Chapter Two Description of Alternatives

This chapter presents detailed descriptions of the alternatives to be evaluated in the impact analysis portion of the Environmental Impact Statement (EIS). First, it describes the alternatives that were developed for evaluation within the Interstate 90 (I-90) corridor, followed by a discussion of the screening criteria used to evaluate each alternative. After identifying which alternatives were eliminated from further study, it presents detailed descriptions of the alternatives that were carried forward. Methods for identifying and implementing ecological and hydrologic connectivity measures within the build alternative are discussed, followed by a short discussion on the decisions that remain within this EIS. Finally, a summary that compares adverse impacts and mitigation measures is presented in tabular form to help define the issues and relative impacts identified, evaluated, and presented in Chapter 3, Affected Environment and Environmental Consequences.

Chapter 2 is organized into the following six sections:

- Section 2.1 provides background information on the alternatives developed for evaluation.
- Section 2.2 describes how the build alternatives were evaluated.
- Section 2.3 describes which alternatives were considered but eliminated from further study and why.
- Section 2.4 describes the alternatives that were advanced for further study and why.
- Section 2.5 describes the decisions that remain within this EIS.
- Section 2.6 describes the environmental impacts that may be expected from this project.

2.1 What alternatives were developed for evaluation?

At the project onset, the Washington State Department of Transportation (WSDOT) developed a set of alternatives for analysis within the I-90 corridor. The corridor, as described here, refers to the 15-mile-long segment of I-90 beginning just east of the Hyak Interchange near where the highway transitions from six lanes to four lanes (Milepost [MP] 55.1), and ending at the West Easton Interchange (MP 70.3) (Figure 2-1). A total of six alternatives were developed and analyzed within this corridor; they include the following:

- The No-Build Alternative
- The Limited Construction Alternative
- The Rampart Ridge Route Alternative
- The Roaring Ridge Route Alternative
- The Split Route Alternative
- The Common Route Alternative

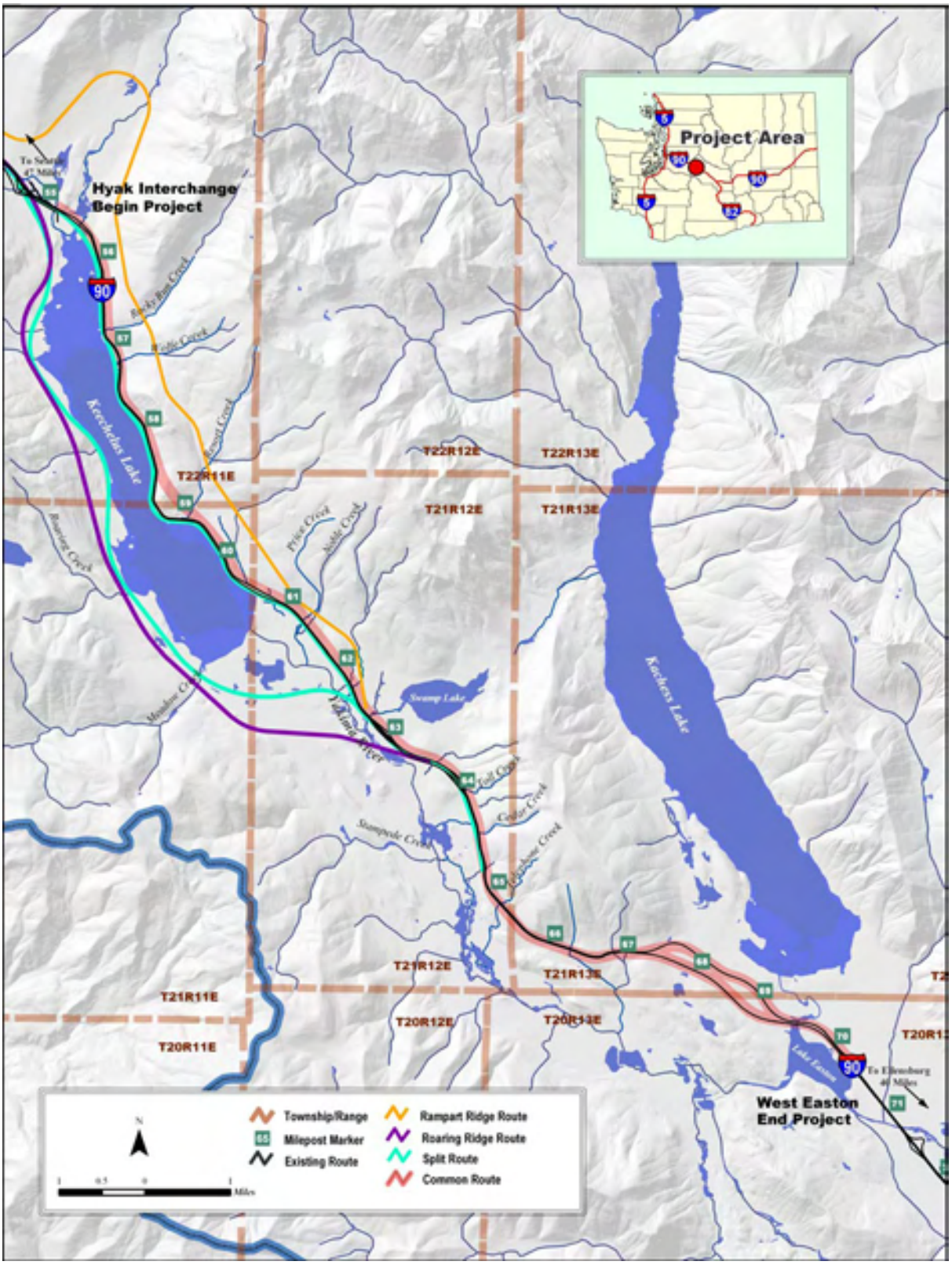


Figure 2-1. Map showing various route alternatives through the 15-mile-long I-90 project corridor

2.1.1 The No-Build Alternative

The National Environmental Policy Act (NEPA) of 1969 requires that each EIS include a "no-build" alternative. This alternative establishes the baseline conditions against which the potential effects of all "build" alternatives are measured.

Under this alternative, the present four-lane facility would be maintained and rehabilitated as needed. Measures include periodic resurfacing with Asphalt Concrete Pavement (ACP) at an interval of 4 to 6 years, and minor safety improvements that would occur as part of ongoing facility operations. When feasible, culverts that act as a barrier to fish may be retrofitted to accommodate fish passage, per agreement with the Washington Department of Fish and Wildlife (WDFW).

Because no new construction would occur under this alternative, the existing facility would not be improved; consequently, the needs identified within the I-90 corridor in Section 1.2 would not be met.

2.1.2 The Limited Construction Alternative

Several limited construction techniques were evaluated during the alternative analysis. These alternatives involve technological-based or public policy actions that focus on improving performance through Transportation System Management (TSM) and Transportation Demand Management (TDM) techniques. Other limited construction techniques include Intelligent Transportation Systems, Mass Transit, and Freight Rail.

2.1.2.1 TRANSPORTATION SYSTEM MANAGEMENT/TRANSPORTATION DEMAND MANAGEMENT/INTELLIGENT TRANSPORTATION SYSTEMS

TSM techniques attempt to maximize efficiency without substantial reconstruction or expansion of the existing facility. Examples of TSM strategies include fringe parking, High Occupancy Vehicle lanes, traveler information, expanded transit, and traffic signal optimization.

TDM techniques attempt to alleviate demand on the transportation facility by reducing the number of daily commutes. Examples of TDM include employer carpool/vanpool matching, High Occupancy Vehicle preferential parking, telecommuting, and flexible work schedules.

Both TSM and TDM strategies are most effective in urban environments where characteristics exist that include the following:

- A population base greater than 200,000.
- The existence of various transportation options.
- The ability to target specific travel patterns (e.g., commuting).

Intelligent Transportation Systems generally comprise integrated communication tools, such as variable message signs. These signs provide warnings or other information that help alleviate traffic congestion by influencing driver behavior.

2.1.2.2 MASS TRANSIT AND FREIGHT RAIL

Other techniques for reducing congestion without substantial reconstruction or expansion of the existing alignment include developing mass transit systems and shipping more freight by railroad.

Examples of mass transit systems include buses, passenger trains, and subway systems. To be effective, these transportation systems require the development of multiple routes and stations throughout a regional area.

Improving railroad lines and subsidizing the movement of freight through the corridor is another technique aimed at reducing truck traffic to and from Puget Sound ports through the I-90 corridor.

2.1.3 The Rampart Ridge Route

The Rampart Ridge Route would construct a new six-lane highway to the northeast of Keechelus Lake from MP 54.0 to just west of MP 63.0 (Figure 2-1). This proposed route would leave existing I-90 west of the Hyak Interchange and bear northeast up the Gold Creek Valley for approximately 1 mile before swinging to the southeast and crossing Gold Creek. From here, it would traverse the lower northwest-facing slopes of Rampart Ridge until exiting the Gold Creek Valley. The route would then head south-southeast along Keechelus Ridge 500 to 700 feet above and approximately parallel to the existing alignment. It would rejoin I-90 between MP 62.0 and MP 63.0, just west of the Stampede Pass Interchange. From this point east, it would approximate the existing alignment to the end of the project at the West Easton Interchange.

2.1.4 The Roaring Ridge Route

The Roaring Ridge Route would construct a new six-lane highway to the southwest of Keechelus Lake from the Hyak Interchange to the Cabin Creek Interchange (Figure 2-1). The proposed route would leave existing I-90 just east of the Hyak Interchange at MP 54.9. From here, it would turn south crossing over the Iron Horse State Park near the Keechelus Lake Boat Launch, and then traverse the northeast-facing slopes of Roaring Ridge approximately 100 to 300 feet above the southwest shore of Keechelus Lake. South of Keechelus Lake, the route would veer to the east crossing back over the Iron Horse State Park and the Yakima River at Sawmill Flats, where it would rejoin I-90 at MP 64.0, just west of the Cabin Creek Interchange. From this point east, the route would approximate the existing alignment to the end of the project at the West Easton Interchange.

2.1.5 The Split Route

The Split Route would construct three new eastbound lanes along the southwestern shore of Keechelus Lake and convert that portion of the existing alignment along the northeast shore of the lake to westbound lanes (Figure 2-1). The eastbound lanes of the Split Route would begin near the Hyak Interchange at MP 54.9. From here, the route would turn south crossing over the Iron Horse State Park near the Keechelus Lake Boat Launch. It would then approximate the

Iron Horse State Park right-of-way (ROW) to the southern end of Keechelus Lake. At the south end of the lake, the proposed route would turn eastward, crossing back over the Yakima River near the Crystal Springs Campground before rejoining I-90 at MP 63.0, just west of the Stampede Pass Interchange. From this point east, it would approximate the existing alignment to the end of the project at the West Easton Interchange.

2.1.6 The Common Route

The Common Route Alternative would reconstruct a six-lane highway from MP 55.1, eastward to MP 70.3 (Figure 2-1). This proposed route would begin at the Hyak Interchange and head south-southeast following the existing I-90 footprint. After crossing over Gold Creek, the route intersects four tributary streams that drain into Keechelus Lake as it traverses the lower slopes of Keechelus Ridge. South of Keechelus Lake, the route crosses three more streams, all tributaries to the Yakima River, before passing over the outlet to Swamp Lake near MP 62.7. From here, the roadway negotiates the southwestern side of Amabilis Mountain, crossing six more Yakima River tributaries before descending Easton Hill and continuing to the West Easton Interchange, the eastern terminus of the project.

