Chapter 3 Affected Environment and Consequences

This chapter presents the environmental consequences of the project alternatives to 15 elements of the environment, as well as cumulative environmental effects and other environmental considerations.

As discussed in Chapter 2, *Alternatives Considered*, FHWA and WSDOT modified the project between publication of the Draft and Final EIS based on additional technical information. These modifications applied to all of the build alternatives. Because of these modifications, the impacts presented differ in some respects from the values presented in the Draft EIS. Impact data for the No-Build Alternative was carried forward from the Draft EIS.

The lead agencies have committed to mitigate environmental impacts that cannot be avoided or minimized. Mitigation is based on legal requirements and performance standards, which establish specific thresholds for project actions. To meet these commitments, the lead agencies will carry out specific compensatory mitigation, and will implement BMPs during construction. BMPs are tools or actions designed to achieve a desired result by establishing factors such as the timing of construction, construction methods, or methods to protect specific resources.

As WSDOT completes the project design and construction plans, it will include and use BMPs designed to meet the project commitments and performance standards for each resource. Example BMPs specific to each discipline are found in each section of Chapter 3. The effectiveness of the BMPs will be monitored as part of WSDOT's construction compliance program. This will allow WSDOT to adjust or replace BMPs in order to assure compliance with performance standards and meet project commitments.

3.1 Geology and Soils

This section discusses potential impacts of the project alternatives to geology and soils. This section also discusses the management of soil and rock materials during construction. The study area for geology and soils includes the regional geology, soils, and hazards that are near, underlie, or are located along the project area.

More information on regional geology can be found in Section 3.1 of the Draft EIS and the *Geology and Soils Discipline Report* (WSDOT 2002e).

What new information has been developed since the Draft EIS?

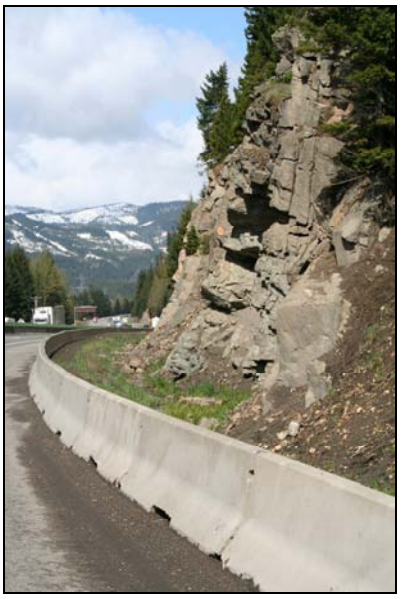
WSDOT has conducted several geologic and geotechnical investigations in the project area since the Draft EIS was completed. These include investigations to further assess the sub-surface soil and rock conditions between Hyak and Keechelus Dam to determine earthquake seismic design criteria, and to examine the stability of several rock slopes and the feasibility of various design approaches (Golder and Wyllie & Norrish 2005, WSDOT 2007b, Wyllie & Norrish 2006). WSDOT also tested rock for use as construction materials. Additional reports include the *Materials and Staging Report* (Appendix E), *Unstable Slopes on I-90 Snoqualmie Pass*, which was requested by the Governor of Washington State (Appendix G), and *Avalanche Loads and Risk on Proposed Viaduct East Shed Area, I-90* (Appendix F).

WSDOT used the results of these technical studies in the *Value Engineering Study Report* (WSDOT 2006a) and CEVP studies. Information from these reports and studies, as well as comments from the public and reviewing agencies, has been incorporated into this section.

What are the major characteristics of the affected environment?

Regional Geology and Soils

The geology in the project area is complex. In general, the highway is underlain by a variety of loosely arranged glacial and stream deposits, and rock units consisting of volcanic and terrestrial sedimentary layers, many of which are fractured and considered hazardous. Deposits from lakes or peat soil underlie the project area adjacent to Keechelus Lake and Swamp Lake. Metamorphic rock common to the Cascade Range, known as the Shuksan Greenschist, underlies the eastern portion of the project area. Major fault systems exist, but none are known to be seismically or geologically active. The project area includes areas with erosion, landslide, rock fall, and avalanche hazards.



Fractured rock is common throughout the project.

Surface Features

The project area lies within the alpine zone on the east side of the Cascade Mountains. The general topography is one of mountainous ridges and peaks, with deep, glacially carved valleys. Most of the valleys exhibit surface features, or geomorphology, typically associated with glacial erosion. The most prominent mountain features surrounding the project alignment are Rampart Ridge, Keechelus Ridge, and Amabilis Mountain. See Section 3.1.1.5 of the Draft EIS for more details.

Rock Resources

The predominant surface material from Hyak to Keechelus Dam is rock from construction of the existing highway, along with glacial, stream, and lake deposits. Glacial materials dominate the surface geology east of Keechelus Dam. The depth of the glacial materials varies along the project area. In areas along the valley bottom and stream channels, the glacial material may be very deep. Several feet of glacial rock is found on all but the steepest slopes outside the limits of the valley bottoms. Some of this rock may be useable during project construction, and WSDOT has assessed several potential rock sources (Appendix E).

Geotechnical crews evaluate rock for design concerns and potential use in road construction. (Shown: Slide Curve)

Soil Resources

In general, project area soils are deep and well drained with moderate permeability, as discussed in Appendix C of the Draft EIS.

Geologic Hazard Areas

Geologic hazards along the existing highway include erosion, unstable slopes, avalanche, and earthquake hazard areas. The locations of unstable slopes and avalanche hazard areas are shown in Exhibit 2-11 in Chapter 2. Further information is available in Section 3.1.1.4 of the Draft EIS, in the geotechnical and rock slope investigations (WSDOT 2007b, Wyllie & Norrish 2006), and in *Avalanche Loads and Risk on Proposed Viaduct East Shed Area, I-90* (Appendix F).

Erosion Hazard Areas

The Draft EIS summarized soil erosion potential, which was identified by reviewing published maps of soil and erosion hazard areas. The analysis identified erosion hazards with potential to deliver sediment to streams.

Unstable Slope Hazard Areas

In the drainages surrounding the highway, WSDOT identified 244 landslides or slope failures. Most of these were classified as "shallow-rapid" events, defined as near-surface landslides consisting of soil and hillside materials with little rock. These events were usually associated with large storms, particularly in areas of recent forest harvest. The inner gorge areas of the steep tributary streams, such as Rocky Run Creek (MP 56.8), are particularly vulnerable to these shallow-rapid slides.

WSDOT regularly cleans landslide debris from I-90 in the project area.

Within the right-of-way, the existing fill embankment beneath the eastbound lane at Slide Curve (MP 59.1 to MP 59.2) is an ongoing landslide hazard due to settling. WSDOT is investigating and monitoring this area as part of ongoing geotechnical investigation, and will identify a solution to this problem during final engineering design.

The highly divided volcanic and sedimentary rocks along the highway are vulnerable to rock fall along many of the existing cut slopes and natural slopes.

WSDOT's goal is to stabilize slopes within the project area.

Rock fall may occur during construction when 1) new cut slopes adversely affect the boundaries between rock types, weakening the rock, or 2) where they are subject to construction activities such as blasting. The vulnerability of the rock slopes depends on the material strength and the character and geometric relations of discontinuities in the rock mass.

Cut slopes may increase unstable slope hazards by redirecting surface water runoff onto landslide areas or areas of high erosion hazard.

Additional geotechnical studies conducted in 2005 determined that the geological integrity of the rock faces in the Keechelus Lake area is sufficiently stable to support the proposed new highway configuration (WSDOT 2007b).

WSDOT has identified and rated 22 unstable slopes in the project area with potential for rock fall. Some slopes have been stabilized under the WSDOT unstable slopes management system. Mitigation for the remaining sites has been deferred to coincide with the I-90 project. Details on the locations and ratings for unstable slopes may be found in the geotechnical studies performed from 2005 to 2007 (WSDOT 2007b, Golder and Wyllie & Norrish 2005).

The potential for slope failures is generally higher where geologic faults intersect rock and soil cuts or natural slopes with loose soil. The highway crosses an inactive geologic fault at MP 64.1 on the north side of Amabilis Mountain near the Cabin Creek Interchange. Currently, WSDOT does not consider this area to have unstable slopes based on the current knowledge of the fault and WSDOT's rating methodology. However, since cut and fill activities are planned for the Cabin Creek Interchange, WSDOT will conduct further geologic and geotechnical investigations as part of the final design for this portion of the project area.

Unstable Slope History

The project area, and especially the area around Slide Curve near MP 59.0, has a history of rock slides. Since 1957, rock slides have caused nine fatalities in the project area.

In 1957, a major rock fall killed several construction workers during road construction. WSDOT concluded that the slide happened because more competent rock material had been weakened or removed during construction activities. Major rock slides also occurred during construction in 1970, resulting in the death of one construction worker.

In response to the danger of rock slides, during the 1960s and 1970s, WSDOT built wide catchment ditches adjacent to the highway shoulders where small-volume events would be captured. Since the mid-1990s, WSDOT has placed concrete barriers along many of the rock fall ditches to improve their effectiveness.

Where slope heights and the volume of falling rock or debris are modest, these treatments have been effective at mitigating the hazards of falling rock. However, large volume slope failures can exceed the capability of the ditch and barrier systems. When this happens, debris can enter the travel lanes. This was the case in February 1998 when one driver was killed, and in September and November 2005 when rock slides occurred at two different locations, one just outside of the project area and one near the snowshed. The September rock slide resulted in three fatalities. The November rock slide caused a short complete closure and an extended partial closure while repairs were made.

WSDOT performed emergency stabilization work at MP 50.3 in 2006 following the 2005 fatalities. As a result of the fatalities in 2005, Governor Christine Gregroire directed WSDOT to evaluate the slope hazards along the I-90 corridor. More details of unstable slope history can be found in the *2006 Conceptual Geotechnical Report - Volume 3 of 5* (WSDOT 2007b) and in Appendix G.

Avalanche Hazard Areas

As discussed in the Draft EIS, there are five avalanche chutes near the existing snowshed (MP 58.1) (Exhibit 3-1). The two avalanche chutes that have historically posed the greatest hazards are ES-3 and ES-4. Both of these avalanche chutes produce numerous small avalanches, although ES-4 presents a greater hazard for the existing eastbound lanes. Historically, an area near MP 59 also has produced small avalanches. ES-5, which is located just east of the snowshed, is considered an extreme hazard for the existing highway, and could experience rare and unusually large avalanches. ES-2, which is located just west of the snowshed, also is considered an extreme hazard (Appendix F).

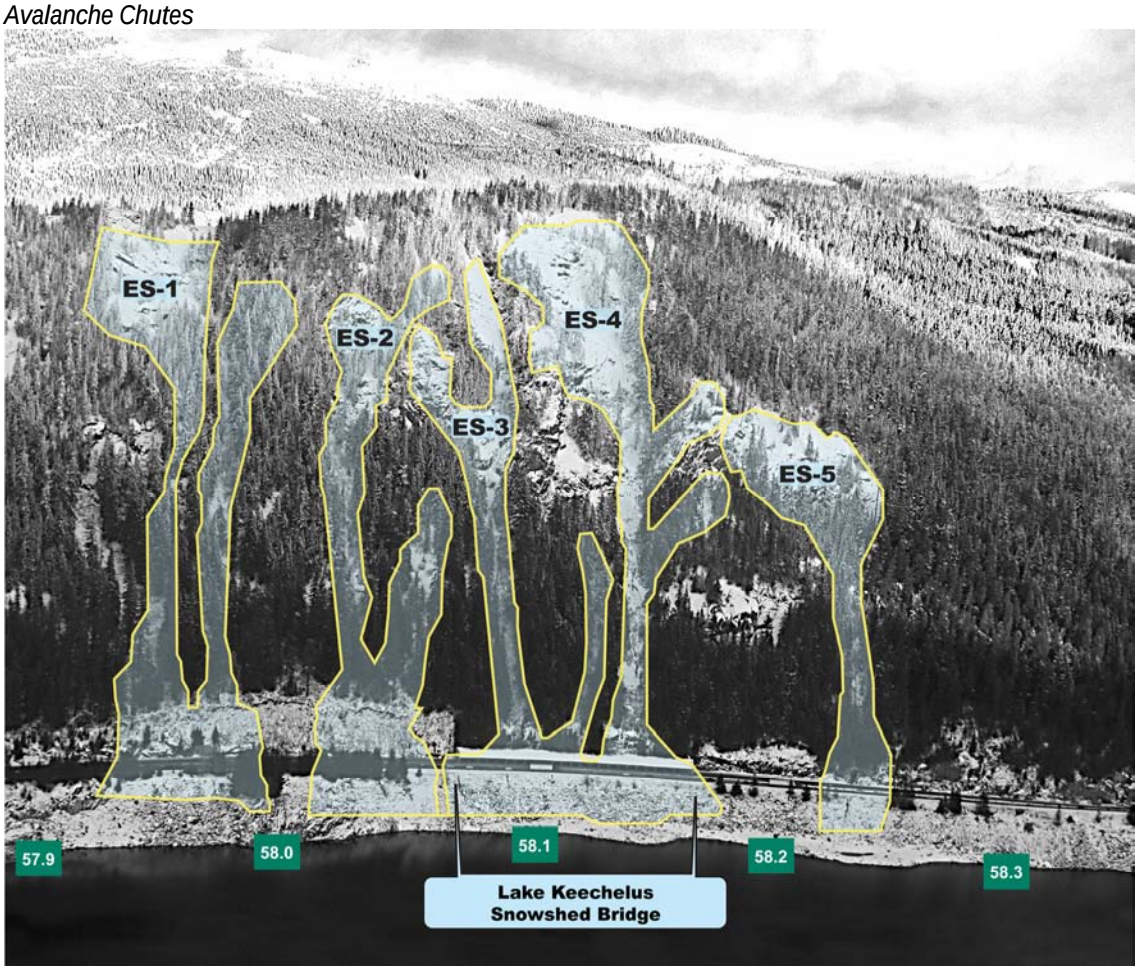
Avalanches regularly block I-90.

Earthquake Hazard Areas

None of the faults in the project area that I-90 crosses are known to be active. However, a relatively strong earthquake in the Seattle area, such as the 2001 Nisqually earthquake, could trigger ground shaking in the project area. Potential effects from earthquake-induced ground shaking could be mitigated by applying standard engineering design techniques, which are governed by national and local building codes.

Soils in the Gold Creek area contain deep zones of loose silt and sand that could liquefy as a result of intense short-duration ground shaking resulting from a large earthquake in Western Washington. This could cause damage to bridges if the bridge foundations were too shallow, since the foundations would sink by several inches. WSDOT would construct all structures in this area with deep foundations to prevent damage as a result of liquefaction.

Exhibit 3-1
Avalanche Chutes



What are the expected environmental consequences?

What beneficial effects would result?

No-Build Alternative

Under the No-Build Alternative, WSDOT would continue its slope stabilization program. This program would provide some direct beneficial effects, including improving safety and reducing the danger of avalanches and rock fall. These beneficial effects would be much smaller than for any of the build alternatives. There would be no indirect beneficial effects.

Build Alternatives

Any of the build alternatives would result in beneficial effects, since reducing hazards due to avalanches and rock fall is part of the project's purpose and need. Beneficial effects would be similar for all of the build alternatives, including the Preferred Alternative.

Erosion Hazard Reduction

Installing larger bridges and culverts would allow water and debris to pass beneath I-90, instead of onto the highway surface. This would reduce maintenance costs and increase public safety.

Unstable Slope Hazard Reduction

WSDOT has designed all of the build alternatives to correct unstable slopes, which would be beneficial to highway safety. Slope stabilization would increase public safety and reduce delays due to rock fall. Stabilization methods would include rock bolting, netting, rock fall ditches, shotcrete treatments, water drainage features, retaining walls, and engineered slopes.

Avalanche Hazard Reduction

One of the greatest beneficial effects would be reducing avalanche hazards at the major avalanche chutes. Reducing avalanche hazards would increase public safety and reduce delays due to avalanche.

Most of the beneficial effects for the project would take place in the Keechelus Lake Alignment area, which is where most of the geologic hazard areas are located. All of the build alternatives would effectively reduce risk of avalanche and rock fall. The difference between the alternatives is that Alternative 1 would avoid major hazard areas by tunneling, while Alternatives 2, 3, and 4 (the Preferred Alternative) would rely on slope stabilization and constructing a larger, longer snowshed. All of the alternatives would meet the project's purpose and need. However, the cost of construction and maintenance vary substantially by alternative, as discussed in Section 2.6, *What would the project cost?*

Earthquake Hazard Reduction

To prevent damage to new bridges during earthquakes, the bridges would be built using deep foundations consisting of drilled shafts of reinforced concrete extending below the liquefiable soils. These shafts would be designed to remain intact during an earthquake.

What adverse impacts are expected?

No-Build Alternative

The No-Build Alternative would not result in any direct adverse impacts. The No-Build Alternative would result in indirect adverse impacts as traffic volumes increase over time, and this traffic would be subject to the uncorrected hazards from avalanches and unstable slopes.

Under the No-Build Alternative, WSDOT would continue with its existing slope stabilization program. This program would create temporary adverse impacts from construction during slope stabilization.

Build Alternatives

Temporary Impacts

Temporary impacts to geology and soils would be limited to construction impacts and would be similar for all of the build alternatives.

Excavation. Project construction would require using, transporting, storing, and processing large amounts of fill material, cut material, and aggregate. Exhibit 3-2 shows WSDOT's estimated total cut and fill quantities. While these quantities will change as design is completed, WSDOT believes that these are reasonable estimates for planning purposes.

The Preferred Alternative would result in between 300,000 and 700,000 cubic yards of excess material during Phase 1 of construction. WSDOT would remove most of this material from the existing rock cuts between MP 57.1 and MP 59.3. The final amount of excess materials would depend on the contractor's methods and the amount of excavated material that could be re-used for aggregate.

WSDOT may use the majority of this material near Slide Curve, where the profile of the westbound lane would be raised and additional material would be required. Some of the excess material may be suitable for use as select wall backfill or as aggregate for the crushed surfacing base course. It would not be suitable for asphalt concrete pavement or Portland cement concrete pavement. WSDOT will develop detailed calculations of the amount of material that is available and needed prior to permitting.

Exhibit 3-2
Estimated Cut and Fill Volumes (thousand cubic yards)

	Keechelus Lake Alignment Alternatives				CEA Improvement Packages			
Material Type	**1**	**2**	**3**	**4 (PA)**	**A**	**B**	**C**	**PA**
Highway Excavation	362	842	847	451	2,077	2,085	2,218	3,480
Tunnel Excavation	1,907	615	307	0	0	0	0	0
Total Cut	**2,269**	**1,457**	**1,154**	**451**	**2,077**	**2,085**	**2,218**	**3,480**
Common Embankment	374	344	357	376	2,850	2,400	1,865	3,050
Select Wall Backfill	39	178	279	344	73	73	73	680
Total Fill	**413**	**522**	**636**	**720**	**2,923**	**2,473**	**1,938**	**3,730**
Net Cut/Fill	**1,856**	**935**	**518**	**(269)**	**(846)**	**(388)**	**280**	**(250)**

CEA – connectivity emphasis area
PA – Preferred Alternative

Aggregates. Exhibit 3-3 shows WSDOT's estimated aggregate quantities for the project. These quantities would be similar for all of the build alternatives, since WSDOT would widen the highway to three lanes in each direction and replace all of the existing pavement under all alternatives.

Exhibit 3-3
Estimated Aggregate Quantity Summary (cubic yards)

Material Type	Phase 1	Remaining Project Area
Crushed Surfacing Base Course	58,000	228,000
Asphalt Aggregate	28,000	90,000
Portland Cement Concrete Pavement Coarse Aggregate	43,000	80,000
Portland Cement Concrete Pavement Sand	15,000	46,000

WSDOT identified five potential aggregate sources in the project area, which were evaluated in the *Materials and Staging Report* (Appendix E). WSDOT's preferred site for aggregate is Pit Site PS-S-255 at Rocky Run Creek.

Sand, gravel, and crushed rock are the most common **aggregate** types used for road building.

Pit site PS-S-255 contains approximately 500,000 cubic yards of material, of which only 50 percent is suitable for aggregate. This material was deposited as a composite alluvial fan from Rocky Run Creek and is exposed only during low lake levels. WSDOT could only extract the aggregate material when Keechelus Lake water levels are low enough to gain access to the site.

WSDOT's use of this site would be in consultation with USBR, which manages Keechelus Lake. Removing rock from Pit site PS-S-255 would mitigate the potential decrease of lake storage capacity from additional fill to Keechelus Lake, as discussed in Section 3.3, *Water Resources*.

At this site, WSDOT plans to excavate only the amount necessary to mitigate for the project's irrigation storage impacts to Keechelus Lake. The primary impact from extracting this aggregate material for construction would be depletion of this resource. However, over time, natural deposition processes from Rocky Run Creek would replenish these materials. Consequently, WSDOT considers removal of this material to be a temporary impact.

Although several other existing rock sources exist outside the project area on USFS lands, WSDOT does not intend to develop additional rock source sites on these lands. Private rock sources may be used for specialized materials as needed; however, these sites would be subject to environmental review and permitting, and would be required to be consistent with the ecological connectivity objectives of the MDT.

Staging, Stockpiling, and Processing. WSDOT identified sites that were already disturbed to use for staging, stockpiling, and processing. Even so, storing cut and fill materials may cause impacts on resources such as wetlands. WSDOT has inventoried the potential staging and stockpiling sites for wetlands, and will examine

them further as part of the permitting process. WSDOT believes that impacts can be eliminated through avoidance, minimization, timing, and construction BMPs. Restoring the sites following completion of the project would create a substantial environmental benefit. WSDOT is tracking the issue of site restoration through their Commitment Tracking System.

Additional information on materials, staging, stockpiling, and processing sites is available in the *Materials and Staging Report* (Appendix E), and illustrated in Exhibit 2-20 in Chapter 2.

