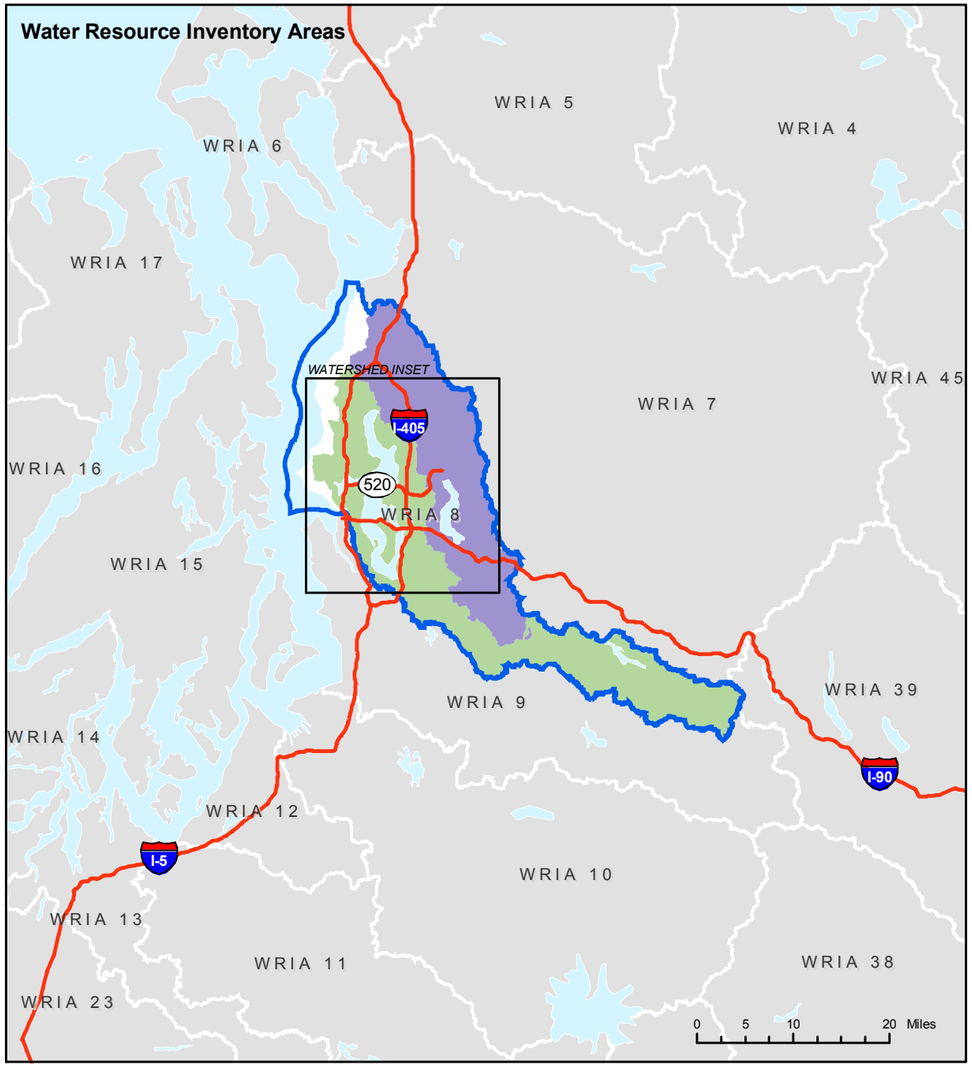
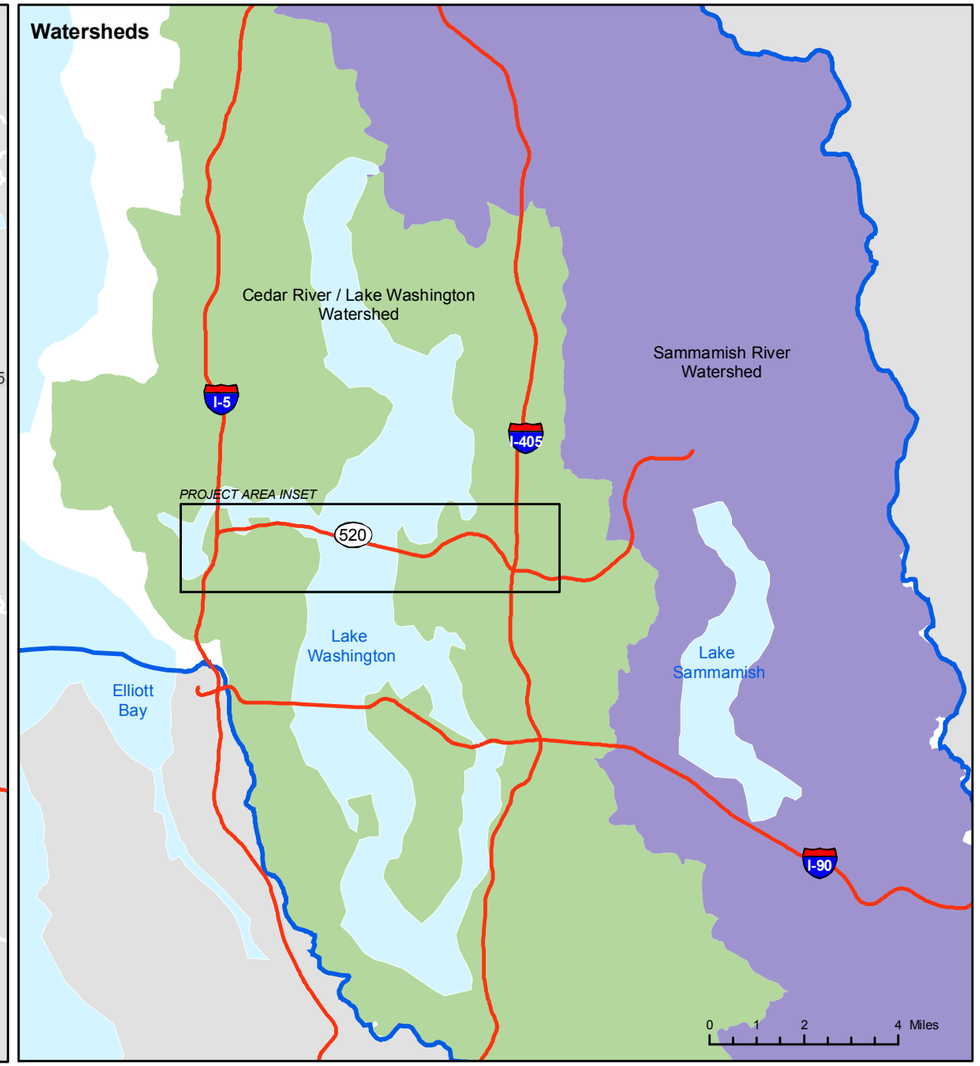
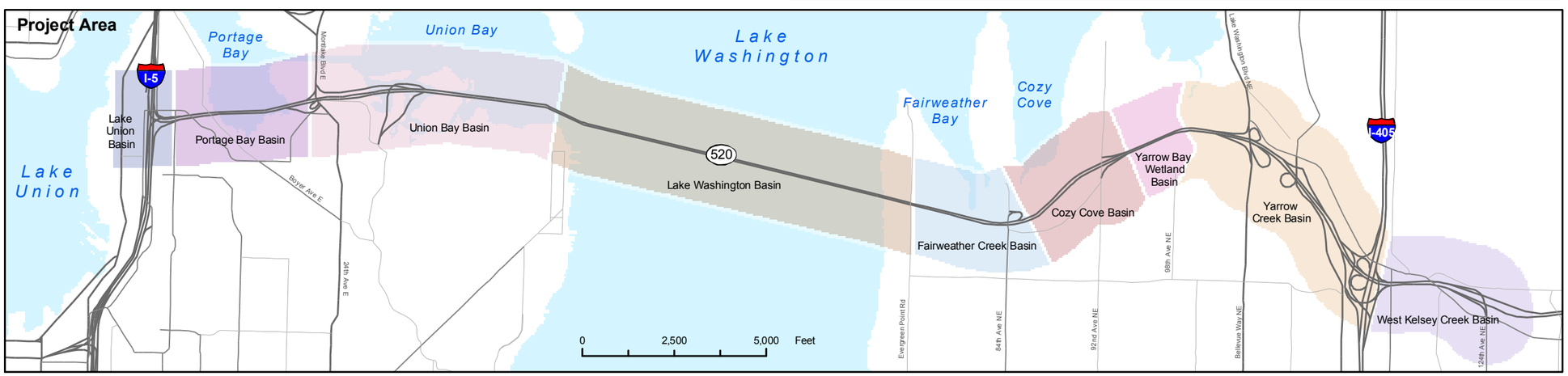




WRIAs and Watersheds

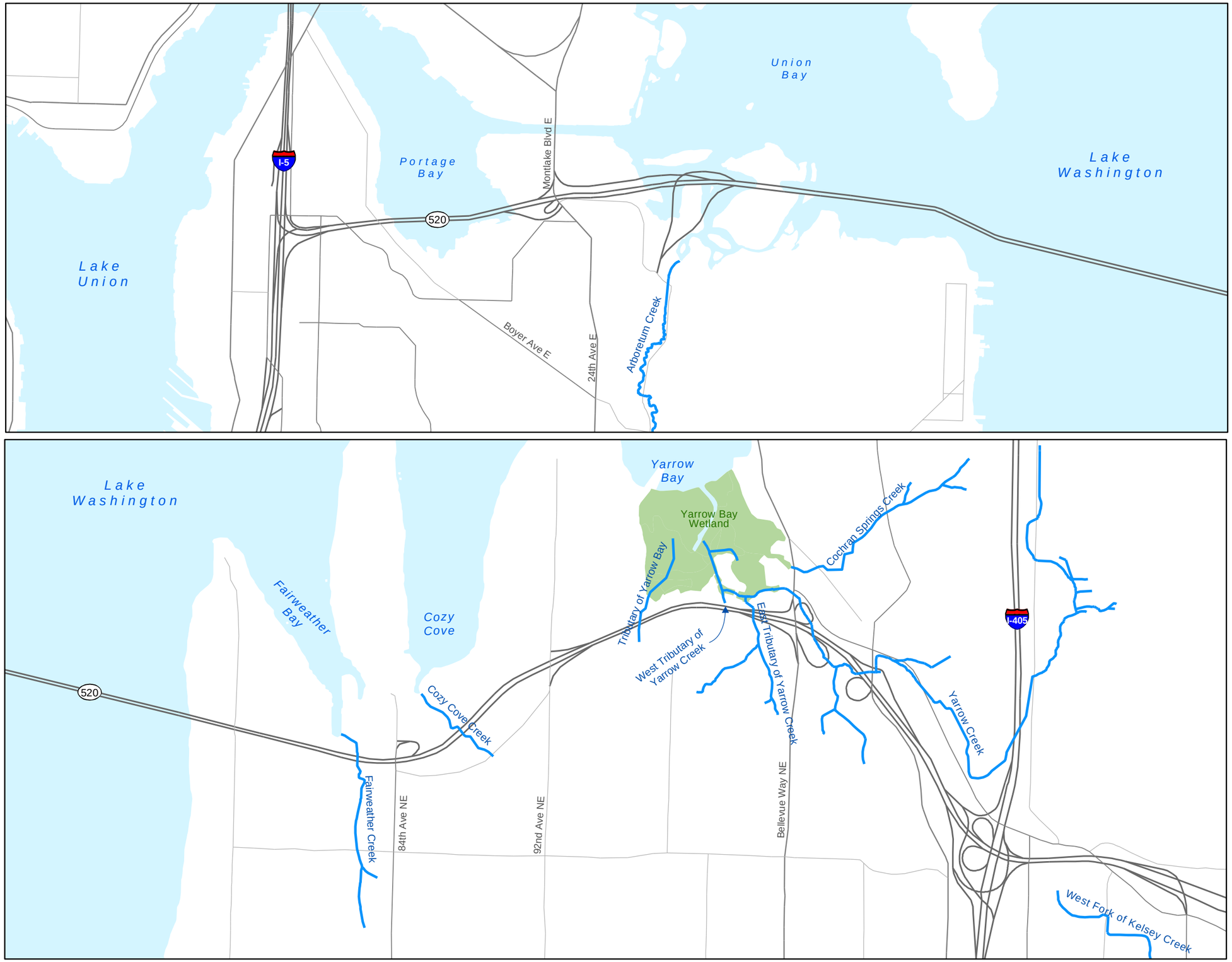
- WRIA 8 Boundary
- Cedar River / Lake Washington Watershed
- Sammamish River Watershed



N

Exhibit 29. **Location of Affected Watershed and Basins**

SR 520 Bridge Replacement and HOV Project

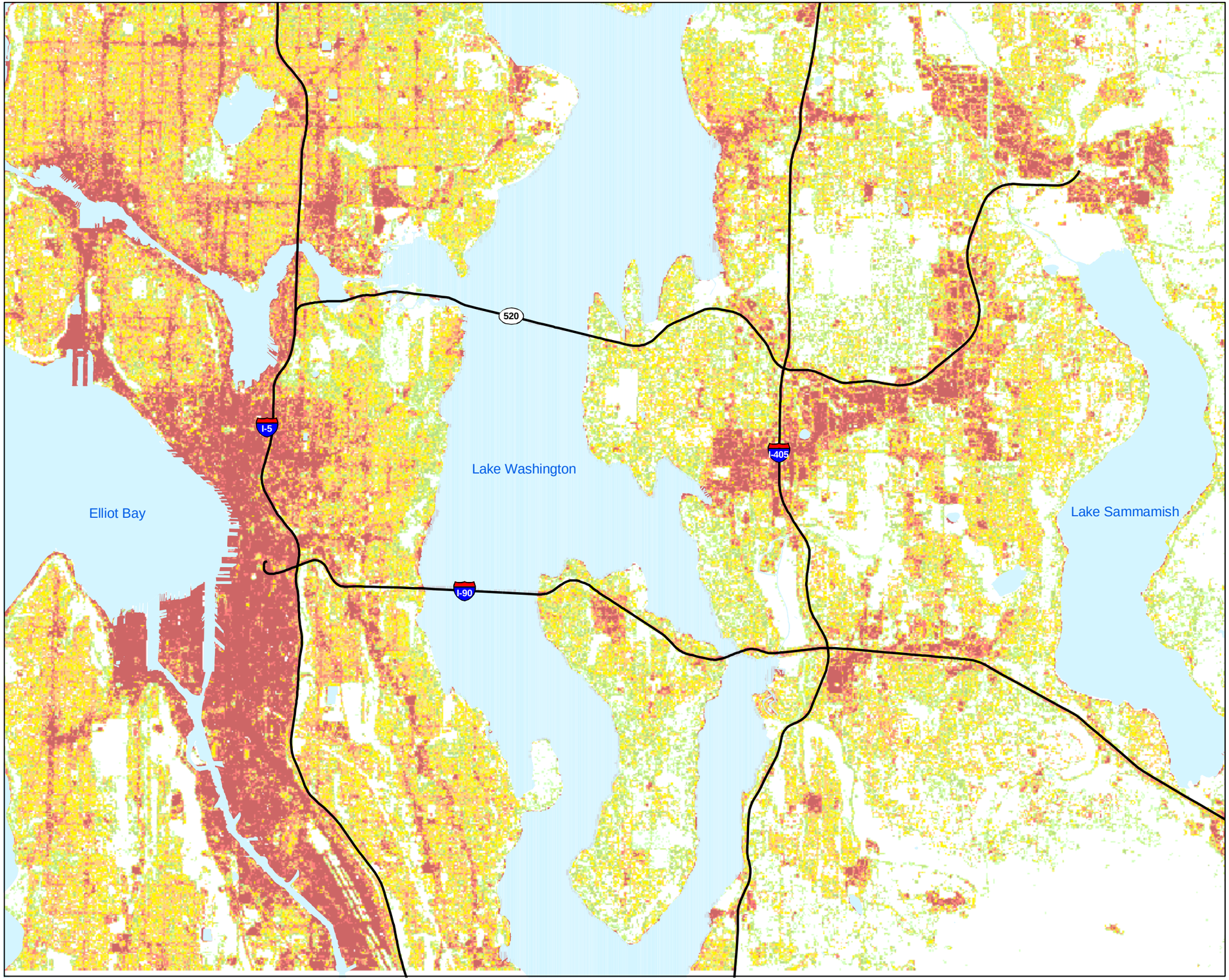


Stream

Source: King County (2003) GIS Data (Streams and Waterbodies); City of Seattle (2003) GIS Data (Streams); City of Bellevue (2004) GIS Data (Streams). Horizontal datum for all layers is NAD83(91), vertical datum for layers is NAVD88.

Exhibit 30. **Project Area \ Waterbodies**

SR 520 Bridge Replacement and HOV Project



Impervious Surface

- 0 - 10%
- 10 - 20%
- 20 - 30%
- 30 - 40%
- 40 - 50%
- 50 - 60%
- 60 - 70%
- 70 - 80 %
- 80 - 90 %
- 90 - 100%

Source: CommEn Space (2000)
Impervious Surface

N

0 0.5 1 Miles

Exhibit 31. **Relative Amount of Impervious Surface Within the SR 520 Project Vicinity**

SR 520 BRIDGE REPLACEMENT AND HOV PROJECT

There are apartments and over-water condominiums along the Lake Washington shoreline south of the Evergreen Point Bridge.

Little natural shoreline habitat remains in the Ship Canal/Lake Union area, where there is much less open water habitat to support fish species compared to Lake Washington. Docks, houseboats, and other structures cover most of the shoreline. Only small sections of the shoreline are open with natural substrates and slopes. A small section of north Lake Union, a portion of south Portage Bay, and the shorelines under the Portage Bay and Evergreen Point bridge crossings provide the only shoreline habitats with natural characteristics within the project area.

The Marsh and Foster Islands area of Union Bay has generally undeveloped shorelines that emerged when the elevation of the lake was lowered in 1916. These shorelines generally have very gradual slopes with silt substrate and dense aquatic vegetation. The aquatic vegetation is commonly white water lily or Eurasian milfoil. These species are nonnative. Much of the shallowest water has dense growths of cattail. Various forms of native riparian vegetation grow along much of the shoreline not occupied by SR 520, walking trails, or access points. Wetland forest vegetation is developing in the shallower portions of the shoreline and near shore areas of Union Bay.

Lake Washington has a large number of tributaries providing fish habitat (Williams et al. 1975). Although only a few of the larger tributaries support sustaining populations of Chinook salmon, many smaller tributaries support other anadromous and resident salmonids. Small numbers of the Coastal Puget Sound distinct population segment of bull trout have occasionally been reported in Lake Washington.

What fish species occur in the project area?

Many fish species inhabit the Lake Washington watershed. Most of these species are likely to occur at least occasionally in the project area. The more common of these species are listed in **Exhibit 32**, which provides information on the general habitat used by the species of greatest concern within the watershed. Juvenile sockeye salmon commonly rear in the lake for a year in the open water along the floating portion of the Evergreen Point Bridge. A number of other

Exhibit 32. Lake Washington Watershed Prevalent Fish Species and Their Ecological Roles

Species Scientific Name	Federal and State Status [a]	Native or Nonnative Species	Ecological Role
River lamprey *Lampetra ayresi*	FCo, SC	Native	Salmonid predator observed in Lake Washington system. High predation rates measured for this species.
Bull trout *Salvelinus confluentus*	FT, SC	Native	Overlapping habitat with other salmonids, but very low numbers or nonexistent in most of watershed. Major fish predator.
Cutthroat trout *Oncorhynchus clarki* (formerly *Salmo clarki*)	None for Puget Sound ESU	Native	Young compete with other salmonids for prey. Adult cutthroat consume fish, including Chinook salmon and sockeye salmon. Population likely smaller than some other potential predators.
Steelhead/rainbow trout *Oncorhynchus mykiss* (resident and steelhead)	None for Puget Sound ESU	Native	Overlapping habitat with other salmonids, consume similar prey. Some predation on young salmonids probable.
Chinook salmon *Oncorhynchus tshawytscha*	FT, SC	Native	Wild and hatchery origin.
Coho salmon *Oncorhynchus kisutch*	FCo for Puget Sound	Native	Probably most abundant in north Lake Washington, primarily hatchery.
Sockeye salmon/ kokanee *Oncorhynchus nerka*	None for Lake Washington	Native [b]	Pelagic in open water areas.
Largemouth bass *Micropterus salmoides*	None	Nonnative	Major fish predator that occupies shoreline habitat. Young compete with young salmonids for some prey.
Smallmouth bass *Micropterus dolomieui*	None	Nonnative	Major fish predator that occupies salmonid fish habitat, resulting in some prey competition. Population size uncertain.
Brown bullhead *Ictalurus nebulosus*	None	Native	Competitor with young salmonids for some of same prey.
Longfin smelt *Spirinchus thaleichthys*	None	Native	Pelagic in open water areas. Little likelihood of salmonid prey competition.
Northern pikeminnow *Ptychocheilus oregonensis*	None	Native	Major fish predator that occupies salmonid fish habitat. Former common name was “northern squawfish.”
Peamouth chub *Mylochelius caurinus*	None	Native	Large numbers. Some occupy shallow benthic habitat, consume some of same prey as young salmonids.
Threespine stickleback *Gasterosteus aculeatus*	None	Native	Numerous, substrate-oriented, often near aquatic vegetation, provides prey for larger fish.
Pelagic sculpin *Cottus aleuticus*	None	Native	Also known as coast range sculpin. Pelagic in open water areas. Some overlap in prey with young salmonids. Sculpins represent 72 percent of Lake Washington biomass.
Prickly sculpin *Cottus asper*	None	Native	Benthic habitat from shorelines to deep water. Prey competition with young salmonids. Sculpins represent 72 percent of Lake Washington biomass. Larger sculpins prey on small fish.
Yellow perch *Perca flavescens*	None	Nonnative	Prey overlap with young salmonids. Abundant but substantially less than peamouth (introduced).