2.2 How were the alternatives evaluated?

The WSDOT created an Interdisciplinary Team (IDT) during project scoping. The IDT has provided guidance and direction to WSDOT in preparing the EIS (see Section 1.7, *Who Participated in Developing this EIS?* for more information). The IDT developed a set of coarse screening criteria to help develop the proposed alternatives; they include the following:

- Meet the project purpose and need.
- Lie within the mission and goals of the WSDOT.
- Minimize environmental impacts.
- Feasible in terms of design and costs.

After developing the proposed alternatives based on the coarse screening criteria, a set of fine screening criteria was used to reduce the number of alternatives subject to detailed evaluation. The following objectives for each need were developed and used as a threshold to determine if alternatives met the project purpose.

- **Avalanches:** Routine closures of the highway for avalanche control work and cleanup should be eliminated. To provide a safe and reliable route, build alternatives should be designed to protect travelers from avalanches of a size that could occur within a 30-year period.
- **Slope Instability:** Build alternatives should eliminate all slopes identified as unstable, or mitigate them to a level consistent with WSDOT standard practices for unstable slopes. No new unstable slopes should be created.

- **Projected Traffic Demands and Public Safety:** Engineering and operational standards, safety, and traffic/freight capacity should be met with reasonable cost. Build alternatives should provide a Level of Service (LOS) C (refer to Table 3.7-1) for the projected 20-year traffic volumes to ensure that the facility provides for future needs. This objective has been reduced from the WSDOT standard capacity objective of LOS B for major rural arterials within rolling or mountainous terrain. This lower LOS is appropriate for the area and would be acceptable to highway users. Highway users recognize the environmentally sensitive nature of the area, understand the limits terrain places on design of the roadway, and the trade-offs between a higher LOS and associated costs. Specific safety objectives include improving the highway to meet current design standards, replacement of structures having substandard vertical clearance, additional chain-on and chain-off areas to accommodate anticipated use, reduction of headlight glare, and providing adequate area for snow storage.
- **Structural Deficiencies:** Build alternatives must address the deteriorated pavement to allow continued use of the highway system. Pavement type selection will be based on an analysis of the lowest lifecycle costs.
- **Ecological Connectivity:** Build alternatives should be designed to meet requirements of the Washington Hydraulic Code. The code implements provisions for the protection of fish life by minimizing project specific and cumulative impacts. In addition, alternatives should be consistent with the *Wenatchee National Forest Land and Resource Management Plan* as amended by the *Northwest Forest Plan* and the *Snoqualmie Pass Adaptive Management Area* (*SPAMA*) *Plan*, and include mitigation for adverse impacts to ecological connectivity.

In addition to evaluating the alternatives' ability to meet the project purpose, the IDT used a broad list of criteria to evaluate reasonableness based on potential benefits and impacts. The IDT examined impacts to water resources, historical properties, visual quality, habitats, watersheds, communities, recreation properties and usage, transportation, and also developed costs and feasibility criteria. A more detailed description of the screening process can be found in the IDT's technical memoranda (WSDOT 2002).

2.3 Which of the alternatives were eliminated from further study and why?

Based on application of the fine screening criteria, four of the six proposed alternatives evaluated were eliminated from further study. WSDOT prepared detailed technical memoranda to capture the reasons why a build alternative should or should not be carried forward for analysis in the EIS. These memoranda are based on both the coarse and fine criteria developed by the IDT.

The findings of these memoranda are summarized below. Alternatives eliminated from further study include the following:

- The Limited Construction Alternative
- The Rampart Ridge Route Alternative
- The Roaring Ridge Route Alternative
- The Split Route Alternative

These alternatives were eliminated for the reasons discussed below.

2.3.1 The Limited Construction Alternative

Because the project area's transportation characteristics are not conducive to implementing limited construction techniques that utilize TSM, TDM, and Intelligent Transportation Systems, they were not developed beyond the fine screening stage.

Furthermore, expanding mass transit and freight rail systems would not adequately address projected traffic volumes, nor do they offer solutions that meet any of the other project needs such as deteriorating pavement, unstable slopes, and avalanches.

2.3.1.1 Transportation System Management/Transportation Demand Management/Intelligent Transportation Systems

Taken together, TSM, TDM, and Intelligent Transportation Systems techniques would not adequately address the projected 20-year traffic volumes within the I-90 corridor; also, they do not address any other project needs and so were not developed beyond the fine screening stage. Nevertheless, applicable limited construction strategies (e.g., vanpools, incident management, traveler information, and enhanced enforcement) are currently in place and would be expanded as needed to maximize the efficiency of the system.

2.3.1.2 Mass Transit and Freight Rail

Passenger mass transit requires large population centers, multiple and/or major destination points, and consistent user demand. Because the development density and demographics of the project corridor are not conducive to a successful mass transit system, this limited construction technique was not carried forward beyond the fine screening stage.

Strategies to improve the freight rail system or to subsidize freight rail to reduce truck volumes on I-90 have also been suggested. However, neither of these strategies would reduce truck traffic enough to meet projected 20-year traffic volumes within the I-90 corridor. For example, if the number of the trucks currently using I-90 were replaced by freight rail in 2025, the highway would still operate at a LOS D, which falls below the capacity objective of a LOS C.

2.3.2 The Rampart Ridge Route

While the Rampart Ridge Route could potentially address the project purpose and need, this alternative constructs a new six-lane highway where none previously existed. As a result, this alternative would generate additional direct and indirect environmental impacts when compared to alternatives that utilize more of the existing footprint. Furthermore, this route requires moving the project termini outside of the project limits and would needlessly reconstruct sections of roadway that currently meet WSDOT design standards.

Because this route would be from 500 feet to 700 feet higher in elevation, it would expose travelers to more severe winter weather conditions than does the existing alignment. Crossing the Gold Creek Valley would require an elevated span that would be prone to icing. Additionally, this route would create another mountain pass that would be approximately 400 feet higher than the Snoqualmie Pass summit. A 3.5-mile-long, 5 percent grade would be required for eastbound traffic, and a 5-mile-long, 5 percent grade would be required for westbound traffic. While reclamation of the existing highway's footprint would be required, it is highly unlikely that it could be restored to pre-highway conditions. Therefore, a net loss of natural resources would occur.

Because it would reconstruct existing good quality roadway, create operational and maintenance problems, and generate additional environmental impacts, the Rampart Ridge Route was eliminated from further study.

2.3.3 The Roaring Ridge Route

The Roaring Ridge alternative would also construct a new six-lane highway where none previously existed. As a result, this alternative would generate additional direct and indirect environmental impacts when compared to alternatives that utilize more of the existing footprint. For example, this alternative would require acquisition of lands within the Iron Horse State Park ROW. Indirect impacts would result from increased noise levels and decreased visual quality along the southwest shore of Keechelus Lake. Additional operational and maintenance problems would be created from avalanches and rockfall. While reclamation of the existing highway's footprint would be required, it is highly unlikely that it could be restored to pre-highway conditions. Therefore, a net loss of natural resources would occur.

Because it would create operational and maintenance problems, and generate additional environmental impacts, the Roaring Ridge Route was eliminated from further study.

2.3.4 The Split Route

Like the Rampart Ridge and Roaring Ridge alternatives, the Split Route alternative also proposes to construct new lanes where none previously existed, and would create additional environmental impacts. This alternative would directly and indirectly impact properties within the corridor by requiring acquisition of lands within the Iron Horse State Park ROW. Indirect impacts would result from increased noise levels and decreased visual quality along the

southwest shore of Keechelus Lake. Additional operational and maintenance problems would be created from avalanches and rockfall. While reclamation of the existing highway's footprint could occur, it is highly unlikely that it could be restored to pre-highway conditions. Therefore, a net loss of natural resources would occur.

Because it would create operational and maintenance problems, and generate additional environmental impacts, the Split Route was eliminated from further study.

2.4 Which of the alternatives were advanced for further study and why?

All of the proposed route and limited construction alternatives developed by the WSDOT project team and the IDT were intended to meet the project's stated purpose: to meet projected traffic demand, improve public safety, and meet the identified project needs along the 15-mile-long project corridor. After applying the fine screening criteria, it became apparent that the Common Route was the alternative that would best satisfy the project's purpose by addressing all of the project's needs as described in Section 1.2. Therefore, WSDOT and the IDT chose to advance both the No-Build and Common Route Alternatives for further study.

2.4.1 Which Common Route design alternatives were eliminated from further study and why?

Once the decision was made to advance the No-Build and the Common Route Alternatives, work began on Common Route design variations. While developing alternatives within the Common Route to meet the project needs, variations for horizontal and vertical alignment, roadway configuration, construction techniques, access point locations, and other design considerations were evaluated. Although this discussion does not cover every concept considered and not carried forward, the major concepts that were eliminated warrant brief discussion.

The main objective of the Common Route Alternative is to minimize new impacts by utilizing the existing footprint as much as possible. Even so, several realignment options were considered along the route that addressed additional design objectives. For example, various roadway configurations were considered while developing alignment alternatives along Keechelus Lake. These included an expanded snowshed, a stacked viaduct (one direction built above the other), and tunnel alignments of varied lengths. These alternatives were eliminated because of concerns over construction and an inability to meet minimum design standards.

Realignment alternatives were also considered for the area south of Keechelus Dam from MP 60.0 to MP 63.0, which would have shifted the highway northward away from the Yakima River. Utilizing independent alignments to increase median width and improve the visual quality along the west side and

southwest side of Amabilis Mountain from MP 63.0 to MP 67.0 was also considered. These options were eliminated from further study because they did not avoid or minimize impacts to wetlands, old growth forest habitats, and other sensitive areas.

Utilizing portions of the existing roadway rendered obsolete by realignment for use as view areas was considered. This design option was considered as a possible enhancement; however, it was eliminated because of design obstacles or constraints, safety concerns, added operational requirements, and cost.

The WSDOT project team also considered changing the location of existing access points during the design development stage of the Common Route Alternative. These concepts were eliminated due to a lack of adequate space available for new interchanges, additional impacts that would occur from required changes to the local road network, and due to a lack of demonstrated need for new and modified access points.

2.4.2 Which Common Route design alternatives were advanced for further study and why?

The WSDOT project team has developed four different Common Route design alternatives along the eastern shore of Keechelus Lake. Collectively, these alternatives are referred to as the Keechelus Lake Alignment Alternatives.

The proposed Common Route design alternatives advanced for further study would reconstruct a six-lane highway beginning at MP 55.1, just west of Coal Creek and the Hyak Interchange, and ending at MP 70.3, or the West Easton Interchange. This route would utilize between 80 to 100 percent of the existing alignment. Improvements planned within these project limits include additional lanes, wider medians and shoulders, and retaining walls. Auxiliary truck-climbing lanes are planned for Easton Hill that will expand the highway width in some locations. Details for each improvement are depicted in the Design Appendix (Appendix B).

The WSDOT project team has developed four different Common Route design alternatives along the eastern shore of Keechelus Lake from MP 56.6, just east of Rocky Run Creek, to MP 59.9, at Resort Creek. Collectively, these alternatives are referred to as the Keechelus Lake Alignment Alternatives. A detailed description of each alternative is presented in Section 2.4.3.

While evaluating design alternatives along the proposed Common Route, the WSDOT project team recognized that not only could hydrologic connectivity be improved at many of the stream crossings within the corridor, but some of the crossings may also be well suited for enhancing ecological connectivity. The WSDOT project team and the IDT agreed that to adequately address both would require the expertise of specialists from outside of the IDT.