Transporting Materials. Transporting cut and fill material could impact traffic flow. Impacts would be highest at the four interchanges within the project area. A more detailed discussion of transportation impacts can be found in Section 3.7, *Transportation,* and in the *Transportation Discipline Report* (Appendix P).

Disposal of Materials. Phase 1 of the project would result in 300,000 to 700,000 cubic yards of surplus material. Most of this material would be used at Slide Curve, although WSDOT may dispose of some material off site. Disposal would be conducted under permit by the contractor. Permit conditions will be developed in conjunction with appropriate regulatory agencies.

Erosion Hazards. Constructing the project has the potential to increase erosion, especially in areas with soft and loose soil conditions. Erosion also could occur in areas where grades direct surface water to vulnerable areas, fill embankments are constructed near soft or loose soil, or where construction occurs in streams or Keechelus Lake. Areas most susceptible to erosion are located along Keechelus Lake, especially in areas of soft and potentially liquefiable soil in the vicinity of the proposed bridges crossing Gold Creek. WSDOT will mitigate for these soil conditions by designing appropriate deep foundations for the highway structures. BMPs would be used to minimize project area erosion.

For Keechelus Lake Alignment Alternatives 1, 2, and 3, hazards associated with rock stability during tunneling would depend on site-specific engineering design and construction techniques, as well as

on the inherent site conditions. Groundwater drainage from tunnel excavations also could affect high-erosion hazard areas. The hazards associated with tunneling would be less for Alternatives 2 and 3, which include shorter tunnels.

Unstable Slope Hazards. Construction activities such as blasting and grading can create landslide conditions. Temporary drainage associated with road construction could trigger shallow debris slides along the highway if BMPs are not properly implemented, or if runoff is routed onto a slope with potentially unstable soils. WSDOT does not expect most of the identified landslide or slope failure hazards to directly affect the highway, as long as bridges and culverts are large enough to allow slide debris to pass beneath the highway. Highway design features and BMPs would minimize landslide hazards**.**

Construction activities may increase rock fall hazards temporarily where new slopes intersect either weak rock or loose or marginally stable slopes, especially along Keechelus Lake. WSDOT does not expect these impacts to continue past the construction period. All the build alternatives would include stabilizing rock slopes.

Geologic and geotechnical investigations have assessed the feasibility of planned and potential rock cuts, and provided a preliminary assessment of potential measures for stabilizing slopes necessary to obtain an acceptable safety factor. WSDOT will perform more detailed investigations and analysis of the rock slopes along the entire alignment and use this information during final design.

Avalanche Hazards. WSDOT does not expect construction activities to increase avalanche hazards, since work will not take place during the winter.

Permanent Impacts

Permanent impacts are those associated with ongoing highway operation. None of the build alternatives would result in substantial direct or indirect permanent impacts to geologic and soil resources.

How will FHWA and WSDOT mitigate for adverse environmental impacts?

Avoidance and Minimization

WSDOT has worked to avoid and minimize impacts to geology and soils by conducting extensive geotechnical investigation and by designing the project based on the findings of that investigation. The project has been designed to avoid areas of unstable soil and rock to the greatest extent possible, and to stabilize these areas where necessary.

Best Management Practices

BMPs for geology and soils will be designed to meet applicable commitments and performance standards, including:

- National Pollutant Discharge Elimination System (NPDES) General Permit for Construction Activities
- NPDES General Permit for Sand and Gravel Operations
- Temporary Erosion and Sediment Control Plans
- Erosion and sediment control requirements of the WSDOT *Design Manual* (WSDOT 2007c) and *Standard Specifications for Road, Bridge, and Municipal Construction* (WSDOT 2008b)
- Spill Prevention, Control and Countermeasure Plans
- Applicable permit requirements
- Conditions imposed by the USFS related to use of federal land for additional easement
- Applicable conservation measures included in the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries) ESA Consultation Concurrence Letter (NOAA Fisheries 2008)

- Applicable parts of the *Implementing Agreement between the Washington State Department of Ecology and the Washington State Department of Transportation* (Ecology and WSDOT 1998), or as revised

- Objectives of the USFS ACS

- Construction safety requirements and maintaining operation of the highway during construction, including Occupational Safety and Health Administration requirements and highway safety standards

Some example BMPs that WSDOT could use to comply with these standards would include requiring:

- Covered loads

- Short-term stabilization during construction, including seasonal shut-down and stabilization procedures

- Perimeter ditching or other erosion control measures

- Plastic sheeting in severe weather to protect sub-grades or fill materials

- Staged fill placement or surcharges

- Temporary walls

- Temporary crushed rock armoring of exposed soil

- Approved water diversions to avoid streambank destabilization

- Soil preparation and integrated vegetation management, as well as design meeting the roadside master plan for roadside vegetation mitigation measures

- Blasting and removal in lifts rather than large blasts

- Rock fall fencing and netting at high risk locations
- Piling material at regulated levels
- Rock ballast for buttressing in landslide areas
- Temporary containment fences for rock fall and avalanches
- Replacing soft or unsuitable foundation materials
- Rock bolting, netting, drainage, shotcrete, terracing, rock fall ditches, and other methods to mitigate rock fall hazard areas and unstable slopes
- Slope monitoring as needed, such as optical or physical stationing, to monitor and track expected slope movement or settlement
- Additional core sampling to understand underlying material and geology
- Barges and large drilling equipment for lake shore placement of drilled caissons in soft or loose conditions
- Placing compacted soil or rock to span poor sub-grade areas, and to more evenly distribute loads or settlement

Compensatory Mitigation

Since there will be no permanent adverse impacts to geology and soils, no compensatory mitigation will be required.

3.2 Air Quality

Motor vehicle emissions can affect air quality.

This section discusses the expected impacts of the project alternatives to air quality. Air quality is discussed in terms of the area affected, the applicable air quality regulations, and the key air pollutants. The study area for air quality varies with the potential pollutant.

Further information on air quality impacts can be found in Section 3.2 of the Draft EIS and in the *Air Quality Discipline Report* (WSDOT 2003b).

What new information has been developed since the Draft EIS?

No new issues were introduced and WSDOT did not conduct any new analysis beyond that which was done for the Draft EIS. Comments from the public and reviewing agencies have been incorporated into this section.

What are the major characteristics of the affected environment?

What are the key potential pollutants?

Carbon monoxide (CO) in vehicle exhaust is the primary pollutant of concern because of its potential to cause CO hotspots. Consequently, CO is the primary focus of the analysis and the only pollutant for which WSDOT performed predictive modeling.

"Hotspots" are locations where emissions from specific sources may expose individuals and population groups to elevated risks of adverse health effects.

Other potential pollutants include ozone precursors and particulate matter. Ozone precursors are volatile organic compounds and nitrogen oxides, which are emitted by vehicles; however, WSDOT does not expect them to produce substantial localized or regional air pollution impacts. Particulate matter less than 10 microns in diameter (PM_{10}) is emitted in vehicle exhaust, and released by tire and brake wear. Motor vehicles also emit sulfur oxides and nitrogen oxides, but the impact of these pollutants near highways is generally

low. Refer to the *Air Quality Discipline Report* (WSDOT 2003b) for more details.

What is the area of potential environmental impact?

For CO, the area of potential environmental impact is the same as the project area. Because of this, WSDOT modeled existing and future CO concentrations within 500 feet of I-90 throughout the project area.

The impact of fugitive dust and PM_{10} from construction activities usually occurs adjacent to construction areas. The area of potential environmental impact for these emissions is within the project area, in proximity to proposed construction.

For nitrogen oxides and volatile organic compounds, the area of potential environmental impact is Kittitas County, including the Alpine Lakes Wilderness Area north of I-90. (See Exhibit 1-3 in Chapter 1, *Purpose and Need*.) The effect of these chemicals on ozone levels usually occurs several hours after they are emitted and can occur many miles from the source.

What are the applicable air quality standards?

Ambient Air Quality Standards

The Washington State Department of Ecology (Ecology) Central Regional Office in Yakima enforces air quality regulations in Kittitas County. The United States Environmental Protection Agency (USEPA) National Ambient Air Quality Standards (NAAQS) and Ecology's suspended particulate regulations apply. These regulations are designed to limit emissions from air pollution sources, and to minimize concentrations of pollutants in the outdoor air. Unless the State has adopted more stringent standards, the NAAQS apply.

Regional Air Quality Standards

Ecology maintains a network of air pollutant monitoring stations throughout the state. These stations are located in areas where there may be air quality problems, usually in or near urban areas or close

to large air pollution sources. A limited number of additional stations are located in remote areas to provide a measure of regional background air pollution levels.

One air pollutant monitoring station in Kittitas County in Ellensburg measures PM_{10} and in one North Bend measures ozone and particulate matter less than 2.5 microns in diameter ($PM_{2.5}$). Another monitoring station at the top of the Snoqualmie Pass Ski Area measures air quality values as part of the national network of the Interagency Monitoring of Protected Visual Environments Program. Based on monitoring information collected over a period of years, state and federal agencies designate regions as being "attainment," "non-attainment," or "unclassifiable" areas for regulated air pollutants. "Attainment" means that air quality in an area meets the federal health-based ambient air quality standards. The project area is in an attainment area for ozone and PM_{10}. There are no substantial local or regional sources of ozone precursors. Because of this, WSDOT did not develop a qualitative analysis of photochemical ozone for the Draft or Final EIS.

Prevention of Significant Deterioration

The Clean Air Act Section 162 established the goal of preventing significant deterioration of air quality in all international parks, national parks that exceed 6,000 acres, and national wilderness areas that exceed 5,000 acres, if these areas were in existence on August 7, 1977. These areas were defined as mandatory Class I areas, where any appreciable deterioration of air quality is considered significant.

The Alpine Lakes Wilderness Area is a Class I area under the Clean Air Act.

The Clean Air Act allows almost no air quality degradation in Class I areas resulting from proposed emission sources, and Clean Air Act Section 169A established the additional goal of preventing impairment of visibility in Class I areas. The 1999 USEPA Regional Haze Regulation also directs states to achieve "natural" visibility conditions in Class I areas within the next 60 years. The closest Class I area to the project site is the Alpine Lakes Wilderness Area, whose nearest border is about one mile northeast of I-90.

What is the current air quality in the project area?

The air pollutant monitoring site nearest to the project is Ecology's monitoring site 0017, located in North Bend. The site collects data on ozone, $PM_{2.5}$, wind, and temperature.

Overall, air quality in the area is considered good. Data collected during the period between January 1, 2002 and December 31, 2004 showed that on 991 days out of the 1,041 days for which data were collected, the site had an air quality index value less than or equal to 50, which is considered to be "good" air quality with no advisories to citizens. There were 48 days with values between 51 and 100, which is considered "moderate" with an advisory to unusually sensitive individuals to consider limiting prolonged outdoor exertion. Two summer days had values over 100, which is considered "unhealthy for sensitive groups" with an advisory to sensitive individuals to limit prolonged outdoor exertion.

The criteria air pollutant report for Kittitas County reported 100 percent days of "good" air quality values in 2003, and no PM_{10} exceedances (USEPA 1999).

What are the expected environmental consequences?

What beneficial effects would result?

No-Build Alternative

The No-Build Alternative would not result in any beneficial direct or indirect effects.

Build Alternatives

Any of the build alternatives would result in beneficial direct effects to CO concentrations by reducing traffic congestion. This improvement would continue at least until traffic congestion reaches present levels once again. There would be no indirect beneficial effects.

What adverse impacts are expected?

No-Build Alternative

The No-Build Alternative would not result in any direct adverse impacts. The No-Build Alternative would result in increased traffic congestion; however, the Draft EIS concluded that this would not result in violation of any applicable air quality standards.

Build Alternatives

Temporary Impacts

Any of the build alternatives would result in temporary adverse impacts from construction.

Fugitive Dust. Construction activities would produce fugitive dust due to wind erosion and by operating construction equipment on exposed earth surfaces. Dust emissions depend on soil types and moisture. Fugitive dust releases generally constitute the largest source of PM_{10} during construction. Most of the dust particles would settle out adjacent to construction areas, while a small fraction would be transported further downwind and would contribute to the regional ambient PM_{10} level. Air quality impacts caused by construction equipment emissions are short-term and would cease upon completion of construction activities. Implementing the BMPs described at the end of this section would minimize fugitive dust emissions and eliminate adverse air quality impacts.

Slash Disposal. Wood debris generated during construction will be used as habitat features or chipped and mulched whenever possible. However, some material may be burned for disposal, producing dust and smoke. If material is burned, WSDOT would obtain permits or approvals from Ecology, Washington Department of Natural Resources (WDNR), and the USFS. Burning would occur only during favorable weather conditions.

Odors. Short-term, localized odors might be generated by exhaust from construction equipment, asphalt paving, line painting, and burning. Because of the rural nature of the project area and the relatively large distances to sensitive receptors, WSDOT does not

expect that these temporary odor emissions would produce any adverse air quality impacts.

Combustion Emissions from Construction Equipment. Mobile construction equipment and portable stationary engines would emit air pollutants from combustion, including nitrogen oxides, CO, PM_{10}, and toxic air pollutants. Because of their temporary and intermittent nature, the concentrations of such emissions would be substantially lower than the applicable air quality standards. Also, because of the rural nature of the project and the minor amount of PM_{10} released by mobile sources, WSDOT does not expect PM_{10} emissions associated with the I-90 project to result in substantial environmental effects.

Emissions from Temporary Stationary Sources. Highway construction could require operating temporary asphalt plants, concrete batch plants, and gravel borrow pits. These operations would be subject to permitting by Ecology's Central Regional Office. Emission controls would be required based on best available control technology. With these controls, WSDOT anticipates that ambient pollutants would not exceed the NAAQS or Washington State standards.

Permanent Impacts

A permanent impact occurs when air quality standards are exceeded. The Draft EIS concluded that the environmental impacts to air quality would be the same for the No-Build Alternative and any of the build alternatives. The Draft EIS also concluded that under any of the build alternatives, federal, state, and regional air quality standards would be met, including the NAAQS and Clean Air Act standards. WSDOT analyzed potential permanent impacts from CO and toxic air pollutants.

Impacts from Carbon Monoxide. The Draft EIS concluded that the CO modeling analysis found in the *Air Quality Discipline Report* (WSDOT 2003b) represented the potential CO impact from all of the build alternatives studied, including the Preferred Alternative. For the project area, WSDOT conducted CO modeling analysis based on the requirements of Washington Administrative Code (WAC) 173-

420 and USEPA guidelines. WSDOT used the CAL3QHC air quality dispersion model for estimating CO concentrations.

For both existing conditions and future conditions for all of the alternatives, the modeled CO concentrations at all receptors within 500 feet of the highway were much lower than the 1-hour state and federal CO standard of 35 parts per million and the eight-hour state and federal CO standard of nine parts per million.

Traffic congestion can lead to increased carbon monoxide concentrations.

Further, all build alternatives, including the Preferred Alternative, would most likely result in lower CO concentrations than current conditions or the No-Build Alternative, through the projected reduction in traffic congestion. Based on these findings, WSDOT concluded that constructing any of the build alternatives, including the Preferred Alternative, would not produce any adverse air quality impacts from CO.

Impacts from Toxic Air Pollutants. Vehicle emissions from combustion contain toxic air pollutants, which have the potential to produce acute or chronic public health effects, especially in sensitive receptors. In addition to inhalation of toxic air pollutants, some of these toxins may be deposited on soils and surface waters. Toxic air pollutants may then be taken up by plants or ingested by animals, concentrating the toxins up through the food chain.

Due to the mobile nature of toxic air pollutant sources and their relatively low emission rates, WSDOT concluded that emissions from the project highway would produce minimal pollutant impacts in a localized area, and emissions from operating vehicles within the project highway would not produce any adverse air quality impacts to receptors within the project area. Vehicle emissions are almost completely proportional to traffic volumes, and would be similar under either the No-Build Alternative or any of the build alternatives.

How will FHWA and WSDOT mitigate for adverse environmental impacts?

Avoidance and Minimization

WSDOT will avoid and minimize air quality impacts as possible throughout the project. Measures may include:

- Staging construction to minimize overall traffic congestion
- Encouraging construction workers to car pool

Best Management Practices

BMPs for air quality will be designed to meet applicable commitments and performance standards, including:

- Permit conditions from Ecology's Central Regional Office for temporary exhaust emissions sources and suspended particulates
- The NAAQS
- Air quality BMPs included as permit requirements or as conditions imposed by the USFS related to use of federal land for additional highway easement

Some example BMPs that WSDOT could use include requiring contractors to:

- Water all active construction areas as needed to control dust
- Cover all trucks hauling soil, sand, and other fine-grained material that would create dust, or require all trucks to maintain at least two feet of freeboard
- Pave, apply water regularly, or apply nontoxic soil stabilizers on all unpaved access roads, parking areas, and staging areas at construction sites
- Sweep to control dust (with water sweepers) at all paved access roads, parking areas, and staging areas at construction sites

- If practicable, limit traffic speeds on unpaved access roads to 15 mph
- Install erosion control measures to prevent silt runoff to public highways
- Route transport vehicles to minimize the impacts to traffic flow
- Minimize the size of the construction area, cover exposed soil, and re-vegetate disrupted areas as soon as practical
- Construct wind barriers to reduce wind velocity over exposed earth
- Use wheel washers to remove mud from construction vehicles prior to exiting the site to reduce the potential emissions from particulate matter
- Clean road surfaces regularly to reduce re-entrained particulate matter

Exhaust emission control BMPs could include requiring contractors to:

- Use newer construction equipment and maintain all equipment in good mechanical condition to minimize exhaust emissions
- Limit unnecessary engine idle time for vehicles and equipment

Other BMPs could include:

- Re-use wood from downed trees, logs, and removed vegetation as habitat features or chipped and mulched instead of burning whenever possible
- Obtain and comply with applicable permits if slash is burned

Compensatory Mitigation

Since there will be no permanent adverse impacts to air quality, no compensatory mitigation will be required.

3.3 Water Resources

Keechelus Lake is the headwater of the Yakima River.

This section discusses the expected environmental impacts of the project alternatives to water resources, including surface water, groundwater, stormwater, floodplains, and stream geomorphology.

The study area for water resources is the Upper Yakima River Sub-Basin, which contains the Keechelus Lake, Lake Kachess, and Lake Easton watersheds. After leaving Hyak, I-90 runs along the north shore of Keechelus Lake and then along the left bank of the Yakima River (looking downstream) for the remainder of the project area. The highway crosses 14 major tributary streams that flow into Keechelus Lake or the Yakima River.

I-90 and its associated fill, bridges, and culverts influence many hydraulic and hydrologic processes associated with water resources in the project area. The highway impedes passage of surface and groundwater in some areas, creating a barrier to hydrologic connectivity (Appendix D).

Surface water includes lakes, streams, ponds, and wetlands.

Groundwater is water found beneath the earth's surface in saturated soil and rock.

Stormwater is precipitation that runs off impervious surfaces and enters drainage ditches or other features constructed to convey and/or treat it.

Stream geomorphology refers to the processes that form and transform stream channels.

What new information has been developed since the Draft EIS?

Since publishing the Draft EIS, WSDOT has revised and completed several additional technical reports that are relevant to water resources, including:

- *Mitigation Development Team Recommendation Package* (Appendix D)
- *Water Resources Addendum to the EIS* (Appendix H)
- *Stormwater Treatment and BMP Report* (Appendix I)
- *Biological Assessment* (Appendix M)

Hydrologic connectivity is maintaining natural flow paths that transmit water, sediment, and nutrients to and through watersheds, aquifers and streams.

Ecological connectivity is a general term that incorporates hydrologic connectivity. The project's purpose and need statement identifies ecological connectivity as a project need.

- *2006 Conceptual Geotechnical Report, I-90 Snoqualmie Pass East, Hyak to Keechelus Dam, Washington, Volumes 1 through 5* (WSDOT 2007b)

- *Analysis of Groundwater Monitoring Data for Hydrologic Connectivity I-90 Snoqualmie Pass East* (WSDOT 2007d)

- *Draft Technical Memorandum No. 5 - Off-Site Hydrologic & Hydraulic Analyses* (WSDOT 2007e)

- *Technical Memorandum No. 3 – Hydrologic/ Hydraulic Design Standards and Procedures* (WSDOT 2007f)

- *Draft Technical Memorandum No. 4 – Stormwater Quality BMP Selection: Constrained Areas and Mitigation* (WSDOT 2008c)

The Final EIS has been updated to be consistent with these technical reports and with the 2006 amendments to the WSDOT *Highway Runoff Manual* (WSDOT 2006b).

Following identification of the Preferred Alternative, WSDOT formed an interagency Stormwater Technical Committee to assist with problem solving associated with stormwater treatment. The committee includes technical specialists from WSDOT, USFS, Ecology, USFWS, and USEPA. The committee will continue to advise WSDOT through completion of final design, and has concentrated its efforts on areas where specific site conditions pose challenges to meeting the requirements of the *Highway Runoff Manual* (WSDOT 2006b).