[a] FCo=Federal Species of Concern, FT=Federally Threatened, SC=State Candidate Species, ESU=evolutionarily significant unit.
[b] Introduced stock, uncertain whether there was originally a native stock inhabiting this watershed.

introduced (exotic) species also occur in Lake Washington, such as black crappie, carp, tench, and goldfish.

Salmonids in the Lake Washington watershed are a mix of native and introduced stocks. Recent evidence for sockeye indicates that the Cedar River and Issaquah Creek spawners are likely descendents of introduced fish (Baker Lake stock), while those spawning in Bear Creek may be native fish (Hendry et al. 1996). All sockeye tend to have similar life history patterns in the Lake Washington watershed, but the Cedar River sockeye tend to be larger and older than the Bear Creek spawners (Hendry and Quinn 1997). Chinook salmon naturally reproduce in many of the watershed streams and are supplemented by hatchery production of fish originally from the Green River (Weitkamp and Ruggerone 2000). Steelhead/rainbow trout are a mix of introduced hatchery and native stocks. Cutthroat trout are assumed to be native coastal cutthroat.

Lake Washington and the Ship Canal provide the migratory corridor and juvenile-rearing area for all salmonids produced in the Lake Washington watershed. The connection of the Ship Canal with Lake Washington allows all fish to move freely between the two areas. Anadromous salmonids migrate through Lake Union and the Ship Canal on their way to Puget Sound as juveniles and again on their return spawning migration as adults. Juvenile salmonids migrating and rearing in the project area include subyearling Chinook and chum salmon. Yearling sockeye, coho, and steelhead salmon, along with a few Chinook salmon, also migrate to Puget Sound through the Ship Canal. Adults of each salmon species migrate upstream through the Ship Canal to Lake Washington tributaries. Subadult and adult bull trout and cutthroat trout also most likely migrate in both directions through the Ship Canal.

The shoreline of Lake Washington at the existing and proposed east end of the Evergreen Point Bridge has been identified in the past as a place where sockeye salmon spawn based on WDFW map records (Buchanan pers. comm. 2004). No recent surveys have been conducted to determine if spawning sockeye have recently used this location (**Exhibit 33**). The sockeye spawning area that is located under the east highrise of the Evergreen Point Bridge is one of more than 85 shoreline spawning areas identified in Lake Washington on maps provided by WDFW (Buchanan pers. comm. 2004). This spawning area under SR 520 represents less than 1 percent of the identified sockeye shoreline spawning area within Lake Washington.

Exhibit 33. Identified Sockeye Salmon Spawning Beach

Union Bay shoreline at Foster Island

Lake Washington east shoreline crossing location for each build alternative

Portage Bay shoreline north of west end of Portage Bay Bridge

Portage Bay shoreline north of east end of Portage Bay Bridge

Lake Washington tributaries provide spawning and early rearing habitat for anadromous Chinook, coho, and sockeye salmon and steelhead trout. Cutthroat trout are also present in many of the tributaries and the lake. Rainbow trout were commonly planted in Lake Washington in the past and are still present in the lake.

Several observers have reported sightings of individual bull trout (native char) in the watershed, but there is no evidence of a substantial population or of reproduction occurring within Lake Washington or the lake's tributaries. There is a substantial reproducing population of adfluvial bull trout in the Chester Morse Reservoir within the upper Cedar River watershed and the major tributaries of the Cedar River. Some bull trout observed in the Ship Canal and Lake Washington may have originally come from this upper Cedar River population and moved downstream, thus becoming isolated from their original population. Amphidromous bull trout produced in other watersheds may occasionally migrate into the Ship Canal and Lake Washington, or prey on juvenile salmon downstream from the Ballard Locks.

USFWS has identified Lake Washington as critical foraging, migration, and overwintering habitat for bull trout; this also includes the lower Cedar River, the Sammamish River, Lake Sammamish, Lake Union, the Ship Canal, and all accessible tributaries and lakes. As part of their critical habitat designation, USFWS did not identify specific physical features in Lake Washington that may be important to bull trout survival.

The Ship Canal is the migratory corridor for all anadromous salmonids produced in the Lake Washington watershed. Fish species in the Ship Canal are the same as those in Lake Washington except that no deep-water habitat is present and the species that require this habitat type are likely to be rare in the Ship Canal.

The shorelines and shallow water areas of Portage Bay and Union Bay provide habitat only for those species adapted to shallow water habitats. Many introduced species such as carp, smallmouth bass, and yellow perch use the shallow areas of abundant aquatic vegetation within this highly altered habitat.

How does the Evergreen Point Bridge affect fish habitat in Lake Washington?

Many fish react to the presence of an object like the floating portion of the Evergreen Point Bridge as they would to a shoreline. Object-oriented fish will tend to congregate near the bridge and potentially move or migrate in the vicinity of the bridge across the lake until they reach the end of the floating portion. The Evergreen Point Bridge apparently does not affect sockeye spawning in the lake because the spawning area on the shoreline at the east end of the bridge was identified after the bridge was already built.

The Evergreen Point and I-90 floating bridges tend to interrupt wind and water currents produced by the wind on Lake Washington. The southerly and northerly winds tend to move surface water currents north or south on the lake, commonly at an angle to the shorelines. Prevailing winds are commonly out of the southwest toward the east end of the Evergreen Point Bridge, which is a partial barrier to wind-driven surface currents. The effect of the bridges on water movements and biological resources in Lake Washington is not clearly defined. Available information on water quality, plankton, and fish distribution implies other factors have a substantially greater effect on these characteristics than the presence of the bridges (Arhonditsis et al. 2002,

2004; Edmondson 1997; Edmondson and Litt 1982; Chigbu 2000; Chigbu et al. 1998; Chigbu and Sibley 1998a, 1998b).

The characteristics of Lake Washington have changed substantially since the Evergreen Point Bridge was constructed. These changes are mainly due to the reduced amounts of phosphorus being discharged into the lake. Prior to 1963, Lake Washington received primary and secondary treated sewage that added a substantial nutrient load to the lake and caused eutrophication (Edmondson 1991). Since then, the reduction of phosphorous in the lake from about 70 parts per billion (ppb) to 15 ppb has resulted in major changes in the life forms in the lake. The cyanobacteria *Oscillatoria rubescens*, which was a dominant phytoplankton in the lake when phosphorous concentrations were high, subsequently became a small part of the phytoplankton community after the sewage discharges ceased. The possum shrimp (*Neomysis mercedis*) also decreased at about the same time. These changes allowed a great increase in the water flea *Daphnia* sp., which provides food for young sockeye salmon and longfin smelt. The population of longfin smelt has increased substantially since the 1960s.

Eutrophication occurs when high nutrient levels are present in lake water, leading to abundant algae production that can result in lower dissolved oxygen levels.

During the last 50 years, other limnological changes have occurred in Lake Washington. The annual mean alkalinity has increased from about 29 milligrams (mg) to over 40 mg of calcium carbonate per liter. The change in alkalinity may be due to urbanization, which has altered the discharge of sewage to Lake Washington tributaries. Surface water temperatures have steadily increased by 1 to 2°C (Arhonditsis et al. 2004). High densities of macrophytes that grow in many shallow areas of the lake can produce low dissolved oxygen levels, which can have adverse effects on fish (Frodge et al. 1995).

The bridges interrupt wind-driven currents by effectively dividing the lake into three circulation cells for surface water. This may have some effect on how much phytoplankton and zooplankton grow in the lake, but no information is currently available that documents such an effect. However, juvenile sockeye salmon have very high growth rates in Lake Washington (Ballantyne et al. 2003), which indicates that they are finding more than adequate prey in the lake.

Do any federally listed fish species or federal fish species of concern occur in the project area?

Lake Washington supports one or more life stages of Chinook salmon and bull trout, which are currently listed as threatened under the Endangered Species Act (ESA). Lake Washington Chinook salmon are a

part of the Puget Sound evolutionarily significant unit (ESU) of Chinook salmon listed as threatened under the ESA (NMFS 1998, 1999). We verified the current ESA listing of these fish species on July 13, 2004 (NOAA Fisheries 2004a). Recently, NOAA Fisheries has proposed critical habitat for the Puget Sound ESU of Chinook salmon (NOAA Fisheries 2004b). This proposed habitat includes Lake Washington, as well as the Ship Canal and Lake Union between the Ballard Locks and Lake Washington. No critical habitat is proposed for any streams crossed by the proposed project alignment.

An **ESU** or **evolutionarily significant unit** of a fish species is the term used by NOAA Fisheries for the population protected by a listing under the ESA.

USFWS lists bull trout (*Salvelinus confluentus*) as threatened in King County. Distribution of bull trout in the Lake Washington watershed is uncertain, but individuals have been observed recently near the Ballard Locks and at various other locations over a number of years. Recently, USFWS proposed bull trout critical habitat in Lake Washington and in the Ship Canal and Lake Union between the Ballard Locks and Lake Washington (USFWS 2004b). NOAA Fisheries indicates that these areas provide foraging, migratory, and overwintering habitat for amphidromous bull trout outside of currently delineated core areas in the Puget Sound Recovery Unit. USFWS has not proposed critical habitat for bull trout in any Lake Washington tributaries.

The Puget Sound/Strait of Georgia population of coho salmon is listed as a species of concern by NOAA Fisheries. Life history and distribution information for these species and other salmonids occurring within the project area is provided in Attachment 2.

Do any state-listed or other state priority fish species occur in the project area?

Priority fish species include all state endangered, threatened, sensitive, and candidate species, and species of recreational, commercial, or tribal importance that are considered vulnerable. All fish species with state candidate status that occur in the project area also hold a federal designation and have been discussed earlier in this section. No state sensitive, threatened, or endangered fish species occur within the study area. Other fish species that are designated as Priority Species (WDFW 2002) may occur within the study area. These are chum, sockeye, and kokanee salmon; rainbow/steelhead trout; and coastal cutthroat trout. Life history and distribution information for these species are provided in Attachment 2.

Current Status of Bull Trout in the Lake Washington System

Puget Sound has the only known amphidromous population of bull trout found in the mainland United States. Amphidromous fish migrate from their natal freshwater streams to nearshore marine waters multiple times during their life, spending a few months in the marine waters before returning to their natal stream for spawning. The Coastal-Puget Sound population of bull trout is listed as threatened and receives protection under the ESA.

The USFWS Draft Recovery Plan for the Coastal-Puget Sound Segment (USFWS 2004a) stated that the potential for bull trout spawning in the Lake Washington basin is believed to be very low. Citing Rieman and McIntyre (1993), the plan stated that bull trout distribution and abundance depends on more specific habitat requirements than most other salmonids, including water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Sedell and Everest 1991; Howell and Buchanan 1992; Pratt 1992; Rieman and McIntyre 1993, 1995; Rich 1996; and Watson and Hillman 1997). Watson and Hillman (1997) stated further that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear.

The Recovery Plan identified eight core areas, including the Lake Washington system, as containing habitat important to bull trout for foraging, migration, and overwintering, but it did not identify habitat characteristics that might be important for bull trout recovery. The Lake Washington system includes the Ship Canal, Portage Bay, Union Bay, Lake Washington, and all accessible tributaries.

The population, extent of use, and recovery value of bull trout in Lake Washington is currently unknown (USFWS 2004a). Adult and subadult bull trout have been infrequently observed in Lake Washington and at the Hiram M. Chittenden Locks (Ballard Locks). In recent years small numbers of bull trout have been observed in Shilshole Bay and the area downstream from the Locks, where they were found to feed on juvenile salmon and marine forage fish.

Factors that affect bull trout recover include road construction and maintenance, reduction in riparian shading, contaminant inputs, and impervious surfaces. Recovery actions propose improving and reducing these limiting factors to minimize contaminant input, meet water quality standards, restore and protect riparian areas along lake shorelines, and reduce transportation corridor impacts to streams.

What are the general habitat characteristics of project area streams?

In the project area east of Lake Washington, the SR 520 corridor directly crosses Fairweather Creek, Cozy Cove Creek, the Tributary to Yarrow Bay, and Yarrow Creek. The basic characteristics of these streams are listed in **Exhibit 34**. This section discusses the characteristics of these streams that help to sustain fish resources.

Fish species have evolved to cope with a sequence of habitats found in natural watersheds. Fish are affected by habitat conditions within a stream, which in turn are affected by conditions within the entire watershed. For example, water quality and streamflow are affected when water percolates through the soil to the stream, even though the source of this water may be a great distance from the stream.

Human activity in the Lake Washington watershed affects fish habitat in a variety of ways. Land clearing removes shade and large streamside trees that once fell periodically into a stream. Construction adjacent to

Exhibit 34. Features of Eastside Streams That Cross through the Project Area

Stream	Receiving Water	Total Stream Length (miles)	Jurisdiction	Local Jurisdiction Stream Type	Local Jurisdiction Stream Buffer (feet)[a]
Fairweather Creek	Lake Washington	1.4	Hunts Point	None [b]	0 (50)[c]
			Medina	All streams	25
Cozy Cove Creek	Lake Washington	0.4	Hunts Point	None [b]	0 (50)[c]
			Clyde Hill	None [b]	0 (50)[c]
Tributary to Yarrow Bay	Yarrow Bay Wetland	0.6	Kirkland	Class A	75
West Tributary of Yarrow Creek	Yarrow Creek	0.4	Kirkland	Class A	75
East Tributary of Yarrow Creek	Yarrow Creek	<0.1	Kirkland	Class A	75
			Bellevue	Type A	50
Mainstem Yarrow Creek	Lake Washington	3.0	Kirkland	Class A	75

[a] Buffer widths were determined from City Codes, as follows: Medina, Chapter 18.12.090; Hunts Point, Chapter 16.15; Clyde Hill, Chapter 18.04.300; Bellevue, Chapter 20.25H.070; and Kirkland, Chapter 23.90.90.

[b] No streams within Hunts Point or Clyde Hill are covered under a Sensitive Areas Ordinance.

[c] Because City Code does not stipulate a buffer for these streams, a buffer of 50 feet was assigned to evaluate the project's effects on the riparian buffers.

streams often causes erosion, which in turn fills the water with sediment that can clog spawning gravel. Many of these effects can be controlled by appropriate project design and the application of appropriate BMPs. Culverts can block fish passage and alter water flow. Removing creek meanders (straightening stream channels) and filling wetlands eliminates feeding areas and the slow water habitats important for sheltering young coho and other salmonids from the high winter streamflows.

In the project area, salmonid species (salmon, trout, and bull trout) are the most sensitive to instream habitat conditions. Salmonids depend on healthy instream habitats for food, water volume, cover, water quality, and fish passage.

Channel Morphology

The physical form of the streambed (channel morphology) directly influences fish habitat quality and quantity. Stream habitat can be classified into units such as pools, riffles, and runs/glides. Almost all salmonid species spawn in riffles or pools. For maximum use, these

areas should be plentiful, of adequate size, and contain properly sized substrate (gravel and small cobbles). A 1-to-1 pool-to-riffle ratio is optimum for aquatic habitat. The number of pools is another important measure of the quality of pool habitat. Generally, streams with a high percentage of riffles and few pools are low in fish biomass and species diversity.

Stream Substrate

The size and distribution of stream substrate (stream bottom material) is also an important habitat variable, particularly for salmonids. Salmonids require beds of gravel for spawning. Some species prefer to lay their eggs in pea-sized gravel, while others can use large rocks. Fine sediment can seriously reduce salmonid spawning success by smothering redds (salmonid nests), thus entombing salmonids embryos (cutting them off from a supply of oxygenated water) and limiting the capability of juvenile fish emerging from the gravel. Sediment suspended in the water column can also affect the health of individual fish. Potential sources of fine sediment in urban and urbanizing streams include surface erosion from new construction, roads, and unstable gullies and slopes.

Sediment

The erosion of streambanks, whether from natural or manmade causes, may deliver large amounts of sediment into a stream, to the detriment of water quality and fish habitat. As the sediment moves through the stream system, it can disrupt run-riffle-pool sequences, fill spawning gravels with fine sediment, and scour riffles. Streams in forested or undeveloped areas have been shown to have more stable flows and less sediment than streams in cultivated or developed watersheds.

Large Woody Debris

Large pieces of wood, referred to as large woody debris (LWD), play an important habitat role in Pacific Northwest streams. Large woody debris produces and enhances fish habitat because it forms pools and increases channel complexity in streams. It also provides cover where fish can hide from predators and can improve both the quantity and quality of fish habitat. During periods of low flow and winter high-flow conditions, LWD modifies streamflow, adds structure, and increases the volume of usable habitat for some fish in small streams. Finally, LWD plays a very important role in retaining nutrients and regulating temperatures in streams. Smaller wood is important because it increases

wood jam complexity and provides primary source food for the stream food web.

Fish Passage

Maintaining fish passage and habitat are particularly important for anadromous fish, including juveniles migrating to the sea and adults returning to the streams to spawn. During migration periods, anadromous fish frequently encounter culverts (pipes or arches that allow water to flow from one side of a road to the other). Culvert openings that are too high above the stream channel for fish to jump into or that are positioned at a grade too steep for fish to ascend can be barriers to fish migration and limit the distribution of a species.

Riparian Vegetation

Streamside (riparian) vegetation plays a number of important roles in supporting the instream habitat components listed above. Riparian vegetation influences the complexity of the stream food web and the water quality of stream channels by:

- Contributing LWD to the stream channel to create pool habitat
- Shading the streams to maintain cool stream temperatures required by salmonids and other aquatic biota
- Contributing organic debris, leaf litter, and other stream inputs that support many stream food webs
- Stabilizing streambanks, which minimizes streambank erosion and reduces the occurrence of landslides

In addition, riparian vegetation reduces fine sediment input to the stream system; filters nutrients and pollutants from shallow groundwater and stormwater runoff; and supports wildlife through refuge, feeding, watering, and providing migration corridors.

Exhibit 35 summarizes the habitat conditions in the streams that cross the proposed project corridor. In addition to a qualitative assessment of the potential spawning and rearing habitat, this exhibit is limited to the specific reaches surveyed or the area immediately adjacent to the proposed project corridor.

WDNR Stream Type Definitions
(from WAC 222-16-031)

Type 1 Streams: Streams classified as "shorelines of the state" under Chapter 90.58 RCW

Type 2 Streams: Streams that are not classified as Type 1 and that have a high fish, wildlife, or human use, with a defined channel 20 feet or greater and a gradient of less than 4 percent.

Type 3 Streams: Streams that are not classified as Type 1 or 2 and that have a moderate to slight fish, wildlife, and human use, with a defined channel 2 feet or greater and a gradient of less than 16 percent (in western Washington).

Type 4 Streams: Streams that are not classified as Types 1-3, and which are perennial nonfish habitat streams.

Type 5 Streams: Stream channels not classified as Types 1-4, and which are seasonal, nonfish habitat streams.