Accordingly, the WSDOT convened the Mitigation Development Team (MDT), a group of hydrologists and biologists from various agencies tasked with identifying areas that could benefit from restoration efforts along the proposed Common Route. Having assessed existing hydrologic and biologic conditions, the MDT concurred that many of the stream crossings within the corridor could serve as conduits for enhancing both hydrologic and ecological connectivity, while meeting WSDOT design standards for a rural interstate highway. The

A Connectivity Enhancement Area (CEA) represent locations that could benefit from both hydrologic and ecological enhancement measures.

MDT identified 15 different areas that could benefit from both hydrologic and ecological enhancement measures. Most of these areas are associated with stream crossings, but some locations were included because they are preferred wildlife corridors. Each feature and its surrounding area identified by the MDT are referred to as a Connectivity Enhancement Area (CEA). Guided by the MDT, the WSDOT project team designed various sets of enhancement options for each CEA. A detailed description of all CEAs and their associated set of options are presented in Section 2.4.7.

In summary, this EIS analyzes improvements to the common route of the 15-mile I-90 corridor. This analysis is accomplished in two ways. First, the four Keechelus Lake Alignment Alternatives and three associated CEAs are considered. Second, the remainder of the route, including 11 CEAs and all other roadway improvements (additional lanes, wider medians and shoulders, and retaining walls) are analyzed. At eight of the CEAs, multiple options were analyzed. These options are grouped, along with the roadway improvements, into Improvement Packages. These Improvement Packages permit summary comparisons of the combined effects that could result from implementing common roadway improvements and multiple CRA options throughout the I-90 corridor. The Keechelus Lake Alignment Alternatives are discussed in Section 2.4.3. The CEAs and Improvement Packages are discussed in Section 2.4.7.

2.4.3 The Keechelus Lake Alignment Alternatives

The Keechelus Lake Alignment Alternatives were developed as a subset of the Common Route Alternative to satisfy the project's purpose and need statement. The concepts of avoidance and minimization were adhered to as much as possible during development of these alternatives.

The four Keechelus Lake Alignment Alternatives differ in the extent to which they accommodate the following factors:

- Avalanche control and slope stability
- Cost
- Geometric design
- Ecological connectivity

Figure 2-2 shows the location of the four Keechelus Lake Alignment Alternatives and three associated CEAs that fall within the area of the Keechelus Lake Alignment Alternatives. From west to east, they include the Rocky Run Creek, Wolfe Creek, and Resort Creek CEAs. All of the restoration activities described below would improve aquatic and terrestrial habitats by enhancing the passage of organisms and materials associated with each type of habitat. Details for existing and proposed structures at each CEA for the four Keechelus Lake Alignment Alternatives are presented in Table 2-1. Based on preliminary January 2003 estimates, the cost to complete each of the Keechelus Lake Alignment Alternatives is presented in Table 2-2.

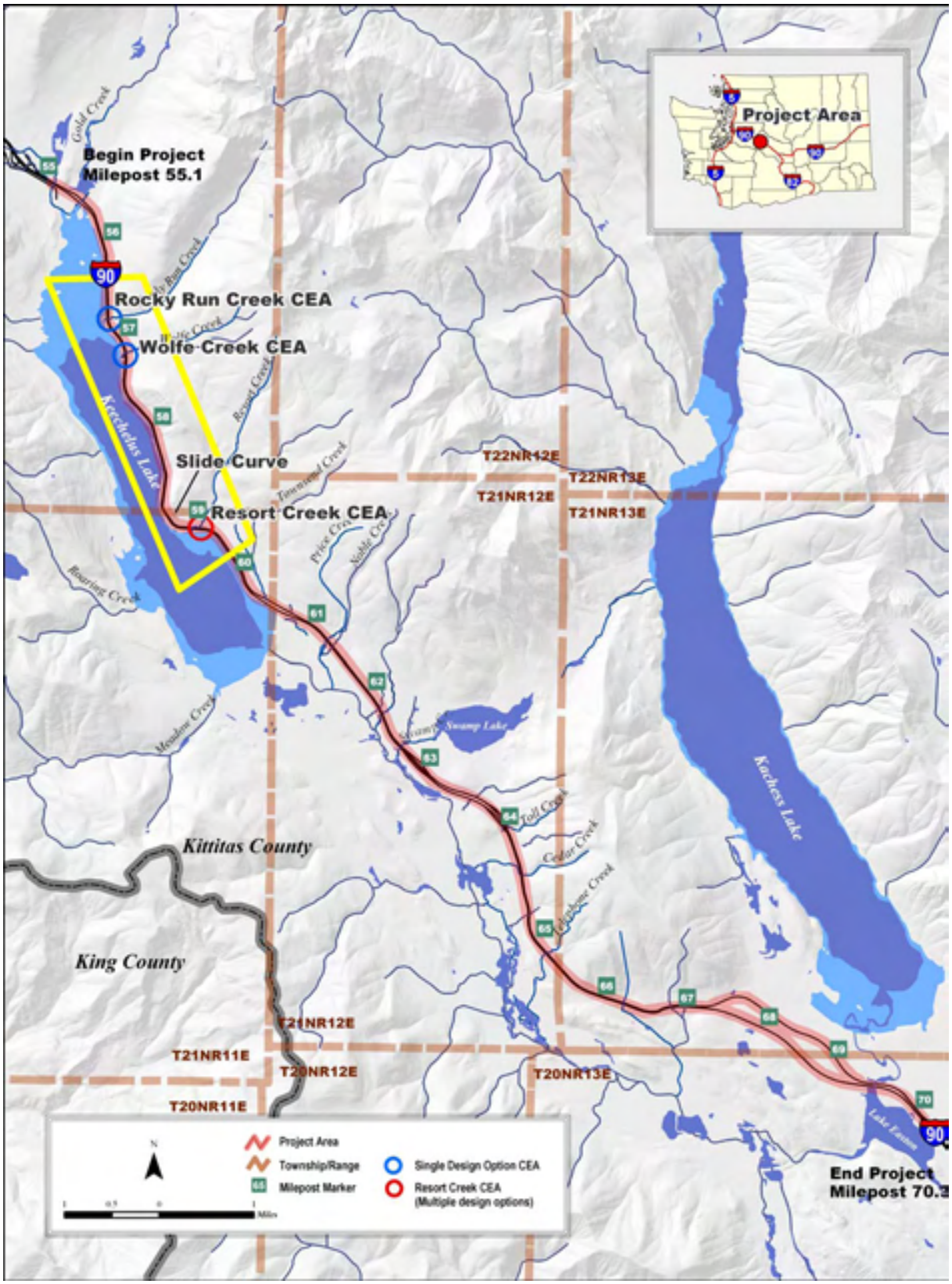


Figure 2-2. Map showing the area of the four Keechelus Lake Alignment Alternatives and the location of each associated CEA

Table 2-1. Keechelus Lake Alignment Alternative Stream Crossing Structures at CEAs

LOCATION	MP	ATTRIBUTES	EXISTING STRUCTURE		TUNNEL ALIGNMENT ALTERNATIVES						
					1		2		3		4
Rocky Run Creek	55.3	Structure Type	Single Span Bridge Eastbound	Double 6-foot Corrugated Metal Culvert Westbound	Single Span Bridge[1]		Single Span Bridge[1]		Single Span Bridge[1]		Single Span Bridge[1]
		Length	37 feet approx.	12 feet	120 feet approx.		120 feet approx.		120 feet approx.		120 feet approx.
		Clearance	11 feet min.	6 feet	8 feet min.		8 feet min.		8 feet min.		8 feet min.
		Width	40 feet	75 feet	70 feet		70 feet		70 feet		70 feet
Wolfe Creek	55.5	Structure Type	6-foot Corrugated Metal Culvert		Large Span Bottomless Culvert[1]		Large Span Bottomless Culvert[1]		Large Span Bottomless Culvert[1]		Large Span Bottomless Culvert[1]
		Length	6 feet		25 feet approx.		25 feet approx.		25 feet approx.		25 feet approx.
		Clearance	6 feet		8 feet min.		8 feet min.		8 feet min.		8 feet min.
		Width	150 feet		75 feet		75 feet		75 feet		75 feet
Resort Creek	60.6	Structure Type	6-foot Corrugated Metal Culvert		Single Span Bridge Eastbound	Single Span Bridge Eastbound	Single Span Bridge Eastbound	Single Span Bridge Westbound	4 Large Span Bottomless Culverts Eastbound	Single Span Bridge Westbound	4 Large Span Bottomless Culverts
		Length	6 feet		120 feet approx.	120 feet approx.	120 feet approx.	120 feet approx.	100 feet approx.	120 feet approx.	100 feet approx.
		Clearance	6 feet		10 feet min	10 feet min.	10 feet min.	10 feet min.	10 feet min.	10 feet min.	10 feet min.
		Width	150 feet		62 feet	62 feet	62 feet	62 feet	75 feet	62 feet	150 feet

Notes: 1. Identical bridges or culverts will be used for both eastbound and westbound alignments.
The dimensions shown are approximate, and were developed for preliminary evaluation and assessment of impacts. Actual bridge and culvert sizes will vary, depending on the topography and intended purpose of the structure.
If additional clearance is needed on single span bridges, thin slab spans may be used to obtain clearance for bridge lengths of up to 80 feet.
Bottomless culverts will be included at locations where fish passage is required, and will be designed using standards required by WDFW and WSDOT.
The minimum recommended clearance for bridges over the Interstate is 16.5 feet. New bridges will meet or exceed this standard.

Table 2-2. Cost Estimates for Each of the Keechelus Lake Alignment Alternatives

Location	KEECHELUS LAKE ALIGNMENT ALTERNATIVES			
	Alternative 1	*Alternative 2*	*Alternative 3*	*Alternative 4*
Wall and Structure Costs	$2.9 million	$62.0 million	$54.7 million	$58.6 million
Tunnel Costs	$364.0 million	$140.0 million	$92.0 million	N/A
Roadway Costs[1]	$8.2 million	$7.5 million	$7.0 million	$7.7 million
Embankment and Other Costs[2]	$88.0 million	$97.8 million	$82.8 million	$70.0 million
CEA Costs	$3.9 million	$4.1 million	$4.2 million	$3.5 million
TOTAL	**$467 million**	**$311 million**	**$241 million**	**$140 million**

Notes: 1. Roadway costs include all surfacing, asphalt, and Portland cement Concrete Pavement (PCCP).
2. Other Costs includes all cut and fill, traffic control, and all other work items associated with the alignment alternatives.
3. CEA costs include structure and wall costs at Rocky Run, Wolfe, and Resort Creeks CEAs.
Costs are current dollars based on January 2003 estimates. Costs did not take into account project phasing or construction scenarios, which could extend completion timelines.