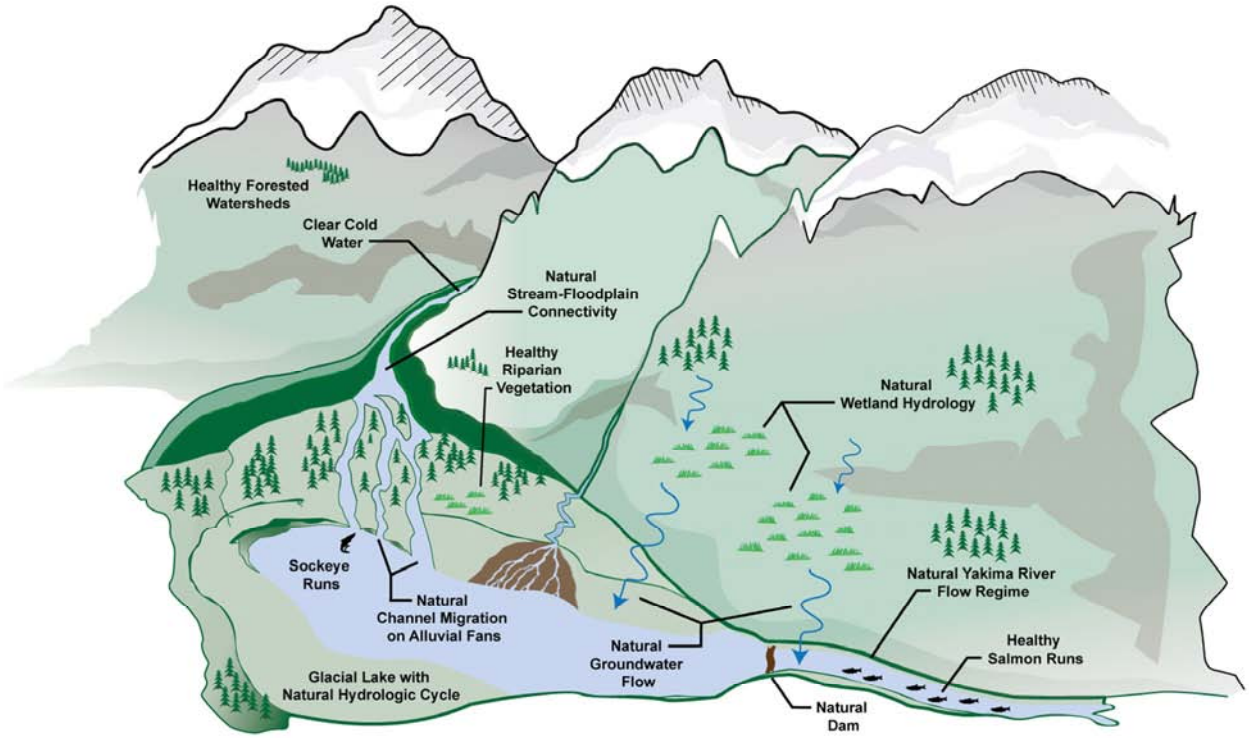
In addition, the lead agencies have incorporated comments from the public and reviewing agencies into this section.

What are the major characteristics of the affected environment?

This section describes the water resources within the project area. The movement of water, or the hydrologic cycle, in project area watersheds has changed over time due to dam construction and the

establishment of the reservoir system, timber harvest, railway construction and construction of I-90. This history is shown in Exhibit 3-4 and Exhibit 3-5.

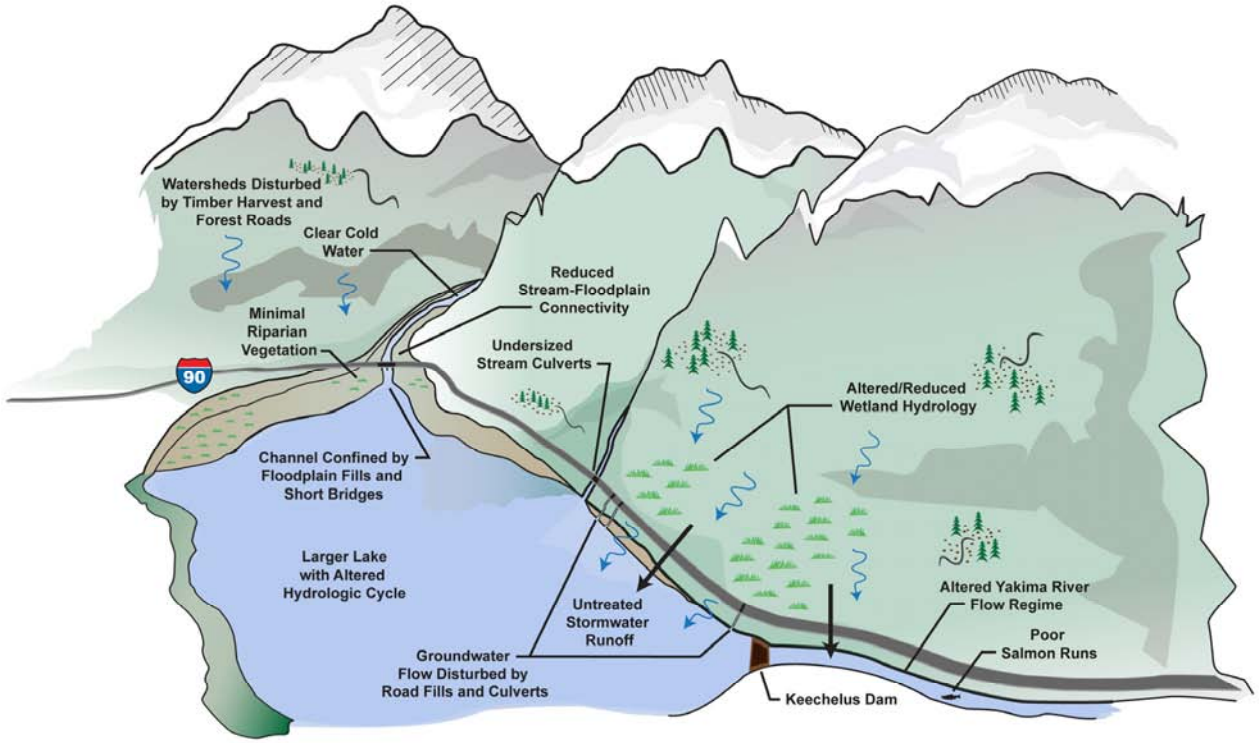
Exhibit 3-4
Pre-Settlement Hydrologic Cycle



These exhibits illustrate the ways that historic practices have modified the original flows of surface and ground water. The primary effects have been that:

- Stream channels have been artificially confined by bridges and culverts
- Groundwater flow has been altered by highway fill
- Freeway stormwater runoff is not being treated
- Water levels in Keechelus Lake fluctuate with its use as an irrigation reservoir

Exhibit 3-5
Existing Conditions Hydrologic Cycle



Surface Water

The project area is within the 6,000-square-mile Yakima River Basin, which Ecology has designated as Water Resource Inventory Area 39. The study area is the 2,100-square-mile Upper Yakima River Sub-Basin. Fourteen main tributaries and numerous smaller unnamed creeks either cross the highway or may otherwise be directly affected by the project. There are three USBR-operated reservoirs in the vicinity of the project. Two of the reservoirs, Keechelus Lake and Lake Easton, are located within the project area. The third reservoir, Lake Kachess, is located just outside of the project area to the east. Additional details can be found in Section 3.3 of the Draft EIS.

Generally, surface water quality within the project areas is high. Water quality evaluation has been based on macroinvertebrates, Section 303(d) listings, limited water quality monitoring, and sedimentation.

Macroinvertebrates. The composition of an aquatic invertebrate community can be an indicator of water quality. Because of their low mobility, aquatic invertebrates typically cannot escape the effects of reduced water quality, substrate alteration, or fluctuation in stream flows. Aquatic macroinvertebrates were collected from sites upstream and downstream of I-90 on nine project area streams. The data indicated that aquatic macroinvertebrate communities in the project area are generally in good condition, and that communities downstream of the highway are, in some cases, in better condition than communities upstream of the highway (WSDOT 2002f).

Macroinvertebrates are aquatic invertebrates including insects, crustaceans, mollusks, and worms that live in a river channel, pond, lake, wetland, or ocean. Their presence or absence is one indicator of water quality.

Aquatic macroinvertebrate communities in project area creeks are generally in good condition.

Many of the sites showed an increase in Benthic Index of Biotic Integrity scores downstream of I-90 relative to sites upstream of I-90. With the exception of Coal Creek, the project area streams are not measurably affected by I-90 using the Benthic Index of Biotic Integrity score. Only Coal Creek showed a decrease in biotic integrity score at both riffle and pool sites downstream of I-90 relative to upstream sites (WSDOT 2002f).

The Benthic Index of Biotic Integrity is an index which measures the health of streams. It is composed of metrics that measure different aspects of stream biology, including diversity, amount, habit, reproductive strategy, and feeding ecology of macroinvertebrates.

Section 303(d) Listings. In accordance with Section 303(d) of the federal Clean Water Act, every four years each state must identify water bodies that do not meet water quality standards. These are water quality-limited estuaries, lakes, and streams that fall short of state surface water quality standards, and are not expected to improve within the next four years.

Most project area streams meet the water quality requirements of the Clean Water Act. (Shown: Telephone Creek)

Within the project area, two water bodies are included on the 2004 303(d) list: one segment of the Yakima River near the mouth of Lake Easton and Keechelus Lake. The Yakima River segment is listed for exceeding stream temperature. According to the *Wenatchee National Forest Water Temperature Total Maximum Daily Load Technical Report* (Ecology 2003), elevated temperatures in forest streams are attributed to several factors: small amounts of riparian shade, a small percentage of groundwater inflow making up the total stream flow, thermally stratified inflow from lakes and reservoirs, and low flow from flow diversion. However, the effects of reservoir storage on stream temperatures are not completely understood at this time. For example, the Keechelus Lake intake structure is located

well below the full pool elevation. During full pool, it is expected that the lake would discharge cool water to the Yakima River. The influence of lake discharges on stream temperatures during low pool relative to historical conditions is unknown.

Keechelus Lake is listed for exceeding the National Toxics Rule criterion for dioxin and for total polychlorinated biphenyls in composite fish tissue samples. The source of the pollutants in Keechelus Lake that result in the listing is unknown. None of these listings appear to be the result of constructing or operating I-90.

Limited Water Quality Monitoring. The water quality of the streams crossing I-90 is generally considered excellent and the streams currently meet the designated uses for Ecology's water quality standards. In 2001, WSDOT performed water quality monitoring during storm events. Some short term and localized exceedances of numeric water quality criteria were measured during these storm events. Detailed results of the monitoring are available in Section 3.3 of the Draft EIS and in the *Final Discipline Report for I-90 Snoqualmie Pass East: Hydrologic Systems, Water Quality, and Floodplains* (WSDOT 2002g).

WSDOT educates local students on water quality monitoring.

Monitored water quality parameters included temperature, turbidity, fecal coliform, dissolved oxygen, lead, arsenic, chromium, pH, and specific conductivity. This effort showed that streams that cross I-90 in the project area do not have substantial levels of contamination; however, pollutant levels were sometimes higher than State criteria. It was not clear to what extent these exceedances were related to the presence of the highway. For example, some criteria were exceeded upstream of the highway but not downstream, where highway runoff would have an effect. These are referred to as "potential" exceedances since only four samples were taken for most parameters and normal water quality is high.

Sedimentation. Sediment deposition due to streambed erosion has been documented in the project area (Appendix I). Streambed erosion is largely driven by watershed-scale activities. However, highways and other forms of land development can add to such

deficiencies incrementally by introducing pollutants and modifying land cover and hydrology. For some streams crossing I-90, localized sediment deposition may be partially attributed to the historical accumulation of traction sand in runoff from the existing I-90 roadbed. In addition to traction sand, sediment impacts were identified to be from channel cross-section alterations. These channel cross-section alterations are due to undersized highway crossing structures and accelerated bank erosion from both upstream and downstream of I-90.

Groundwater

Groundwater quality in the project area appears to be very good, which is likely due to its mountainous terrain and low level of development. There have been few groundwater studies in the project area; however, all of the federally regulated drinking water systems in the area currently meet state and federal water quality standards.

In the project area, I-90 is primarily located on the boundary between the Yakima River valley and the surrounding uplands. As a result, it passes over transitional zones between geologic formations. These transition zones are important for seepage, groundwater recharge, and wetland flow. Groundwater monitoring data collected in 2005 and 2006 indicate that fall storms and spring snowmelt are critical periods for groundwater recharge and flow. Groundwater levels are lowest during the late summer, and in midwinter when soils and seepage zones freeze. Snowmelt from higher elevations and leakage from Keechelus Lake and Lake Kachess may elevate late-spring and early-summer groundwater levels in the Swamp Creek valley (WSDOT 2007d).

The highway and associated fill materials have intercepted and re-routed the original pattern of groundwater flow in some locations. During project planning, the MDT identified 10 specific HCZs where conveying surface water and shallow subsurface water beneath the highway is important. HCZs are typically located adjacent to wetlands, seeps, springs, or other visible signs of water (Appendix D).

Hydrologic Connectivity Zones

HCZs are geographic zones where connections between groundwater and surface water play an important role in maintaining natural flow paths which transmit water, sediment and nutrients in support of aquatic organisms and sustaining streamflow. WSDOT identified HCZs where I-90 divides wetlands, alluvial fans, seepage zones and important aquifer recharge areas.

Floodplains and Stream Geomorphology

I-90 is located outside the 100-year floodplains of most of the streams that it passes over in the project area. Exceptions include portions of the Yakima River floodplain and where the highway crosses Gold Creek, Swamp Creek, and the Kachess River. In general, reservoir operations govern the floodplain hydrology in the project area.

Stream geomorphology refers to stream channel characteristics such as connectivity to floodplains, channel migration or confinement, capacity for sediment transport, and base and peak flows. Three types of stream systems occur in the project corridor: naturally confined channels, artificially confined channels, and alluvial fans. Streams with naturally confined channels do not actively migrate, and can be accommodated by crossing structures that are sufficient to provide fish passage. Rocky Run Creek, Wolfe Creek, Telephone Creek, and several unnamed creeks have naturally confined channels. Townsend Creek has a natural, moderately confined channel.

Artificially confined channels have restricted migration, generally as a result of culverts and bridges, which can result in restricted meander, decreased channel complexity, bank erosion, and altered sediment transport characteristics. Culverts and bridges may prevent fish passage due to high water velocities, low water depths, and, for culverts, drop-offs at the downstream ends. The Kachess River, Gold Creek, Resort Creek, Price Creek, Noble Creek, Bonnie Creek, Swamp Creek, Toll Creek, Cedar Creek, Hudson Creek, and several unnamed creeks in the project area have artificially confined channels.

Throughout the project area, bridges and culverts have created artificially confined stream channels. (Shown: Gold Creek)

An alluvial fan is a fan-shaped deposit formed where a fast-flowing stream flattens, slows, and spreads, typically at the exit of a canyon onto a flatter plain. Resort Creek, Gold Creek, and Rocky Run Creek are examples of streams with alluvial fans.

Rocky Run alluvial fan system

Refer to Section 3.4, *Wetlands and Other Jurisdictional Waters,* for more details regarding streams.

What are the expected environmental consequences?

What beneficial effects would result?

No-Build Alternative

The No-Build Alternative would have no beneficial direct or indirect effects to water resources.

Build Alternatives

The I-90 project offers an opportunity to restore some of the natural hydrology and hydraulics of the streams in the project area, which were altered as a result of the original highway construction and other land use changes. The project would achieve these beneficial effects by replacing existing bridges, culverts, and highway fill with longer bridges and wider, bottomless culverts, along with additional smaller culverts at HCZs. These replacements would improve hydrologic connectivity, sediment transport, channel migration, floodplain function, and groundwater movement. Water quality would be improved through lowered water temperature and sediment load.

Most of the beneficial effects of the project would be direct effects; however, all of the build alternatives also would create indirect beneficial effects as the removal of barriers would allow for the gradual restoration of more natural stream movement and habitat. The types of beneficial effects to water resources would be similar for all of the build alternatives.

Types of Beneficial Effects

Improved Hydrologic Connectivity. Replacing narrow bridges and culverts would result in major benefits to hydrologic connectivity at each of the stream crossings.

Lower Stream Velocities. Narrow bridges and culverts raise stream velocities, which can impede fish passage and lead to increased channel scour and erosion. Replacing them with wider bridges and culverts should result in lower stream velocities.

Improved Channel Migration. Installing wider bridges and culverts would improve channel migration at each of the artificially confined stream channels. The benefit would be greater where longer bridges are installed, since this would provide more potential area for the stream to meander.

Floodplain Restoration. Floodplain function improves when streams can access more of their natural floodplain during floods. Installing wider bridges and removing highway fill would allow for more normal floodplain functions.

Restored Capacity for Sediment Transport. Normal sediment transport would be improved by replacing undersized culverts that currently block sediment flow. WSDOT has designed new culverts and bridges to improve sediment transport.

Reduced Sediment and Temperature. Reducing stream velocities and restoring floodplain function would help to stabilize stream banks and improve riparian vegetation and cover. Increased vegetation and cover would reduce temperature and decrease sediment loading.

Improved Groundwater Flow. The MDT identified locations throughout the project area where special measures are needed to reestablish natural surface and subsurface flow paths. These areas, called HCZs, were established where I-90 divides wetlands, alluvial fans, seepage zones and important aquifer recharge areas. The MDT

identified the following general objectives for hydrologic connectivity at these locations:

- Maintain natural mechanisms for delivering and routing water
- Improve floodwater retention and groundwater recharge
- Provide lower water temperatures
- Provide continuity between surface and subsurface flow, particularly at low gradient wetlands or areas of unconfined surface flow

These objectives emphasize restoring natural hydrologic functions. This does not necessarily mean providing natural flow conditions or water levels within the immediate area of the highway. It does mean that WSDOT would seek to transmit water across the highway in a way that maintains and restores the functions that natural dispersed groundwater flow paths would provide.

Exhibit 3-6 and Exhibit 3-7 illustrate two examples of structures that might be used at HCZs. The design shown in Exhibit 3-6 could be used to link low-gradient wetland habitats on either side of the highway. Open-bottomed culverts would allow surface and subsurface flow at multiple locations along the HCZ, as well as passage for small animals. The design in Exhibit 3-7 focuses on subsurface drainage, and might be appropriate in locations where the objective is to convey hillslope seepage to aquifer recharge areas and wetlands on the downslope side of the highway.

Additional information on the general location and function of the HCZs is available in Section 3.3 of the Draft EIS, and in the *Mitigation Development Team Recommendation Package* (Appendix D). More precise HCZ locations are shown in Appendix C, *Project Design*. None of the HCZs are located in Phase 1 of the project. WSDOT will determine the final design and location of each structure when later phases of the project are funded.

Exhibit 3-6
Hydrologic Connectivity Structures Linking Low Gradient Wetlands

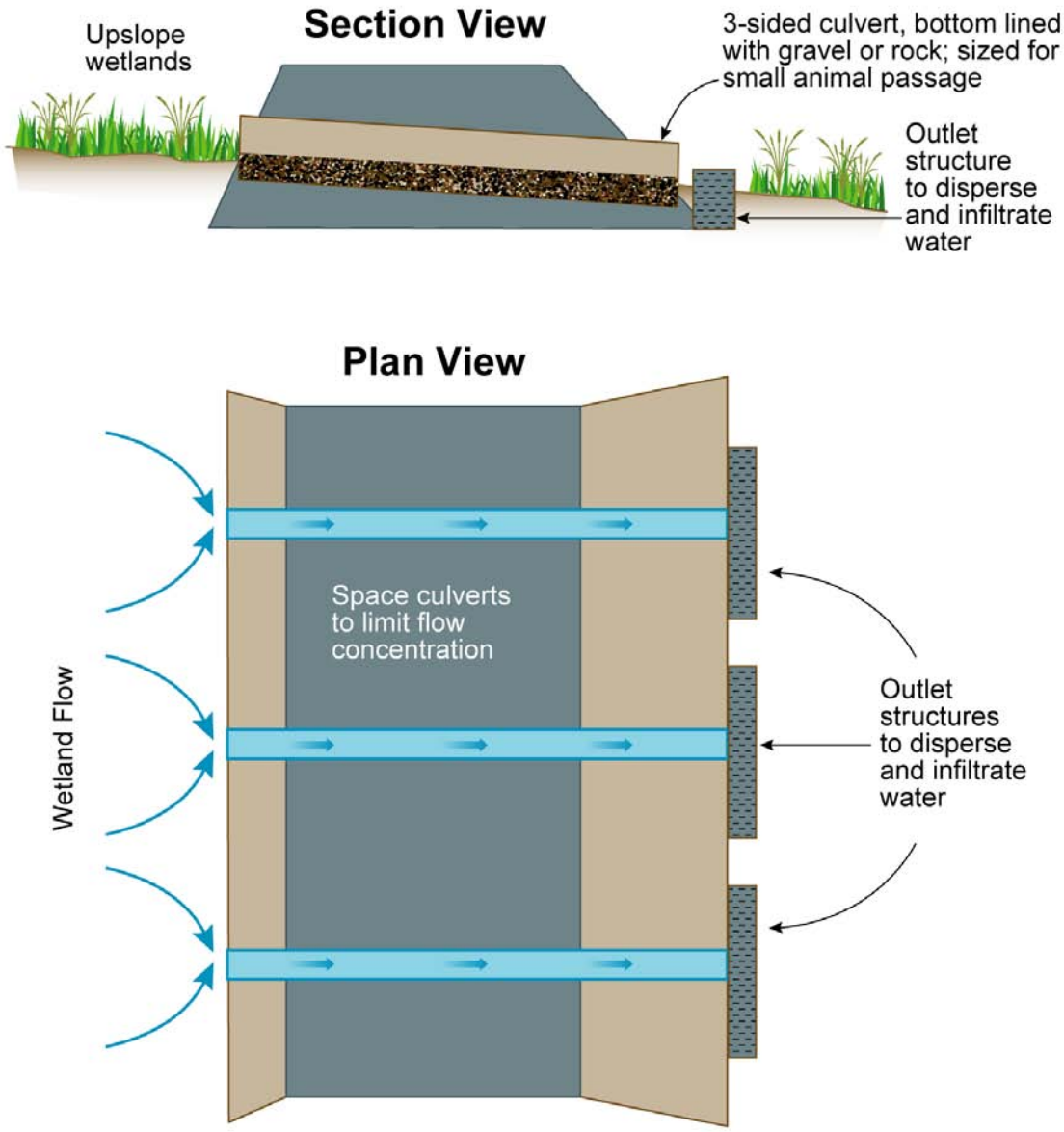
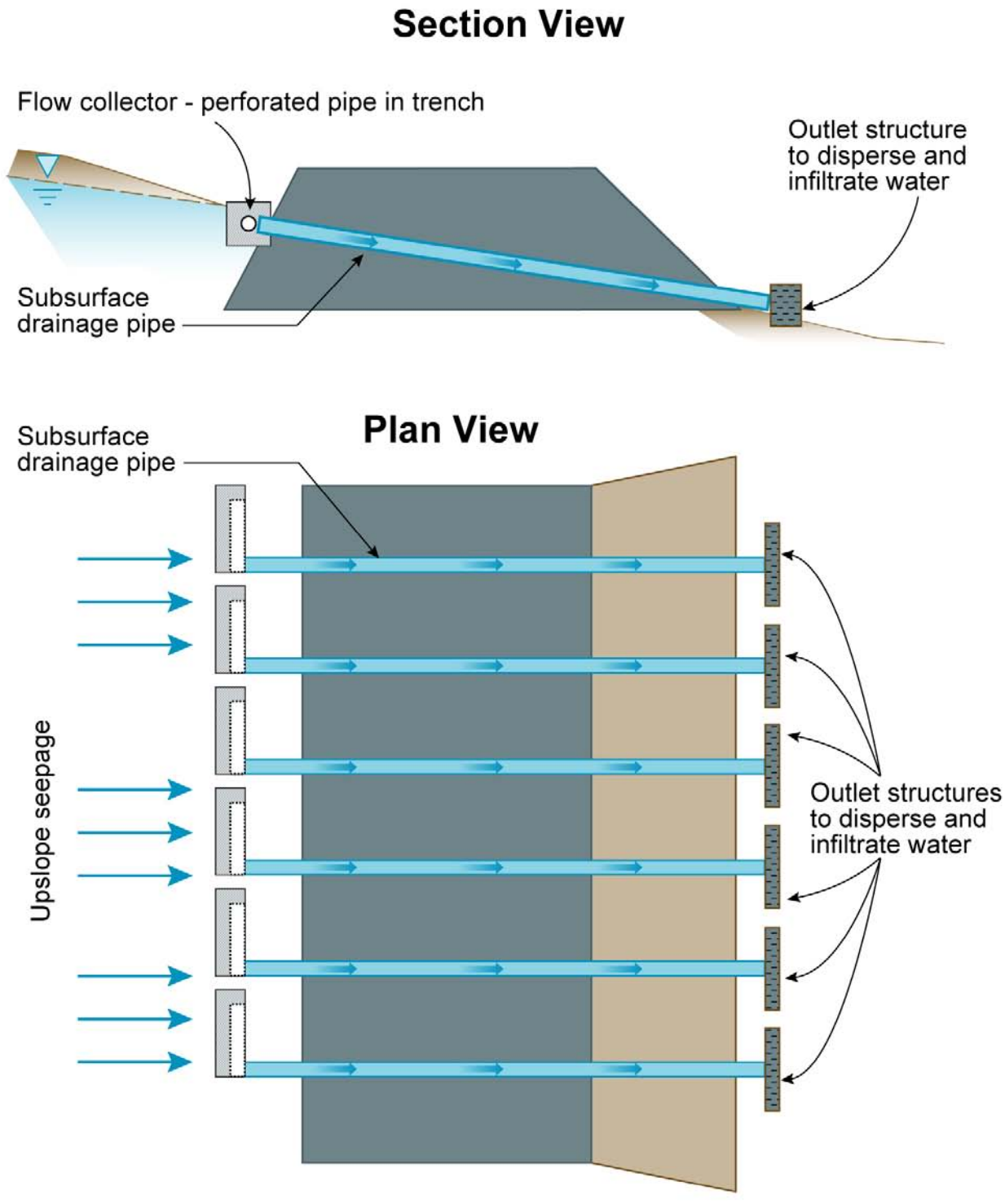


