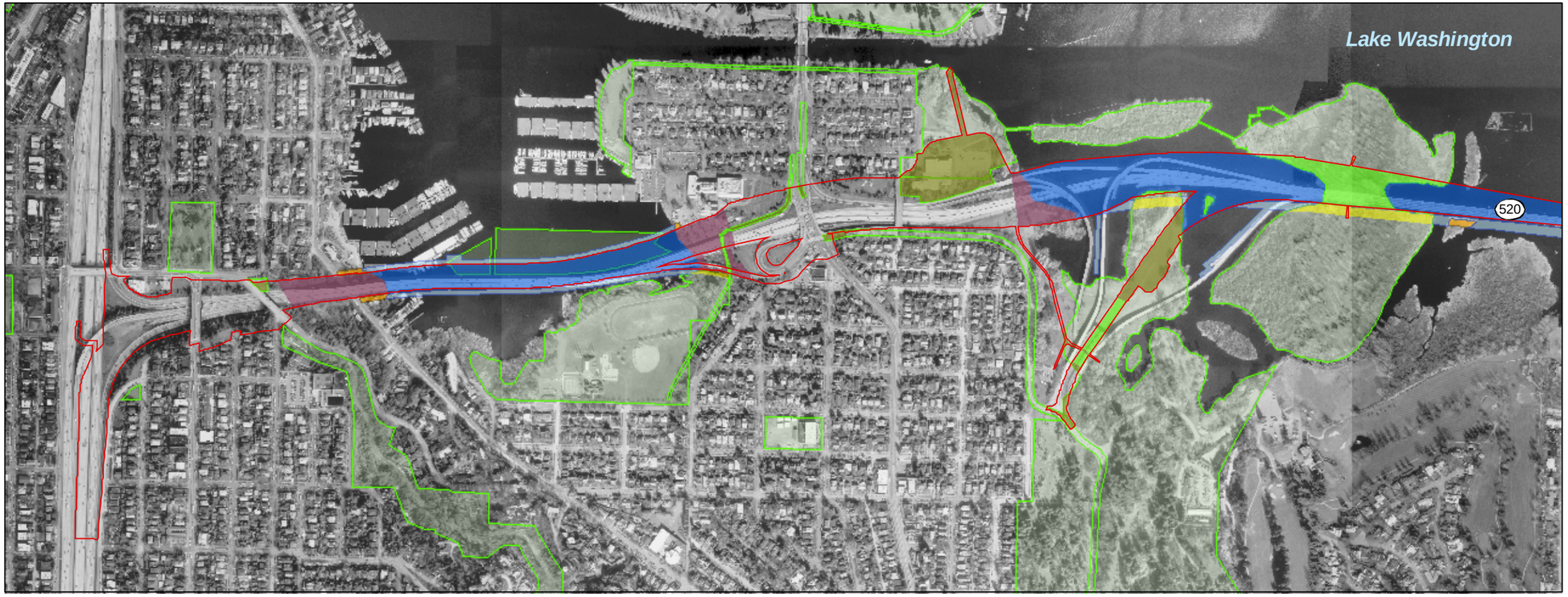
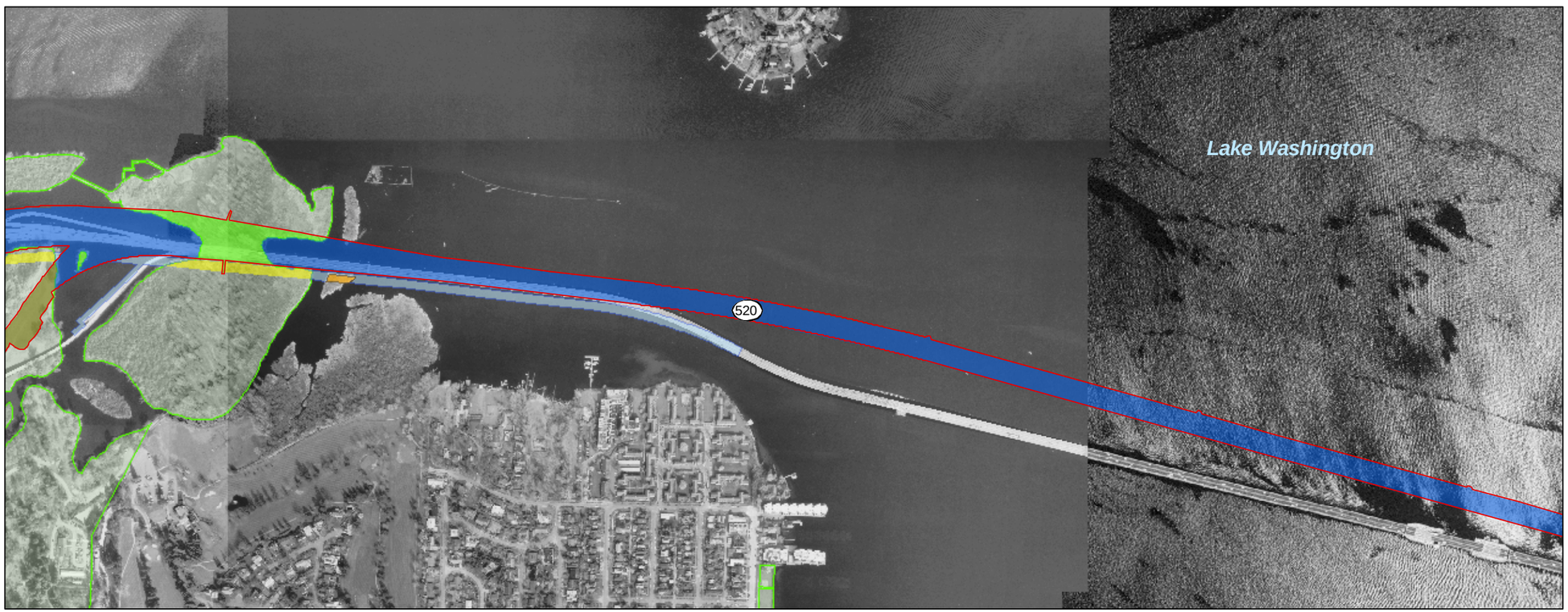




6-Lane Permanent Footprint

Park Within 1/4 mile of Project Area

Cover Types Effects for the 6-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 Matrix

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 58. **Effects of 6-Lane Alternative on Cover Types in the Seattle Project Area**

SR 520 Bridge Replacement and HOV Project

How would changes in water quality affect wildlife?

No Build Alternative

Under the Continued Operation Scenario, the quality of stormwater runoff might decline over time because of increased roadway traffic. See Appendix T, *Water Resources Discipline Report*, for more information on the anticipated effects of the alternatives on water quality. Declining water quality could expose wildlife that forage on plants, invertebrates, and fish in wetlands and aquatic areas (e.g., waterfowl, great blue herons) to higher contaminant levels. The health and fecundity of some animals could be affected, depending on the overall pollutant levels.

Under the Catastrophic Failure Scenario, the loss of the Portage Bay and Evergreen Point Bridges and associated vehicle traffic could reduce pollutant loading in this area, which could benefit wildlife because of reduced contamination. However, vehicles would be routed to other areas; consequently, pollutant loading could increase in those areas. The effect on wildlife in those rerouted areas would depend on existing contaminant levels and the type of existing stormwater treatment.

4-Lane and 6-Lane Alternatives

The 4-Lane Alternative would implement stormwater treatment facilities and water quality BMPs to treat and remove pollutants. Sediment loads to receiving waterbodies, including wetlands, would be reduced in all basins of the Seattle project area. Metals loading would either decrease or increase, depending on the individual basin. Stormwater discharges would comply with federal and state water quality regulations. Effects on water quality within specific basins is presented in Appendix T, *Water Resources Discipline Report*.

What types of wildlife disturbances would occur as a result of the project?

No Build Alternative

Under the Continued Operation Scenario, no new wildlife disturbances would occur. Under the Catastrophic Failure Scenario, the loss of the Portage Bay and Evergreen Point bridges and associated vehicle traffic would reduce noise disturbance, particularly at the Washington Park Arboretum and across Lake Washington. Depending on their current sensitivity to disturbance, some waterfowl and other birds that currently avoid these areas could begin to use them again. If this were

to occur, there would be a larger population of waterfowl and other aquatic birds than under existing conditions.

Under the Catastrophic Failure Scenario, vehicles would have to use alternative routes. Depending on the routes chosen and the existing noise levels, habitat, and wildlife use in those rerouted areas, the additional traffic could increase noise disturbance and the risk of wildlife-automobile collisions.

4-Lane Alternative

Highway noise disturbs wildlife and can affect species distribution and behavior. WSDOT noise analysts predict that under the 4-Lane Alternative, noise levels in the general area would be lower than existing conditions since sound walls would be installed along both sides of the highway through the Seattle project area. Consequently, disturbance to wildlife would likely be slightly less than under existing conditions.

6-Lane Alternative

Like the 4-Lane Alternative, noise levels in the general area under the 6-Lane Alternative would be lower than existing conditions. Consequently, disturbances to wildlife from the highway are expected to be very similar under both alternatives. Because the 6-Lane roadway footprint would be wider than the 4-Lane Alternative, the area of potential wildlife avoidance underneath elevated portions of the roadway would be greater.

How would the project create barriers or obstructions to animal movement?

No Build Alternative

Under the Continued Operation Scenario there would be no changes to the barriers or obstructions to animal movement. The Catastrophic Failure Scenario would remove an obstruction to flying birds, but could also impede some animal passage if portions of elevated roadway over land collapsed.

4-Lane Alternative

Throughout most of the Seattle project area, the roadway would be higher above the water than the existing bridge. Elevating the roadway (especially through the Portage Bay and Foster Island areas) and installing sound walls in many areas could both positively and negatively affect waterfowl and other aquatic birds, depending on their

flight patterns and behavior. If a bird is near or in the water (i.e., take-off and landing), the higher structure would presumably interfere less than the existing structure. However, when a bird is in flight away from the water, the higher structure and sound walls could cause greater interference. These potential effects are not expected to affect birds foraging in the area or elevate their risk of predation by eagles.

Passerine birds would not be affected by changes in the roadway elevation because the roadway is generally located over open water, away from passerine habitat. However, highway ramps and the portion of the highway that crosses Foster Island would be adjacent to passerine habitat. The higher roadway could hinder or improve the ability of passerines to forage in the vicinity, depending on the species of bird and their typical foraging height. The 4-Lane Alternative would likely not have a substantial effect on the overall foraging success or behavior of passerines in the vicinity.

For terrestrial wildlife, passage between the north and south portions of Foster Island would improve. Under existing conditions, SR 520's at-grade roadway and adjacent fencing are a barrier to wildlife movement. The only passage available for terrestrial wildlife is through the pedestrian tunnel under the highway. The 4-Lane Alternative would elevate the highway over Foster Island, and the existing at-grade roadway and fencing would be removed.

In the remainder of the Seattle project area, the highway would be elevated, as under existing conditions. Consequently, terrestrial wildlife passage in the vicinity would be the same as under existing conditions.

6-Lane Alternative

Like the 4-Lane Alternative, the 6-Lane Alternative would not substantially affect bird behavior or foraging success. It would, however, improve terrestrial wildlife passage between the north and south portions of Foster Island.

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

No Build Alternative

The Seattle and Lake Washington project areas contain suitable habitat for one federally listed wildlife species (bald eagle) and one federal species of concern (peregrine falcon). Under the Continued Operation

Scenario, no highway-related changes would occur; therefore, these federally listed species would not be affected.

Under the Catastrophic Failure Scenario, the loss of the Portage Bay and Evergreen Point bridges and associated vehicle traffic would reduce noise disturbance in areas where the Broadmoor bald eagle pair are known to occur (e.g., Lake Washington and the Washington Park Arboretum). Reducing noise and removing the elevated roadway structure could benefit the Broadmoor eagle pair by allowing them to forage and nest in areas that they may not currently use. However, the birds are already adapted to disturbance and have successfully produced young over several years. Consequently, increases in the birds' fecundity are not expected.

Although noise levels would decrease in the Lake Washington project area and at the Arboretum under the Catastrophic Failure scenario, noise levels would likely increase in other areas as traffic is diverted onto alternative routes. More traffic in shoreline areas used by nesting eagles could increase noise levels, which could affect eagle behavior, depending on the birds' existing tolerance to noise and traffic.

In the Seattle project area, a pair of peregrine falcons is known to forage along Portage Bay. This pair is highly adapted to urban conditions; their nest site is under the I-5 Ship Canal Bridge outside of the project area. Consequently, decreased noise levels around Portage Bay and increased noise in other areas used by the birds (due to automobiles using alternative routes) are not expected to affect the peregrine falcons.

4-Lane Alternative

In the Seattle and Lake Washington project areas, the 4-Lane Alternative would have minimal permanent effects on bald eagles and peregrine falcons. Noise disturbance to the birds would be slightly less than existing conditions because of the sound walls, which would mitigate highway noise levels around the bald eagle foraging areas and nesting areas in Lake Washington and Portage Bay, and the peregrine falcon foraging areas in Union Bay. The 4-Lane Alternative would remove a narrow swath of wetland and shoreline vegetation where these raptors forage. The effect of the 4-Lane Alternative on prey availability would be minimal however, because the affected foraging area is small. Long-term effects on the abundance of prey (birds and fish) for eagle and peregrine falcon in other parts of the project area are not expected, as explained further in the general wildlife effects section

and in the *Fish Resources* section of this report. The 4-Lane Alternative may affect bald eagle use of some potential perch trees because the eagles may avoid using trees underneath the new elevated roadway in the Washington Park Arboretum. Construction of the elevated roadway could require removal of some of these trees. However, most of the suitable nesting and perching trees are outside the project footprint and would not be affected by the project.

Under the 4-Lane Alternative, the new bridge across the Arboretum would be substantially higher than the existing roadway (approximately 30 to 40 feet higher, compared to existing conditions) and sound walls would also be adjacent to the elevated roadway. It is unknown whether the elevated roadway and sound walls would be more or less obstructive (relative to the existing lower roadway) to foraging eagles and peregrine falcons. In either case, these birds have some degree of tolerance to these types of flight obstructions, and significant impediments to the foraging success of the birds are not expected.

6-Lane Alternative

Highway noise levels under the 6-Lane Alternative would be similar to the 4-Lane Alternative; therefore, potential disturbance to federally listed species and federal species of concern would also be similar. Because roadway elevation would also be similar to the 4-Lane Alternative, effects on peregrine falcons and bald eagles are expected to be the same. The 6-Lane Alternative would have a slightly greater effect on wetlands and shorelines around Portage Bay and Foster Island that provide foraging habitat for bald eagles and peregrines. The affected area is small and effects on birds are not expected. Most of the suitable bald eagle nesting and perching trees are located outside the project footprint and would not be affected by the project.

How would the project permanently affect state-listed or other state priority species?

No Build Alternative

State-listed or state-priority species that are known or expected to occur in the Seattle and Lake Washington project areas include the western grebe, common loon, great blue heron, hooded merganser, wood duck, band-tailed pigeon, and pileated woodpecker. Under the Continued Operation Scenario, no highway-related changes in disturbance or

habitat would occur; consequently, no effects on these species would occur.

Under the Catastrophic Failure Scenario, the loss of the bridge and associated vehicle traffic would reduce noise disturbance in areas that provide suitable habitat for these state-listed and state-priority birds (i.e., Lake Washington and the Washington Park Arboretum vicinity). Reducing noise and eliminating the elevated roadway structure could improve foraging and/or nesting opportunities for the birds, if the birds previously avoided suitable habitat due to the presence of the roadway and its associated noise. However, traffic would increase in other areas because vehicles would have to use alternative routes. Depending on the routes chosen and existing noise levels, habitat, and wildlife use in those areas, increased traffic could result in increased disturbance to state-listed and state-priority species.

