around piling and other underwater structures.
Bay Pipefish	native	Occupies shallow subtidal habitats. Diet includes plankton and small crustaceans.
Arrow Goby	native	Bottom-dwelling fish known to use burrows created by shellfish. Diet overlaps with young anadromous salmonids.
Pacific Staghorn Sculpin	native	Common in estuaries. Occupies benthic habitats. Larger sculpins are a potential predator of young anadromous salmonids.
Tidepool Sculpin	native	Small intertidal fish. Diet overlaps with young anadromous salmonids.
Sand Sole	native	Medium-sized bottom-dwelling flatfish. Larger soles are a potential predator of young anadromous salmonids.
Speckled Sand Dab	native	Medium-sized bottom-dwelling flatfish. Diet overlaps with young anadromous salmonids.

4.1.2 Listed or Sensitive Fish Species and Habitats

Puget Sound Chinook salmon are listed as threatened under the ESA (NMFS 1999); however, this applies to native populations, which are not present in the Deschutes River or Percival Creek watersheds (Pilon, pers. comm.; Dickison, pers. comm.). The Capitol Lake Basin and freshwaters flowing into it are not designated as critical habitat. The estuarine waters of Budd Inlet are designated as critical habitat.

Puget Sound steelhead are also listed as threatened under the ESA (NMFS 2007). 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 (Haring and Konovsky 1999).

Bull trout, listed as federally threatened (USFWS 1999), 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 (USFWS 2005).

Two species of ESA-listed rockfish occur in Puget Sound. The bocaccio rockfish (*Sebastes paucispinis*) is listed as endangered while the yelloweye rockfish (*Sebastes ruberrimus*) is listed as threatened under the ESA. Although larval and juvenile rockfish could occasionally be present in the study area, as they are widely dispersed by surface water currents, adults and juvenile rockfish are not likely to occur in the relatively shallow waters of West Bay, where kelp beds and underwater cliff habitats deeper than 45 feet (both preferred habitat) (USACE 2012) are generally lacking. As the study area does not represent high quality habitat and no rockfish have been observed in Budd Inlet (Hayes et al. 2008), these two species are not considered further in this document.

4.1.3 Fish Habitat Conditions in the Study Area

The study area includes riverine, lacustrine, and estuarine fish habitat features. Each of these habitats, described in greater detail below, provides unique ecological functions that support a variety of freshwater and marine fish.

4.1.3.1 Deschutes River Basin

The study area includes the Deschutes River, which is the largest drainage system within Water Resource Inventory Area (WRIA) 14, the Deschutes River watershed. The Deschutes River drains a total of approximately 166 square miles, representing approximately 84% of the WRIA (Haring and Konovsky 1999). The headwaters of the Deschutes River are located in the Mt. Baker-Snoqualmie National Forest, within Lewis County, and the lower portion of the river flows through the City of Tumwater and the City of Olympia, draining into Capitol Lake and eventually into Budd Inlet.

The Deschutes River basin includes commercial forestry in the upper basin and agriculture and rural residential in the middle of the watershed. Urban land uses in the lower watershed include portions of the cities of Tumwater and Olympia. Riparian cover is limited within much of the study area, reflecting current land uses, with riparian conditions including a combination of high-density urban land use, mixed coniferous and deciduous forest, and maintained grass areas. However, high-quality riparian shorelines are located along the east shore of the Middle Basin, the east and south shore of the South Basin, and the west shore of Percival Cove. The City of Olympia designates these priority habitat areas as "Important Riparian Areas." In addition, the forested hillside of Capitol Lake is the largest contiguous habitat unit within the City of Olympia or the City of Tumwater (TRPC 2008).

Flows in the Deschutes River (measured at the E Street Bridge in Tumwater) range from 1 to 243 cfs, based on data from 1945 through 2019 (Moffatt & Nichol 2021), with a mean of 11.98 cfs and a 50% exceedance flow of 7.53 cfs.

4.1.3.2 Capitol Lake

Historically, the Deschutes Estuary and the area that is now Capitol Lake was a part of Budd Inlet, consisted of intertidal tideflats that typically form at the mouths of estuaries. The study area has been substantially altered in the last 100 years, including construction of BNSF railroad tracks across the mouth of the Deschutes River in 1929, separating what is now the North Basin and Middle Basin and a railway installed at the mouth of Percival Creek, creating Percival Cove (TRPC 2008). Around 1942, the 5th Avenue Bridge was constructed using earthen fill and the 5th Avenue Dam and tide gates were installed in 1951, blocking tidal flow and creating the freshwater habitat of Capitol Lake and a reflecting pool for the state capitol building. Additional fill in the lake was introduced in 1956, when the I-5 bridge was constructed, which separated the Middle Basin and South Basin of the lake. More in-water fill was placed in the North Basin to construct Deschutes Parkway and Marathon Park in the 1970s, and additional armoring was installed in 1999 for the construction of Heritage Park (Herrera 2005). Overall, the North Basin of Capitol Lake's shoreline is highly modified, including an armored bulkhead along Heritage Park on the east side and riprap supporting Deschutes Parkway on the west side, which extends along the western shoreline of the Middle Basin. In contrast, the shorelines in the Middle and South Basins are more natural, including wetlands and riparian vegetation at the basin margins.

The existing habitat in Capitol Lake consists of a shallow lake environment with low to moderate densities of aquatic macrophytes, including invasive species, covering the lake environment. The restriction of water flow created several environmental issues in Capitol Lake. Water exchange in the Capitol Lake Basin (currently exchanging every 14 days) is limited compared to historical estuary conditions, with water exchange rates varying from 0.2 day (high winter flows) to as slow as 9 days (summer low flows) (Roberts et al. 2012).

There are now three basins in Capitol Lake (the North Basin, Middle Basin, and South Basin), with the Deschutes River flowing north through all three basins to West Bay (Figure 1.1). Capitol Lake is 1.6 miles long, with 5.3 miles of shoreline. The mean lake depth is 9 feet, with a maximum depth of 20 feet and a lake volume of approximately 2,400 acre-feet. Historically, the Deschutes River discharged directly into Budd Inlet.

Drainage from Percival Creek and Percival Cove flows into the Middle Basin under the Deschutes Parkway. The size of each basin (North, Middle, and South) and Percival Cove is 96 acres, 120 acres, 30 acres, and 16 acres, respectively, and the total area of Capitol Lake Basin is about 260 acres. Normal summer lake level is 8.65 feet (NAVD88), while winter lake levels are approximately 1.0 foot higher at 9.61 feet (NAVD88) (Moffatt & Nichol 2020).

The construction of the 5th Avenue Dam has resulted in sediment deposition in Capitol Lake from upstream in the Deschutes River and Percival Creek, filling the lake and slowly and promoting the development of freshwater wetland habitat, especially along the margins of the basins. The largest deposition thickness of over 13 feet occurred in the South Basin due to channel migration, while most of the Middle Basin had deposits of approximately 7 feet of sediment, with some areas showing nearly 10 feet of deposition (Moffatt & Nichol 2021). In the North Basin, the original channel was filled with 3 to 6 feet of sediment, while most of the North Basin had a deposition amount between 1.5 and 3 feet. The total annual sedimentation volume dropped 32% from 21,647 cubic yards (CY) to 13,994 CY based on the 1949-2013 and 2013-2020 data (Moffatt & Nichol 2021).

A streambank erosion survey was conducted during 1982 and 1983 and determined that the majority of eroding material from the upstream consisted of fine sands, silts, and clays that were transported along the river and deposited in Capitol Lake (TRPC 2008). This is reflected by moderate to high (11% to 20%) percent fines in spawning gravels in the river mainstem and several tributaries (Schuett-Hames and Flores 1994). Fine sediments within the river were found to originate from a variety of sources, including: erosion of glacial terrace banks; erosion and landslide occurrences due to record flood events; bank erosion in tributaries; increased levels of shoreline armoring that may contribute to localized scour; and other anthropogenic factors associated with shoreline modification and infrastructure that may lead to runoff, landslides, and downstream sediment input (Raines 2007).

Sediment data collected in Capitol Lake indicate that grain size varies from sand to silt, with the eastern and western sides of the North Basin characterized by fine sediment deposits, while coarser sediments are observed near the dam. Coarse sandy sediments are observed in the Middle Basin near the BNSF railroad trestle between the Middle and North Basins. The estimated annual sediment load to Capitol Lake is between 29,000 and 55,000 CY/year (1952–1996), while for Percival Creek the annual sediment load is 1,400 to 6,000 CY/year, resulting in increasing lake bed elevations of approximately 3 feet every 25 years in Capitol Lake (Moffatt & Nichol 2021).

To address sedimentation, two sediment traps were constructed in 1978. The traps were built by removing 200,000 CY of sediment in the South Basin and the Middle Basin north of the I-5 Bridge. However, the South Basin trap did not function well and was abandoned. The only maintenance dredging of the Middle Basin trap since 1978 occurred in 1987, when 57,000 CY of sediment were dredged, with an accumulation rate of 6,300 CY/yr increase in thickness in this trap (Entranco 1990). In 2019, some areas in the lake were dredged during an oil spill cleanup by Washington State Department of Ecology (Ecology), with a dredged sediment thickness in these areas ranging from 6 inches to 4 feet.

Water quality is a fundamental determinant of habitat conditions for fish and affects their survival, distribution, growth, behavior, and susceptibility to disease. Water quality in Capitol Lake has long been studied, and portions of the Deschutes River, Capitol Lake, and Budd Inlet do not meet Washington State criteria and standards (Ecology 2015b). The Capitol Lake Basin is considered eutrophic or highly productive based on total phosphorus and chlorophyll-a concentrations, with

Percival Cove showing the greatest productivity. Capitol Lake is currently 303(d) listed for total phosphorus and fecal coliform bacteria, while the reaches of the Deschutes River upstream of the lake are 303(d) listed for water temperature and DO, in addition to fecal coliform bacteria (Ecology 2020a). However, this assessment is based on freshwater riverine standards, and as described previously in Section 4.1, phosphorus levels have been decreasing in recent years.

Water quality is a problem in the basin and the focus of a Total Maximum Daily Load (TMDL) study that is currently underway by Ecology (Ecology 2015b). This study has found that the 5th Avenue Dam causes the largest negative impact on DO of any activity evaluated due to the dam's combined effects of changing circulation as well as nitrogen and carbon loads. In addition, Ecology (2015b) Capitol Lake water quality would not improve significantly with a reduction of man-made phosphorus sources, unless this action is coupled with dam removal, because natural sources would continue to provide phosphorus from the watershed and lake sediments would continue to fuel plant growth in the lake.

Aquatic life is threatened by high levels of phosphorus, which tends to promote the growth of algae and aquatic weeds (such as the noxious weed, Eurasian watermilfoil) which in turn reduces the DO content of the water (Thurston County 2006). High total phosphorus and nitrate and nitrite concentrations above the regional reference condition were recorded over multiple years (Thurston County 2017). However, \phosphorus levels have been decreasing in recent years. For more detail on water quality in the study area, see the *Water Quality Discipline Report* (Herrera 2021a).

Anadromous salmonids undergo a physiological transition as outmigrating juveniles prepare to move from a freshwater environment to a saltwater environment. In natural estuary settings, the transition from freshwater to saltwater is gradual and occurs over a distance related to the freshwater inflows from the river's watershed and the topographic and bathymetric configuration of the estuary relative to tides. The gradual increase in salinity provides juvenile salmon with a physiological transition zone to gradually acclimate to saltwater (Simenstad et al. 1992, Thorpe 1994). In Capitol Lake, the transition is abbreviated as outmigrating salmon move from the largely freshwater habitats of Capitol Lake to the saltwater of Budd Inlet in a short distance near the 5th Avenue Dam and tide gate. Such an abrupt transition is assumed to provide physiological stress to the outmigrating salmon and potentially reduces their fitness and overall survival in the marine environment (Chittenden et al. 2008).

Riparian conditions in Capitol Lake vary substantially within the three basins. 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 (generally 40 to 50 feet) of riparian vegetation, which consists primarily of shrubs and grass (including landscaped and maintained grasses). Although some trees are present, these are generally ornamental and native deciduous trees, with few to no tall trees (over 100 feet) or coniferous trees. Such conditions provide relatively few riparian functions compared to what occurred here before the lake was created. Conditions on the west bank of the Middle Basin are similar; however, 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 riparian zone, consisting of mature mixed forest, including overhanging vegetation. The South Basin also has somewhat natural riparian conditions, consisting of emergent and scrub-shrub vegetation as well as some patches of deciduous trees.

Salmonids are cold water species who are sensitive to warmer water temperatures. Many of the freshwater fish of Capitol Lake are warmwater species who prefer warmer water temperatures, which can be exacerbated by shallow lake basins and the lack of natural flushing due to the presence of the 5th Avenue Dam. In addition to the invasive and non-native fish populations listed in Table 4.4, Capitol Lake also contains well-documented populations of plants, invertebrates, amphibians, waterfowl, and aquatic mammal species. Aquatic invasive plants found in Capitol Lake and the surrounding waterbodies include purple loosestrife (*Lythrum salicaria*) and Eurasian watermilfoil (*Myriophyllum spicatum*), which are classified as high priority for control (WISC 2020). Eurasian watermilfoil has the greatest potential to negatively affect fish habitat. Eurasian watermilfoil spreads rapidly and commonly forms dense, thick mats. The mats reduce sunlight and oxygen in underlying waters, thus degrading water quality, outcompeting native vegetation, decreasing habitat quality for native fish species, and inhibiting recreational activities. Watermilfoil treatment and control activities have occurred in Capitol Lake since 2004; however, the species continues to spread, reaching all three lake basins and Percival Cove (see the *Aquatic Invasive Species Discipline Report* for details (Herrera 2021b).

Watermilfoil often forms a floating canopy that shades native aquatic plants and reduces their growth (Frodge et al. 1995). Watermilfoil contributes to phosphorus loading in the lake sediments through its release of phosphorus during decomposition. Dense communities can reduce DO to below 5 parts per million (less than the minimum requirements for salmonids) through oxygen consumption during respiration at night (WDFW 2001). In addition, the decomposition of dead plant material increases the biological oxygen demand, further reducing DO and pH. In summary, dense communities of aquatic vegetation, or floating mats of detached plants, can adversely affect localized water quality conditions. Under extreme conditions, these situations can become anoxic.

In addition, excessive accumulation and decomposition of organic material can transform areas of natural sand or gravel substrate to fine silt and mud, with substantial accumulations of organic material from the decomposition of watermilfoil and other aquatic vegetation. The dense vegetation reduces the currents and wave energy in these areas, encouraging the accumulation of fine sediment material.

The presence of Eurasian watermilfoil can also affect the distribution and habitat usage of salmonids. Tabor et al. (2006) found that the presence of Eurasian watermilfoil in Lake Washington appeared to cause juvenile Chinook salmon to be farther offshore in deeper water, where they be more susceptible to bass predation. Most bass congregate near docks and other artificial structures (Celedonia et al. 2008b), but distribution shifts to deeper littoral zones in late summer were theorized to reflect watermilfoil growth under and adjacent to these structures.

In addition to invasive plants, one of the primary invasive organisms of concern is the New Zealand mudsnail, a prohibited invasive species in Washington. This species reproduces both sexually and asexually, has broad environmental tolerances, has no naturel predators in Washington, and can survive outside the aquatic environment for long time periods, allowing large densities to form (see the *Aquatic Invasive Species Discipline Report* for details). The New Zealand mudsnail consumes high amounts of periphyton and can outcompete native fish species for natural resources, resulting in reduced body weight and health of native salmonids (Vinson and Baker 2008, Alonso and Castro-Díez 2012). First observed in Capitol Lake in 2009, the snail has spread to the North Basin, Middle Basin, South Basin, and the Deschutes River. Management approaches have been applied to control the snail, including draining the lake and exposing the snails to freezing and backflushing the lake with saltwater, both methods that achieved partial success. Furthermore, the lake has been closed to recreation as a management measure to prevent the spread of the snail to other waterbodies.

5th Avenue Dam Fish Passage Structure

The 5th Avenue roadway is located atop the 5th Avenue Dam; the section of roadway atop the spillway is referred to as the 5th Avenue Bridge. The spillway includes two flood control discharge channels and a fishway channel with timber baffles that form a fish ladder designed to provide water depth, velocity, and jump conditions that facilitate fish passage between the lake and the marine waters of Budd Inlet.

The fishway meets WDFW fish passage criteria and is considered 100% passable following improvements made in 2002 (WDFW Site ID: 970005). Previously, the tide gate and fishway could potentially delay the upstream migration of adult salmonids during low tides (Haring and Konovsky 1999), affecting the movement of smaller fish (i.e., less than 6 inches long). This occurred when the lower lake levels in winter and the relatively high elevation of the fish ladder limited movement into and out of the lake to times when the tide gate is open and flow conditions were sufficient to allow these relatively weak-swimming fish to move freely.

Currently, the exchange of water when the tide gate is open creates the potential to entrain fish and move them into areas that are not suitable for them (i.e., freshwater fish into Budd Inlet and marine fish into Capitol Lake). No information is available about whether this effect actually occurs and, if so, the number and species of fish that may be impacted by the tide gate openings.

4.1.3.3 Marine Habitat

Budd Inlet is the southernmost arm of Puget Sound and is the only inlet in Thurston County that is fed by a large river, the Deschutes. More sediment is transported by the Deschutes River than by any other river in Thurston County except for the Nisqually River. Budd Inlet is the most heavily developed and most heavily armored of the inlets in Thurston County, with nearly half of the shoreline armored (Coast and Harbor Engineering 2016). West Bay, located within the City of Olympia on the southwest corner of the inlet, is surrounded by development.

Historically, West Bay was a shallow water estuarine tideflat with unrestricted flows from the Deschutes River and numerous small pocket estuaries from Garfield Creek, Schneider Creek, and other small drainages. West Bay was an important ecological connection between Budd Inlet and the adjacent freshwater and upland habitats. The estuary provided a transitional area critical for out-migrating juvenile salmon and returning adults, and the highly productive tideflats of West Bay supported key shellfish species including Olympia oysters, clams, and crabs, and provided habitat for primary production of benthic and epibenthic invertebrates. These filter feeding organisms helped to maintain good water quality in the estuary, and contributed to the diets of fish, birds, and mammals. In addition, tidal flushing occurred frequently, as the intertidal tideflats were exposed during low tides (Coast and Harbor Engineering 2016).

In addition to the ecological effects from estuary disconnection, the shoreline of West Bay has also been directly exposed to numerous ecological impacts from human development, including disconnection of upland habitats from the marine waters, conversion of shallow tideflats into both deeper waters and uplands, reduced sediment supply and large wood inputs from bluffs and rivers and streams, reduced water quality and contamination, and shoreline degradation from fill and armor placement (Coast and Harbor Engineering 2016).

The vast majority of the east shoreline of West Bay is now armored, with industrial, commercial, and residential development in the uplands. The west shoreline has also been impacted, although some segments of semi-natural shoreline still persist. West Bay does not have mapped eelgrass presence or mapped sand lance (*Ammodytes hexapterus*) or Pacific herring (*Clupea pallasii*) spawning, although there are some patchy fringes of both dune grass and approximately 9 acres of patchy fringe salt marsh in the southwest corner of the bay (Ecology 2020b). In addition, the west shoreline has approximately 0.7 mile of mapped surf smelt (*Hypomesus pretiosus*) spawning, centered near West Bay Park (WDFW 2020c); however, forage fish spawning opportunity is generally limited in West Bay.

Dredge and fill activities in West Bay and the construction of Capitol Lake have significantly reduced tideflat habitat in West Bay over the last 150 years. The reduction in the amount of tideflat habitat has 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. Dredging has also changed a large intertidal tideflat into deeper subtidal marine habitat, thus increasing water volumes and reducing tidal flushing.

West Bay is on the 303(d) list for DO and bacteria in the water column, as well as exceedances of 2,3,7,8-TCDD (Dioxin), polychlorinated biphenyls (PCBs), and multiple types of polycyclic aromatic hydrocarbons (PAHs) that were detected in sediment bioassays with fish tissue (Ecology 2020a).

Marine Salmonid Habitat

Estuaries are critical habitat features for both juvenile and adult Chinook salmon, providing feeding opportunities as well as transition from freshwater to saltwater and back. In the marine environment, Chinook salmon require habitats ranging from shallow intertidal tideflat, beach, and marsh used for foraging, migration, and refuge by juveniles to deepwater marine areas used by resident and returning adults (Fresh et al. 2011). Removing the connection between freshwater features and West Bay has degraded the quality and availability of habitat for fish and aquatic species. Impeding the hydrologic connections of the Deschutes River and other streams cut off sediment sources. Sediment inputs are a critical component to healthy beaches and provide suitable substrate for forage fish spawning and invertebrate production, which are important prey resources for Chinook salmon. Surf smelt and sand lance require gravel and sand substrate, respectively, within the middle and upper intertidal ranges, while Pacific herring require macroalgae as substrate to attach their eggs (Penttila 2007). Pacific herring and sand lance (which currently do not spawn in the study area).

The shallow, nutrient-rich waters of the South Sound are optimal rearing conditions for wild Chinook salmon natal to other rivers, as this habitat is known to support juvenile Chinook salmon from watersheds as far north as the Green River (TCDLE 2004).