Exhibit 3-7
Hydrologic Connectivity Structures for Seepage Zones



Improved Surface Water Quality. When the present highway was built in the 1940s and 1950s and upgraded in the 1970s, it did not include stormwater treatment facilities, following the guidelines in place at the time of construction.

Steep constrained slopes uphill of I-90 cause snow and stormwater to accumulate in existing undersized ditches and flow to streams untreated.

WSDOT has committed to treating stormwater runoff for the equivalent of all new and existing impervious surfaces in the project area. WSDOT will provide on-site treatment systems and off-site mitigation when on-site treatment is not possible because of physical constraints. This commitment meets or exceeds the requirements of the *Highway Runoff Manual* (WSDOT 2006b). WSDOT conducted additional feasibility and design work for stormwater mitigation sites in 2008, and determined that in some areas, stormwater treatment is physically impossible because the highway is located between steep rock banks and Keechelus Lake, with no additional room. The project design will compensate for the lack of stormwater treatment in these constrained areas by providing additional treatment at other sites near the project area.

Steep slope on the uphill side of I-90.

Stormwater treatment would be accomplished through the use of BMPs such as biofiltration swales, detention ponds, vegetated filter strips, planted roadsides, ecology embankments, and natural or engineered dispersion. Some example structures are shown in Exhibit 2-13 in Chapter 2.

Stormwater inlets clog with snow and ice, which causes water to build up on the roadway creating unsafe conditions.

Exhibit 3-8 shows modeled pollutant load rates for treated and untreated disturbed surfaces. The exhibit shows that stormwater treatment substantially reduces the pollutant loading rate.

Exhibit 3-8
Modeled Pollutant Load Rates (pounds per acre)

Mean Annual Load	TSS	Total Zinc	Dissolved Zinc	Total Copper	Dissolved Copper
Load from untreated surfaces	565	1.1	0.4	0.2	0.053
Load from treated surfaces	45	0.28	0.2	0.065	0.035

Source: Biological Assessment (Appendix M)
TSS – total suspended solids

Exhibit 3-9 shows the pollutant loading before and after construction of the project. This exhibit shows that although the amount of impervious surface would increase, installing stormwater treatment for the entire highway would lower the overall pollutant loads. The amounts shown are for the Preferred Alternative; however, the differences between the Preferred Alternative and the other build alternatives would be extremely small, since the total amount of impervious surface would be similar for all build alternatives, and WSDOT's commitment to treating the equivalent of all impervious surfaces would be the same for all of the build alternatives.

Exhibit 3-9
Pre- and Post-Project Pollutant Loading (pounds)

Annual Effluent Load	TSS	Total Zinc	Dissolved Zinc	Total Copper	Dissolved Copper
Phase I					
Load from existing impervious surface, pre-project	32,431	63.14	22.96	11.48	3.04
Load from new and existing impervious surface, post-project	22,856	52.12	22.84	10.03	3.36
Net change	-9,575	-11.02	-0.12	-1.45	0.32
Remaining project area					
Load from existing impervious surface, pre-project	50,172	97.68	35.52	17.76	4.71
Load from new and existing impervious surface, post-project	1,255	7.81	5.58	1.81	0.98
Net change	-48,917	-89.87	-29.94	-15.95	-3.73
Project Total					
Load from existing impervious surface, pre-project	82,603	160.82	58.48	29.24	7.75
Load from new and existing impervious surface, post-project	24,112	59.93	28.42	11.85	4.34
Net change	-58,491	-100.89	-30.06	-17.39	-3.41

Post-project pollutant loadings do not include the beneficial effects of off-site compensatory treatment.
TSS – total suspended solids

Exhibit 3-10 shows modeled pollutant concentrations for treated and untreated runoff. The exhibit shows that stormwater treatment substantially reduces the pollutant concentrations.

Exhibit 3-10
Modeled Pollutant Concentrations

Expected Pollutant Concentrations	TSS (mg/L)	Total Zinc (µg/L)	Dissolved Zinc (µg/L)	Total Copper (µg/L)	Dissolved Copper (µg/L)
Concentrations for untreated runoff	93	174	62	31	7.6
Concentrations for treated runoff	6.4	40	27	7	5

Source: Biological Assessment (Appendix M)
TSS – total suspended solids

Exhibit 3-11 shows the pollutant concentrations before and after construction of the project. This exhibit shows that installing stormwater treatment for the entire highway would lower the overall pollutant concentrations just as it would lower overall pollutant loads, even though the amount of impervious surface would increase. The amounts shown are for the Preferred Alternative; however, as with overall pollutant loads, the differences between the Preferred Alternative and the other build alternatives would be extremely small.

Alternatives Comparison

Keeechelus Lake Alignment Alternatives. The beneficial effects of the Keechelus Lake Alignment Alternatives on water resources would differ from each other only slightly. All of the alternatives considered would include the same improvements to Rocky Run Creek, Wolf Creek and Resort Creek. The four alternatives would create different amounts of new impervious surface, and this would in turn lead to differing amounts of stormwater runoff. However, WSDOT has committed to treating runoff from 100 percent of both existing and new impervious surfaces, or treating the off-site equivalent in cases where treatment would be physically impossible.

CEA Improvement Packages. The benefits to water resources would include those described in Section 3.4, *Wetlands and Other Jurisdictional Waters*. As described in that section, the Preferred Alternative would have the largest benefit, followed by Improvement

Packages A, B and C. All of the CEA Improvement Packages would provide similar beneficial effects to water quality resulting from treatment of stormwater runoff.

Exhibit 3-11
Pre- and Post-Project Pollutant Concentrations

Concentration	TSS (mg/L)	Total Zinc (µg/L)	Dissolved Zinc (µg/L)	Total Copper (µg/L)	Dissolved Copper (µg/L)
Phase I					
Pollutant concentration for runoff pre-project	93.0	174.0	62.0	31.0	7.60
Pollutant concentration for runoff post-project	48.40	105.0	43.98	18.64	6.26
Net change	-44.6	-69.0	-18.02	-12.36	-1.34
Remaining project area					
Pollutant concentration for runoff pre-project	93.0	174.0	62.0	31.0	7.60
Pollutant concentration for runoff post-project	6.40	40.0	27.0	7.0	5.0
Net change	-86.60	-134.0	-35.0	-24.0	-2.60
Project Total					
Pollutant concentration for runoff pre-project	93.0	174.0	62.0	31.0	7.60
Pollutant concentration for runoff post-project	37.22	87.69	39.46	15.54	5.93
Net change	-55.78	-86.31	-22.54	-15.46	-1.67

Post-project pollutant loadings do not include the beneficial effects of off-site compensatory treatment.
TSS – total suspended solids

Exhibit 3-12 illustrates the improvements that the Preferred Alternative would have on the hydrologic cycle in the project area. Improvements would be similar for all of the build alternatives.

Additional information on the options considered at each CEA and their potential beneficial effects can be found in the Draft EIS (WDOT 2005a), the *Mitigation Development Team Recommendation Package* (Appendix D), and the *Conceptual Wetland & Aquatic Resources Mitigation Plan* (Appendix J).

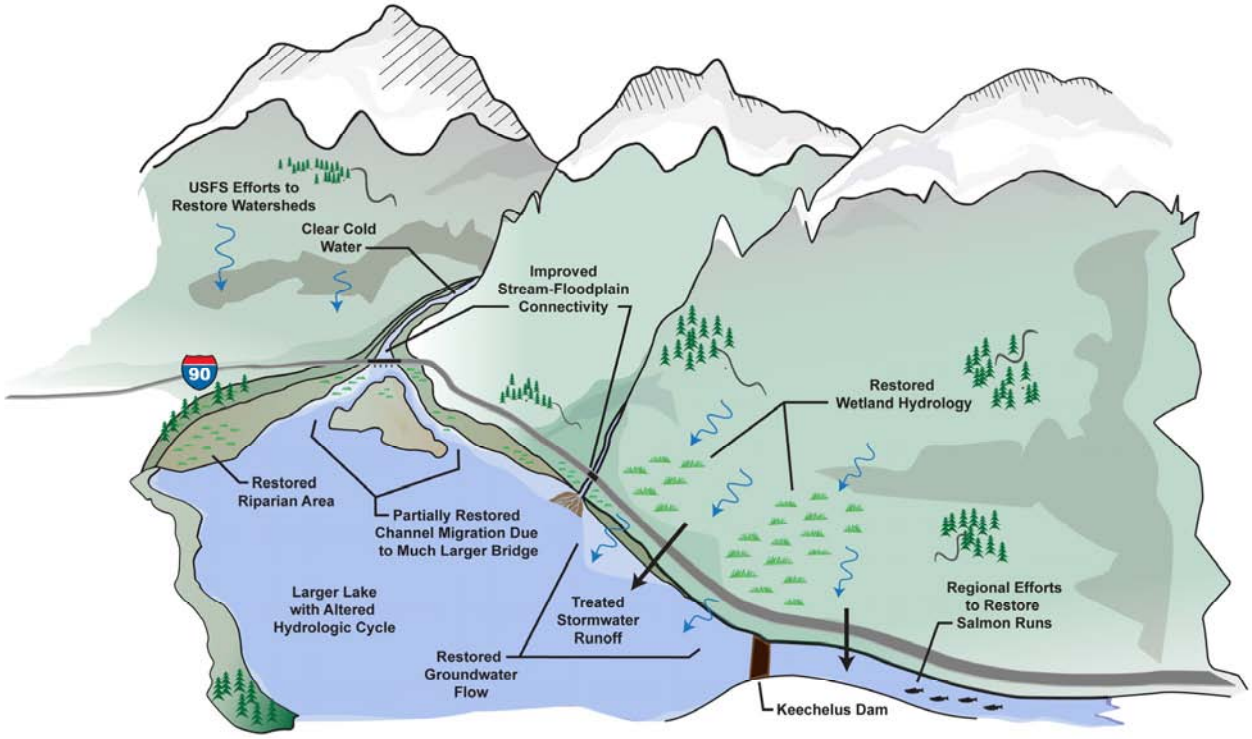
What adverse impacts are expected?

No-Build Alternative

The No-Build Alternative would not result in any temporary adverse impacts to water resources. This alternative would result in indirect

adverse impacts, including water quality impacts as traffic volume continued to grow in the absence of treatment for stormwater runoff.

Exhibit 3-12
Preferred Alternative Hydrologic Cycle



Build Alternatives

Temporary Impacts

Temporary impacts to water resources may result from construction activities that occur during highway realignment and widening, crossing structure replacement, and tunnel construction. The types of temporary construction impacts are generally similar for all of the build alternatives.

Surface Water Runoff. Construction has the potential to increase runoff to surface water through soil compaction, changes in drainage patterns, and clearing of vegetation in temporary staging areas. Fill removal and restoration activities may cause temporary surface water diversions or confinement during construction. WSDOT expects flow alterations to be minor, and anticipates that standard construction BMPs would minimize the potential for additional

runoff. Required BMPs will include Temporary Erosion and Sediment Control Plans and Spill Prevention, Control, and Countermeasure Plans, which would be designed and implemented in accordance with the *Highway Runoff Manual* (WSDOT 2006b).

Water Use for Construction. Any of the build alternatives would require large amounts of water for processing materials, concrete production, dust suppression, and highway fill compaction. WSDOT estimates that the Preferred Alternative would require approximately 152 million gallons of water for Phase 1 of construction. The remainder of the project area would require approximately 309 million gallons. For further details see Appendix Y, *Construction Water Needs Technical Memorandum*.

Construction water may be from groundwater or surface water sources, and may be acquired through purchase of water or through purchase or lease of valid water rights. Final selection of water sources will depend on construction phasing (which would determine the amount of water needed and peak demands) and on the location and cost of potential water sources. WSDOT will approve all construction water sources prior to their use and any water rights acquired, either through lease or purchase, would be approved by Ecology or Yakima County Superior Court. WSDOT believes that the acquisition of water from properly permitted sources with valid rights would not adversely impact groundwater or surface water, or impair existing water rights.

Floodplain Disturbance. Floodplains would likely be disturbed when installing bridges and culverts, removing highway fill, and widening and realigning the highway. Floodplain soils may be compacted by equipment, impairing shallow groundwater flow and recharge. WSDOT expects all of these impacts to be temporary, and that impacts can be avoided or minimized by limiting construction access, restoration efforts, and applying construction BMPs. Post-construction restoration may include rehabilitating areas by removing temporary road surfaces, treatment to reduce the effects of compaction, and revegetation.

Channel Disturbance. Channel function may be affected during construction by temporary cofferdams and diversions that impair natural channel form and function. Construction activity may directly affect channels during bridge and culvert installation by disturbing banks and the channel bed. These impacts would be temporary and WSDOT does not anticipate that they would result in permanent changes to channel function. For more information see Section 3.3.2.2 of the Draft EIS.

As discussed in Section 3.4, *Wetlands and Other Jurisdictional Waters,* WSDOT calculated temporary impacts using the following assumptions:

- A 15-foot buffer around all project fills
- A 30-foot buffer around all proposed structures, including bridges, culverts and retaining walls, which would allow room for construction equipment
- Impacts from proposed haul roads

Exact numbers for temporary impacts will continue to change until project design is finalized, and will be included in project permitting documents.

Release of Hazardous Materials. The 303(d) listing for dioxins and polychlorinated biphenyls in Keechelus Lake indicates that there may be a source of these pollutants in the area. WSDOT has conducted extensive geotechnical drilling in the project area, including the lake sediments that will be disturbed during construction. No evidence of contamination has been found, and WSDOT believes that it is unlikely that the source is within the construction area. However, the project will include continuous monitoring for environmental compliance, and the monitoring plan will include provisions for unanticipated discovery of hazardous material.

Permanent Impacts

Permanent impacts are those associated with the design and operation of the new highway. All of the build alternatives would result in some permanent impacts to surface water, groundwater, floodplains, wetlands, and stream geomorphology. WSDOT expects that the all permanent impacts would be direct, and that none of the build alternatives would result in indirect impacts to water resources.

Filling Aquatic and Shoreline Habitat. All of the build alternatives would require filling some areas of shoreline and aquatic habitat. WSDOT assessed the amounts of fill to all jurisdictional waters for each of the alternatives. This information is presented in Section 3.4, *Wetlands and Other Jurisdictional Waters.*

Increased Surface Water Runoff. Adding impervious surface could increase the flow of untreated stormwater to surface water, including Keechelus Lake and its tributaries. Stormwater runoff contains traction sand and phosphorus from the use of de-icers, which are two potential categories of pollutants that are not modeled in Exhibit 3-8 through Exhibit 3-11.

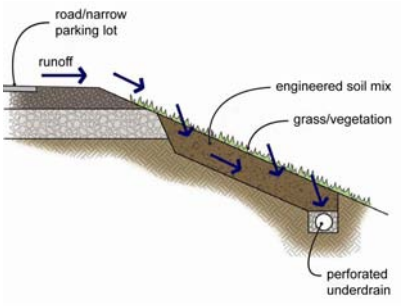
Traction sand use has decreased substantially in recent years. WSDOT now only applies sand under certain winter road conditions, primarily to provide traction at curves and grades where chemical treatment may not be effective. WSDOT has partially replaced sand use with chemical deicers (magnesium chloride and calcium chloride).

Orthophosphate is a common trace substance found in anti-icer and deicer products and is expected to be present in highway runoff within the project area. WSDOT's approach to deicer use also involves source control, by following application guidelines in the *Statewide Snow and Ice Plan* (WSDOT 2007g). However, WSDOT cannot eliminate the use of either traction sand or chemical deicers entirely, because they are essential to winter highway safety.

According to the *Highway Runoff Manual (*WSDOT2006b), phosphorus control BMPs are required only when the receiving

water has been identified and documented as having excess phosphorus. This is not the case for the I-90 project, where all of the receiving water bodies have been identified as being naturally low in phosphorous. Consequently, there is no requirement to treat the additional phosphorus from de-icers.

Nevertheless, stormwater treatment will remove both traction sand and phosphorus, and their use is expected to decrease overall levels of both. The primary stormwater treatment mechanism proposed would be Ecology Embankments. The *Highway Runoff Manual* (WSDOT 2006b) states that "*The Ecology Embankment removes suspended solids, phosphorus, and metals from highway runoff through physical straining, ion exchange, carbonate precipitation, and biofiltration*" (page 5-7).



Ecology Embankment

Groundwater. WSDOT expects that the overall impacts to groundwater would be positive, and that there would be no permanent adverse impacts.

Floodplains and Stream Geomorphology. WSDOT expects that the project would not increase flood flows or reduce flood capacity at any of the project area streams. Installing the proposed bridges and culverts would allow for channel migration, increase capacity for sediment and debris flow, and expand floodplains currently confined under the highway. In some instances, streams may become shallow and a new channel may form. WSDOT expects that the overall impacts to stream geomorphology would be positive and that there would be no permanent adverse impacts. Restoration efforts would focus on streams and CEAs where there is a need to improve floodplain, stream, and overall ecological connectivity.

Impacts to Lake Storage Capacity. Despite fill to Keechelus Lake, there would be no net loss of storage capacity of the lake. WSDOT would replace the capacity lost through fill by removing material from Pit Site PS-S-255, which is below the ordinary high water mark (OHWM) of the lake. Additional storage capacity would be added by removing existing highway fill at the new Gold Creek bridges. Excavation amounts would be adjusted so that no net loss or gain of the reservoir's storage capacity would result. If WSDOT elected to

use the Gold Creek site, temporary impacts to the wetland buffer could occur. WSDOT would restore the site and buffer to a condition that meets or exceeds the existing wetland functions.

Lake Easton is the only other reservoir in the project area. Construction would not take place near this lake and no temporary or permanent impacts are anticipated.

How will FHWA and WSDOT mitigate for adverse environmental impacts?

Avoidance and Minimization

WSDOT has designed the I-90 project to avoid and minimize impacts to water resources wherever possible, including:

- Adjusting the alignment and decreasing median widths to avoid impacts to sensitive aquatic habitat.
- Using the existing highway rather than placing new fill.
- Incorporating retaining walls, steep fill slopes, long-span bridges and wide culverts in areas where existing structures and standard fill slopes encroach into floodplains, stream channels, and wetlands.
- Incorporating the MDT design objectives and performance standards wherever applicable and reasonable.
- Designing outfalls to reduce adverse impacts, including sediment plumes. Typical outfall systems include rock splash pads, flow dispersal trenches and other energy dissipaters.