4-Lane Alternative

Removing trees in forested areas and filling wetlands (see **Exhibit 56**), particularly in the Washington Park Arboretum, would reduce cover and/or foraging habitat for western grebes, great blue herons, hooded mergansers, wood ducks, band-tailed pigeon, and pileated woodpeckers. Noise from highway traffic under the 4-Lane Alternative would be less than existing conditions and the No Build Alternative; therefore, disturbance to these birds would be slightly reduced. Elevating the roadway (especially through the Portage Bay and Foster Island areas) could have both positive and negative effects on the birds, depending on their flight patterns and behavior. When the birds are near or in the water (i.e., take-off and landing), the more elevated structure would presumably be less of an obstruction than the existing structure. However, when the birds are in flight away from the water, the higher bridge structure could interfere with the birds more than the existing structure. It is unknown whether these changes would affect the birds' foraging use of the area or other behavior.

Wintering wood ducks in open water habitat near the Washington Park Arboretum

6-Lane Alternative

The effects of noise disturbance on state-listed and priority birds would be similar to the 4-Lane Alternative because the anticipated highway noise levels under both the 4-Lane and 6-Lane Alternatives are similar. The 6-Lane Alternative would remove an approximately 0.1 additional

acre of wetland, which provides potential habitat for great blue herons, hooded mergansers, and wood ducks (**Exhibit 56**).

Under the 6-Lane Alternative, roadway elevation would be similar to the 4-Lane Alternative, and effects on great blue herons and state-listed and priority waterfowl are expected to be the same. Under either build alternative, the roadway may obstruct foraging, but the birds are expected to be able to maneuver around the roadway without significant impediments to their foraging success.

Eastside

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

No Build Alternative

The Continued Operation and Catastrophic Failure scenarios under the No Build Alternative would not affect vegetation. Consequently no changes to wildlife would occur because of removal of vegetation.

4-Lane Alternative

In the Eastside project area, vegetation under the 4-Lane Alternative would be removed in approximately 23.9 acres of Urban Matrix cover type and approximately 0.9 acre of Parks and Other Protected Areas (**Exhibits 56** and **59**). Shading effects would be limited to approximately 0.7 acre of trees within the Urban Matrix cover type.

In the affected Urban Matrix cover type, existing habitat quality is generally low and consists primarily of a narrow band of upland conifer trees and shrubs that line the roadway. Because of the fragmented nature of the vegetation in this area, the lack of structural diversity and forage diversity, and the location next to the existing highway, effects on wildlife from loss of upland trees and shrubs in this area are expected to be limited to a loss of forage and cover for urban-adapted species, including American robins, house sparrows, black-capped chickadees, and opossums. Affected animals may find adequate habitat adjacent to the affected area or may be displaced to areas more remote from the roadway. Affected species are common and abundant in the project area; adverse effects on the larger populations of these animals in the Eastside project area would not occur.

While most of the affected vegetation in the Eastside Urban Matrix area occurs in low quality areas, approximately 3.0 acres of wetland habitat

would be removed. Depending on existing habitat quality in each affected area, remaining wetland, and proximity to other wetland habitats, wildlife could be displaced to other areas. Species that could be affected include garter snakes, songbirds such as marsh wrens and warblers, and Pacific treefrogs. Because of the low mobility of garter snakes and treefrogs relative to birds, they may have less success (or could be unsuccessful) in migrating to unaffected areas with suitable habitat. If unable to move to other appropriate habitat, these animals could die. A more detailed account of individual wetlands and effects is presented in the *Wetlands* section of this report.

Vegetation removed under the 4-Lane Alternative in the Parks and Other Protected Areas cover type would include approximately 0.4 acre of trees and 0.5 acre of shrubs/grasses.

Potential changes in vegetation and habitat could also occur because of changes in hydrology from increases in impervious surface and changes in stormwater runoff. Wetlands are the most likely habitat type to be affected by changes in hydrology; wetland plants require more specific soil moisture than upland vegetation. In the most extreme scenario, changes in hydrology could cause wetland loss, with a concomitant shift in wildlife use from wetland-adapted species (e.g., garter snakes, Pacific treefrogs, and marsh wrens) to more generalist and upland-adapted species (e.g., American robins, black-capped chickadees). However, a more likely scenario is minor changes in hydrology that would have no effect or an insignificant effect on vegetation and wildlife. See the *Wetlands* section of this report for additional information on the effects of changes in wetland hydrology in the Eastside project area under the 4-Lane Alternative.

6-Lane Alternative

Relative to the 4-Lane Alternative, the 6-Lane Alternative would affect approximately 11.1 more acres of Urban Matrix and 1.7 more acres of Parks and Other Protected Areas (**Exhibits 56** and **60**). The increase in affected area is relatively small compared to the available habitat in the area, and the habitat quality in Urban Matrix is low, so overall effects on wildlife distribution, abundance, and fecundity in the Eastside project area are not expected.

Although the 6-Lane Alternative would add more impervious surface, the effects on vegetation and habitat from changes in hydrology are expected to be similar to the 4-Lane Alternative.

4-Lane Permanent Footprint

Park Within 1/4 mile of Project Area

Cover Type 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

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.

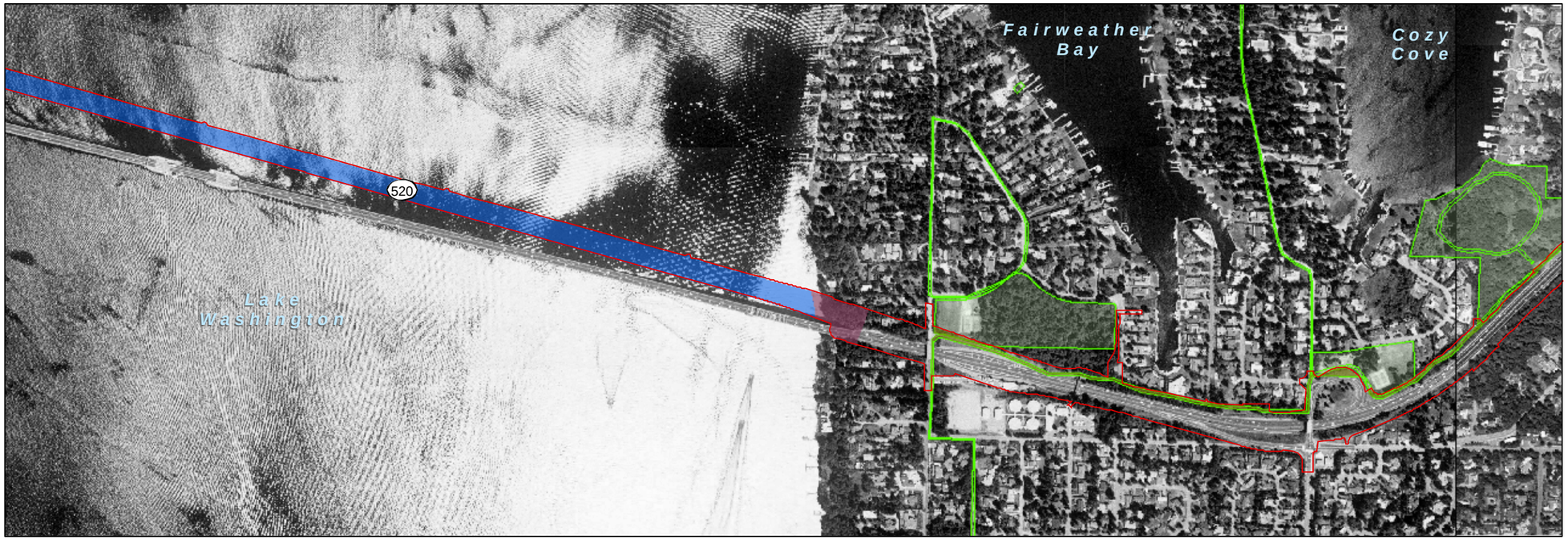
Source: City of Seattle (2003) GIS Data (aerial photo and parks). Horizontal datum for all layers is NAD83(91), vertical datum for layers is NAVD88.

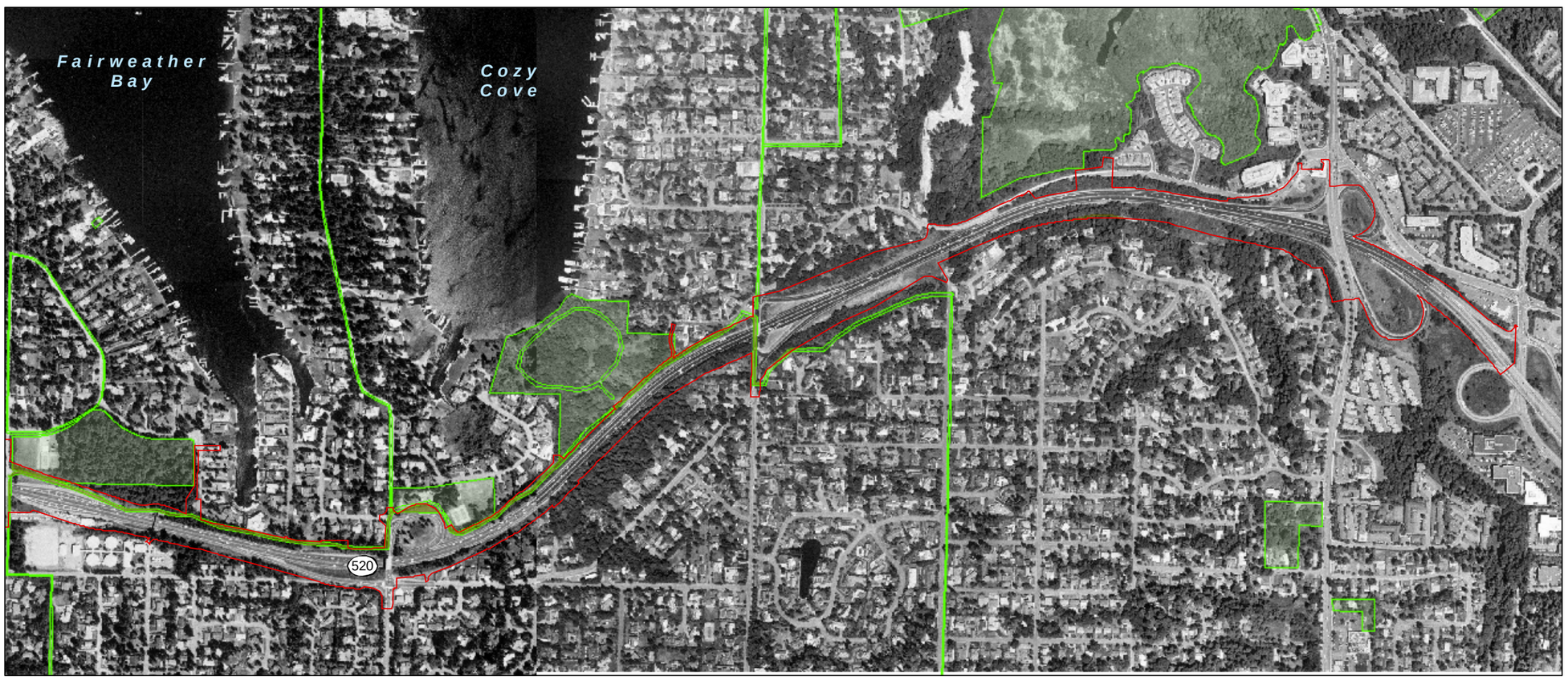
N

0 250 500 1,000 Feet

Exhibit 59. **Effects of 4-Lane Alternative on Cover Types in the Eastside Project Area**

SR 520 Bridge Replacement and HOV Project





6-Lane Permanent Footprint

Park Within 1/4 mile of Project Area

Cover Types Effects for the 6-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 Matrix

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). Horizontal datum for all layers is NAD83(91), vertical datum for layers is NAVD88.

N

0 250 500 1,000 Feet

Exhibit 60. **Effects of 6-Lane Alternative on Cover Types in the Eastside Project Area**

SR 520 Bridge Replacement and HOV Project

How would changes in water quality affect wildlife?

No Build Alternative

Under the Continued Operation Scenario, the quality of stormwater runoff could decline due to the anticipated increased roadway traffic over time. (See Appendix T, *Water Resources Discipline Report,* for more detailed information on anticipated effects of the alternatives on water quality.) Reduction in water quality could increase contaminant levels in wetlands and aquatic areas where wildlife (e.g., waterfowl and great blue herons) forage on plants, invertebrates, and fish. Depending on overall pollutant levels, the health and fecundity of some animals could be reduced.

Under the Catastrophic Failure Scenario, reduction in traffic on SR 520 in the Eastside project area would reduce pollutant loading, which would have potential benefits to wildlife. However, vehicles would be rerouted to other areas, where pollutant loading would increase. The effects on wildlife would depend on the existing contaminant levels and stormwater treatment in those areas of increased traffic.

4-Lane and 6-Lane Alternatives

Both the 4-Lane and 6-Lane Alternatives would treat stormwater runoff in the Eastside project area. Sediment loads in roadway runoff would be reduced in all basins of the Eastside project area. Metals loading would increase or decrease depending on the individual basin. Effects on water quality within specific basins can be found in the Appendix T, *Water Resources Discipline Report*. Whether changes in water quality would be substantial enough to affect survivorship and fecundity of individual animals is unknown.

What types of wildlife disturbances would occur as a result of the project?

No Build Alternative

Under the Continued Operation Scenario, no changes in disturbance to wildlife would occur. Under the Catastrophic Failure Scenario, the loss of the Evergreen Point Bridge would reduce traffic and disturbance in the Eastside project area. However, because of the existing relatively poor habitat quality adjacent to SR 520 in the Eastside project area and the presence of mostly urban-adapted species, a reduction in noise levels is expected to have a negligible effect.

Under the Catastrophic Failure Scenario, traffic increases would occur in other areas because vehicles would have to use alternative routes. Depending on the routes chosen and existing noise levels, habitat, and wildlife use in those areas, increased traffic could increase disturbance to wildlife.

4-Lane Alternative

Under the 4-Lane Alternative, noise levels would be lower than existing conditions because of the sound walls that would be installed along both sides of the roadway. Consequently, disturbance to wildlife is expected to be slightly lower than existing conditions. In most Eastside areas, the wildlife species are adapted to an urban environment, so small reductions in noise disturbance would likely have a negligible effect on them. However, in areas of higher quality habitat, such as Wetherill Park, the reduction in noise levels because of an adjacent sound wall could result in greater wildlife use, particularly for birds that are more sensitive to noise.

6-Lane Alternative

Like the 4-Lane Alternative, the 6-Lane Alternative would include sound walls in the Eastside project area. Consequently, highway noise levels from the 6-Lane Alternative would be similar to the 4-Lane Alternative, and the effect of highway disturbance on wildlife would also be similar.

How would the project affect barriers and obstructions to animal movement?

No Build Alternative

Under both the Continued Operation and Catastrophic Failure scenarios, wildlife movement under the highway at the stream crossings in the Eastside project area would remain severely impeded because of undersized culverts. Fencing and other existing roadside barriers would also remain as barriers to movement of terrestrial wildlife.

4-Lane Alternative

The 4-Lane Alternative would replace or retrofit three culverts with larger pipes or bottomless culverts at highway stream crossings. These wider, and possibly bottomless, culverts would increase the likelihood of terrestrial animal passage across the highway. Actual wildlife passage through the wider culverts would depend on the size and behavior of individual wildlife species. Species most likely to benefit

include small mammals like raccoons, opossums, and possibly squirrels. The culverts likely would not be sized to allow for passage of large mammals such as deer. Under the 4-Lane Alternative, fencing along the bicycle/pedestrian trail and sound walls would create more barriers to animal movement than exist today, but would also protect them from being hit on the roadway. Lids over the highway may serve as corridors for wildlife movement across the roadway.