Exhibit 35. Habitat Conditions and Salmonid Distribution in the Surveyed Reaches of Streams Crossing the Proposed Project Corridor

Stream Name	Known or Presumed Fish Use[a]	Channel Morphology Conditions [b]	Substrate and Sediment Conditions [c]	Riparian Vegetation and Large Woody Debris Conditions [d]	Bank Conditions and Degree of Hydromodification [e]	Fish Passage [f]	Spawning Potential [g]	Rearing Potential[h]
Fairweather Creek	Cutthroat trout, Coho salmon	Poor	Fair	Poor	Poor	Good	Poor	Poor
Cozy Cove Creek	Cutthroat trout, Coho salmon	Poor	Fair	Poor	Poor	Poor	Poor	Fair
Tributary to Yarrow Bay	Cutthroat trout, Coho salmon	Poor	Fair	Fair	Good	Poor	Fair	Poor
Lower mainstem Yarrow Creek	Cutthroat trout, Coho salmon	Poor	Fair	Fair	Good	Good	Fair	Good
West Tributary to Yarrow Creek	Cutthroat trout, Coho salmon	Poor	Poor	Fair	Good	Poor	Poor	Poor
East Tributary to Yarrow Creek	Cutthroat trout, Coho salmon	Poor	Fair	Fair	Good	Poor	Fair	Fair
Middle Reaches Yarrow Creek	Cutthroat trout, Coho salmon	Poor	Poor	Poor	Poor	Poor	Poor	Poor

[a] Fish use information based on King County and 25 authors (2001); Williams et al. (1975); StreamNet (2002); and 2002 Parametrix electrofishing results. Fish observations were obtained by a limited amount of recent fish sampling within project area streams. It should be noted that rigorous sampling efforts were not undertaken. This list is based solely on available fish presence data and available instream habitat.

[b] Ratings based on WSFPB (1992) and Peterson et al. (1992). Good = pools >50 percent of the low-flow surface, fair = 35 percent to 50 percent, poor = <35 percent.

[c] Ratings based on NMFS (1996). Good = dominant substrate gravel/cobble, low embeddedness and <12 percent fines; fair = gravel/cobble, moderate embeddedness and 12 to 17 percent fines; poor = silt/s, high embeddedness and >17 percent fines.

[d] Ratings based on NMFS (1996). Good = riparian reserves >80 percent and adequate refugia, fair = 80 percent to 90 percent and incomplete refugia, poor = <80 percent and inadequate refugia.

[e] Ratings based on Snohomish County (2002) and NMFS (1996). Good = <10 percent shoreline hardening or bank erosion, fair = 10 percent to 20 percent, poor = >20 percent.

[f] Ratings based on NMFS (1996). Good = fish passage at all flows, fair = at all but base/peak flows, poor = impeded at all flows.

[g] Spawning and rearing potential are for the area immediately adjacent to the project corridor and evaluated on the basis of best professional judgment.

[h] Chinook salmon distribution is limited to stream reaches downstream from the project corridor.

Fairweather Creek

Fairweather Creek (WRIA 08-0257), also referred to as Medina Creek, is a very small stream (1.4 miles long) that drains from Medina north into Fairweather Bay, which is part of Lake Washington (**Exhibit 36**). SR 520 crosses the lower reaches of the stream. Fairweather Creek is a Type 3 stream located in the Medina and Hunts Point jurisdictions. The watershed covers approximately 600 acres, with the elevation difference between the headwaters and the mouth being approximately 20 feet. The watershed is heavily developed, primarily with residential uses.

Exhibit 36. Detail Map of Fairweather Creek

Upstream (south) of SR 520, the stream habitat quality is low. Riparian vegetation consists of grass and a few shrubs, with almost no tree cover except for a few scattered red alders. Invasive species such as English ivy, nightshade, and Himalayan blackberry make up more than half of the existing riparian vegetation. After Fairweather Creek crosses the SR 520 corridor (about 0.5 mile east of the Lake Washington shoreline), it flows for about 400 feet north before discharging into Fairweather Bay. In this reach, the stream flows through single-family residential neighborhoods, with landscaped lawns immediately adjacent to the stream. Here, the stream is extremely channelized and characterized by riprapped banks 4 to 5 feet high. Just one piece of instream LWD was present in the surveyed reaches. A few pools are present in the reach downstream from SR 520, but they are small and of poor quality. The dominant stream substrate is large gravel, with a relatively high degree of embedded fine sediments.

The base streamflow of Fairweather Creek is approximately 2 cubic feet per second (cfs) and the 2-year peak flow is estimated at 36.5 cfs (Anderson and Ray et al. 2001). High stream velocities, combined with elevated levels of pollutants in the stream in the winter and high instream temperatures in the summer, probably limit the use of this stream by anadromous salmonids.

Fairweather Creek is listed on the 1998 Washington Department of Ecology (Ecology) 303(d) list for temperature and fecal coliform bacteria (Ecology 1998). King County water quality monitoring data from 1999 to 2004 show that the mean temperature in Fairweather Creek was 12.6°C (with a range of 5.1°C to 22.4°C) and that dissolved oxygen levels averaged 9.8 milligrams per liter (mg/L) (with a range of 5.5 to 12.2 mg/L) during the same time period (King County 2004a).

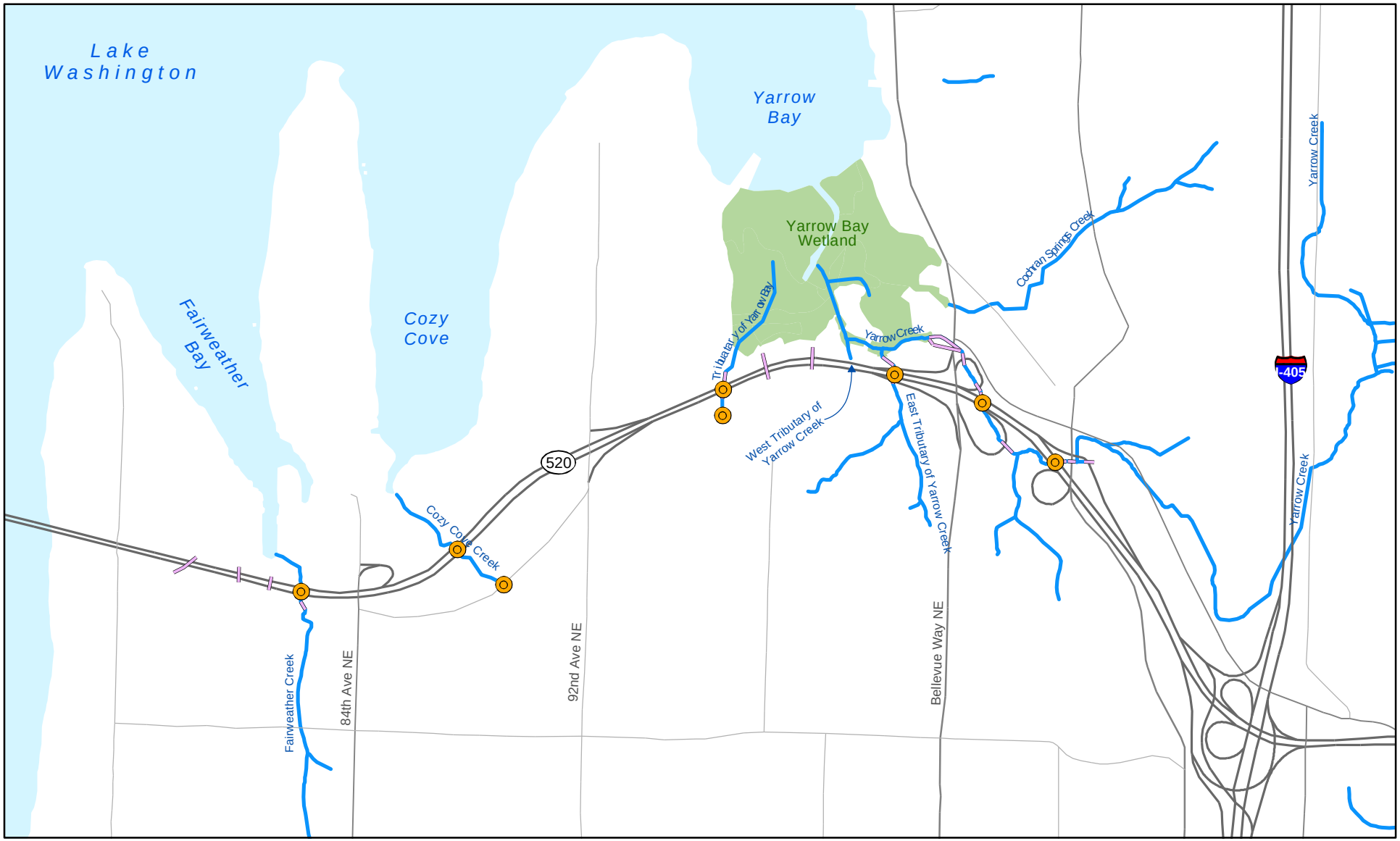
Sustained stream temperatures of more than 20ºC can be lethal for salmon (Groot and Margolis 1991). Furthermore, more than 50 percent of water samples from this period had temperatures that were higher than state water quality standards.

The fish resources of Fairweather Creek have not been extensively inventoried, although StreamNet (2002) and Williams et al. (1975) indicate that coho salmon use the stream for rearing. Three coho salmon and eleven cutthroat trout, all juveniles, were present downstream from SR 520 in a 2001 stream survey (Anderson and Ray et al. 2001).

Stickleback and sculpin were also present. There are no known recent reports of salmonids present upstream of SR 520, probably because of two in-line culverts under SR 520 (**Exhibits 37** and **38**). During storms, these culverts have peak velocities of over 13 cubic feet per second (over six times greater than recommended velocities for salmonids), thus creating velocity barriers that can flush fish downstream.

In 2002 and 2003, a salmon incubator was located behind a residence on Medina Circle, upstream of SR 520, in a project funded by Medina (Jahn pers. comm. 2004). Ten thousand coho salmon fry were hatched from eggs in the 5-gallon incubator and released onsite. This program is anticipated to continue in the future.

The very small size of Fairweather Creek (average channel width is less than 6 feet) makes it unlikely that any of Lake Washington's Chinook salmon spawn here. Furthermore, it is highly unlikely that salmon extensively spawn or rear in the surveyed reach because of the low diversity of habitat types, poor riparian and stream cover conditions, and degraded substrate conditions. Although there are no reports of Chinook salmon using the stream, juveniles migrating along Lake Washington shorelines may use the mouth of the stream for short-term rearing. However, the quality of habitat is substantially degraded from natural conditions.



Source: King County (2003) GIS data (Streams); City of Seattle (2003) GIS data (Streams); City of Bellevue (2004) GIS Data (Streams). Fish barrier status is based on WSDOTculvert database and field inspection. Horizontal datum for all layers is NAD83(91), vertical datum for layers is NAVD88.

Fish Barrier Culverts

Culverts

Streams

N

0 500 1,000 Feet

Exhibit 37. **Fish Barrier Culverts**

SR 520 Bridge Replacement and HOV Project

File Path: P:\Parametrix\168395\180171 SR 520 Bridge Replacement\GIS\Layouts\Ecosystems\Fish_Barrier_Culverts.mxd

Exhibit 38. Summary Table of Fish Passage Conditions Along Surveyed Streams of the Proposed Project Corridor

Stream Name	Culvert Location	WSDOT Culvert?	Culvert Description [a]	Culvert Length (feet)	Fish Passage Barrier?	Available Upstream Fish Habitat?	Comments
Fairweather Creek	Two in-line culverts crossing under SR 520	Yes	North culvert is 48-inch-diameter, round concrete pipe. South culvert is 60-inch-diameter CMP	180	Partial [b]	Yes	Slope barrier [b]
Cozy Cove Creek	Culvert under SR 520	Yes	48-inch-diameter round CMP	170	Potential [c]	500 feet of low quality habitat	
Cozy Cove Creek	Culvert under Northeast 28th Street	No	24-inch-diameter round concrete pipe	Unknown	Total [c]	Unknown	Total fish passage barrier due to high perched culvert under Northeast 28th Street.
Tributary to Yarrow Bay	Culvert under SR 520	Yes	36-inch[-diameter?] round CMP	300	Total [b,c]	No	Total fish passage barrier due to high perched outlet.
West Tributary (Tributary 1) to Yarrow Creek	Two culverts (not parallel) under SR 520	Yes	West culvert is 18-inch-diameter, round concrete. East culvert is 24-inch-diameter, round CMP	Unknown	Partial [c]	No	Partial barrier due to culvert perch and sediment in culvert outlets. The inlets of these culverts were not located and the pipes do not connect to a stream channel upstream of SR 520.
East Tributary (Tributary 2) to Yarrow Creek	Culvert under SR 520	Yes	48-inch-diameter CMP	350	Total [b,c]	Yes	Slope barrier [b]
East Tributary (Tributary 2) to Yarrow Creek	Under abandoned road, south of SR 520, 571 feet upstream of SR 520 culvert	No	36-inch-diameter CMP	80 (est.)	Partial [c]	Yes	Partial barrier due to culvert under abandoned road. Outlet is perched with steep approach and inlet has partially screened flow control device with inlet drop.
Yarrow Creek	Culvert inlet located under Lake Washington Blvd	Unknown	Dual concrete 48-inch-diameter, round concrete	370 (est.)	Potential [c]	Yes	The culverts are connected to an adjacent culvert that joins underground in stormwater structure.

Exhibit 38. Summary Table of Fish Passage Conditions Along Surveyed Streams of the Proposed Project Corridor

Stream Name	Culvert Location	WSDOT Culvert?	Culvert Description [a]	Culvert Length (feet)	Fish Passage Barrier?	Available Upstream Fish Habitat?	Comments
Yarrow Creek	Westbound on-ramp to SR 520 (from northbound Lake Washington Blvd)	Yes	Dual concrete 48-inch-diameter, round CMP	115	Potential [c]	Yes	
Yarrow Creek	Westbound on-ramp to SR 520 (from northbound Lake Washington Blvd)	Yes	Dual concrete 48-inch-diameter, round CMP	100	Potential [c]	Yes	
Yarrow Creek	Culvert under SR 520	Yes	Dual concrete 48-inch-diameter, round CMP	200	Partial [b]	Yes	Velocity barrier [b]
Yarrow Creek	Culvert under south cloverleaf (eastbound SR 520 to Lake Washington Blvd)	Yes	Dual concrete 48-inch-diameter, round CMP	190	Potential [c]	Yes	
Yarrow Creek	Under SR 520 near 108th Avenue Northeast	Yes	Dual concrete 36-inch-diameter, round CMP	240	Partial [b]	Yes	Depth barrier [b]
Yarrow Creek	Under 108th Avenue Northeast, just north of SR 520	Yes	Dual 36-inch-diameter, round concrete	80 (est.)	Unknown	Yes	
Yarrow Creek	Under westbound SR 520 off-ramp to Northeast 108th Avenue Northeast	Yes	Squash CMP, 48-inches wide by 28-inches high	100 (est.)	Unknown	Yes	

[a] CMP = Corrugated Metal Pipe

[b] Data from WSDOT and WDFW (2003).

[c] Data from observations and measurements during site reconnaissance.

Cozy Cove Creek

Cozy Cove Creek is a short (approximately 0.5 mile long), small stream (average channel width is less than 6 feet) that drains from Medina north into Cozy Cove, which is part of Lake Washington (**Exhibit 39**). It is a Type 3 stream located in the Hunts Point jurisdiction. After the stream crosses the SR 520 corridor, it flows for about 1,000 feet north before discharging to the cove. The stream flows through single-family residential neighborhoods, with landscaped lawns immediately adjacent to the stream.

Cozy Cove Creek
Located just downstream of SR 520, Cozy Cove Creek is an example of a stream affected by residential development. The stream is channelized and contained within riprapped banks. The riparian vegetation consists exclusively of grass and landscaping as the stream flows through residential yards.

Just prior to flowing into the cove, the stream runs through emergent and scrub/shrub wetlands. From this wetland upstream to SR 520, the stream is extensively channelized, with most of the bank length armored by riprap. The riparian vegetation zone is very narrow in this reach and is dominated by grass and a few shrubs. Upstream and south of SR 520, the stream flows through a landscaped trail system located between several residences. This reach includes many footbridges and several artificial log weir-formed pools. The riparian zone is wider, with vegetation consisting of grass, shrubs, and some mixed trees.

Exhibit 39. Detail Map of Cozy Cove Creek

Only one piece of instream LWD was present in the surveyed area and, although pools occupy about 20 percent of the habitat (by area), they are all relatively small with little cover. Large gravel is the dominant stream substrate, and there is a moderate degree of substrate embeddedness. The amount of surface fines varies from 7 to 9 percent. About 540 feet upstream of SR 520, the culvert under Northeast 28th Street is a total barrier to fish passage because its outlet is perched 4.5 feet above the channel.

The fish resources of Cozy Cove Creek have not been inventoried, but juvenile cutthroat trout were observed in the stream at the time of the habitat surveys in May 2002. The very small size of the tributary and its limited accessible length (less than 1,400 feet) make it unlikely that any of Lake Washington's salmon spawn in the stream. Juvenile coho and possibly Chinook salmon migrating along Lake Washington shorelines may use the lower reaches of the stream or the wetland at the mouth of the stream for short-term rearing, although the quality of habitat is substantially degraded from natural conditions.

Tributary of Yarrow Bay

The tributary of Yarrow Bay is the westernmost stream that flows into the Yarrow Bay wetland. The Yarrow Bay wetland is a large (over 80 acres) wetland complex that is one of the few remaining large wetland areas along the shores of Lake Washington (**Exhibit 40**). The wetland filters contaminants from surface water runoff prior to discharge into Lake Washington and serves as an important storage area for flood waters. Beaver activity in the wetland provides a large amount of LWD that provides habitat for salmonids.

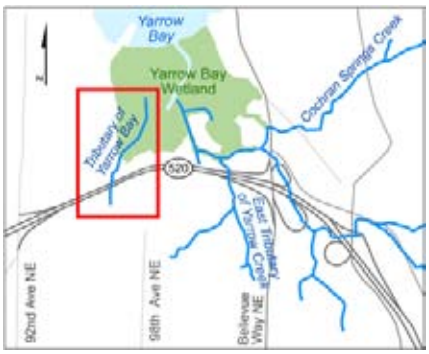


Exhibit 40. Detail Map of Tributary of Yarrow Bay

The stream originates in Clyde Hill from a stormwater pipe that discharges from under Northeast 35th Street. The water flows down a steep concrete chute to the base of the slope. This chute presents a total fish passage barrier. Below the chute, the stream flows over some broken concrete slabs before entering the long culvert under SR 520 and Northeast Points Drive.

Fish passage is blocked at the outlet of the culvert passing under SR 520, where the pipe is perched over 6 feet high. Menconi and Johnson (1998) said that this culvert, at river mile (RM) 0.2, blocks migratory fish passage. A large area has eroded at the outlet, probably because of scouring from high peak flows. The stream is entrenched downstream through a relatively high-gradient reach, with an exclusively riffle habitat. Farther downstream, the stream gradient decreases and the channel becomes braided and diffused as it enters the Yarrow Bay wetland complex in Kirkland. The substrate is dominated by large gravel. Although moderate amounts of LWD is present, it does not form pools. The riparian corridor along the stream is a wide and well-developed deciduous forest consisting of moderately dense, medium-sized trees. Channel widths in this reach average about 4 feet. There are no known fish inventories of this tributary to Yarrow Bay; however, based on the stream size and instream habitat conditions, the stream could support cutthroat trout up to the impassable culvert under Northeast Points Drive and SR 520.

Culvert on Tributary of Yarrow Bay
This culvert is an example of a complete fish passage barrier. The pipe, which runs under Northeast Points Drive and SR 520, has a 6-foot drop from the outlet. The banks are eroding at the culvert outlet, likely due to large magnitude streamflows during storms.

Yarrow Creek and Tributaries

Yarrow Creek (WRIA 08-0252) is about 3 miles long. Its headwaters are in Bellevue just east of I-405, about 2 miles north of the I-405/SR 520 Interchange. The stream flows south for about 1.75 miles, crosses I-405,

Exhibit 41. Yarrow Creek and Associated Tributaries

then flows about another mile in a general northwesterly direction (paralleling SR 520) before flowing through the Yarrow Bay wetland into Yarrow Bay in Kirkland (**Exhibit 41**). King County (2004b) measured mean streamflows in Yarrow Creek at between 1 and 2 cfs. Two tributary streams to Yarrow Creek (west tributary and east tributary) flow north from Bellevue, cross SR 520, and flow into Yarrow Creek near the north edge of the Yarrow Bay wetland. The streams' lengths on the south side of SR 520 are 600 feet (west tributary) and 0.5 mile (east tributary), respectively. Streamflow in these tributaries is most likely less than 1 cfs under most conditions; however, specific flow data are not available. In the reach paralleling SR 520, the stream crosses the highway twice—once near Lake Washington Boulevard and once near 108th Avenue Northeast.