Best Management Practices

BMPs for water resources will be designed to meet applicable commitments and performance standards, including:

- Clean Water Act Section 404 Permit(s)
- Clean Water Act Section 401 Water Quality Certification
- NPDES General Permit for Construction Activities

- NPDES General Permit for Sand and Gravel Operations
- Temporary Erosion and Sediment Control Plans
- Spill Prevention, Control and Countermeasure Plans
- Erosion and sediment control requirements of the WSDOT *Design Manual* (WSDOT 2007c) and *Standard Specifications for Road, Bridge, and Municipal Construction* (WSDOT 2008b)
- WSDOT *Highway Runoff Manual* (WSDOT 2006b)
- Applicable measures specified in the USFWS Biological Opinion
- Applicable conservation measures included in the NOAA Fisheries' ESA Consultation Concurrence Letter (NOAA Fisheries 2008)
- Applicable parts of the *Implementing Agreement between the Washington State Department of Ecology and the Washington State Department of Transportation* (Ecology and WSDOT 1998), or as revised
- Objectives of the USFS ACS
- MDT design objectives and performance standards
- Applicable permit conditions
- Applicable conditions and stipulations related to the transfer of federal land for highway easement

Some example BMPs that WSDOT could use to comply with these standards includes requiring:

- Covered loads
- Short term stabilization during construction, including seasonal shut-down and stabilization procedures
- Perimeter ditching or other erosion control measures
- Plastic sheeting in severe weather to protect sub-grades or fill materials
- Staged fill placement or surcharges
- Temporary walls
- Temporary crushed rock armoring of exposed soil
- Approved water diversions to avoid streambank destabilization
- Roadside vegetation measures, including soil preparation, integrated vegetation management, and meeting the standards in the roadside master plan
- Conducting work around Keechelus Lake during low pool elevations when the shoreline is exposed
- Conducting vehicle fueling and maintenance at least 150 feet from the nearest stream wherever possible
- Using coffer dams to isolate all in-water structures from surrounding water until concrete is fully cured

Compensatory Mitigation

WSDOT will provide stormwater treatment for the equivalent of all impervious surfaces. To compensate for areas where the terrain makes treatment impracticable, WSDOT will provide additional treatment in other off-site locations in or near the project corridor.

WSDOT will use the *Highway Runoff Manual* (WSDOT 2006b) Appendix 2A procedure or the "equivalent area" approach to mitigate for constrained areas in which stormwater treatment is physically impossible. This approach allows WSDOT to retrofit stormwater treatment onto existing off-site impervious surface with pollution loading characteristics similar to the constrained areas.

WSDOT conducted reconnaissance field work to evaluate equivalent area treatment opportunities on I-90 to the west of the project area and within the Keechelus Lake watershed, and has tentatively identified compensatory treatment areas. Final decisions will be made as part of final design and permitting. WSDOT's analysis is discussed in *Draft Technical Memorandum No. 4 – Stormwater Quality BMP Selection: Constrained Areas and Mitigation* (WSDOT 2008c).

3.4 Wetlands and Other Jurisdictional Waters

This section describes the impact of the project alternatives to jurisdictional waters in the project area, including wetlands, reservoirs, streams, and certain ditches.

Jurisdictional waters: Aquatic and wetland features that are regulated by federal, state, and local agencies. Jurisdictional waters include both "waters of Washington State" and "waters of the US."

The study area for wetlands and other jurisdictional waters includes any jurisdictional waters that would be affected by the project, including potential mitigation sites, materials staging and stockpiling sites, and haul roads.

What new information has been developed since the Draft EIS?

Since publishing the Draft EIS, WSDOT has updated the *Wetland/Biology Discipline Report* (Appendix K). This update:

- Included additional information on jurisdictional waters in the study area, including buffers, ditches and the OHWM of streams and reservoirs
- Identified wetlands without hydric soil indicators located within Keechelus Lake
- Revised wetland ratings using the revised *Washington State Wetland Rating System for Eastern Washington* (Ecology 2004)
- Updated wetland impacts based on revisions to the preliminary design of the Preferred Alternative

WSDOT also published the *Conceptual Wetland & Aquatic Resources Mitigation Plan* (Appendix J). This document describes WSDOT's conceptual strategy to mitigate impacts to wetlands, aquatic resources, and other habitats associated with I-90 and the proposed project. A final Wetland & Aquatic Resources Mitigation Plan will be submitted to the relevant agencies as part of the permitting process.

Comments from the public and reviewing agencies have been incorporated into this section.

What are the major characteristics of the affected environment?

Wetlands

Palustrine systems are nontidal wetlands dominated by trees, shrubs, emergent herbaceous plants, mosses, and/or lichens, and some tidal wetlands. Palustrine wetlands are commonly referred to as marshes, swamps, bogs, fens, prairies, seeps, and intermittent ponds.

Riverine systems include all wetlands and deepwater habitats contained within a river channel, except wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens; and some marine wetlands.

WSDOT identified over 100 wetlands within the study area. Most of these are palustrine wetlands, with a few riverine wetlands found adjacent to the streams. These wetlands are described individually in the *Wetland/Biology Discipline Report* (Appendix K).

The wetlands in the study area vary in their plant communities, species diversity, habitat structure, and landscape position. In general, wetlands immediately adjacent to the highway are degraded herbaceous wetlands dominated by non-native species, while those farther from the road are higher-quality forested wetlands.

WSDOT rated project area wetlands based on their functions, using the *Washington State Wetland Rating System for Eastern Washington* (Ecology 2004). The ratings range from Category I to IV, with Category I considered the most valuable and Category IV considered the least valuable. A few Category I wetlands are located in the study area. These typically contain old-growth or mature conifer trees. Category II wetlands in the study area often are associated with streams. The majority of the wetlands in the study area are Category III and Category IV. Many of the Category IV wetlands in the study area are associated with the ditches that run parallel to the highway.

Category I wetlands are the highest value wetlands. (Shown: Category I Palustrine wetland near Stampede Pass)

The largest wetland complex in the study area is adjacent to the highway and below the OHWM of Keechelus Lake. These wetlands and other jurisdictional waters in the drawdown zone of Keechelus Lake are difficult to classify. Because of the artificial hydrologic regime of the reservoir, many Keechelus Lake wetlands are completely flooded when the reservoir is filled and completely dry during the summer months. The depth of inundation depends on

the amount of water available annually and management activities of the USBR, with some parts of the Keechelus Lake wetlands under 25 feet of water at its spillway elevation, or "maximum pool."

Category IV wetlands are lower-value wetlands, and are often associated with roadside ditches. (Shown: Category IV Emergent wetland near Swamp Creek.)

Wetlands are normally classified based on three characteristics: hydrology, hydrophytic vegetation, and hydric soils. Pockets of hydrophytic vegetation exist along much of the shoreline of Keechelus Lake; however, many of these areas do not have hydric soils. WSDOT consulted with USACE and Ecology in order to clarify the regulation of these areas. Following review of the wetland survey data and a review in the field, the three agencies agreed on the following classification system for jurisdictional waters within the drawdown zone of Keechelus Lake:

- ***Wetlands*** exhibit all three wetland characteristics (hydrology, hydrophytic vegetation, and hydric soils)

- ***Wetlands without hydric soil indicators*** exhibit hydrology and hydrophytic vegetation but lack hydric soil indicators

- ***Other waters*** exhibit hydrology but lack hydrophytic vegetation and hydric soil indicators

In calculating impacts to wetlands in Keechelus Lake, WSDOT included wetlands and wetlands without hydric soil indicators.

Wetland Buffers

Wetland buffers are relatively undisturbed areas adjacent to wetlands, which can reduce impacts from adjacent land uses. WSDOT determined preliminary wetland buffer widths using guidance issued jointly by Ecology, USACE, and USEPA (Ecology et al. 2006). This guidance provides buffer widths that vary by wetland type, rating, and the intensity of adjacent land uses. Kittitas County, in conjunction with the USFS, will determine the final wetland buffers during project permitting, in order to meet codes as well as meet the USFS Aquatic Conservation Strategy objectives. The County determines the buffer requirements for each wetland on a case-by-case basis.

Most project area wetlands have relatively undisturbed buffers, since these buffer areas are part of undeveloped state or federal land. These buffers primarily provide habitat for birds, amphibians and mammals, as well as protecting water quality.

Wetland buffers immediately adjacent to the highway are disturbed. Here, the area that would normally be wetland buffer is occupied by the highway or an un-vegetated shoulder.

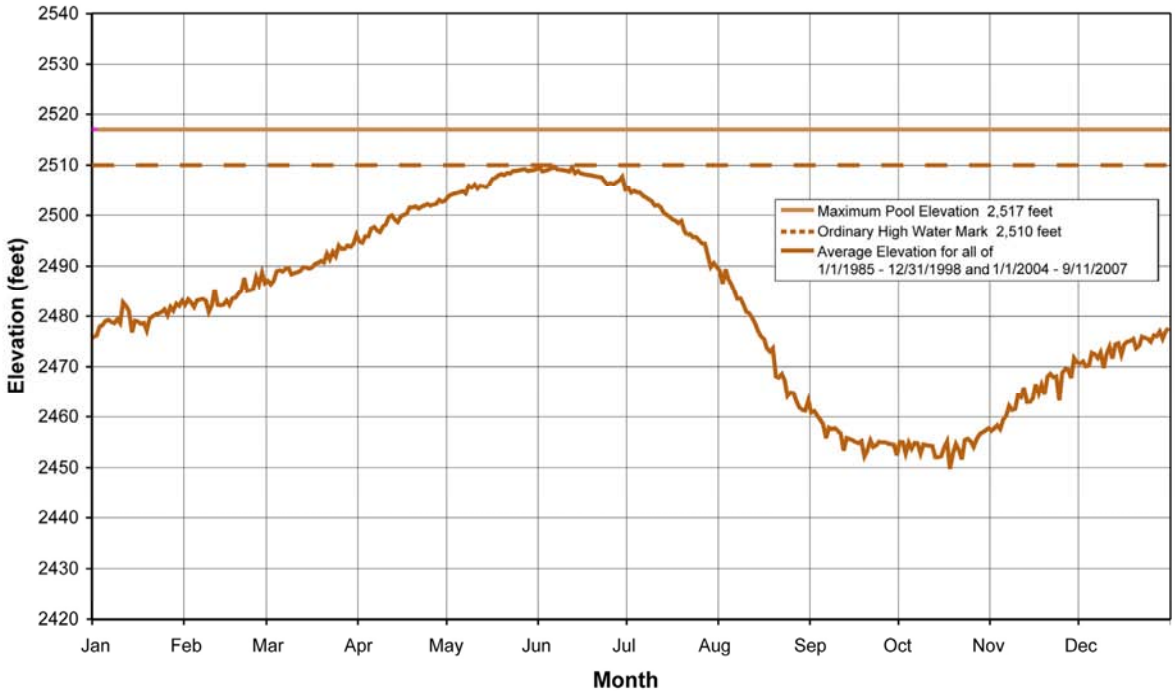
Other Jurisdictional Waters

Reservoirs. The USBR operates three reservoirs within the project vicinity: Keechelus Lake, Kachess Lake, and Lake Easton. Two of the reservoirs, Keechelus Lake and Lake Easton, are located within the project area. The third reservoir, Kachess Lake, is just outside of the project area to the east. The water levels in Keechelus Lake vary seasonally depending on factors such as snowmelt and irrigation needs. The lake has a maximum pool of 2,517 feet above sea level. Average high water elevation reaches approximately 2,510 feet, and WSDOT considers this elevation to be the OHWM of the lake (see Appendix K). Exhibit 3-13 shows average lake elevation and typical annual fluctuations.

Ponds. WSDOT identified and delineated three ponds within the project area. All are located at Crystal Springs Sno-Park. These ponds are abandoned gravel pits with very steep banks that were excavated in upland areas. All three ponds appear to be hydrologically isolated. Soils are extremely gravelly and lack hydric indicators, or are too deeply ponded for soil investigation. Two of the ponds contain standing water for most of the spring and summer. They are almost entirely devoid of vegetation, except for willows at the OHWM. The third pond dries up by June and contains scattered herbaceous vegetation at the bottom.

Abandoned gravel pit located at Crystal Springs Sno-Park.

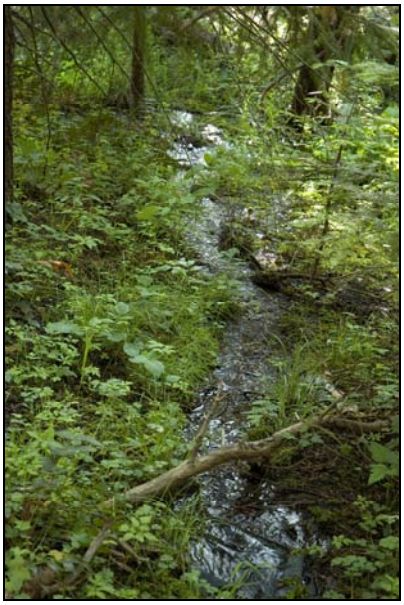
Exhibit 3-13
Average Keechelus Lake High Water Elevation from 1985 through 2007



Note: Data from 1999 through 2003 was removed from the data set because during this period lake levels were held artificially low due to the Keechelus Dam Safety of Dams Project

Streams. WSDOT identified approximately numerous small unnamed streams within the project area. Eight are located between Hyak and Keechelus Dam, drain into Keechelus Lake, and eventually flow into the Yakima River. The remaining streams are located between Keechelus Dam and Easton. The majority of these streams are tributaries to the Yakima River; however, a few flow subsurface and their connection to the river is not known.

WSDOT has completed a comprehensive stream inventory for Phase 1 of the project and does not expect to encounter additional streams in this area. However, WSDOT does expect to encounter additional small streams in the remainder of the project area. Inventoried project area streams are listed in Appendix K.



The project area contains approximately 42 streams. (Shown: Unnamed Creek [MP 65.0])

Potentially Jurisdictional Ditches. Under certain circumstances, drainage ditches can be jurisdictional waters. WSDOT inventoried potentially jurisdictional ditches for Phase 1 of the project. Within this area, WSDOT found 31 potentially jurisdictional ditch segments. These ditches are mostly parallel to the westbound lanes of I-90, on the upgradient (north) side of the highway. A few potentially jurisdictional ditches are located in the median.

WSDOT surveyed potential jurisdictional ditches for the first phase of the project.

Potentially jurisdictional ditches are likely to exist in the remainder of the project area. WSDOT will survey these areas prior to permitting for further phases of the project.

What are the expected environmental consequences?

While any of the build alternatives would have some adverse impacts on jurisdictional waters, FHWA and WSDOT anticipate that overall effects would be highly positive.

What beneficial effects would result?

No-Build Alternative

The No-Build Alternative would not result in direct or indirect beneficial effects to wetlands or other jurisdictional waters.

Build Alternatives

Types of Beneficial Effects

WSDOT has designed the project, including all of the build alternatives, to have substantial benefits to wetlands and other jurisdictional waters. Most of these beneficial effects would be direct effects; however, all of the build alternatives also would create indirect beneficial effects as the removal of barriers gradually allows for the restoration of wetland habitat, more natural stream movement, and more natural passage of groundwater.

Restored Habitat. The project has been designed to restore riparian habitat at each stream crossing. The area under the larger bridges and culverts would be planted with native vegetation and augmented with habitat elements such as natural substrates, logs, and root wads.

The largest beneficial impact would be at Gold Creek, where 8.45 acres of wetland, stream channel, and riparian zone would be restored under the Preferred Alternative. Smaller but similar improvements would be made at other stream crossings.

Habitat restoration opportunities at the Price/Noble Creek CEA include animal crossings, land restoration, hydrologic connectivity zones, and improved stream channel migration.

Connected Wetlands and Riparian Areas. WSDOT designed bridges and culverts to connect habitat that is currently separated by the highway. This would enhance the functions of the existing habitat and allow for species movement between currently-separated habitats.

Improved Channel Migration. In areas where longer bridges would be installed, WSDOT would remove road fill and restore stream channel, floodplain, wetland and riparian habitat underneath and adjacent to the bridges. This would allow for more normal stream functions, including increased stream meander and the formation of additional aquatic habitat.

Enhanced Groundwater Flow. The project would include hydrologic connectivity improvements at the HCZs, reestablishing a more natural flow of groundwater under the highway. These improvements would improve water quality, hydrologic function, and habitat.

Improved Water Quality. The existing highway has no facilities for treating stormwater runoff. The project includes stormwater treatment as an element of both construction and operation, and would include treatment for all impervious surfaces, or off-site compensatory treatment for those areas that cannot be treated due to site constraints. Stormwater treatment would minimize the degradation of adjacent wetlands and other aquatic resources.

Alternatives Comparison

Keechelus Lake Alignment Alternatives. The primary difference in beneficial effects between the Keechelus Lake Alignment Alternatives would result from the amount of highway fill that would be removed. In all, Alternative 1 would remove a total of 38 acres of highway fill, Alternative 2 would remove 21 acres, Alternative 3

would remove 13 acres, and Alternative 4 would remove five acres. However, these figures do not accurately indicate the beneficial effect, since most of the highway fill removed along Keechelus Lake would be on steep slopes that would not be conducive to aquatic restoration.

Alternatives 1 and 2 would involve removing highway along portions of the Keechelus Lake shoreline that were bypassed by the tunnels. This could result in some improvement to lakeshore vegetation and habitat. Alternative 2 would have a smaller benefit than Alternative 1, since removal would be limited to the area of Slide Curve. Alternatives 3 and 4 (the Preferred Alternative) would not involve removal of the existing highway, and thus would not result in this beneficial effect. For Alternatives 2, 3 and 4, replacement of the existing culverts at Rocky Run Creek, Wolfe Creek, and Resort Creek would increase hydrologic and habitat connectivity.

CEA Improvement Packages. All of the options considered at the CEAs would improve hydrologic conditions in the vicinity of I-90, which would help to restore wetlands and other aquatic habitat, improve habitat connectivity, and facilitate movement of wildlife across the highway. However, the amount of improvement to wetlands and other jurisdictional waters would be greatest for the Preferred Alternative, which most fully implements the MDT's ecological connectivity recommendations. Under this alternative, WSDOT would remove and restore approximately 19.3 acres of highway fill.

Improvement Package A would provide the second greatest improvement to wetlands and other jurisdictional waters. Bridges would be installed at a larger number of streams than under Improvement Packages B or C. These would improve channel migration and improve water supply to downstream wetlands.

Improvement Package B would provide benefits similar to Improvement Package A; however, there would be less benefit to wetlands, since shorter bridges and smaller culverts would be

installed. There would nevertheless be a major improvement in hydrologic connectivity and wetland habitat.

Improvement Package C would provide the least improvement in connectivity. While there would be substantial improvement over existing hydrologic connectivity and benefits to wetlands, Option C would not meet the MDT's connectivity objectives at all of the CEAs.

What adverse impacts are expected?

No-Build Alternative

The No-Build Alternative would not result in direct permanent impacts to wetlands or other jurisdictional waters. This alternative would result in indirect adverse impacts, including water quality impacts to wetlands and other jurisdictional waters as traffic volumes continue to grow in the absence of treatment for stormwater runoff. The current situation, including artificially constrained channels, habitat separation, and lack of stormwater treatment, would continue.

Build Alternatives

Types of Adverse Impacts

Temporary Impacts

Construction of any of the build alternatives would cause temporary impacts to wetlands and other jurisdictional waters. Temporary impacts generally would be the result of vegetation clearing and ground disturbance during construction. These activities would cause temporary impacts to wetlands, wetland buffers, reservoirs, streams, and potentially jurisdictional ditches. The lead agencies expect that all temporary impacts would be mitigated and limited through the use of appropriate BMPs, including re-vegetation.

WSDOT analyzed temporary impacts for the Preferred Alternative. These figures are presented in the *Wetland/Biology Discipline Report* (Appendix K). These temporary impacts would be similar for all of the build alternatives. WSDOT calculated temporary impacts using the following assumptions:

- A 15-foot buffer around all project fills
- A 30-foot buffer around all proposed structures, including bridges, culverts and retaining walls, which would allow room for construction equipment
- Impacts from proposed haul roads

Exact numbers for temporary impacts will continue to change until the project design is finalized, and will be included in project permitting documents.

Permanent Impacts

WSDOT analyzed the effects of the build alternatives on wetlands, wetland buffers, streams, reservoirs, and potentially jurisdictional ditches. This analysis was based on revised impact footprints for each of the alternatives following the revisions to the project to eliminate the viaduct bridges, replace the snowshed, modify the proposed design speed, and move the alignment to avoid high-quality resources. WSDOT's analysis also was based on the results of updated wetland inventories conducted in 2006 and 2007. Because WSDOT's analysis of permanent impacts is based on this updated information, the impacts reported in this section are different than those presented in the Draft EIS, which were based on the information available at that time.

Most permanent impacts would be direct impacts from wetland fill. Indirect impacts to wetlands could occur in some places where wetlands would be partially filled and the function of the remaining wetland could be compromised because of their smaller size. WSDOT assessed potential indirect impacts for the first phase of construction and determined that such impacts could occur at several

wetlands near Resort Creek and Townsend Creek. These results are presented in Appendix K. Indirect impacts will be offset by the proposed mitigation activities, which would connect the remaining wetland to other wetlands in the vicinity.

No permanent adverse impacts to materials and staging sites or other auxiliary sites are expected. However, WSDOT will conduct further wetland impact analysis as part of permitting for these sites.

Alternatives Comparison

Keechelus Lake Alignment Alternatives

The differences in impacts between the Keechelus Lake Alignment Alternatives result primarily from impacts to the Category I wetlands near Resort Creek, which would be severely affected by the tunnel outlet included in Alternatives 1, 2, and 3.

Exhibit 3-14 shows the anticipated permanent impacts to wetlands, wetland buffers, reservoirs, streams, and potentially jurisdictional ditches in the Keechelus Lake Alignment.