6-Lane Alternative

The 6-Lane Alternative would replace or retrofit up to four more culverts than the 4-Lane Alternative. Similar to the 4-Lane Alternative, the culverts would be wider than the existing culverts. Compared to the 4-Lane Alternative, however, each of the new or retrofitted culverts would be longer and the additional culvert length may impede wildlife passage. Barriers to animal movement from fencing and sound walls under the 6-Lane Alternative would be similar to the 4-Lane Alternative. The 6-Lane Alternative would also include lids that wildlife may use to cross SR 520.

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

No Build Alternative

One federally listed species (the bald eagle) occurs in the Eastside project area; no federal species of concern are known to occur. Under the Continued Operation Scenario, bald eagle use of the Eastside project area would remain unaffected. Because bald eagles use Lake Washington and shoreline habitats that are generally 1,000 feet or more from SR 520 in the Eastside project area, reduction of traffic on the highway under the Catastrophic Failure Scenario is not expected to affect bald eagles. Under this scenario, noise levels in other areas would increase because of additional traffic.

4-Lane Alternative

One bald eagle nesting territory, the Hunts Point nesting territory, occurs in the Eastside project area. The two Hunts Point nest sites are 900 feet and 2,400 feet, respectively, from the roadway, and the foraging territory for the Hunts Point eagles is over 1,000 feet from the proposed 4-Lane Alternative alignment. Highway noise at these distances is expected to be obscured by other ambient noise. For these reasons, no effects on the Hunts Point bald eagles are expected. The vicinity along the roadway does not provide habitat for wintering bald

eagles, and consequently no permanent effects on wintering eagles would occur in this area.

6-Lane Alternative

For the same reasons as the 4-Lane Alternative, operation of the highway under the 6-Lane Alternative would not affect bald eagles.

How would the project permanently affect state-listed or other state priority species?

No Build Alternative

State-listed or state-priority species that are known or expected to occur in the Eastside project area include the great blue heron, wood duck, band-tailed pigeon, and pileated woodpecker. Under the Continued Operation Scenario, no highway-related changes in disturbance or habitat would occur; consequently, these species would not be affected.

Under the Catastrophic Failure Scenario, the loss of the Evergreen Point Bridge and associated vehicle traffic on SR 520 would result in reduced noise disturbance in areas adjacent to the roadway. However, these areas do not provide suitable habitat for great blue herons or pileated woodpeckers. Consequently, these species would not be affected by noise reduction in the area. Under this scenario, traffic would increase in other areas because vehicles would have to use alternative routes. Depending on the routes chosen and existing noise levels, habitat, and wildlife use in those areas, increased traffic could result in increased disturbance to state-listed and state-priority species.

4-Lane and 6-Lane Alternatives

Vegetation on the Eastside would not be removed in areas that provide habitat for state-listed and priority species. In areas where suitable habitat for these species is located near the highway (e.g., Wetherill Park), a decrease in noise levels under the build alternatives would slightly reduce noise disturbance to these species.

How would the project permanently affect other species of special interest that occur in the project area?

No Build Alternative

The existing red-tailed hawk nest near Yarrow Bay is approximately 900 feet from the roadway alignment; disturbance to the hawks would remain insignificant under the Continued Operation Scenario.

The reduction in traffic on SR 520 in the Eastside project area under the Catastrophic Failure Scenario would also not affect the nest site because of its distance from the roadway. Under the Catastrophic Failure Scenario, increased traffic would occur in other areas because vehicles would have to use alternative routes. Depending on the routes chosen and existing noise levels, habitat, and wildlife use in those areas, increased traffic could result in increased disturbance to other species of special interest.

4-Lane and 6-Lane Alternatives

Because the red-tailed hawk nest is approximately 900 feet from the roadway, there would be no measurable difference in noise levels between existing conditions and the build alternatives. Neither the 4-Lane nor the 6-Lane Alternative would remove large trees that provide suitable hawk nest sites.

How would project construction temporarily affect habitat and associated wildlife species?

Construction activity could temporarily affect habitat and/or wildlife through:

- Disturbance from noise and associated construction activity
- Temporary vegetation effects
- Water quality effects

The likelihood and anticipated magnitude of these three types of temporary effects are described further below. Note that because there would be no construction under the No Build Alternative, this alternative would have no temporary effects on vegetation and wildlife.

Seattle and Lake Washington

How would noise and associated construction activity affect wildlife?

4-Lane Alternative

Noise and associated construction activity can disturb wildlife. The degree of disturbance would depend on noise level, timing, duration, and the sensitivity of the individual species. In general, most area wildlife are adapted to urban conditions and highway noise. However, loud construction activities could temporarily displace some animals or prevent them from using adjacent habitats. In extreme cases, birds

could abandon their nests in response to noise disturbance. Noise disturbances from construction in the Seattle project area would occur over approximately 4 years under the 4-Lane Alternative. In the discussion that follows, the terms "construction noise" and "general construction" refer to the use of all heavy equipment, except pile driving. Operation of barges is considered a part of the general construction activities. Pile driving is discussed separately because of the much greater noise levels that this activity would create.

Average noise levels near wildlife habitat along SR 520 (i.e., within 100 feet) would rise from the current levels (60 to low 70s decibels on an A-weighted scale [dBA], depending on the location) to a maximum of 94 dBA during general construction of the new road surface. Noise levels would decrease with distance from the construction area, and in most cases, noise levels at distances of 750 to 1,000 feet would be the existing ambient noise, not the construction noise.

Pile driving in the Portage Bay and the Washington Park Arboretum areas is anticipated to raise noise levels to a maximum of 105 dBA 50 feet from the pile driver. Noise levels would decrease with distance from pile driving. At 500 feet, anticipated noise levels from the pile driver would range from approximately 80 to 95 dBA, and at 1,000 feet, noise levels would range from approximately 72 to 92 dBA (Minor pers. comm. 2004). See Appendix M, *Noise Discipline Report*, for more details on construction noise.

Lighting associated with nighttime highway construction could also disturb wildlife. Disturbance is expected to be greatest in areas where existing light levels are relatively low and in areas with minimal vegetation or other structures to block the light. Nighttime light levels could cause loafing waterfowl on Lake Washington, including cormorants that use the piers near the Washington Park Arboretum, to be displaced to areas away from the disturbance.

6-Lane Alternative

The 6-Lane Alternative would have the same type of construction activities as the 4-Lane Alternative, but would last longer and require more pile driving than the 4-Lane Alternative. Construction in the Seattle project area would occur over approximately 5 years for the 6-Lane Alternative. For these reasons, overall disturbance to wildlife from construction would be greater under the 6-Lane Alternative.

How would temporary vegetation clearing and shading affect wildlife and habitat?

4-Lane Alternative

In the Seattle project area, construction of temporary work bridges, platforms, and a detour bridge under the 4-Lane Alternative would affect approximately 5.3 acres of vegetation (most of which is wetland) from clearing or shading (**Exhibit 61**). Some tree and shrub clearing along the shoreline could expose these areas to increased erosion. Most of the affected shoreline is not highly exposed to wave action from boats using the Montlake Cut, so the effects would be low. WSDOT would revegetate the affected areas and stabilize any exposed shoreline areas to offset adverse effects.

Although the temporary structures would be in place for only a relatively short time in Portage Bay (28 months) and adjacent to the west approach to the Evergreen Point Bridge (41 months), and shaded and cleared areas would be revegetated after construction, the effects of construction activity on wetlands in the Arboretum would be evident for several years. Lacustrine wetlands would revert to preconstruction conditions relatively quickly. Trees, shrubs, and emergent plants in the palustrine wetlands would take time to reestablish, which could affect wildlife habitat and the hydrologic functions of the wetlands. However, because of the small area affected and the temporary nature of the effect, these changes in vegetation would have a minimal effect on wildlife's use of the broader area.

6-Lane Alternative

In the Seattle project area, construction of temporary work bridges, platforms, and a detour bridge under the 6-Lane Alternative would create a shading effect on approximately 3.9 acres of vegetation (mostly wetland) (Exhibit 61). Like the 4-Lane Alternative, some vegetation would be cleared in these shaded areas, but the effects would be less.

Exhibit 61. Acres of Temporary Clearing or Shading, by Cover Type and Alternative in the Seattle Project Area

Area, Cover Type, and Habitat Type[a]	4-Lane Alternative	6-Lane Alternative
Parks and Other Protected Areas		
Deciduous and/or Coniferous Trees	0.68	0.73
Shrub/Grass	0.05	0.05
Wetland	0.88	0.90
Total	**1.61**	**1.68**
Open Water[b]		
Wetland	**2.28**	**1.83**
Urban Matrix		
Deciduous and/or Coniferous Trees	0.11	0.09
Shrub/Grass	0.92	0.11
Wetland	0.40	0.17
Total	**1.43**	**0.37**
Total for Seattle Project Area	**5.32[c]**	**3.88[c]**

Note: 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. No temporary effects on vegetation would occur under the No Build Alternative.

[a]The Lake Washington project area contains only open water habitats that lack wetland vegetation, and therefore effects to vegetation would not occur in these areas. No temporary effect on vegetation would occur in the Eastside project area for either action alternative.

[b]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.

[c]Within the shaded area, some vegetation would be cleared to install the temporary bridge column supports.

How would wildlife be affected by temporary effects on water quality?

4-Lane Alternative

The 4-Lane Alternative could affect wildlife and habitat through construction-related water quality effects. Specific effects that could occur include:

- Effects on foraging waterfowl and other aquatic birds from disturbing deep-water sediments (and causing clouding of water that could obscure prey of waterfowl and other aquatic birds) through pile driving and other in-water work
- Destruction of Pacific treefrog eggs through sedimentation

- Poisoning or otherwise injuring waterfowl, beavers, and other aquatic wildlife through spills of oil, gasoline, concrete, and other toxic substances

Measures to avoid or minimize these effects would include using erosion control barriers and implementing other best management practices (BMPs).

6-Lane Alternative

The 6-Lane Alternative would have the same effect on water quality in Seattle and Lake Washington as the 4-Lane Alternative; however, the magnitude of potential effect would be greater because there would be more construction occurring over a longer period of time. As long as BMPs are followed and toxic substances are not spilled or released, no major water quality effects on wildlife are expected during construction.

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

4-Lane Alternative

Vegetation clearing associated with temporary bridges could involve removing several large trees near the Washington Park Arboretum. These trees provide potential eagle nesting and perching sites. However, most of the suitable nesting and perching trees are located outside the project area and would not be affected.

Noise from general construction activities and pile driving (which would occur throughout the eagle nesting season for up to 4 years under the 4-Lane Alternative) could affect both nesting and foraging eagles, particularly the eagles that occupy the Broadmoor nesting territory. The effects of construction noise on nesting and foraging bald eagles in urban environments have not been well-studied. However, at Discovery Park in Seattle, nest monitoring over 8 years indicated that construction noise that was approximately 1,300 feet away did not adversely affect bald eagles at their nest site. Construction equipment used for the wastewater treatment plant in Discovery Park was similar to the equipment that is planned for general construction activities for the proposed project. Consequently, noise levels generated from general construction activities of the project would be similar to noise levels generated from the Discovery Park project. However, pile driving was not a part of construction activities at Discovery Park (Parametrix 1996).

The foraging area for the Broadmoor eagle pair includes the area along Lake Washington where construction activities and pile driving would occur, and the pair's three nest sites are approximately 900 feet to 1,500 feet from construction and pile driving areas. The eagles are expected to avoid foraging in the immediate vicinity of construction and pile driving. However, remaining foraging habitat within the eagles' territory is expected to provide sufficient prey for the birds.

Because eagles are more sensitive to noise at their nest site than in their foraging areas, the Broadmoor eagles at their nest site could be affected. General construction noise (from construction activities excluding pile driving) is not expected to affect the Broadmoor eagles at their nest site, as noise at distances greater than 750 to 1,000 feet from the construction area would be dominated by existing ambient, not construction, noise. However, the louder noises created by pile driving could adversely affect the nesting activity of the Broadmoor eagle pair. USFWS considers pile driving within 1 mile of an eagle nest site as having the potential to adversely affect eagles.

Comparing existing noise levels at the Broadmoor eagles' nest sites to anticipated noise levels from pile driving helps to determine how pile driving would affect the eagles. Based on model output, and assuming that hollow metal piles would be used for the temporary bridge, noise levels from pile driving could range from approximately 74 to 93 dBA at the closest Broadmoor eagle nest (approximately 900 feet from the nearest pile driving). These noise level ranges are based on a maximum pile driving noise of 105 dBA at 50 feet, with a 3.0 to 7.5 dBA reduction per doubling of distance. Existing noise levels near the Broadmoor eagle nest are in the upper 50s to mid 60s dBA.

At the next closest Broadmoor eagle nest site (approximately 1,250 feet from the nearest pile driving), noise levels from pile driving would range from 70 to 91 dBA. At the farthest Broadmoor eagle nest site (approximately 1,500 feet from the nearest pile driving), noise levels would range from 69 to 90 dBA. It is important to note that these model results provide general ranges of anticipated noise levels. Actual noise levels from pile driving would vary considerably from pile to pile, depending on the pile size, ground type, and ground cover reduction (Minor 2004, pers. comm.).

Because of the anticipated disturbance of the Broadmoor eagles, the 4-Lane Alternative could affect the nesting success of the eagle pair. Effects could occur over multiple years, given the approximately 4-year

schedule for construction activities in this area. However, the pair also has demonstrated a tolerance to noise and urban conditions; it is also possible that the pair would be only negligibly affected by construction, with no effects on their nest success.

Construction activities could affect wintering bald eagles that forage in the Seattle and Lake Washington project areas. However, wintering eagles are not restricted by a need to remain near their nest sites, and the birds are expected to be able to move to other foraging areas outside of the construction and pile driving areas. Because of this, overall effects on wintering eagles are expected to be negligible.

Construction noise and pile driving may affect foraging peregrine falcons at Portage Bay. The birds would likely avoid portions of the bay near construction and pile driving activities. However, other foraging habitat that the birds are known to use (such as Union Bay) would remain, and overall effects on the birds are expected to be negligible.

6-Lane Alternative

The 6-Lane Alternative would have the same type of construction activities as the 4-Lane Alternative but would last up to 5 years. The distances between the pile driving locations and the Broadmoor eagle nest sites would be very similar to the 4-Lane Alternative, and anticipated noise levels at the nest sites from pile driving would be virtually identical. However, the 6-Lane Alternative would be built over a longer period of time in this area and would require more pile driving, increasing the possible effect on the nesting success of the Broadmoor eagle pair. Disturbance to foraging peregrine falcons and wintering bald eagles would also be slightly greater under the 6-Lane Alternative, but because of the availability of other unaffected habitat, overall effects on peregrine falcons and wintering bald eagles are expected to be negligible.

How would the project temporarily affect other state-listed or other state priority species?

4-Lane Alternative

Noise from construction activities and pile driving is expected to temporarily displace state-listed and priority species (i.e., western grebe, common loon, great blue heron, hooded merganser, wood duck, and pileated woodpecker). None of these species are known to nest in the Seattle or Lake Washington project areas; consequently, construction disturbance would not affect nesting success for these

species. If nesting band-tailed pigeons are present near construction and pile-driving activities, disturbance could affect the birds' nesting success and cause possible nest abandonment.

6-Lane Alternative

The 6-Lane Alternative would have the same type of effects on state-listed and other priority species as the 4-Lane Alternative, but the duration of disturbance would be longer in the Seattle project area.

Eastside

How would noise and associated construction activity affect wildlife?

4-Lane Alternative

Under the 4-Lane Alternative, construction in the Eastside project area would occur over approximately 3 years. Effects from general construction activities would be similar to Seattle and Lake Washington. Depending on the animal or bird, the level of noise, and the timing and duration of construction, effects could range from no effect, to temporary displacement of an animal to less noisy areas, to bird nest abandonment.