2.4.3.1 KEECHELUS LAKE ALIGNMENT ALTERNATIVE 1: LONG TUNNELS

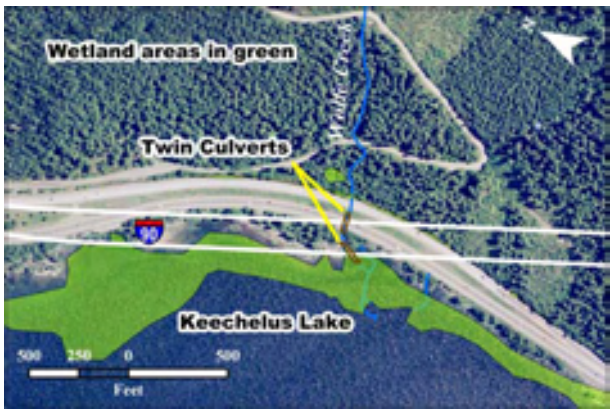
The first Keechelus Lake Alignment Alternative would construct twin three-lane tunnels for a distance of 1.9-miles (Figure 2-3). This design completely removes the substandard curves within this section of the Common Route and realigns the highway to meet 75 miles per hour (mph) design standards. This is the recommended design speed based on the current posted speed limit and the existing operating (measured) speeds. Because this alternative bypasses all avalanche zones, it eliminates the potential for accidents, injuries, and road closures from avalanches. It also eliminates the threat of accidents and injuries from rock fall by avoiding unstable slopes. That portion of the existing roadway along Keechelus Lake rendered obsolete by the tunnel would be removed and reclaimed with the exception of the Keechelus Lake snowshed. This historic resource will be avoided and future management will be coordinated with the State Historic Preservation Office (SHPO).

Figure 2-3. Map of Keechelus Lake Alignment Alternative 1: Long Tunnels

Rocky Run Creek CEA: Existing conveyance structures at Rocky Run Creek include twin 6-foot corrugated metal culverts at the westbound crossing, and a 100-foot bridge at the eastbound crossing. Twin single span bridges (approximately 120 feet long) that would provide for fish passage at all reservoir pool levels are proposed at the Rocky Run Creek CEA.

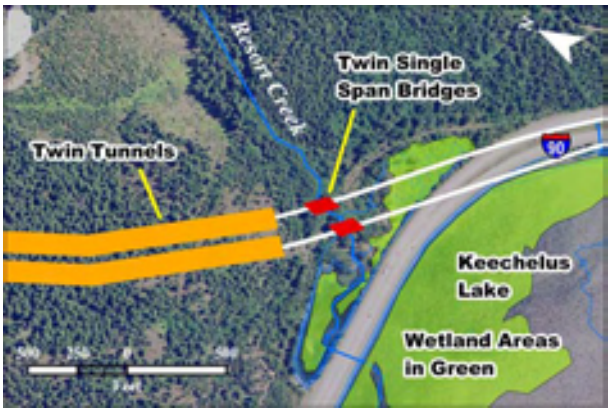
Rocky Run Creek CEA under Alternative 1

Wolfe Creek CEA: Conveyance structures currently in place at Wolfe Creek include a 6-foot corrugated metal culvert under both the westbound and eastbound lanes. A large-span (10-foot to 30-foot span) bottomless culvert that would provide for fish passage at all reservoir pool levels is proposed at both the eastbound and westbound creek crossings.



Wolfe Creek CEA under Alternative 1

Resort Creek CEA under Alternative 1: Existing conveyance structures at Resort Creek include a 6-foot corrugated metal culvert under both the westbound and eastbound lanes. This alternative includes constructing twin single span bridges (approximately 120 feet long) that would provide for fish passage at all reservoir pool levels.



Resort Creek CEA under Alternative 1

Based on preliminary January 2003 estimates, the cost to complete Keechelus Lake Alignment Alternative 1 is approximately $467 million (Table 2-2).

2.4.3.2 KEECHELUS LAKE ALIGNMENT ALTERNATIVE 2: SHORT TUNNELS

Keechelus Lake Alignment Alternative 2 would construct twin three-lane tunnels for a distance of 0.6 mile that bypass Slide Curve (Figure 2-4). This alternative straightens the substandard curves from just east of Rocky Run Creek to Resort Creek, and eliminates those at Slide Curve. Realignment of these curves would allow the highway to meet 70 mph design standards.

Figure 2-4. Map of Keechelus Lake Alignment Alternative 2: Short Tunnels

Bridges would be constructed over Keechelus Lake near the existing snowshed. These bridges would be designed in a manner that will convey avalanches under the roadway, significantly reducing the potential for injuries and road closures due to avalanches. Mitigation measures to reduce accidents and injuries from rock fall include slope netting, rock bolting, or slope flattening. That portion of the existing roadway along Keechelus Lake rendered obsolete by the tunnel would be removed and reclaimed with the exception of the Keechelus Lake snowshed. This historic resource will be avoided and future management will be coordinated with the SHPO.

Restoration measures for Rocky Run Creek, Wolfe Creek, and Resort Creek CEAs within Alternative 2 are identical to Alternative 1.

Based on preliminary January 2003 estimates, the cost to complete Keechelus Lake Alignment Alternative 2 is approximately $311 million (Table 2-2).

2.4.3.3 KEECHELUS LAKE ALIGNMENT ALTERNATIVE 3: SHORT TUNNEL WESTBOUND, NO TUNNEL EASTBOUND

Keechelus Lake Alignment Alternative 3 would construct a three-lane tunnel for a distance of 0.6 mile in the westbound direction, and three eastbound lanes that approximate the existing footprint (Figure 2-5). This design straightens the substandard curves from just east of Rocky Run Creek to the snowshed, and eliminates those curves in the westbound direction at Slide Curve. Westbound lanes would meet 70 mph design standards; eastbound lanes would meet 65 mph design standards due to substandard curves. Bridges would be constructed over Keechelus Lake near the existing snowshed. These bridges would be designed in

a manner that will convey avalanches under the roadway, significantly reducing the potential for injuries and road closures due to avalanches. Avalanche fencing would be constructed on the slopes above Slide Curve to protect eastbound lanes from avalanches. Mitigation measures to reduce accidents and injuries from rock fall include slope netting, rock bolting, or slope flattening. The Keechelus Lake Snowshed would be avoided and future management coordinated with the SHPO.

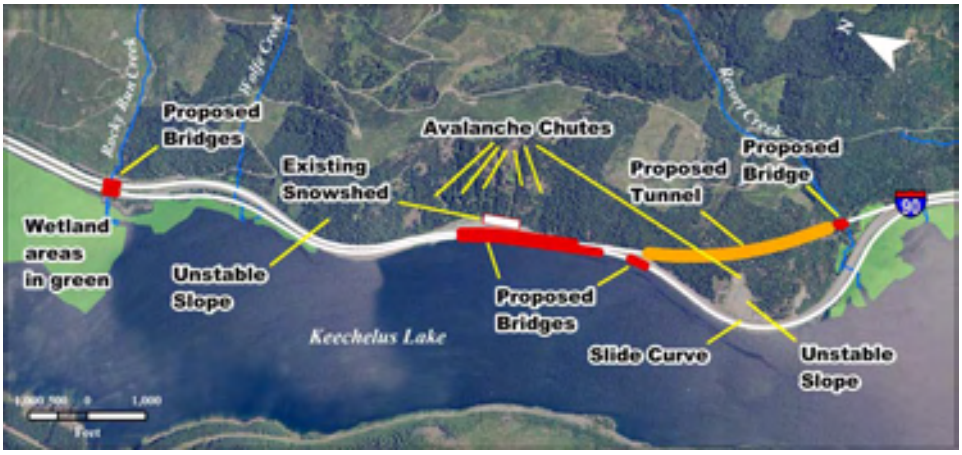


Figure 2-5. Map of Keechelus Lake Alignment Alternative 3: Short Tunnel Westbound, No Tunnel Eastbound

Resort Creek CEA under Alternative 3: Restoration measures for the Rocky Run Creek and Wolfe Creek CEAs within Alternative 3 are identical to Alternative 1. However, the existing 6-foot corrugated metal culverts at Resort Creek would be replaced by a single span bridge (approximately 120 feet long) in the westbound lanes, and a series of large-span (10-foot to 30-foot span) bottomless culverts in the eastbound lanes that would provide for fish passage at all reservoir pool levels.

Resort Creek CEA under Alternative 3

Based on preliminary January 2003 estimates, the cost to complete Keechelus Lake Alignment Alternative 3 is approximately $241 million (Table 2-2).

2.4.3.4 KEECHELUS LAKE ALIGNMENT ALTERNATIVE 4: BOTH DIRECTIONS OF TRAFFIC ALONG KEECHELUS LAKE AROUND SLIDE CURVE

Keechelus Lake Alignment Alternative 4 would construct three lanes in both the westbound and eastbound directions around Slide Curve (Figure 2-6). This design would straighten the substandard curves from just east of Rocky Run

Creek to the snowshed, but would not remove the substandard curves at Slide Curve. Consequently, both westbound and eastbound lanes would meet 60 mph design standards.

Figure 2-6. Map of Keechelus Lake Alignment Alternative 4: Both Directions of Traffic Along Keechelus Lake Around Slide Curve

Bridges would be constructed over Keechelus Lake near the existing snowshed. These bridges would be designed in a manner that will convey avalanches under the roadway, significantly reducing the potential for injuries and road closures due to avalanches. Avalanche fencing would be constructed on the slopes above Slide Curve to protect both westbound and eastbound lanes from avalanches. Mitigation measures to reduce accidents and injuries from rock fall include slope netting, rock bolting, or slope flattening. The Keechelus Lake Snowshed would be avoided and future management coordinated with the SHPO.

Resort Creek CEA under Alternative 4: Restoration measures for Rocky Run Creek and Wolfe Creek CEAs within Alternative 4 are identical to Alternative 1. However, the existing 6-foot corrugated metal culverts at Resort Creek would be replaced by a series of large-span (10-foot to 30-foot span) bottomless culverts across both the westbound and eastbound lanes.

Resort Creek CEA under Alternative 4

Based on preliminary January 2003 estimates, the cost to complete Keechelus Lake Alignment Alternative 4 is approximately $140 million (Table 2-2).

2.4.4 Which CEAs were considered but eliminated from further study and why?

The 15 CEAs identified by the MDT were evaluated. The Coal Creek CEA was not carried forward for further analysis because the existing bridges are already

sufficient in width and are structurally adequate, making reconstruction unnecessary. Possible improvements in connectivity at this location were also deemed minimal. The existing crossing is situated adjacent to lands considered not conducive for wildlife crossings. The WSDOT maintenance facility to the south, private property subject to development on the north, multiple roadways, and high use by humans limit the effectiveness of a wildlife crossing at Coal Creek.

2.4.5 What are CEA options?

For each of the 11 CEAs located outside of the Keechelus Lake Alignments, enhancement options were developed. As discussed in Chapter 1, WSDOT understands the importance of hydrologic and ecological connectivity throughout the I-90 project corridor. Consequently, WSDOT proposes to build bridges and culverts that will improve channel migration and floodplain development, the structure and function of wetland and riparian habitats, and passage of aquatic and wildlife species.

Providing adequate fish passage ensures that all existing and viable aquatic habitats within the upper Yakima River basin are utilized. Accommodating the movement of wildlife will increase the likelihood of interactions within and between wildlife populations in both the Southern Cascade and Northern Cascade ecoregions.

2.4.6 Which CEA options were considered but eliminated from further study and why?

While evaluating connectivity options along the proposed Common Route, several early options were developed that were eliminated from further study. These include options located within both the project's CEAs and outside of the project limits. Options located outside of the project limits were eliminated because there is no need to reconstruct the highway in these areas, and, therefore, the opportunity to resolve connectivity issues does not exist.

Six preliminary connectivity options were eliminated from further study. They include two options located within the Price/Noble Creeks CEA, three at the Easton Hill CEA, and one at Coal Creek (Figure 2-7). These options were eliminated prior to the MDT analysis and are not included in the MDT Draft Recommendation Package, but are discussed briefly below.