Exhibit 3-14
Permanent Impacts, Keechelus Lake Alignment Alternatives

Category	Alternative 1	Alternative 2	Alternative 3	Alternative 4/ Preferred Alternative
Category I wetlands (acres)	2.00	1.93	1.41	0.00
Category II wetlands (acres)	0.87	0.87	0.87	0.87
Category III wetlands (acres)	0.36	0.36	1.02	0.80
Category III wetlands without hydric soil indicators (acres)	3.89	4.02	4.48	4.48
Category IV wetlands (acres)	0.26	0.46	0.46	0.46
Total wetlands (acres)	**7.38**	**7.64**	**8.24**	**6.61**
Wetland buffers (acres)	3.80	3.72	2.21	0.74
Wetlands buffers for wetlands without hydric soil indicators (acres)	4.34	6.45	6.89	6.89
Reservoirs (acres)	0.94	1.22	4.06	3.80
Streams (acres)	0.19	0.19	0.08	0.07
Potentially jurisdictional ditches (feet)	454.28	1,522.16	1,559.98	2,538.25

The area of permanent impact is between MP 56.6 and MP 59.9.

CEA Improvement Packages

Permanent impacts to wetlands would differ only slightly between the alternatives, depending on the structures that would be built at each CEA.

Exhibit 3-15 shows the anticipated permanent impacts to wetlands, wetland buffers, reservoirs, streams, and potentially jurisdictional ditches for the CEA Improvement Packages.

Exhibit 3-15
Permanent Impacts, CEA Improvement Packages

Wetland Category	Option Package A	Option Package B	Option Package C	Preferred Alternative
Category I wetlands (acres)	0.22	0.32	0.42	0.3
Category II wetlands (acres)	3.28	3.54	3.51	4.39
Category III wetlands (acres)	2.61	3.24	3.31	2.59
Category III wetlands without hydric soil indicators (acres)	1.23	1.23	1.23	1.30
Category IV wetlands (acres)	1.00	1.05	1.05	1.01
Total wetlands (acres)	**8.34**	**9.38**	**9.52**	**9.59**
Wetland buffers (acres)	11.22	12.44	12.82	11.37
Wetlands buffers for wetlands without hydric soil indicators (acres)	2.08	2.08	2.08	2.08
Reservoirs (acres)	2.30	2.34	2.34	2.33
Ponds/Pits (acres)	NA	NA	NA	2.55
Streams (acres)	0.83	0.85	0.91	0.83
Potentially jurisdictional ditches (feet)	1,229.49	1,284.64	1,204.91	1,271.56

The area of permanent impact includes the entire project area, except the area between MP 56.6 and MP 59.9.

How will FHWA and WSDOT mitigate for adverse environmental impacts?

FHWA, WSDOT and their partner agencies have developed a landscape-scale, watershed-based strategy to mitigate for project impacts. Applying this strategy to the project will mitigate localized impacts related to project implementation on a sub-basin scale, address watershed level connectivity objectives, and decrease the impact of I-90 on the larger landscape. The wetland and aquatic

resource mitigation and design strategy developed for this project includes:

- Collecting data necessary for initial design and adaptive management through extensive research and monitoring
- Incorporating connectivity investments and design elements into the project that will reestablish and enhance hydrologic, water quality, and habitat functions and meet ecological connectivity objectives
- Minimizing and avoiding project-related impacts to wetlands and other jurisdictional waters to the extent practicable through design modification, BMPs, and other reasonable measures
- Shifting unavoidable impacts from high- to low-quality wetlands and habitats
- Working with agency and non-governmental partners on habitat conservation acquisitions that provide long-term protection of connectivity investments and design elements
- Preserving high-quality and unique habitats
- Providing thoughtful, focused compensatory mitigation, compatible with the needs identified for the project, and commensurate with the level and degree of impact

Avoidance and Minimization

WSDOT designed the I-90 project to avoid and minimize impacts to wetlands and other jurisdictional waters where ever possible. Through these measures, WSDOT has lowered the overall amount of impacts and shifted impacts from higher-quality to lower-quality wetlands.

Avoidance and minimization has been accomplished by measures such as:

- Using retaining walls rather than fill slopes in order to avoid affecting wetlands and other waters
- Shifting the alignment at specific locations to avoid wetlands and other jurisdictional waters
- Lowering the design speed to use more of the existing right-of-way and decrease the amount of fill
- Eliminating the viaduct bridges to reduce fill to Keechelus Lake from retaining walls and support structures
- Retaining narrow medians in order to minimize areas of new fill despite the need for more snow storage
- Incorporating the MDT design objectives and performance standards wherever applicable and reasonable.

The effects of these avoidance measures have been substantial, as shown in Exhibit 3-16, which shows the change in projected impact to wetlands for the Preferred Alternative between 2004 and 2008.

Exhibit 3-16
Change in Acres of Wetland Impacts by Wetland Category for Entire 15-mile Project from 2004 to 2008 Design

Source	Wetland Category				
	I	II	III	IV	Total
November 2004 Wetland/Biology Discipline Report	2.74	9.64	1.94	0.94	15.26
May 2008 Wetland/Biology Discipline Report	0.3	5.26	9.18	1.46	16.20
Percent Change	-91.3	-54.6	+473.2	+55.3	+6.20

The 2004 report did not include additional wetland areas added during 2007, nor did it contain WSDOT avoidance and minimization measures.

Incremental design changes have shifted wetland impacts from higher-quality Category I and II wetlands to lower-valued Category III and IV wetlands, based on the wetland delineations current before September 2007. The increase in impacts to Category III wetlands is a result of the addition of areas classified as “wetlands without hydric soil indicators” by the USACE in fall 2007.

Best Management Practices

BMPs for wetlands will be designed to meet applicable commitments and performance standards listed in Section 3.3, *Water Resources*, as well as:

- The final Wetland & Aquatic Resources Mitigation Plan
- The project-specific roadside master plan, which will guide re-vegetation adjacent to the highway

Example BMPs that WSDOT could use to comply with these standards include all of those listed in Section 3.3 plus the following:

- Delineating boundaries of expected permanent impacts
- Delineating boundaries of expected temporary impacts, both horizontally and vertically, utilizing recoverable material and allowing full restoration
- Placing high visibility fencing around wetlands and sensitive habitats to avoid inadvertent impacts during construction
- Isolating the work zone with material such as sand bags or silt curtains
- Working during low water periods
- Minimizing clearing and grading
- Implementing an education and outreach program for contractors and construction workers

Compensatory Mitigation

Compensatory mitigation will be needed to offset areas of permanent loss of wetlands. The overall goals of the proposed compensatory mitigation are to:

- Replace wetland functions and area equal to the permanent impacts resulting from building the Preferred Alternative
- Advance landscape-scale, watershed-based ecological connectivity objectives in the project area

These goals provide a framework for selecting mitigation sites and mitigation ratios, as well as for developing target functions at the mitigation sites. The proposed compensatory mitigation will achieve the overall goals by focusing restoration efforts at locations currently affected by the highway. In addition, protecting high-quality, unique wetlands and other habitats from development will preserve wildlife corridors within the project area.

WSDOT has completed a *Conceptual Wetland & Aquatic Resources Mitigation Plan* (Appendix J). This plan is subject to regulatory review and will be finalized as part of the project's Clean Water Act Section 404 permit and other applicable permits. WSDOT commits to implementing the measures contained in the final plan.

Restoration of Wetlands and Other Aquatic Habitats

WSDOT will restore wetland areas, stream channels, and riparian areas at each CEA where new bridges and culverts are installed. Wetlands and riparian areas probably existed prior to the original highway construction at these locations, and the project has been designed to reestablish connections between wetlands and other high quality habitats, as well as restore channel migration and floodplain functions.

Mitigation measures proposed at locations within and adjacent to CEAs include:

- Restoring and creating wetland, stream, and riparian zone area and function
- Restoring connections between wetlands and other important wildlife habitats
- Restoring channel migration and surface and subsurface flow paths
- Restoring connections between streams, floodplains, and riparian zones
- Restoring passage for fish and aquatic organisms at stream crossings

Impacts from these restoration activities would be limited to soil disturbance during construction. Mitigation sites temporarily affected by construction will be restored once construction is complete. Restoration activities may include:

- Restoring pre-construction contours
- Replacing or amending surface soils
- Planting or seeding with native herbaceous and/or woody vegetation

WSDOT will maintain and monitor all planted areas, based on the commitments made in the final Wetland & Aquatic Resources Mitigation Plan, which will be completed by WSDOT as part of project permitting.

Habitat Preservation

Preservation is an important component of reestablishing and maintaining ecological connectivity and will help to protect the project's connectivity investments. Although preservation does not

replace wetland area or function affected by the project, it has the benefit of providing larger mitigation areas, protecting high-quality, high-functioning wetlands that might otherwise be affected adversely by future development, and removing the uncertainty of success associated with creation or restoration projects.

WSDOT is acquiring a 265-acre property for habitat preservation in the Gold Creek Valley. This property contains wetlands, riparian areas, and mature forest, including potential habitat for northern spotted owls, marbled murrelets, and bull trout. This property has potential for high-density development, which would be avoided through this acquisition. WSDOT has committed to preserve this property in perpetuity.

WSDOT is acquiring a 265-acres preservation site in the Gold Creek valley.

Proposed Wetland Mitigation Ratio

Compensatory mitigation is one component of the cumulative, sequenced mitigation strategy developed for this project. Within the context of the unprecedented investment in landscape-scale habitat and hydrologic connectivity incorporated into this project, WSDOT is proposing a minimum wetland replacement ratio of 1:1 for required compensatory wetland mitigation. Stream and riparian zone restoration will contribute additional area and function, which is not accounted for in this ratio.

WSDOT will compensate for unavoidable impacts to wetland area and function at a minimum 1:1 mitigation ratio, in accordance with Federal Executive Order 11990, Governor's Executive Order 89-10 (Protection of Wetlands: "No Net Loss") and WSDOT Directive 31-12 (Protection of Wetlands Action Plan). A Clean Water Act Section 404 permit will be obtained. The number of traditional compensatory mitigation sites in the project area is limited due to both public ownership of the majority of the surrounding land and to geography. However, within the unique context of the project, opportunities to improve wetland and stream function abound. The connectivity investments within CEAs and HCZs will improve water quality, hydrologic function, and habitat by reestablishing connections through the barrier created by I-90. Removing highway fill and incorporating natural substrates and habitat elements into the

design of connectivity structures also will increase the area of wetlands, riparian zones, stream channels, and floodplains.

In addition to the enhancements to wetland area and function designed into the project, WSDOT has identified several areas where restoring degraded wetlands and preserving unique, high-quality habitat will promote ecological connectivity objectives in the project area. The *Conceptual Wetland & Aquatic Resources Mitigation Plan* (Appendix J) identifies potential wetland restoration and preservation sites and describes proposed activities at each site.

Proposed Wetland Mitigation Sites

WSDOT has performed an extensive ongoing wetland mitigation site assessment in the project area. As a result of the work completed to date, six preferred or acceptable wetland mitigation sites have been identified for Phase 1. These sites would provide wetland restoration, wetland and upland habitat preservation, and enhanced wildlife connectivity.

WSDOT has conducted a preliminary assessment of the area of restoration. Based on current design information, wetland restoration would total:

- 7.06 acres of Category II riverine/lake fringe scrub-shrub wetlands
- 0.13 acre of Category II riverine emergent and forested wetlands
- 3.75 acres of Category II slope emergent and forested wetlands

At this time, two preferred wetland mitigation sites have been selected for the remaining project area. These are the Bonnie Creek and Swamp Creek sites. These sites would provide restoration of riverine and depressional wetlands with emergent, scrub-shrub, and forested classes. Additional wetland mitigation is expected to be available at Swamp Creek and/or Unnamed Creek (MP 67.1). WSDOT will continue to work with resource agencies to identify additional wetland mitigation area for the remaining project area.

Further details on all of these potential mitigation sites can be found in Chapter 4 of the *Conceptual Wetlands & Aquatic Resources Mitigation Plan* (Appendix J).

Proposed Stream Mitigation Sites

Stream mitigation proposed for Phase 1 includes stream channel, riparian zone, and/or hydrologic connectivity restoration at Gold Creek, Rocky Run Creek, Wolfe Creek, Unnamed Creek (MP 57.3), Resort Creek, Unnamed Creek (MP 59.7), Townsend Creek and Unnamed Creek (MP 60.9). Total riparian zone restoration for this phase would be 4.11 acres.

Stream mitigation proposed for the remaining project area includes stream channel, riparian zone, and/or hydrologic connectivity restoration at Price Creek, Noble Creek, Bonnie Creek, Swamp Creek, Unnamed Creek (MP 63.7), Toll Creek, Cedar Creek, Unnamed Creek (MP 65.1), Telephone Creek, Hudson Creek Unnamed Creek (MP 67.1), and Unnamed Creek (MP 67.2). Total riparian zone restoration for the remaining project area would be 7.2 acres.

Further details on all of these potential stream mitigation sites can be found in Chapter 4 of the *Conceptual Wetlands & Aquatic Resources Mitigation Plan* (Appendix J).

Highway Reclamation

As phases of the project are completed, WSDOT will perform extensive restoration activities that include areas of additional forested habitat, highway reclamation, buffer improvements, and highway slope vegetation with native species.

3.5 Fish, Aquatic Species, and Habitats

The I-90 project area is entirely within the Upper Yakima River Basin. (Shown: Yakima River near Crystal Springs Campground)

This section discusses the expected environmental impacts of the project alternatives to fish and aquatic habitat, with additional information on fish species listed under the ESA and other statutes. The study area for fish, aquatic species, and habitats consists of streams, lakes, and ponds within or downstream of the project area. Associated wetlands are discussed in Section 3.4, *Wetlands and Other Jurisdictional Waters*. Further information can be found in the *Aquatic Species Discipline Report* (WSDOT 2002f) and its supplement (WSDOT 2005b).

What new information has been developed since the Draft EIS?

Since publishing the Draft EIS, the MDT completed their report and recommendations regarding the Preferred Alternative (Appendix D). WSDOT completed a *Biological Assessment* (Appendix M) that provides updated information on the presence of ESA-listed species. The USFS completed a *Biological Evaluation* that describes potential effects on sensitive species and their habitat. The *Biological Evaluation* appears as an appendix to the *Biological Assessment* (Appendix M). Comments from the public and reviewing agencies have been incorporated into this section.

What are the major characteristics of the affected environment?

The study area comprises streams, lakes, ponds, and wetlands along the 15-mile I-90 corridor. Exhibit 3-17 lists the primary water bodies in the project area. Each of these water bodies has associated wetlands and riparian areas that provide components of fish habitat. In addition, the project area contains numerous small unnamed streams. Additional information on project area streams and their associated habitat can be found in Section 3.5 of the Draft EIS, the *Wetland/Biology Discipline Report* (Appendix K), and the

Conceptual Wetland & Aquatic Resources Mitigation Plan (Appendix J).

Exhibit 3-17
Primary Water Bodies in the Project Area

Creeks	Creeks (continued)	Lakes	Rivers
Coal Creek	Unnamed Creek (MP 64.5)	Keechelus Lake	Yakima River
Gold Creek	Cedar Creek	Lake Easton	Yakima River Side Channel
Rocky Run Creek	Unnamed Creek (MP 65.0)	Kachess Lake	Kachess River (below Kachess Dam)
Wolfe Creek	Unnamed Creek (MP 65.1)	Swamp Lake	
Unnamed Creek (MP 57.3)	Unnamed Creek (MP 65.2)		
Resort Creek	Unnamed Creek (MP 65.4)		
Unnamed Creek (MP 59.7)	Telephone Creek		
Townsend Creek	Unnamed Creek (MP 65.6)		
Unnamed Creek (MP 60.9)	Unnamed Creek (MP 66.1)		
Unnamed Creek (MP 61.0A)	Unnamed Creek (MP 66.3)		
Unnamed Creek (MP 61.0B)	Unnamed Creek (MP 66.4)		
Price Creek	Hudson Creek		
Noble Creek	Unnamed Creek (MP 66.8)		
Unnamed Creek (MP 62.2)	Unnamed Creek (MP 66.9)		
Bonnie Creek	Unnamed Creek (MP 67.0)		
Unnamed Creek at Crystal Springs	Unnamed Creek (MP 67.1)		
Swamp Creek	Unnamed Creek (MP 67.2)		
Unnamed Creek (MP 63.7)	Unnamed Creek (MP 67.3)		
Toll Creek	Unnamed Creek (MP 67.4)		

Aquatic Habitat

Several measures show that the overall health of the aquatic environment in the project area is good. As described in Section 3.3, *Water Resources*, water quality is high throughout the study area, with only local and occasional deviations from state standards. These deviations do not appear to be related to the highway.

Amphibians

Amphibians are another measure of the health of the aquatic environment. Amphibians are relatively sedentary and have semi-permeable skin, which makes them more sensitive to contamination and degradation than many other species. Wetlands and streams within approximately 0.5 mile of I-90 were assessed for amphibian habitat. These surveys showed that the highway separates amphibian habitat in at least two locations:

Amphibians are an important indicator of the health of the aquatic environment. (Shown: Rough-Skinned Newt)

- I-90 separates habitat areas that occur on both sides of the highway from the beginning of the project area to Wolfe Creek
- I-90 separates the wetland complexes along the Yakima River floodplain from the Swamp Creek drainage

These surveys showed that amphibian habitat is present within the project area and that in some cases it is fragmented by the highway. Additional information on amphibian habitat in the project area is presented in Section 3.5 of the Draft EIS and in the *Aquatic Species Discipline Report* (WSDOT 2002f).

Habitat for Western toad, Cascade frog, Pacific tree frog, long-toed salamander, northwestern salamander, rough-skinned newt, Pacific giant salamander, and tailed frog were found in the project area (Exhibit 3-18). With the exception of the long-toed salamander, all of these species were observed in the field.

Shown: Pacific Giant Salamander

None of these species are listed as threatened or endangered under the ESA, nor does the USFWS consider them to be species of concern. (The Draft EIS incorrectly stated that the Cascade frog and Columbia spotted frog were listed as species of concern.) Three species are candidate or monitor species for the Washington Department of Fish and Wildlife (WDFW). Refer to Section 3.5 of the Draft EIS for descriptions of available habitat and species distribution by project area segment.

Exhibit 3-18
Amphibian Species Status

Amphibian	Habitat	USFWS/USFS Status	WDFW Status
Western toad	Marshes, pond or stream margins/forested uplands	None	Candidate
Cascade frog	Marshes, pond or stream margins/forested uplands	None	Monitor
Pacific tree frog	Marshes, pond or stream margins/forested uplands	None	None
Long-toed salamander[1]	Marshes, pond or stream margins/forested uplands	None	None
Northwestern salamander	Marshes, pond or stream margins/forested uplands	None	None
Rough-skinned newt	Marshes, pond or stream margins/forested uplands	None	None
Pacific giant salamander	Cool, forested streams	None	None
Tailed frog	Cool, forested streams	None	Monitor

1. Habitat found in study area although species not directly observed
USFS – US Forest Service
USFWS – US Fish and Wildlife Service
WDFW – Washington Department of Fish and Wildlife

Fish Species

How have project area dams affected fish populations?

Anadromous salmon, steelhead, and over 30 resident fish species inhabit the Yakima River system. The *Aquatic Species Discipline Report* (WSDOT 2002f) presents detailed life history information on some of the important fish species in the project area.

Salmon and steelhead populations in the Upper Yakima system are much smaller than their historic numbers, partially as a result of dams on the Yakima and Columbia Rivers that block or reduce passage or alter flow regimes. In the project area, the presence of Keechelus Dam has resulted in isolated populations of bull trout and redband trout that live in Keechelus Lake (above the dam) and spawn in Gold Creek, but cannot migrate to the Yakima River below the dam.

Flow regime refers to a river basin's flow magnitude and duration given a particular precipitation event (amount and intensity) and also the frequency of the events.

How has I-90 affected fish passage?

Culverts in the project area can create barriers to fish passage. (Shown: "perched" culvert at Resort Creek)

The highway affects fish populations primarily through culverts that either block or limit fish passage at streams within the project area, including cutthroat trout populations that cannot move from the Yakima River or Keechelus Lake to their tributary streams. The upstream dewatering of Gold Creek also is a barrier to fish passage. Culverts block fish passage in a variety of ways, including shallow water depths, high water velocities, or "perched" culverts, where erosion creates a drop from the end of the culvert that blocks returning fish. The highway can increase these effects by confining the stream and thus leading to higher water velocities and increased erosion.

Exhibit 3-19 shows the known fish barriers in the project area. The remaining stream crossings will be evaluated for their fish barrier effect, and solutions will be developed during the design of the appropriate phase of the project.

Exhibit 3-19
Known Fish Passage Barriers in the Project Area

Water Body	Barriers
Gold Creek	Channel confinement, lack of riparian vegetation, upstream dewatering
Rocky Run Creek	Culverts that constrict flow and increase velocity
Wolfe Creek	Culvert barrier that constricts flow
Resort Creek	Culvert barrier except at Keechelus Lake high pool
Townsend Creek	Culvert barrier; possible barrier at the old US Highway 10 roadbed
Price Creek	Culvert barrier (10-foot box culvert)
Noble Creek	Culvert barrier
Bonnie Creek	Culvert barrier
Swamp Creek	No barrier
Toll Creek	Culvert barrier
Cedar Creek	Culvert barrier
Telephone Creek	Culvert barrier
Hudson Creek	Non-fish bearing

Source: Biological Assessment (Appendix M)

Which fish species have special status?

Distinct Population Segment: a vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species.

Several species and distinct population segments of fish found in the project area are listed under the ESA, or are special status species by the USFWS, USFS, or WDFW. Exhibit 3-20 shows listed species or species of concern.