No pile driving would occur in the Eastside project area. Because pile driving is louder than other construction activities, wildlife disturbance from construction noise in the Eastside project area would not extend as far from the roadway as it would in the Seattle and Lake Washington project areas.

6-Lane Alternative

Construction noise levels under the 6-Lane Alternative would be similar to the 4-Lane Alternative, except that construction would occur over a longer period of time (approximately 3 1/2 years). The longer construction period would have a greater overall effect on wildlife.

How would temporary vegetation clearing and shading affect wildlife and habitat?

4-Lane and 6-Lane Alternatives

Temporary clearing of vegetation or shading would not occur in the Eastside project area.

How would wildlife be affected by temporary effects on water quality?

4-Lane and 6-Lane Alternatives

Potential construction-related water quality effects in the Eastside project area under the build alternatives would be the same as described for the Seattle and Lake Washington project areas.

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

4-Lane and 6-Lane Alternatives

Construction effects on eagles at the Hunts Point nesting territory are expected to be negligible under the 4-Lane and 6-Lane Alternatives. The two Hunts Point nest sites are 900 feet and 2,400 feet, respectively, from the construction area; no pile driving would occur within 1 mile of these nests. In addition, the foraging territory for the Hunts Point eagles is over 1,000 feet from project construction areas. The vicinity of the roadway in the Eastside project area does not provide habitat for wintering bald eagles, and consequently no temporary effects on wintering eagles would occur here.

How would the project temporarily affect other state-listed or other state priority species?

4-Lane and 6-Lane Alternatives

Noise from construction activities could affect a small great blue heron rookery located at Yarrow Bay, approximately 500 to 600 feet from the construction area. The birds forage along Yarrow Bay, farther away from the project alignment than their nesting area. Pile driving would not occur within 1 mile of the nest site, and peak noise levels from construction activities would be only about 5 dBA above the existing noise levels. For these reasons, temporary construction effects on nesting great blue herons are not expected.

No band-tailed pigeon nests are known to occur in the Eastside project area. If band-tailed pigeons are present near construction activities, disturbance could affect the birds' nesting success and cause possible nest abandonment.

The pileated woodpecker may also use forested habitats in the Eastside project area. However, the fragmented nature and relatively young age of tree cover in the vicinity makes it unlikely that the birds are there. If pileated woodpeckers forage near the roadway, construction could

displace the birds to undisturbed habitats. Given the low anticipated use by the birds and relatively small area of effect, the likelihood of displacement is expected to be low.

How would the project temporarily affect other species of special interest in the Eastside project area?

4-Lane Alternative

A red-tailed hawk nest near Yarrow Bay is approximately 900 feet from the project construction area. Suitable foraging habitat is generally located farther from the project construction area. Construction noise and pile driving are not expected to affect the hawks because (1) noise at distances greater than 750 to 1,000 feet from the construction area would be dominated by existing ambient, not construction, noise; and (2) pile driving would not occur within 1 mile of the nest site.

6-Lane Alternative

Under the 6-Lane Alternative, the distance of the red-tailed hawk nest site and foraging areas from construction activities would be approximately the same as under the 4-Lane Alternative. Consequently, construction effects are not expected to affect red-tailed hawks under the 6-Lane Alternative.

How would the alternatives differ in their effects on habitat and wildlife?

Exhibit 62 summarizes the differences in permanent effects on habitat and wildlife among the three alternatives. The 4-Lane and 6-Lane Alternatives would generally affect wildlife and habitat in similar ways. However, there are relatively small differences in the amount of vegetation clearing/shading and habitat loss and in improvements to wildlife passage through culverts.

Construction noise levels and distance of construction areas from bald eagle, heron, and red-tailed hawk nest sites and other sensitive habitats are very similar between the build alternatives. However, because the 6-Lane Alternative would have more construction over a longer period than the 4-Lane Alternative, noise disturbance effects on wildlife would be greater. Because of the longer construction period, risk of wildlife effects from spills of oil, gasoline, or other toxic substances would be greater under the 6-Lane Alternative. Other minor differences between the build alternatives would not result in differential temporary effects to wildlife.

Exhibit 62. Summary of Permanent Effects on Wildlife and Habitat, by Alternative

Type of Permanent Effect				
Vegetation/Habitat Loss and Shading	**Changes in Aquatic Wildlife Health from Change in Water Quality**	**Disturbance from Highway Operations**	**Changes in Barriers to Animal Movement**	**Effects to Federally Listed Species (bald eagle)**
No Build Alternative				
Continued Operation Scenario				
No change.	Possible decline in aquatic wildlife health in basins over time with deterioration of water quality because of increasing traffic load.	No change.	No change.	No change.
Catastrophic Failure Scenario				
If the bridge were to fail, reduction in shading could increase vegetation growth and habitat quality in some areas.	Failure of the bridges would affect the health of aquatic wildlife, depending on the rerouted traffic patterns.	Reduced disturbance in project area, but potential increased disturbance in other areas.	Reduction in flight obstructions for birds.	Reduced disturbance to bald eagles in project area, but potential increased disturbance in other areas.
4-Lane Alternative				
Loss of wildlife habitat area and quality, most notably to wetlands and other higher-quality habitats within Parks and Other Protected Areas.	Possible improvement to aquatic wildlife health in basins where improved stormwater treatment enhances water quality.	Reduced noise compared to existing conditions.	More elevated roadway could have some effect (both positive and negative) on foraging birds. Improvement in stream crossings in Eastside project area, relative to existing conditions.	Disturbance from highway traffic slightly less than under existing conditions. Some loss of potential nest and perch trees around Washington Park Arboretum.
6-Lane Alternative				
Greater loss of wildlife habitat area and quality than the 4-Lane Alternative.	Similar to 4-Lane Alternative.	Similar to 4-Lane Alternative and less than existing conditions.	Same as 4-Lane Alternative, but additional areas of improved stream crossings in the Eastside project area. However, longer culvert length under 6-Lane may hinder wildlife use, compared to the 4-Lane Alternative.	Similar to 6-Lane Alternative.

Wildlife and Habitat Mitigation

What has been done to avoid or minimize negative effects to wildlife and wildlife habitat?

Measures to avoid or minimize effects on wildlife and habitat include the following:

- Limiting construction to a relatively small area immediately adjacent to the existing roadway, to minimize vegetation clearing.
- Following BMPs and other safety measures to minimize erosion and sedimentation and to minimize the risk of spilling contaminants.
- Replanting temporary affected areas with native vegetation.
- Planting native shade-tolerant vegetation in areas under the elevated roadway and ramps, where feasible and practical.
- Improving culverts relative to existing conditions, to increase the likelihood that terrestrial animals would be able to pass under the highway at creek crossings.
- Minimizing pile driving near the Broadmoor eagle pair nest site during the early part of the bald eagle nesting season, when the birds are most sensitive to disturbance. The bald eagle nesting period is January 1 to August 15.
- Avoiding or minimizing effects on the beaver lodge near Foster Island, during construction, if possible. Its proximity to the proposed bridge columns and construction piles may preclude its avoidance.

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

The project could result in unavoidable negative effects on the Broadmoor bald eagle pair. To compensate for this negative effect, the project could consider purchasing and/or protecting shoreline habitat or other habitat in the vicinity of Lake Washington that provides existing suitable large trees for potential eagle nest sites. If sites with

suitable trees cannot be identified, WSDOT could undertake restoration or enhancement of habitats that would support eagles.

Unavoidable negative effects would also occur at wetlands. As discussed in detail in the *Wetlands* section of this report, wetlands would be replaced to achieve no net loss of habitat or function.

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References

WSDOT. 2001. *Protection of Wetlands Action Plan*. WSDOT Directive 31-12. Environmental Procedures Manual.

Wetlands

Alt, David B. and D. Hyndman. 1984. *Roadside Geology of Washington*. Mountain Press Publishing Company, Missoula, Montana.

Brinson, Mark M. 1993. A *Hydrogeomorphic Classification for Wetlands*. Technical Report WRP-DE-4. Prepared for the U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

CH2M HILL and Parametrix, Inc. 2004. *Final Stormwater Management Report*. Prepared for the Washington State Department of Transportation, Urban Corridors Office and Sound Transit, Seattle, Washington.

Cowardin, L.M., V. Carter, F. C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. Government Printing Office, Washington, DC.

Ecology. 1993. *Washington State Wetland Rating System for Western Washington*. Second Edition. Publication #93-74. Washington State Department of Ecology, Olympia, Washington.

Ecology. 1997. *Washington State Wetland Identification and Delineation Manual*. Publication #96-94. Washington State Department of Ecology, Olympia, Washington.

Ecology. 2004. *Wetlands in Washington State*. Volume 2: Managing and Protecting Wetlands. Draft. Washington State Department of Ecology Publication #04-06-024. August.

Environmental Laboratory. 1987. *Corps of Engineers Wetland Delineation Manual*. Technical Report Y-87-1. Environmental Laboratory, Department of the Army, Waterways Experiment Station, Vicksburg, Mississippi.

Franklin, J.F., and C.T. Dyrness. 1988. *Natural Vegetation of Oregon and Washington*. Oregon State University Press, Corvallis, Oregon.

Greytag Macbeth Corporation. 1994. *Munsell Soil Color Charts.*

Kauffmann J.B., M. Mahrt, and W.D. Edge. 2001. Wildlife of Riparian Habitats. Chapter 14, pp. 361-388. In: *Wildlife-Habitat Relationships in Oregon and Washington*. D.H. Johnson and T.A. O'Neil (eds.). Oregon State University Press, Corvallis, Oregon.

Mitsch, W.J., and J.G. Gosselink. 2000. *Wetlands*. Third Edition. John Wiley and Sons.

Reed, P.B., Jr. 1997. *Revision of the National List of Plant Species that Occur in Wetlands*. U.S. Department of Interior, Fish and Wildlife Service, Washington, DC.

Richter, K.O. 1997. *Criteria for Restoration and Creation of Wetland Habitats of Lentic-Breeding Amphibians in the Pacific Northwest.* pp. 72-94. In: *Wetland and Riparian Restoration: A Broader View*. K.B. McDonald and F. Weinmann (eds.). EPA 910-97-007. U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

Sheldon, D., T. Hruby, P. Johnson, K. Harper, A. McMillan, S. Stanley, E. Stockdale. 2003. *Freshwater Wetland in Washington State*. Volume 1: A Synthesis of the Science. Draft. Washington State Department of Ecology Publication #03-06-016. August.

Snyder, D.E., P.S. Gale, and R.F. Russell. 1973. *Soil Survey of King County Area, Washington*. Soil Conservation Service, in cooperation with Washington Agricultural Experimental Station. U.S. Government Printing Office, Washington DC.

Soil Conservation Service. 1991. *Hydric soils of the United States.* U.S. Department of Agriculture, in cooperation with the National Technical Committee for Hydric Soils.

WSDOT. 1993. *Implementing Agreement between the WSDOT and the Washington State Department of Ecology Concerning Wetlands Protection and Management*. Washington State Department of Transportation.

WSDOT. 2000. *Wetland Functions Characterization Tool for Linear Projects*. Wetland Strategic Plan Implementation Project. Washington State Department of Transportation, Environmental Affairs Office.

Fish Resources

Anderson and Ray Landscape Architecture, The Watershed Company, Roth Hill Engineering Partners, Inc, and Robert Foley Associates. 2001. *Medina Creek Conceptual Restoration Plan*. Prepared of the City of Mill Creek, Washington.

Arhonditsis, G. B., M. T. Brett, C. L. DeGasperi, and D. E. Schindler. 2004. Effects of climatic variability on the thermal properties of Lake Washington. *Limnology and Oceanography* 49:256-270.

Arhonditsis, G. B., M. T. Brett, and J. Frodge. 2002. Environmental control and limnological impacts of a large recurrent spring bloom in Lake Washington, USA. *Water Quality of Lakes, Rivers, and Coastal Zones*.

Ballantyne, A.P., M.T. Brett, and D.E. Schindler. 2003. The importance of dietary phosphorus and highly unsaturated fatty acids for sockeye (*Oncorhynchus nerka*) growth in Lake Washington—a bioenergetics approach. *Canadian Journal of Fisheries and Aquatic Sciences* 60:12-22.

Buchanan, K. Washington Department of Fish and Wildlife. July 26, 2004—personal communication with Don Weitkamp.

Buerge, D. 1984. Indian Lake Washington. *The Weekly* [now *Seattle Weekly*]. Aug. 1-7, pp. 29-33.

Chigbu, P. 2000. Population biology of longfin smelt, and aspects of the ecology of other major planktivorous fishes in Lake Washington. *Journal of Freshwater Ecology* 115:543-557.

Chigbu, P. and T. H. Sibley. 1998a. Feeding ecology of longfin smelt (*Spirinchus thaleichthys*) in Lake Washington. *Fisheries Research* 38:109-119.

Chigbu, P., and T. H. Sibley. 1998b. Predation by longfin smelt (*Spirinchus thaleichthys*) on the mysid *Neomysis mercedis* in Lake Washington. *Freshwater Biology* 40: 295-304.

Chigbu, P., T. H. Sibley, and D. A. Beauchamp. 1998. Abundance and distribution of *Neomysis mercedis* and a major predator, longfin smelt (*Spirinchus thaleichthys*) in Lake Washington. *Hydrobiologia* 386:167-182.

City of Bellevue. 2004. *Custom GIS Data CD/February 2004*. http://www.ci.bellevue.wa.us/ page.asp?view=22076. ArcGIS 8.3. Mapping Center, City of Bellevue, Bellevue, Washington.

City of Seattle. 2003. *Custom GIS Data CD/September 2003.* ArcGIS 8.3. Seattle Public Utilities, Seattle, Washington.

CommEn Space. 2000. *Spectral Mixing Analysis of Landsat 7 Image, July 7, 1999 – Seattle/Puget Sound Region*. www.commenspace.org. Accessed April 2004.

Ecology. 1998. *303(d) List of Threatened and Impaired Water Bodies.* Washington State Department of Ecology, Olympia, Washington. 132 pp.

Edmondson, W.T. 1991. *Responsiveness of Lake Washington to Human Activity in the Watershed*. pp. 629-638. In: Proceedings Puget Sound Research '91, Puget Sound Water Quality Authority, Olympia, Washington.

Edmondson, W.T. 1997. *Aphanizomenon* in Lake Washington. *Archives Hydrobiology Supplement* 107:409–446.

Edmondson, W. T., and A. H. Litt. 1982. *Daphnia* in Lake Washington. *Limnology and Oceanography* 27:272-293.

Feist, B.E. 1991. *Potential Impacts of Pile Driving on Juvenile Pink* (Oncorhynchus gorbuscha) *and Chum* (O. keta) *Salmon Behavior and Distribution*. Thesis, University of Washington, Seattle, Washington.

Frodge, J. D., D. A. Marino, G. B. Pauley, and G. L. Thomas. 1995. Mortality of largemouth bass (*Micropterus salmoides*) and steelhead trout (*Oncorhynchus mykiss*) in densely vegetated littoral areas tested using in situ bioassay. *Lake and Reservoir Management* 11:343-358.

Groot, C. and L. Margolis, (eds). 1991. *Pacific Salmon Life Histories.* Vancouver, BC: UBC Press, University of British Columbia. 561 pp.

Hendry, A.P. and T.P. Quinn. 1997. Variation in adult life history and morphology among Lake Washington sockeye salmon (*Oncorhynchus nerka*) populations in relation to habitat features and ancestral affinities. *Canadian Journal of Fisheries and Aquatic Sciences* 54:75-84.

Hendry, A.P., T.P. Quinn, and F.M. Utter. 1996. Genetic Evidence for the Persistence and Divergence of Native and Introduced Sockeye Salmon (*Oncorhynchus nerka*) within Lake Washington, Washington. *Canadian Journal of Fisheries and Aquatic Sciences* 53:823-832.