The lower mainstem of Yarrow Creek flows through an extensive wetland complex. The habitat consists primarily of glides with bankfull widths of approximately 6 feet. There are a relatively high number of pools present, and the riparian vegetation consists of scrub/shrub wetland plants with a few scattered deciduous trees. Some LWD is present, and there are overhanging vegetation and undercut banks to provide fish cover. During high overbank flows, the surrounding wetland could also provide fish access to places to take refuge from fast-flowing water. Substrate in the glide and pool areas consists of mostly fine sediment, but coarse gravels and small cobbles predominate in riffles.

Yarrow Creek is on the Ecology 303(d) list because it exceeds the fecal coliform criteria (Ecology 1998). King County water quality monitoring data from 1997 to 2002 showed that while 20 percent of the samples in Yarrow Creek exceeded the fecal coliform standards, only 4 percent of the samples exceeded the dissolved oxygen standards (King County 2004b). Metals measured in stormwater samples did not exceed the state criteria (King County 2004b). The mean temperature was measured at 10.8ºC (with a range of 7.5ºC to 15.0ºC); no samples exceeded the state water temperature standards.

At the time of the survey, the west tributary had very low flow of just a few gallons per minute. The stream originates in Bellevue from a culvert under Northeast 34th Street, then flows downslope in a channel that is steep, narrow (1 to 2 feet wide), and deeply incised (2 feet deep). The substrate of this stream is silt and sand, with some scattered gravels

and cobbles. At the bottom of the slope, the stream sheet flows over an old access road into a large wetland immediately south of SR 520. Fish passage is restricted, and this stream reach is nonfish bearing. The inlet to the culvert under SR 520 could not be located; it is likely at least partially buried, possibly in the wetland located between the access road and SR 520. Exiting the culvert on the north side of SR 520, the stream meanders for a short distance through an ill-defined channel through the Yarrow Bay wetland before flowing into the Yarrow Creek mainstem in Kirkland.

East Tributary of Yarrow Creek
Located downstream from SR 520, the east tributary of Yarrow Creek is an example of relatively high quality habitat. This reach has good substrate quality, with extensive gravel and cobble, as well as a well-developed riparian zone providing stream shading and instream cover.

The east tributary is the largest of the surveyed tributaries. It flows south from Bellevue through high-quality riffle and pool habitat. South of SR 520, riparian conditions are good, with wide (100 to 300 feet) buffers of dense, mixed forest. Large woody debris is plentiful, which results in the formation of several deep, high-quality pools with cover for fish. General substrate conditions are good, with a variety of small to large gravels predominating, although a high percentage of fines were also recorded. At the bottom of the slope, the stream flows over an old abandoned road, where fish passage is impeded by a structure located in a large pool at the culvert inlet that has a partially screened and perched flow control device. Furthermore, the culvert outlet is perched and has a steep approach. The habitat downstream of the SR 520 culvert is of similar quality, although the stream becomes braided as it enters the Yarrow Bay wetland and flows to Yarrow Creek in Kirkland.

Mainstem of Yarrow Creek
Located downstream from Northeast 108th Street (south of SR 520), the mainstem of Yarrow Creek is an example of a reach that has been affected by invasive, nonnative vegetation. This area is dominated by reed canarygrass. Stream substrate is primarily silt and sand.

The middle reaches of the Yarrow Creek mainstem cross SR 520 twice, at SR 520's interchange with Lake Washington Boulevard and at its interchange with 108th Avenue Northeast. The stream flows through six culverts at these crossings, with more than 900 feet of stream contained in these pipes. None of these are perched, although fish passage could not be determined. In this reach the stream is almost all glide habitat, with a riparian zone consisting of grasses and a few shrubs. Few pools or pieces of LWD are present, and the substrate is dominated by fine sediment. These reaches represent degraded stream habitat. Upstream of SR 520, where Yarrow Creek parallels Northeast Northup Way, habitat

conditions improve, with a greater variety of habitat types and substrates.

The fish resources of Yarrow Creek have not been extensively inventoried. The stream historically supported coho salmon (Williams et al. 1975), which may have used the stream until the 1970s (Schulze *in* Kerwin 2001). Kokanee were presumed to have used the stream, based on historical records of a Native American village located near its mouth (Buerge 1984; Tobin and Pendergrass 1993). It is likely that juvenile coho salmon use the stream channels through the wetland because they have been found in Cochran Springs Creek, a tributary to Yarrow Creek (The Watershed Company 1998). Cutthroat trout were observed in the east tributary and in the mainstem immediately upstream and downstream of I-405. Cutthroat trout inhabit almost the entire length, from the mouth at Yarrow Bay upstream to Bridle Trails State Park (The Watershed Company 1998; Paulson pers. comm. 2004). The very small size of the west and east tributaries and the multiple fish passage barriers on these streams make it unlikely that any salmon access them for spawning. Juvenile Chinook salmon migrating along Lake Washington shorelines may use the mouth and the Yarrow Bay wetland for short-term rearing, although none have been reported in recent surveys.

West Tributary of Kelsey Creek

Although the West Tributary of Kelsey Creek does not cross the SR 520 corridor, its headwaters are located near the SR 520 and I-405 interchange (**Exhibit 42**). In the upper reaches of the stream west of 124th Avenue Northeast, the stream is confined to culverts with no fish habitat. Downstream, the 2.4-mile-long stream flows through central Bellevue to its confluence with the mainstem of Kelsey Creek at Kelsey Creek Park (RM 2.7). Land uses vary widely across the length of the west tributary and include parklands as well as residential and commercial. Several stormwater detention sites are located along the upstream reaches of the stream. Streamflow progresses from slow-moving, beaver-dammed reaches upstream to pool-riffle sequences downstream. Chinook salmon have been observed near the confluence with the Kelsey Creek mainstem, and coho salmon have been reported up to RM 1.0 (King County and 25 authors 2001). No salmon have been

Exhibit 42. Map of West Tributary of Kelsey Creek Headwaters

reported in the upper 1 mile of the stream, a large amount of which is located within pipes.

Potential Effects of the Project

What methods were used to evaluate the project's potential effects on fish resources?

Biologists on the ecosystems discipline team analyzed the potential effects of the SR 520 Bridge Replacement HOV Project on fish resources by reviewing existing information on the fish resources of Lake Washington, Portage and Union bays, and the streams within the project area. Project biologists, along with resource agency representatives, made visual inspections of the habitat conditions. We surveyed streams that cross through the proposed project corridor on the Eastside to identify habitat conditions and fish passage barriers. We also assessed project design data and WSDOT construction practices to identify changes to fish habitat likely to occur during and following construction of each project alternative.

How would the project permanently affect fish and aquatic habitat?

The proposed project would place new structures and/or maintain existing structures within the shorelines, open water, and stream habitats supporting fish species in the Lake Washington watershed. Where new structures would be constructed, the existing structures would be removed. These changes would be in the Portage Bay and Union Bay portions of the area, the open waters of Lake Washington, the eastern shoreline of Lake Washington, and three tributaries to Lake Washington. Bridge fixed-approach structures would be placed over new shoreline areas. A wider floating portion of the Evergreen Point Bridge would be placed over the open waters of Lake Washington. Existing bridge structures would be removed in Portage Bay, Union Bay, and over Lake Washington. New fish-passable replacement culverts would be installed to convey several Eastside streams under the expanded roadway.

Seattle and Lake Washington

No permanent changes to aquatic habitat within Seattle would occur outside the Portage Bay, Union Bay, and Lake Washington shoreline area. Existing bridge structures would be removed and new higher and

wider structures would be constructed across Portage Bay, Union Bay, and the Washington Park Arboretum. The existing floating bridge over Lake Washington would be replaced by a new double-pontoon structure immediately north of the existing bridge.

No Build Alternative

The Continued Operation Scenario assumes that continued maintenance would allow the corridor to continue operation until 2030, with no unplanned loss of structures from old age or natural disaster. No physical changes to Lake Washington, the existing shoreline, or project area streams would occur in this scenario. The amount of untreated stormwater runoff entering the lake from SR 520 would remain unchanged. It is possible that concentrations of pollutants and contaminants could change as the result of improvements in automobiles that reduce emissions or increases in traffic volumes. However, there is no way to accurately predict any such changes that could occur. Therefore, it is assumed that because the Continued Operations Scenario would not increase impervious surface area, it would result in little change to existing water quality and not change effects on fish populations.

The Catastrophic Failure Scenario assumes that some portion of both the Portage Bay Bridge and the Evergreen Point Bridge would be lost before 2030. The foreseeable effects of losing these structures would be large amounts of concrete rubble or bridge pontoons deposited on the shorelines and the bottom of the lake, depending on the location and nature of the failure.

4-Lane Alternative

The 4-Lane Alternative would replace the existing Portage Bay Bridge at the same location with the widening to the north. The west approach to the Evergreen Point Bridge along the Union Bay shoreline would also be replaced and widened to the north. The existing support columns, roadways, pontoons, and anchor systems would be replaced with similar but larger structures than are present now. The new roadway and bridges would overlap the existing bridges (the existing bridges would be removed). The 4-Lane Alternative would cover more of the shorelines and open water due to its greater width than the existing bridges.

The 4-Lane Alternative would be wider (**Exhibit 43**) at each place where the bridge would cross the Lake Washington shoreline and would be

higher over Portage Bay and the Arboretum than the existing bridges. At the Portage Bay shorelines, the new bridge would range from about 30 feet to 89 feet wider at the west and east ends, respectively. Over the Arboretum, the 4-Lane Alternative would be about 54 feet wider on the west side of Foster Island and 36 feet wider on the east side.

Exhibit 43. Approximate Widths (in feet) of Bridges at Shoreline Crossings, by Alternative

Location	Existing (No Build Alternative)	4-Lane Alternative	6-Lane Alternative
Portage Bay			
West shoreline	62	94	148
East shoreline	78	180	198
Foster Island			
West shoreline	96	150	224
East shoreline	60	96	147
Lake Washington			
East shoreline	65	154	180

The 4-Lane Alternative would be slightly to substantially higher above the shorelines and water than the existing Portage Bay Bridge and the Evergreen Point Bridge on the east side of Union Bay. Both proposed bridges are sufficiently high at the west shoreline of Portage Bay (**Exhibit 44**) and at Foster Island (**Exhibit 45**) to allow natural vegetation to grow underneath. Mature trees (40 to 80 feet high) currently grow within the shadow of the existing Portage Bay Bridge.

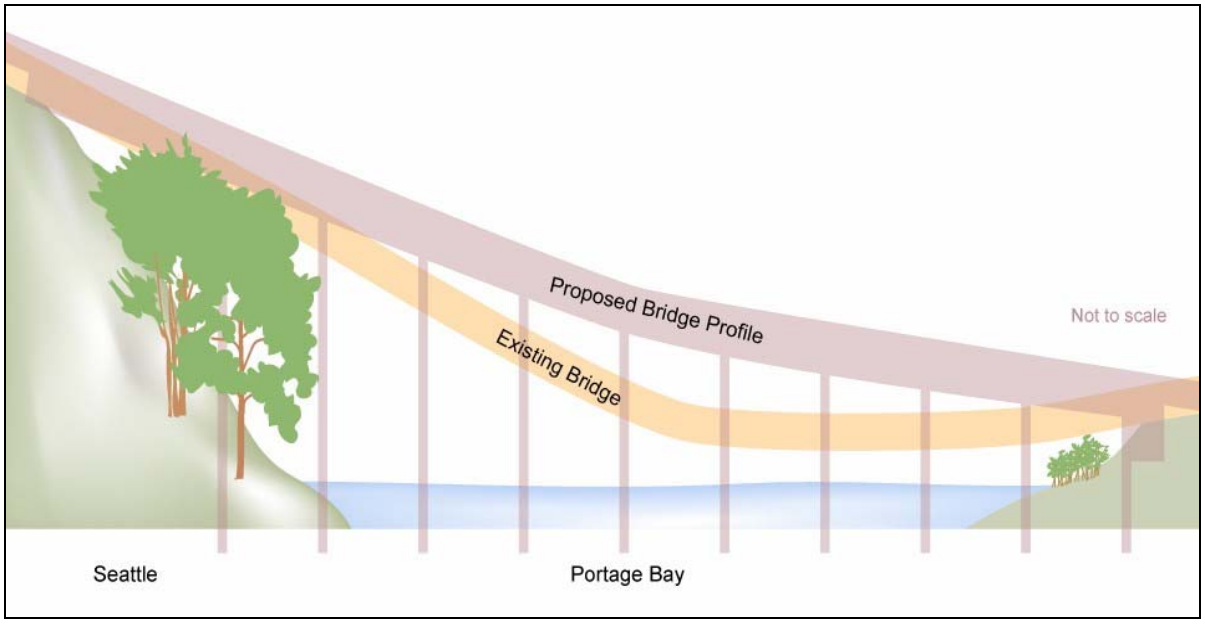


Exhibit 44. Profile of Approximate Height of Existing and Proposed Bridge over Portage Bay and its Shorelines

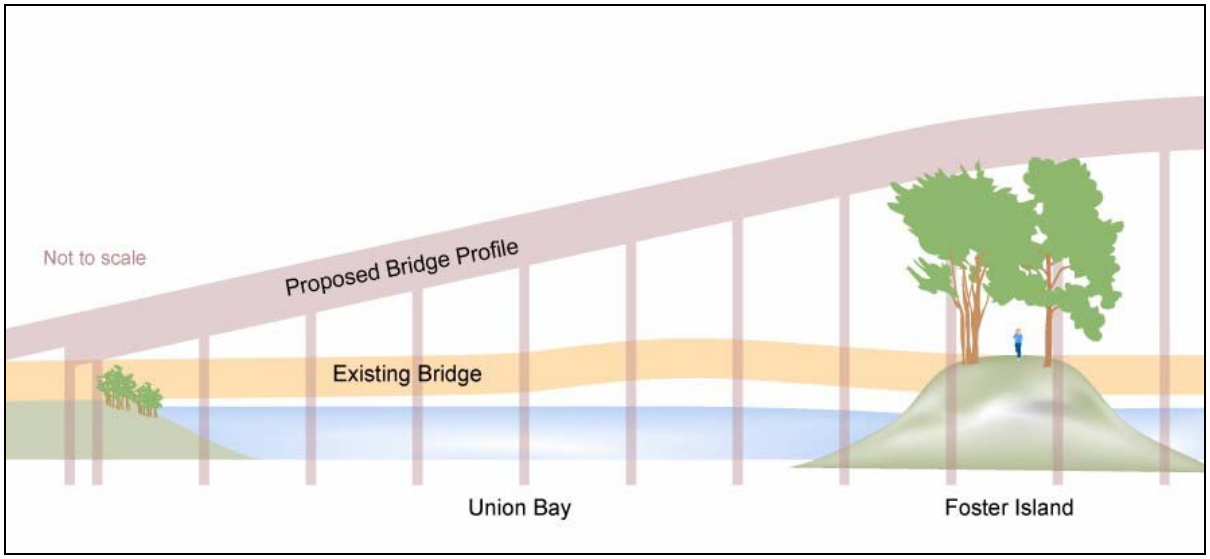


Exhibit 45. Profile of Approximate Height of Existing and Proposed Bridges over Union Bay Portion of Arboretum

Under the 4-Lane Alternative, the Portage Bay Bridge would be 16 feet higher in its midsection than the existing bridge and 6 feet higher at the west shoreline of Portage Bay (**Exhibit 46**). Compared to the existing bridges, the greater height of the proposed bridges would reduce the shading effect by allowing more light to penetrate underneath the structures. The increased light would be offset, however, by the wider bridge structures. These changes would improve habitat for fish and aquatic vegetation.

Exhibit 46. Approximate Distance (in feet) from Bottom of Bridges to Water Surface

Location	Existing (No Build Alternative)	4-Lane Alternative	6-Lane Alternative
Portage Bay			
West end	60	66	66
Mid-span	11	27	27
East end	9	12	12
Arboretum Area			
West end	4	14	14
East end	7	48	48

Concrete columns would support the Portage Bay Bridge and the fixed west approach structure of the Evergreen Point Bridge. **Exhibit 47** lists the numbers of support columns for various portions of the Portage Bay and Evergreen Point bridges. Existing columns are about 4 feet in diameter; the new columns would be about 10 feet in diameter. Existing

columns cover about 12.6 square feet of bottom area each; the new columns would cover about 78.5 square feet each. Thus, under the 4-Lane Alternative, the new columns would occupy about 14,400 square feet (0.3 acre) of lake bottom area compared to 6,800 square feet (0.2 acre) for the existing bridges.

Exhibit 47. Approximate Numbers of Concrete Columns for Portions of the Bridges, by Alternative

Location	Existing (No Build Alternative)	4-Lane Alternative	6-Lane Alternative
Portage Bay	76	54	54
West Approach, Evergreen Point Bridge	454	122	162
East Highrise, Evergreen Point Bridge	14	8	8

Paired concrete pontoons, about 410 feet long by 60 to 75 feet wide, would support the floating portion of the Evergreen Point Bridge. The pontoons would extend deeper in the water column and cover a larger area than those supporting the existing bridge (**Exhibit 48**). The pontoons would extend about 3 feet deeper in Lake Washington and displace about 22.8 acre-feet more of the lake water than the current bridge. Pontoons supporting the existing floating bridge extend the full width of the bridge. Under the 4-Lane Alternative, the pontoons would be paired with a lagoon between the pontoons.

Exhibit 48. Area and Dimensions of Pontoons for the Floating Portion of the Evergreen Point Bridge, by Alternative

Location	Existing (No Build Alternative)	4-Lane Alternative	6-Lane Alternative
Floating bridge length	7,578 feet	7,620 feet	7,620 feet
Pontoon area, total	10.4 acres	21.5 acres	27.3 acres
Pontoon depth	8-9 feet	12 feet	12 feet
Pontoon width	60 feet	60 feet	75 feet

The 4-Lane Alternative without expanded pontoons capable of supporting high-capacity transit would be approximately 2 feet shallower. The effect would be a minor decrease in the amount of space occupied by the pontoons in Lake Washington.

Stormwater runoff from the new structures (with increased impervious surface area) would be treated prior to release to the receiving waters. In Portage Bay and Union Bay, stormwater would be collected and

treated, in contrast to today where stormwater is directly discharged to Lake Washington. On the Evergreen Point Bridge, fine particulate material containing metals would be removed from the road surface by high-efficiency sweeping.

6-Lane Alternative

Under the 6-Lane Alternative, the Portage Bay and Evergreen Point bridges would be wider than the 4-Lane Alternative bridges, thus shading more of the shorelines and aquatic habitat in Portage Bay, Union Bay, and Lake Washington (see **Exhibit 45**). However, the bridges would also be higher above the shorelines than the existing bridges, thereby allowing greater light penetration under the structures.

At the Portage Bay shorelines, the Portage Bay Bridge would be 148 feet wide at the west shore, expand to 160 feet wide at mid-bay, and expand further to 198 feet wide at the east shore. This is wider than the existing bridge, which is 62 feet wide at the west shore and mid-bay, and 78 feet wide at the east shore. Over the Arboretum, the 6-Lane Alternative would be 224 feet wide at the west shore and 147 feet wide at the Foster Island shore. The existing bridge is 96 feet and 60 feet wide, respectively, at these locations (see **Exhibit 43**).

Mature trees (40 to 80 feet high) grow within the shadow of the existing Portage Bay Bridge. The new bridge proposed under the 6-Lane Alternative would be substantially higher (16 feet) than the existing bridge over the middle of the bay and at the west shore (6 feet higher). The increased height of the bridge compared to the existing bridge would reduce the degree of shading, but would increase the width of the area shaded. Overall, habitat for fish and aquatic vegetation would improve compared to the existing habitat because of the reduced light differential at the edge of the shadow and the increased amount of riparian vegetation overhanging the shoreline.

The 6-Lane Alternative would also have concrete columns supporting the west approach, west highrise, and east highrise of the Evergreen Point Bridge. The size of the columns would be larger than the existing bridge, but there would be fewer columns (see **Exhibit 47**), with substantially greater space between the columns. The 6-Lane Alternative columns would cover approximately 0.4 acre of lake bottom.