4.2 WILDLIFE AND WILDLIFE HABITAT

4.2.1 Wildlife Use in Study Area

The study area contains a diverse mix of terrestrial and aquatic habitats used by numerous wildlife species. Shellfish, shorebirds, and other wading birds are found on the beaches and tideflats of Budd Inlet, while bats forage in the neighboring riparian areas and Capitol Lake. Various birds and mammals use the freshwater and marine habitats of the Deschutes River and South, Middle, and North Basins. The following sections describe wildlife found in the study area (i.e., organized by shellfish, birds, bats, and other mammals). For each wildlife group, one or two indicator species have been selected for the effects analysis, which are highlighted in the discussion. The emphasis is on wildlife that use habitats expected to be affected by the proposed alternatives – deepwater, freshwater wetlands, and estuarine habitat. Upland habitats are not expected to be widely affected by the proposed project; thus, less emphasis was given to wildlife use of this habitat type.

4.2.1.1 Shellfish

Shellfish include crabs, numerous clams, the Olympia oyster (*Ostrea lurida*), mussels, shrimp, abalone, and more. Native shellfish, such as geoduck clams (*Panopea abrupta*), hardshell clams (e.g., native littleneck [*Protothaca staminea*], butter [*Saxidomus giganteus*], and horse [*Tresus nuttallii*]), and Olympia oysters are of high ecological, economic, cultural, and recreational value in Washington. Within the study area, Olympia oysters occur as scattered individuals and small patches throughout the low intertidal and shallow subtidal habitats of Budd Inlet (Curtis, pers. comm.). Restoration efforts to re-establish this native species in the study area are ongoing. Shellfish recorded by WDFW in Budd Inlet also include green shore crab (*Hemigrapsus oregonensis*), humpy shrimp (*Pandalus goniurus*), bay ghost shrimp (*Neotrypaea californiensis*), blue mud shrimp (*Upogebia pugettensis*), heart cockle (*Clinocardium nuttallii*), bent-nose macoma (*Macoma nasuta*), soft-shell clam (*Mya arenaria*), native littleneck clam, butter clam, manila littleneck clam (*Tapes japonica*), gaper clam (*T. capax*), northern gaper clam (*T. nuttallii*), and moon snail (*Polinices lewisii*) (Hayes et al. 2008). Other shellfish present include geoduck, which were monitored most recently by the Squaxin Tribe in 2018, and found during sporadic surveys by WDFW mostly occurring in 1988 and 1990. Due to the impaired water quality from multiple pollution sources and low flushing in Budd Inlet, there are no safe public harvest sites in the majority of Budd Inlet, and WDFW has not conducted general surveys of shellfish.

Indicator shellfish species selected for this project include the **green shore crab** and **native littleneck clam**. Habitat association and use of these species are considered representative of the shellfish species group for the purposes of this analysis. Both species use mud or sandy mud habitats with tidal influence. The green shore crab is a common crab found in the higher intertidal zone of tideflats (Ricketts et al. 1985 as cited in Hayes et al. 2008). In addition, its planktonic larvae and the planktonic larvae of several other crab species can utilize estuaries and nearshore areas as a nursery (D. Lowry, pers. comm., and Telnack and Phipps 2007 as cited in Hayes et al. 2008). The native littleneck clam is found in packed mud or in gravel mixed with sand but seems to prefer clayey gravel (Ricketts et al. 1985 as cited in Hayes et al. 2008). In some areas, it occurs so densely that the valves often touch, such as the level gravel beaches of Hood Canal and Whollochet Bay near Carr Inlet.

4.2.1.2 Birds

Birds in the study area can be described in five groups: shorebirds/wading birds, diving/dabbling ducks, insectivorous birds, raptors, and passerine birds. Numerous species in each group use the study area year-round or seasonally for breeding or wintering. WDFW (2008) compiled available data on birds utilizing Capitol Lake and summarized 52 species associated with aquatic habitats or resources of the lake as either permanent (year-round) or seasonal residents. Table 4.6 is a summary of these species by species groups and habitat or resource association. The table also notes the specific species selected as indicator species for the impacts analysis, and a brief description of each species follows the table. Indicator species were chosen to represent a wide range of habitat use and foraging strategies to reflect both existing conditions and the range of potential impacts on wildlife. A description of each habitat type and conditions in the study area is provided in Section 4.2.3.

Table 4.6 Bird Species and Species Groups Present in the Study Area

Species Group & Species	Habitat Association & Use	Indicator Species
Shorebirds / Wading Birds		
Greater yellowlegs, spotted sandpiper, dunlin, western sandpiper, least sandpiper, killdeer, short-billed and long-billed dowitcher, great blue heron, green 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.	Western sandpiper Great blue heron
Diving / Dabbling Ducks		
Canada goose, northern pintail, American wigeon, mallard, gadwall, lesser scaup, ring-necked duck, bufflehead, common goldeneye, Barrow's goldeneye, black scoter, surf scoter, hooded merganser, common merganser, ruddy duck, American coot	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.	Common goldeneye American wigeon
Insectivorous Birds		
Barn swallow, purple martin, northern rough-winged swallow,	Seasonal (spring and summer); forage on flying insects; Capitol Lake is important source for insect production and emerging prey.	Violet-green swallow

Species Group & Species	Habitat Association & Use	Indicator Species
tree swallow, violet-green swallow, Vaux's swift		
Raptors		
Merlin, peregrine falcon, osprey, 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), birds and fish (bald eagle).	Bald eagle
Passerine Birds		
Warblers, thrushes, tanagers, sparrows, finches, jays, chickadees, wrens, and other perching birds	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).	Yellow warbler

**Protected under the Federal Bald and Golden Eagle Protection Act.*

All bird species listed are protected under the federal Migratory Bird Treaty Act.

As the most abundant shorebird in Washington State, the **western sandpiper** (*Calidris mauri*) can be found along the coast and throughout Puget Sound shoreline habitats, preferring tideflats and sandy beaches. They can be observed during the winter months and during migration to and from their breeding grounds in Alaska. Western sandpipers use their long bills to probe mud and sand substrates to pick insect larvae, crustaceans, mollusks, and other aquatic invertebrates.

Great blue heron (*Ardea herodias*) are wading shorebirds that use the study area year-round for foraging and breeding. They forage in shallow water and along shorelines of fresh, brackish, or saltwater, or in certain types of open terrestrial habitats. Great blue herons consume mostly fish but have a variable diet and also prey on amphibians, invertebrates, reptiles, mammals, and birds. WDFW and local citizens have documented active breeding and rookery locations on forested slopes of both the West Bay and East Bay of Budd Inlet, approximately 4,000 and 6,000 feet from the 5th Avenue Dam, respectively (WDFW 2020e). In 2016, the City of Olympia acquired undeveloped properties on the west side of Budd Inlet between West Bay Drive and Rogers Street (known as the West Bay Woods) that support and surround a long-time rookery for great blue heron.

Common goldeneye (*Bucephala clangula*) are diving ducks that are found in the study area during winter primarily in the marine waters of shallow coastal bays, estuaries, and harbors wherever adequate food exists (Bellrose 1980 as cited in Hayes et al. 2008). They forage mostly under water and in shallow protected waters with sandy, gravel, or rocky substrates searching for crustaceans, mollusks, and fish. In contrast, **American wigeon** (*Anas americana*) in the study area primarily use freshwater wetlands to forage on emergent vegetation. Almost entirely herbivorous during overwintering, this dabbling duck consumes stems and leafy parts of aquatic plants, leafy parts of upland grasses, and clovers (Bellrose 1980 as cited in Hayes et al. 2008).

Violet-green swallow (*Tachycineta thalassina*) use the study area during spring and summer for breeding and post-breeding foraging before migrating south during the winter. They forage almost exclusively on flying insects and are one of six species of aerial foraging birds that make significant use of Capitol Lake as foraging habitat (Hayes et al. 2008). Violet-green swallows nest in tree cavities, cliffs, buildings, old woodpecker holes, and nest boxes.

Bald eagle (*Haliaeetus leucocephalus*), along with the other raptor species in the group, are both permanent and seasonal residents in the study area. For breeding, they use large trees in riparian areas associated with both marine and freshwater shorelines as nest sites and forage in adjacent waters. They are generalized in their prey requirements and consume a variety of food such as live and dead fish, ducks, other water birds, and small mammals (Stinson et al. 2001).

The **yellow warbler** (*Dendroica petechial*) is a small songbird found in the study area during spring and summer. In general, it uses brushy habitats on forest edges to forage for insects (e.g., caterpillars), but chooses deciduous forest or thickets near water for breeding. They glean prey from tree branches and foliage and fly out to catch insects in midair.

4.2.1.3 Bats

Capitol Lake is an important source of emerging volant (i.e., flying) insects that are prey for multiple species of bats (Falxa 2007). Two bat species in particular, little brown bat (*Myotis lucifugus*) and Yuma myotis (*M. yumanensis*), are dependent on aquatic insects produced by the lake, as documented through surveys and telemetry. Both species have been radio-tagged from large breeding colonies located at Woodard Bay in Henderson Inlet and at the Evergreen State College (Falxa 2007). An estimated 3,000 bats occupy the Woodard Bay colony, located approximately 7 miles from Capitol Lake, but the proportion of the colony that forages at the Capitol Lake is not known. Other species documented in the study area include big brown bats (*Eptesicus fuscus*), silver-haired bats (*Lasionycteris noctivagans*), Townsend's big-eared bat (*Corynorhinus townsendii*), hoary bat (*Lasiurus cinereus*), and California myotis (*Myotis californicus*) (Hayes et al. 2008).

These bats use Capitol Lake to forage and do not appear to use other smaller lakes and ponds more proximate to their colonies. Thus, Capitol Lake appears to be an important feeding area for these bats. The amount of time the bats spend foraging over Capitol Lake appears to indicate that insect prey is not available at high densities. Foraging time over the course of an evening is lower for areas that exhibit high insect density (Falxa 2007).

Little brown bat has been selected as the indicator species for the effects analysis. Like other myotis bats, this species emerges at dusk to feed and eats a variety of insect prey. Aquatic insects such as midges, caddisflies, and mayflies are the primary prey, although beetles, moths, and other kinds of flies are also taken (Nagorsen and Brigham 1993). The diet changes seasonally in response to insect abundance, with midges predominant in spring and caddisflies and mayflies most important in summer. The little brown myotis is able to adjust its hunting techniques quickly to take advantage of insect concentrations. Most prey is captured in the air and eaten while flying. After an initial feeding period of 15 to 20 minutes, individuals occupy temporary night roosts that have been located and documented by Falxa (2007) near Capitol Lake. Little brown bats roost in nursery colonies during summer in buildings and other man-made structures, tree cavities, rock crevices, caves, and under the bark of trees. The sexes live separately and the males rarely occupy nursery colonies. The little brown bat hibernates in caves and abandoned mines; it does not appear to hibernate in buildings (Nagorsen and Brigham 1993).

4.2.1.4 Other Mammals

Apart from bats (described above), most mammals that use the study area are aquatic or semi-aquatic and primarily visit the area to find prey or forage. WDFW (2008) compiled available information and 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 4.7 summarizes the species and species groups of mammals and is followed by a brief description of the indicator species selected for the effects analysis.

Table 4.7 Mammal Species and Species Groups Present in the Study Area

Species Group & Species	Habitat Association & Use	Indicator Species
Freshwater Aquatic Mammals		
Nutria*, 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, crayfishes, fishes, and amphibians (otter, mink).	Northern river otter
Marine Mammals**		
Orca***, harbor seal, California sea lion	Seasonal and migratory use of marine waters to prey on salmon and other fish species during seasonal runs.	Harbor seal Orca

**Nutria are considered an aquatic invasive species in Washington State and are classified as a Prohibited Level 3 Species (WAC 220-640-050).*
*** All marine mammals are protected under the federal Marine Mammal Protection Act.*
**** Southern Resident Orca are listed as Endangered under the federal Endangered Species Act.*

Northern river otter (*Lontra canadensis*) are medium-sized aquatic carnivores that forage in and along aquatic, estuarine, and marine nearshore habitats. They are opportunistic feeders capable of taking a diversity of aquatic prey, including larger animals (e.g., turtles), but typically prefer fish. They are a generalist species and adapt their forage and behavior patterns to a variety of habitat types and conditions. River otter are known to use Capitol Lake as documented by nuisance trapping efforts and WDFW data (Hayes et al. 2008).

Harbor seals (*Phoca vitulina*) are regionally common residents in South Puget Sound that prey on fish and haul out on land to rest and breed. In the study area, harbor seals are especially evident near the 5th Avenue Bridge/Dam fish ladder during the August–September fall Chinook salmon migration, with up to 15 animals visible at once (K. Keown, pers. comm. and R. Beach, pers. comm., as cited in Hayes et al.

2008). Based on the WDFW Seal and Sea Lion Atlas (WDFW 2000), no haul-out sites exist in the area that Capitol Lake now occupies, but some non-mapped haul-out sites have been documented in Budd Inlet where small aggregations (1–3) of harbor seals have been observed (Hayes et al. 2008). Harbor seals from these various haul-out sites may be some of the same individuals that visit the dam fish ladder. Overall, 30–40 harbor seals are thought to regularly occupy Budd Inlet (S. Jeffries, pers. comm., as cited in Hayes et al. 2008).

Hayes et al. (2008) states that it is unclear whether harbor seals are attracted specifically to the availability of fall-run Chinook salmon, and return to south Puget Sound at other times of the year during runs of coho salmon, chum salmon, and steelhead trout or other marine fish. In general, seal abundance declines after fall-run Chinook salmon stop running. However, seals may revisit the 5th Avenue Bridge/Dam fish ladder simply as a result of foraging nearby. The availability of readily accessible food at the dam fish ladder may play a role in maintaining more harbor seals in lower Budd Inlet than might otherwise be present.

Orca (*Orcinus orca*)**, or killer whales**, are long-lived, highly social marine mammals that are found in the wider Salish Sea during spring, summer and fall. There are two distinct types of killer whales commonly found in Puget Sound: the southern resident (fish eating) and the transient (marine mammal eating) whales. The southern residents are found coastally from central Southeast Alaska to central California, and the west coast transients occur from Southeast Alaska to southern California (Wiles 2016). The southern resident population is listed as endangered under the federal ESA and consists of three designated pods – J, K, and L. Whales of the same pod spend most of their time together and contain several females and her descendants. The transients (also called Bigg's whales) display a more fluid social organization and are more mobile than the southern residents, travelling greater distances and having greater home ranges (Wiles 2016). Both types have been observed in study area, but orcas in Budd Inlet are typically transient whales. Chinook salmon are the preferred forage species for orca.

The state of Washington, 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 Task Force led this work, which was completed in 2019 (Southern Resident Orca Task Force 2019).

4.2.2 Listed or Sensitive Wildlife Species and Habitats

The southern resident population of the killer whale is listed as endangered under the federal ESA (NMFS 2005), and critical habitat is currently designated for inland waters of Washington State including the study area. Other listed species are described below.

Giant chain fern (*Woodwardia fimbriata*), a state-listed sensitive plant species typically found in damp coastal forests, is mapped as currently occurring within the east portion of the study area (DNR 2020). Additionally, tall agroseris (*Agoseris elata*), a state-listed sensitive plant species found meadows, open forests, and exposed rocky ridges, is mapped as historically occurring throughout the study area (DNR 2020). Both plant species are perennial forbs native to Washington State.

Little brown bat and Yuma myotis are not listed as threatened, endangered, or candidate species by the state. 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.

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 for its terrestrial habitat and remnant wooded shoreline, which provide nesting and foraging habitat for wildlife (WDFW 2020e).

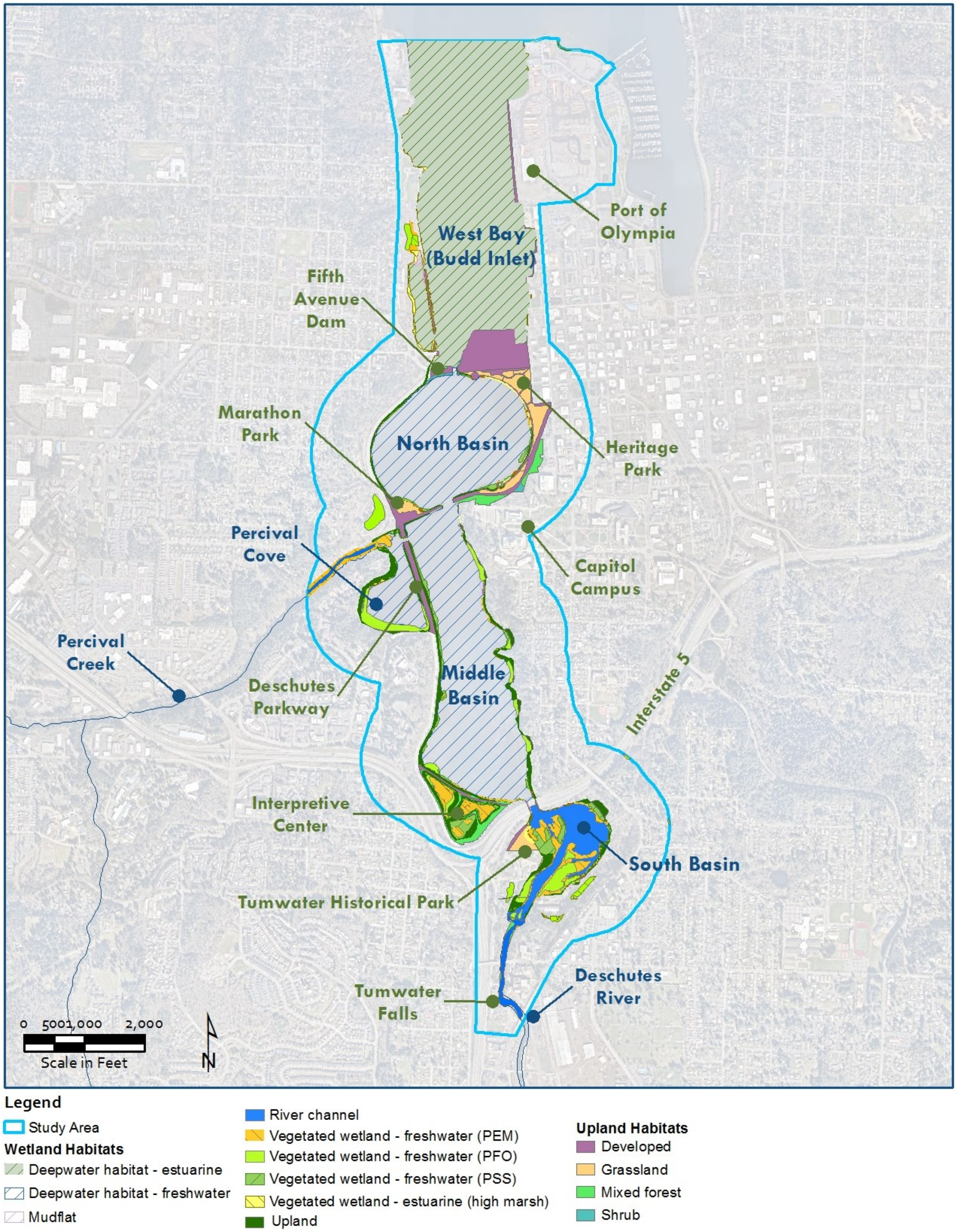
4.2.3 Habitat Conditions in Study Area

To identify and map wildlife habitat in the study area, two data sources and methods were used. For upland habitats such as forest habitat, the Coastal Change Analysis Program (C-CAP) data and method of categorizing vegetation were used to map forest, shrubland, and open space (NOAA 2016). For wildlife habitats that involve wetlands, the wetland types developed for the *Wetlands Discipline Report* (ESA 2021) were incorporated here. However, several wetland classes have been combined to represent two wildlife habitat types for wetlands: freshwater wetlands and estuarine wetlands. These data and various aerial imagery were used along with field reconnaissance to create a map of existing wildlife habitat types in the study area (Figure 4.2). The types, the extent of each type within the study area, and the indicator species (described above) that are associated with each type are summarized in Table 4.8. A brief description of each habitat type and conditions in the study area is provided after the table.

Table 4.8 Wildlife Habitat Types in Study Area

Habitat Types	Estimated Area (acres)	Indicator Species Use
Freshwater wetland	52	Great blue heron, American wigeon, violet-green swallow, bald eagle, yellow warbler, little brown bat, northern river otter
Deepwater habitat - Freshwater	240	American wigeon, violet-green swallow, little brown bat, northern river otter
Mixed forest	126	Great blue heron
Shrub land	7	Yellow warbler
Open space (Developed)	17	Violet-green swallow
West Bay only		
Deepwater habitat - Estuarine	208	Green shore crab, littleneck clam, common goldeneye, bald eagle, northern river otter, harbor sea, orca
Estuarine wetland	4	Green shore crab, native littleneck clam, Western sandpiper, great blue heron, common goldeneye, bald eagle, northern river otter, harbor seal, orca

Figure 4.2 Wildlife Habitats in the Study Area



4.2.3.1 Wetland Habitats

Wetland habitats in the study area include freshwater and estuarine wetland communities, as described in the following sections.