Jahn, S. 2004. Director, City of Medina Public Works Department. March 9, 2004—personal Communication with P. Lawson.

Kerwin, J. 2001. *Salmon and Steelhead Habitat Limiting Factors Report for the Cedar – Sammamish Basin (Water Resource Inventory Area 8).* Washington Conservation Commission, Olympia, Washington.

King County. 1991. *Stream Survey Report Criteria.* King County Department of Development and Environmental Services, Seattle, Washington.

King County. 2003. *King County GIS Data CD #3: Standard Data/March 2003, and Data CD #4: Parcel Data/March 2003*. ArcGIS 8.3. http://www.metrokc.gov/gis/services/sales_main. htm. King County GIS Center, Seattle, Washington.

King County. 2004a. Fairweather Creek water quality data for 1979 to 2004. Excel file provided by Bob Brenner, King County Water and Land Resources Division.

King County. 2004b. Streams monitoring program: Yarrow Creek (Site A499). http://dnr.metrokc.gov/wlr/waterres/streams/YARROW_intro.htm.

King County and 25 authors. 2001. *WRIA 8 Salmonid Distribution Maps and Database.* Seattle, Washington.

Longmuir, C., and T. Lively. 2001. *Bubble Curtain Systems for Use During Marine Pile Driving*. Report by Fraser River Pile & Dredge Ltd., New Westminster, British Columbia.

Menconi, C., and A. Johnson. 1998. *Bellevue Culvert Inventory*. Report to City of Bellevue. December 1998.

NMFS. 1996. *Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale.* National Marine Fisheries Service, Environmental Technical Services Division, Habitat Conservation Branch. 28 pp.

NMFS. 1998. *Endangered and Threatened Species: Proposed Endangered Status for Two Chinook Salmon ESUs and Proposed Threatened Status for Five Chinook Salmon ESUs; Proposed Redefinition, Threatened Status, and Revision of Critical Habitat for One Chinook Salmon ESU; Proposed Designation of Chinook Salmon Critical Habitat in California, Oregon, Washington, Idaho.* Proposed Rule. Federal Register 63(45):11482-11520. (National Marine Fisheries Service). March 9, 1998.

NMFS. 1999. *Endangered and Threatened Species: Threatened Status for Three Chinook Salmon Evolutionarily Significant Units (ESUs) in Washington and Oregon, and Endangered Status for One Chinook Salmon ESU in Washington.* Final Rule. Federal Register 64(56):14308-14328. (National Marine Fisheries Service). March 24, 1999.

NOAA Fisheries. 2004a. *Endangered Species Act Status Reviews and Listing Information*. http://www.nwr.noaa.gov/1salmon/salmesa/ index.htm. (National Oceanic and Atmospheric Administration Fisheries). Last updated on June 17, 2004. Accessed on September 15, 2004.

NOAA (National Oceanic and Atmospheric Administration) Fisheries. 2004b. *Endangered and Threatened Species; Designation of Critical Habitat for 13 Evolutionary Significant Units of Pacific Salmon* (Oncorhynchus spp.) *and Steelhead (O. mykiss) in Washington, Oregon, and Idaho.* Proposed Rule. December 14, 2004. Federal Register 69(239):74572-74846.

Paulson, K. 2004. Fisheries Biologist, City of Bellevue Public Utilities Department. March 1, 2004—personal communication with P. Lawson.

Peterson, N.P., A. Hendry, and T.P. Quinn. 1992. *Assessment of Cumulative Effects on Salmonid Habitat: Some Suggested Parameters and Target Conditions.* TFW-F3-92-001, WA Timber, Fish and Wildlife.

Rogers, P. H. and M. Cox. 1988. *Underwater Sound as a Biological Stimulus.* Pages 131-149 in. Atema, J, R. R. Fay, A. N. Popper and W. N. Tavolga editors. Sensory biology of aquatic animals, Springer-Verlag. New York.

Snohomish County. 2002. *DNR Habitat Condition Criteria and Data Sources.* Snohomish County Surface Water Management, Everett, Washington.

Stotz, T., and J. Colby. 2001. *January 2001 Dive Report for Mukilteo Wingwall Replacement Project*. Washington State Ferries Memorandum. 5 pp. + appendices.

StreamNet. 2002. *Salmonid Distribution Map and Data.* http://205.230.28.30:8080/website/snetmapper /viewer.htm.

Tabor, R.A. J.A. Scheurer, H.A., Gearns, and E.P. Bixler. 2004. *Nearshore Habitat Use by Juvenile Chinook Salmon in Lentic Systems of the Lake Washington Basin.* Annual Report 2002, by U.S. Fish and Wildlife Service to Seattle Public Utilities, Seattle, Washington. 58 pp.

Tobin, C., and L. F. Pendergrass. 1993 (updated 1997). *Bellevue Historic and Cultural Resources Survey*. City of Bellevue Design and Development.

USFWS. 2004a. *Bull Trout* (Salvelinus confluentus) *Draft Recovery Plan, Coastal-Puget Sound Distinct Population Segment.* Volume I. U.S. Fish and Wildlife Service, Region 1, Portland, Oregon. 389 pp.

USFWS. 2004b. *Endangered and Threatened Wildlife and Plants: Proposed Designation of Critical Habitat for Populations of Bull Trout: Proposed Rule*. U.S. Fish and Wildlife Service. Federal Register 69(122):35768-35857.

The Watershed Company. 1998. *Kirkland's Streams, Wetlands, and Wildlife Study*. Report prepared for the City of Kirkland's Planning and Community Development. Kirkland, Washington.

WDFW. 2002. *Species of Concern*. http://wdfw.wa.gov/wlm/ diversity/soc/concern.htm. Accessed on July 18, 2002. Washington Department of Fish and Wildlife, Olympia, Washington.

WDFW. 2003. *Design of Road Culverts for Fish Passage*. Habitat and Lands Program, Environmental Engineering Division. Washington Department of Fish and Wildlife. Olympia, Washington.

Weitkamp, D.E., and G.T. Ruggerone. 2000. *Factors Affecting Chinook Salmon Populations, Background Report.* Prepared by Parametrix, Inc., Natural Resources Consultants, and Cedar River Associates for City of Seattle, Washington. 224 pp.

WSDOT and WDFW. 2003. *Progress Performance Report for WSDOT Fish Passage Inventory*. Washington State Department of Transportation Fish Passage Barrier Removal Program; Washington State Department of Fish and Wildlife Technical Applications Division. Olympia, Washington.

WSDOT. 2003. *Hood Canal Bridge Retrofit and East Half Replacement Projects. Biological Assessment and Essential Fish Habitat Assessment.* WSDOT Project No. 0L3305, Olympia, Washington.

WSDOT. 2004. *Highway Runoff Manual*. Publication M31-16. 2004. March.

WSFPB. 1992. *The Standard Methodology for Conducting Watershed Analysis under Chapter 222-22 WAC, Version 1.00*, Approved August 12, 1992. Washington Department of Fish and Wildlife.

Williams, R.W., R.M. Laramie, and J.J. Ames. 1975. *A Catalog of Washington Streams and Salmon Utilization*. Volume 1: Puget Sound Region. Washington State Department of Fisheries, Olympia, Washington.

Wildlife and Habitat

Anthony, R.G. and F.B. Isaacs. 1989. Characteristics of bald eagle nest sites in Oregon. *Journal of Wildlife Management* 53:148-159.

Aubry, K.B. and C.M. Raley. 1993. *Wildlife Habitat Relationships in Washington and Oregon*. Annual report, fiscal year 1993, on file at Pacific Northwest Research Station, Olympia, Washington.

Audubon Society. 1999. *List of Birds of the Wetherill Nature Preserve*. Compiled by the East Lake Washington Audubon Society from monthly inventories between June 1998 and May 1999.

Butler, R.W. 1995. *The Patient Predator: Foraging and Population Ecology of the Great Blue Heron* (Ardea herodias) *in British Columbia*. Occasional Paper Number 86. Canadian Wildlife Service, Ontario, Canada.

Calambokidis, J., S.M. Speich, J. Peard, G.H. Steiger, J.C. Cubbage, D.M. Fry, and L.J. Lowenstine. 1985. *Biology of Puget Sound Marine Mammals and Marine Birds: Population Health and Evidence of Pollution Effects*. National Oceanic and Atmospheric Administration. Technical Memo NOS. OMA 18.

Livingston, S.A., C.S. Todd, W.B. Krohn, and R.B. Jr. 1990. Habitat models for nesting bald eagles in Maine. *Journal of Wildlife Management* 54(4):645-653.

Minor, M. 2004. Michael Minor and Associates. Portland, Oregon. October 13, 2004—personal communication with Julie Grialou, Parametrix.

Nelson, S.K. 1988. *Habitat Use and Densities of Cavity Nesting Birds in the Oregon Coast Ranges.* Master's Thesis, Oregon State Univ. Corvallis, Oregon.

ODFW. 1996. *Species at Risk: Sensitive, Threatened, and Endangered Vertebrates of Oregon*. Second edition. Oregon Department of Fish and Wildlife. Portland, Oregon.

Parametrix, Inc. 2004. SR 520 wildlife site reconnaissance investigation by Julie Grialou, wildlife biologist. February 2004.

Parametrix, Inc. 1996. *West Point Secondary Treatment Facilities Bald Eagle Monitoring Annual Report for 1995-96 Nesting Season*. Prepared for King County Department of Metropolitan Services. December 1996.

Shuford, W.D. 1993. Red-tailed hawk. In: W.D. Shuford (ed.). *The Marin County Breeding Bird Atlas: A Distributional and Natural History of Coastal California Birds.* California Avifauna Series1. Bushtit Books, Bolinas, California.

Smith, M.R., P.W. Mattocks, Jr., and K.M. Cassidy. 1997. *Breeding Birds of Washington State*. Volume 4. In: K. Cassidy, C.E. Grue, M.R. Smith, and K.M. Dvornich (eds.), Washington State Gap Analysis – Final Report. Seattle Audubon Society Publications in Zoology No. 1, Seattle, Washington.

Stalmaster, M.V. 1987. *The Bald Eagle*. Universe Books, New York, New York.

Stofel, J. 2004. Staff biologist, Washington Department of Fish and Wildlife, Mill Creek, Washington. March 8, 2004—e-mail communication.

USFWS. 2004. Response letter to Parametrix, Inc., dated March 2, 2004, regarding listed, proposed, and candidate species, as well as species of concern, that may occur in the SR 520 project vicinity.

WDFW. 1993a. *Status of the Western Pond Turtle* (Clemmys marmorata) *in Washington*. Washington Department of Fish and Wildlife, Olympia, Washington.

WDFW. 1993b. *Management Recommendations for the Red-Tailed Hawk* (Buteo jamaicensis). Washington Department of Fish and Wildlife, Mill Creek, Washington.

WDFW. 2003. *Management Recommendations for Washington's Priority Species.* Volume IV: Birds. Washington Department of Fish and Wildlife, Olympia, Washington.

WDFW. 2004. Electronic data documenting priority species and habitats in the SR 520 project vicinity. Washington Department of Fish and Wildlife, Olympia, Washington.

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Attachment 1

Description of Water Bodies Outside the Project Area

Attachment 1

Description of Water Bodies Outside the Project Area

This attachment describes water bodies located outside the project area containing fish resources that may be potentially affected by the project.

Cedar River

The Cedar River is the largest tributary to Lake Washington, providing about 53 percent of the surface flow into the lake. It discharges at the south end of the lake near Renton. It provides 21.5 miles of mainstream salmon habitat up to the Landsburg pipeline crossing, and another 17.5 miles of potential habitat upstream to a natural migration barrier at Lower Cedar Falls. Although the Cedar River would not be directly affected by any alternatives considered in the SR 520 Bridge Replacement and HOV Project, the salmon resources of this river could be affected.

The Cedar River drains an area of about 66 square miles downstream from the City of Seattle diversion dam at Landsburg in southeastern King County (King County 1993). Upstream of Landsburg, the watershed covers approximately 84 square miles. Mean annual discharge to Lake Washington at Renton is 638 cubic feet per second (cfs), with mean monthly ranges of 183 to 1,118 cfs. Generally the water quality of the river meets salmon requirements.

The Cedar River supports a substantial population of Chinook salmon, which are part of the Puget Sound Chinook salmon evolutionarily significant unit (ESU) listed under the Endangered Species Act (ESA) as threatened. Juvenile Chinook salmon produced in the Cedar River migrate downstream into Lake Washington from late winter through May. The early migrants, which are about 1 inch in size, move into Lake Washington shortly after emergence from the gravel. The later migrants undergo extended rearing in the Cedar River, growing to a substantial size of about 2 inches before migrating into and through Lake Washington.

Sockeye salmon are also produced in the Cedar River. These fish comprise the majority of the sockeye that rear in Lake Washington. The Cedar River also produces coho salmon, steelhead trout,

cutthroat trout, native char, and mountain whitefish, which migrate or may migrate into and through Lake Washington.

Coal Creek

Coal Creek is a 7-mile-long stream draining to Lake Washington just south of the I-90 East Channel Bridge. The stream drains a former mining area that is now developed primarily as single-family residences. Some commercial and multifamily development is also present in the watershed. Coho and sockeye salmon are reported to reproduce in Coal Creek (Williams et al. 1975, King County and 25 Authors 2001). Other resident salmonids (cutthroat and rainbow trout) are also expected to occur in the stream.

Juanita Creek

Juanita Creek is a small, 14-mile-long stream draining the north Kirkland area to Juanita Bay in Lake Washington. Land use in the Juanita Creek watershed is predominantly single-family residences with some light commercial development. Juanita Creek supports spawning and early rearing by coho and sockeye salmon that rear in Lake Washington. Cutthroat and rainbow trout most likely reside in Juanita Creek.

Sammamish River

The Sammamish River basin watershed covers 150 square miles. All but 26 square miles of this area drains through Lake Sammamish or Bear Creek (King County 1993). The Sammamish River was historically a broad, densely vegetated wetland of slow-moving water (called Sammamish Slough) that meandered through forests between Lake Washington and Lake Sammamish (Stickney and McDonald 1977). After completion of the Montlake Cut, the lower elevation of Lake Washington caused the Sammamish Slough to gain velocity. Around 1916, the U. S. Army Corps of Engineers (the Corps) straightened and widened the slough into a distinct channel. In the mid-1930s, the Corps dredged the river and began a maintenance program to restrict vegetation growth along its banks. In the 1960s the Corps began a project, sponsored by King County, to dredge, straighten, and fill the channel meanders to protect agricultural lands from spring floods (KCSWM 1993). Currently, the Sammamish River flows north (approximately 13.8 miles) in a relatively straight, uniform, U-shaped channel along much of its length (Williams et al. 1975).

Land use adjacent to the river is a combination of urban, residential, and agricultural uses. Small tributaries to the Sammamish River include Swamp Creek, North Creek, and Little Bear Creek. The main tributary, Bear Creek, enters the Sammamish River just north (downstream) of SR 520 in Redmond.

Warm water discharges from Lake Sammamish, exacerbated by limited shade along the river corridor, allow summer water temperatures to approach a critically high range for coldwater fish species. Water quality is further degraded by discharges from small tributaries and stormwater outfalls that contribute fine sediment and pollutants commonly associated with agricultural, urban, and suburban development.

The Sammamish River is inhabited by a variety of resident fish that move freely between the river, Lake Washington, and Lake Sammamish. The river provides a migratory corridor for anadromous salmon produced in each of its tributaries, as well as those produced in Lake Sammamish tributaries. Young Chinook salmon, coho, and steelhead migrate downstream through the Sammamish River from late winter through early summer. Adult salmon migrate upstream from early summer through autumn. Migrating adult salmon may stay in local pockets of cooler water within the Sammamish River for prolonged periods of days to weeks before migrating into Lake Sammamish or tributaries such as Bear Creek.