Exhibit 3-20
Fish Species Status

Fish	WDFW Status	USFS Status	ESA Status
Bull trout – Columbia River Distinct Population Segment	Candidate	Sensitive	Threatened
Steelhead trout – Middle Columbia River Distinct Population Segment	Candidate	Sensitive	Threatened
Westslope cutthroat trout	None	Sensitive	Species of concern
Pacific lamprey	None	Sensitive	Species of concern
River lamprey	Candidate	Sensitive	Species of concern
Pygmy whitefish	Sensitive	Sensitive	Species of concern
Umatilla Dace	Sensitive	Not listed	Not listed
Redband trout	Unknown	Sensitive	Species of concern

ESA – Endangered Species Act
USFS – US Forest Service
WDFW – Washington Department of Fish and Wildlife

Survey data have documented the presence of bull trout, westslope cutthroat trout, and pygmy whitefish in the study area. Survey results for these species are given below. Pacific lamprey, river lamprey and steelhead trout are present in the Yakima River watershed below the Lake Easton dam. However, there is no evidence to indicate that adults of these species can bypass the dam, although Lake Easton dam may provide passage for juvenile steelhead trout.

Bull Trout - Columbia River Distinct Population Segment

Two isolated bull trout stocks occur in the project area: 1) the Keechelus Lake stock, and 2) the Yakima River stock occurring in Lake Easton and the mainstem of the Yakima River.

Two populations of bull trout live in the project area.

Keechelus Lake Stock. Construction of the Keechelus Dam between 1913 and 1917 isolated the Keechelus Lake stock.

Currently, the only known population in Keechelus Lake spawns in Gold Creek, and surveys for this project detected bull trout only in Gold Creek. However, bull trout are likely present in Coal Creek, and there is anecdotal evidence of their presence at Rocky Run Creek. The Keechelus Lake stock is considered critical, primarily because of its chronically low numbers and isolation from other stocks. Refer to the *Biological Assessment* (Appendix M) for more details.

Yakima River Stock. WDFW recognizes the Yakima River bull trout as a distinct stock. These bull trout are assumed to inhabit the mainstem and spawn in tributaries. Yakima River bull trout are listed as threatened under the ESA because of chronically low numbers of fish encountered in reference areas. The USBR has concluded that the principle limiting factor for bull trout populations in the Yakima Basin is the lack of spawning and juvenile rearing habitat. Other limiting factors include brook trout hybridization and competition, decline in juvenile salmon as a prey base, an extremely altered river flow regime to deliver irrigation water, and limited access to spawning areas in creeks because of barriers to fish passage.

Steelhead Trout - Middle Columbia River Distinct Population Segment

Before the Easton Diversion dam was constructed, Middle Columbia River steelhead had access to most of the upper Yakima watershed reaches, including Keechelus Lake. Good quality spawning and rearing habitat is located between the Keechelus and Easton Dams, but returning numbers to the upper Yakima River are small. The fish ladder at Easton Dam provides passage for juvenile Middle Columbia River steelhead under certain flow regimes. All Yakima River steelhead are summer-run steelhead.

Summer-run steelhead enter freshwater in a sexually immature condition between May and October and require several months to mature and spawn.

Westslope Cutthroat Trout

Cutthroat trout are distributed throughout the project area, and high numbers were found in Coal, Gold, Rocky Run, Resort, Bonnie, and Hudson Creeks (WSDOT 2002f). Several of these populations cannot move between the lakes, rivers, and tributary streams because

culverts along I-90 block access to Keechelus Lake and the Yakima River. Isolation and the presence of brook trout threaten the persistence of cutthroat trout above Keechelus Dam.

Pygmy Whitefish

Pygmy whitefish most commonly occur in large, deep, unproductive (low nutrient) lakes. Pygmy whitefish are found in both Keechelus Lake and Kachess Lake (WDFW 1998).

Pacific Lamprey and River Lamprey

Both of these species are present within the Yakima River watershed below Lake Easton Dam, and their presence is suspected in Keechelus Lake. There is a high probability that suitable habitat exists within the project area.

Critical Habitat

Under the ESA, the USFWS or NOAA Fisheries may designate critical habitat for a listed species. Critical habitat is a specific geographic area(s) that contains features essential for the conservation of a threatened or endangered species. Critical habitat may include an area that is not currently occupied by the species but that would be needed for its recovery.

For Columbia River bull trout, the USFWS has designated a 0.5-mile reach of Gold Creek beginning about 0.25 river mile above the I-90 bridges as critical habitat, along with portions of the Yakima and Kachess Rivers. The USFWS did not designate any federal lands as critical habitat.

For Middle Columbia River steelhead, NOAA Fisheries has designated the mainstem of the Yakima River downstream from Keechelus Dam and the Kachess River as critical habitat, including the portion within the project area.

What are the expected environmental consequences?

What beneficial effects would result?

No-Build Alternative

The No-Build Alternative would not result in any beneficial effects to fish, aquatic species, or aquatic habitat.

Build Alternatives

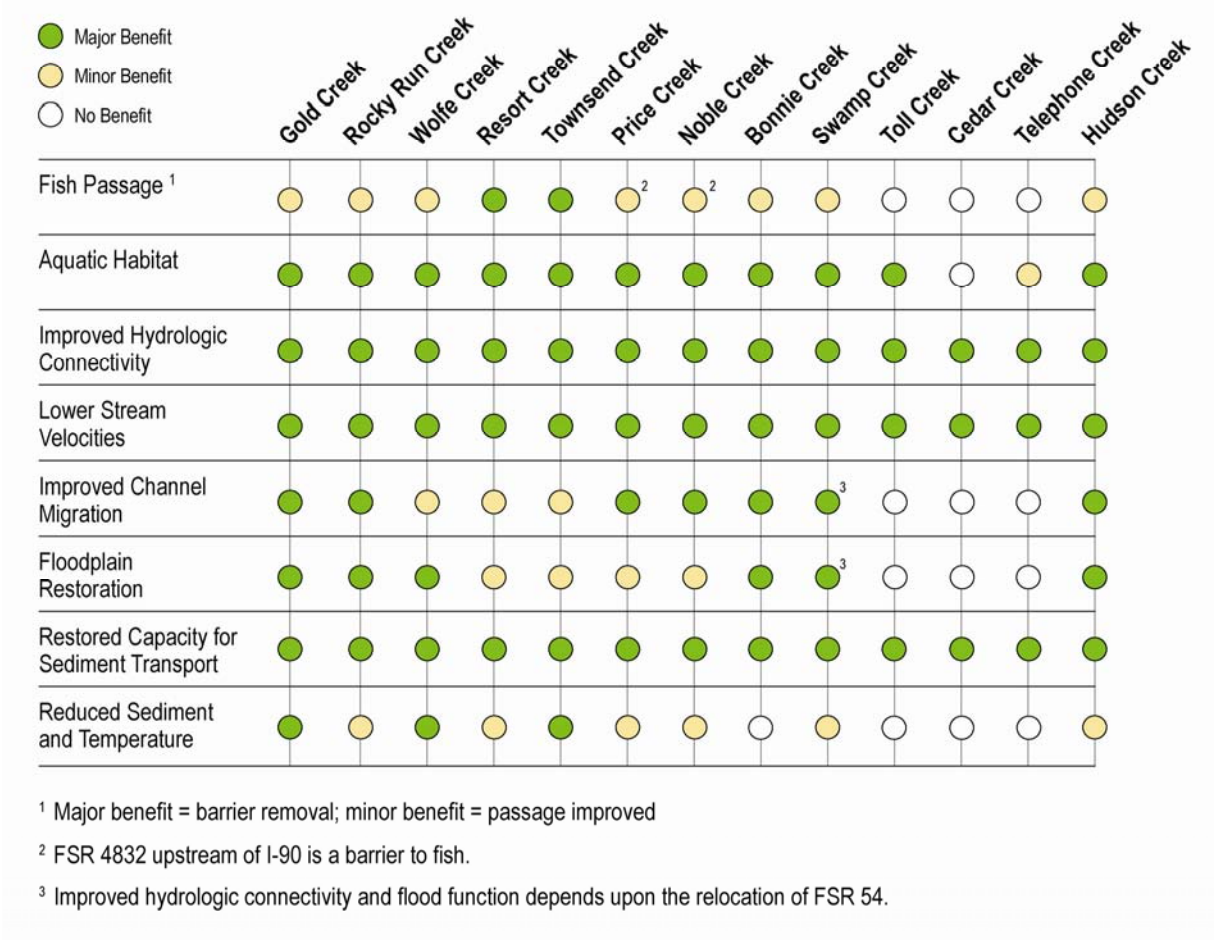
While all of the build alternatives would have some negative impacts on aquatic habitat and species, FHWA and WSDOT anticipate that overall effects of any of the build alternatives would be highly positive.

Exhibit 3-21 summarizes the beneficial effects at each major water body for the Preferred Alternative. Beneficial effects would be similar but less effective for the other build alternatives, since the Preferred Alternative was designed to maximize the benefit at each CEA.

Improved Fish Passage. Few culverts in the project area allow fish passage. In some cases, the original culvert design did not allow fish passage. In other cases, the culvert created increased water velocities leading to erosion at the downstream end of the culvert, which eventually created a barrier to fish passage.

WSDOT would design the proposed bridges and culverts for fish bearing streams to meet WDFW stream simulation criteria for fish passage. These structures would open up currently inaccessible habitat areas and improve connection to the designated critical habitat for bull trout and steelhead. These improvements would benefit resident fish populations, and as fish passage is improved throughout the Yakima River basin, returning populations would be able to re-colonize a larger amount of stream habitat for spawning.

Exhibit 3-21
Beneficial Impacts for Keechelus Lake Alignment and Improvement Packages Area



Information derived from the most current WSDOT design plans and the MDT Recommendation Package (Appendix D).

Connected Habitat. WSDOT has designed bridges and culverts to connect habitat that is currently separated by the highway. Culverts would have a bottomless clearspan design using natural substrate materials. Using longer bridges and natural substrates in the culverts, along with restoring riparian vegetation along restored stream channels, should connect habitats for fish and other aquatic species.

Increasing Aquatic Habitat. In areas where longer bridges would be installed, WSDOT will remove road fill and restore stream channels, floodplains, and riparian habitat underneath and adjacent to the bridges. Restoring floodplains for streams that currently have

artificially confined movement should lead to increased stream meander and the formation of additional aquatic habitat.

Restoring In-Stream Physical Processes. WSDOT has designed bridges and culverts to improve passage of channel sediment and large woody debris.

Improving Water Quality. Under existing conditions, no designed stormwater treatment is provided for runoff from impervious surfaces in the project area. The combination of proposed stormwater treatment measures described in Section 3.3, *Water Resources*, along with avoidance, minimization, and BMPs, would contribute to improved water quality and to the health of fish and fish habitat.

Improving Groundwater Flow. Designing and installing additional culverts at the HCZs would help restore surface and shallow subsurface water flows under the highway. This water is currently channeled along the side of the highway into streams and culverts, and contributes to higher flow volumes, velocities, and channel instability.

What adverse impacts are expected?

No-Build Alternative

The No-Build Alternative would not result in any direct adverse impacts. This alternative would result in indirect adverse impacts, including water quality impacts as traffic volumes continue to grow in the absence of treatment for stormwater runoff.

Build Alternatives

Temporary Impacts

Constructing any of the build alternatives would create temporary impacts to fish habitat because of impacts to wetlands and other jurisdictional waters, including streams, reservoirs, and jurisdictional ditches. Temporary impacts would be similar for all of the build alternatives, all of which would widen the highway to three lanes in each direction. All would include constructing improvements at

each of the CEAs. The primary differences between the build alternatives would be the area of disturbance of stream habitat for each of the improvements proposed.

FHWA and WSDOT have concluded that applying appropriate construction BMPs and restoration activities would successfully mitigate for all temporary impacts, regardless of which build alternative was chosen. WSDOT has completed a detailed assessment of temporary impacts to wetlands, wetland buffers, reservoirs, streams, and potentially jurisdictional ditches for the Preferred Alternative. The assessment is presented in the *Wetland/Biology Discipline Report* (Appendix K) and in the *Conceptual Wetland & Aquatic Resources Mitigation Plan* (Appendix J).

Excavation and Grading. Excavation and grading may increase sediment delivery to water bodies. Removing portions of the existing highway would generate fine concrete dust and slurry, which may run off to surface water. High levels of sediment can cause direct injury, increase avoidance behavior, and reduce feeding success for aquatic species, as well as affect the survival of eggs and newly hatched fish.

Removing Riparian Vegetation. Removing riparian vegetation would be necessary where bridges, culverts and the snowshed are replaced. Removing riparian vegetation can cause direct mortality to amphibians and small mammals, and may disrupt the movement of species, increase vulnerability to predation, increase water temperatures, and cause erosion and sedimentation. Most impacts from removing vegetation would be temporary, since WSDOT would require its contractors to minimize vegetation clearing to the extent possible and implement an approved revegetation plan.

Removal of existing culverts would have long-term benefits, but would require BMPs to prevent short-term construction impacts.

Removing and Replacing Culverts and Bridges. While the overall impacts of replacing culverts and bridges would be positive, removal and construction have the potential to cause erosion, increases in turbidity, and sedimentation.

In-Water Work. In-water work includes constructing footings, piers, and retaining walls, and in some cases removing culverts. In-water work has the potential to temporarily increase turbidity.

Concrete Curing. Uncured concrete has the potential to cause elevated pH in water.

Blasting and Pile Driving. Fish may be disturbed by the sound of or physical shock from blasting or pile driving. The potential effect is reduced with distance from streams and with reduced blasting charge size. Blasting in the vicinity of Keechelus Lake would occur on the slopes north of I-90, which are substantially higher in elevation than the shoreline, far enough from the lake that there would be no impacts to fish. Some pile driving would be necessary but would be very limited in duration and frequency. WSDOT does not propose any blasting or pile driving in the vicinity of the Yakima or Kachess Rivers or their tributaries.

Equipment Maintenance and Fueling. Heavy equipment and vehicles used during construction present the potential for spills during fueling and maintenance.

Construction Timing and Duration. The potential for water quality effects are greater during rainy periods, which increase potential runoff from the site.

Permanent Impacts

WSDOT analyzed the potential adverse permanent impact of the build alternatives on wetlands, wetland buffers, streams, reservoirs, and potentially jurisdictional ditches, all of which contribute to fish habitat. The results of this analysis are presented in Section 3.4, *Wetlands and Other Jurisdictional Waters,* since these impacts represent the permanent impacts to fish and aquatic habitat as well.

WSDOT based this analysis on impact footprints for each of the build alternatives that included revisions to the project to eliminate the viaduct bridges, replace the snowshed, modify the proposed design speed, and move the alignment to avoid high-quality

resources. WSDOT's analysis also was based on the results of updated wetland inventories conducted in 2006 and 2007. Consequently, the impacts described in this section are somewhat different than those presented in the Draft EIS, which were based on the information available at that time.

Under the ESA, FHWA is required to analyze the potential impacts of the identified Preferred Alternative to listed species. These potential impacts are presented in the *Biological Assessment* (Appendix M). As shown in Exhibit 3-22, the *Biological Assessment* concluded that the Preferred Alternative is likely to adversely affect one listed species, Columbia River bull trout. FHWA therefore requested formal USFWS consultation for this species. Based on this consultation, FHWA and WSDOT believe that the project would not have a substantial adverse impact to this species.

Because Middle Columbia River Steelhead are present and the *Biological Assessment* (Appendix M) concluded that that project is unlikely to adversely affect this species, FHWA and WSDOT have completed informal consultation with NOAA Fisheries for Middle-Columbia River Steelhead, and received a letter of concurrence dated April 7, 2008 (NOAA Fisheries 2008).

Exhibit 3-22
Effects Determination – ESA-Listed Fish Species

Threatened Species in Project Area	Species	Critical Habitat
Columbia River Bull Trout	LAA	NLAA
Middle Columbia River Steelhead	NLAA	NLAA

LAA = May Affect and is Likely to Adversely Affect
NLAA = May Affect but Not Likely to Adversely Affect

For sensitive species that are not listed under ESA, the USFS prepared a *Biological Evaluation* (Appendix M). This document concluded that while the Preferred Alternative may impact individuals or habitat, it is unlikely to contribute to a trend toward federal listing or loss of viability to the population or any of these species.

While these impact determinations are based on the Preferred Alternative, FHWA and WSDOT believe that impacts would be similar for any of the build alternatives.

How will FHWA and WSDOT mitigate for adverse environmental impacts?

Avoidance and Minimization

WSDOT has designed the project to avoid and minimize impacts to fish and aquatic habitat wherever possible. The new highway alignment for all of the build alternatives has been designed to avoid aquatic habitat, including streams and associated wetlands, as much as possible. These measures have resulted in a reduction in overall wetland impacts, and in shifting those impacts from higher-value to lower-value wetlands. Section 3.3, *Wetlands and Other Jurisdictional Waters*, describes the results of this avoidance and minimization effort.

WSDOT also incorporated the MDT design objectives and performance standards into the design of the project wherever applicable and reasonable.

Best Management Practices

BMPs for fish and aquatic habitat and species will be designed to meet applicable commitments and performance standards listed in Section 3.3, *Water Resources*, as well as:

- The *Design of Road Culverts for Fish Passage* manual (WDFW 2003)

- WSDOT's *Fish Exclusion Protocols and Standards* (WSDOT 2006c), which requires isolating the work area during construction and conducting fish removal and release of fish only by qualified biologists

- The Washington State Hydraulic Code (WAC 220-110), which governs culvert and bridge removal and replacement

- Applicable measures specified in the USFWS Biological Opinion

- Applicable conservation measures included in the NOAA Fisheries' ESA Consultation Concurrence Letter (NOAA Fisheries 2008)

- WDFW guidelines for stream crossing structures

Example BMPs that WSDOT could use to comply with these standards include all of those listed in Section 3.3, as well as:

- Removing as much of the existing structure as possible during bridge removal before dismantling it to minimize material and debris entering the water

- Any in-water construction would be subject to seasonal restrictions to minimize adverse impacts to fish spawning and larval development

- Removing fish from the work zone prior to construction

Compensatory Mitigation

The lead agencies believe that by combining avoidance, mitigation, and BMPs, the impacts of the project to fish and other aquatic species and their habitats will be minimized. Potential impacts to Columbia River bull trout will be mitigated through compliance with the applicable measures specified in the USFWS Biological Opinion. The project also will implement the conservation measures in the *Biological Assessment* and the *Biological Evaluation* (Appendix M). The remaining impacts will be mitigated through beneficial effects including fish passage restoration, increase in overall habitat, improved in-stream physical processes, and improved water quality. Consequently, no additional compensatory mitigation will be required.

3.6 Terrestrial Species

This section discusses the expected environmental impacts of the project alternatives on terrestrial plant and animal communities. The study area for terrestrial species is approximately one mile on either side of I-90.

More detail on impacts to terrestrial species can be found in the *Terrestrial Species Assessment* (WSDOT 2003c) and its supplemental report (WSDOT 2004a), and in the *Wildlife Habitat Linkage Assessment* (USFS 2000).

WSDOT determined whether species were present or absent within the I-90 corridor based on review of existing scientific literature, databases, or computer-aided modeling of wildlife-habitat associations.

Field surveys conducted for the I-90 project

- Camera and snow tracking surveys for mammals throughout the corridor
- Inventories of fungi, lichen, mosses, liverworts, vascular plants, and mollusks throughout the corridor
- Marbled murrelet surveys in the Gold Creek area
- Amphibian surveys throughout the corridor
- Additional baseline wildlife monitoring beginning in summer 2007
- Testing of potential wildlife fencing designs beginning in summer 2007

What new information has been developed since the Draft EIS?

Since publishing the Draft EIS, WSDOT completed a *Biological Assessment* (Appendix M) that provides updated information on the presence of ESA-listed species. The USFS completed a *Biological Evaluation* that describes potential effects on sensitive species and their habitat. The *Biological Evaluation* appears as an appendix to the *Biological Assessment* (Appendix M).

The *Mitigation Development Team Recommendation Package* (Appendix D) was finalized in July 2006. The MDT recommendations formed the basis of the Preferred Alternative for improvements at the CEAs. WSDOT also completed the *Wildlife Monitoring Plan* (Appendix O).

Comments from the public and reviewing agencies have been incorporated into this section.

What are the major characteristics of the affected environment?

Why is the project corridor important for terrestrial species?

Important wildlife habitat areas

North of I-90:

- Alpine Lakes Wilderness
- North Cascades National Park

South of I-90:

- Goat Rocks Wilderness
- Mt. Rainier National Park

The I-90 project is located in an area recognized as a critical connective link in the north-south movement of species in the Cascade Range (Exhibit 3-23). The importance of the project area for wildlife movement is based on its location between large blocks of federal land that are largely protected from development. See Section 3.11, *Land Use,* for a discussion of land management in the project area.

Connection between these areas of relatively protected lands is limited to an area approximately 25 miles wide. Land to the east and west of the I-90 project area is largely in private ownership, and development is occurring rapidly. These areas of private land have potential value as wildlife corridors, but the cost and other difficulties in acquiring a sufficient amount of land would be high. The project area, with its lower amount of private land, is a more appropriate site for investing public funds.

I-90 bisects the entire width of this wildlife corridor. Along with the three lakes in the project area, the highway is the primary barrier to north-south movement of wildlife. The average daily traffic volume on I-90 for 2007 was approximately 28,000 vehicles per day, which represents a very substantial barrier to the movement of wildlife.

Image of a deer from a mounted wildlife monitoring camera near Snoqualmie Pass.

Wildlife/vehicle collisions in the project corridor affect both wildlife populations and traffic safety. Some data are available for deer and elk mortality from collisions with vehicles. Deer and elk are safety hazards to motorists because they are large mammals. Mortality for smaller mammals, birds, amphibians, or any other terrestrial species has not been studied.

Exhibit 3-23
Habitat Linkage Areas

Through a partnership between WSDOT and USFS, pathways on federally-managed and private lands adjacent to the project were evaluated for their ecological connectivity in relation to I-90.