Freshwater Wetlands

Freshwater wetlands provide scattered patches of habitat for dabbling ducks and shorebirds along with aquatic mammals. As described in Section 4.1.2.2, Capitol Lake is relatively shallow with a mean depth of 9 feet. The shallow waters result in eutrophic conditions, leading to reduced water quality (elevated fecal coliform counts, phosphorus levels, and Eurasian watermilfoil development) and thus the quality of the lake for a suite of native organisms. However, this high productivity likely enhances Capitol Lake as a producer of flying insects with aquatic larval stages (Herrera 2005). This insect production appears to be an important foraging base for several species of bats and birds, such as swallows and other insectivorous birds. In particular, the maternal roost of over 3,000 Yuma myotis and little brown bats from Woodard Bay and at least one substantial roost (500+ individuals) from another nearby location may depend on Capitol Lake while rearing young (Falxa 2007, Hayes et al. 2008). Vaux's swifts (*Chaetura vauxi*), also entirely dependent on flying insects, are known to preferentially forage over freshwater aquatic habitats (Bull and Beckwith 1993, as cited in Hayes et al. 2008). At least one other bat species (Townsend's big-eared bat) and several species of swallows are known to forage for insects emerging from or flying over Capitol Lake, but how dependent these species are on flying insect production derived from this aquatic-habitat is unclear (Hayes et al. 2008).

Freshwater wetlands are also present throughout the Middle Basin, Percival Cove, and South Basin including palustrine forested, scrub-shrub, and emergent wetlands (see the *Wetlands Discipline Report* for detailed characterization). In the Middle Basin, the shallow waters and Percival Cove provide waterfowl habitat while scattered patches of wetland along edges support passerine birds and raptors. Constructed wetlands in the south end of the Middle Basin, within Interpretive Center, provide additional deepwater and emergent wetland habitat for wildlife. Percival Cove includes emergent and scrub-shrub wetlands that offer foraging, roosting, and breeding habitats for dabbling ducks, geese, and grebes, as well as wading birds like great blue heron. Wildlife habitat in the South Basin includes wetlands associated with the Deschutes River and patches of scrub-shrub and emergent wetlands near Tumwater Historical Park.

Estuarine Wetlands

The West Bay of Budd Inlet is primarily deepwater estuarine habitat but also supports some tideflats, and estuarine wetland habitats on the west side of the Bay. Despite historical modification of the Deschutes River system, loss of tideflat habitat, and shoreline armoring, as described previously in Section 4.1.2.3, the estuarine waters of the West Bay are productive and support a marine food web critical to multiple species groups and individual species of wildlife. The brackish waters promote high biological activity and food for diving ducks and shorebirds as well as marine mammals. The remaining beaches, tideflats, and nearshore provide patches of habitat for crab, shrimp, clam, and other types of shellfish, including Olympia oyster.

4.2.3.2 Forest Habitats

The study area contains patches of disconnected or contiguous forest habitats including conifer, deciduous, and mixed forest (i.e., conifer and deciduous). Figure 4.2 shows the distribution of forest types in the study area. The forest types are based on the C-CAP data and classification system, which distinguishes forest patches by dominance (greater than 75%) and that have at least 20% of the total vegetation and taller than 16.5 feet in height.

Mixed forests are dominated by all trees, including conifer and deciduous, with neither group providing more than 75% of total cover. Mixed forest is the most common forest type with approximately 126 acres present in the study area. Mixed forest is present adjacent to Percival Cove, the east side of the Middle Basin, and along the east and south riparian shorelines of the South Basin. These habitats provide roosting and nesting trees for bats, great blue heron, and raptors such as bald eagle and osprey (*Pandion haliaetus*). Numerous species of passerine birds use forest habitats on a year-round or seasonal basis for breeding.

4.2.3.3 Shrubland

Shrubland habitat is dominated by low-growing vegetation such as rose, salal, and blackberry, that provide more than 20% of the total vegetation and are less than 20 feet tall. This vegetation type includes shrubs, young trees, and/or landscape trees. This habitat is very limited in the study area. Small patches are present within West Bay Park and the shoreline of Budd Inlet. The western portion of the Capitol Lake shoreline supports a narrow fringe of upland shrub habitat between the shoreline of the lake and Deschutes Parkway SW. This fringe of shrub habitat is also present between Percival Cove and the Middle Basin. These narrow edge habitats likely provide temporary resting or roosting areas for passerine birds using the study area and for waterfowl using the freshwater habitats.

4.2.3.4 Open Space (Developed)

Open space (developed) is dominated by managed and manicured grasses and/or low-lying vegetation, including parks. The largest area of open space is present on the eastern shoreline of Capitol Lake within Heritage Park. This patch of habitat is regularly maintained through mowing and has a high level of human activity, and thus supports limited use by wildlife. Marathon Park at the south end of Capitol Lake also supports some limited grass (maintained) habitats that may provide foraging or resting areas for passerine birds or waterfowl.

4.3 TRIBAL RESOURCES

The Capitol Lake – Deschutes Estuary Project 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 People of the Squaxin, the 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.

In 1854 Joel Palmer, Oregon Territory Superintendent of Indian Affairs, and Isaac I. Stevens, Washington Territory Governor and Superintendent of Indian Affairs, negotiated the Medicine Creek Treaty with Indigenous people in the Southern Puget Sound region (Ecology 2009). Under this treaty, ratified in 1859, lands in the Southern Puget Sound stretching from the Cascades to the Black Hills and south to the Skookumchuck River were ceded to the U.S. Government by the treaty signatories. This area includes the ancestral lands of the Squaxin Island, Nisqually Indian Tribe, and Confederated Tribes of the Chehalis Reservation (Ecology 2009; Marr et al. 1980). This treaty between the U.S. Government and signatories established certain rights, including the following under Article 3:

"The right of taking fish, at all usual and accustomed grounds and stations, is further secured to said Indians in common with all citizens of the Territory, and of erecting temporary houses for the purpose of curing, together with the privilege of hunting, gathering roots and berries, and pasturing their horses on open and unclaimed lands: Provided, however, That they shall not take shellfish from any beds staked or cultivated by citizens, and that they shall alter all stallions not intended for breeding-horses, and shall keep up and confine the latter" (Treaty of Medicine Creek, 1854).

These treaty rights are referred to today as "Usual and Accustomed Areas" or "U&A areas" and have been subject to repeated litigation (Bernholz and Weiner 2008). In 1974 these rights were upheld in a landmark court case decided by Judge Boldt and upheld by the U.S. Supreme Court in 1979 (NWIFC 2020a). The Washington State Attorney General's Office has summarized the adjudicated U&As for off-reservation treaty fishing rights of Western Washington tribes based upon the findings of Judge Boldt and other sources, including court orders pertaining to U&A areas (Washington State Attorney General's Office 2007). No U&A areas are listed for the Confederated Tribes of the Chehalis Reservation, presumably because they are not signatories of the Treaty of Medicine Creek. The Attorney General's document identifies the following U&As for the Squaxin Island Tribe and the Nisqually Indian Tribe.

"Nisqually Indian Tribe

- Saltwaters areas of the mouth of the Nisqually River and surrounding bay
- Nisqually River & tributaries
- McAllister (a/k/a Medicine or Shenahnam) Creek
- Squalticu Creek
- Chambers Creek
- Lakes between Steilacoom and McAllister Creeks
- All saltwater areas of southern Puget Sound from the northernmost tip of the area generally known as Henderson Bay south to the Nisqually River bay area to a line drawn from Johnson Point to Devils Head; from a line drawn east from Point Fosdick on Kitsap Peninsula to Day's Island south of the Nisqually River bay area (to a line drawn from Johnson Point to Devils Head); and all waters between Henderson Bay and the Narrows (to

a line drawn from Point Fosdick to Day's Island) including Carr Inlet and Hale Passage; as well as all the freshwater rivers and streams which drain into that area

Squaxin Island Tribe

- Shallow bays, estuaries, inlets, and open waters of Southern Puget Sound
- Freshwater streams and creeks draining into those waters
- Saltwater north and west of line drawn from Mahnckes Point (Kitsap Peninsula) to the westernmost point of McNeil Island bordering Pitt Passage then extending from Hyde Point on McNeil Island to Gibson Point on Fox Island and then extending from Fox Point on Fox Island to Point Fosdick on the Kitsap peninsula, generally known as the Carr Inlet/Henderson Bay/Hale"

The U&A areas for the Squaxin Island Tribe and Nisqually Indian Tribe as described above by the Attorney General's Office appear to coincide with the project boundaries.

The Nisqually Indian Tribe and Squaxin Island Tribe are members of the Northwest Indian Fisheries Commission, which formed after the Boldt decision and provides natural resources management support to member tribes. Salmon are among some of the most significant resources that contribute to the spiritual and cultural identity of the treaty tribes. The traditional diet of the Southern 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 would have provided abundant resources. For further discussion, see the *Cultural Resources Discipline Report* (ESA and NW Vernacular 2021). The tribes have been actively involved in salmon recovery efforts throughout their U&A areas.

5.0 Impacts and Mitigation Measures

5.1 OVERVIEW

This section describes the probable fish and wildlife impacts from the No Action Alternative and the action alternatives (Managed Lake, Estuary, and Hybrid Alternatives). This section also identifies mitigation measures that could avoid, minimize, or reduce the identified impact below the level of significance.

5.2 NO ACTION ALTERNATIVE

The No Action Alternative would not result in construction impacts on fish and wildlife because the project would not be built. Under the No Action Alternative, the 5th Avenue Dam would remain. Potential impacts would be related to limited ongoing maintenance of the 5th Avenue Dam and ongoing sedimentation of the Capitol Lake – Deschutes Estuary, since no sediment management strategies would be implemented.

5.2.1 Fish

The lack of active lake management to remove sediment and submerged aquatic vegetation could continue to affect habitat quality and habitat use by some fish or other aquatic species. Under existing conditions, sediment accumulation in the Capitol Lake Basin increases the elevation of the lake bed approximately 3 feet every 25 years (Moffat & Nicol 2020). Sediment would continue to accumulate in the North Basin, resulting in a shallower lake, while sedimentation within the habitats in the Middle and South Basins would continue a slow transition from riverine to wetland habitat, reducing the aquatic habitat area. Water depths and velocities in the main river channel would be maintained, or slightly increased compared to existing conditions. Shallow lake areas can increase the water temperature and decrease DO, negatively impacting salmonids. Sediment accumulation can also disconnect the river channel from adjacent wetlands, resulting in a simplified system with little habitat heterogeneity and impacting rearing habitat for species such as coho salmon. The growth of both native aquatic plant species and invasive species would also continue, which would generally have a negative impact on salmon and a mixed effect on freshwater fish, depending on the species. As described in Section 4.1.1.2, Eurasian watermilfoil has the greatest potential to negatively affect fish and fish habitat, particularly for salmon, and would continue to persist in the lake, with its distribution in the lake potentially expanding. The mats reduce sunlight and oxygen in underlying waters, thus degrading water quality, outcompeting native vegetation, and decreasing habitat quality for native fish species. Watermilfoil treatment and control activities have occurred in Capitol Lake since 2004; however, the species continues to spread, reaching all three lake basins and Percival Cove (see the *Aquatic Invasive Species Discipline Report* for details [Herrera 2021b]).

While the habitat changes from continued deposition of sediment in Capitol Lake would impact salmon, warmwater resident fish species (e.g., smallmouth bass) may benefit from such changes as they have higher temperature tolerances and utilize aquatic vegetation (e.g., watermilfoil) for cover during feeding. Many of these species are piscivorous and prey on salmonids, so increases in their populations may increase the predation of juvenile salmonids. In addition, under the No Action Alternative, water and sediment quality conditions in the North Basin would generally be maintained and are not expected to result in impacts on fish species (Herrera 2021a). Maximum current velocities in Capitol Lake are not predicted to change substantially over time, when considering two representative, extreme hydrologic events (flooding events and future sea level rise) (Moffatt & Nichol 2021).

As Capitol Lake fills with sediment over time, and in the absence of maintenance dredging, the capacity of the lake to act as a sediment sink would be reduced, and ultimately eliminated. Sedimentation rates in Budd Inlet would increase over time, producing shallower marine habitat on the east shoreline of West Bay and potentially decreasing habitat suitability for benthic-oriented marine fish while benefitting shoreline-oriented marine fish. The quality of the water entering Budd Inlet would become increasingly similar to that of the Deschutes River as the lake becomes more river-like (higher dissolved inorganic nitrogen, fewer algae, and less variable DO and pH), but these changes would be small in comparison to the existing conditions in the inlet and are not expected to have a meaningful effect on fish.

Under the No Action Alternative, impacts on fish and aquatic habitat would be **less-than-significant** because the changes described above would occur incrementally and would not be expected to cause a species or species group to be extirpated from the study area.

5.2.2 Wildlife

The No Action Alternative would not result in construction impacts on wildlife or vegetation because there would be no construction. Potential impacts would be limited to the ongoing maintenance of the 5^{th} Avenue Dam and continued sedimentation of the Capitol Lake – Deschutes Estuary, since no sediment management strategies would be implemented. However, limited management of nuisance and invasive species would continue.

As sedimentation of the Capitol Lake Basin continues, there would be a corresponding transition from shallow, deepwater areas to emergent wetland dominated by a variety of rushes, sedges, and cattails. Eventually, woody plants (such as Douglas spirea and salmonberry) would gain a footing and the emergent wetland would transition to a scrub-shrub or forested wetland. This transition would take place over a period of decades and would have a corresponding effect on the types of species that could be supported. Significance determinations are made for each species group below.

5.2.2.1 Shellfish

Sediment would continue to fill the basin, and eventually more sediment would be transported through the dam. This would lead to additional deposits of sediment in areas of Budd Inlet, particularly closer to the dam. This increase in sedimentation would have detrimental impacts on benthic invertebrates such as Olympia oyster; green crab; little neck, butter, and horse clams; mussels; and moon snails. The impacts would not be immediate as it would take decades for the sediment to build up in the basin to a point where most of it was transported to Budd Inlet.

Water quality may be adversely affected as emergent and woody plants encroach into the basin as the lake becomes more shallow with a corresponding nutrient and sediment load transferred to the estuary. Fallen leaves and decaying vegetation in the basin would likely increase the biological oxygen demand (BOD) within the lake, and water exiting the basin would have decreased oxygen levels, further affecting benthic invertebrates in Budd Inlet. However, these changes would not affect regional populations of shellfish and thus the impact would be **less-than-significant**.

5.2.2.2 Birds

The following narrative describes the anticipated impacts of the No Action Alternative on species groups of birds and the associated indicator species.

Shorebirds/Wading Birds

The slow transition from deepwater shoreline to vegetated wetlands would eventually eliminate most foraging habitat for those species that use shallow open water for foraging. Great blue herons can forage in areas 3 feet or so deep, and may be able to find small pocket openings in emergent wetlands, but eventually these areas would become scarce as sediment fills the basin and the density of wetland vegetation increases. Spotted sandpipers use the margins of lakes and wetlands and may be able to find small areas for foraging in the margin between vegetated wetlands and the adjacent uplands. The amount of habitat for both of these common species would be substantially decreased from the existing conditions. This is considered **a less-than-significant** adverse impact on this species group.

Diving/Dabbling Ducks

Both of these species groups use deepwater areas – dabbling ducks feed in shallow areas on vegetation and invertebrates, while diving ducks forage in deeper water. As open water decreases with increased sedimentation and rising vegetation density, habitat for these birds would be reduced substantially. The numbers of common goldeneye, a diving duck, and American wigeon, a dabbling duck, would decrease as the lake habitat transitions to a vegetated wetland. This is considered **a less-than-significant** adverse impact on this species group.

Insectivorous Birds

These aerial feeders depend on insects emerging from the lake for prey. As the lake transitions to vegetated wetland, the number of emergent insects would decrease substantially. Violet-green swallows do not solely depend on water-born insect and forage on a variety of other invertebrates such as leaf hoppers, aphids, beetles, and flying ants that can be found higher above the ground. So while the reduction in the amount of emergent insects may have some effect on the prey availability for these birds, they are versatile feeders not overly depending on the lake habitat. There would be a **less-than-significant a**dverse impact on this species group from the transition from a lake to wetland habitat.

Raptors

The impact of the No Action Alternative on raptors is variable, depending on the species under consideration, but effects would be **less-than-significant**. Cooper's and sharp-shinned hawks, for instance, may find more small to medium-sized passerine birds available for prey as the lake transitions to an emergent and scrub-shrub or forested wetland.

The indicator species for this group is the bald eagle, which primarily feeds in open water for fish. The change in habitat from open water to wetland would reduce foraging opportunities for bald eagles, limiting their feeding area to the deepwater portion of the channel. Bald eagles would likely reduce or eliminate their use of this area and shift to nearby freshwater lakes or nearby estuaries.

Passerine Birds

This wide-ranging and variable group of songbirds responds well to increased habitat interspersion and foliage height diversity. As the lake transitions to an emergent and then a scrub-shrub wetland, the corresponding increase in habitat diversity would contribute to an expected increase in the numbers and types of passerine birds that use the area. Yellow warbler, the indicator species for this group, would likely increase in occurrence as the wetlands transition to scrub-scrub and offer additional nesting and foraging areas compared to the deepwater lake habitat.

For these five bird species groups, the changes would not decrease the regional population of these species and thus the impact would be **less-than-significant**. The resulting habitat transition would provide a **moderate beneficial effect** for passerine birds.

5.2.2.3 Bats

Yuma and little brown myotis bats from the Woodard Bay colony regularly use the lake for foraging. These bats fly a relatively long distance to Capitol Lake, bypassing other smaller surface waters. The transition of the lake to a vegetated wetland would substantially reduce the ability of the area to support bats. The Woodard Bay colony occupies an abandoned railroad trestle and supports about 3,000 Yuma and little brown bats.

The lake appears to be a vital food source for this bat colony. Because the bats fly for such a long distance (7.5 miles) to the lake and bypass other surface waters, the lake appears to the primary foraging area for the colony (Towanda and Falxa 2007). Because of the size of the bat colony and its regional importance, and the dependence of the colony on Capitol Lake for foraging, the loss of foraging habitat from the transition to wetland is considered a **significant impact** on this species group.

To place this impact in context, however, it should be noted that the bat colony is dependent on two man-made structures – the abandoned trestle and the artificial freshwater lake that is Capitol Lake. In its natural state, the basin was an extension of Budd Inlet and thus did not support foraging bats.

5.2.2.4 Other Water-Dependent Mammals

Fish-eating species, such as the river otter, would likely decline within the basin as deepwater areas transition to wetland and reduce the fish carrying capacity of the lake as it fills with sediment. Other species, such as muskrat, may increase in density and occurrence as emergent wetland slowly encroaches into the lake. Raccoons are a versatile and common species likely to be unaffected by the habitat transition. As the lake transitions to a wetland habitat, river otters may be more limited in their occurrence to upstream areas of Percival Creek where foraging opportunities are better than the vegetated wetlands.

Marine mammals would likely experience negligible adverse impacts from the transition of the lake to wetland and the lack of sediment management activities. Resident orcas are highly dependent on salmon, and the decrease in fish habitat and the expected decrease in DO from increased BOD would have a negligible effect on orca forage opportunities as the contribution of the basin to Chinook salmon population is minimal and orcas do not typically frequent Budd Inlet. Orcas that do occasionally visit Budd Inlet are more likely to be transient orca and not the Endangered Southern Resident whales. Likewise, these effects would be similar for harbor seals that feed in Budd Inlet. These impacts would be **less-than-significant**.

5.2.3 Summary of Impacts – No Action Alternative

Under the No Action Alternative, impacts on fish and wildlife would range from **less-than-significant** to **significant**. In general, impacts on fish and aquatic habitat would be **less-than-significant**. For wildlife species, the alterations in habitat under the No Action Alternative would generally represent impacts that are **less-than-significant** for most species groups and indicator species, including shellfish, birds, and water-dependent mammals. For bats in the area, however, the long-term loss of foraging habitat from the transition of open water to wetland is considered a **significant impact** on this species group.

Under the No Action Alternative, continuation of current, limited management practices would not benefit species of importance to the Squaxin Island Tribe, Nisqually Indian Tribe, and Confederated Tribes of the Chehalis Reservation, specifically salmon and shellfish. The impacts on salmon related to habitat changes from continued deposition of sediment in Capitol Lake would likely not measurably affect fish available for harvest.

5.3 IMPACTS COMMON TO ALL ACTION ALTERNATIVES

5.3.1 Fish

5.3.1.1 Impacts on Fish from Construction (Common to all Action Alternatives)

All action alternatives – Managed Lake, Estuary, and Hybrid – have construction impacts associated with the following:

- Initial dredging in the North Basin; or North and Middle Basins
- Construction of habitat areas in the Middle Basin; or North and Middle Basins
- Construction of recreational amenities (boardwalks, dock, boat launch, and 5th Avenue Pedestrian Bridge)

The freshwater in-water work window would extend from June 1 to August 15 and November 15 to February 15 each year, based on project-specific initial coordination with the regulatory agencies. This is similar to the prescriptive in-water work window of the adjacent marine water, which extends from July 15 through February 15 each year. Construction would occur over a 4- to 8--year period. The project would obtain all necessary federal, state, and local environmental permits and approvals for all action alternatives.