Bear Creek

Bear Creek basin, north of Lake Sammamish, covers approximately 51 square miles. Land use is predominantly urban residential and commercial (King County 1990a). Bear Creek is a small stream with a mean annual flow of 19 to 33 cfs. The downstream reach of Bear Creek is located in Redmond. This reach was historically straightened and dredged by the Corps. Recent restoration of a portion of the channel has enhanced in-stream habitat and geomorphology in this reach.

King County has designated the lower reaches of Bear Creek as a Regionally Significant Resource Area because of its excellent habitat and water quality; it is also one of the most productive salmon spawning streams in the Puget Sound basin. Although Bear Creek has excellent water quality, it has been degraded by commercial,

industrial, and dairy operations (King County 1990a). The most common sources of degradation are increases in sediment loads and high-flow bank erosion in Lower Bear Creek (King County 1990a).

Currently, Bear Creek and its tributaries support populations of salmon, including Chinook, coho, sockeye, and kokanee salmon; steelhead and rainbow trout; and coastal cutthroat trout (Williams et al. 1975, WDF et al. 1993, WDFW 1998, Kerwin 2001). Productivity in Bear Creek has been much reduced from historic levels (Schultz and Students 1935, Ostergaard 1998). Habitat degradation has reduced or eliminated fish spawning in the area crossed by SR 520, but the creek still serves as an important migration corridor and also provides important rearing habitat.

Lake Sammamish Watershed

The Lake Sammamish watershed includes Lake Sammamish, Issaquah Creek, and a number of other small tributaries. Although none of these features are directly crossed by the project, they are important because they support populations of anadromous fish that use the project area for certain life stages.

Lake Sammamish

Lake Sammamish, with a surface area of approximately 4,900 acres, is one of the largest lakes in the Puget Sound basin (King County 1994a). The lake receives flow primarily from Issaquah Creek and discharges north through the Sammamish River to Lake Washington, Lake Union, and Puget Sound. Lake Sammamish also has numerous small tributaries, which are not discussed in this evaluation.

Flow through Lake Sammamish flushes the lake approximately every 2 years (King County 2001). Most of the watershed is located within the King County Urban Growth Boundary and is (or will be) developed with high-density residential and commercial land uses (King County 1994b).

Lake Sammamish serves as a rearing environment and migratory pathway for both resident and anadromous salmon, with Chinook, coho, sockeye, and kokanee salmon; steelhead; and coastal cutthroat trout likely to be found in the lake and its tributaries (King County 1990b, Pfeifer 1992). Subpopulations of Lake Washington sockeye and kokanee spawn along the shorelines. Although actual spawner numbers are unknown, shore spawning populations have been

declining in recent years. Lake Sammamish is listed as a King County Sensitive Lake because numerous water quality studies over the last 30 years have suggested that the lake is sensitive to phosphorus loading, which reduces dissolved oxygen (King County 1990b, 1995). Rapid and intense development has degraded the hydrology and water quality in Lake Sammamish and the numerous creeks that drain into the lake (King County 1990b).

Issaquah Creek

The Issaquah Creek watershed is approximately 55 square miles. The 17-mile-long stream originates in forested rural areas of eastern King County, with high-gradient headwaters on Tiger Mountain (King County 1994c). The small streams converge to form the mainstem of Issaquah Creek, which flows north through the substantially urbanized area of Issaquah to discharge at the south end of Lake Sammamish.

Land use in the basin is a combination of commercial forestry, farms, and urban development (King County 1994c). Land within the watershed is rapidly being developed for commercial uses. Sedimentation and flooding are common in the lower reaches of Issaquah Creek and are expected to worsen as development in the upper basin continues (King County 1994c).

Issaquah Creek produces most of the anadromous salmon migrating into and through Lake Sammamish—steelhead, rainbow, and cutthroat trout, as well as both wild and hatchery Chinook, coho, and sockeye salmon.

References

Kerwin, J. 2001. *Salmon and Steelhead Habitat Limiting Factors Report for the Cedar – Sammamish Basin (Water Resource Inventory Area 8).* Washington Conservation Commission, Olympia, Washington.

King County. 1990a. *Bear Creek Basin Plan.* King County Water and Land Resources Division, Seattle, Washington. July

King County. 1990b. *East Lake Sammamish Basin: Conditions Report–Preliminary Analysis.* King County Surface Water Management Division, Seattle, Washington. 148 pp + Appendices.

King County. 1993. *Cedar River Current and Future Conditions Report.* King County Department of Public Works, Surface Water Management Division, Seattle, Washington. 408 pp. + appendices.

King County. 1994a. *East Lake Sammamish Basin: Watershed Management Committee: Basin and Nonpoint Action Plan.* King County Surface Water Management Division and Washington State Department of Ecology, Seattle, Washington. 97 pp. + appendices.

King County. 1994b. *Issaquah Creek Watershed Management Committee Proposed Basin and Nonpoint Action Plan.* King County Surface Water Management Division and City of Issaquah/East Lake Sammamish Watershed Management Committee.

King County. 1994c. *Water quality of small lakes and streams: western King County 1990 to 1993*. King County Department of Metropolitan Services, Seattle, Washington.

King County. 1995. *Lake Sammamish Total Phosphorus Model.* King County Department of Metropolitan Services; Water Pollution Control Department and King County Surface Water Management Division, Seattle, Washington.

King County. 2001. Lake Sammamish Water Quality. http://www.splash.metrokc.gov/wrl/waterres /lakes/SAMM.htm. Accessed January 3, 2001. King County Department of Natural Resources.

King County and 25 authors. 2001. *WRIA 8 Salmonid Distribution Maps and Database.* Seattle, Washington.

KCSWM (King County Surface Water Management Division). 1993. *Sammamish River Corridor Conditions and Enhancement Opportunities.* Department of Public Works. 54 pp. + appendices.

Ostergaard, E. 1998. *1996 Salmon Spawning Assessments in the Lake Washington Watershed.* King County Water and Land Resources Division, Seattle, Washington.

Pfeifer, B. 1992. *Fisheries Investigations of Lakes Washington and Sammamish – 1980 – 1990. Part V. Wild Cutthroat and Kokanee in Lakes Washington and Sammamish (draft document).* Wash. Dep. Game. 210 pp. (Available from West Coast Sockeye Salmon Administrative Record, National Marine Fisheries Service, Portland, Oregon.)

Schultz, L.P. and Students. 1935. The Breeding Activities of the Little Redfish, a Landlocked Form the Sockeye Salmon, *Oncorhynchus nerka. Mid-Pacific Magazine.*

Stickney, A.E. and L. McDonald. 1977. *Squak Slough 1870-1920.* Published by Friends of the Bothell Library, Bothell, Washington. Seattle, Washington: Evergreen Printing Company.

Washington Department of Fisheries (WDF), Washington Department of Wildlife, and Western Washington Treaty Indian Tribes. 1993. *1992 Washington State Salmon and Steelhead Stock Inventory (SASSI): Summary Report.* Washington Department of Fisheries, Olympia, Washington. 212 pp.

WDFW. 1998. *1998 Washington State Salmonid Stock Inventory (SASSI). Appendix: Bull Trout and Dolly Varden.* Washington Department of Fish and Wildlife, Olympia, Washington. 437 pp.

Williams, R.W., R.M. Laramie, and J.J. Ames. 1975. *A Catalog of Washington Streams and Salmon Utilization.* Volume 1: Puget Sound Region. Washington State Department of Fisheries, Olympia, Washington.

Attachment 2

Salmon in the Lake Washington Watershed

Attachment 2

Salmon in the Lake Washington Watershed

The following descriptions provide life history information for salmon produced in the Lake Washington watershed.

Chinook Salmon (*Oncorhynchus tshawytscha*)

Lake Washington Chinook salmon are a part of the Puget Sound evolutionarily significant unit (ESU) of Chinook salmon listed as threatened under the Endangered Species Act (ESA) (NMFS 1998, 1999). Puget Sound Chinook salmon characteristically return to their natal streams (the streams where they were hatched) and spawn there at 3 or 4 years of age. Chinook salmon reproducing in the Lake Washington watershed are summer/fall run fish that have an ocean-type life cycle. Ocean-type fish commonly migrate to the ocean during the first 2 to 6 months of life following emergence from the spawning gravel. Chinook salmon runs passing through Lake Washington include runs to the Cedar River, to Bear Creek via the Sammamish River, to Issaquah Creek, and to several other small streams. Adults from each of these runs migrate through the Lake Washington Ship Canal and into Lake Washington before reaching their spawning rivers and creeks.

The timing of adult Chinook salmon migrations through Lake Washington is similar to that of other fall Chinook salmon stocks in south Puget Sound (Warner and Fresh 1999). Adult Chinook salmon first arrive at the Hiram M. Chittenden Locks (Ballard Locks) in mid-June, peak in mid-to-late August, and are generally through the locks by early October. The total run of naturally spawning Chinook salmon in WRIA 8 is smaller than the hatchery-produced run and is destined primarily for the Cedar River, Bear Creek, Issaquah Creek, and Kelsey Creek on the eastern side of Lake Washington. The number of hatchery-produced fish that stray and naturally spawn is unknown.

Although natural spawning of Chinook salmon in Lake Washington was reported once (Roberson 1967), it is unlikely that a lake-spawning population still occurs in the lake. Generally, Chinook salmon have not been found to spawn along lake shorelines. Most Chinook salmon populations spawn in larger (third- or fourth-order)

streams, including rivers and major tributaries of rivers (Bjornn and Reiser 1991).

Juvenile Chinook salmon that have just emerged from the gravel are known as fry. Using Cedar River Chinook salmon as an example, the fry emerge from the gravel in late winter to early spring and begin migrating downstream by at least mid-January, continuing through until at least early July (Warner and Fresh 1999). It appears that many of the fry migrate from the Cedar River to Lake Washington shortly after emergence. These fry subsequently rear along Lake Washington shorelines in very shallow water (3 feet deep or less) with unvegetated sandy substrate (Tabor et al. 2003). Some of the fry rear within the river for several months before migrating into and through Lake Washington in late May and June.

Juvenile Chinook salmon entering Lake Washington are commonly either fry that migrate to the lake shortly following their emergence from the spawning gravel of tributaries, or as fingerlings after several months of rearing in their natal streams. The small (30 to 40 millimeters [mm]) fry appear to migrate slowly along the shorelines in very shallow water (less than 1 meter) and rear in sandy-gravel beach portions of the shoreline (Tabor and Pisakowski 2002, Tabor et al. 2003). Information available from other locations supports these observations of young Chinook salmon in lentic (still water) environments such as lakes or ponds. In Lake Sammamish, aggregations of juvenile hatchery Chinook salmon (and coho) have been observed in surface waters extending from the shoreline to nearshore areas overlying relatively deep water (Pflug pers. comm. 2000).

Most juvenile ocean-type Chinook salmon migrate to marine water during their first year of life. This appears to be true for Lake Washington watershed Chinook salmon, although a substantial number may rear within Lake Washington for 1 or more years. It has been determined that 24 percent reared for 2 years in Lake Washington, and 1 percent for 3 years (Buckley 1963). Less than 1 percent of Chinook salmon reared for 4 or 5 years in Lake Washington before migrating to marine water.

Young Chinook salmon migrate from Lake Washington to Puget Sound through the Lake Washington Ship Canal and Lake Union in very shallow water along the shorelines (Tabor and Pisakowski 2002). Some young Chinook salmon may enter this area early in the spring

to rear along the shorelines, as they do in Lake Washington. Little is known about the amount of time Chinook salmon spend in the Lake Washington Ship Canal.

Tabor et al. (2003) determined that young Chinook salmon fry in Lake Washington, the Lake Washington Ship Canal, and Lake Sammamish use primarily sand and gravel substrates in very shallow water. The numbers of Chinook salmon along riprap and bulkhead shorelines were much lower. Tabor et al. (2003) and Pisakowski and Tabor (2000) observed that young Chinook salmon concentrated in very shallow water at depths of about 1.3 feet. Chinook salmon form loose feeding aggregations near the surface during the day, but separate and remain inactive near the bottom at night. The smaller Chinook salmon use woody debris in the lake for cover when they first enter the lake environment, but later, as their size increases, they show no preference for woody debris. Young Chinook salmon are often found near but not under overwater structures. The juvenile Chinook salmon remain within these shallow water habitats from March through mid-May. After mid-May, the young Chinook salmon move away to deeper water or migrate out of the lake system.

The timing of juvenile Chinook salmon migrants through the Ballard Locks appears to be from mid-May through July (Goetz et al. 1998, Johnson et al. 1999). Although peak emigration appears to be in June, juvenile Chinook salmon are present in the system through at least July (Fresh pers. comm. 2000). Timing of Chinook salmon migration is later than that of sockeye salmon, the most abundant salmon migrating through the locks.

Bull Trout (*Salvelinus confluentus*)

The distribution of bull trout in the Lake Washington watershed is uncertain. They are classified by the WDFW as char that may be either native bull trout or introduced Dolly Varden (*S. malma*). The two species are similar enough in appearance that field identification is difficult even for most fishery biologists. Therefore, WDFW has combined information on their status and distribution into a common inventory (WDFW 1998). All char observed in the watershed are assumed to be bull trout; however, there have been few reported sightings.

Bull trout exhibit multiple life history strategies, commonly occupy patchy distributions, and are associated with cool water and complex

habitats. The four recognized life history forms include resident (nonmigratory), adfluvial (lake rearing), fluvial (migratory stream and river rearing), and anadromous (saltwater migratory) fish. Bull trout produced within the Lake Washington basin are part of the Coastal-Puget Sound population segment. This population segment is unique because it is thought to contain the only anadromous forms of bull trout within the coterminous United States (USFWS 1998a). In June 1998, the U.S. Fish and Wildlife Service (USFWS) proposed listing bull trout in the Coastal-Puget Sound distinct population segment (DPS) as threatened under the ESA (USFWS 1998a); since then, they have issued a final ruling determining a threatened status for bull trout (USFWS 1999). The status of the migratory (adfluvial, fluvial, and anadromous) life history forms is of greatest concern throughout most of the bull trout range. Most of the remaining populations in some areas may be largely composed of resident bull trout (Leary et al. 1991, Williams and Mullan 1992).

Resident bull trout spend their entire lives in fresh water, while anadromous forms live in tributary streams for 2 or 3 years before migrating to estuaries as smolts (sexually immature migrating salmon) (Wydoski and Whitney 1979). Char are generally longer-lived than salmon, with bull trout up to 12 years old having been identified in Washington (Brown 1994). Migratory bull trout typically move downstream in the summer and often congregate in large slow pools to feed (Bjornn 1991). As bull trout grow, they tend to prey primarily on fish (Bjornn 1991). After entering Puget Sound, the diet of anadromous char includes smelt, herring, and juvenile salmon (Brown 1994).

Bull trout are found in a variety of habitats, including lakes, reservoirs, large rivers, and small streams, but primarily inhabit colder streams (Rieman and McIntyre 1993). Habitat components that influence bull trout distribution and abundance include temperature, cover, channel form and stability, valley form, spawning and rearing substrates, and migratory corridors (Rieman and McIntyre 1993; USFWS 1998b). Migratory bull trout move between many habitats during their life cycle, while the nonmigratory form maintains a relatively small home range, typically completing its life cycle in small headwater streams.

Bull trout are believed to be restricted in their spawning distribution by water temperature. Locally, fluvial and anadromous bull trout spawn from late September to early November, depending on

location, with spawning typically beginning when stream temperatures fall below 45°F (WDFW Mill Creek file records). Stream temperature directly affects embryo survival (Goetz 1989). Emergence occurs from early April through May (Bjornn 1991, Rieman and McIntyre 1993). Bull trout fry are often found in shallow backwater areas of streams that contain woody debris. Fry are bottom dwellers and may occupy interstitial spaces in the streambed (Brown 1994).