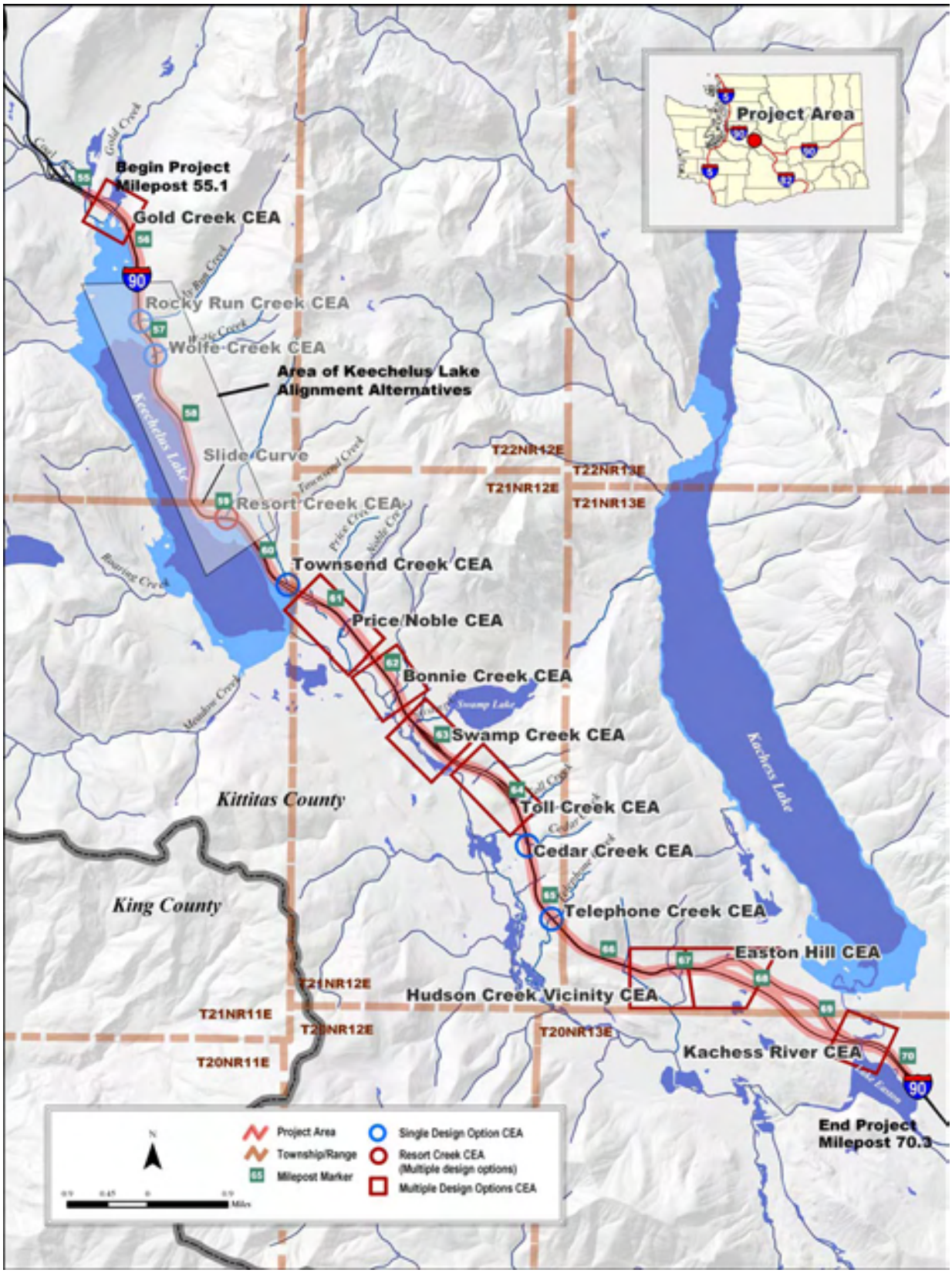


Figure 2-7. Map showing the location of Connectivity Enhancement Areas through the 15-mile-long I-90 project corridor

The first connectivity option eliminated within the Price/Noble Creeks CEA would have constructed a single 3,500-foot viaduct across the entire area. This design was eliminated from further study because it did not conform to the strategy of making reasonable investments in structures to provide the greatest benefit-to-cost ratio for connectivity. The second connectivity option eliminated at the Price/Noble Creeks CEA consisted of a bottomless culvert at MP 60.8 and bridges across both creeks. This design was eliminated because the area where the culvert was planned has the highest recorded rate of wildlife roadkill within the project corridor. Placing a culvert at this location would not provide adequate passage for wildlife; options carried forward include bridges at this location.

The three connectivity options eliminated at the Easton Hill CEA would have employed connectivity structures similar to those currently proposed but would have realigned westbound I-90 to parallel the eastbound lanes with a 100-foot separation. These options were eliminated because they would increase habitat impacts and decrease visual quality, and at a higher cost than options requiring less realignment of the existing roadway.

2.4.7 Which connectivity enhancement options were advanced for further study?

WSDOT developed connectivity enhancement options for each of the 14 CEAs. In order to evaluate a range of connectivity solutions, up to three preliminary options were developed for eight of these locations that include the following: Gold Creek, Price/Noble Creeks, Bonnie Creek, Swamp Creek, Toll Creek, Hudson Creek, Easton Hill, and Kachess River areas. These locations correspond to three north-south linkage zones identified by Singleton and Lehmkuhl (2000). They have higher value habitat and occur where freeway design is less constrained by topography. Therefore, these are primary connectivity locations.

The structure and function of habitats are less dynamic at Townsend Creek, Cedar Creek, and Telephone Creek. These locations are not aligned with identified linkage zones because they are situated along terrain features that act as a natural barrier to many species. The MDT recommended, and the IDT concurred, that other CEAs represented a greater potential benefit for a larger group of species. Therefore, WSDOT developed a single proposed design at each location to provide adequate passage of surface water, debris, and fish if present. These locations would serve as secondary connectivity structures.

Rocky Run Creek, Wolfe Creek, and Resort Creek CEAs have connectivity enhancement options that are specific to the Keechelus Lake Alignment Alternatives (see Section 2.4.3).

The remainder of this section presents enhancement options for all CEAs except for those already discussed as part of the Keechelus Lake Alignment Alternatives. Figure 2-7 shows the location of all CEAs throughout the 15-mile-long project corridor. Structural dimensions are preliminary and subject to change as the design and field studies (geotechnical, biological, land surveying, etc.) reach completion. Bridge lengths are consistent with industry standards and current WSDOT design guidelines.

Cost information associated with these options is shown on Table 2-3. The largest difference in costs is a result of bridges, retaining walls, and culverts.

Table 2-3. Cost Information for Connectivity Enhancement Options

Proposed Elements	*Option A*	*Option B*	*Option C*
Costs at CEA[1] (Wall and Structure)			
Gold Creek	$17.9 million	$17.8 million	$7.8 million
Townsend Creek	$0.5 million	$0.5 million	$0.5 million
Price/Noble Creeks	$25.2 million	$12.1 million	$5.3 million
Bonnie Creek	$9.9 million	$8.0 million	$0.5 million
Swamp Creek	$10.5 million	$3.1 million	$1.5 million
Toll Creek	$2.5 million	$2.5 million	$1.0 million
Cedar Creek	$0.2 million	$0.2 million	$0.2 million
Telephone Creek	$0.1 million	$0.1 million	$0.1 million
Hudson Creek Vicinity	$2.5 million	$1.4 million	$0.1 million
Easton Hill Vicinity	$1.8 million	$1.4 million	$1.8 million
Lake Kachess Area	$2.0 million	$0.5 million	$0.5 million

Notes: 1. Estimated costs at CEAs include bridge structures, large culverts, and retaining walls, which represent the largest cost differential between Improvement Packages.

Currently, portions of the project area have no fencing to prevent wildlife from crossing the highway; some portions contain limited or inadequate fencing. Although guide fencing has demonstrated effectiveness, it raises important biological, maintenance, safety and aesthetic issues. WSDOT will continue to evaluate the issue of wildlife fencing, and will develop a comprehensive fencing plan in cooperation with natural resource agencies. The proposed fencing plan will be included in the Final EIS. For additional discussion on fencing, refer to Section 3.6.2, *Effects of Highways on Wildlife*, and Section 4.2.3, *Terrestrial Species and Habitat*.

2.4.7.1 GOLD CREEK CEA

Bridges would provide for additional channel enhancement, wetland connectivity, and the movement of aquatic, semi-aquatic, and wildlife. Animal passage across I-90 is particularly important in this section of this project, as well as the Price/Noble and Easton Hill CEAs. The full benefits of constructing connectivity improvements at this location will not be realized until the United States Forest Service (USFS) constructs a bridge of similar dimensions on Forest Service Road (FSR) 4832, located immediately to the north; replacement of this bridge is not a part of the I-90 Snoqualmie Pass East project. The enhancement options below offer solutions for improving connectivity within the Gold Creek CEA.

Gold Creek Area under Option A: Option A proposes that twin single span bridges (approximately 120 feet long) be constructed at the western edge of the Gold Creek floodplain. The area beneath these bridges would be above the high-pool elevation of Keechelus Lake, providing a passage opportunity along the lake shoreline at all water levels. Additionally, two multi-span bridges (approximately 900 feet long in the westbound direction and 1,100 feet long in the eastbound direction) would be constructed across the channel migration zone. The bridges would provide a clearance of at least 18 feet. Removal of existing roadbed within the channel migration zone would allow for channel migration, and would help to restore aquatic, riparian, and terrestrial habitat components. The area provided by these structures would allow for the movement of aquatic and wildlife species at lower water levels.

Gold Creek CEA under Option A

Gold Creek Area under Option B: Option B would construct multi-span bridges (approximately 1,000 feet long westbound and 1,200 feet long eastbound) across Gold Creek's channel migration zone. The bridges would provide a clearance of at least 18 feet. The existing road embankment would be removed to allow for normal channel migration, and would help to restore aquatic, riparian, and terrestrial habitat components. A 100-foot wide terrestrial connectivity bench would be constructed adjacent to the western abutments of both bridges, and extend across the northwest shoreline of Keechelus Lake to provide a location for the movement of aquatic and wildlife species year round.

Gold Creek CEA under Option B

Gold Creek Area under Option C: Twin single span bridges (approximately 120 feet long) would be constructed at the western edge of the Gold Creek floodplain under Option C. Both bridges would have a clearance of 12 feet. A 100-foot wide terrestrial connectivity bench would be constructed adjacent to the western abutments of both bridges and extend across the northwest shoreline of Keechelus Lake to provide a location for the movement of aquatic and wildlife species year round. Twin multi-span bridges (approximately 300 feet long) would be constructed across most of the active channel migration zone. Removal of existing road embankment would increase normal channel migration, and help restore the aquatic, riparian, and terrestrial habitat components.

Gold Creek CEA under Option C

2.4.7.2 TOWNSEND CREEK CEA

Connectivity in the Townsend Creek CEA would be improved by constructing a large-span bottomless culvert (10-foot to 30-foot span) that would provide for the movement of aquatic and willdife species.

Townsend Creek CEA Option

2.4.7.3 PRICE/NOBLE CREEKS CEA

Bridges would provide for channel migration, wetland connectivity, and the movement of aquatic and wildlife species. Methods to convey water through the roadbed will be incorporated within hydrologic connectivity zones. Specific locations have been identified as areas in which conveyance of water through the roadway is important. These areas are referred to as hydrologic connectivity zones, and would connect surface or subsurface flows, wetlands, seepage zones, or other hydrologic features not always directly associated with stream crossings. Depending on the level of hydrological conveyance needed, the methods used to accommodate this conveyance could range from areas of permeable fill, to culvert pipes, or large bottomless culverts.