The 6-Lane Alternative would increase the amount of impervious surface area draining to Portage Bay, Union Bay, and Lake Washington. All stormwater runoff from the roadway, bridges, and ramps would be

collected and treated prior to release to Lake Washington, Portage Bay, and Union Bay.

The pontoons supporting the floating portion of the Evergreen Point Bridge would extend deeper into Lake Washington and cover a larger area than with existing conditions (see **Exhibit 48**). The pontoons would extend about 3 feet deeper in the lake and displace about 40.5 acre-feet more of Lake Washington water.

Eastside

No Build Alternative

No physical changes to Eastside streams would occur from the Continued Operation Scenario. The amount of untreated stormwater runoff from SR 520 would remain unchanged. Concentrations of pollutants and contaminants may change as the result of possible vehicle improvements that could reduce emissions or through projected increases in traffic volumes, although these potential changes in water quality cannot be accurately predicted. It is likely that fish habitat conditions and effects on fish would not change substantially under the Continued Operation Scenario.

If the Catastrophic Failure Scenario were to occur, the water quality in Eastside streams that currently receive runoff from SR 520 would be maintained or improved because of the substantial decrease in traffic volumes on the Eastside following bridge failure. No physical changes to Eastside streams are anticipated. Therefore, instream habitat would be maintained or slightly improved compared to existing conditions.

4-Lane Alternative

The primary potential effects of the 4-Lane Alternative on fish habitat in the Eastside project area would relate to construction of a bridge operations facility, replacement of existing culverts that cross under SR 520, additional impervious surfaces (including alteration of the streams, existing hydrologic regimes, and water quality), and the loss of riparian vegetation. These effects would result primarily from the widening of the SR 520 roadway and from the construction of additional impervious surfaces.

Bridge Operations Facility

Under the 4-Lane Alternative, the Evergreen Point Bridge would be about 90 feet wider than the existing bridge at the eastern shoreline of Lake Washington. This alternative would construct a bridge operations

facility on the east shore of Lake Washington under the east end of the bridge. The facility would include a dock extending about 70 feet from the shoreline under the bridge. A 50-foot boat and an 18-foot boat would be moored at the dock.

The dock would provide new over-water cover where two residential wood docks currently exist. The new dock would have a metal grating deck, supported by steel piles. The dock would extend over the sockeye spawning area identified on WDFW map records (Buchanan pers. comm. 2004). The effect of the facility and its dock on sockeye spawning is uncertain. Sockeye currently can be found along Lake Washington shorelines where docks are common. Redds have not been observed beneath docks but occur immediately adjacent to docks (Paulson pers. comm. 2004). Construction of the bridge operations facility on the hillside could potentially alter groundwater flow and discharge, which may provide the stimulus for sockeye to spawn at this location.

Culverts

The 4-Lane Alternative would replace or lengthen culverts to accommodate widening of the roadway. Lengthening a culvert would require placing a currently open stream channel inside a culvert. Fairweather and Cozy Cove creeks, the only fish-bearing streams where these activities would be necessary (**Exhibit 49**), would experience a net loss of approximately 47 lineal feet of open-channel habitat.

The loss of open-channel habitat can have a negative effect on fish habitat. However, both of the culverts that require lengthening are known or suspected fish passage barriers. In cases where culvert lengthening would occur on perennial fish-bearing streams that contain suitable fish habitat upstream from the SR 520 crossing, the longer replacement culverts would be designed and constructed to be fully fish passable in accordance with Washington Department of Fish and Wildlife (WDFW) guidelines (WDFW 2003). The preferred option for culvert replacement, where feasible, would be an arch or box culvert that has natural streambed material throughout. This would maintain some of the structure and functions present in the open water reaches of the streams (for example, natural substrate and hydraulic roughness). If full replacement of the culverts is not feasible from an engineering standpoint, the existing culverts could be retrofitted to be fully fish passable through the use of culvert baffles or other engineering means.

Because of these improvements, overall fish passage conditions in Eastside streams would be improved at the Fairweather and Cozy Cove

crossings. In addition to upgrading fish passage conditions in the lengthened culverts, several other culverts not directly affected by the project would be upgraded as part of mitigation activities (see *Fish Resources Mitigation* section and **Exhibit 49**). To the extent possible, project design would seek to avoid and minimize loss of open stream channel by designing replacement structures that incorporate natural substrate on the bottom of the culvert.

Stream Water Quantity

As discussed in Appendix T, *Water Resources Discipline Report*, the 4-Lane Alternative would add approximately 9.5 acres of additional impervious surface to Eastside stream sub-basins. This is about a 54 percent increase in impervious surface area for the new roadway on the Eastside. However, negative effects on stream hydrology would be expected to be minimal because of the following factors:

- WSDOT would detain and treat all stormwater drainage to fish-bearing streams in the Eastside project area. Stormwater detention facilities would be designed in accordance with the WSDOT *Highway Runoff Manual* (2004).
- During storms, the duration and magnitude of stormwater discharge into Eastside streams would be less than with the No Build Alternative.
- The additional impervious surface from the 4-Lane Alternative represents approximately 1.4 percent of the total impervious surface within Eastside stream sub-basins, and thus would contribute a relatively small portion of the overall streamflow.

Because there are no stormwater facilities in the Eastside project area today, the 4-Lane Alternative would have beneficial effects on the magnitude of peak flows within Eastside streams compared to the No Build Alternative. Likewise, no negative effects on stream base flows would occur from the increase in impervious surface.

Stream Water Quality

Stormwater that runs off of SR 520 in the Eastside project area today is not treated before it is discharged into streams or ditches that eventually drain to Lake Washington. Under the 4-Lane Alternative, all stormwater entering Eastside streams would be treated for water quality before being discharged into streams. Stormwater discharges to Eastside basins for the 4-Lane Alternative would comply with water quality regulations, in accordance with WSDOT's *Highway Runoff Manual* (WSDOT 2004). Therefore, stormwater discharge would not

have adverse effects on aquatic life within Eastside streams. See Appendix T, *Water Resources Discipline Report*, for further information about stormwater quality and pollutant loading.

Exhibit 49. Effects of Build Alternatives on Eastside Culvert Crossings

Stream Name	Station Location (4-Lane)	Fish Passage Barrier?	4-Lane Alternative		6-Lane Alternative	
			Lineal Feet of Pipe Extension Required	Proposed Actions[c]	Lineal Feet of Pipe Extension Required	Proposed Actions[c]
Fairweather Creek	265+50	Partial[a]	27	Replace or retrofit culvert to be fully fish passable[a]	41	Replace or retrofit culvert to be fully fish passable[a]
Cozy Cove Creek	284+00	Potential[b]	20	Replace or retrofit culvert to be fully fish passable[a]	40	Replace or retrofit culvert to be fully fish passable[a]
Tributary to Yarrow Bay	318+20	Total[a,b]	None	Ameliorate erosion problem at outlet as project mitigation	None	Ameliorate erosion problem at outlet as project mitigation
West Tributary to Yarrow Creek	328+50	No stream is present upstream of SR 520	None	None	None	None
East Tributary to Yarrow Creek	337+50	Total[a,b]	None	Replace or retrofit culvert to be fully fish passable[a] as project mitigation	40	Replace or retrofit culvert to be fully fish passable[a]
Mainstem Yarrow Creek	None	Potential[b]	None, but stormwater discharge site	None (possible project mitigation site)	None, but stormwater discharge site	None (possible project mitigation site)
Mainstem Yarrow Creek	180 feet above northwest ramp	Potential[b]	None	NA (outside alternative alignment)	None	Replace or retrofit culvert to be fully fish passable[a]
Mainstem Yarrow Creek	354+50 (northwest ramp)	Potential[b]	None	NA (outside alternative alignment)	None	Replace or retrofit culvert to be fully fish passable[a] as project mitigation
Mainstem Yarrow Creek	354+50	Partial[a]	None	NA (outside alternative alignment)	25	Replace or retrofit culvert to be fully fish passable[a]
Mainstem Yarrow Creek	360+00 (southeast ramp)	Potential[b]	None	NA (outside alternative alignment)	None	Replace or retrofit culvert to be fully fish passable[a] as project mitigation
Mainstem Yarrow Creek	365+50	Partial[a]	None	NA (outside alternative alignment)	None	Replace or retrofit culvert to be fully fish passable[a] as project mitigation

[a] Classified by WSDOT and WDFW (2003).
[b] Classified based on site reconnaissance.
[c] Culverts would be designed to be fully fish passable according to WDFW (2003).
CMP = Corrugated Metal Pipe
NA = Not Applicable

Riparian Vegetation

Removing streamside vegetation to construct the expanded roadway would reduce the amount and quality of LWD recruited to streams, reduce stream shade that in turn could increase stream temperatures, and destabilize effects on streambanks, thus adding to streambank erosion. The ecosystems discipline team calculated riparian buffer effects using the limits of construction defined in the preliminary design plans, which extend 5 feet outside the footprint of permanent structures under the 4-Lane Alternative. The effect numbers are approximate and may not depict the exact permanent clearing area.

Permanent effects on riparian buffers would occur along three streams in the Eastside project area and would total approximately 7,500 square feet (**Exhibit 50**). However, much of this area is also classified as wetland or wetland buffer, and those effects would be mitigated as discussed previously in the *Wetlands* section of this discipline report.

Exhibit 50. Riparian Buffer Effects on Eastside Streams from Proposed Project, by Alternative

Stream	Permanent Fill within Riparian Buffer (square feet)	
	4-Lane Alternative[a]	6-Lane Alternative[b]
Fairweather Creek	1,962	5,962
Cozy Cove Creek	5,543	6,823[a]
Tributary to Yarrow Bay	26	1,018
West Tributary of Yarrow Creek	0	0
East Tributary of Yarrow Creek	0	10,070
Mainstem Yarrow Creek	0	8,750
Totals	**7,531 (0.17 acre)**	**32,623 (0.75 acre)**

[a] Approximately 63 percent of the total affected riparian buffer area for this alternative was classified and accounted for as wetland and/or wetland buffer effects. The amount of buffer counted as wetland or wetland buffer was 44 percent for Fairweather Creek, 71 percent for Cozy Cove, and 100 percent for the Yarrow Bay Tributary.

[b] Approximately 60 percent of the total affected riparian buffer area for this alternative was classified and accounted for as wetland or wetland buffer effects. The amount of buffer previously counted as wetland or wetland buffer was 85 percent for Fairweather Creek, 59 percent for Cozy Cove, 100 percent for the Yarrow Bay Tributary, 9 percent for the East Tributary to Yarrow Creek, and 100 percent for the Yarrow Creek Mainstem.

Depending on the stream, the amount of permanent buffer that would be removed because of placement of fill would range from 26 to 5,543 square feet under the 4-Lane Alternative. Clearing of vegetative material along the Cozy Cove Creek and Fairweather Creek corridors could potentially reduce instream cover, which would have adverse effects on fish. Although the existing riparian conditions along the

streams vary, the majority of streams have riparian buffers that are already moderately to severely degraded under existing conditions. Therefore, many of the functions that riparian vegetation provides (such as LWD recruitment, contribution of organic material, and regulation of stream temperatures) are already altered and would not be substantially affected compared to existing conditions. In streams where effects to riparian vegetation losses would be large or involve removing trees or large shrubs that provide substantial shade, stream buffer mitigation would occur where feasible (see the *Fish Resources Mitigation* section for details).

6-Lane Alternative

The general types of potential effects on Eastside fish habitat from the 6-Lane Alternative would be identical to those discussed for the 4-Lane Alternative. This would include the construction of a bridge operations facility, replacement of culverts that cross SR 520, increased impervious surfaces (including alteration of the streams, existing hydrologic regimes, and water quality), and removal of riparian vegetation. The difference between the 4-Lane and 6-Lane Alternatives would be the magnitude and locations of these potential effects.

Bridge Operations Facility

The Evergreen Point Bridge would construct a new bridge operations facility on the east shore of Lake Washington under the east end of the bridge. The facility would be the same as for the 4-Lane Alternative described above. The new dock would extend over a sockeye spawning area identified on WDFW map records (Buchanan pers. comm. 2004). The effect of the facility and its dock on sockeye spawning is uncertain. Sockeye currently inhabit Lake Washington shorelines where docks are common. Redds have not been observed beneath docks but occur immediately adjacent to docks (Paulson pers. comm. 2004). Construction of the bridge operations facility on the hillside could potentially alter groundwater flow and discharge, which may provide the stimulus for sockeye to spawn at this location.

Culverts

The 6-Lane Alternative would replace or extend culverts to accommodate widening of the roadway. Lengthening a culvert would require replacing a currently open stream channel inside a culvert. Four fish-bearing perennial streams (Fairweather Creek, Cozy Cove Creek, the East Tributary to Yarrow Creek, and the Yarrow Creek mainstem) would require replacement or lengthening of the culverts under SR 520

(see **Exhibit 47**). Approximately 146 lineal feet of open-channel habitat would be lost due to culvert extensions. As with the 4-Lane Alternative, the new culverts would be designed and constructed to be fully fish passable in accordance with WDFW guidelines (WDFW 2003); replacement culverts that maintain some aspects of natural stream form would be the preferred option for culvert replacements.

Although the 6-Lane Alternative would result in a net loss of open-channel fish habitat in these four streams, fish passage conditions would improve where these streams cross SR 520. Compared to the 4-Lane Alternative, the 6-Lane Alternative would result in more length of stream being lost, but would improve overall fish passage for the East Tributary to Yarrow Creek and the Yarrow Creek mainstem. Because the East Tributary to Yarrow Creek has a minimum of 500 feet of moderate-to-good salmonid habitat upstream of SR 520, the 6-Lane Alternative would improve more fish habitat (based on fish passage) than the 4-Lane Alternative.

In addition to fish passage upgrades from culvert lengthening, fish passage conditions at several other culverts not directly affected by the proposed project would be upgraded as part of mitigation activities (see *Fish Resources Mitigation* section and **Exhibit 49**).

Stream Water Quantity

As discussed in Appendix T, *Water Resources Discipline Report*, the 6-Lane Alternative would add approximately 15 acres of additional impervious surface to Eastside stream sub-basins. This translates into a 56 percent increase in impervious surface in the Eastside project area compared to the No Build Alternative. Effects that could occur because of the additional impervious surface and the factors that minimize and reduce these effects are identical to those discussed previously for the 4-Lane Alternative.

None of the stormwater from the existing roadway is currently detained. Although the 6-Lane Alternative would generate more stormwater runoff due to increased impervious surface area, this alternative would benefit Eastside streams by reducing the magnitude of peak flows compared to today. Also, the existing relative contribution of runoff from SR 520 to streamflows is relatively small compared to the entire drainage basin. Impervious surface of the 6-Lane Alternative represents less than 4 percent of the total impervious surface in the Eastside stream sub-basins. No negative effects on stream base flows would occur from the increase in impervious surface.

Stream Water Quality

WSDOT does not currently treat runoff from SR 520 in the project area before it is discharged into conveyance features (streams or ditches). Under the 6-Lane Alternative, all stormwater entering Eastside streams would be treated for water quality before discharging to the streams, which would meet water quality standards in Eastside streams. Changes to stormwater quality would be similar to those described above for the 4-Lane Alternative.

Riparian Vegetation

The 6-Lane Alternative would permanently remove 32,623 square feet of riparian vegetation (due to placement of fill) at five Eastside streams (see **Exhibit 50**). This is about four times more riparian buffer loss than under the 4-Lane Alternative. Depending on the stream, the area of riparian buffer loss would range between 1,000 to 10,000 square feet.

Under the 6-Lane Alternative, 10,000 square feet of riparian buffer would be cleared along the East Tributary of Yarrow Creek compared to no buffer loss from the 4-Lane Alternative. The area that would be cleared is along a narrow but functional existing buffer. The mainstem of Yarrow Creek also would have substantially more riparian buffer loss under the 6-Lane Alternative because the alignment would extend farther to the east, where the stream parallels SR 520. However, the riparian buffers of Yarrow Creek are already moderately to severely degraded under existing conditions, and the habitat that would be lost is mainly reed canarygrass, which is a nonnative, invasive plant species.

The 6-Lane Alternative would result in minor effects on the Eastside streams' ability to recruit LWD, contribute organic material to downstream waters, and regulate temperature. In individual cases where effects on riparian vegetation along the streams would include removal of large shrubs and trees that provide substantial shading (for example, along the East Tributary to Yarrow Creek), revegetation would occur where feasible (see the *Fish Resources Mitigation* section for details). Due to its larger footprint, the 6-Lane Alternative would have comparatively greater negative effects on stream buffers than the 4-Lane Alternative.

How would project construction temporarily affect fish and aquatic habitat?

Temporary structures would be constructed over aquatic habitat, which would disturb riparian soils and vegetation, and disturb bottom

sediment in the water at some locations within the project area. This work would include construction of temporary bridge structures on temporary piles, in-water construction of support columns, construction of the new roadway, placement of floating bridge anchors in Lake Washington, movement of pontoons into position, removal of the existing column-supported bridges, and removal of the temporary bridges and their piles.

How would construction potentially affect fish resources in Portage Bay, Union Bay, and Lake Washington?

Construction of the Portage Bay Bridge and Evergreen Point Bridge for both the 4-Lane and 6-Lane Alternatives would require building temporary bridge structures and work platforms for work access or as temporary roadways. For the 4-Lane Alternative, the temporary structures would remain in place for up to 3 years over Portage Bay and up to 4 years over Union Bay and the east side of Lake Washington. For the 6-Lane Alternative, the temporary structures would remain in place for up to 5 years. The Portage Bay temporary bridges would be 30 feet wide and located on both the north and south sides of the new bridge. The Union Bay-Lake Washington detour bridge would be 60 feet wide and located on the south side of the existing Evergreen Point Bridge. After traffic is shifted to the detour bridge, the existing bridge would then be used as a work platform. The temporary bridges would provide additional shading of up to 4 acres in the Seattle project area for several years. These shallow water areas currently support dense aquatic macrophyte beds in Union Bay-Lake Washington. This habitat supports resident species such as bass, carp, and catfish. It is likely that the milfoil would continue to grow, but the water lilies would not.

Temporary bridges would be supported by rows of steel or untreated wood piles (18- to 24-inch diameter) spaced at 30-foot intervals. Temporary bridges would be about 20 feet or more above the lake surface. If piles are driven with an impact hammer, WSDOT or its contractors would take appropriate measures to attenuate noise energy transmission to the water to minimize injury to fish in the immediate vicinity of pile driving. See Appendix H, *Geology and Soils Discipline Report*, and Appendix M, *Noise Discipline Report*, for more information on attenuation of noise energy.

Up to 450 temporary steel piles (5,580 square feet for 24-inch piles) would be placed in Portage Bay. About 1,110 to 1,600 temporary piles (13,764 to 19,840 square feet for 24-inch piles) would be placed in the

area of the west approach to the Evergreen Point Bridge. Most of these piles would be placed in shallow water (2 to 8 feet deep) with mud substrate and dense aquatic vegetation, a place where transmission of baropressure would be minimized compared to deeper, open water. All piles would be pulled during removal of the temporary bridges upon completion of construction. The temporary piles would occupy additional bottom area during the construction period; the additional structure could potentially attract smallmouth bass. However, the mostly dense aquatic vegetation where the temporary piles would be located is already habitat for bass and species with similar requirements.

Driving steel piles with an impact hammer has the potential to injure or kill some fish. Under certain conditions, the hammer impacts can transmit sufficient sound pressure to the adjacent water to physically affect fish. Hammer-type pile driving can produce sound pressure levels of about 190 decibels (dB) (re: 1 μPa) at a distance of about 150 feet in deep water (WSDOT 2003). Sound pressure levels of 180 dB can damage the auditory hair cells of fish. Sound pressure levels in excess of 180 dB can lead to barotrauma (hemorrhage or rupture of internal organs such as the swim bladder and kidneys, or damage to the auditory system), potentially resulting in fish mortality.

In shallow water less than 6 feet deep, sound pressure attenuates more quickly than in deep water. Pile driving for bridge construction would occur in areas with depths in the range of about 5 to 40 feet (WSDOT 2003).

Driving piles in water can affect the general behavior of fish within a radius of 6 to 700 yards of the source (Feist 1991). According to one study, juvenile pink and chum salmon showed some avoidance of the immediate pile-driving location but did not change their shoreline orientation or cease foraging (Feist 1991). The potential effects of driving wood versus steel piles appear to be different. Wood piles may not transmit as much sound energy to the water.