The range of potential impacts associated with the main construction elements is described below.

Initial Dredging and Creation of Habitat Areas

All of the action alternatives include dredging, either in the North Basin or in the North and Middle Basins (Table 5.1), as well as the placement of dredged sediments in the Middle Basin into temporary constructed containment cells to create habitat areas. These actions can affect fish from the entrainment of organisms during dredging and increases in turbidity from dredging and spoil placement.

Table 5.1 Comparison of Construction Impacts from Dredging

Initial Dredging Parameter	No Action Alternative	Managed Lake Alternative	Estuary Alternative	Hybrid Alternative
Initial Dredging	No	Yes	Yes	Yes
Dredging Location	n/a	North Basin	North and Middle Basins	North and Middle Basins
Dredging Volume (CY)	n/a	350,000[a]	525,000[b]	500,000[c]
Months of Dredging (approximate)	n/a	12	15	15
In-water Work Seasons Required for Dredging	n/a	2	3	3

Initial Dredging Parameter	No Action Alternative	Managed Lake Alternative	Estuary Alternative	Hybrid Alternative
Habitat Island Formation from Dredge Spoils	No	Yes	Yes	Yes
Sheet Piling for Dredged Material Containment Cells (LF)	n/a	32,000	34,000	24,000

[a] All dredged material would be reused on-site for habitat island creation.
[b] 513,000 CY would be reused on-site for habitat island creation and shoreline enhancement, while 13,000 CY would require export.
[c] All dredged materials would be reused on-site for habitat island creation and shoreline enhancement.

Entrainment and Direct Mortality

Dredging activities would generate short-term and localized increases in suspended sediments and increase in-water turbidity levels. Dredging can injure or kill fish captured or entrained in the sediment and associated water removed during the activity (Reine and Clarke 1998), as well as result in mortality to fish eggs and larvae in the benthic environment (Wegner et al. 2017). Dredging in the North and Middle Basins and dredge placement to establish habitat areas in the Middle Basin both present a risk of entrainment and injury or mortality under all action alternatives.

The magnitude and extent of these potential effects of entrainment on fish in Capitol Lake would depend on the type of dredge equipment and areal extent of dredging. For all action alternatives, dredging would be completed by a small hydraulic high-volume dredge, but could be supplemented by a mechanical dredge depending on sediment characteristics. Hydraulic dredging tends to entrain more organisms, including fish, than does mechanical dredging, as the former creates stronger suction fields than mechanical dredging (which fish are generally able to avoid, with a potential exception of bottom-fish).

The extent of dredging is similar for the Estuary and Hybrid Alternatives (see Table 5.1); however, both alternatives have substantially more dredging (60 and 43% more dredge volume, respectively) than under the Managed Lake Alternative, primarily because dredging under the Managed Lake Alternative would occur only in the North Basin, while under the other two action alternatives additional dredging would also occur in the Middle Basin. The Estuary and Hybrid Alternatives would also both involve approximately 3 months more of dredging that would the Managed Lake Alternative, at 15 months versus 12 months, a 25% increase in dredge duration.

Since substantially more dredging would occur under the Estuary and Hybrid Alternatives than the Managed Lake Alternative, the potential for detrimental impacts on fish would be greater in those alternatives. However, under all action alternatives, dredging impacts would be somewhat localized at any given time, and adherence to state and federal timing restrictions on in-water work will ensure that there would be no direct impacts on anadromous salmon, including outmigrating juvenile salmon in the spring and early summer. Smaller anadromous (e.g., stickleback) and resident freshwater fish would have the greatest potential for impact; however, BMPs during dredging will be employed to reduce the potential for entrainment impacts on fish, such as the use of a closed versus open clamshell dredge (if mechanical dredging is used).

In addition, the potential impacts of placing dredged materials to create habitat areas include burying existing plants and animals in the containment cell locations. The implementation of fish exclusion, such as turbidity curtains, and fish removal/relocation would substantially reduce the potential of any such impacts on both anadromous and resident freshwater fish.

Some mortality and injury to fish from initial dredging are expected to occur (individual fish could be harmed or killed and larvae of some species could be entrained). However, the vast majority of fish would avoid the areas of active dredging due to increased turbidity (see below). Although individual fish would be impacted, these impacts are small and would not measurably affect the local populations of either anadromous or freshwater resident fish present in Capitol Lake and are considered **less-than-significant.**

Turbidity and Sedimentation

Dredging and dredged material placement for habitat area establishment would generate short-term and localized increases in suspended sediments and turbidity in the lake at and adjacent to the areas being dredged and adjacent to the containment cells where dredged material would be pumped into the cells to dewater the sediments where spoils would be placed. Excessive suspended sediments resulting in turbidity can have physiological and behavioral effects on fish, including clogging fish gills, avoidance, and impaired foraging (Bash et al. 2001). Dredging activities would be regulated under a water quality permit, which would define required BMPs, set allowable mixing zones, and set monitoring requirements. For dredging activities in the lake basin, the mixing zone for rivers and streams would apply, which is 300 feet (see the *Water Quality Discipline Report*).

The factors affecting the magnitude of turbidity generated are essentially identical to that described above under entrainment, specifically the extent of dredging (both areal and temporal) and the type of dredge equipment used. As with entrainment, the amount of suspended sediments and turbidity for the Estuary and Hybrid Alternatives would be somewhat greater than under the Managed Lake Alternative, indicating a higher potential for impacts from turbidity for those alternatives.

However, dredging impacts would be somewhat localized at any given time, and adherence to state and federal timing restrictions on in-water work will ensure that there would be no direct impacts on juvenile salmonids outmigrating in the spring and early summer. Returning adult anadromous salmonids have higher tolerances to turbidity (Newcombe and Flagg 1983) and should generally avoid active dredging areas. BMPs during dredging will be employed to reduce sediment suspension and turbidity and reduce the potential for adverse impacts on fish, such as the use of a closed versus open clamshell dredge (if mechanical dredging is used).

Turbidity generated from dredged material placed in the containment cells and would be minimized by allowing the sediments sufficient time to dewater before more material is placed in the cell. In addition, silt curtains would be deployed to help control turbidity outside of the fill site. Water quality in the cells will be monitored, and if turbidity levels are high, additional treatment methods would be applied before the water is allowed to re-enter the lake. This could include pumping water from the cells to an on-land treatment system (such as a Baker tank located outside of sensitive areas) that would treat the water.

For all action alternatives, the magnitude and extent of turbidity are expected to be minor, short-term, and localized based on the use of the BMPs described above. Although some behavioral impacts on fish would likely occur, such as avoidance and temporary behavioral changes, no substantial mortality is expected to result. Deposition of sediment on the lake bed from construction-generated suspended sediment would not be substantial and would be comparable to the natural deposition from sediment transported from the Deschutes River. For all action alternatives, impacts from dredging-associated turbidity and sedimentation on anadromous fish (including salmon) as well as resident freshwater fish would be **less-than-significant**.

Water Quality

In addition to increased temporary and localized turbidity, water quality effects from dredging and dredged material placement could include decreased DO (due to increased BOD from suspended and dissolved organic matter), and reintroduction of previously buried nutrients to the waterbody (Herrera 2021a). In the most severe cases, this process can cause anoxia (low oxygen levels) and result in harm or mortality to fish. However, based on the chemistry of the benthic material on the bottom of the lake, and the use of hydraulic dredging versus mechanical dredging as the primary dredging method, such DO reductions are extremely unlikely. If they did occur, any such reductions would be localized and short term, with minimal impacts (US Navy 1990; Herrera 2021a). Even if some amount of mechanical dredging does occur, widespread anoxic conditions would not occur due to the limited duration and extent of dredging. In addition, although contaminated sediments can also be remobilized by dredging, the sediments in Capitol Lake are relatively clean and no substantial remobilization of such materials is anticipated.

Curing concrete can contribute to high pH (alkaline) conditions in the water column if the concrete source has been recently cast and not allowed adequate curing times. Where the pH effects are of a large magnitude, the pH of the water column can rise to the point where deleterious effects to fish and wildlife could occur. However, no such effects are anticipated, considering the minimal number of concrete piles (20) associated with the project and delaying installation of pre-cast concrete piles until the concrete has completely cured.

Any additional water quality effects from dredging would not have the potential to result in mortality, and any sub-lethal harm to fish would be minimal and temporary under all action alternatives. Under all action alternatives, water quality impacts from dredging on anadromous fish (including salmon) as well as resident freshwater fish would be **less-than-significant**.

Noise and Vibration

All action alternatives would create in-water noise and vibration during dredging. The noise generated by dredging would not cause lethal or sub-lethal physiological effects but could have some effects on fish behavior and movement, including avoidance (Wenger et al. 2017).

In addition, all action alternatives include the temporary placement of containment cells to create shallow water habitat areas in the Middle and North Basins. The areas would be created by placing dredged material into containment cells formed by the temporary installation of sheet piling. The sheet pile walls would be installed (and removed) using vibratory methods, with the length of sheet piling varying by alternative. The Managed Lake and Estuary Alternatives have a similar extent of sheet pile installation, while the Hybrid Alternative has about 25% less length of sheet pile.

Vibratory pile driver hammers use an oscillatory motion and heavy weight to force the pile into the substrate. They typically produce substantially lower sound levels than do impact hammers, with a slower rise time (the time for the noise wave form to rise from 10 to 90% of its highest peak) and lower sound frequencies. As a result, the pile-driving sound levels from the vibratory hammer are less intense and spread over a longer time period, thereby minimizing the potential to harm aquatic organisms (Teachout 2007). Vibratory installation of steel piles in a river in California resulted in sound pressure levels that were not measurable above the background noise created by the current (Reyff 2006). Carlson et al. (2001) studied acoustic data and salmonid response during construction of a new pier on the Oregon Coast, and found that the use of vibratory hammers for pile installation are not likely to have a significant impact on migrating salmon behavior, because infrasound produced by vibratory pile driving is short in duration and because of the relatively short range of the component of the total sound field to which salmon show an avoidance response. No mortality of fish or substantial behavioral impacts are expected to occur from the sheet pile installation.

Under all action alternatives, impacts on anadromous fish (including salmon) as well as resident freshwater fish from noise and vibration associated with both dredging and containment cell installation and removal would be **less-than-significant**.

Summary of Impacts from Initial Dredging and Creation of Habitat Areas

Overall, the potential impacts on fish from initial dredging and dredge spoil placement activities common to all action alternatives, when including associated BMPs, would vary depending on the life history and ecology of the species. Some fish, including resident freshwater fish, would likely be harmed, killed, or show behavioral changes, primarily due to entrainment during dredging. For salmon and other species that occupy the limnetic zone of open water, adverse impacts would be limited because of the fishes' abilities to avoid the construction areas. Impacts would be greater for species associated with lake bottom habitats (see Table 4.4), such as burrowing species, because of to these fishes' vulnerability to entrainment during dredging and burial during dredge material placement. However, any such impacts would be relatively minor, of temporary duration, and would not result in a large degree of mortality, when considering the entire population of any given species in the lake. As no substantial widespread impacts on any anadromous or resident fish species are anticipated, impacts from dredging and dredge disposal activities are expected to be **less-than-significant** under all of the action alternatives.

Construction of New In-water/Overwater Structures

New overwater structures constructed in all action alternatives include boardwalks in the South and Middle Basins, a new 5th Avenue Pedestrian Bridge, a new dock at Capitol Lake Interpretive Center, and a new boat ramp at Marathon Park. The in-water work associated with constructing these structures would include the placement of foundation piles or piling bents and minor grading, which would result in localized and temporary increases in turbidity and in-water noise and vibration during construction. The placement of these structures would involve a combination of pile installation techniques, including approximately 20 concrete piles installed by auguring (screwing) the piles to construct the boardwalks and a new dock at Marathon Park, as well as the installation of approximately seven 24-inch diameter steel piles driven with a combination of vibratory and impact methods to construct the 5th Avenue Pedestrian Bridge.

Turbidity and Sedimentation

Construction of new in-water and overwater structures would generate minor turbidity from substrate disturbance during pile installation and the use of barges. Containment systems would be used during construction to prevent debris from falling into the water. Any impacts on fish from pile installation and boardwalk or bridge deck construction would be both minor and temporary. For all action alternatives, impacts from turbidity and sedimentation associated with the construction of new in-water structures on anadromous fish (including salmon) as well as resident freshwater fish would be **less-than-significant.**

Noise and Vibration

No substantial impacts on fish from in-water noise from pile installation are expected from auguring or vibratory pile driving. However, the use of impact hammers can cause impacts on fish, including injury and mortality. Impact hammers use various mechanical methods to pound the piles into the substrate. These differences result in substantially different underwater sound characteristics and potential impacts on aquatic species. The risk of injury or mortality for aquatic species and fish associated with impact pile driving noise is generally related to the effects of rapid pressure changes, especially on gas-filled spaces in the body. Rapid volume changes of the swim bladder may cause it to tear, causing death or severe injury, reduce hearing sensitivity in some hearing specialist species, or cause temporary stunning and alterations in behavior (Hastings and Popper 2005).

Impact pile driving of 24-inch hollow steel piles would likely produce peak sound levels around 206 decibels (dB), which is the presumed single pile-strike injury threshold for fish (WSDOT 2020). Pile driving would also exceed the fish disturbance threshold for cumulative sound exposure level (SEL) for multiple strikes (150 dB root mean square [RMS]) and/or injury thresholds for fish (smaller than 2 grams [g], (183 dBPeak) or larger than 2 g (187 dBPeak).

The ranges of sound levels from pile driving are predicted to be much higher than the disturbance threshold for fish; however, this prediction assumes open water conditions within direct line of sight of the pile driving activity and no obstructions. When underwater sound waves encounter an obstruction, such as a land mass, they are stopped or reflected. Therefore, the relatively confined setting of the South Basin may effectively contain the sounds generated by pile-driving activities within that basin. Most fish within the North Basin could be disturbed to some degree by the pile-driving activities, and fish within the injury threshold zone could be physically harmed. These potential impacts do not take into account methods or BMPs that would minimize the sound levels or enhance the attenuation rate of the sound levels generated by the pile driving.

The project would employ BMPs developed to reduce underwater noise generated by impact pile driving. These noise attenuating devices include air bubble curtains (confined or unconfined), temporary noise attenuation piles, or air filled fabric barriers. An air bubble curtain is a device used during pile driving that infuses the area surrounding piles with air, thereby generating a bubble screen. The purpose is to reduce peak underwater sound pressure levels (SPLs), thereby reducing potential adverse impacts on aquatic organisms. The use of such devices, properly designed and implemented, has been shown to reduce peak sound levels by a factor of from 2 to 38 dB, with most devices achieving attenuation in the range of 5 to 20 dB (WSDOT 2020). The use of such a BMP, especially in an area with relatively soft sediments, would almost certainly reduce the peak single-strike noise level to below the 206 dB injury level. Combined with the fact only seven piles would be proofed with an impact hammer, this would likely limit the number of impact strikes, limiting the potential for fish injury due to cumulative SEL exposure. The project would likely result in some negative impacts on fish due to changes in behavior; however, these impacts would not result in mortality, but rather a minor and temporary impairment to fish closest to the noise source. With the implementation of BMPs, noise impacts from pile driving on fish would be **less-than-significant** to anadromous fish (including salmon) as well as resident freshwater fish under all of the action alternatives.

Summary of Impacts on Fish from Construction of New In-water/Overwater Structures

Overall, the potential impacts on fish from the construction of new in-water and overwater structures would vary depending upon the life history and ecology of the species. For salmon and other species that occupy the limnetic zone of open water, adverse impacts from turbidity would be limited because of the fishes' abilities to avoid the construction areas, as compared to species associated with lake bottom habitats; conversely, salmon and other fish species with a swim bladder are more susceptible to damage from in-water noise. However, given the limited time, any such impacts are expected to be relatively minor, of temporary duration, and would not result in a large degree of mortality, when considering the entire population of any given species in the lake. As no substantial widespread impacts on any anadromous or resident fish species are anticipated, impacts from construction of new in-water/overwater structures on these species groups are expected to be **less-than-significant** under all of action alternatives.

5.3.1.2 Impacts on Fish from Operation (Common to all Action Alternatives)

The action alternatives have in common several operational activities that would affect fish. These activities include the maintenance dredging to manage accumulated sediment, the presence of the new habitat areas, and the operational impacts on fish of increased overwater and in-water structures associated with the boardwalks and the 5th Avenue Pedestrian Bridge, as well as the associated artificial lighting. The adverse impacts and/or beneficial effects of these activities vary by alternative and are discussed below in Sections 5.4.2.2, 5.5.2.2, and 5.6.2.2.

5.3.2 Wildlife

5.3.2.1 Impacts on Wildlife from Construction (Common to all Action Alternatives)

Initial Dredging and Creation of Habitat Areas

Initial dredging and the related creation of habitat areas would cause temporary disturbance to water-dependent species over a 4- to 8-year period during the in-water work windows. In particular, the use of pile driving for the installation of sheet piles for the habitat areas would be disruptive to wildlife. Dabbling and diving ducks would likely avoid the area during the construction period due to the loud noise and general human-caused disturbances from construction work. The in-water work window includes June through mid-August and mid-November through February each year. Thus, the disturbance would occur during summer and winter. Summer broods and wintering waterfowl would avoid the areas of construction.

Piscivorous birds such as bald eagle and great blue heron would avoid the area during construction. Raptors that currently feed in the upland areas and passerine birds would not be affected by construction. Freshwater mammals, such as river otter, would likely avoid the area during the day when active work is occurring but would still use the site before or after construction commences during the early morning hours or in the evening. The sediment disturbance and associated turbidity would likely temporarily affect the production of aquatic emergent insects and reduce prey availability for bats in parts of the project area with active construction. However, substantial portions of the project area would still be available for foraging. There is some local evidence that hibernating bats may venture out on dry and calm evenings during the winter to feed, but the vast majority of their foraging occurs during the spring, summer, and early fall, concentrated during the summer when they are raising young. In-water construction would occur from June 1 to August 15 and November 15 to February 15, and is expected to cause some disruption to bat feeding. Bat activity is significantly reduced after September; therefore, work within the November 15 to February 15 work window could have less disruption to bat feeding, although most bat activity occur outside of the daytime construction hours, regardless. As a result, impacts are expected to be **less-than-significant.**

There could be minor impacts on marine benthic organisms in West Bay from the increased turbidity and associated sedimentation. These effects would be temporary and received in pulses associated with major dredge/construction times. These impacts would be temporary over the course of the construction period, and these natural systems would recover quickly; thus, the impact would be **less-than significant**.

Construction of New In-water/ Overwater Structures

The new 5th Avenue Pedestrian Bridge would be supported on piles and span from Deschutes Parkway, and tie into the existing Heritage Park pathway adjacent to 5th Avenue. Construction of the bridge would take 4 to 5 months, and in-water-work would occur during the work window. During this time, wildlife that use the north end of the lake or West Bay would likely avoid the area because of noise and increased human activity. In particular, noise from pile driving would disrupt wildlife. Waterfowl are the freshwater species group most likely affected by this construction, but they could move to other parts of the basin for foraging or resting. Once construction is complete, the waterfowl would return to using this area. On the marine side of the bridge, harbor seals may be disturbed by the construction noise and choose to use areas away from such noise.

Construction of the boardwalks and dock is expected to occur over an approximately 4- to 6-month duration and would be staged from land or water. Construction would temporarily disturb wetland and upland habitat during the construction period. This temporary disturbance is negligible and would have minimal corresponding impacts on wildlife. Wildlife that use these lake margins or wetlands in these areas would avoid these sites during construction. Species most likely affected by construction of these elements include great blue heron, dabbling ducks, spotted sandpiper, and some passerine birds. These effects would be **less-than-significant**, limited to the construction period.

Construction Staging Areas

Construction for all action alternatives would be staged around the 5th Avenue Dam, in Marathon Park, and in Tumwater Historic Park, with some staging expected to occur on portable barges or on floats throughout the Capitol Lake Basin and upland within adjoining parks and public spaces.

These elements represent additional disturbance factors to wildlife, particularly waterfowl, that regularly use the lake for foraging and resting. These disturbances are considered **less-that-significant impacts.**

5.3.2.2 Impacts on Wildlife from Operation (Common to all Action Alternatives)

The action alternatives have in common several operational activities that would affect wildlife, including maintenance dredging, the presence of the new habitat areas, and the operational impacts of increased overwater and in-water structures. The adverse impacts and/or beneficial effects of these activities vary by alternative and are described below in Sections 5.4, 5.5, and 5.6.

5.3.3 Tribal Resources

In-water construction-related activities such as dredging, creation of habitat areas, and in-water and overwater construction would cause physical or behavioral responses in fish. These activities could also affect aquatic habitat, which could result in a minor reduction in the number of fish surviving to adulthood and returning to fishing areas, thereby affecting the number of fish available for harvest (in marine waters) by tribes. However, no impacts on tribal fishing from dredging activities are expected as all initial dredging would occur within Capitol Lake, which is currently closed to fishing. As described in Section 5.3.1.1, no substantial widespread impacts on any anadromous or resident fish species are anticipated.