The intent of the hydrologic connectivity zones is not to make the roadway prism through the entire project permeable; rather, they are site specific. Transport of runoff will be accomplished using traditional stormwater design features.

Currently, the westbound lanes access the Price Creek Sno-park facility during the winter. The eastbound lanes provide access to public toilets and have recently opened for year-round use. The enhancement options below offer solutions for improving connectivity within the Price/Noble Creeks CEA.

Price/Noble Creeks Area under Option A: Under Option A, twin single span bridges (approximately 120 feet long) would be constructed over a draw in the vicinity of MP 60.9, providing at least 18 feet of vertical clearance for the movement of animals through this area. Methods to convey water through the roadbed would be incorporated within the hydrologic connectivity zone near MP 61.0. Twin multi-span bridges (approximately 800 feet long) would be constructed over Price and Noble Creeks. Twin multi-span bridges (approximately 800 feet long) with a minimum vertical clearance of 18 feet would be constructed east of Noble Creek to encourage the movement of both surface and groundwater through the I-90 road prism. The rest area would be closed, the pavement at the Price Creek Sno-park would be removed, and the area would be restored to natural conditions.

Price/Noble Creeks CEA under Option A

Price/Noble Creeks Area under Option B: Option B would construct twin single span bridges (approximately 120 feet long) over a draw in the vicinity of MP 60.9, providing at least 18 feet of vertical clearance for the movement of animals through this area. Methods to convey water through the roadbed would be incorporated within the hydrologic connectivity zone near MP 61.0. Twin multi-span bridges (approximately 800 feet long) would be constructed over Price and Noble Creeks. Methods to encourage the movement of both surface and groundwater through the I-90 road prism within the hydrologic connectivity zone east of Noble Creek will be finalized upon further investigation. The rest area would be closed, the pavement at the Price Creek Sno-park will be removed, and the area would be restored to natural conditions.

Price/Noble Creeks CEA under Option B

Price/Noble Creeks Area under Option C: Twin single span bridges (approximately 120 feet long) would be constructed over a draw in the vicinity of MP 60.9, providing at least 18 feet of vertical clearance for the movement of animals through this area under Option C. Methods to convey water through the roadbed would be incorporated within the hydrologic connectivity zone near MP 61.0. Twin single span bridges (approximately 120 feet long) would be constructed over Price Creek and over Noble Creek. Methods to encourage the movement of both surface and groundwater through the I-90 road prism within the hydrologic connectivity zone east of Noble Creek will be finalized upon further investigation. The current Sno-park/public restroom facilities would remain under this option.

Price/Noble Creeks CEA under Option C

2.4.7.4 BONNIE CREEK CEA

Bridges would provide for channel migration, wetland connectivity, and the movement of aquatic and wildlife species. Methods to convey water through the roadbed would be incorporated within hydrologic connectivity zones. The enhancement options below offer solutions for improving connectivity within the Bonnie Creek CEA.

Bonnie Creek Area under Option A: Option A would construct twin multi-span bridges (approximately 600 feet long) with a minimum vertical clearance of 20 feet across Bonnie Creek and an unnamed creek 300 feet to the west. Methods to convey water through the roadbed would be incorporated within the hydrologic connectivity zone approximately 500 feet east of the bridge.

Bonnie Creek CEA under Option A

Bonnie Creek Area under Option B: Under Option B, twin two-span bridges (approximately 250 feet long) would be constructed across Bonnie Creek providing at least 12 feet of vertical clearance for the movement of animals through this area. Methods to promote the movement of both surface and groundwater through the I-90 road prism would be incorporated within the hydrologic connectivity zones approximately 500 feet east of the bridge and at the unnamed tributary west of the bridge.

Bonnie Creek CEA under Option B

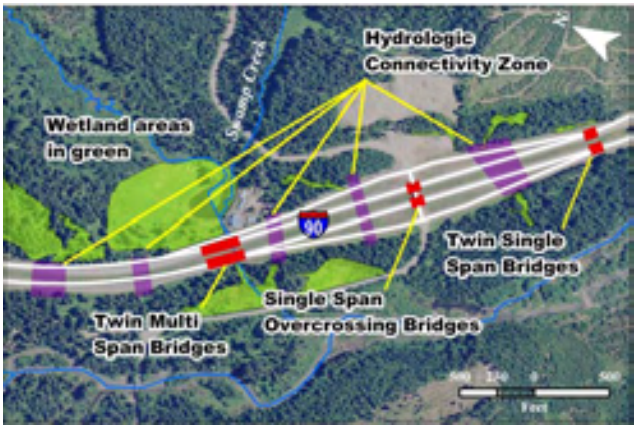
Bonnie Creek Area under Option C: Bottomless culverts that provide for fish passage would be constructed over Bonnie Creek under Option C. Methods to promote the movement of both surface and groundwater through the I-90 road prism would be incorporated within the hydrologic connectivity zone approximately 500 feet east of the bridge and at the unnamed tributary west of the bridge.

Bonnie Creek CEA under Option C

2.4.7.5 SWAMP CREEK CEA

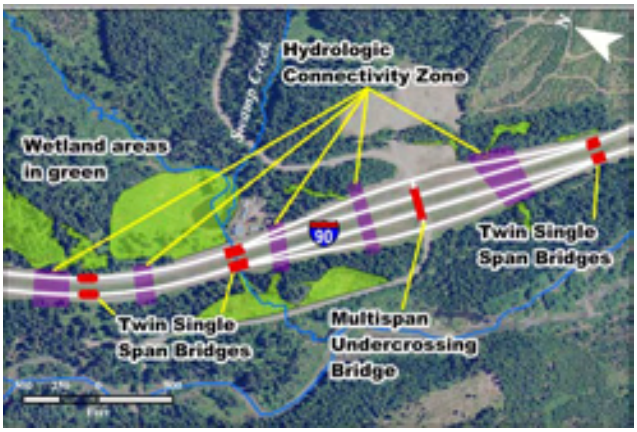
Bridges would provide for channel migration, wetland connectivity, and the movement of aquatic and wildlife species. The minimum recommended clearance for bridges over the interstate is 16.5 feet. The new bridge will meet or exceed this standard. Methods to convey water through the roadbed would be incorporated within hydrologic connectivity zones. The enhancement options below offer solutions for improving connectivity within the Swamp Creek CEA.

Swamp Creek Area under Option A: Twin multi-span bridges (approximately 250 feet long) with a minimum vertical clearance of 16.5 feet would be constructed over Swamp Creek under Option A. The I-90 profile would be raised, and the Stampede Pass Interchange would be reconstructed to an overcrossing (I-90 over Stampede Pass Road). Methods to promote the movement of both surface and groundwater through the I-90 road prism would be incorporated within the hydrologic connectivity zones. One set of twin single span bridges would be constructed in the location of the existing undercrossing, and another set of twin single span bridges (approximately 120 feet long) would be constructed at the east end of the interchange.



Swamp Creek CEA under Option A

Swamp Creek Area under Option B: Option B would construct twin single span bridges (approximately 120 feet long) across Swamp Creek. The highway's profile would be raised from 3 to 5 feet to increase the clearance over the creek. Methods to promote the movement of both surface and groundwater through the I-90 road prism would be incorporated within the hydrologic connectivity zones. Twin single span bridges (approximately 120 feet long) would be constructed at the east end of the interchange. The existing undercrossing would be replaced to meet current clearance standards. At the request of the USFS, twin single span bridges were added west of Swamp Creek near MP 62.5.



Swamp Creek CEA under Option B

Swamp Creek Area under Option C: Twin single span bridges (approximately 120 feet long) would be constructed across Swamp Creek under Option C. The highway's profile would remain approximately the same. Methods to promote the movement of both surface and groundwater through the I-90 road prism would be incorporated within the hydrologic connectivity zones. A bottomless culvert would be constructed at the east end of the interchange for conveying surface water. The existing undercrossing would be replaced to meet current clearance standards.

Swamp Creek CEA under Option C

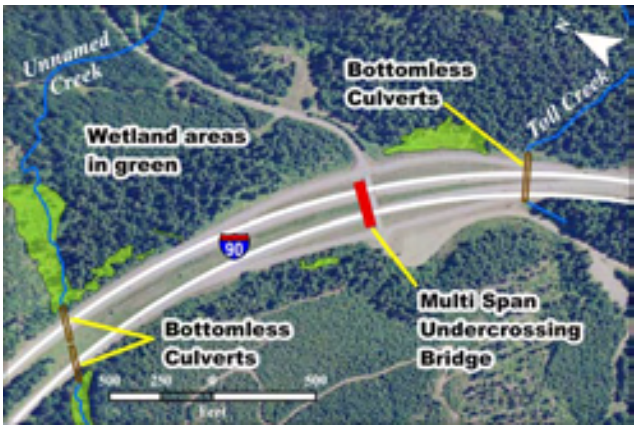
2.4.7.6 TOLL CREEK CEA

Bridges would provide for channel migration, wetland connectivity, and the movement of aquatic and wildlife species. Bottomless culverts would be used to convey water through the roadbed. The enhancement options below offer solutions for improving connectivity within the Toll Creek CEA.

Toll Creek Area under Options A and B: Options A and B would construct twin single span bridges (approximately 125 feet long) with a minimum vertical clearance of 16.5 feet at the unnamed creek west of the Cabin Creek Interchange to provide for the passage of aquatic and wildlife species. Twin bottomless culverts would be installed at Toll Creek that accommodate the hydraulic potential of the stream and permits the passage of debris. The existing undercrossing would be replaced to meet current clearance standards.

Toll Creek CEA under Options A and B

Toll Creek Area under Option C: Under Option C, twin bottomless culverts would be constructed at the unnamed creek west of the Cabin Creek Interchange to provide for the passage of aquatic and wildlife species. Twin bottomless culverts would be installed at Toll Creek that accommodate the hydraulic potential of the stream and permits the passage of debris. The existing undercrossing would be replaced to meet current clearance standards.



Toll Creek CEA under Option C

2.4.7.7 CEDAR CREEK CEA

Connectivity in the Cedar Creek CEA would be improved by constructing twin culverts that accommodate stream flow and permits the passage of debris.

Cedar Creek CEA Option

2.4.7.8 TELEPHONE CREEK CEA

Connectivity in the Telephone Creek CEA would be improved by constructing a culvert that accommodates stream flow and permits the passage of debris.

Telephone Creek CEA Option

2.4.7.9 HUDSON CREEK VICINITY CEA

Bridges would provide for channel migration, wetland connectivity, and the movement of aquatic and wildlife species. Culverts would be used to convey water through the roadbed. The enhancement options below offer solutions for improving connectivity within the Hudson Creek Vicinity CEA.

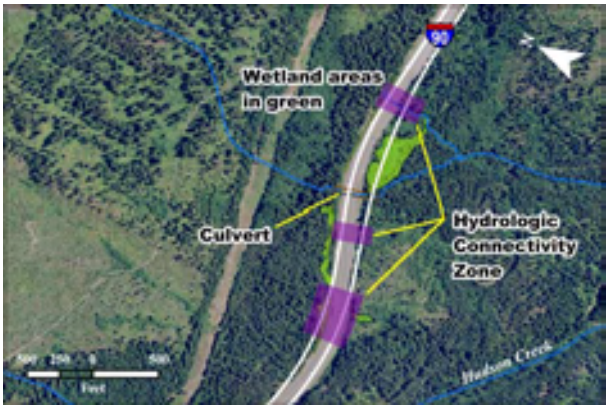
Hudson Creek Area Option A: Option A would construct twin two-span bridges (approximately 230 feet long) that provide at least 10 feet of vertical clearance over a tributary to Hudson Creek. Two hydrologic connectivity zones were identified in this area. Methods for conveying groundwater within these zones would be determined after further investigation and analysis.