Bull trout are widely distributed across their range, but that distribution tends to be very patchy (Rieman and McIntyre 1993). This is true even in pristine environments (Rieman and McIntyre 1993). Bull trout have been extirpated from many of the large rivers within their historical range and exist primarily as isolated headwater populations. Their decline has been attributed to habitat degradation, blockage of migratory corridors by dams, poor water quality, the introduction of nonnative species, and the effects of past fisheries management practices (USFWS 1998a).

Historically, bull trout were probably well-distributed throughout the central Puget Sound region (Goetz 1994); however, information regarding the current distribution of bull trout in the Lake Washington basin is meager. Spawning populations occur in Chester Morse Lake in the Cedar River basin, where cool water meets spawning requirements, but they have not been confirmed in the lower Cedar River, Lake Washington, Lake Sammamish, or their tributaries (WDFW 1998; USFWS 1998a). These water bodies have recently been proposed as critical habitat for bull trout (USFWS 2004).

On the Cedar River, the Chester Morse resident population likely produces a few individuals that pass downstream from the dam to become isolated from the main population, but there have been few other reports of native char in the Lake Washington basin (USFWS 1998a). A total of one to several native char have been observed in Issaquah Creek , the Ballard Locks, or Lake Washington (Bradbury and Pfeifer 1992; USFWS 1998a) in the past 20 years. These fish likely originated in other basins and were foraging within the Lake Washington system, or they are isolated individuals that have moved downstream from the Chester Morse resident population. No char have been reported recently in Lake Sammamish (WDFW 1998).

Water characteristics within much of the Lake Washington basin are not appropriate for char throughout the entire year, which limits bull

trout populations. Historical conditions in the basin, aside from the upper Cedar River, are not likely to have met bull trout spawning temperature requirements. Furthermore, the bull trout incubation period requires a sediment-free environment, which is commonly absent in the highly urbanized streams of the Lake Washington system, including those along the project corridor.

Coho Salmon (*Oncorhynchus kisutch*)

Coho salmon are discussed in this report because they have been identified as a species of concern by the National Oceanic and Atmospheric Administration (NOAA) Fisheries. The status of the Puget Sound/Strait of Georgia ESU was previously determined to warrant further consideration for federal ESA listing because of concerns about current genetic, environmental, and habitat conditions (NMFS 1995).

Factors identified as potentially deleterious to Puget Sound coho stocks include high harvest rates, extensive habitat degradation, unfavorable ocean conditions, and declines in adult size (Weitkamp et al. 1995).

Coho reproduce in many Lake Washington watershed tributaries and migrate through Lake Washington. They typically follow a stream-type life cycle, rearing in fresh water into their second year of life before migrating to estuaries during the late spring (Wydoski and Whitney 1979, Sandercock 1991). Smolts migrate to and rear in the marine environment into their third year of life before returning to fresh water to spawn. Adult Lake Washington coho enter fresh water from mid-September to mid-November and spawn from late October through late February (Williams et al. 1975, WDF et al. 1993). Adult coho spawn in a variety of habitats and use substrates from fine gravel to cobbles in waters less than 3 feet deep. Coho salmon usually spend about 2 weeks on the spawning grounds from the time of their arrival until their death (Sandercock 1991).

The length of incubation depends on temperature, but coho embryos commonly hatch after about 6 to 8 weeks in the gravel and may rear in the gravel for an additional 2 to 4 weeks before emergence (Wydoski and Whitney 1979, Groot and Margolis 1991). Following emergence, coho fry feed on terrestrial and aquatic insects, usually maintaining distinct feeding territories during daylight hours.

Typically, coho smolts emigrate with increased spring flows between mid-April and mid-July, with peak migration in May. Some young coho remain within their natal tributary for a full year before migrating downstream, while others migrate to downstream areas for a portion of their freshwater rearing.

Juvenile coho migrate out of the Lake Washington system rapidly over a relatively short period of time in the late spring. Figure 1 shows the timing of juvenile coho at various points in their downstream migration from tributaries through Lake Washington to Puget Sound.

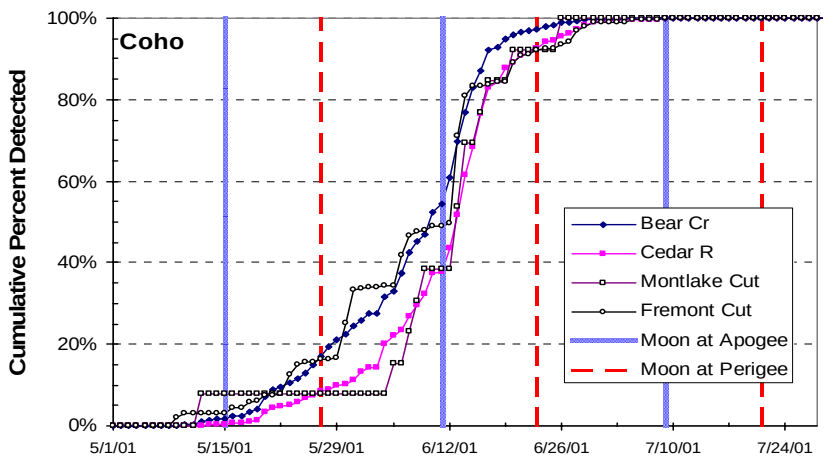

Figure 1. Migration Timing of Juvenile Coho Salmon in the Lake Washington System

Provided by Fred Goetz, USACE, Seattle District

The most productive rearing areas for coho tend to be small streams with abundant slow water habitats, such as pools (Wydoski and Whitney 1979, Sandercock 1991, Bisson et al. 1988). Access to deep pools and cover in the form of woody debris or undercut banks increases winter survival of coho rearing in streams. During winter coho commonly seek refuge in ponds and small tributaries to avoid being flushed downstream during extreme high-flow events (Cederholm and Scarlett 1982, Peterson 1982). Woody debris is also important because it provides cover, food, and substrate for many aquatic insects that are prey for rearing coho.

Sockeye-Kokanee Salmon (*Oncorhynchus nerka*)

Both the sockeye (anadromous form) and the kokanee (nonanadromous form) of *Oncorhynchus nerka* are present in the Lake Washington watershed. Sockeye juveniles generally migrate to sea in

the spring of their second year of life after rearing for 1 or 2 years in Lake Washington. They grow to maturity in the Pacific Ocean, and migrate back through the Lake Washington Ship Canal and Lake Washington to their natal streams to spawn in the autumn. Sockeye differ from other anadromous salmon because the young commonly rear in lakes rather than in streams before migrating to marine habitats.

Anadromous sockeye were introduced into the Lake Washington watershed from the Baker River Stock between 1937 and 1945 (Hendry et al. 2000). Sockeye in Bear Creek (Cottage Creek) appear to be native, while sockeye spawning in the Cedar River, Issaquah Creek, and the beaches of Lake Washington are from introduced stock (Hendry et al. 1996). In the Lake Washington watershed, anadromous sockeye reproduce in the Cedar River system and south Lake Washington.

Migration of sockeye smolts from Lake Washington through the Lake Washington Ship Canal to marine waters occurs primarily in the late spring over a period of about 50 to 60 days (Figure 2). Sockeye fry emerge from the gravel and migrate into Lake Washington from January through late May, where they rear for approximately 1 year (Woodey 1966). Juveniles are pelagic in Lake Washington, feeding primarily on zooplankton before migrating to Puget Sound the following May (Woodey 1972).

In Lake Washington, juvenile sockeye feed intensively during the afternoon through dusk in the summer and autumn months (Doble and Eggers 1978). Their diet consists exclusively of zooplankton (passively floating microscopic animals). During the winter, a high percentage of juveniles do not feed.

Anadromous sockeye salmon are commonly much larger (up to twice as long) than the nonanadromous kokanee, largely because of differences in productivity between the marine and lake environments (Foerster 1968, Wood and Foote 1990). Except for their smaller size, kokanee resemble anadromous sockeye in appearance and bright spawning coloration (Burgner 1991). Kokanee spawn either in streams or along lake shorelines, and spawning is generally segregated from sockeye spawning by time and location. Kokanee remain in fresh water their entire life, rearing in lakes until maturity and then returning to spawn in their natal streams (Ricker 1938, Vernon 1957, McCart 1970).

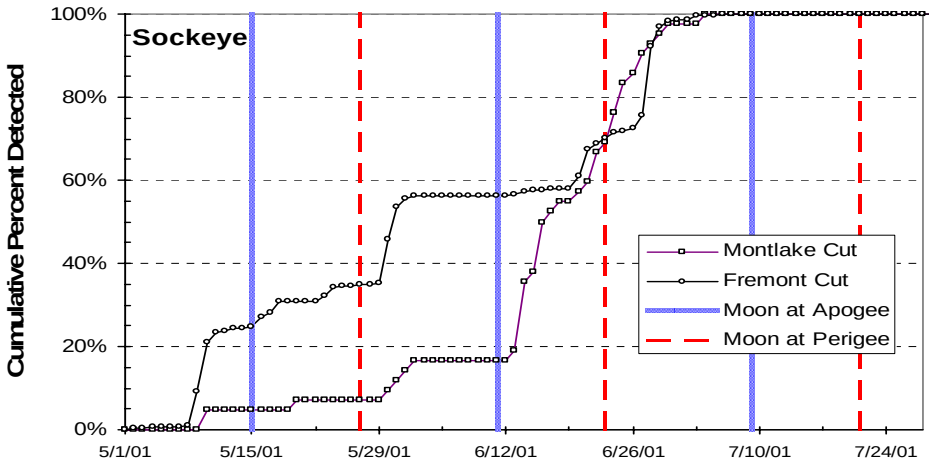

Figure 2. Migration timing of juvenile sockeye salmon, Lake Washington system
(provided by Fred Goetz, USACE, Seattle District)

Both native and introduced kokanee occur in the watershed. Kokanee rear primarily in Lake Sammamish and reproduce in the lake's tributaries. The sockeye and kokanee populations of the Lake Washington watershed may not be closely related. Kokanee exist in lakes with and without anadromous sockeye runs. Burgner (1991) indicated that Lake Washington and Lake Sammamish contain native kokanee populations and no native anadromous sockeye runs.

The principal food of kokanee is similar to that of young anadromous sockeye (i.e., zooplankton and insects). Therefore, the potential exists for intraspecific competition in lakes where both anadromous sockeye and kokanee are present.

In Lake Sammamish, kokanee mature around 4 years of age (a range of 3 to 5 years). At least two races occur in Lake Sammamish, based on spawn timing. Early-run kokanee in Issaquah Creek are native, while kokanee in other tributaries to Lake Sammamish and the Sammamish River are believed to be nonnative, based on their later-run timing (Ostergaard et al. 1995). Early-run fish currently spawn predominantly in Issaquah Creek from late July to early September. Late-run fish spawn from late September or early October through December.

Before development of the railroad along Lake Sammamish, many of the lake's east shore tributaries supported kokanee spawners (King County DNR 2000). Ostergaard (1996) described eight creeks along the east and south shores of Lake Sammamish that historically supported native early-run kokanee. The numbers of returning

spawners in these streams have decreased substantially over the past two decades (King County DNR 2000).

Neither anadromous sockeye nor kokanee in the Lake Washington basin have federal status under the ESA. A smaller early-run spawning population has prompted a petition to USFWS for an emergency listing of the stock for protection under the ESA, although USFWS has not listed kokanee stock.

Chum Salmon (*Oncorhynchus keta*)

Chum salmon migrate to the marine environment immediately after emergence (Salo 1991). Therefore, chum are typically found in streams that drain directly to salt water. No stocks of chum are present in the Lake Washington/Sammamish watershed (WDF et al. 1993). Small numbers of chum are typically seen in midwinter ascending the Ballard Locks fishway at the west end of the Lake Washington Ship Canal, but their ultimate fate within the basin is unknown.

Rainbow/Steelhead Trout (*Oncorhynchus mykiss*)

Resident rainbow trout are the nonmigratory form of steelhead and have a similar life cycle to the steelhead, except they do not spend a portion of their lives in the marine environment. Spawning occurs primarily at gravel riffles in tributary streams in early spring after adults move upstream from a lake or larger stream. Egg and alevin incubation extends from early spring to early summer, with fry emergence occurring into midsummer. Fry gradually disperse in the rearing stream, often with a net movement downstream to a larger river or lake, although some larger juveniles and adults remain in larger tributaries such as Issaquah Creek or Bear Creek. Resident rainbow trout reach maturity in 2 to 3 years.

Rainbow trout are native to the Lake Washington basin, but are not abundant in Lake Washington or Lake Sammamish (Bradbury and Pfeifer 1992). The resident, nonmigratory form of the species occurs in both lakes and streams upstream of natural and manmade migratory blockages. Their origins in headwater above migratory barriers are obscure, but are likely the result of past access or historical stocking.

Winter-run steelhead are native to the larger tributaries of the Sammamish River and Lake Sammamish, notably Issaquah Creek,

but have been greatly reduced in abundance in recent years. Adfluvial or resident rainbow spawn and rear in Big Bear Creek.

Cutthroat Trout (*Salmo clarki*)

Cutthroat trout occur in both anadromous and nonanadromous (adfluvial) forms. Lake Washington cutthroat appear to be a nonanadromous coastal stock, spawning in nearly all of the tributaries and rearing in either the larger tributaries or Lakes Washington and Sammamish.

Cutthroat commonly spawn in small streams where larger anadromous salmon do not find adequate habitat (Trotter 1989). Spawning commonly occurs from March through May in shallow riffles. Embryos develop in the gravel for 4 to 7 weeks before hatching (Pauley et al. 1989). Newly hatched fry rear in the gravel for about 2 weeks before emerging. Fry immediately move to low-velocity habitats with good overhead cover such as stream margins, side channels, and backwaters (Heggenes et al. 1991). Cutthroat trout and coho salmon fry tend to occur in the same habitats, where they may compete for resources. Cutthroat may migrate within streams during their first year of life, and migrate to lakes for additional rearing during their second and third years. Cutthroat mature in their fourth to sixth year of life, but may migrate back to natal streams prior to sexual maturation. Cutthroat are strong competitors with coho salmon of the same size (Sabo and Pauley 1997); however, coho frequently emerge earlier than cutthroat and at a larger size, giving them a competitive advantage. Subadult and adult cutthroat prey on smaller fish, including other salmon such as sockeye in Lake Washington (Beauchamp et al. 1992).

References

Beauchamp, D.A., S.A. Vecht, and G.L. Thomas. 1992. Temporal, Spatial, and Size-Related Foraging of Wild Cutthroat Trout in Lake Washington. *Northwest Science* 66:149-159.

Bisson, P.A., K. Sullivan, J.L. Nielsen. 1988. Channel Hydraulics, Habitat Use, and Body Form of Juvenile Coho Salmon, Steelhead, and Cutthroat Trout in Streams. *Transactions of the American Fisheries Society* 117:262-273.

Bjornn, T.C. 1991. Bull trout (*Salvelinus confluentus*). Pages 230-235 *in* Stolz, J., and J. Schnell, eds. *Trout*. Harrisburg, PA: Stackpole Books.

Bjornn, T.C. and D.W. Reiser. 1991. Habitat Requirements of Salmonids in Streams. *American Fisheries Society Special Publication* 19:83-138.

Bradbury, A. and B. Pfeifer. 1992. *Lake Sammamish Creel Survey – 1982-1983. Part IV. Fisheries Investigation of Lake Washington and Sammamish – 1980-1990.* Washington Department of Fish and Wildlife. Unpublished draft report.

Brown, L. 1994.*On the Zoogeography and Life History of Washington's Native Char.* Washington Department of Fish and Wildlife, Report #94-04. 41 pp.