Effects on fish can be minimized by employing a bubble curtain or other sound-attenuating devices around the pile. In the project area, where current velocities are low, bubble curtains are likely to be effective in reducing sound transmission and the potential to injure hearing in fish or produce tissue damage in their swim bladders.

Using a vibratory hammer instead of an impact hammer can minimize the effects of driving steel piles in the water because it produces lower sound pressure levels. Piles driven with a vibratory hammer commonly require proofing with an impact hammer to ensure the appropriate weight-bearing capacity. However, use of a vibratory hammer may not be feasible on the proposed project because of the existing soil conditions and other design constraints. It is likely that piles could be driven using a combination of both vibrating and impact hammer equipment, but additional geotechnical analysis must be performed before a preferred approach is selected.

Concrete bridge support columns would be constructed by the drilled shaft method. Steel cylinders would be inserted and sediment excavated from within the cylinder to provide a space to cast in place the concrete support column. The steel cylinder would prevent release of excavated sediment during construction. Water pumped from inside the cylinder would be treated prior to discharge to Portage Bay or Lake Washington, preventing degradation of water quality, which could adversely affect fish.

In-water construction would be limited by permit conditions to approved work windows (specific time frames). The current standard in-water work period for the Ship Canal (Portage Bay) is October 1 to April 15. For Union Bay and Lake Washington, the in-water work period is July 16 to April 30. Some construction would likely occur during hours of darkness or reduced light. Therefore, artificial lighting would be required in work areas on the construction bridge and the new bridge. Lighting would be directed onto work areas and would avoid direct illumination of the lake and shorelines as much as practical to avoid affecting fish behavior.

Construction of the bridges would involve transporting large girders, pontoons, and other materials by barge through the Ship Canal and Lake Washington. Work vessels would also move through the same area. These vessels would operate for prolonged periods in the shallow water along the bridge alignment in Portage Bay and Union Bay, which could produce propeller wash that disturbs soft sediment in the shallow areas. Work vessels would also operate for prolonged periods along the floating portion of the Evergreen Point Bridge to place anchors and pontoons.

Both vessel movements and construction from vessels have the potential to conflict with Tribal fishing in Portage Bay, Union Bay, and

Lake Washington. Fishers could be displaced or lose fishing gear because of construction activities or vessel movements.

How would construction of the floating bridge pontoons for the Evergreen Point Bridge potentially affect fish resources?

Under the 4-Lane and 6-Lane Alternatives, the Evergreen Point Bridge would require construction of reinforced concrete pontoons and anchors. These would be constructed at a graving dock to be built as part of the Hood Canal Floating Bridge Project.

A graving dock is a large, gated channel excavated next to the shoreline of a body of water. When a group of pontoons and anchors have been constructed, the graving dock is flooded to float the pontoons and anchors. For this project, flooding of the graving dock would follow a protocol developed by WSDOT, in cooperation with WDFW, NOAA Fisheries, and USFWS, for construction of the Hood Canal Bridge pontoons. Work dates at the graving dock would be limited by fish restrictions, as detailed in the Hydraulics Project Approval (HPA) for the Hood Canal Floating Bridge Project to be issued by WDFW. All applicable screening requirements would be followed during pumping operations. The graving dock gate would then be opened, and a tug would tow the pontoons and anchors out of the graving dock into the adjacent body of water. The pontoons and anchors would be towed to the Evergreen Point Bridge site in Lake Washington.

The Hood Canal Floating Bridge Project will satisfy the ESA's requirements for construction and operation of a graving dock by obtaining Biological Opinions from USFWS and NOAA Fisheries. Continued operation of the graving dock to manufacture the pontoons and anchors for the Evergreen Point Bridge will be covered in a Biological Assessment to be submitted to NOAA Fisheries and USFWS for the SR 520 Bridge Replacement and HOV Project.

How would construction potentially affect fish resources in the Eastside project area?

Construction of the project could temporarily affect streams in the Eastside project area. These effects, which include increased sedimentation and altered streamflow, are discussed in more detail in the following sections.

4-Lane Alternative

Construction of the 4-Lane Alternative could temporarily disturb instream habitat, which would alter streamflow patterns, increase sedimentation, and alter stream buffer and riparian vegetation. These potential effects on fish from instream work are primarily associated with construction activities, such as replacing or extending culverts and installing retaining walls, but would be minimized or eliminated by the implementation of appropriate BMPs (see *Fish Resources Mitigation* section for details).

Direct Disturbance and Stream Diversions

Construction equipment and construction personnel entering a stream can disturb fish, their prey, and aquatic habitat. Except where absolutely necessary, construction equipment would not enter below the ordinary high water mark of Eastside streams. Where it is necessary to enter the stream below the ordinary high water mark (as in the case of culvert replacements/extensions), streams would be dewatered prior to replacing or lengthening culverts. Dewatering and stream diversions could strand or entrain (draw in) fish and create temporary barriers to fish migration. However, fish stranding and entrainment would be minimized or eliminated by the application of WSDOT policy, which requires appropriate NOAA Fisheries protocols for fish exclusion and handling be applied for all projects.

Before beginning in-water work, all fish would be excluded from the work area by physical means (for example, with nets or sandbags) and removed from the work area with appropriate methods (such as electrofishing or dipnetting). BMPs to reduce potential effects from this action include dewatering during the driest time of the year when migrations of salmon are least likely. Project construction would adhere to the terms of project permits, including timing restrictions. The duration of any in-water work, including stream diversions, would be limited to the shortest time possible. Care would be taken to prevent fish from recolonizing the work areas before construction is finished. These measures should minimize any adverse effects on fish species from the 4-Lane Alternative construction activities.

Instream Sedimentation

Constructing culvert extensions/replacements, retaining walls, and stormwater facility discharges could introduce fine sediments into Eastside streams, primarily through erosion and runoff processes. Fine sediments can negatively affect fish and fish habitat within streams.

These effects would be greatest in stream reaches inhabited by salmon during critical spawning periods or rearing periods, where a blanket of fine sediment could diminish abundance and diversity of streambed invertebrate (fish food) production. Unavoidable or uncontrolled sediment inputs on streambed gravels would affect future suitability for fish spawning unless fall/winter peak flows "flush out" sediments introduced during the construction period.

The potential for erosion and sedimentation would be highest where construction activities occur within or directly adjacent to streams. Within the Eastside project area, these areas include streams that cross or flow adjacent to SR 520 and where construction work must take place in-water (below the ordinary high water mark) or adjacent to or above project area waterbodies.

These potential sedimentation effects would be minimized by:

- **Avoidance**—The 4-Lane Alternative would use retaining walls to minimize effects on streams, wetlands, and other critical areas. Except where absolutely necessary, construction equipment would not enter below the ordinary high water mark of Eastside streams. Staging areas and stockpiling areas would be located well away from streams and lakes.
- **Construction Methods**—Streams would be dewatered prior to culvert replacement or lengthening work. All conditions of the WDFW HPA and other approvals, including timing restrictions, would be strictly adhered to.
- **Prevention**—Appropriate BMPs (as outlined in the *Fish Resources Mitigation* section) would reduce the risk of erosion and reduce or minimize the chance of sediments entering project waters. Erosion and sediment control measures could include mulching, matting, and netting; filter fabric fencing; quarry rock entrance mats; sediment traps and ponds; surface water interceptor swales and ditches; and the placement of construction material stockpiles away from streams. In addition, a temporary erosion and sediment control plan would be prepared and implemented to minimize and control pollution and erosion from stormwater. Erosion and sediment control BMPs would be properly implemented, monitored, and maintained during construction, so no long-term water quality effects would occur. Even with BMPs, some temporary short-term water quality effects on sediment (such as increases in stream turbidity) are possible, particularly during large

storms. However, the magnitude of these effects would be small and not likely to cause harm to individual fish that may be in the project area.

Stream Buffer and Riparian Vegetation

Permanent effects on stream buffer and riparian vegetation were discussed previously and calculated based on estimates of the construction limits. The construction footprint, which extends 5 feet outside the footprint of permanent structures, would contain the effects from all construction equipment and activities. Because all construction-related activities would occur within these limits, no additional temporary clearing, grubbing, and construction access effects are anticipated. All temporarily cleared or disturbed areas would be replanted with appropriate native vegetation. The primary anticipated construction-related effects on aquatic resources in the Eastside would result from temporary sedimentation and construction noise.

Other Potential Construction Effects

Other potential short-term construction effects could include hazardous materials (for example, oil and gasoline), chemical contaminants, nutrients, or other material entering project area waters. Control of hazardous materials is a standard provision in construction contracts and permits; these would be addressed with BMPs. Servicing and refueling of vehicles would not occur within 100 feet of streams and wetlands to reduce potential spills of petroleum and hydraulic fluids in sensitive areas. The contractor would be required to submit a spill prevention and response plan prior to the commencement of work.

Construction noise, which could disturb or displace fish, could occur for relatively long periods (weeks to months) at any given stream crossing. For all instream work, the HPA would specify a work window that allows construction only when spawning fish are absent. This would eliminate the potential effect of noise. Within the ordinary high water mark of Eastside streams, no instream pile driving is planned as part of the proposed project.

6-Lane Alternative

The 6-Lane Alternative would have the same types of construction effects on streams crossed by SR 520 on the Eastside as the 4-Lane Alternative. The difference between the alternatives would be the magnitude and locations of the effects.

The 6-Lane Alternative would affect more lineal feet of stream and require more culvert replacements than the 4-Lane Alternative (see **Exhibit 49**). Therefore, there would be a greater chance of effects on fish or fish habitat from direct disturbance, flow diversion, or downstream sedimentation. These effects would be minimized by construction timing and by application of the BMPs and conservation measures discussed for the 4-Lane Alternative.

How would project construction affect federally listed species and federal species of concern?

Construction would involve work in and over Portage Bay, Union Bay (Arboretum area), and Lake Washington where Chinook salmon, coho salmon, and bull trout potentially occur. In Lake Washington and its bays, this work would involve driving temporary piles, in-water construction of support columns, placement of floating bridge anchors in Lake Washington, movement of pontoons into position, removal of the existing column-supported bridges, and removal of the temporary piles. In Eastside streams, construction work would involve stream diversions, culvert extensions, and riparian buffer clearing. These activities would potentially affect only coho salmon; bull trout and Chinook salmon are not known to be present within the Eastside streams that would be affected by construction.

Temporary bridge structures necessary for work access and work platforms, or as temporary roadways, could affect habitat supporting juvenile Chinook salmon and bull trout. The temporary bridges would affect shoreline habitat for up to 5 years by providing low-level cover over the shorelines and shallow water. The bridges would be supported by numerous temporary piles that would be removed following construction. Effects would occur primarily in the aquatic vegetation portion of the shoreline habitat, but they would extend into deeper water east of Foster Island. The effects would probably occur over the period of five out-migrations of juvenile Chinook salmon for either alternative.

Most of the construction work would occur in shallow water habitat characterized by dense aquatic vegetation. Chinook salmon and bull trout are not likely to occupy this habitat type.

The impact of pile driving on the lake bottom (substrate) has the potential to injure or kill Chinook salmon and bull trout because it produces sound pressures that can cause barotraumas in the fish (Longmuir and Lively 2001, Stotz and Colby 2001).

The type and size of the pile, the hardness of the substrate, the depth of water, and the type and size of the pile-driving hammer each influence the sound energy produced during pile driving. The size of the pile directly affects the level of sound energy; more energy is required to drive larger piles. Wood and concrete piles produce lower levels of sound energy in water than hollow steel piles of a similar size, and may be less harmful to fish. Firmer substrates produce greater sound energy because they require more energy to drive the piles.

In shallow water, sound attenuates more rapidly as the distance from the source increases (Rogers and Cox 1988). Impact hammers produce intense, sharp spikes of sound, which can easily reach levels that harm fish. The larger hammers produce more intense sounds. Vibratory hammers, on the other hand, produce sounds of lower intensity, with a rapid repetition rate. Sound pressure levels greater than 150 dB root mean square (RMS) may affect fish behavior. Peak sound pressure levels exceeding 180 dB (re: 1µPa) may cause physical injury to fish.

Driving piles in the project area, which has shallow water with soft lake bottom and dense aquatic vegetation, would likely minimize transmission of sound energy. Appropriate and available BMPs would be used during construction to minimize sound energy generation and transmission from pile driving. The numbers of piles driven during construction would be similar for each of the proposed alternatives.

Chinook salmon and bull trout use of the Eastside project area is limited or absent. Habitat parameters (stream temperature, substrate, and depths) are not adequate to support these species, particularly in the vicinity of the proposed SR 520 alternatives. Therefore, no effects from project construction would occur to these species in the Eastside project area.

Coho salmon use at least some of the Eastside streams and could potentially be affected by construction work, including stream diversions, culvert extensions and replacements, and riparian buffer clearing. However, as discussed previously, the use of specific construction methods combined with avoidance/minimization of impacts to sensitive areas where feasible would result in minimal

effects to any juvenile or adult coho salmon present within Eastside project area streams.

How do the alternatives differ in their effects on streams and fish and aquatic habitat?

The build alternatives would have similar effects on fish resources in the lakes and streams in the project area; the effects would vary in magnitude. As **Exhibit 51** shows, the larger footprint of the 6-Lane Alternative (compared to the 4-Lane Alternative) would result in slightly greater temporary and permanent effects on individual habitat parameters within the SR 520 corridor.

The ecosystems discipline team is unable to determine the degree to which the 4-Lane and 6-Lane Alternatives would differ with respect to direct and indirect effects on individual fish or fish populations. Although the length of the construction phase of the proposed 6-Lane Alternative could have slightly greater negative effects on individual fish than the 4-Lane Alternative, the operation of the build alternatives would likely be indistinguishable from each other and an overall improvement compared to today. Improvements to fish and aquatic habitat would result from the higher bridge elevations over shorelines and shallow water (lower intensity, but wider area shaded), fish-passable culverts, and stormwater treatment and detention within the project area.

Fish Resources Mitigation

What would be done to avoid or minimize potential negative effects on fish species or aquatic habitat?

WSDOT has designed each build alternative to include features that would minimize the permanent and construction effects of the proposed alternatives.

Exhibit 51. Summary Comparison of the Potential Effects of the SR 520 Build Alternatives on Fish Resource Habitat Parameters

Project Area	Comparative Basis	Measurement Units	No Build Alternative	4-Lane Alternative	6-Lane Alternative
Portage Bay (west, mid, east)	Height	Feet	60, 11, 9	66, 27, 12	66, 27, 12
	Width	Feet	62, 62, 78	94, 142, 180	148, 155, 198
Portage Bay	Number of support columns [a]	Number	76	54	54
Union Bay (west, east)	Height	Feet	4, 7	14, 48	14, 52
	Width	Feet	126, 96	175, 150	250, 224
Union Bay	Number of support columns[1]	Number	454	122	162
Lake Washington West Approach	Height / Width	Feet	7 / 62	48 / 96	52 / 147
Lake Washington East Approach	Height / Width	Feet	65, 65	70 / 154	70 / 180
Support Column Area—Total	Acre	Acre	0.2	0.3	0.4
All Bridges	Stormwater Management	NA		9.5	14.7
Eastside Streams	Additional impervious surface	Acres		9.5	14.7
	Additional impervious surface	Percent increase over existing roadway		54	56
	Stormwater Management	NA		Runoff treatment and detention	Runoff treatment and detention
	Culverts requiring lengthening	Number of culverts		2	4
	Total length of additional culverts	Feet		47	146
	Culverts undergoing fish passage improvements	Number of culverts		3 to 4	5 to 8
	Riparian buffer effects	Acres		0.17	0.75

The 250-foot-wide shadow produced by the 6-Lane Alternative would be separated into several isolated parts resulting from the separate eastbound and westbound bridges and separate ramps.

[a] Existing support columns are 4 feet in diameter; proposed support columns are 10 feet in diameter.

For both the 4-Lane and 6-Lane Alternatives, the Portage Bay Bridge and west approach to the Evergreen Point Bridge would be higher above the water, thus reducing the shading effects on the water and shorelines compared to the existing bridges. Although the new

structures would be substantially wider, their higher elevations would allow more light to reach shoreline areas currently in the bridges' shadows. This change in light conditions would reduce the light contrast at the shadow edge, thereby reducing avoidance behavior by young salmonids and allowing greater growth of riparian vegetation overhanging shorelines.

The project designers have included retaining walls that limit the effects on streams and stream buffers on the Eastside. Existing culverts that block fish passage would be replaced or retrofitted to be fully fish passable. Although runoff from the existing SR 520 is untreated, stormwater treatment for the new roadway and bridges would be included for both the 4-Lane and 6-Lane Alternatives.

Fish Passable Culvert
This WSDOT culvert, located outside of the project area, is an example of an improved culvert that is fully fish passable. The culvert has a natural streambed throughout its length, and is sized to pass stormflows and debris.

All in-water work would be restricted to authorized construction periods that exclude periods when juvenile salmon are likely to be present in substantial numbers. Adherence to designated work windows, as identified by the appropriate agencies (WDFW, NOAA Fisheries, and USFWS), would also eliminate or reduce in-water interference during periods when returning adult salmon are present.

The potential effects of driving piles or support columns could be minimized by several methods. BMPs for sound pressure attenuation during pile driving would reduce the transmission of energy to the surrounding water, thus minimizing levels that could potentially injure fish.

WSDOT intends to implement measures that would reduce the likelihood of conflict with Tribal fishing, including coordination with the Muckleshoot Tribe to document important access points in areas where proposed structures would be built. Coordination with representatives of the Muckleshoot Tribe has already begun. Additional coordination would be done to avoid construction conflicts with Tribal fishers potentially harvesting salmon in Portage Bay, Union Bay, and Lake Washington.

During bridge construction, contractors would use BMPs to avoid unintentional discharge of sediment from the permanent support column excavation, and a containment system would be used to contain

falling debris during construction of the new bridge deck and demolition of the existing bridge deck.

Contractors would restore temporarily cleared areas to preconstruction grades and replant the areas with appropriate native vegetation.

Additional BMPs that contractors could use during construction include:

- Developing and implementing a temporary erosion and sediment control plan for clearing vegetation removal, grading, ditching, filling, embankment compaction, or excavation. The BMPs in the plan will be used to control sediments from all vegetation or ground-disturbing activities.
- Using effective erosion control measures such as filter-fabric fence, straw mulch, straw bales, and plastic sheeting to prevent silt and soil from entering surface waters (including wetlands).
- Hydroseeding all bare soil areas following grading.
- Clearly labeling streams and stream buffers on construction plans and in the field.
- Demarcating clearing limits with orange barrier fencing wherever clearing is proposed in or near critical areas.
- Locating staging areas and equipment storage areas away from sensitive areas (i.e., streams and wetlands).
- Refraining from vehicle refueling and maintenance activities within 100 feet of streams and wetlands.
- Minimizing the duration of in-water work (below the ordinary high water mark) and strictly adhering to the appropriate fish work windows as dictated by the WDFW HPA permit.

Work over and in the water and along shorelines of Lake Washington and the Ship Canal could follow these additional BMPs:

- Employing energy reduction measures to avoid extreme sound energy transfer to adjacent water that may injure fish during pile driving.
- Surrounding work areas with containment booms to contain debris or spilled fluids.
- Using containment tarps or netting when working over water to retain fallen materials.

- Retrieving any floating debris generated by construction and ensuring disposal of the debris at an appropriate upland site.
- Prohibiting disposed of waste and excess materials below the ordinary high water mark.
- Complying with Washington's surface water quality standards (Chapter 173-201A WAC), which specify a mixing zone beyond which water quality standards cannot be exceeded. Monitoring of water quality would occur during construction to ensure compliance with Ecology's standards to protect fish and aquatic life.
- Preparing a Spill Prevention, Control, and Countermeasures Plan for the project, to be submitted by the contractor to the Project Engineer prior to beginning construction, and maintaining a copy with any updates at the work site.
- Containing excavated sediment in Baker tanks or other appropriate containers to avoid discharge to surface water, and taking the sediments to an approved disposal site.
- Curing concrete before contact with surface water as required by WAC 110-220-070(1)(g) to avoid higher pH levels that can occur when fresh concrete contacts water.
- Checking equipment regularly to prevent spills into surface water from fuel hoses, oil drums, or oil or fuel transfer valves and fittings.
- Keeping the nighttime lighting to the minimum that is necessary for the intended purpose. Lights would be directed onto the work areas and away from the water.

How could the project compensate for unavoidable negative effects on fish or aquatic habitat?