Hudson Creek CEA under Option A

Hudson Creek Area Option B: Option B would construct twin single span bridges (approximately 120 feet long) that provide at least 10 feet of vertical clearance over a tributary to Hudson Creek. Three hydrologic connectivity zones were identified in this area. Methods for conveying groundwater within these zones would be determined after further investigation and analysis.

Hudson Creek CEA under Option B

Hudson Creek Area Option C: Option C would install a culvert (approximately 4 feet square) at the Hudson Creek tributary. Three hydrologic connectivity zones were identified in this area. Methods for conveying groundwater within these zones will be determined after further investigation and analysis.



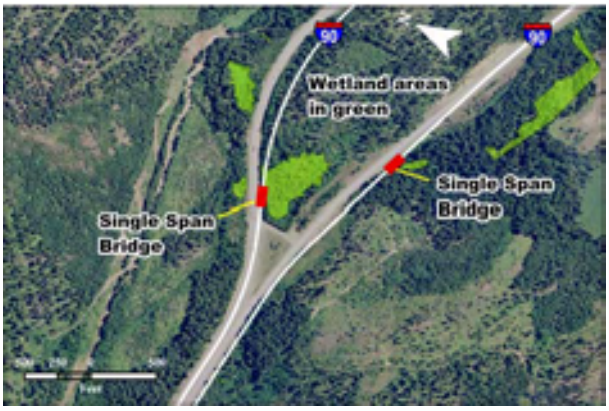
Hudson Creek CEA under Option C

2.4.7.10 EASTON HILL CEA

Bridges would provide for wetland connectivity and the movement of aquatic and wildlife species. Methods to convey water through the roadbed would be incorporated within hydrologic connectivity zones. Animal passage across I-90

is especially important in this section of the project, as well as the Gold Creek and Price/Noble CEAs. The enhancement options below offer solutions for improving connectivity within the Easton Hill CEA.

Easton Hill Area Option A: Under Option A, the westbound alignment would be reconstructed to accommodate a larger radius curve near the top of Easton Hill. A single span bridge (approximately 120 feet long) with a vertical clearance of at least 10 feet would be constructed on this new alignment over a draw that holds a wetland complex near MP 67.75. The eastbound alignment would be moved southward approximately 100 feet, and a single span bridge (approximately 120 feet long) with a vertical clearance of at least 16.5 feet would be constructed on this new alignment over the draw near MP 67.80.



Easton Hill CEA under Option A

Easton Hill Area Option B: Option B would construct an ecological connectivity structure over the highway at MP 67.5. This structure would promote the movement of aquatic and wildlife species over the roadway. Methods to promote the movement of both surface and groundwater through the I-90 road prism would be constructed in the westbound lanes near a wetland complex just east of MP 67.5.

Easton Hill CEA under Option B

Easton Hill Area Option C: Under Option C, the westbound alignment would be reconstructed to accommodate a larger radius curve near the top of Easton Hill. An ecological connectivity structure would be constructed over the westbound lanes of the highway at MP 68.0. The eastbound alignment would be moved southward approximately 100 feet, and a single span bridge (approximately 120 feet long) with a vertical clearance of at least 16.5 feet would be constructed on this new alignment over the draw near MP 67.80. Methods to promote the movement of both surface and groundwater through the I-90 road prism would be constructed in the westbound lanes near a wetland complex just east of MP 67.5.

Easton Hill CEA under Option C

2.4.7.11 KACHESS RIVER CEA

Kachess River Area Option A: Bridges over the Kachess River would be widened to accommodate additional lanes in both directions. These bridges would continue to provide for the movement of aquatic and wildlife species. This option would replace both the existing eastbound and westbound bridges over the county road at MP 69.0 with twin 120-foot long single span bridges. These bridges would provide for the movement of wildlife species along the county road under the interstate.

Kachess River CEA Option A

Kachess River Area Options B and C: This option would widen the bridges over the county road at MP 69.0 to accommodate an additional lane in the eastbound direction. The westbound bridge would also be widened or replaced with a bridge of the same length.

Kachess River CEA Options B and C

2.4.8 Improvement Packages

For purposes of analysis, the WSDOT project team and the IDT grouped roadway improvements with the CEA options into Improvement Packages. These Improvement Packages permit summary comparisons of the combined effects that could result from implementing roadway improvements and multiple CEA options throughout the I-90 corridor.

This structure (a long bridge) is representative of the structures described in Improvement Package A and would provide the greatest improvement in connectivity.

The approximate dimensions of each connectivity enhancement option is presented in Table 2-4.

The Improvement Packages presented here represent a range of permeability and cost. For example, the reader could expect that Improvement Package A could restore hydrologic and ecological connectivity at a higher price, while Improvement Packages B or C could enhance connectivity at a reduced level and cost.

This structure (a shorter bridge) is representative of the structures described in Improvement Package B and would provide a lesser level of connectivity than Improvement Package A, but more than Improvement Package C.

Table 2-4. Improvement Package Crossing Structure Attributes
(Page 1 of 4)

LOCATION	MILE POST	ATTRIBUTES	EXISTING STRUCTURE		Improvement Package A		Improvement Package B		Improvement Package C	
Gold Creek West	55.3	Structure Type	No Structure		Single Span Bridge[1]		No Structure		Single Span Bridge[1]	
		Length			120 feet approx.				120 feet approx.	
		Clearance			18 feet min.				12 feet min.	
		Width			62 feet				62 feet	
Gold Creek	55.5	Structure Type	Multi-Span Bridge Eastbound	Multi-Span Bridge Westbound	Multi-Span Bridge Eastbound	Multi-Span Bridge Westbound	Multi-Span Bridge Eastbound	Multi-Span Bridge Westbound	Multi-Span Bridge Eastbound	Multi-Span Bridge Westbound
		Length	126 feet	138 feet	1100 feet approx.	900 feet approx.	1200 feet approx.	1000 feet approx.	300 feet approx.	300 feet approx.
		Clearance	21 feet	20 feet	30 feet min.	30 feet min.	30 feet min.	30 feet min.	30 feet min.	30 feet min.
		Width	40 feet	40 feet	62 feet	62 feet	62 feet	62 feet	62 feet	62 feet
Townsend Creek	60.6	Structure Type	6 foot diam. Corrugated Metal Culvert		Large Span Bottomless Culvert[1]		Large Span Bottomless Culvert[1]		Large Span Bottomless Culvert[1]	
		Length	6 feet		16 feet approx.		16 feet approx.		16 feet approx.	
		Clearance	6 feet		10 feet approx.		10 feet approx.		10 feet approx.	
		Width	150 feet		75 feet		75 feet		75 feet	
Price/Noble Vicinity West	60.9	Structure Type	2 foot Culvert		Single Span Bridge[1]		Single Span Bridge[1]		Single Span Bridge[1]	
		Length	2 feet		120 feet approx.		120 feet approx.		120 feet approx.	
		Clearance	2 feet		18 feet min.		18 feet min.		18 feet min.	
		Width	150 feet		60 feet		60 feet		60 feet	
Price Creek	61.3	Structure Type	10 foot Box Culvert		Multi-Span Bridge[1]		Multi-Span Bridge[1]		Single Span Bridge[1]	
		Length	10 feet		800 feet approx.		800 feet approx.		120 feet approx.	
		Clearance	10 feet		18 feet min.		9 feet ave. 13 feet at creeks		13 feet min.	
		Width	200 feet		60 feet		60 feet		60 feet	

Table 2-4. Improvement Package Crossing Structure Attributes
(Page 2 of 4)

LOCATION	MILE POST	ATTRIBUTES	EXISTING STRUCTURE		Improvement Package A	Improvement Package B	Improvement Package C
Noble Creek	61.4	Structure Type	4 foot diam. Corrugated Metal Culvert		Multi Span Bridge for Price Creek Spans Noble Creek Also	Multi Span Bridge for Price Creek Spans Noble Creek Also	Single Span Bridge[1]
		Length	4 feet				120 feet approx.
		Clearance	4 feet				13 feet min.
		Width	250 feet				60 feet
Price/Noble Vicinity East[2]	61.8	Structure Type	2 foot diam. Culverts		Multi-Span Bridge[1]	Hydrologic Connectivity Zone – Conveyance methods and limits to be determined through further study.	Hydrologic Connectivity Zone – Conveyance methods and limits to be determined through further study.
		Length	2 feet		800 feet approx.		
		Clearance	2 feet		1 foot min.		
		Width	250 feet		60 feet		
Bonnie Creek West Fork	62.2	Structure Type	2 foot diam. Corrugated Metal Culvert		Multi-Span Bridge (Both Aligns)	Hydrologic Connectivity Zone – Conveyance methods and limits to be determined through further study.	Hydrologic Connectivity Zone – Conveyance methods and limits to be determined through further study.
		Length	2 feet		600 feet approx.		
		Clearance	2 feet		20 feet min.		
		Width	150 feet		60 feet		
Bonnie Creek East Fork[2]	62.3	Structure Type	6 foot X 6 foot Box Culvert	6 foot diam. Corrugated Metal Culvert	Multi Span Bridge Spans Both West and East Forks	Multi-Span Bridge[1]	Large Span Bottomless Culvert[1]
		Length	6 feet	6 feet		250 feet approx.	16 feet approx.
		Clearance	6 feet	6 feet		12 feet min.	10 feet. min.
		Width	150 feet	150 feet		60 feet	75 feet
Swamp Creek Vicinity West	62.5	Structure Type	No Structure		Hydrologic Connectivity Zone – Conveyance methods and limits to be determined through further study.	Single Span Bridge[1]	Hydrologic Connectivity Zone – Conveyance methods and limits to be determined through further study.
		Length				120 feet approx.	
		Clearance				12 feet min.	
		Width				60 feet	
Swamp Creek[2]	62.8	Structure Type	8 foot Double Box		Multi-Span Bridge[1]	Single Span Bridge[1]	Single Span Bridge[1]
		Length	16 feet		250 feet approx.	120 feet approx.	120 feet approx.
		Clearance	6 feet		15 feet min.	12 feet min.	12 feet min.
		Width	200 feet		84 feet	60 feet	60 feet

Table 2-4. Improvement Package Crossing Structure Attributes
(Page 3 of 4)