Buckley, R.M. 1963. *Prolonged Fresh-Water Residence of Juvenile Fall Chinook Salmon.* Washington State Department of Fisheries, 1962 Annual Report pp. 25-26.

Burgner, R.L. 1991. Life History of Sockeye Salmon. *In* Groot, C. and L. Margolis, eds. *Pacific Salmon Life Histories.* UBC Press, University of British Columbia. Vancouver, BC.

Cederholm, C.J. and W. Scarlett. 1982. Seasonal Immigrations of Juvenile Salmonids into Four Small Tributaries of the Clearwater River, Washington, 1977-1981. Pages 98-110 *in* Brannon, E.L. and E.O. Salo, eds. *Proceedings of the Salmon and Trout Migratory Behavior Symposium, University of Washington, Seattle, Washington.*

Doble, B.D. and D.M. Eggers. 1978. Diel Feeding Chronology, Rate of Gastric Evacuation, Daily Ration, and Prey Selectivity in Lake Washington Juvenile Sockeye Salmon (*Oncorhynchus nerka*). *Transactions of the American Fisheries Society* 107:36-45.

Foerster, R.E. 1968. *The Sockeye Salmon.* Fisheries Research Board of Canada. Bulletin 162. 422 pp.

Fresh, K. Washington Department of Fish and Wildlife. October 2000. Verbal communication with Bob Pfeifer.

Goetz, F. 1989. (Also frequently cited as: Willamette National Forest 1989). *Biology of the Bull Trout* Salvelinus confluentus: *A Literature Review.* Willamette National Forest, Eugene, Oregon. 53 pp.

Goetz, F.A. 1994. Distribution and Ecology of Bull Trout (*Salvelinus confluentus*) in the Cascade Mountains. Thesis, Oregon State University, Eugene, Oregon.

Goetz, F., J. Dawson, T. Shaw, and J. Dillon. 1998. *Evaluation of Low Frequency Underwater Sound Emitters for Guiding Salmon and Steelhead Smolts away from a Navigation Lock at the Hiram M. Chittenden Locks, Seattle, Washington.* U.S. Army Corps of Engineers, Seattle District, Seattle, Washington.

Groot, C. and L. Margolis, (eds). 1991. *Pacific Salmon Life Histories.* Vancouver, BC: UBC Press, University of British Columbia. 561 pp.

Heggenes, J., T.G. Northcote, and A. Peter. 1991. Seasonal Habitat Selection and Preferences by Cutthroat Trout (*Oncorhynchus clarki*) in a Small, Coastal Stream. *Canadian Journal of Fisheries and Aquatic Sciences* 48:1364-1370.

Hendry, A.P., J.K. Wendurg, P Bentzen, E.C. Volk, and T.P. Quinn. 2000. Rapid Evolution of Reproductive Isolation in the Wild: Evidence From Introduced Salmon. *Science* 290:516-518.

Hendry, A.P., T.P. Quinn, and F.M. Utter. 1996. Genetic Evidence for the Persistence and Divergence of Native and Introduced Sockeye Salmon (*Oncorhynchus nerka*) within Lake Washington, Washington. *Canadian Journal of Fisheries and Aquatic Sciences* 53:823-832.

Johnson, P.N., G.A. Frederick, and G.R. Ploskey. 1999. *The Effectiveness of Strobe Lights for Vertically Displacing Juvenile Salmon out of Flow Entering a 4.3 x 4.9 km Filling Intake at Hiram M. Chittenden, Seattle.* Anadromous Fish Evaluation Program, U.S. Army Corps of Engineers, Walla Walla, Washington.

King County DNR. 2000. *Historic and Current Status of Kokanee in the Lake Washington Basin.* Discussion Draft. Prepared by K2 Resource Consultants, Inc. King County Department of Natural Resources. March 13, 2000.

Leary, R.F., F.W. Allendorf, and S.H. Forbes. 1991. *Conservation Genetics of Bull Trout in the Columbia and Klamath River Drainages.* Wild Trout and Salmon Genetics Laboratory Report 91/2. Missoula, Montana: Division of Biological Sciences, University of Montana.

McCart, P. 1970. A Polymorphic Population of Oncorhynchus nerka in Babine Lake, British Columbia. Vancouver, B.C.: Ph.D. thesis, Univ. British Columbia.

NMFS. 1995. *Endangered and Threatened Species; Proposed Threatened Status for Three Contiguous ESUs of Coho Salmon Ranging From Oregon Through Central California.* National Marine Fisheries Service. Proposed Rule July 25, 1995. Federal Register 60(142):38011-38030.

NMFS. 1998. *Endangered and Threatened Species: Proposed Endangered Status for Two Chinook Salmon ESUs and Proposed Threatened Status for Five Chinook Salmon ESUs; Proposed Redefinition, Threatened Status, and Revision of Critical Habitat for One Chinook Salmon ESU; Proposed Designation of Chinook Salmon Critical Habitat in California, Oregon, Washington, Idaho.* Proposed Rule. Federal Register 63(45):11482-11520. (National Marine Fisheries Service). March 9, 1998.

NMFS. 1999. *Endangered and Threatened Species: Threatened Status for Three Chinook Salmon Evolutionarily Significant Units (ESUs) in Washington and Oregon, and Endangered Status for One Chinook Salmon ESU in Washington.* Final Rule. Federal Register 64(56):14308-14328. (National Marine Fisheries Service). March 24, 1999.

Ostergaard, E., C. Young, and K. Ludwa. 1995. *Abundance of Spawning Kokanee in the Sammamish River Basin. 1994 Status Report.* King County Surface Water Management Division, Seattle, Washington. 194 pp.

Ostergaard, E. 1996. 1995 Status Report: Abundance of Spawning Kokanee in the Sammamish River Basin. Addendum to 1994 Status Report. King County Surface Water Management Division, Seattle, Washington.

Pauley, G.B., K. Oshima, K.L. Bowers, and G.L. Thomas. 1989. Sea-Run Cutthroat Trout. *U.S. Fish and Wildlife Service Biological Report* 82(11.86). 21 pp.

Peterson, P. 1982. Immigration of Juvenile Coho Salmon *(Oncorhynchus kisutch)* into Riverine Ponds. *Canadian Journal of Fisheries and Aquatic Sciences* 39:1308-1310.

Pflug, D. City of Seattle, Washington. March 2, 2000—Verbal communication with Don Weitkamp.

Ricker, W.E. 1938. "Residual" and Kokanee Salmon in Cultus Lake. *Journal of Fisheries Research Board of Canada* 4:192-217.

Rieman, B.E. and J.D. McIntyre. 1993. *Demographic and Habitat Requirements for Conservation of Bull Trout.* General Technical Report. U.S. Forest Service Intermountain Research Station, Ogden, Utah. 38 pp.

Roberson, K. 1967. An Occurrence of Chinook Salmon Beach Spawning in Lake Washington. *Transactions of the American Fisheries Society* 96:423-424.

Sabo, J.L. and G.B. Pauley. 1997. Competition Between Stream-Dwelling Cutthroat Trout (*Oncorhynchus clarki*) and Coho Salmon (*Oncorhynchus kisutch*): Effects of Relative Size and Population Origin. *Canadian Journal of Fisheries and Aquatic Sciences* 54:2609-2617.

Salo, E.O. 1991. Life History of Chum Salmon (*Oncorhynchus keta*). Pages 231-309 *in* Groot, C. and L. Margolis, eds. *Pacific Salmon Life Histories.* Vancouver, B.C., Canada: Univ. British Columbia Press.

Sandercock, F.K. 1991. Life History of Coho Salmon. Pages 396-445 *in* Groot, C. and L. Margolis, eds. *Pacific Salmon Life Histories.* Vancouver, B.C., Canada: Univ. British Columbia Press.

Tabor, R.A. and R.M. Pisakowski. 2002. *Nearshore Habitat Use by Juvenile Chinook Salmon in Lentic Systems of the Lake Washington Basin.* Report by U.S. Fish and Wildlife Service to Seattle Public Utilities, Seattle, Washington. 57 pp.

Tabor R., C. McCoy, S. Camacho, M. Celedonia, and S. Vecht. 2003. *Habitat use and movements of juvenile Chinook salmon in south Lake Washington, 2003 investigations*. Abstract, 2003 Greater Lake Washington Chinook Salmon Workshop, Seattle Public Utilities, Seattle, Washington.

Trotter, P.C. 1989. Coastal Cutthroat Trout: A Life History Compendium. *Transactions of the American Fisheries Society* 118:463-473.

USFWS. 1998a. *Endangered and Threatened Wildlife and Plants; Proposal to List the Coastal Puget Sound, Jarbidge River, and St. Mary-Belly River Population Segment of Bull Trout as Threatened Species.* Proposed rule June 10, 1998. U.S. Fish and Wildlife Service. Federal Register 63(111):31693-31710.

USFWS. 1998b. *Candidate and Listing Priority Assignment Form for the Coastal/Puget Sound Population Segment.* U.S. Fish and Wildlife Service. 89 pp.

UFWS. 1999. *Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for Bull Trout in the Coterminous United States. Final rule November 1, 1999.* U.S. Fish and Wildlife Service. Federal Register 64 (210):58910-58933.

USFWS. 2004. *Bull Trout* (Salvelinus confluentus) *Draft Recovery Plan, Coastal-Puget Sound Distinct Population Segment.* Volume I. U.S. Fish and Wildlife Service, Region 1, Portland, Oregon. 389 pp.

Vernon, E.H. 1957. Morphometric Comparison of Three Races of Kokanee (*Oncorhynchus nerka*) Within a Large British Columbia Lake. *J. Fish. Res. Bd. Canada* 14(4):573-98.

Warner, E., and K. Fresh. 1999. *Technical Review Draft: Lake Washington Chinook Salmon Recovery Plan.* Muckleshoot Indian Tribe, Auburn, Washington. Washington Department of Fish and Wildlife, Fish Management, Olympia, Washington. 141 pp.

WDF, Washington Department of Wildlife, and Western Washington Treaty Indian Tribes. 1993. *1992 Washington State Salmon and Steelhead Stock Inventory (SASSI): Summary Report.* Washington Department of Fisheries, Olympia, Washington. 212 pp.

WDFW. 1998. *1998 Washington State Salmonid Stock Inventory (SASSI). Appendix: Bull Trout and Dolly Varden.* Washington Department of Fish and Wildlife, Olympia, Washington. 437 pp.

Weitkamp, L.A., T.C. Mainwright, G.J. Bryant, G.B. Milner, D.J. Teel, R.G. Kope, and R.S. Waples. 1995. *Status Review of Coho Salmon From Washington, Oregon, and California.* NOAA Technical Memo NMFS-NWFSC-24. U.S. Department of Commerce. 285 pp.

Williams, K.R. and J.M. Mullan. 1992. Implications of Age, Growth, Distribution, and Other Vitae for Rainbow/Steelhead, Cutthroat,

Brook, and Bull Trout in the Methow River, Washington. Appendix K *in* Mullan, J.M., K.R. Williams, G. Rhodus, T.W. Hillman, and J.D. McIntyre. 1992. *Production and Habitat of Salmonids in Mid-Columbia River Tributary Streams.* U.S. Fish and Wildlife Service Monograph 1.

Williams, R.W., R.M. Laramie, J.J. Ames. 1975. *A Catalog of Washington Streams and Salmon Utilization.* Volume 1: Puget Sound Region. Washington State Department of Fisheries, Olympia, Washington.

Wood, C.C. and C.J. Foote. 1990. Genetic Differences in the Early Development and Growth of Sympatric Sockeye Salmon and Kokanee (*Oncorhynchus nerka*), and Their Hybrids. *Canadian Journal of Fisheries and Aquatic Sciences* 47: 2250-2260.

Woodey, J.C. 1966. Sockeye Salmon Spawning Grounds and Adult Returns in the Lake Washington Watershed, 1965. Seattle, Washington: Thesis, University of Washington. 101 pp.

Woodey, J.C. 1972. Distribution, Feeding, and Growth of Juvenile Sockeye Salmon in Lake Washington. Seattle, Washington: Dissertation, University of Washington. 207 pp.

Wydoski, R. S. and R. R. Whitney. 1979. *Inland Fishes of Washington.* University of Washington Press, Seattle, Washington. 220 pp.

Attachment 3

Federal Special-Status Species

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CRITICAL HABITAT; CANDIDATE SPECIES; AND SPECIES OF CONCERN IN WESTERN WASHINGTON AS PREPARED BY THE U.S. FISH AND WILDLIFE SERVICE WESTERN WASHINGTON FISH AND WILDLIFE OFFICE

(Revised April 8, 2004)

KING COUNTY

LISTED

Wintering bald eagles (*Haliaeetus leucocephalus*) occur in the county. Wintering activities occur from October 31 through March 31.

There are five bald eagle communal winter night roosts located in the county.

There are two bald eagle wintering concentrations located in the county along the Skykomish-Beckler-Tye Rivers and Foss River.

There are 38 bald eagle nesting territories located in the county. Nesting activities occur from about January 1 through August 15.

Bull trout (*Salvelinus confluentus*) occur in the county.

Canada lynx (*Lynx canadensis*) may occur in the county.

Gray wolves (*Canis lupus*) may occur in the county.

Grizzly bears (*Ursus arctos* = *U. a. horribilis*) may occur in the county.

Marbled murrelets (*Brachyramphus marmoratus*) occur in the county. Nesting murrelets occur from April 1 through September 15.

Northern spotted owls (*Strix occidentalis caurina*) occur in the county throughout the year.

Major concerns that should be addressed in your Biological Assessment of project impacts to listed species include:

1. Level of use of the project area by listed species.
2. Effect of the project on listed species' primary food stocks, prey species, and foraging areas in all areas influenced by the project.
3. Impacts from project activities and implementation (e.g., increased noise levels, increased human activity and/or access, loss or degradation of habitat) that may result in disturbance to listed species and/or their avoidance of the project area.

Arenaria paludicola (marsh sandwort) may occur in the county.

Castilleja levisecta (golden paintbrush) may occur in the county.

1. Major concerns that should be addressed in a Biological Assessment of listed plant species include:
2. Distribution of taxon in project vicinity.
3. Disturbance (trampling, uprooting, collecting, etc.) of individual plants and loss of habitat.

Changes in hydrology where taxon is found.

DESIGNATED

Critical habitat for the northern spotted owl has been designated in King County.
Critical habitat for the marbled murrelet has been designated in King County.

PROPOSED

None

CANDIDATE

Pacific fisher (*Martes pennanti pacifica*)
Yellow-billed cuckoo (*Coccyzus americanus*)

SPECIES OF CONCERN

Beller's ground beetle (*Agonum belleri*)
California wolverine (*Gulo gulo luteus*)
Cascades frog (*Rana cascadae*)
Hatch's click beetle (*Eanus hatchi*)
Larch Mountain salamander (*Plethodon larselli*)
Long-eared myotis (*Myotis evotis*)
Long-legged myotis (*Myotis volans*)
Northern goshawk (*Accipiter gentilis*)
Northern sea otter (*Enhydra lutris kenyoni*)
Northwestern pond turtle (*Emys* (= *Clemmys*) *marmorata marmorata*)
Olive-sided flycatcher (*Contopus cooperi*)
Pacific lamprey (*Lampetra tridentata*)
Pacific Townsend's big-eared bat (*Corynorhinus townsendii townsendii*)
Peregrine falcon (*Falco peregrinus*)
River lamprey (*Lampetra ayresi*)
Tailed frog (*Ascaphus truei*)
Valley silverspot (butterfly) (*Speyeria zerene bremeri*)
Western toad (*Bufo boreas*)
Aster curtus (white-top aster)
Botrychium pedunculosum (stalked moonwort)
Cimicifuga elata (tall bugbane)