Effects on fish and aquatic habitat would be compensated for with construction of either build alternative. In cooperation with resource agencies, WSDOT would develop plans for habitat improvements, restoration, or construction to mitigate the effects of bridge construction and the increased width of shoreline and shallow water crossings. Specific plans would be included in permit applications for construction of the SR 520 Bridge Replacement and HOV Project.

Restoration of shoreline habitat could include providing shoreline areas with sand-gravel substrate that is devoid of invasive weeds, such as

Eurasian milfoil and white water lily. This shoreline habitat would support rearing/migrating juvenile salmonids.

WSDOT could compensate for culvert lengthening and stream buffer effects on Eastside streams by upgrading identified fish passage barrier culverts located outside of the project area, but near the project corridor. Depending on the alternative selected (see **Exhibit 49**), from one to three culverts could be upgraded, further improving fish passage conditions in the project vicinity.

WSDOT would design the graving dock for the Hood Canal Floating Bridge Project to allow fish to be trapped and removed. Prior to operating the graving dock, WSDOT would prepare a plan to minimize the number of fish trapped in the graving dock when the gate is closed, and to minimize the likelihood of take associated with removing the trapped fish. For construction of the SR 520 pontoons, WSDOT would continue to implement that plan's protective measures.

WSDOT would address stream buffer effects to satisfy the requirements of the local critical areas regulations and to enhance instream fish habitat to the maximum extent possible. There are two approaches for mitigating the effects of clearing riparian vegetation within stream buffers. With the first approach, native riparian vegetation would be planted to improve habitat and provide stream shading along each of the streams where vegetation would be cleared. The extent of riparian planting would be dictated by the extent of the clearing effects. It is likely that the primary focus of this mitigation approach would be on underplanting of currently vegetated areas, which would increase plant density or increase the numbers of native trees and shrubs.

The second approach to mitigating effects on riparian vegetation within stream buffers would involve larger-scale revegetation along fish-bearing streams within or outside (either upstream or offsite) the immediate project area. This approach has several advantages:

- Mitigation could be concentrated along a stream where significant salmonid use is confirmed and where stream reaches have been identified as lacking in riparian vegetation, stream shading, LWD, or bank stability (for example, Yarrow Creek).
- Revegetation could cover sufficient area to improve important stream processes and functions (such as stream temperature, LWD recruitment levels, nutrient cycling, bank stabilization, and floodplain functions) in a meaningful and measurable way.

- Maintenance, monitoring, and adaptive management techniques would be more efficient and effective on one or two large parcels than on multiple small parcels.

Most of the streams affected by the build alternatives would undergo relatively small amounts (less than 10,100 square feet) of clearing in the riparian buffers for construction of the proposed project. The effects on fish from this clearing, if any, would be small in magnitude and difficult to measure, particularly considering the already degraded nature of the existing riparian buffer. Furthermore, onsite mitigation at such sites likely may not substantially improve stream functions. Mitigation for small buffer effects on the streams could be to revegetate another site, where riparian restoration has a greater chance to improve the functions and processes of fish-bearing streams.

For fish-bearing streams with larger buffer effects, priority would be given to revegetating the remaining stream buffer at the same place vegetation was cleared. The combination of both onsite and offsite mitigation would largely maintain existing riparian functions of streams along the proposed project alignment, while substantially improving riparian quality and fish habitat at one or more mitigation sites.

Wildlife and Habitat

Wildlife and habitat are important components of ecosystem health and function. Some of the ways in which wildlife affect ecosystems include consuming vegetation, insects, or other wildlife; providing a source of prey and nutrients to other animals; and serving as a mechanism of seed dispersal.

Affected Environment

How was information on wildlife habitat and wildlife occurrence collected?

The ecosystems discipline team generally looked for the occurrence of wildlife and wildlife habitat up to 1/4 mile from the proposed project alignment. The 1/4-mile boundary was chosen because the proposed project generally could affect wildlife and habitat within this area. However, because nesting bald eagles (a federally threatened species) have the potential to be affected by pile driving out to 1 mile from a given nest site, we documented the occurrence of bald eagle nests sites out to 1 mile from the proposed project alignment.

The ecosystem discipline team identified basic landscape cover types and the specific wildlife habitats within each cover type for all areas within 1/4 mile of the project corridor. For example, we identified Parks and Other Protected Areas as a cover type, and noted deciduous forest, coniferous forest, wetland, and other habitats within this cover type.

The team also reviewed reports from the Washington Department of Fish and Wildlife (WDFW) and other sources about the habitat associations and distribution of wildlife in the project area vicinity. The WDFW Priority Habitat and Species (PHS) database provided information on specific locations of priority species and priority habitat. WDFW defines priority species as those species that are priorities for conservation and management. Priority species include state endangered, threatened, sensitive, and candidate species; animal aggregations considered vulnerable; and those species of recreational, commercial, or Tribal importance that are vulnerable. Priority habitats

are those habitat types or elements with unique or significant value to a diverse group of species.

We reviewed USFWS information about known or expected occurrences of federally listed species and federal species of concern in King County and conversed with federal, state, and local biologists to obtain additional species occurrence information. To supplement the existing data, the ecosystem discipline team investigated field conditions and reviewed aerial photographs of the project area to categorize the cover types and to identify habitat occurrence within these cover types.

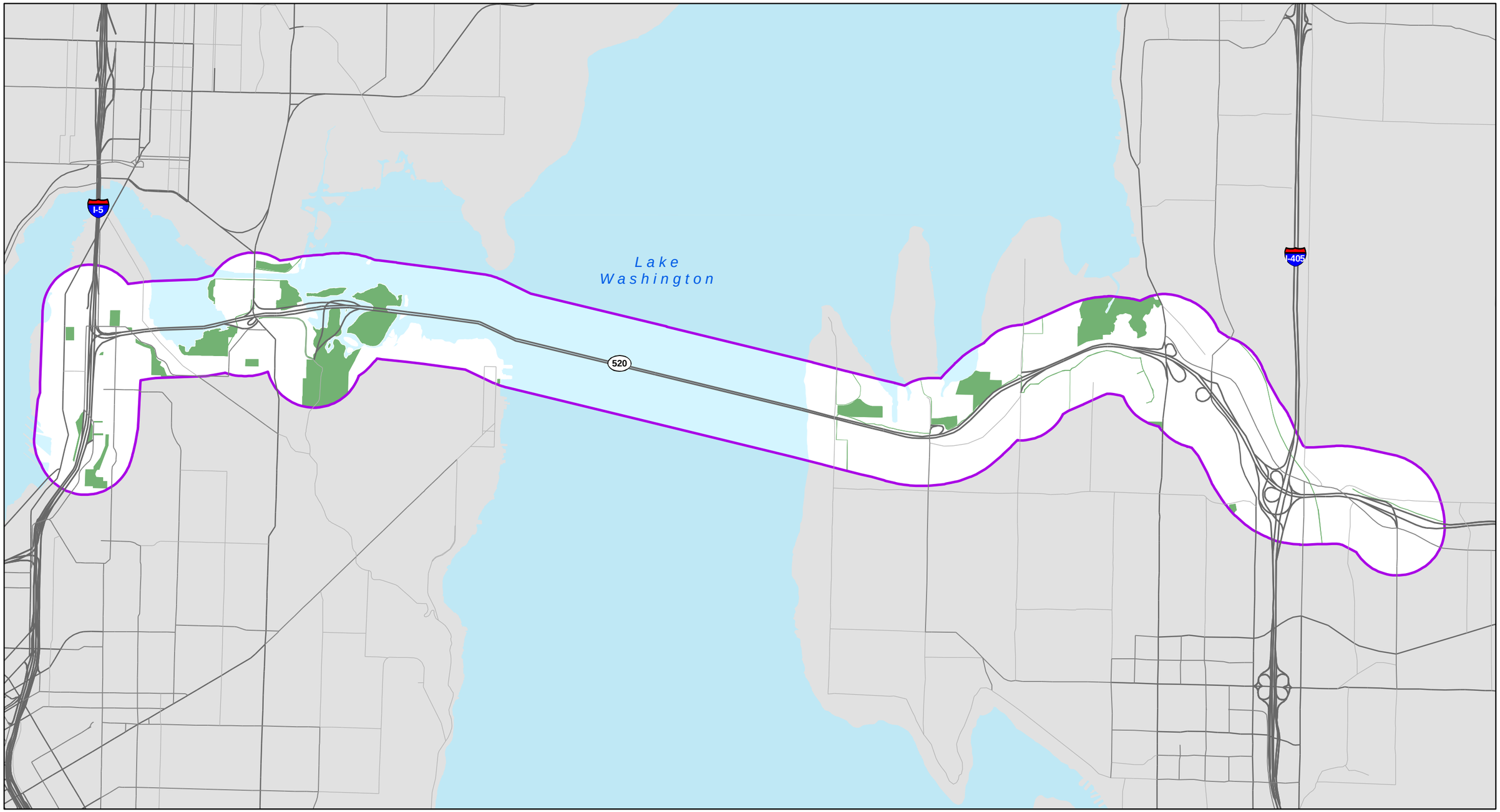
What are the landscape cover types and wildlife habitat characteristics of the project area?

The project area was categorized into three cover types based on similarities in landscape features (for example, presence of vegetation, buildings, roads) and expected wildlife occurrence and use. The three cover types in the project area include (1) Urban Matrix, (2) Open Water, and (3) Parks and Other Protected Areas. **Exhibit 52** shows the location of the existing habitat types in the project area. Within these landscape cover types, various habitats are present, as described further in **Exhibit 53**.

Typical habitat in the Urban Matrix cover type

Typical habitat in the Open Water cover type

Typical habitat in the Parks and Other Protected Areas cover type



Project Area (within 1/4 mile)

Open Water

Parks and Other Protected Areas

Urban Matrix

N

0 2,500 5,000 Feet

Exhibit 52. **Existing Habitat Types in the Project Area**

SR 520 Bridge Replacement and HOV Project

File Path: P:\Parametrix\168395\180171 SR 520 Bridge Replacement\GIS\Layouts\Ecosystems\Habitat\Habitat.mxd

Exhibit 53. Project Area Landscape Cover Types, Habitats, and Representative Associated Wildlife

Cover Type	Description	Habitat Occurrence and Representative Associated Wildlife	Other Notes
Urban Matrix	Commercial and residential areas with buildings, asphalt, ornamental gardens, lawns, and scattered trees.	Limited wildlife habitat available. Roadside deciduous and coniferous trees provide some habitat for common birds (e.g., European starlings, American robins, American crows, black-capped chickadees). Ornamental and native trees and shrubs in residential lots provide habitat for additional species (e.g., Steller's jays, northern flickers, ruby-crowned kinglets, raccoons). Small shrub-scrub, emergent, and forested wetlands provide habitat for Pacific treefrogs, garter snakes, raccoons, song sparrows, bushtits, and other songbirds. Wildlife species diversity is generally expected to be greater in the larger and more structurally diverse wetlands. Riparian vegetation along Fairweather Creek and most of Cozy Cove Creek is dominated by ornamental lawns, Himalayan blackberry, and other nonnative vegetation and therefore provides relatively low-quality wildlife habitat. However, a portion of Cozy Creek near Cozy Cove, as well as most of Yarrow Creek and its tributaries within the Urban Matrix cover type, contain riparian trees and shrubs and wetlands that provide habitat for a variety of riparian-associated wildlife.	Most abundant cover type, distributed throughout the project area. Approximately 64 percent of the project area is Urban Matrix. Urban Matrix in the Eastside generally provides higher quality wildlife habitat than Urban Matrix in Seattle due to the more frequent occurrence of native vegetation in the Eastside Urban Matrix.
Open Water	Portage Bay, Union Bay, and Lake Washington. Lake Union is approximately 0.25 mile from the alignment.	Provides habitat for a variety of freshwater-associated wildlife, including waterfowl, the most common of which are American coots, buffleheads, mallards, scaups, goldeneyes, widgeons, Canada geese, double-crested cormorants, pied-billed grebes, and western grebes; bald eagles; great blue herons; belted kingfishers; river otters; beavers; Pacific treefrogs; and bullfrogs. Bat species forage over open water.	Approximately 29 percent of the project area is open water.

Exhibit 53. Project Area Landscape Cover Types, Habitats, and Representative Associated Wildlife

Cover Type	Description	Habitat Occurrence and Representative Associated Wildlife	Other Notes
Parks and Other Protected Areas	Includes Roanoke Park, Interlaken Park, East Montlake Park, Washington Park Arboretum, Fairweather Park, Wetherill Park, and Yarrow Bay wetland. Parks consisting solely of sports fields are not included because these areas do not provide valuable wildlife habitat.	Near the proposed project alignment, these parks and other protected areas contain mostly upland deciduous forests (usually dominated by big-leaf maple); riparian forests (dominated by cottonwoods and other riparian-associated deciduous trees); and forested, scrub-shrub, and emergent wetlands. The Arboretum contains native upland and wetland habitat. It also maintains an important collection of large, primarily ornamental, tree species near MOHAI. Wetherill Park contains forested areas dominated by Oregon ash. The Yarrow Bay wetland park includes Yarrow Bay Creek and tributaries. The upland forests within the parks and other protected areas provide habitat for a variety of birds, including warblers and other songbirds, hairy woodpeckers, red-tailed hawks, Cooper's hawks, and band-tailed pigeons. Wildlife associated with the wetlands and riparian areas include red-winged blackbirds, marsh wrens, great blue herons, belted kingfishers, beavers, mink, foraging bats (e.g., little brown bats and big brown bats), Pacific treefrogs, and garter snakes. Large cottonwoods, which are most abundant in the Washington Park Arboretum, are capable of providing great blue heron, bald eagle, and other raptor nest and perch sites. Great-horned owls and wood ducks are known to occur at Wetherill Park (Audubon Society 1999). Wood ducks are also present at the Arboretum.	Approximately 7 percent of the project area is Parks and Other Protected Areas habitat type. Seattle includes Roanoke Park, Interlaken Park, East Montlake Park, and the Arboretum. The Eastside includes Fairweather Park, Wetherill Park, and the Yarrow Bay wetland. Lake Washington does not contain parks or other protected areas.

Do any federally listed species occur in the project area?

USFWS (2004) identified six federally listed wildlife species (bald eagle, Canada lynx, gray wolf, grizzly bear, marbled murrelet, and northern spotted owl), two federally listed plant species (marsh sandwort and golden paintbrush), and one candidate wildlife species (yellow-billed cuckoo) as occurring or potentially occurring in King County. The SR 520 Bridge Replacement and HOV Project area contains suitable habitat for only one of these species, the bald eagle.

Bald eagle nest in the Arboretum near the proposed project

Bald Eagle

Bald eagles generally are found along shores of saltwater and freshwater lakes and rivers that support substantial prey densities (generally anadromous fish or waterfowl) (Livingston et al. 1990, Stalmaster 1987). Breeding bald eagles use large trees for nesting that are generally within a mile of and have an unobstructed view of water (ODFW 1996; Anthony and Isaacs 1989). Nest trees are usually found in old-growth or residual old-growth stands, but some nesting also occurs in riverine and lakeside forests dominated by cottonwood (ODFW 1996). Both breeding and wintering bald eagles forage over open water and use riparian trees (often cottonwoods) for perching. The occurrence of bald eagles in the project area is presented in **Exhibit 54**.

Exhibit 54. Bald Eagle Breeding Territories near the Project Area

Breeding Territory	Distance from Alignment	Nest Site and History
Broadmoor	Northern portion of territory includes the project alignment	Territory contains three nest sites in the Arboretum area south of SR 520. Nest #1 was active in 1998 (productivity unknown) and 1999 (unsuccessful – i.e., produced no fledgings); the site is approximately 1,250 feet from the project alignment. Nest #2 was active in 2000 (two young) and 2001 (successful, but number of young unknown); the site is approximately 900 feet from the project alignment. Nest #3 was active in 2002 (productivity unknown), 2003 (productivity unknown), and 2004 (unsuccessful); the site is approximately 1,500 feet from the project alignment.
Hunts Point	Territory extends to approximately 600 feet south of project alignment	Territory contains two nest sites. Nest at Yarrow Bay wetland was active in 1996 (one young), 1997 (one young), and 1998 (two young); the site is approximately 900 feet from the project alignment. The Hunts Point nest, which was active in 1999 (productivity unknown), 2000 (unsuccessful), and 2001 (one young), is approximately 2,300 feet from the project alignment. This nest site was not checked in 2002, 2003, or 2004.

Source: WDFW (2004), Stofel (pers. comm. 2004).
Note: Broadmoor territory includes nests at Washington Park Arboretum.

Do any federal species of concern occur in the project area?

USFWS (2004) identified six mammal species, three bird species, four amphibian species, one reptile species, three invertebrates species, and three plant species as federal species of concern that are known to occur or may occur in King County (Attachment 3). The project area contains suitable habitat for only one of these species, the peregrine falcon. Isolated sightings of western pond turtles are likely pet releases in Lake Washington. Viable populations of these turtles do not occur in the area. Western pond turtles have been nearly extirpated from the Puget Sound area, largely due to habitat alteration and loss, disturbance from humans, and introduction of nonnative predators (WDFW 1993a).

Peregrine Falcon

The peregrine falcon nests on coastal cliffs and rocks, especially on the outer coast and on the San Juan Islands (Smith et al. 1997). However, the species has been documented nesting on skyscrapers in urban areas, such as in Seattle (**Exhibit 55**).

Do any state-listed or other state priority wildlife species occur in the project area?

Two state-listed endangered species, the western pond turtle and the peregrine falcon, and one threatened species, the bald eagle, are known to occur near the project area (WDFW 2003). In addition, seven other state priority species—the western grebe, common loon, great blue heron, hooded merganser, wood duck, band-tailed pigeon, and pileated woodpecker—are known to or may occur in the vicinity. Bald eagles and peregrine falcons are described in the preceding section. Information on the western grebe, common loon, great blue heron, hooded merganser, wood duck, band-tailed pigeon, and pileated woodpecker is provided in **Exhibit 55** and in the following sections.

Exhibit 55. Occurrence of Threatened, Endangered, and Other Wildlife of Special Interest in the Project Area

Species	Seattle	Lake Washington	Eastside
Bald Eagle[a]	One bald eagle territory with three associated bald eagle nest sites, one in the Arboretum and two at the Broadmoor Golf Course, and wintering bald eagles around Portage Bay and Lake Union.	Wintering bald eagles forage on waterfowl and fish in the lake.	One bald eagle territory with two associated bald eagle nest sites (see **Exhibit 52**).
Peregrine Falcon	Forages in vicinity of Union Bay, where pigeons and waterfowl are prey.	No known occurrence.	No known occurrence.
Western Pond Turtle[a]	Documented sightings of individuals have been reported at the Arboretum, but viable population not present. Sightings represent released pets.	No known occurrence.	No known occurrence.
Western Grebe	Wintering western grebes occasionally occur at Union Bay. Not present in summer.	Wintering western grebes in Lake Washington. Not present in summer.	No known occurrence.
Common Loon	No known occurrence.	Rarely observed in winter on Lake Washington. Not present during summer.	No known occurrence.
Great Blue Heron	Forages in wetlands in the Arboretum, Portage Bay, and Union Bay.	Most use is limited to shallow waters outside of Lake Washington.	Forages in wetlands at Wetherill Park and the Yarrow Bay wetland. Heron rookery with three nests occurs at the Yarrow Bay wetland.[b]
Hooded Mergansers and Wood Ducks	In winter, occasionally occur in wetland and open water habitats at the Arboretum.	Rarely observed on the lake during the winter months.	Wood ducks probably nest at Wetherill Park.[c] In winter, hooded mergansers and wood ducks may occasionally occur in wetland and open water habitats in the vicinity of Wetherhill Park and Yarrow Bay wetland.
Band-tailed Pigeon	May nest in forested areas of the Arboretum	Does not occur.	May nest in forested portions of parks and other protected areas (e.g., Wetherill Park and Yarrow Bay wetland).
Pileated Woodpecker	May occasionally forage in the Arboretum. Nesting pileated woodpeckers are not expected in the vicinity.	Does not occur.	May occasionally forage at the parks (e.g., Wetherill Park). Nesting pileated woodpeckers are not expected in the vicinity.
Red-tailed Hawk	May occasionally forage in the Arboretum.	Does not occur.	A red-tailed hawk nest site occurs at the Yarrow Bay wetland.[d]

[a] WDFW (2004).
[b] The rookery is approximately 500 to 600 feet north of the proposed project alignment. The nests were first detected in February 2004; nesting activity at the rookery has not been monitored (Parametrix 2004).
[c] Audubon Society (1999).
[d] The nest site, which is approximately 900 feet from the proposed project alignment, has not been monitored in recent years.