5.4 MANAGED LAKE ALTERNATIVE

5.4.1 Fish

5.4.1.1 Impacts on Fish from Construction

In addition to the construction activities described in *Impacts Common to All Action Alternatives*, Section 5.3.1, the Managed Lake Alternative would include the following:

- 5th Avenue Dam overhaul repairs

An overhaul is necessary for the radial gates and mechanical and electrical components to maintain reliable functionality. Additional ongoing inspection and maintenance of the gates, mechanical, and electrical systems and some repair/patching of the concrete structure would likely be required during the 30-year time horizon evaluated. Specific work includes soil stabilization of the earthen portion of the dam, concrete and reinforcement repair and cathodic protection, electrical and mechanical system upgrades, and radial gate repair and reconstruction.

Most of the work associated with dam repair does not involve in-water work within either Capitol Lake or Budd Inlet. However, construction of a buttressing berm to improve stability of the earthen dam includes placement of up to 25,000 cubic yards (19,114 cubic meters) of aggregate and riprap placed along approximately 0.5 acre (0.2 hectare) of the shoreline on the downstream (West Bay) side of the earthen dam (in-water work) and adjacent to the dam along a portion of shoreline. This work, which would take approximately 4 weeks to complete, would result in some temporary turbidity and sedimentation in West Bay, which could have minor effects on aquatic life. Appropriate BMPs would be implemented for the buttressing and other dam overhaul work, such as the use of containment devices where appropriate, and all in-water work timing restrictions would be strictly adhered to. Based on these requirements, the temporary nature of the repairs, and minimal in-water work required, any impacts on fish and fish habitat for all species groups would be minor and temporary, and therefore **less-than-significant**.

5.4.1.2 Impacts on Fish from Operation

Under the Managed Lake Alternative, the Capitol Lake Basin would remain a freshwater system and remain physically separated from the marine waters of Budd Inlet. General fish distribution patterns in both the lake and within Budd Inlet would be similar to existing conditions, with lake habitat supporting those anadromous and freshwater species that currently are distributed in the lake (see Section 4.1.1). Marine fish distribution would continue to be limited to those areas of the study area downstream of the dam.

Primary operational effects of the Managed Lake Alternative would be related to alterations in aquatic habitat (specifically lake bathymetry and associated water depths), due to both initial and maintenance dredging, as well as the direct effects of the maintenance dredging. In addition, potential impacts from operation could include those from installation of habitat areas and overwater and in-water structures, as well as associated with the operation of long-term lighting, as discussed below.

Aquatic Habitat Alterations

Initial dredging would remove sediment from the North Basin while maintenance dredging would be limited to a single event in the North Basin, approximately 20 years after construction of the alternative. Because of initial dredging to a depth of -3 feet (NAVD 88), much of the North Basin would become deeper although the total wetted area in the North Basin would remain unchanged. Dredging would result in substantially more deep freshwater habitat, defined as water depths greater than 8.2 feet. The amount of deepwater habitat would increase from approximately 54 to 86 acres under the Managed Lake Alternative, as compared to existing conditions, an increase of approximately 60%.

In the Middle Basin, the placement of dredged material to form habitat areas would reduce the wetted area by approximately 30 acres. The dredged material would affect habitat at intermediate water depths (2 to 6.6 feet) with very little change in shallow (<2 feet water depth) and deeper (> 6.6 feet water depths). The South Basin would initially remain unchanged from existing conditions, both in total wetted area and water depths. In the long term, both the Middle and South Basins would have continued deposition of sediment and the margins of the basin would gradually transition to wetlands.

In addition, the dredging would result in the removal of a substantial amount of invasive aquatic vegetation, including invasive Eurasian watermilfoil. This loss of invasive and native aquatic vegetation and deepening of the channels would have a neutral to slightly beneficial effect on both water temperatures within the study area as well as on some associated water quality parameters, such as DO. Removal of aquatic vegetation during maintenance dredging would also result in minor benefits to salmon species and minor negative impacts on bottom-oriented fish and piscivorous freshwater resident predators (such as bass) that utilize such vegetation to increase feeding success.

The amount of overwater vegetation would gradually increase adjacent to the created habitat areas, providing shade and cover for fish species, including anadromous salmonids (especially juvenile coho salmon), which utilize and benefit from such habitat. Negligible changes would be expected to existing upland vegetation along the perimeter of the lake. In the long term, the channel margins in most of the Middle and South Basins would transition to wetland habitat with sporadic shallow water openings, creating a more riverine-like system in these basins than currently exists, while the thalweg of the Deschutes River would function more as a true riverine system, likely reducing the use of these areas by fish that prefer slower water, lacustrine habitat.

Overall, the alterations in aquatic habitat in the lake associated with changes in both the amount and depth of in-water habitat would result in **minor beneficial effects** for both the anadromous and freshwater species groups, although some minor reductions in the numbers of bottom-dwelling resident fish in the Middle and South Basins may occur. A proportion of coho and Chinook salmon may experience a slight benefit from the removal of aquatic vegetation in the North Basin and the development of complex edge habitat in conjunction with a more riverine-like main channel in the Middle and South Basins.

Habitat Areas

Under the Managed Lake Alternative, dredge material from initial dredging would be used to create habitat areas in the Middle Basin. The areas would be constructed to resemble natural floodplain islands, with irregular shapes and would be orientated and placed in locations that avoid erosion hotspots. The habitat areas would provide high-quality migration and rearing habitat for juvenile salmonids, due to the gradual 10:1 slopes of the constructed habitat and the presence of natural vegetative communities that would become established on the nutrient-rich lake bed sediments that comprise the habitat areas. These features would offer salmon heterogeneous, complex fresh-water habitat that could provide both cover from predators and a source of food (insect drift). Overall changes in habitat zone area throughout the study area are discussed above under *Aquatic Habitat Alterations.*

Overwater and In-water Structures

The Managed Lake Alternative, includes new permanent overwater structures (OWS) and in-water structures, in the form of boardwalks and pedestrian bridges, supported by piles, in the Middle and South Basins, and a new 5th Avenue Pedestrian Bridge in the North Basin. All overwater structure would be located in the freshwater environment. The alignments of these structures would add approximately 54,480 SF (at summer lake level) of overwater structure, as compared to existing conditions.

Overwater structures produce shade that can have direct or indirect negative impacts on fish, while the elements that support such structures, such as piles and columns, can also have negative or positive effects on some fish species, related to changes in predation. The placement of additional permanent overwater structures can alter in-water shading intensities and patterns. Shade effectively creates a different habitat type in contrast with the adjacent open water aquatic environments that lack shade, especially in the transition between light and shade, where an edge effect can potentially influence fish behavior and habitat selection.

Shading of the water column (in-water shading) can affect aquatic habitat by reducing the growth of aquatic vegetation in shallower areas. The presence of large structures in freshwater systems, such as the SR 520 floating bridge in Lake Washington, has also been shown to delay the outmigration of juvenile salmonids (Celedonia et al. 2008a). Large overwater structures, such as ferry docks, can also disturb the composition of the marine nearshore aquatic community (vegetation and benthic organisms) by decreasing light availability, and may also negatively affect the migratory behavior of juvenile salmonids, which in turn may influence outmigration timing and survival (Nightingale and Simenstad 2001). In addition, docks and piers provide the ideal shade and overhead cover for ambush predators, with largemouth and smallmouth bass most likely to benefit from increased predation opportunities under shoreline structures (Celedonia et al. 2008b).

Effects of OWS on fish vary depending on numerous factors that influence in-water shade levels including the width of new bridge decks, the height over water of new bridge decks, light diffraction around the structures, light refraction in water, and the spatial alignment of the structures in relation to the path of the sun. The general east and west alignment of the 5th Avenue Pedestrian Bridge would produce less shade than would the boardwalks, which are generally oriented north to south. In both cases, the height of the structures above the water level would likely allow some sunlight under the structures, depending on orientation and seasonal factors.

For the Managed Lake Alternative, bass and other predatory freshwater fish (e.g., northern pikeminnow) may benefit from the increase in overwater structure through increased predation success on juvenile salmonids, which would be negatively affected. However, the potential negative impacts from shading on fish and aquatic species are likely minimal given the relatively small size of the boardwalks and pedestrian bridge, compared to the size of the open water portion of the Capitol Lake Basin. In addition, the created habitat areas would create complex vegetated habitat that can provide cover for juvenile salmonids to avoid predation.

The presence of piles or columns in the water column can also lead to similar changes in predation as described above. However, the project would result in only a relatively small number of generally small-diameter piles installed to support the overwater structures, with approximately 290 small-diameter piles installed for the boardwalk on the west shoreline of the Middle Basin and seven piles for the 5th Avenue Pedestrian Bridge, so any effects on fish migration and predation would be minimal, with **less-than-significant impacts** on all of the species indicator groups.

Artificial Lighting

Artificial lighting would be installed to light the path of the 5th Avenue Pedestrian Bridge under all action alternatives, including the Managed Lake Alternative. Currently, both the 4th Avenue and 5th Avenue vehicular bridges have lighting. Artificial lighting has the potential to affect the distribution and behavior of some fish, including salmonids. The magnitude of such effects would vary with the amount of light reaching the water surface and the expected fish use of the illuminated area. Effects would vary by species, life history stage, foraging strategy, and other physical and environmental factors (Celedonia et al. 2008b; Machesan et al. 2005). Any potentially negative impacts on fish from artificial lighting will be minimized by reducing the intensity of the light reaching the water surface through positioning the lights to illuminate only the walkways or by use of other methods, such as hoods that prevent excess light from reaching the water surface. In addition, the light intensity will be limited to the minimum amount to achieve visibility and address safety concerns. Based on the minimization measures, the artificial light is expected to have **less-than-significant impacts** on all of the species indicator groups.

Buttressing Berm

The Managed Lake Alternative would involve the placement of a buttressing berm to improve stability of the earthen dam. This berm would be created by placement of up to 25,000 cubic yards (19,115 cubic meters) of aggregate and riprap placed along approximately 0.5 acre of the shoreline on the downstream (Budd Inlet) side of the earthen dam (in-water work) and adjacent to the dam along a portion of shoreline. The displacement of current native marine sediments by rock armoring would result in a reduction in the quality of the habitat and a minor reduction in habitat functions supporting the marine species groups. Specifically, the production of benthic macroinvertebrates would be affected where the rock material displaced native sediments, however the affected area includes only a very small portion of Budd Inlet and reducing the invertebrate population in this area would be, at most, limited to individual fish and would not negatively affect fish populations or result in measurable changes to species distributions or densities. Therefore, the buttressing berm would result in **less than significant** impacts to marine fish species.

Maintenance Dredging

Potential impacts on fish associated with dredging for construction are described in Section 5.31 and would also apply to maintenance dredging, which would occur approximately 20 years after project construction. Note that while beyond the analysis timeframe of 30 years, maintenance dredging would occur more frequently after this initial dredge event, as the sediment storage capacity in the Middle and South Basins would be reduced over time. Maintenance dredging for the Managed Lake Alternative would occur in the freshwaters of the North Basin, with the impacts would be limited to freshwater or anadromous species in the freshwater of the North Basin. For salmon and other limnetic fish, maintenance dredging would cause **less-than-significant impacts** under the Managed Lake Alternative. The impacts would be limited to freshwater or anadromous species in the freshwater of the North Basin and very similar to those evaluated in Section 5.31 for initial dredging in the North Basin.

Disposal of dredge spoils associated with the Managed Lake Alternative would occur by using hoppers to transport dredged material from the lake to a transload facility established at a location such as Marathon Park. Dredged material would then be transferred from the barge(s) to highway legal trucks for disposal at an upland facility. As on-site disposal of spoils from maintenance dredging is not included under the Managed Lake Alternative, there would be **no impacts** on fish from dredge disposal activities.

5.4.2 Wildlife

5.4.2.1 Impacts on Wildlife from Construction

Construction activities related to repair of the 5th Avenue Dam would be similar to those described in Section 5.3.2 for the 5th Avenue Pedestrian Bridge; however, no pile driving would be required and there would be less noise. Repairs of the dam would require approximately 100 days of construction over a 1-year period. BMPs would minimize these potential adverse impacts. Species groups most likely affected would be waterfowl that forage or rest on the lake near the dam. During repair activities, wildlife that use the north end of the lake or West Bay would likely avoid the area because of noise and increased human activity. Once construction is complete, the waterfowl would return to using this area. On the marine side of the dam, harbor seals may be disturbed by the construction noise and choose to use areas away from such noise. Because other areas of the lake and West Bay are available for wildlife to forage or rest in during repair activities, impacts on wildlife would be **less-than-significant**.

5.4.2.2 Impacts on Wildlife from Operation

Under the Managed Lake Alternative, the North Basin would remain open water while the Middle and South Basins would progress to a mix of vegetated wetlands and shallow water habitat over time. This transition would take place over a period of decades. The main effects of this alternative are associated with these habitat changes, and the habitat areas established in the Middle and South Basin. See the *Wetlands Discipline Report* (ESA 2021) for a more detailed description. Additionally, maintenance dredging of the North Basin would occur after approximately 20 years. Wetland vegetation would develop in shallower areas as sediment accumulates as the 20-year mark approaches.

Most of the Middle and South Basins would transition to wetland habitat as sediment accumulates, with sporadic shallow water openings (Table 5.2 lists the estimated vegetation changes). The habitat areas would be at elevations that support emergent, scrub-shrub, and forested wetlands. Additionally, ridges or hummocks on the constructed habitat would support upland vegetation, creating a wetland/upland mosaic.

Table 5.2 Estimated Acreage of Habitat Types under the Managed Lake Alternative

Habitat Type	Dominant Vegetation	Estimated Acreage[1]
Deepwater Habitat - Freshwater	Unvegetated or common waterweed, pondweed species, yellow water lily, watershield, duckweed, arrowleaf	107
Vegetated Freshwater Wetland	Willow, western red cedar, red alder, spirea, twinberry, dogwood, slough sedge, soft rush, piggyback plant m	210
Deepwater Habitat – Estuarine[2]	Aquatic vegetation	208
Estuarine Wetland and Tideflat[2]	Tufted hairgrass, meadow barley, Douglas' aster, Baltic rush, seashore saltgrass, Pacific silverweed, sea plantain, pickleweed, fleshy jaumea, Puget Sound gumweed, lakeshore sedge	4

Notes:

1. Areas are estimated based on modeled future conditions and rounded to the nearest acre and do not account for in-water or overwater structures.
2. West Bay only.

The habitat areas replace what is deepwater habitat under existing conditions. After initial construction and plant installation, the habitat areas would take several years to develop. Negligible changes are expected to existing upland vegetation along the perimeter of the lake. The habitat areas would be monitored and managed according to the prescriptions in the Habitat Enhancement Plan (as described in Section 5.7).

The following narrative describes the anticipated impacts of the Managed Lake Alternative on species groups and the associated indicator species.

Shellfish

Maintenance dredging of the North Basin would occur after approximately 20 years, removing excess sediment buildup. **No impacts** on estuarine benthic invertebrates within West Bay would be expected.

Birds

Shorebirds/Wading Birds

Development of habitat areas would offer additional foraging opportunities for great blue heron with the increase in shoreline habitat for wading. Spotted sandpiper also would make use of the margin of these habitat areas for foraging. The additional created habitat would occur around the margin of the constructed habitat areas, and would represent a **minor beneficial effect** on both species.

In the long term, the South and Middle Basins would transition to vegetated wetland habitat as these areas fill in with sediment. It is not possible to predict the exact outcome of this process, but there would likely be an increase in foraging areas for these bird species as the lake fills in, and the water becomes shallow enough for foraging for shorebirds and wading birds. The impacts of maintenance dredging in the North Basin would be comparable to initial dredging impacts described in Section 5.3.2 and would cause minor disturbances to this group. The impacts of maintenance dredging would be temporary and **less-than-significant.**

Diving/Dabbling Ducks

Dabbling ducks would find additional foraging areas along the margin of the habitat areas in the medium term (5 years or so) before the area transitions to wetlands. Some deepwater habitat that was used by diving ducks would be replaced by the habitat areas, but this change would be negligible and the impact would be **less-than-significant**.

Similar to the effect for wading birds, as the South and Middle Basins fill in and become shallow water and wetland habitat, there would likely be more foraging habitat for dabbling ducks. Habitat would likely decrease for diving ducks, especially those that forage on fish, as the basins fill in and support fewer fish. This is considered a **less-than-significant impact** on common waterfowl species as there is no lack of freshwater pond and lake habitat in the region.

Maintenance dredging in the North Basin would cause minor disturbances to waterfowl and represent a **less-than-significant i**mpact.

Insectivorous Birds

Violet-green swallows and other aerial feeders would be negligibly affected by the implementation of the Managed Lake Alternative, comparable to existing conditions. The slow transition from open water in the South and Middle Basins would reduce the production of emergent insects, but the riparian, transitional, and upland areas of the constructed habitat would produce other insects that offer other prey opportunities for insectivorous birds. The impact on this species group would be **less-than-significant**.

Raptors

Bald eagles and osprey would experience a negligible adverse impact from the transition of deepwater habitat to wetland habitat areas. Foraging opportunities for these species would be reduced as the South and Middle Basins transition to vegetated wetland habitat. About 100 acres of open water would remain in the North Basin for foraging for these species. Other raptors, such as Cooper's and sharp-shinned hawks, would have additional hunting opportunities for passerine birds that would use the constructed habitat areas, a **minor beneficial effect.**

Passerine Birds

No change in the upland habitat surround the lake is anticipated under this alternative; thus, there would be **no impact** on passerine birds that occur here. The habitat areas would offer additional foraging and nesting opportunities for a number of passerine birds such as yellow warbler, chickadees, and wrens, a **minor beneficial effect.**

Bats

Feeding habitat for Yuma and little brown bats would be reduced by from the installation of the habitat areas and would decrease slowly as the South and Middle Basins transition from open water to a mix of vegetated wetlands and shallow water habitat. While the constructed habitat areas would likely produce a number of insect species, bats generally prefer the emergent insects supported by the lake sediments and deepwater areas of the basin. Thus, the loss of deepwater habitat is an adverse impact on this species group. About 100 acres of deepwater habitat would persist in the North Basin to support emergent insects for foraging bats. This change would reduce the habitat quantity for this species; however, it is not expected to substantially decrease the regional population, and thus the impact would be **less-than-significant**. Further, these changes would occur gradually over decades, and the slow transition would allow for the bat colony to adapt, possibly finding other feeding locations.

Effects from maintenance dredging of the North Basin would be comparable to initial dredging impacts described in Section 5.3.2 and would cause minor disturbances to this group. These impacts are temporary and **less-than-significant.**

Other Water-Dependent Mammals

The loss of deepwater habitat as the South and Middle Basins transform to shallow water and vegetated wetland habitat would reduce the fish productivity of the basin and reduce the forage base of otters that currently use the lake. The potential impacts on otters would be negligible. Conversely, the habitat areas would afford resting and potentially denning sites for otters.

The Managed Lake Alternative would have **no impact** on orcas or harbor seals that use Budd Inlet.

5.4.3 Summary of Impacts – Managed Lake Alternative

Under the Managed Alternative, impacts on fish and wildlife would range from **less-than-significant** to **minor, beneficial effects**. No significant adverse impacts on fish or wildlife would occur, or on the habitats upon which they depend. Habitat zones would change, including the creation of habitat areas in the Middle Basin, and species would adapt to the altered habit conditions. In addition, the alternative would result in minor adverse impacts associated with new overwater and in-water structures as well as artificial lighting. The transition of deepwater habitat to wetland and upland habitat areas would provide a minor beneficial effect for some species, such as raptors and passerines, with the additional foraging and nesting opportunities provided by the habitat.

Some coho and Chinook salmon may experience a slight benefit from the removal of aquatic vegetation in the North Basin and the development of complex edge habitat in conjunction with a more riverine-like main channel in the Middle and South Basins, although this benefit may be at least partially offset by an increase of overwater structure leading to slightly increased predation on these species. However, maintaining a freshwater lake system would not substantially benefit species of importance to the Squaxin Island Tribe, Nisqually Indian Tribe, and Confederated Tribes of the Chehalis Reservation, specifically salmon and shellfish. Impacts on salmon related to habitat changes from continued deposition of sediment in Capitol Lake would likely not measurably affect fish available for harvest. Maintenance dredging could result in impacts on tribal resources similar to those described in Section 5.3.1.1 by causing physical or behavioral responses, or by affecting aquatic habitat.

5.5 ESTUARY ALTERNATIVE

5.5.1 Fish

5.5.1.1 Impacts on Fish from Construction

In addition to construction activities described in *Impacts Common to All Action Alternatives*, Section 5.3.1, construction impacts on fish and fish habitat would primarily be associated with the following:

- 5th Avenue Dam / Bridge Removal
- Construction of a new 5th Avenue Bridge for vehicles and Deschutes Parkway Realignment
- Slope Stabilization along Deschutes Parkway

Other construction activities that could temporarily affect fish and aquatic habitat, although on a much smaller scale, include replacing stormwater outfalls along Deschutes Parkway SW and the Arc of Statehood, replacing culverts at Capitol Lake Interpretive Center, and coating the concrete at the Arc of Statehood.