From 1996 through 2006, WSDOT maintenance personnel collected data on deer and elk mortality in the project area. WSDOT removed 160 deer and elk carcasses during the 10-year period. These numbers underestimate the actual number of animals killed because they only reflect the animals that were picked up and reported by WSDOT maintenance personnel. The numbers do not include animals that were hit and died off the highway or were picked up by others. Most deer are killed during June and July, and most elk are killed in April and October.

Mortality rates were highest at the north end of Keechelus Lake (MP 55 to MP 57), the south end of Keechelus Lake (MP 60 to MP 63), and Easton Hill (MP 67 to MP 69). These locations are the same as the known wildlife corridors in the area and appear to be driven largely by landforms that channel animal movement to particular locations. These landforms include lakes, rivers, rock cuts and other steep grades, and mountains. Wildlife corridors also are influenced by the tendency of some species of wildlife to avoid areas of human development and disturbance. Fencing to prevent wildlife from reaching the highway within the project corridor is sporadic.

Elk killed in collision with vehicle near proposed wildlife overcrossing structure.

Forested habitats dominate the immediate area, with six different forest zones located in or near the project area, each with multiple plant associations. Wetland and riparian communities are interspersed throughout the corridor, especially at stream crossings and along the shore of Keechelus Lake. Refer to Section 3.4, *Wetlands and Other Jurisdictional Waters,* for further discussion.

A checkerboard pattern of private and public land ownership exists along the I-90 project corridor. This pattern of land ownership has resulted in occasionally conflicting land management practices and habitat fragmentation, which is a threat to some species in the project area (Exhibit 3-24). The area is a patchwork of forest types and ages, including relatively recent clear-cuts, single-species even-aged stands, and small areas of old-growth forests.

This fragmented pattern of land ownership has been and continues to be a driving force behind public and private efforts to acquire land for conservation purposes. As described in Section 3.11, *Land Use*, many thousands of acres of private land in the Central Cascades area have been transferred to public ownership since the late 1990s, much of it near the project area.

There are some small patches of mature or old-growth forest within the highway corridor, much of it immediately adjacent to the highway. Other mature forest occurs on steep slopes and along several riparian corridors. Other unique habitats in the vicinity of the project area include talus slopes, cliffs, bluffs, and wetlands.

Wetlands and riparian areas are discussed in Section 3.4, *Wetlands and Other Jurisdictional Waters*.

Exhibit 3-24
Habitat Fragmentation in and Near the I-90 Corridor

The combination of the highway, power lines, and timber harvest creates fragmented habitat.

In addition to its value as a wildlife corridor, a wide variety of wildlife species live in the project area. The rain shadow effect of the Cascade Mountains, along with rapid change in elevation, creates a wide variety of habitats within a relatively small area, and this leads to wide diversity of wildlife species.

What protected species use the project area?

The project area is home to five terrestrial species that are listed as endangered, threatened, or as species of concern under the ESA. These species and their habitat associations are described in detail in the *Biological Assessment* (Appendix M). ESA-listed fish species are discussed in Section 3.5, *Fish, Aquatic Species, and Habitats*.

Gray wolf (Canis lupus). Gray wolves are extremely rare in the project area, and evidence of their presence is very limited. Gray wolves generally avoid areas of human activity, including highways, but their presence in the project area cannot be ruled out.

Gray wolves are not common in the project area but their presence cannot be ruled out. (Photo not from project area)

Grizzly bear (Ursus arctos horribilis). Sightings and other evidence indicate that a limited number of grizzly bears (probably less than 50) use the area north of I-90 in the North Cascades. Because bears from other populations are not expected to contribute substantially to the North Cascades population, maintaining connectivity within the North Cascades is especially important. The immediate project area contains little or no suitable habitat for grizzly bears because of the relatively high level of human activity in the immediate vicinity of the I-90 corridor. However, grizzly bears are a wide-ranging species and may travel through the project corridor.

Canada lynx (Lynx Canadensis). Lynx are considered present, but uncommon or rare in the project area. Lynx habitat occurs outside the project area between Keechelus and Kachess Lakes, in the Alpine Lakes Wilderness and other land north of the project area, and in the vicinity of Manastash Ridge and Rimrock Lake south of the project area.

Northern spotted owl (Strix occidentalis caurina). Northern spotted owls may occur in forests along the project corridor during foraging and dispersal, but nesting is not likely. Northern spotted owl sites have been documented near the project area, though none are closer than about 1.5 miles from I-90. There are no known northern spotted owl nests in the general project vicinity. Suitable habitat for northern spotted owls is likely to be present along the I-90 corridor, but this habitat is likely too fragmented to support nesting. Dispersal habitat (which allows northern spotted owls to move across the landscape to establish new territories) is present, particularly in the vicinity of Gold Creek, Swamp Lake, and Crystal Springs.

Northern spotted owls have been documented near the project area.

Critical habitat for the northern spotted owl has been designated in Kittitas County. The project area is located between three different critical habitat units but does not overlap any these units.

Marbled murrelet (Brachyramphus marmoratus). The marbled murrelet is a small seabird in the auk family. It is unusual because it

nests far inland in old-growth and mature forest. Surveys indicated marbled murrelet presence in the Gold Creek Valley, though outside of the project area.

Federal regulations require the evaluation of Forest Service Sensitive Species, Sensitive and Strategic Species, Landbird Conservation Strategy Focal Species, Forest Service Management Indicator Species, and Federal and State Species of Concern. The USFS evaluated these species, and concluded that the project may impact individuals or habitat, but is unlikely to contribute to a trend toward federal listing or loss of viability for any of these populations or species. More information is available in the project *Biological Evaluation*, which is an appendix to the *Biological Assessment* (Appendix M).

What are the expected environmental consequences?

What beneficial effects would result?

No-Build Alternative

The No-Build Alternative would not result in any beneficial effects to terrestrial species. I-90 would continue to act as a barrier to wildlife movement and would continue to divide wildlife habitat.

Build Alternatives

Including ecological connectivity as part of the project's purpose and need led WSDOT to design the project from the beginning with the aim of making major improvements to wildlife habitat and connectivity. Consequently, while the build alternatives would result in some adverse impacts, the overall effect of the project on terrestrial species would be strongly beneficial.

Improving Ecological Connectivity. The project would make the following investments to improve ecological connectivity:

- Replace existing narrow bridges and culverts at the following stream crossings with longer structures (some streams would have more than one bridge): Gold Creek, Rocky Run Creek,

Resort Creek, Unnamed Creek (MP 60.9), Price Creek, Noble Creek, Bonnie Creek, Swamp Creek, Unnamed Creek (MP 63.7), and Hudson Creek.

- Replace small culverts with wider bottomless culverts, which would be sized to serve as wildlife undercrossings, at the following stream crossings: Wolfe Creek, Townsend Creek, Toll Creek, Cedar Creek, and Telephone Creek.

- Build three wildlife overcrossings, one at the rock knob at the east end of Keechelus Lake near MP 60.8, and two near the Kachess River near MP 68.5 (westbound) and MP 68.7 (eastbound).

- Build bridges at the east end of the Gold Creek valley near MP 55.3, MP 63.2, and MP 67.1, and at Easton Hill near MP 67.7 (westbound) and MP 67.8 (eastbound) to allow wildlife to cross under the highway.

- Install small- and medium-sized culverts (approximately six per mile) to provide passage for smaller and low-mobility species as well as to improve groundwater flow under the highway. The width of the culverts will correspond with the passage size needed by low mobility species to connect with adjacent habitat. WSDOT will add culverts at increased frequency and density in areas where habitat and topography allows; however, areas with engineering constraints will have less frequent and dense culverts. In the later phases of the project, WSDOT will use monitoring data from the first phase of the project, along with inter-agency input, in the design and placement of these culverts.

- Direct animals to the crossing locations using an integrated mix of fencing, topography, and walls.

These improvements have been designed so that benefits at each individual location also would result in benefits at the watershed and landscape scale. This concept of site-specific improvements that will "roll up" to watershed and landscape scale benefits was central to the recommendations made by the MDT for improvements at each CEA.

The likelihood that wildlife would use connectivity structures is high. WSDOT designed these structures with input from recognized experts following proven designs. The openness ratio at each creek crossing would be improved, and the total openness ratio would improve over existing conditions, which would encourage wildlife use. These larger structures would also provide more secure dispersal opportunities for a wider variety of species. WSDOT would use fencing, land forms, and retaining walls to guide wildlife away from the highway and toward the crossing structures.

Openness Ratio is defined as the characteristics of a crossing structure that represents the animal's perception of the passage under the highway.

The proposed connectivity improvements would substantially improve the ability of wildlife to cross the highway. Highly mobile terrestrial species with large home ranges would see the largest benefit, since these populations would likely experience a greater degree of gene flow between populations north and south of I-90. The potential for inbreeding and localized extinctions would be reduced. Low-mobility species with smaller home ranges also would benefit, especially as habitat quality and connection improve over time.

All wildlife species potentially would benefit by gaining access to vacant areas of suitable habitat on opposing sides of the highway. Dispersal of young would be increased and individuals would have greater access to a range of breeding and foraging sites.

Increasing Riparian Habitat. Riparian habitat, in addition to its benefits to aquatic species, is an important source of shelter, foraging habitat, and water for many terrestrial species. WSDOT has designed the project to restore riparian habitat at stream crossings. The area under the larger bridges and culverts would be planted with native vegetation and augmented with habitat elements such as natural substrates, logs, and root wads. These improvements would result in an increase in riparian habitat for the project area as a whole, and would add an important element of habitat connectivity, linking riparian habitat upstream and downstream along the streams where structures would be built. Wetland areas that are currently separated by the highway would be connected.

The largest beneficial impacts would be at Gold Creek and Bonnie Creek. Under the Preferred Alternative, WSDOT would remove roadbed fill and restore approximately 8.45 acres of riparian area, wetlands, and streams at Gold Creek. At Bonnie Creek, WSDOT would restore 3.2 acres of riparian area wetlands and streams. Smaller but similar improvements would be made at other stream crossings.

Decreasing Wildlife Mortality. The lead agencies expect that wildlife crossing structures, along with installing guide fencing, would reduce wildlife mortality and increase traffic safety by reducing wildlife/vehicle collisions. WSDOT would use fencing with vertical retaining walls, natural topographic barriers, boulder fields, and other measures to form a continuous integrated system.

The specific beneficial effects to USFS sensitive species and their habitats are discussed in the *Biological Evaluation* (Appendix M).

What adverse impacts are expected?

No-Build Alternative

The No-Build Alternative would not result in any temporary or permanent direct impacts to terrestrial species or habitat. I-90 would continue to act as a barrier to wildlife movement, and would continue to divide wildlife habitat. An indirect adverse impact of increasing traffic volume would be that the barrier effect of the highway would continue to grow.

Build Alternatives

Temporary Impacts

All of the build alternatives would result in similar temporary impacts to wildlife. Temporary impacts would generally be the result of noise and other disturbance during construction, including noise from blasting and operating machinery. These impacts would occur during the spring, summer, and fall when the project area is free of snow.

Potential construction noise impacts could include:

- Causing wolves, grizzly bears, lynx and/or their prey species to avoid the project area.

- Causing birds, including northern spotted owls, marbled murrelets, and other species of breeding birds to abandon nest sites prematurely. Blasting is especially likely to cause disturbance to birds. Noise can displace owls from foraging and roosting activities. The *Biological Assessment* (Appendix M) analyzed impacts to species listed under the ESA, and the *Biological Evaluation*, which is an appendix to the *Biological Assessment* (Appendix M), analyzed adverse impacts to USFS sensitive species and their habitats.

WSDOT would minimize the effects of construction noise through phased construction, which would allow higher mobility species to move to habitat area not experiencing disturbance.

An additional potential temporary impact would be vegetation clearing for staging and stockpiling areas. To the extent possible, WSDOT has identified potential staging and stockpiling areas, temporary access roads, and material processing areas on previously disturbed lands that are not heavily used by wildlife. Some additional vegetation would be cleared during construction of new highway lanes.

WSDOT calculated temporary impacts using the following assumptions:

- A 15-foot buffer around all project fills

- A 30-foot buffer around all proposed structures, including bridges, culverts and retaining walls, which would allow room for construction equipment.

- Impacts from proposed haul roads

Exact numbers for temporary impacts will continue to change until the project design is finalized, and will be included in project permitting documents. Temporary impacts would last no longer than the construction period and would be successfully mitigated by standard construction BMPs.

Permanent Impacts

FHWA and WSDOT anticipate that all impacts to terrestrial habitat and species would be direct rather than indirect impacts.

Habitat Loss. Permanent impact to terrestrial species would primarily result from the permanent fill to create the new highway lanes. Realigning and widening the highway would result in permanent loss of some habitat, including mature forest, immature forest, and non-forested lands. This may include areas important to wildlife for breeding, shelter, or foraging, and may cause some direct mortality to birds, small mammals, invertebrates, plants, or other terrestrial organisms.

Exhibit 3-25 and Exhibit 3-26 summarize the impacts to habitat for the Keechelus Lake Alignment Alternatives and the CEA Improvement Packages.

Exhibit 3-25
Summary of Habitat Impacts – Keechelus Lake Alignment Alternatives (acres)

No Build	Alternative 1	Alternative 2	Alternative 3	Alternative 4/ Preferred Alternative
Mature forest lost (> than 80 years)				
None	1.7	3.4	2.8	5.1
Terrestrial habitat lost				
None	31.3	46.7	45.8	49.2

Listed and Sensitive Species. Under the ESA, FHWA is required to analyze the potential impacts of the identified Preferred Alternative to listed species. These potential impacts are presented in the *Biological Assessment* (Appendix M). As shown in Exhibit 3-27, the *Biological Assessment* concluded that the Preferred Alternative may affect and is likely to adversely affect one listed species, the northern

spotted owl. Based on this finding, FHWA conducted formal consultation with USFWS. During consultation, FHWA and USFWS agreed that the project also may adversely affect marbled murrelets. FHWA therefore requested formal USFWS consultation for this species as well. Based on this consultation, FHWA and WSDOT believe that the project would not have a substantial adverse impact to these species.

Exhibit 3-26
Summary of Habitat Impacts – CEA Improvement Packages (acres)

No Build	Option A	Option B	Option C	Preferred Alternative
Mature forest lost (>80 years)				
None	70.2	71.3	79.1	70.3
Terrestrial habitat lost				
None	197.2	202.2	205.5	199.5

Exhibit 3-27
Effects Determination – Terrestrial Species

Listed or Proposed Species in Project Area	Species	Critical Habitat
Gray wolf (E)	NLAA	NA
Grizzly bear (T)	NLAA	NA
Canada lynx (T)	NLAA	NA
Bald eagle (T)	NLAA	NA
Northern spotted owl (T)	LAA	NE
Marbled murrelet (T)	LAA	NA
Ute ladies'-tresses (T)	NE	NA

E – endangered
LAA – may affect and is likely to adversely affect
NA – not applicable since critical habitat is not present in the action area
NE – no effect
NLAA – may affect but not likely to adversely affect
T – threatened

The *Biological Assessment* concluded that the Preferred Alternative may affect but is not likely to adversely affect an additional five listed species: gray wolf; grizzly bear; Canada lynx; bald eagle; and marbled murrelet.

The USFS prepared a *Biological Evaluation* (Appendix M) that discusses the impacts on all Federal and State Species of Concern, Forest Service Management Indicator Species, Landbird Conservation Strategy Species, and Forest Service Sensitive and Strategic Species. This document concluded that while the Preferred Alternative may impact individuals or habitat, it is unlikely to contribute to a trend toward federal listing or loss of viability to the population or any of these species.

While these impact determinations are based on the Preferred Alternative, the lead agencies believe that impacts would be similar for any of the build alternatives.

Potential Introduction or Spread of Noxious Weeds. Fourteen noxious weed species are established within the I-90 corridor. The build alternatives will not increase the total roadside area where these species are known to initially establish themselves. However, construction-related ground disturbance has the potential to spread already-established noxious weeds to new areas, especially near stockpiling and staging areas or along new access roads. Noxious weeds also may be introduced by vehicles, personnel, and construction materials that may inadvertently carry the seeds to the project site.

WSDOT would minimize the spread of noxious weed through project design and by using construction BMPs. WSDOT would continue to work closely with the USFS and the county and state Noxious Weed Control Boards to keep noxious weeds from invading native habitats. WSDOT will comply with USFS guidelines for invasive plant management (USDA 2005a and 2005b).

Disturbance to Wildlife from Operational Noise. WSDOT does not expect that operational noise from the growth in traffic volume on I-90 would have an impact on wildlife. Modeling results suggest

that the increase over present conditions would be at most two to three A-weighted decibels (dBA), or approximately five percent over existing levels in the immediate vicinity of the right-of-way. While noise can affect activities such as nesting or feeding, it is unlikely that noise-sensitive species currently use the area for critical life stages because of existing noise levels. See the *Biological Assessment* (Appendix M).

Disturbance to Wildlife from Lighting. WSDOT does not expect lighting to affect wildlife. Lighting would be limited to chain-up and chain-off areas at interchanges and locations within the project corridor for safety reasons, and would be directed towards the highway surface. See Section 3.12, *Visual Quality*.

How will FHWA and WSDOT mitigate for adverse environmental impacts?

Avoidance and Minimization

WSDOT has worked to adjust the location of the highway to avoid and minimize impacts wherever possible, including moving the highway alignment to avoid old growth forest, riparian areas, and wetlands. WSDOT expects that as the design is completed, impacts can be reduced further, and that the impacts presented represent the worst case.

Recreational use near the proposed crossing structures could interfere with wildlife attempting to use them. FHWA and WSDOT anticipate that the USFS will manage lands adjacent to crossing structures in a manner that is consistent with their use for wildlife, as discussed in Section 1.13, *What other actions are necessary to complete the project?*

WSDOT will use fencing to reduce wildlife/vehicle collisions and enhance use of the connectivity structures. WSDOT began testing various fence designs in 2007 to determine their ability to withstand the harsh weather conditions in the project area.

Fencing is never completely effective, and WSDOT does not expect that fencing will completely exclude every animal, especially small

species that can go through mesh fences or species that can go over fences (for example, by using overhanging trees). This is particularly true in the I-90 project area, where harsh weather conditions make some kinds of fencing impractical. However, WSDOT believes that even for these species, the combination of fencing and the connectivity structures will lead to enhanced population viability. While the primary focus of wildlife fencing will be on reducing wildlife/vehicle collisions and enhancing traffic safety, WSDOT will consider specialized treatment for special status species.

Wildlife Monitoring

WSDOT has developed a *Wildlife Monitoring Plan* (Appendix O) in cooperation with its Wildlife Monitoring Technical Committee and the Western Transportation Institute at Montana State University. WSDOT has started pre-construction monitoring, which will continue through construction and after completion of the project. Because the project would be built over many years, WSDOT expects to apply the monitoring results from earlier construction phases to subsequent phases.

An I-90 citizen monitoring group has been collecting pre-construction data on wildlife movement by snow tracking.

Monitoring would consist of two tiers:

- Baseline monitoring in and near the highway right-of-way, which would collect data on current wildlife movement (including accidents involving wildlife), and data on the use and effectiveness of the crossing structure designs after they are built. Pre-construction monitoring began in 2008.

- Additional monitoring farther away from the highway right-of-way, which would complement the baseline monitoring and may help to advance the state of knowledge of wildlife crossing design and performance, along with landscape level topics such as population viability. WSDOT would most likely partner with other agencies and groups to accomplish this additional monitoring.

Image of a bear from a mounted wildlife monitoring camera near Snoqualmie Pass.

Habitat Preservation

WSDOT is working with federal and state partner agencies to acquire habitat preservation areas in the project area, as described in Section 3.4, *Wetlands and Other Jurisdictional Waters*.

Best Management Practices

BMPs for terrestrial species will be designed to meet applicable commitments and performance standards, including:

- NPDES General Permit for Construction Activities
- NPDES General Permit for Sand and Gravel Operations
- Temporary Erosion and Sediment Control Plans
- Spill Prevention, Control and Countermeasure Plans
- Erosion and sediment control requirements of the WSDOT *Design Manual* (WSDOT 2007c) and *Standard Specifications for Road, Bridge, and Municipal Construction* (WSDOT 2008b)
- Applicable measures specified in the USFWS Biological Opinion
- Applicable parts of the *Implementing Agreement between the Washington State Department of Ecology and the Washington State Department of Transportation* (Ecology and WSDOT 1998), or as revised
- Applicable permit conditions
- Applicable conditions related to the transfer of federal land for highway easement

Some example BMPs that WSDOT could use to comply with these standards include:

- Reducing wildlife/vehicle collisions at fence ends by incorporating "V" or "J" shaped fence ends that turn animals back toward the main fence when they approach the fence end
- Designing fences with escape routes, jump-offs and/or one-way gates for animals that get caught inside the fencing
- Merging fence ends with topographic features that limit wildlife movement to reduce the "fence-end effect"
- Managing vegetation at culverts targeted for smaller species to encourage the effectiveness of the crossing
- Following the procedures in the project-specific roadside vegetation management plan, which will be completed before construction begins, to minimize encroachment by invasive weed species during construction
- Using integrated vegetation management techniques and establishing native vegetation, in conformance with WSDOT's and USFS's existing procedures
- Mowing and trimming, selectively using herbicides, releasing weed-eating insects, improving soils, and planting native plants to manage vegetation

Compensatory Mitigation

FHWA and WSDOT believe that by combining avoidance, mitigation, and BMPs, the impacts of the project to terrestrial species will be minimized. Potential impacts to the marbeled murrelet and northern spotted owl will be mitigated through compliance with the applicable measures specified in the USFWS Biological Opinion. The project also will implement the conservation measures in the *Biological Assessment* and the *Biological Evaluation* (Appendix M). The project will mitigate for the remaining impacts through the beneficial effects of the build alternatives, which includes improved

ecological connectivity, an increase in riparian habitat, and a decrease in wildlife mortality. Consequently, no additional compensatory mitigation will be required. However, WSDOT has acquired areas of mature forest now in private ownership as part of the preservation component of the *Conceptual Wetland & Aquatic Resources Mitigation Plan* (Appendix J).