Western Grebe and Common Loon

In the winter, western grebes and common loons are associated with the coastal waters and lakes of western Washington. Common loons are less common than western grebes in western Washington. Both species forage on fish.

Great Blue Heron

Great blue herons are associated with both freshwater and saltwater wetlands, seashores, rivers, swamps, marshes, and ditches (WDFW 2003). This species feeds on aquatic and marine animals in shallow waters and occasionally preys upon mice and voles (Calambokidis et al. 1985, Butler 1995). Nests of these colonial breeders are usually constructed in the tallest trees available at a given site (WDFW 2003).

Hooded Merganser and Wood Duck

Hooded mergansers and wood ducks are grouped together under the Cavity Nesting Ducks category of WDFW's PHS database. Only nesting individuals are considered priority species. In Washington, hooded mergansers and wood ducks nest primarily in late-successional forests and riparian areas adjacent to low-gradient rivers, sloughs, lakes, and beaver ponds (WDFW 2003). The ducks nest almost exclusively in tree cavities; as secondary cavity nesters, they use natural cavities or cavities created by large woodpeckers. In addition, both species will use artificial nest boxes where available. Nest trees are generally greater than 24 inches diameter-at-breast height (dbh) (WDFW 2003).

Band-Tailed Pigeon

Band-tailed pigeons may occur in the project area during the breeding season (April to September). During this time, the birds nest in both coniferous and deciduous forests.

Pileated Woodpecker

The pileated woodpecker is generally associated with older forests that have large trees, snags, and coarse woody debris (Aubry and Raley 1993, Nelson 1988). These birds may also use younger forests for foraging, where snags are present (WDFW 2003). In addition, pileated woodpeckers are known to occasionally forage on suet feeders, utility poles, and fruit trees in suburban areas (WDFW 2003).

Do any other wildlife species of special interest occur in the project area?

Other species of special interest include those species that receive protection by county and/or city ordinances but are not federally or state-listed or considered state priority species. These locally protected species include raptors, particularly raptor nest sites. Raptor nests and eggs are also protected under the federal Migratory Bird Treaty Act and the state Revised Code of Washington (RCW 77.15.130).

The project area contains a documented red-tailed hawk nest site. The red-tailed hawk is primarily associated with forest and woodland edges (Shuford 1993). Nests of this species are usually in large trees within open woods or small woodlots that provide good views of surrounding areas (Shuford 1993, WDFW 1993b). Unobstructed access to the nest and isolation from disturbance are generally important nest site characteristics as well. However, active nests have been documented in areas with a high degree of disturbance, such as along the I-5 corridor (Smith et al. 1997).

How are these protected species distributed within the project area?

All of the protected species mentioned above potentially use one or more parts of the project area occasionally if not more frequently. For some species (for example, the peregrine falcon), use is limited to the Seattle habitats such as the Washington Park Arboretum. Other species (such as the western grebes and common loon) use Lake Washington but do not typically inhabit other areas. Bald eagles, pileated woodpeckers, red-tailed hawks, and great blue herons are known to use Eastside habitats such as Wetherhill Park and/or Yarrow Bay wetland. Exhibit 55 describes the occurrence of protected species within each portion of the project area.

Do WDFW priority wildlife habitats occur in the project area?

WDFW priority habitats within the SR 520 project area include urban natural open space, riparian areas, and wetland areas (WDFW 2004). Urban natural open spaces are described under the Parks and Other Protected Areas cover type in Exhibit 53. The occurrence of riparian areas and wetlands are also described in Exhibit 53, as well as the *Wetlands* and *Fish Resources* sections of this report.

Potential Effects of the Project on Wildlife and Wildlife Habitat

What methods were used to evaluate the project's potential effects on wildlife and habitat?

The ecosystems discipline team biologists evaluated the project's potential effects on wildlife and habitat using various methods and resources, including the following:

- GIS analysis and site reconnaissance to determine acreage, type, and location of affected habitat
- Review of anticipated construction and highway traffic noise effects on raptor nest sites and other high quality or sensitive habitat areas
- Review of anticipated construction and highway traffic effects on water quality and quantity
- Literature review of the effects of road construction and operation on wildlife and habitat

How would the project permanently affect habitat and associated wildlife species?

The project has the potential to permanently affect habitat and/or wildlife through four primary mechanisms or pathways:

1. Vegetation effects from direct removal, shading, and changes in hydrology
2. Water quality effects from changes in stormwater
3. Noise disturbance from increased noise levels in the highway vicinity
4. Changes in obstructions to animal movement

The likelihood and anticipated magnitude of these potential effects are described below for each alternative. Effects from wildlife habitat fragmentation would be negligible because the area is already fragmented by the existing roadway. Detailed information on wetland

effects are described in the *Wetlands* section. Effects on fish resources are described in the *Fish Resources* section.

Seattle and Lake Washington

What are the effects of vegetation removal and shading on wildlife habitat?

No Build Alternative

The Continued Operation Scenario would not result in changes to vegetation or wildlife habitat. Under the Catastrophic Failure Scenario, the loss of the bridges could increase light levels and vegetation growth in some shoreline areas, which could improve wildlife habitat by providing additional forage and cover. However, the affected area would be small, and significant changes in wildlife distribution and abundance are not expected.

4-Lane Alternative

In Seattle under the 4-Lane Alternative, vegetation would be removed from areas where the roadway is on the ground, and shaded where the roadway (bridges and approaches) would be elevated, such as in Portage Bay and through the Arboretum (**Exhibits 56** and **57**). Construction of the elevated roadway would also include some removal of vegetation for placement of columns to support the roadway. Approximately 2.4 acres of vegetation (mostly trees and shrubs/grasses) would be removed within the Parks and Other Protected Areas cover type, approximately 0.02 wetland acre would be removed within the Open Water cover type, and approximately 8.1 acres of vegetation (mostly shrubs/grasses) would be removed within the Urban Matrix cover type (**Exhibit 56**). Shading effects would occur to approximately 3.6 acres of vegetation (wetlands, trees, and shrubs/grass) within Parks and Other Protected Areas cover type, approximately 3.0 wetland acres within the Open Water cover type, and approximately 0.9 acre of vegetation (mostly trees) in the Urban Matrix cover type (**Exhibit 56**). Actual shading effects in individual areas would depend on roadway height in the area and existing vegetation cover. Wetland vegetation is expected to be more sensitive to shading than other vegetation types. As mentioned in the *Mitigation* section, native shade-tolerant vegetation would be planted in areas under the elevated roadway and ramps, where feasible and practical.

Exhibit 56. Acres of Permanent Vegetation Removal and Shading, by Cover Type and Alternative

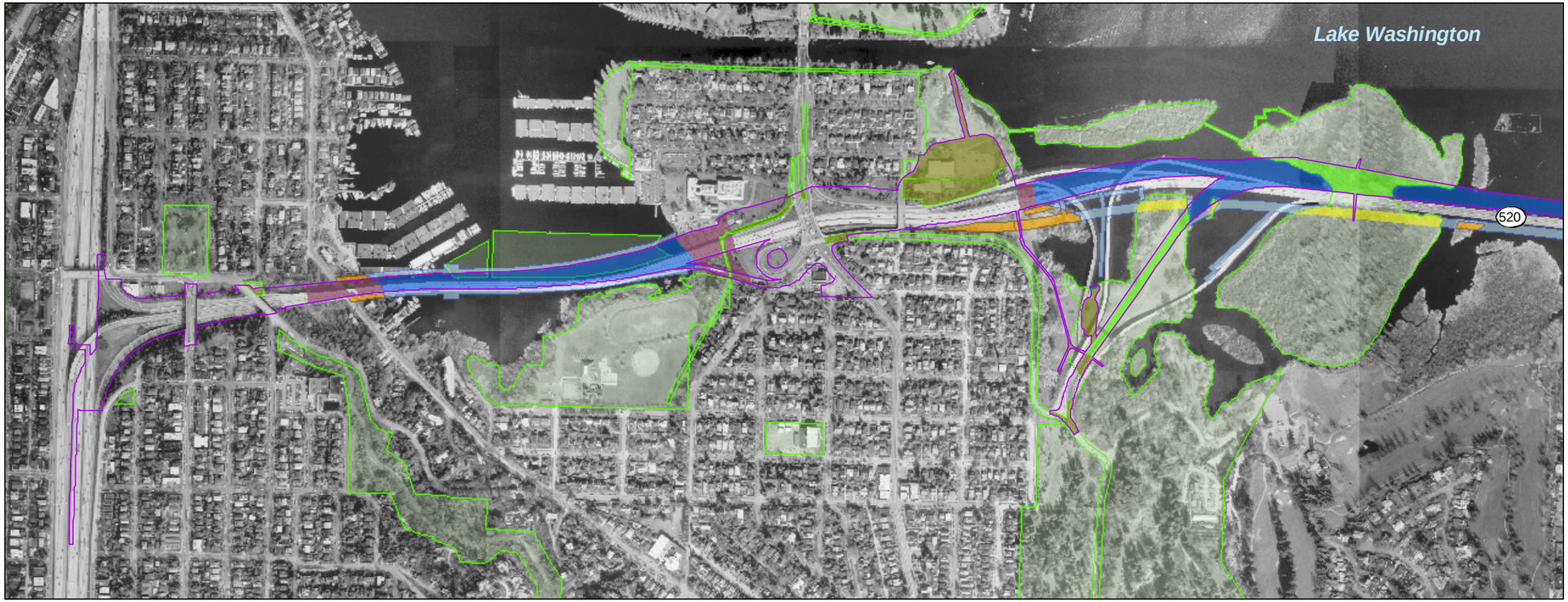
Area, Cover Type, and Habitat Type[a]	4-Lane Alternative			6-Lane Alternative		
	Direct Removal	Shading[b]	Total	Direct Removal	Shading[b]	Total
Seattle						
Parks and Other Protected Areas						
Deciduous and/or Coniferous Trees	0.68	1.12	**1.80**	0.81	1.12	**1.93**
Shrub/Grass	1.60	1.09	**2.69**	2.89	0.33	**3.22**
Wetland	0.14	1.43	**1.57**	0.13	1.62	**1.75**
Total	**2.42**	**3.64**	**6.06**	**3.83**	**3.07**	**6.90**
Open Water[c]						
Wetland	**0.02**	**3.03**	**3.05**	0.11	4.60	4.71
Urban Matrix						
Deciduous and/or Coniferous Trees	2.5	0.74	**3.24**	3.93	0.82	**4.75**
Shrub/Grass	5.59	0.16	**5.75**	7.35	1.29	**8.64**
Wetland	0.02	0.04	**0.04**	0.02	0.44	**0.46**
Total	**8.11**	**0.94**	**9.05**	**11.30**	**2.55**	**13.85**
Seattle Total	**10.55**	**7.61**	**18.16**	**15.24**	**10.22**	**25.46**
Eastside						
Parks and Other Protected Areas						
Deciduous and/or Coniferous Trees	0.39	0	**0.39**	1.37	0	**1.37**
Shrub/Grass	0.52	0	**0.52**	1.20	0	**1.20**
Wetland	0.01	0	**0.01**	0.04	0	**0.04**
Total	**0.92**	0	**0.92**	**2.61**	0	**2.61**
Urban Matrix						
Deciduous and/or Coniferous Trees	13.45	0.73	**14.18**	17.89	1.26	**19.15**
Shrub/Grass	7.4	0	**7.4**	10.8	0	**10.8**
Wetland	3.04	0	**3.04**	6.3	0	**6.3**
Total	**23.89**	**0.73**	**24.62**	**34.99**	**1.26**	**36.25**
Eastside Total	**24.81**	**0.73**	**25.54**	**37.60**	**1.26**	**38.86**
Grand Total	**35.36**	**8.34**	**43.70**	**52.84**	**11.48**	**64.32**

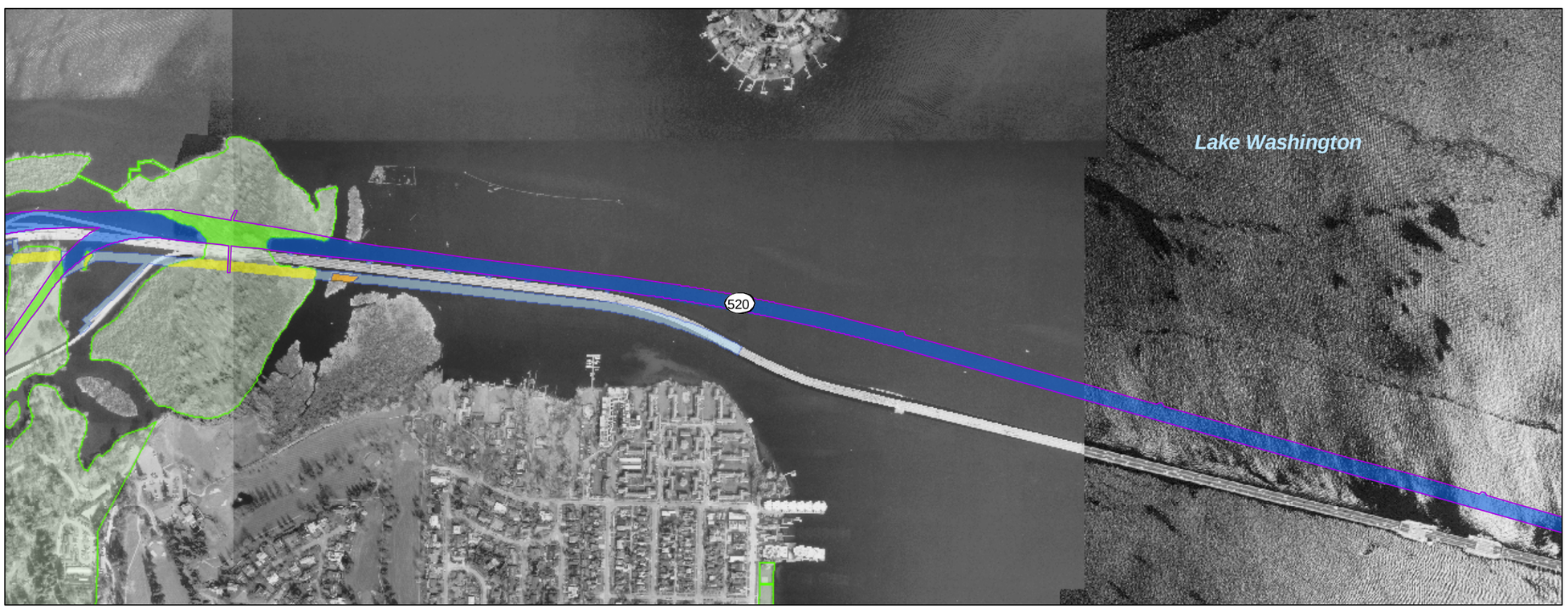
Note: No effects on vegetation would occur under the No Build Alternative. Affected areas were calculated using GPS data gathered in the field, aerial photography, National Wetland Inventory Maps, and local wetland inventories. Affected areas are based on preliminary design information and are subject to change.

[a] The Lake Washington portion of the project area contains only open water habitats lacking wetland vegetation, and therefore effects on vegetation would not occur in these areas.

[b] Within the shaded areas there would be small pockets of vegetation removed at each of the column locations. This is in addition to the vegetation removal areas reported elsewhere in this exhibit.

[c] The Open Water cover type contains wetlands as well as solely open water areas that lack wetland vegetation. Because vegetation removal is not relevant to these nonwetland open water areas, their acreages are not displayed in this exhibit.





4-Lane Permanent Footprint

Park Within 1/4 mile of Project Area

Cover Types Effects for the 4-Lane Alternative

Parks and Other Protected Areas

Temporary shading of existing vegetation

Permanent shading of existing vegetation

Permanent removal of existing vegetation

*Permanent removal of existing vegetation would occur in areas where the roadway or associated facility is at-grade. Shading effects would occur where the roadway or associated facility is elevated.

Open Water

Temporary shading

Permanent shading

Urban Maxtrix

Temporary shading of existing vegetation

Permanent shading of existing vegetation

*Permanent removal of existing vegetation within Urban Matrix would also occur within the permanent footprint area. These areas are not assigned a color but can be inferred from the aerial photo.

NOTES: Pile driving would occur in all elevated roadway areas.

Source: City of Seattle (2003) GIS Data (aerial photo and parks); Parametrix (2004) CAD data (footprint boundary). Horizontal datum for all layers is NAD83(91), vertical datum for layers is NAVD88.

N

0 250 500 Feet

Exhibit 57. **Effects of 4-Lane Alternative on Cover Types in the Seattle Project Area**

SR 520 Bridge Replacement and HOV Project

In the Open Water cover type and in Parks and Other Protected Areas cover type (specifically the Arboretum), existing wildlife habitat quality is relatively high, and upland and wetland vegetation removal would represent a loss of wildlife cover and forage.

Two specimen tree collections near MOHAI would also be affected by the 4-Lane Alternative. The tree collection located west of 24th Avenue Northeast and south of Hamlin Street includes Scotch pine, Italian cypress, Port Orford cedar, and incense cedar. These trees could be removed for the bicycle/pedestrian path and the Montlake Boulevard off-ramps. The tree collection near MOHAI could be also affected, including possible removal of several species of pine and birch.

Also of potential concern in the Parks and Other Protected Areas and in the Open Water cover types is the shading of approximately 4.5 acres of wetlands. The height of the elevated roadway through the Arboretum area (from about 10 to 40 feet above the ground) would be sufficient to accommodate shrubs and some trees; however, the increased bridge width (between 30 and 86 feet wider than the existing Evergreen Point Bridge west approach at Foster Island) would limit light penetration and likely preclude vegetation growth in some portions of the wetlands. In any case, any reduced wildlife use of the areas under the roadway would more likely be due to noise than changes in vegetation.

For the Urban Matrix cover type in Seattle, habitat quality is generally low. Removing vegetation would reduce cover for urban-adapted species (for example, black-capped chickadees, American robins, and eastern gray squirrels).

The elevated roadway would shade open water habitat in the Seattle and Lake Washington portions of the project area (**Exhibit 57**). However, shading in open water areas is not expected to affect wildlife. The proposed project would have an effect on beavers because a large beaver lodge in Union Bay adjacent to Foster Island likely would be destroyed when the new bridge is constructed. Destroying the beaver lodge would displace the animals to other habitats suitable for lodge construction. This displacement and the time and energy required to construct a new lodge could affect the beavers' fecundity until the new lodge is constructed.

This beaver lodge near Foster Island is within the footprint of the 4-Lane and 6-Lane Alternatives.

Potential changes to vegetation and habitat from increases in impervious surface are not expected in Seattle because the stormwater runoff would be treated. Hydrologic changes in this area would be very small because the lake levels largely control the hydrology of the adjacent habitats.

6-Lane Alternative

Compared to the 4-Lane Alternative, the 6-Lane Alternative would remove approximately an additional 4.8 acres of vegetation (mostly shrubs/grass and trees) of the Urban Matrix cover type, and an additional .84 acres of vegetation (mostly shrubs/grass) in the Parks and Other Protected Areas cover type (**Exhibits 56** and **58**).

As with the 4-Lane Alternative, the effect on wildlife from removing vegetation in the Urban Matrix cover type areas would be minimal because of the low quality of the habitat in the area. The effect on wildlife from the loss of trees and shrubs/grasses in Parks and Other Protected Areas would also be minimal because of the small area (1.7 acres) and the limited availability of trees and shrubs/grasses. The 6-Lane Alternative would affect a greater number of specimen trees in the Arboretum collections than the 4-Lane Alternative. Most of the trees would be removed from both the Hamlin Street and MOHAI collection of specimen trees.

Compared to the 4-Lane Alternative, the 6-Lane Alternative's elevated roadway would shade more vegetation (**Exhibits 56** and **58**). Wetland habitats would be more sensitive to shading than other habitats; the effects of shading on individual wetlands are described in greater detail in the *Wetlands* section of this report. In other areas, shading could reduce vegetation or could cause mortality of shade-intolerant trees, shrubs, and grasses. In any case, wildlife would be more likely to avoid areas under an elevated roadway because of the noise, rather than the changes in vegetation. As discussed in the *Wildlife and Habitat Mitigation* section, native shade-tolerant vegetation would be planted in areas under the elevated roadway and ramps, where feasible and practical.

Similar to the 4-Lane Alternative, the 6-Lane Alternative would likely destroy the existing beaver lodge near Foster Island; however, shading in open water habitats is not expected to affect wildlife.