5th Avenue Dam Removal and New 5th Avenue Bridge Construction

The Estuary Alternative includes the removal of the 5th Avenue Dam and the subsequent construction of a new bridge at 5th Avenue, activities that would occur sequentially. Dam removal would involve removal of the earthen portion of the dam (approximately 150 feet wide at the base and 92 feet wide at the top), as well as the existing spillway. Spillway elements that would be removed include concrete abutments, pier walls, wingwalls, a bottom slab that is supported by timber piling, and steel sheet piling cutoff walls located below the bottom slab.

The primary potential impacts on fish from dam removal are associated with in-water work, including increased turbidity as well as in-water noise. The potential biological and behavioral effects on fish of these activities are described in Section 5.3. 1. Approximately 64,000 CY of material would be removed over a footprint area of about 145,000 square feet, with a construction duration of approximately 4 to 6 weeks. To maintain water quality and reduce turbidity during removal of the earthen and structural dam components, coffercells with sealed interlocks would be installed around the earthen dam structure to control turbidity during excavation and demolition activities. The coffercells would isolate the in-water work area from fish and limit turbidity in the construction area, and would be used to remove the earthen portion of the dam, prior to being repositioned to remove the concrete spillway. Once the coffercell installation is completed (during the approved regulatory in-water work window and including fish removal), excavation and demolition work can occur within the cells, as turbid water would be isolated from Capitol Lake and Budd Inlet. Because of the use of the coffercells, the application of appropriate BMPs, and adherence to in-water work windows, impacts from turbidity on all fish species groups potentially present in the work area, including both freshwater and marine, would be negligible.

Likewise, although saw-cutting and micro-blasting would be used to remove the spillway structures, the work area would be isolated from the water column by the coffercells and appropriate BMPs and micro-blasting methods would be implemented, to eliminate waste materials entering the lake or bay, and to minimize vibration and overpressure that could harm fish. Demolition of the concrete spillway would use a combination of land- and marine- based equipment, with BMPs implemented for any marine barges or work boats, to minimize or eliminate grounding or propeller wash impacts on fish and fish habitat.

Construction of the coffercells would require the installation of sheet piles using vibratory methods. Land-based pile installation equipment, stationed on the existing dam, would take approximately 8 to 10 weeks to install the coffercells. As described in Section 5.3.1, in-water vibratory pile installation would have minimal impacts on fish.

Once the dam is removed, a new bridge along 5th Avenue would be constructed. The bridge would be supported by foundation piles consisting of concrete columns supported by drilled shafts. Foundation piling for the new vehicular bridge would be installed following the removal of the 5th Avenue Dam earthen fill material, and most of the piling would be installed within the coffercells. Installing drilled shafts does not create in-water noise or sound pressures that have the potential to kill or injure fish and, in addition, this work would be conducted in the isolated coffercells.

Once the columns are installed, the bridge would be constructed using precast concrete girders. Other elements include bridge abutments, the roadway, and installation of utilities. A small amount (compared to existing bridge footprint) of riprap scour protection would be installed to protect the new bridge abutments.

With implementation of avoidance and minimization measures, such as containment of all overwater debris from entering the water column and minimization of the impacts from the use of work barges during bridge construction, removal of the 5th Avenue Bridge and Dam, and construction of the new 5th Avenue Bridge would be expected to result in only temporary and minor direct impacts on fish, and would have **less-than-significant impacts** on all species groups.

Deschutes Parkway Stabilization

Under the Estuary Alternative, a 7,500-foot long buttress would line Deschutes Parkway from Interpretive Center to the opening to Budd Inlet, and is proposed to increase the stability of the embankment. The buttress, constructed with repurposed earthen dam material and dredged sediment, would be covered in fish mix from about 5 feet above the MHHW to the toe of the buttress to provide suitable substrate material for fish. The slope would create intertidal and saltmarsh habitat along Deschutes Parkway, and the upper portions would be planted with appropriate native salt-tolerant vegetation in accordance with a Habitat Enhancement Plan (see Section 5.7, Mitigation). Although placement of the bulkhead material could temporarily increase suspended sediment and turbidity and would disrupt the existing benthos in the stabilization footprint, the limited time-scale of the work, combined with the limited magnitude of this activity, would result in **less-than-significant** impacts on fish and fish habitat for both anadromous and freshwater resident fish species groups.

Other Construction Impacts

At least 18 corrugated metal (steel) pipe (CMP) outfalls are located along Deschutes Parkway. Under the Estuary Alternative, the outboard portions of these outfalls would be replaced with a more suitable material for saltwater exposure, such as High Density Polyethylene (HDPE) or concrete, and a backwater prevention valve installed or completely replaced. Most of the associated construction work would occur in upland areas, and in-water work would be completed at a low lake level to minimize impacts.

Prior to the removal of the 5th Avenue Dam, the concrete Arc of Statehood wall structure would be treated with an epoxy coating to provide protection from saltwater deterioration. The work would be completed at a low lake level in order to access exposed concrete surfaces and, with the application of appropriate BMPs, keep all concrete cleaning and epoxy from entering Capitol Lake.

Culverts at Interpretive Center would be converted to bridges to improve hydraulic circulation at Interpretive Center as the park transitions to saltwater wetlands. Following culvert removal, the area would be actively planted to aid in the transition to saltwater wetlands in accordance with a Habitat Enhancement Plan (see Section 5.7, *Mitigation*).

For all these activities, the limited disturbance area, adherence to in-water work windows, and the use of appropriate BMPs indicate that impacts on fish and fish habitat would be **less-than-significant** for both anadromous and freshwater resident fish species groups.

5.5.1.2 Impacts on Fish from Operation

The primary operational effect of the Estuary Alternative would be related to alterations in aquatic habitat (specifically the entry of saltwater into the basin and alterations in bathymetry), due to both initial and maintenance dredging and the 5th Avenue Dam removal.

Under the Estuary Alternative, the removal of the 5th Avenue Dam would allow saltwater from Budd Inlet to enter the Capitol Lake Basin, transforming fresh deepwater and wetland habitat to estuarine habitat. The primary impacts on fish associated with the operation of the Estuary Alternative are related to the physical and chemical transition of the freshwater lake habitats to saltwater estuary habitat, as well as the availability and types of wetland/aquatic vegetation habitat areas in the Middle Basin. The transition from a lake to an estuary would result in changes in salinity, water temperature, water quality, sediment deposition patterns, aquatic plants, and invasive species distribution. Water quality in Budd Inlet is not expected to worsen compared to existing conditions, and DO in Budd Inlet may improve slightly under the Estuary Alternative. Due to the influence of water from Budd Inlet entering the Capitol Lake Basin, water quality in the basin would change with the transition from a freshwater system to a saltwater estuary. This could include a slight decrease in DO compared to existing freshwater DO conditions, and potential for (marine) algae blooms. Any such changes are not expected to impact fish. Temperatures in the estuary may increase slightly from existing conditions due to the influence of saltwater at high tide cycles, but any such changes would be well within the tolerances for marine species.

The removal of the dam would also improve migration for anadromous fish. Although migration occurs under existing conditions and is not precluded, removal of the dam would restore natural conditions, including a gradual transition from saltwater to freshwater, and vice-versa, which would benefit anadromous salmon.

The habitat areas would provide vegetated wetland habitat with some upland habitat and replace what is deepwater habitat under existing conditions. After initial construction and plant installation, the habitat areas would take several years to develop. Negligible changes are expected to existing upland vegetation along the perimeter of the lake. The habitat areas would be monitored and managed according to the prescriptions in the Habitat Enhancement Plan (as described in Section 5.7). Additionally, potential impacts from alterations in overwater and in-water structures and lighting are discussed below.

Aquatic Habitat Alterations

The removal of the 5th Avenue Dam, and resulting re-establishment of estuarine habitat conditions would affect fish through changes in salinity, and in the type and amount of aquatic habitat available. After the dam is removed, salinity in the Capitol Lake Basin at medium (average) flow conditions is expected to be in the following ranges for each lake basin under the Estuary Alternative, with salinity farther upstream of the new 5th Avenue Bridge alignment:

- North Basin – 24 to 18 parts per thousand (ppt)
- Middle Basin – 18 to 5 ppt
- Percival Cove – 14 ppt
- South Basin – 5 to near 0 ppt (at base of Tumwater Falls)

The numbers would also vary based on tidal and flow conditions, with greater salinities at high tides and low streamflows and higher salinities at low tide and high streamflow. These salinities are well within the range of a study of Puget Sound reference estuaries by the U.S. Geological Survey (USGS), which found reference salinity values ranging from 1 to 28 ppt (George et al. 2006). Estuarine conditions are usually considered to occur at 0.5 ppt and 29 ppt, and salinity in southern Puget Sound can reach as high as 32 ppt.

The re-establishment of estuarine conditions and resultant salinity changes in the Capitol Lake Basin would have immediate effects on freshwater fish present under existing conditions. For juvenile salmon originating in the Deschutes River or Percival Creek, as well as adult salmon returning to those systems, the Estuary Alternative would provide a natural freshwater to saltwater salinity gradient that is physiologically favorable (Groot and Margolis 1991).

In addition to altered salinity levels, changes in the type of habitat within the current lake basin would also occur under the Estuary Alternative. For salmon, other anadromous species, and marine fishes, the removal of the 5th Avenue Dam and estuarine conditions would provide access to a suitable marine and estuarine habitat of approximately 275 acres (at MHHW), where none currently exists, including sub-tidal, intertidal tideflat, low marsh, and high marsh habitats. At high tides, the extent of deeper water habitats (>8.2 feet deep) would increase by approximately 44 acres as compared to existing depths in the Capitol Lake Basin, with almost all of the increases occurring in the North and Middle Basins. The estuarine habitat that is fully exposed to tidal exchange would provide productive habitat for salmon, other anadromous species, and marine fishes in the area. The North Basin's extensive shallow water habitats with saltmarsh vegetation along the water's edge would provide preferred rearing habitat for juvenile salmon (Fresh 2006) and productive epibenthic and terrestrial origin prey for juvenile salmon. Habitat quality would improve over time as macroinvertebrate populations and saltwater-tolerant aquatic vegetation become established in the intertidal tideflat and marsh habitat areas. Estuaries provide key habitat for Chinook salmon (Garono et al. 2006; Mitsch and Gosselink 2015). Estuaries support key ecological processes such as freshwater input, sediment transport, erosion and accretion of sediments, tidal flow, tidal channel formation and maintenance, distributary channel migration, movement of aquatic organisms, and detritus import and export (Schlenger et al. 2011). Estuarine habitat in the South Sound has experienced severe reductions in both the quantity and quality of such key habitats for fish (Simenstad et al. 2011).

The portion of the study area in Budd Inlet would also experience changes in habitat, with increased deposition of Deschutes River sediments and a return to sediment transport and deposition patterns that occurred prior to dam installation. This could result in some slight benefits to marine species and anadromous salmon, as nutrient-rich sediments may support higher concentrations or more diversity of marine benthic macroinvertebrates, potentially providing increased feeding opportunities for these species groups.

For salmon, other anadromous species, and marine fishes, the estuary conditions in the Estuary Alternative would result in **substantial beneficial effects**, including to ESA-listed Chinook salmon and other salmon species spawned in other river basins that may use the estuary for feeding. Conversely, the brackish water in the North and Middle Basins, and to a lesser degree in the South Basin, that would result from the Estuary Alternative would not be suitable for freshwater fish species, resulting in mortality to these species and constituting a **significant impact** on the native species within group, although in some cases (e.g., bass, carp, and bullhead) the affected species are non-native species that prey on native species, such as salmonids. For those species, conversion of the lake to estuarine habitat would be **less-than-significant**.

Maintenance Dredging

The Estuary Alternatives assumes semi-frequent maintenance dredging (every 6 years following project construction) in the marine environment and a greater volume of material removal over time, compared to the Managed Lake Alternative. The location of the maintenance dredging for the Estuary Alternative would occur on the east side of West Bay, in affected areas within the Port and Turning Basin, the Olympia Yacht Club, and private marinas. For the Estuary and Hybrid Alternatives, maintenance dredging would affect marine or anadromous fish species but not resident freshwater species, as no such species would be present in the marine waters of West Bay. For species associated with bottom habitats, including burrowing species, a greater magnitude of lethal and sub-lethal impacts is anticipated, due to the fishes' vulnerability to entrainment during maintenance dredging. However, no significant adverse impacts are anticipated from dredging, based on the significance criteria and the limited scope, scale, and timing of the maintenance dredging.

The Estuary Alternative would re-establish sediment transport and deposition patterns from the Deschutes River and Percival Creek watersheds into and through the estuary. The Deschutes River delivers substantial volumes of sediment to the area each year. These sediments would deposit in the estuary and over time continue to get moved downstream into lower Budd Inlet, with deposition primarily occurring along the east shoreline of West Bay, the location of several marinas and other water-dependent businesses. The river-origin sediments would deposit on top of the substrates in quantities that would require maintenance dredging as described in Section 1.0.

Maintenance dredging for the Estuary Alternative would not result in any impacts on freshwater fish, as these marine areas do not support such species. Impacts on salmon and other marine or anadromous fish associated with direct entrainment and sediment and turbidity would cause **less-than-significant impacts**, although some fish may experience harm or mortality. For marine species associated with the bottom habitats, including burrowing species in the benthic zone, impacts would be greater than for fish that utilize open water or deeper benthic habitats, due to less vulnerability to entrainment during maintenance dredging, but as the dredging effects would be temporary and only occur over a small area at a given time, impacts would still be **less-than-significant** for this species group.

If material from maintenance dredging is to be disposed of upland, the project would establish transloading facilities at the Port of Olympia or other deepwater marine accessible site. Dredge material would be loaded into highway legal trucks to dispose of material at an upland licensed disposal facility. If dredged material are to be disposed of at an unconfined open water dredged material disposal site, the split hull scows would be used to dispose of material at a permitted deepwater site in Puget Sound, the Anderson-Ketron Island Disposal Site. Although disposal of dredged materials in the open water may have minor deleterious effects on fish and aquatic life due to temporary turbidity, the in-water methods would have **less-than-significant** impacts on all species group, while upland disposal would have no impacts.

Habitat Areas

Under the Estuary Alternative, dredge spoils from initial construction would have been used to create wetland habitat areas in the Middle Basin. The habitat areas would be constructed with zones including upland, transition vegetated wetland, high marsh wetlands, low marsh wetlands, and sub-tidal habitats, depending on tides.

The constructed habitat areas would provide high-quality migration and rearing habitat for juvenile salmonids, due to the gradual 10:1 slopes of the constructed habitat and the presence of natural vegetative communities that would become established on the nutrient-rich lake bed sediments that comprise the habitat areas. These features would offer salmon heterogeneous, complex habitat that could provide both cover from predators and a source of food (insect drift) in an estuarine setting. Changes in bathymetry from habitat island creation is discussed above under *Aquatic Habitat Alterations*.

Overwater and In-water Structures

The Estuary Alternative includes new permanent overwater structures (OWS) and in-water structures, in the form of boardwalks and pedestrian bridges, supported by piles, in the Middle and South Basins, and a new 5th Avenue Pedestrian Bridge in the North Basin, with all new structures located over and in estuarine habitats. The structures would add approximately 37,600 square feet (SF) of overwater structure at MHHW. In addition, the Estuary Alternative would include the placement of large riprap or cobble material along critical infrastructure elements such as the 4th Avenue Bridge, the I-5 Bridge, and the existing railroad bridge. The placement of this material is needed for scour protection to moderate high water velocities during large storm events in an area with the potential for increased current flow from reintroduced tidal hydrology. The potential adverse impacts of overwater and in-water structures on fish is discussed in Section 5.4.1.2

However, under the Estuary Alternative, a net decrease of in-water structure would occur, resulting from the removal of approximately 145,000 SF of fill associated with the 5th Avenue Dam. A net reduction of approximately 107,400 SF of overwater/in-water structure would result in a net benefit to marine and anadromous fish by increasing available habitat and removing an in-water structure that can negatively affect fish through shading and by enhancing predator habitat (see Section 5.4.1.2). The physical footprint of the dam removal would have **moderate beneficial effects** for salmon and marine fish species expected to use the estuary, but would not benefit freshwater resident fish, which would be absent in the estuary.

Artificial Lighting

Artificial lighting would be installed to light the path of the 5th Avenue Pedestrian Bridge and new 5th Avenue vehicular bridge under the Estuary Alternative. As discussed under the Managed Lake Alternative in Section 5.4.1.2 any potentially negative impacts on fish will be minimized or eliminated through lighting design and placement. Based on the minimization measures, the artificial light is expected to have **less-than-significant impacts** on all of the species indicator groups.

Temporary Relocation of In-water Structures to Facilitate Maintenance Dredging

Maintenance dredging would occur in West Bay under the Estuary Alternative. These dredging events would require the temporary removal or relocation of boat storage facilities, including at the Olympia Yacht Club and several marinas, in order the access the substrate requiring dredging. For each dredge event, this includes the temporary removal and storage of up to 100 piles (estimated) that support existing boat moorage and boat houses. The piles would be removed using vibratory methods (potentially using a combination of barge-based and land-based construction equipment), temporarily stored on barges or in the upland, then reinstalled in similar locations once the dredging event is complete, again using vibratory pile installation methods. Similarly, derrick barges, flat deck barges, and land equipment would be used to pull floats from the dredge work area and temporarily store them either at other locations in the marinas or within Budd Inlet, prior to reinstallation of the marina structures once dredging activities are complete.

The temporary removal of these structures would result in some amount of turbidity and in-water noise and vibration, which in turn can result in negative effects on fish. However, the magnitude of any effects are similar to the case for initial dredging and for the installation of piles associated with the pedestrian boardwalk (Section 5.3.1.1). Based on the limited nature of the disturbance, the adherence to regulatory in-water work windows, and the implementation of BMPs, the relocation of piles and floats prior to maintenance dredging are expected to have minor negative effects, that are considered **less-than-significant** on the marine and anadromous fish that may be present in Budd Inlet.

Sediment and Water Quality

As presented in the *Hydrodynamics and Sediment Transport Discipline Report* (Moffatt & Nichol 2021), the predominant direction of long-term sediment movement in the Estuary Alternative would be from the constructed estuary to the West Bay of Budd Inlet. If minor amounts of sediment are suspended and washed into Capitol Lake Basin from West Bay by high waves and strong currents during flood tides, those would be the surface sediments that have been transported downstream from the Deschutes River, which are good quality and similar to those in the Capitol Lake Basin. Therefore, **no**

adverse impacts on marine and anadromous fish from exposure to contaminated sediment would be expected from minor amounts of West Bay sediments deposited in the constructed estuary during flood tides. Deschutes River flows would deposit clean sediments over the existing contaminated sediments in Budd Inlet, minimizing the future exposure of fish and benthic invertebrates that serve as fish prey to these contaminants.

Under the Estuary Alternative, the existing lake basin would become part of the estuary. The quality of the water in the lake basin would vary widely depending on the tide. During very low tides, the river would be unimpeded and flow through a defined channel that would form through the tideflats and habitat areas in the Middle and North Basins. During these very low tides, water in the main channel would reflect Deschutes River water quality: plentiful DO and little algae. During higher tides, water in the lake basin would reflect somewhat worse conditions than the water that currently exists in West Bay during lower tides. It would have lower DO and higher concentrations of algae during the critical summer and fall time period. During higher tides, the water in the basin would have adequate DO but would likely continue to have visual algae blooms (Herrera 2021). Although the Estuary Alternative would result in some negative impacts on water quality in the lake basin based on DO concentrations at different tidal elevations and expected algae blooms, the conditions would be similar to conditions in other Puget Sound Inlets. These changes may have minor impacts on salmon and marine fish, although any such changes are not expected to result in mortality or result in major disruptions to feeding or migration. Overall, impacts on water quality are expected to be **less-than-significant**.

Aquatic Invasive Species Reductions

The transition from freshwater to saltwater would impact aquatic invasive species, which would influence fish through changes to habitat and changes to competition/predation conditions. Aquatic invasive plant species that are intolerant to saltwater would be largely eradicated from the area. Only purple loosestrife is tolerant of saltwater and thus would not be eradicated when saltwater enters the Capitol Lake Basin after dam removal. Other species (e.g., New Zealand Mudsnail, Eurasian watermilfoil, curly pondweed) have low to no tolerance to brackish water and would likely be eliminated in the North and Middle Basins, but these species may survive the lower salinities expected in the South Basin, Percival Cove, and the Interpretive Center ponds. This would likely have **moderate beneficial effects** to anadromous and marine fish by creating room for native salt-tolerant vegetation to establish or naturally unvegetated tideflats depending on elevations relative to the tides.

The six non-native fish species that are present in Capitol Lake are somewhat tolerant of the brackish water in estuaries, but they would not be expected to maintain viable populations in the estuary or other freshwater habitats along the Puget Sound shoreline. Each species is a competitor and/or major predator of juvenile salmon; therefore, effects on these species would be **less-than-significant**. The loss of the non-native predatory fish would have **substantial beneficial effects** for salmon and most other native fish species expected to use the estuary.

5.5.2 Wildlife

5.5.2.1 Impacts on Wildlife from Construction

In addition to construction activities described in *Impacts Common to All Action Alternatives*, Section 5.3.2, construction impacts on wildlife and wildlife habitat would primarily be associated with the following:

- 5th Avenue Dam / Bridge removal
- Construction of a new 5th Avenue Bridge for vehicles and Deschutes Parkway Realignment
- Slope stabilization along Deschutes Parkway

Other construction activities that could temporarily affect fish and aquatic habitat, although on a much smaller scale, include replacing stormwater outfalls along Deschutes Parkway SW and the Arc of Statehood, replacing culverts at Capitol Lake Interpretive Center, and coating the concrete at the Arc of Statehood.

These disturbances would cause wildlife that use these parts of the Capitol Lake Basin to avoid areas of active construction. Diving and dabbling ducks would be most affected as they regularly use the deepwater and lake margin habitat. This is considered a **less-than-significant** impact because it would not reduce the regional population of these common species, and foraging habitat is not limited and available elsewhere for these relatively common species. Effects from the conversion from a lake to an estuary are described under operation impacts below.

Other species that use the lake – bald eagle, osprey, and river otter – would also avoid the area during active construction. River otter would continue to use the area in the evening when construction was not occurring. The adverse impacts are considered **less-than-significant**.

Passerine birds that use the upland and riparian habitat adjacent to the lake would avoid areas of active construction such as along Deschutes Parkway, considered a **negligible and temporary adverse impact.** There would be minimal impacts from replacing culverts at Capitol Lake Interpretive Center to wildlife in general; this is a relatively small construction project that would occur over the course of several weeks.

Harbor seals that use the West Bay at higher tides close to the dam and bridge would also avoid the area during the construction period. This is a **less-than-significant impact**. There would be **no impact** on orcas from construction.

Several trees with a mixed forested area would need to be removed to construct the embankment for the realigned Deschutes Parkway. Trees would be surveyed as part of design and permitting of the selected alternative and any trees that would be removed would be replaced in accordance with City of Olympia's tree protection ordinance.

5.5.2.2 *Impacts on Wildlife from Operation*

Under this alternative, the removal of the 5th Avenue Dam would reintroduce tidal hydrology and change the freshwater lake to an estuary system. The vegetation communities would change from freshwater to estuarine communities, similar to historic conditions. Table 5.3 and Figure 5.1 show the anticipated habitat types and areas. Additionally, there would be impacts from the maintenance dredging in West Bay. These vegetation changes would have corresponding impacts on wildlife that use the basin, as described below. The habitat areas would provide vegetated wetland habitat with some upland habitat and replace what is deepwater habitat under existing conditions. After initial construction and plant installation, the habitat areas would take several years to develop. Negligible changes are expected to existing upland vegetation along the perimeter of the lake. The habitat areas would be monitored and managed according to the prescriptions in the Habitat Enhancement Plan (as described in Section 5.7).

Table 5.3 Estimated Acreage of Habitat Types under the Estuary Alternative

Habitat Type	Dominant Vegetation	Estimated Acreage[1]
Subtidal/Deepwater Habitat – Estuarine	Aquatic vegetation	245
Tideflat	--	152
Low Marsh – Estuarine	Pickleweed, fleshy jaumea	39
High Marsh – Estuarine	Tufted hairgrass, meadow barley, Douglas' aster, Baltic rush, seashore saltgrass, Pacific silverweed, sea plantain, pickleweed, fleshy jaumea, Puget Sound gumweed, lakeshore sedge	49
Vegetated Wetland - Transitional	Sitka spruce, shore pine, Hooker's willow, oceanspray	31
Vegetated Freshwater Wetland	Willow, western red cedar, red alder, spirea, twinberry, dogwood, slough sedge, soft rush, piggyback plant	9

Notes:

1. Areas are estimated based on modeled future conditions and rounded to the nearest acre and do not account for in-water or overwater structures.

Shellfish

Restoration of the basin to a functional estuary would provide a beneficial effect through a substantial increase in habitat for a variety of estuarine benthic invertebrates such as Olympia oyster; green crab; little neck, butter, and horse clams; mussels; and moon snails.

Distribution of these species within the newly formed estuary would depend on the micro-topography, occurrence of pools, and duration of intertidal periods for specific reaches of the basin. In general, oysters and clams are more likely found in the lower area of the basin and would be slow to colonize the basin. More mobile crabs would likely populate suitable regions (that meet their life history requirements) of the basin sooner. These represent **moderate beneficial effects**.

Maintenance dredging in Budd Inlet would occur approximately every 6 years. Dredging would mobilize sediments, temporarily decrease water quality, and remove benthic invertebrates that use the sediment. These impacts are considered **less-than-significant** because of the limited discrete areas where they would occur, the temporary nature of the event, and their limited scope.

Birds

Shorebirds/Wading Birds

Most shorebirds are versatile and would forage along the shoreline or in shallow water in both freshwater and estuarine habitats. The change in foraging opportunities in the estuary would be on the types of prey available and the spatial/temporal changes due to tidal fluctuation.

Herons are versatile feeders and would forage on fish and benthic invertebrates on the extensive tideflats and within shallow water at medium and low tide levels. This would provide a long-term **substantial beneficial effect** for this species group as estuarine vegetation develops and the estuarine basin becomes increasingly functional, supporting a variety of benthic organisms and fish species. The available habitat would be more extensive and dynamic, providing a variety of water depths for foraging corresponding to daily tidal fluctuations.

Shorebirds and wading birds that use low tide tideflats would temporarily avoid areas in West Bay during maintenance dredging. This is a **less-than-significant** impact.

Diving/Dabbling Ducks

Similar to the effect on wading birds, dabbling ducks and diving ducks are able to forage in freshwater and estuarine habitat. Common goldeneye would feed on crayfish, crabs, shrimp, small fish, and snails, among other items. The estuary would provide **moderate beneficial effects** as the system becomes more diverse and the range of foraging opportunities increases. Goldeneye would key into tidal fluctuations and forage in the basin at medium and high tides when diving is optimal. These daily tide cycles would provide dynamic variation in water depths and increased opportunities for foraging over the basin.

Dabbling ducks, such as American wigeon, would sift through shallow areas and in mud for small crustaceans and mollusks. Wigeon would also feed on estuarine vegetation and in nearby grassy areas. Wigeon would feed in most areas of the basin, depending on the water depth and the occurrence of prey items.

Insectivorous Birds

Violet-green swallows and other aerial feeders would find less prey items available as the existing freshwater environment supports a greater variety and density of emergent insects than would the estuary. However, these swallows are versatile and forage on a wide range of flying insects, including those that are supported by terrestrial habitat. Thus, while there would be a minor reduction in the amount of prey for these birds, they would find suitable foraging sites in the vicinity and impacts would be **less-than-significant.**

Raptors

There would be **no impact** on bald eagles and osprey from the transition of the basin from a freshwater lake to a functional estuary. The type of fish supported by the estuary would shift to estuarine species. Bald eagles and osprey are adept at feeding in both freshwater and estuarine environments. Freshwater ponds and lakes are not a dwindling resource in the region as compared to estuary habitat, which has been developed over the centuries in Puget Sound (USGS 2006). The estuary would provide additional habitat for juvenile salmon and may contribute to increased adult production, which are a food source for these predatory birds.

Passerine Birds

There would be negligible effects to the terrestrial habitat surround the lake. Some trees on the margin may succumb to the saltwater effects of the water table, but these effects would be minor and would have negligible impacts on passerine birds. Yellow warbler, the indicator species for passerine birds, would find additional habitat in the riparian and upland habitat formed in the Middle Basin. This additional habitat would be a **minor beneficial effect** for this species group.

Bats

Feeding habitat for Yuma and little brown bats would be substantially reduced by the transition of the basin from a freshwater lake to an estuary. The type of insects preyed upon by these bats depends on the freshwater sediments. The estuary does not offer the types and quantity of insects that these bats feed upon.

The bats that occupy the colony at Woodard Bay travel a relatively far distance and bypass a number of smaller lakes to feed over Capitol Lake. From their behavior, it is clear that the Capitol Lake Basin offers the best foraging opportunity for this large colony of bats. Because of the size of the bat colony (estimated 3,000 individuals), their dependence on the freshwater environment of the Capitol Lake Basin emergent insects, and the elimination of this foraging base, the change to an estuarine environment represents a **significant impact** on the regional population of bats.

Other Water-Dependent Mammals

River otters forage in both freshwater and estuarine environments. In estuaries, they prey upon fish, crustaceans, and mollusks. Otters are known to forage along low tide tideflats in search of crabs and other invertebrates. The constructed habitat areas may offer potential den sites for river otters. Overall, there would be a change in the habitat type and prey items available for otter, but this is considered a neutral effect.

The Estuary Alternative would enhance the salmon production of the basin by providing additional refuge habitat for juvenile salmon and would increase the estuarine benthic organism prey for salmon. Overall, this would have a corresponding **minor beneficial effect** for orcas that may occasionally visit Budd Inlet.

Harbor seals would experience an increase in the area for feeding/resting when the basin is at mean and high tides. There would be a corresponding increase in the occurrence and density of prey items for seals. In addition, the habitat areas in the Middle Basin may offer safe resting spots for harbor seals at high tide.

River otters and harbors seals would likely avoid areas where maintenance dredging occurs. This is a temporary impact that is considered **less-than-significant.**

5.5.3 Summary of Impacts – Estuary Alternative

Under the Estuary Alternative, impacts on fish and wildlife would range from **beneficial** to **less-than-significant** to **significant**. Some habitat zones would change, and species would adapt to the altered habit conditions. The estuary conditions created under the alternative would result in **substantial beneficial effects** for salmon, other anadromous species, and marine fishes. Freshwater ponds and lakes are not a dwindling resource in the region as compared to estuary habitat, which has been developed over the centuries in Puget Sound. In addition, the physical footprint of the dam removal would have **moderate beneficial effects** for salmon and other fish species expected to use the estuary. Conversely, the brackish water in the North and Middle Basins, and to a lesser degree in the South Basin, that would result from the Estuary Alternative would not be suitable for freshwater fish species, resulting in mortality to these species and constituting a **significant impact** on the native species within this group. However, some of the affected species (e.g., bass, carp, and bullhead) are non-native species that prey on native species.

For wildlife species, the change to an estuarine environment would be a **significant impact** on bats because of the size of the colony, their dependence on the freshwater environment of the Capitol Lake Basin emergent insects, and the elimination of this foraging base.

The conversion of deepwater habitat to wetland habitat areas would provide a **minor beneficial effect** for some species, such as raptors and passerines.

Reintroducing tidal hydrology to the entire lake area would benefit many of the species of importance to the Squaxin Island Tribe, Nisqually Indian Tribe, and Confederated Tribes of the Chehalis Reservation, specifically salmon and shellfish, and potentially other fish and wildlife, as well as plants. As described in Section 5.5.1.2, the estuary conditions that would be reestablished under the Estuary Alternative would result in substantial beneficial effects, including to Chinook salmon and other salmon species spawned in other river basins that may use the estuary for feeding. There would also be a net decrease of in-water structure from the removal of fill associated with the 5th Avenue Dam, which would increase available habitat and reduce negative effects of in-water structures on salmon. Reestablishment of a functional estuary would also increase habitat for a variety of shellfish. As described in Section 5.5.2.2, by enhancing the salmon production of the basin by providing additional refuge habitat for juvenile salmon and increasing the estuarine benthic organism prey for salmon, there would be a corresponding **minor beneficial effect** for orcas that may occasionally visit Budd Inlet.

Maintenance dredging could result in impacts on tribal resources similar to those described in Section 5.3.1.1 by causing physical or behavioral responses, or by affecting aquatic habitat, and potentially affecting access to fishing areas within West Bay during maintenance dredging cycles.

5.6 HYBRID ALTERNATIVE

5.6.1 Fish

5.6.1.1 Impacts on Fish from Construction

Construction impacts on fish and fish habitat under the Hybrid Alternative are nearly identical to those described for the Estuary Alternative, including effects from turbidity and in-water noise associated with the 5th Avenue Dam removal, new 5th Avenue Bridge construction, Deschutes Parkway stabilization, and other minor construction elements (see Section 5.5.1.1). However, construction of a 2,600-foot-long sheet pile barrier wall to create a reflecting pool would create additional in-water noise and vibration impacts associated with sheet pile installation.

The reflecting pool barrier wall would also require the construction of approximately 130 sheet pile tail walls to support the barrier wall. The sheet piling for the structure would be installed using a barge-based vibratory hammer and be constructed prior to dam removal to provide a consistent water level for the barge. As described in Section 5.3.1.1, vibratory pile impacts on fish would be relatively small, and have not been shown to result in mortality or injury. Although the wall installation would take approximately 15 months of work over three in-water work windows, the in-water noise levels from vibratory pile driving would not have a significant adverse impact on fish. However, thorough geotechnical investigations have not yet been conducted and it is likely that site conditions would require the use of an impact hammer to drive at least some of the sheet piles, which serves as a load-bearing structure. As previously described, impact pile driving produces in-water noise levels that can negatively impact fish, including lethal and sub-lethal effects. Although the sound levels from impact installation of sheet piles is somewhat less than large-diameter steel piles, monitoring of previous sheet pile installations has shown that sound levels at, or near, the 206 dB injury threshold (WSDOT 2020). The use of impact driving would increase the magnitude of negative impacts on fish; however, the use of noise attenuation devices (e.g., bubble curtains) and adherence to the in-water work timing requirement would result in **less-than-significant** impacts on fish and fish habitat for any anadromous and freshwater resident fish species present during construction.

5.6.1.2 Impacts on Fish from Operation

Similar to the Estuary Alternative, the removal of the 5th Avenue Dam would allow saltwater from Budd Inlet to enter the former lake basins, transforming freshwater riverine and lacustrine aquatic habitats to estuarine habitat. The primary impacts on fish associated with the operation of the Hybrid Alternative are related to the physical and chemical transition of the freshwater lake habitats to saltwater estuary habitat, as well as the availability and types of wetland/aquatic vegetation habitat areas in the Middle Basin. However, the Hybrid Alternative would establish a saltwater reflecting pool that limits estuarine functions and structure within the contained area and would act as an impediment to fish movement throughout the entire North Basin.

Under the transition from a lake to an estuary, the Hybrid Alternative would result in changes in salinity, water temperature, water quality, sediment deposition patterns, aquatic plants, and invasive species distribution similar to the Estuary Alternative (Section 5.5.1.2). As described for the Estuary Alternative, DO levels would decrease and temperatures in the estuary may increase slightly from existing conditions, depending on tidal cycles, but any such changes would be within the tolerances for marine species. In the eastern portion of the existing lake basin (the saltwater reflecting pool), the Hybrid Alternative would result in less DO than currently exists in the lake basin, although it would represent better conditions than the estuary portion of the basin. This portion of the basin would likely experience fewer and less extensive algae blooms than the estuary portion due to twice daily flushing of high tide water.

Primary operational effects of the Hybrid Alternative would be related to alterations in aquatic habitat (specifically the entry of saltwater into the basin and alterations in bathymetry), due to both initial and maintenance dredging and the 5th Avenue Dam removal. In addition, potential impacts from alternative operation could include those from installation of habitat areas and overwater and in-water structures, as well as associated with the operation of long-term lighting, as described below.

Aquatic Habitat Alterations

The removal of the 5th Avenue Dam and re-establishment of estuarine habitat conditions under the Hybrid Alternative would affect fish through changes in salinity and in the type and amount of aquatic habitat available. After the dam is removed, salinity in Capitol Lake at medium (average) flow conditions would be essentially the same as those presented for the Estuary Alternative (Section 5.5.1.2), with slightly more (0.5 to 1.0 ppt) saline conditions in the Middle and North Basins.

In addition to altered salinity levels, changes in the type of habitat within the current lake basin would also occur under the Hybrid Alternative. For salmon, other anadromous species, and marine fishes, removal of the 5th Avenue Dam would provide full access to a suitable marine and estuarine habitat of approximately 215 acres (at MHHW), where none currently exists, including sub-tidal, intertidal tideflat, low marsh, and high marsh habitats. In addition, the Hybrid Alternative would result in approximately 45 acres of sub-tidal marine habitat in the reflecting pool, which would provide some (but not all) functions of a natural estuary as the low and high water levels are limited by the structure. The estuarine habitat that is fully exposed to tidal exchange would provide productive habitat for salmon, other anadromous species, and marine fishes as the area. The North Basin's extensive shallow water habitats, with saltmarsh vegetation along the water's edge of the western portion of the basin, would provide preferred rearing habitat for juvenile salmon (Fresh 2006) and productive epibenthic and terrestrial origin prey for juvenile salmon. Along the eastern shoreline of the estuary outside of the reflecting pool, access to shallow water habitat would be restricted by the wall separating the estuary from the reflecting pool. The edge of the accessible habitat would be a vertical wall instead of shallow, sloping habitats preferred by juvenile salmon for foraging and avoiding predators. This would reduce prey production in the area compared to a naturally sloping shoreline and increase the risk of predation for small fish such as juvenile salmon. Over time, habitat quality in the estuary, especially the western portion of the North Basin, would improve as macroinvertebrate populations and saltwater-tolerant aquatic vegetation become established in the intertidal tideflat and marsh habitat areas. For salmon, including ESA-listed Chinook salmon, other anadromous species, and marine fishes, the estuary provided in the Hybrid Alternative would result in **moderate beneficial effects** as the full range of estuarine functions would not be develop over the entire North Basin area. Conversely as with the Estuary Alternative, the saline or brackish water in the North and Middle Basins, and to a lesser degree in the South Basin, that would result from the Hybrid Alternative is not suitable for native freshwater fish species, resulting in mortality and potential extirpation of these species in Capitol Lake, which constitutes a **significant adverse impact** on native species within this group. For non-native freshwater fish, particularly predatory fish such as bass, the extirpation of these species would be a **less-than-significant impact.**

Effects on Fish Movement from the Reflecting Pool Wall

The saltwater in the reflecting pool would provide fair-to-moderate rearing habitat for salmonids, as the manipulated water levels at low tide and high tide would prevent the area from fully functioning as estuarine habitat. Fish movement between the pool and adjacent estuarine habitat would require locating and moving through the tide gate at a time when flow conditions allow (i.e., adequate depths and velocities given the size and swimming abilities of the fish). Tide gate openings and water levels in the reflecting pool could be managed differently at different times of the year, which would affect fish access. In the summer, the water level in the reflecting pool would be allowed to drop to +5.75 feet NAVD88, to allow for greater water exchange. In the winter, the low water level would be raised to +7 or +8 feet NAVD88, to limit the amount of sediment transported in with the tidal exchange. During the summer water level management and considering typical tidal cycles in April when juvenile salmon are rearing and outmigrating, the tides would be high enough to allow fish movement into and out of the reflecting pool for roughly 8 hours out of every 24 hours. This would be as little as 4 hours out of every 24 hours during the winter water level management period. For marine and anadromous fish, this would restrict or delay the movement or migration into and out of the reflecting pool because the tide gates would be closed during more than half the day.

In addition, the tail walls that would extend perpendicular to the barrier wall separating the pool from the estuary would affect fish movements in the reflecting pool. The tail walls would create right angles for fish to navigate around or over. For bottom-dwelling fish, the tail walls would restrict their mobility by requiring the fish to move around the end of the tail wall or move up and over, causing **less-than-significant impacts** on anadromous and marine fish.

Maintenance Dredging

As described under the Estuary Alternative (Section 5.5.1.2), removal of the dam would restore natural sediment dynamics and result in the accumulation of sediments in West Bay, requiring maintenance dredging. While there are minor differences in dredge frequency and volumes for the Hybrid Alternative, the effects of the dredging are essentially the same, with impacts on salmon and other marine or anadromous fish associated with direct entrainment and sediment and turbidity, causing **less-than-significant impacts** for anadromous and marine fish.

Habitat Areas

As described for the Estuary Alternative (Section 5.5.1.2), dredge spoils would be used to create habitat areas in the Middle Basin. The constructed habitat areas would provide high-quality migration and rearing habitat for juvenile salmonids, due to the gradual 10:1 slopes of the constructed habitat and the presence of natural vegetative communities that would become established on the nutrient-rich lake bed sediments that comprise the habitat areas.

In-water and Overwater Structures

As described for the Estuary Alternative (Section 5.5.1.2), the removal of approximately 145,000 SF of fill within the study area from the removal of the 5th Avenue Dam would increase available habitat by removing an in-water structure that can negatively affect fish through shading and by enhancing predator habitat). However, the Hybrid Alternative also includes a reflecting pool barrier pool that both represents a physical loss of habitat in the water column (from the wall footprint) and a large (50,270 SF) in-water structure. This would reduce the overall net increase in habitat, compared to the Estuary Alternative, to 94,730 SF. In addition, the Hybrid Alternative would include the placement of large riprap or cobble material along critical infrastructure elements such as the 4th Avenue Bridge, the I-5 Bridge, and the existing railroad bridge. The placement of this material is needed for scour protection to moderate high water velocities during large storm events in an area with the potential for increased current flow from reintroduced tidal hydrology. When considered together, the physical footprint of the dam removal, coupled with the increase in-water structure from the reflecting pool wall would have **minor beneficial effects** for salmon and other fish species expected to use the estuary based on the small increase in available habitat (at MHHW).

Artificial Lighting

Under the hybrid alternative, artificial lighting would be installed to light the path of the 5th Avenue Pedestrian Bridge and new 5th Avenue vehicular bridge, as well as the path on the top of Reflecting Pool wall. As discussed under the Managed Lake Alternative in Section 5.4.1.2 any potentially negative impacts on fish will be minimized or eliminated through lighting design and placement. Based on the minimization measures, the artificial light is expected to have **less-than-significant impacts** on all of the species indicator groups.

Relocation of In-water Structures to Facilitate Maintenance Dredging

Same as the Estuary Alternative (Section 5.5.1.2), maintenance dredging would occur in West Bay under the Hybrid Alternative.

Based on the limited nature of the disturbance, the adherence to regulatory in-water work windows, and the implementation of BMPs, the relocation of piles and floats prior to maintenance dredging are expected to have minor negative effects, that are considered **less-than-significant** on the marine and anadromous fish that may be present in Budd Inlet.

Contaminated Sediment Movement and Water Quality

As with the Estuary Alternative (Section 5.5.1.2), the net movement of sediments would predominantly be from the river to the estuary and lower Budd Inlet; the water movement associated with incoming and outgoing tides of lower Budd Inlet may transport some sediment moving in the opposite direction (i.e., from lower Budd Inlet into the lowermost portion of the estuary). Only a very small amount of sediment from Budd Inlet would move upstream, and only at extremely high tides. Furthermore, any minor amount of contaminated sediment would be mixed with cleaner estuarine sediments originating from the Deschutes River. Also, the continued s load of clean sediment from the Deschutes River would, in a relatively short amount of time, bury any potentially contaminated sediment transported from the estuary. Therefore, impacts on marine or anadromous species from contaminated associated with the presence and movement of existing contaminated sediments in Budd Inlet, as well as changes to water quality parameters in the former fresh-water habitats, are expected to be **less-than-significant**.

Aquatic Invasive Species Reductions

The transition from freshwater to saltwater would impact aquatic invasive species, which influence fish through changes to habitat and changes to competition/predation conditions. Aquatic invasive plant species that are intolerant to saltwater area described under the Estuary Alternative (Section 5.5.1.2).

This would result in **moderate beneficial effects** to anadromous and marine fish by creating room for native salt-tolerant vegetation to establish, or naturally unvegetated tideflats, depending on elevations relative to the tides. Likewise, the eradication of the six non-native fish species who are competitors and/or major predators of juvenile salmon would have **moderate beneficial effects** for salmon and all other fish species expected to use the estuary.

5.6.2 Wildlife

5.6.2.1 Impacts on Wildlife from Construction

Construction impacts and the duration of impacts would be the same as those described under the Estuary Alternative. In addition to those effects, a barrier wall would be constructed to contain saltwater that would be used for the new, smaller reflecting pool.

This construction element would add additional noise from pile driving, sediment disturbance, and slightly increase the potential for turbidity and mobilization. BMPs would minimize these potential adverse impacts. The impacts on wildlife and habitat would be greater than those described for the Estuary Alternative but would still be **less-than-significant**.

5.6.2.2 Impacts on Wildlife from Operation

Long-term impacts of the Hybrid Alternative would be similar to those described for the Estuary Alternative, with the exception of the habitat implications associated with the reflecting pool. In this alternative, there would be 45 acres of permanent deepwater habitat and fewer acres of tideflat and wetland habitat compared to the Estuary Alternative. There would also be impacts from the maintenance dredging in the West Bay.

The corresponding impacts on wildlife are described in the narrative below, comparing the effects to the Estuary Alternative and noting where there is a difference between the two alternatives.

Shellfish

The 45 acres of deepwater habitat behind the reflecting pool barrier wall would provide limited habitat for estuarine shellfish. This area would not be directly connected to Budd Inlet and would not experience the daily tidal flushing of the functional estuary and would be less productive than the open estuary. Thus, habitat for shellfish would be extremely limited in the North Basin compared to the Estuary Alternative. Outside of this habitat feature, the impacts of the Hybrid Alternative are the same as those for the Estuary Alternative.

Birds

Shorebirds/Wading Birds

The 45 acres of the reflecting pool would provide minimal habitat for shorebirds and wading birds and thus would provide less habitat for this species group compared to the Estuary Alternative. These birds forage in shallow water, and the reflecting pool would not offer the extensive areas that would be available with the dynamics of the tidally influenced tideflats of the Estuary Alternative. Other than the reflecting pool, the effects of the Hybrid Alternative would be the same for shorebirds and wading birds as the Estuary Alternative. Extensive tideflat area (Table 5.4) would be available for foraging at low tide and varying levels would be available corresponding to tidal level.

Disturbance from maintenance dredging of Budd Inlet would be similar to that described under the Estuary Alternative and would be considered **less-than-significant.**

Table 5.4 Estimated Acreage Habitat Types under the Hybrid Alternative

Habitat Type	Dominant Vegetation	Estimated Acreage[1]
Submerged/Deepwater – Estuarine (Reflecting Pool)	Aquatic vegetation/open water	45
Subtidal/Deepwater Habitat – Estuarine	Aquatic vegetation/open water	238
Tideflat	--	119
Low Marsh – Estuarine	Pickleweed, fleshy jaumea	37
High Marsh – Estuarine	Tufted hairgrass, meadow barley, Douglas' aster, Baltic rush, seashore saltgrass, Pacific silverweed, sea plantain, pickleweed, fleshy jaumea, Puget Sound gumweed, lakeshore sedge	48
Vegetated Wetland - Transitional	Sitka spruce, shore pine, Hooker's willow, oceanspray	29
Vegetated Freshwater Wetland	Willow, western red cedar, red alder, spirea, twinberry, dogwood, slough sedge, soft rush, piggyback plant	9

Notes:

1. Areas are estimated based on modeled future conditions and rounded to the nearest acre and do not account for in-water or overwater structures.

Diving/Dabbling Ducks

The impacts of the Hybrid Alternative would be the same as those of the Estuary Alternative, except for those related to the reflecting pool. Connected through pumped brackish water, the reflecting pool would provide limited habitat for diving and dabbling ducks. The benthic productivity of the reflecting pool and corresponding fish it can support would be lower than the adjacent fully functional estuary (see Section 5.6.1.2, Fish). The reflecting pool would offer some resting deepwater habitat for diving and dabbling ducks when the estuary portion of the project is at low tide, which is a **minor beneficial effect**.

Insectivorous Birds

The impacts of the Hybrid Alternative would be similar to those of the Estuary Alternative. The reflecting pool would contain brackish water and would not provide any additional production of insects that would be prey items for this species group.

Raptors

Bald eagle and osprey would experience similar impacts as those described under the Estuary Alternative. Fish production in the reflecting pool would be lower than that of the functional estuary portion of the project, and thus there would be no additional benefit to this species group (see Section 5.6.1.2, Fish). The reflecting pool would not be subject to the daily dynamics of tidal action and would be much less productive than the open areas of the estuary. This alternative would provide less benefit to raptors than the Estuary Alternative.

Passerine Birds

Impacts on passerine birds from the Hybrid Alternative would be the same as those described for the Estuary Alternative.

Bats

Impacts on bats that feed at Capitol Lake would be the same as those described for the Estuary Alternative. The loss of the freshwater lake, which supports emergent insects fed upon by bats, would result in a **significant impact** on the regional bat population, and specifically on the Woodard Bay bat colony.

Other Water-Dependent Mammals

The reflecting pool would provide minimal habitat for water-dependent mammals such as river otters. The Hybrid Alternative would provide less ecological benefit to this species group compared to the Estuary Alternative; otherwise, the impacts on this species group are the same as those described for the Estuary Alternative.

The impacts on harbor seals and orcas from the Hybrid Alternative would be **less-than-significant**.

5.6.3 Summary of Impacts – Hybrid Alternative

Under the Hybrid Alternative, impacts on fish and wildlife would range from **beneficial** to **less-than-significant** to **significant**, with the nature and scale of impacts similar to those for the Estuary Alternative. Some habitat zones would change, and species would adapt to the altered habit conditions. For salmon, other anadromous species, and marine fishes, the estuary provided in the Hybrid Alternative would result in **moderate beneficial effects** as the full range of estuarine functions would not be develop over the entire North Basin area. Conversely, the saline or brackish water in the North and Middle Basins, and to a lesser degree in the South Basin, that would result from the Hybrid Alternative is not suitable for freshwater fish species, resulting in mortality and potential extirpation of these species in Capitol Lake, which constitutes a **significant adverse impact** on this species group. For wildlife species, the loss of the freshwater lake, which supports emergent insects fed upon by bats, would result in a **significant impact** on the regional bat population, and specifically on the Woodard Bay bat colony.

Reintroducing tidal hydrology to a portion of the current lake area would benefit many of the species of importance to the Squaxin Island Tribe, Nisqually Indian Tribe, and Confederated Tribes of the Chehalis Reservation, specifically salmon and shellfish, and potentially other fish and wildlife, as well as plants. These benefits are generally as described in Section 5.5.3 for the Estuary Alternative. Relative to the Estuary Alternative, the reflecting pool would not benefit species of importance to the tribes and would have less of an overall increase in habitat availability and access. Maintenance dredging could result in impacts on tribal resources similar to those described in Section 5.3.1.1 for the Estuary Alternative by causing physical or behavioral responses, or by affecting aquatic habitat, and potentially affecting access to fishing areas within West Bay during maintenance dredging cycles.

5.7 AVOIDANCE, MINIMIZATION, AND MITIGATION MEASURES

5.7.1 Measures Common to All Action Alternatives

Enterprise Services would avoid and minimize potential impacts by complying with regulations, permits, plans, and authorizations. These anticipated measures, and other mitigation measures that could be recommended or required, are described below.

5.7.1.1 Habitat Enhancement Plan

A Habitat Enhancement Plan would be developed and implemented for the selected alternative during the future design phase. The plan would be developed in coordination with and approved by Ecology; WDFW; City of Olympia; City of Tumwater; other applicable local, state, and federal agencies; and tribes.

Elements of the plan would vary depending on the alternative, and generally include:

- Specific habitat creation, restoration and design treatments for each habitat area (e.g., upland, riparian, wetland, and aquatic). Treatments include grading, planting, weed management, installation of habitat features, and similar treatments.
- Specific performance standards for the habitat areas to measure the success of these areas. Typical performance standards would define thresholds for wetland hydroperiod; cover, density, and diversity of native plants; and other habitat attributes.
- Adaptive management and maintenance measures to ensure that the performance standards are met. For example, if after construction, the native plant assemblages are not establishing as designed, the adaptive management actions could include additional planting, soil amendment, modification of topography, weed control, or other corrective measures. The approach to meeting performance goals and the frequency of active management required to meet the performance goals for the habitat enhancements would vary across the action alternatives. This would be further defined in the permitting process
- Measures to address nuisance and invasive species within the project area. Potential approaches to managing aquatic invasive species would include hand-maintenance (i.e., pulling or seed head removal) and the use of bottom barriers and screens to limit growth.

Noxious and invasive wildlife species, including nutria and Canada geese, will continue to be managed by the U.S. Department of Agriculture, under agreement with Enterprise Services.

5.7.1.2 Construction

During construction of any action alternative, standard overwater and in-water construction and demolition BMPs would be implemented in accordance with environmental regulatory permit requirements. Specific in-water construction periods would also be confirmed through the project permitting process to minimize potential impacts of pile driving and other in-water construction activities on salmonid species. The anticipated in-water work windows of June 1 to August 15 and November 15 to February 15 each year would generally serve to protect both outmigrating juvenile salmon and returning adults. In addition, under all action alternatives, dredged sediments would be re-used to create habitat areas. This would substantially minimize the need for off-site disposal of dredge spoils that can have negative impacts if this includes in-water disposal.

Other BMPs common to all action alternative would include the following:

- Where feasible, the project will utilize vibratory pile installation methods for all pile installation, including both sheet-pile and round piles. Impact driving methods will only be used if geotechnical conditions require such methods for achieving required loading requirements, and where feasible, will be limited to pile proofing only.
- Appropriate BMPs and sound attenuation methods (e.g., bubble curtains) would be developed in coordination with the regulatory agencies and environmental permitting processes, and they would be implemented to minimize potential impacts of any impact pile driving activities.
- During construction, contractors would use BMPs (for example, sediment curtains) to avoid unintentional impacts on habitat and water quality during dredging, habitat island creation, and pedestrian bridge/boardwalk construction.
- Suspended tarps, or similar containment measures, would be used to contain falling debris during construction of the new 5th Avenue automobile bridge, 5th Avenue Pedestrian Bridge, and boardwalks.
- Cofferdams or other appropriate measures would be used to isolate work areas from deepwater areas for the removal of the existing 5th Avenue Dam and construction of the new 5th Avenue Bridge.
- Cleared upland areas will be restored to preconstruction grades and replanting the areas with appropriate native herbaceous and woody species.
- Temporary erosion and sediment control measures and a stormwater management and pollution prevention plan will be implemented.
- Spillage of concrete or other construction material into the water will be prevented.
- A Spill Prevention and Control Plan will be implemented.

5.7.1.3 Operation

The project has been designed to minimize the permanent and temporary impacts of the alternatives. BMPs common to all action alternatives would include the following:

- During recurring dredging, contractors would use BMPs (for example, sediment curtains) to avoid unintentional impacts on habitat and water quality during dredging.
- Position lights on the new 5th Avenue Pedestrian Bridge to illuminate only the walkways or use other methods, such as hoods that prevent excess light from reaching the water surface.
- To the extent practicable, minimize the width of pedestrian boardwalks and utilize fish friendly designs, utilizing grated decking and a minimum number of support piles.

Following this SEPA review process, and as part of the design and permitting of the selected alternative, the Corps, as federal lead agency, will conduct its own review of the project. In addition, the Corps will be consulting under Section 7 of the federal Endangered Species Act with the U.S. Fish and Wildlife Service and National Marine Fisheries Service. Washington Department of Fish and Wildlife would also review the project under state Hydraulic Project Approval requirements. Additional measures may be identified under one or both of these processes that could further reduce potential impacts on tribal resources. Pursuant to NEPA, the Corps would conduct its own analysis related to potential impacts of the project on tribal resources.

5.7.2 Measures Specific to Each Action Alternative

5.7.2.1 Managed Lake Alternative

Installation of the buttressing berm would be timed to occur at low tide as feasible. No additional measures.

5.7.2.2 Estuary and Hybrid Alternatives

Trees removed to realign Deschutes Parkway would be replaced based on City of Olympia's tree protection ordinances and critical areas regulations.

5.7.3 Significant Unavoidable Adverse Impacts

As described in the analysis above, most potential impacts on fish or wildlife from any of the alternatives would not rise to the level of significance as defined by the established significance criteria. The analysis did, however, identify some potential significant unavoidable adverse impacts, as summarized below by alternative.

5.7.3.1 No Action Alternative

- **Operational Impacts on Wildlife from Habitat Alterations**: Because of the size of the Woodard Bay bat colony and its regional importance, and the dependence of the colony on Capitol Lake for foraging, the loss of foraging habitat from the long-term transition to wetland habitat under the No Action Alternative is considered a **significant unavoidable impact** on this species group.

5.7.3.2 Managed Lake Alternative

- **No significant impacts on fish or wildlife,** either during construction or operation.

5.7.3.3 Estuary Alternative

- **Operational Impacts on Fish from Aquatic Habitat Alterations**: The brackish water in the North and Middle Basins, and to a lesser degree in the South Basin, that would result from the Estuary Alternative is not be suitable for freshwater fish species, resulting in mortality to these species; this would be a **significant unavoidable impact** on native species in this group.
- **Operational Impacts on Wildlife from Habitat Alterations**: Because of the size of the bat colony, their dependence on the freshwater environment of the Capitol Lake Basin emergent insects, and the elimination of this foraging base, the change to an estuarine environment under the Estuary Alternative would be a **significant unavoidable impact** on bats that that use Capitol Lake freshwater habitat for foraging.

5.7.3.4 Hybrid Alternative

- **Operational Impacts on Fish from Aquatic Habitat Alterations**: The saline or brackish water in the North and Middle Basins, and to a lesser degree in the South Basin, that would result from the Hybrid Alternative is not suitable for freshwater fish species, resulting in mortality and potential extirpation of these species in Capitol Lake; this would be a **significant unavoidable adverse impact** on native species in this group.
- **Operational Impacts on Wildlife from Habitat Alterations**: The loss of the freshwater lake, which supports emergent insects fed upon by bats, would result in a **significant unavoidable impact** on the regional bat population, and specifically on the Woodard Bay bat colony.

5.7.4 Beneficial Effects

As described in the analysis above, project actions under some alternatives would result in beneficial effects. These effects can be characterized as minor, moderate, or substantial, based on the benefits they provide to fish and wildlife resources. For each project alternative, beneficial effects identified in the analysis are summarized below.

5.7.4.1 Managed Lake Alternative

- **Operational Benefits to Wildlife from Habitat Alterations:** For a number of passerine birds such as yellow warbler, chickadees, and wrens, the transition of 60 acres of deepwater habitat to riparian and upland habitat areas would have a **minor beneficial effect** because of increased foraging and nesting opportunities.
- **Operational Benefits to Wildlife from Habitat Alterations:** The increase in passerine birds resulting from the transition of deepwater habitat would, in turn, have a **minor beneficial effect** for some raptors, such as Cooper's and sharp-shinned hawks, because of the additional hunting opportunities on passerine birds that use the constructed habitat areas.
- **Operational Benefits to Fish from Habitat Alterations:** Alterations in lake bathymetry and water depths in the lake associated with dredging events would have a **minor beneficial effect** on fish, for both the anadromous and freshwater species groups.

5.7.4.2 Estuary Alternative

- **Operational Benefits to Fish from Habitat Alterations:** Conversion of freshwater lake habitat to a tidally influenced brackish estuary would result in **substantial beneficial effects** to fish, specifically anadromous species and marine species, <u>potentially including ESA-listed Chinook salmon and steelhead</u>. This is due to the restoration of natural estuarine salinity gradients, the extirpation of freshwater predator species, and the development of mudlflats and/or marine vegetation.
- **Operational Benefits to Fish from Reduced Overwater and In-water Structures:** The large net reduction in overwater and in-water structures under the alternative that would result from dam removal would result in **moderate beneficial effects** for salmon and marine fish species expected to use the estuary, <u>potentially including ESA-listed Chinook salmon and steelhead.</u> This is due to the increase in available in-water habitat for these species.
- **Operational Benefits to Wildlife from Habitat Alterations:** Shellfish, particularly the more mobile species such as crabs, would likely experience a **moderate beneficial effect**, because of the large expansion of suitable habitat within the estuary.
- **Operational Benefits to Wildlife from Habitat Alterations:** Shorebirds and wading birds, such as heron, would experience a **substantial beneficial effect** from the conversion of freshwater to estuarine habitat, because of an increase in suitable habitat and changes in the types of prey available for this species group.
- **Operational Benefits to Wildlife from Habitat Alterations:** Diving and dabbling ducks would likely experience a **moderate beneficial effect**, because of an increase in foraging opportunities.
- **Operational Benefits to Wildlife from Habitat Alterations:** For a number of raptor and passerine birds, the transition of 60 acres of deepwater habitat to riparian and upland

habitat would have a **minor beneficial effect** because of increased foraging and nesting opportunities.

- **Operational Benefits to Wildlife from Habitat Alterations:** The benefits to salmon from the Estuary Alternative would also result in a **minor beneficial effect** for orcas (an ESA-listed species), as orcas utilize salmon as a key prey base.

5.7.4.3 Hybrid Alternative

- **Operational Benefits to Fish from Reduced Overwater and In-water Structures:** The conversion of freshwater lake habitat to a tidally influenced brackish estuary, which is mostly, but not entirely open to the full range of tidal cycles, would result in **moderate beneficial effects** to fish, specifically anadromous species and marine species, potentially including ESA-listed Chinook salmon and steelhead. This is due to the restoration of natural estuarine salinity gradients, the extirpation of freshwater predator species, and the development of mudlflats and/or marine vegetation.
- **Operational Benefits to Fish from Reduced Overwater and In-water Structures:** The net reduction in overwater and in-water structures under the Hybrid Alternative from dam removal would result in **minor beneficial effects** for salmon and marine fish species expected to use the estuary, potentially including ESA-listed Chinook salmon and steelhead. This is due to the increase in available in-water habitat for these species.
- **Operational Benefits to Wildlife from Habitat Alterations**: Shellfish, particularly the more mobile species such as crabs, would likely experience a moderate beneficial effect, because of the large expansion of suitable habitat within the estuary.
- **Operational Benefits to Wildlife from Habitat Alterations**: Shorebirds and wading birds, such as heron, would experience a moderate beneficial effect from the conversion of freshwater to estuarine habitat, because of an increase in suitable habitat and changes in the types of prey available for this species group.
- **Operational Benefits to Wildlife from Habitat Alterations:** Diving and dabbling ducks would likely experience a **minor beneficial effect**, because of an increase in foraging opportunities.
- **Operational Benefits to Wildlife from Habitat Alterations:** For a number of raptor and passerine birds, the transition of 60 acres of deepwater habitat to riparian and upland habitat areas would have a minor beneficial effect because of increased foraging and nesting opportunities.
- **Operational Benefits to Wildlife from Habitat Alterations:** The benefits to salmon from the Hybrid Alternative would also result in a minor beneficial effect for ESA-listed orcas, as orcas utilize salmon as a key prey base.

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