LOCATION	MILE POST	ATTRIBUTES	EXISTING STRUCTURE	Improvement Package		
				A	B	C
Swamp Creek Vicinity East	63.3	Structure Type	18 inch diam. Culvert	Single Span Bridge[1]	Single Span Bridge[1]	Large Span Bottomless Culvert[1]
		Length	1.5 feet	120 feet approx.	120 feet approx.	16 feet approx.
		Clearance	1.5 feet	10 feet min.	10 feet min.	10 feet min.
		Width	150 feet	84 feet	84 feet	75 feet
Toll Creek Vicinity West	63.6	Structure Type	8 foot X 8 foot Box Culvert	Single Span Bridge[1]	Single Span Bridge[1]	Large Span Bottomless Culvert[1]
		Length	8 feet	125 feet approx.	125 feet approx.	15 feet approx.
		Clearance	8 feet	15 feet min.	15 feet min.	12 feet min.
		Width	150 feet	60 feet	60 feet	75 feet
Toll Creek	64.2	Structure Type	4 foot diam. Conc. Culvert	Culvert	Culvert	Culvert
		Length	4 feet	6 feet approx.	6 feet approx.	6 feet approx.
		Clearance	4 feet	5 feet approx.	5 feet approx.	5 feet approx.
		Width	200 feet	225 feet	225 feet	225 feet
Cedar Creek	64.6	Structure Type	4 foot Box Culvert	Culvert[1]	Culvert[1]	Culvert[1]
		Length	4 feet	4 feet approx.	4 feet approx.	4 feet approx.
		Clearance	4 feet	4 feet approx.	4 feet approx.	4 feet approx.
		Width	150 feet	80 feet	80 feet	80 feet
Telephone Creek	65.6	Structure Type	5 foot X 4 foot Box Culvert	Culvert	Culvert	Culvert
		Length	5 feet	4 feet approx.	4 feet approx.	4 feet approx.
		Clearance	4 feet	4 feet approx.	4 feet approx.	4 feet approx.
		Width	150 feet	150 feet	150 feet	150 feet

Table 2-4. Improvement Package Crossing Structure Attributes
(Page 4 of 4)

LOCATION	MILE POST	ATTRIBUTES	EXISTING STRUCTURE		Improvement Package A		Improvement Package B		Improvement Package C	
Hudson Creek Vicinity East	67.2	Structure Type	2 foot diam. Conc. Culvert		Multi-Span Bridge[1]		Single Span Bridge[1]		Culvert	
		Length	2 feet		230 feet approx.		120 feet approx.		4 feet approx.	
		Clearance	2 feet		10 feet min.		10 feet min.		4 feet min.	
		Width	150 feet		72 feet		72 feet		180 feet	
Easton Hill	67.5	Structure Type	No Structure		Single Span Bridge[1]		Animal Overcrossing Structure[1]		Single Span Bridge Eastbound	Animal Overcrossing Structure Westbound
		Length			120 feet approx.		150 feet approx.		120 feet approx.	150 feet approx.
		Clearance			10 feet min.		N/A		15 feet min.	N/A
		Width			72 feet		250 feet		72 feet	150 feet
Lake Kachess Vicinity (County Road)	69.5	Structure Type	Single Span Bridge Eastbound	Single Span Bridge Westbound	Single Span Bridge[1]		Single Span Bridge Eastbound	Single Span Bridge Westbound	Single Span Bridge Eastbound	Single Span Bridge Westbound
		Length	28 feet	28 feet	120 feet approx.		28 feet	28 feet	28 feet	28 feet
		Clearance	15 feet	16 feet	17 feet min.		15 feet	16 feet	15 feet	16 feet
		Width	38 feet	50 feet	72 feet		60 feet	72 feet	60 feet	72 feet
Kachess River	69.8	Structure Type	Multi-Span Bridge Eastbound	Multi-Span Bridge Westbound	Widen Existing Bridge[1]		Widen Existing Bridge[1]		Widen Existing Bridge[1]	
		Length	99 feet	150 feet	99 feet	150 feet	99 feet	150 feet	99 feet	150 feet
		Clearance	13 feet	13 feet	13 feet	13 feet	13 feet	13 feet	13 feet	13 feet
		Width	38 feet	32 feet	60 feet	60 feet	60 feet	60 feet	60 feet	60 feet

Notes: 1. Identical bridges or culverts will be used for both eastbound and westbound alignments.
2. Additional culverts will be installed as required to convey surface water.
The dimensions shown are approximate, and were developed for preliminary evaluation and assessment of impacts. Actual bridge and culvert sizes will vary, depending on the topography and if additional clearance is needed on single span bridges, thin slab spans may be used to obtain clearance for bridge lengths of up to 80 feet.
Bottomless culverts will be included at locations where fish passage is required, and will be designed using standards required by WDFW and WSDOT. Culverts will be used in non-fish bearing streams and will be designed to the appropriate hydraulic standards. Additional hydrologic connectivity zones have been identified throughout the corridor. Specific attributes of hydrologic connectivity zones will be determined through field study and detailed design.

Quantifying the benefits of increased openness is difficult, while estimating construction costs is more easily accomplished. A higher level of openness requires larger bridges and culverts, and increases the roadway's overall profile, all of which equate to significantly higher costs (Table 2-5). A portion of these costs represents improvements that would be made for hydraulic conveyance and fish passage regardless of the desired connectivity benefits. However, alternatives that only meet minimal standards for water conveyance or fish passage have not been developed, and, therefore no comparison is provided to a "typical" project.

This structure (a bottomless culvert) is representative of Improvement Package C and would provide the least improvement in connectivity.

A full understanding of effective methods for providing habitat connectivity continues to evolve. Workable solutions are truly placement-based and are sensitive to the surrounding landscape. The consensus among wildlife biologists is that larger openings mimic a more natural condition and, therefore, will be more permeable to a greater number of species.

The packaging process allows the decision maker to determine the range of impacts and benefits that could occur by combining various connectivity options with roadway improvements for each CEA within the 15-mile-long project corridor.

The goal of Improvement Package A is to combine needed roadway improvements with connectivity enhancements that facilitates the movement of most species under the highway with a high degree of confidence. This Improvement Package features long bridges with enough clearance to allow for the establishment and growth of plants. The growth of plant communities under the bridges would encourage even low mobility species to successfully pass under the highway.

In contrast, Improvement Package C attempts to combine needed roadway improvements with connectivity enhancement to a level that facilitates the relative movement of most species, but at a reduced cost and with a lower degree of confidence. Improvement Package C features smaller bridges combined with large culverts; the culverts would be strategically placed within each CEA to promote connectivity to the fullest extent possible. Because most plants would not be able to establish and grow within these structures, low mobility species could be less successful at moving under the highway. Furthermore, animals in general may not find or voluntarily pass through these smaller structures. Similar structures have been used elsewhere in the country to move targeted species across roadway barriers with various degrees of success (Clevenger and Waltho 2000, Forma et al. 2003). It is likely that enough individuals of many species will successfully cross the highway to maintain minimal exchange among populations north and south of the highway.

Improvement Package B would provide connectivity at a higher level of confidence than Improvement Package C, but less than Improvement Package A.

Table 2-5. Improvement Package Cost Estimates

Proposed Elements	*Package A*	*Package B*	*Package C*
Costs at CEA[1] (Wall and Structure)			
Gold Creek	$17.9 million	$17.8 million	$7.8 million
Townsend Creek	$0.5 million	$0.5 million	$0.5 million
Price/Noble Creeks	$25.2 million	$12.1 million	$5.3 million
Bonnie Creek	$9.9 million	$8.0 million	$0.5 million
Swamp Creek	$10.5 million	$3.1 million	$1.5 million
Toll Creek	$2.5 million	$2.5 million	$1.0 million
Cedar Creek	$0.2 million	$0.2 million	$0.2 million
Telephone Creek	$0.1 million	$0.1 million	$0.1 million
Hudson Creek Vicinity	$2.5 million	$1.4 million	$0.1 million
Easton Hill Vicinity	$1.8 million	$1.4 million	$1.8 million
Lake Kachess Area	$2.0 million	$0.5 million	$0.5 million
Additional Embankment Costs[2]	$36 million	$18.3 million	0[5]
SUBTOTAL	**$109.1 million**	**$65.9 million**	**$19.3 million**
All Other Costs			
Wall and Structure Costs Outside of CEAs	$14.0 million	$14.0 million	$14.0 million
Roadway Costs[3]	$27.8 million	$28.0 million	$28.6 million
Other Costs[4]	$110.2 million	$109.4 million	$109.4 million
SUBTOTAL	**$152.0 million**	**$151.4 million**	**$152.0 million**
TOTAL	**$261.1 million**	**$217.3 million**	**$171.3 million**

Notes:
1. Estimated costs at CEAs include bridge structures, large culverts, and retaining walls, which represent the largest cost differential between Improvement Packages.
2. Additional embankment includes all necessary materials to build up the roadway to the higher bridges at the CEA.
3. Roadway costs include all surfacing, asphalt, and PCCP.
4. Other Costs includes all cut and fill, traffic control, and all other work items associated with the alternatives.
5. Baseline conditions.

Costs are current dollars based on January 2003 estimates. Costs did not take into account project phasing or construction scenarios.

The packaging process allows the decision maker to determine the range of impacts and benefits that could occur by combining various connectivity options with roadway improvements for each CEA within the 15-mile-long project corridor. Furthermore, the decisionmaker is not constrained to only these Improvement Packages. For example, the decisionmakers could conclude that Option A at Gold Creek be combined with Option C at Price/Noble Creeks and so on. The preferred alternative is likely to be formed by combining proposed roadway improvements with a unique combination of CEA options based on public and agency input, generating a more specific range of impacts and benefits.

2.4.9 Mitigation Development Team's Recommendations

The MDT recommended a set of three broad objectives, which they used in their evaluation of design options:

- Move toward proper functioning of hydrologic processes, and aquatic and terrestrial habitats. Improve the baseline condition of these processes and habitats.
- Increase the likelihood of persistence of local and regional native populations by reducing direct mortality, and improving highway permeability.
- Increase opportunities for movement of organisms between populations in order to reduce the risks associated with demographic isolation and reduced genetic variability.

They then evaluated how Options A, B, and C satisfied their recommended connectivity objectives, and how the options compared to current conditions. Options that the MDT believed did not adequately meet their connectivity objectives were noted accordingly. The MDT provided this information to assist decisionmakers as they consider a preferred alternative. WSDOT and Federal Highway Administration (FHWA) decisionmakers will consider the MDT's recommendations, together with public and agency comments, and other social, economic and environmental factors; those results are presented in Table 2-6.

Table 2-6. Results of MDT Analysis of Adequacy of Design Options

Connectivity Enhancement Areas	*Option A*	*Option B*	*Option C*
Gold Creek	Yes	Yes	No[1]
Price/Noble Creek Areas	Yes	Yes[2]	No[1]
Bonnie Creek	Yes	No	No
Swamp Creek	No	No[1]	No
Toll Creek	Yes	Yes	No
Hudson Creek/Amabalis Mountain	Yes	Yes	No
Easton Hill	Yes[3]	Yes[3]	Yes[3]

Notes: 1. Option does not meet objectives as analyzed, but could meet them if further analyzed and modified.
2. The MDT analyzed this option as if the Sno-park was removed and habitat was restored. If the Sno-park is retained, this option will not meet the objectives.
3. Indicates that additional modifications are necessary.

2.5 What decisions remain?

Figure 2-8 summarizes the process by which route alternatives and connectivity enhancement options were developed, evaluated, and selected. However, two elements of the proposed action require the decisionmaker's further consideration. The two decisions to be made by both the FHWA and the WSDOT include the following:

- Which proposed Keechelus Lake Alignment Alternative would be constructed?
- Which proposed connectivity enhancement option would be constructed in combination with other roadway improvements?

The answer to each of these questions is independent of the other; however, it is essential that a decision be made on both to create a true "build" alternative. Additionally, it is not necessary to tie any Improvement Package or Connectivity Enhancement Option to a specific Keechelus Lake Alignment Alternative in this Draft EIS. Once a preferred alignment alternative is chosen along Keechelus Lake, it will be matched with selected connectivity options to form a "comprehensive preferred alternative." This will occur with the publication of the Final EIS.

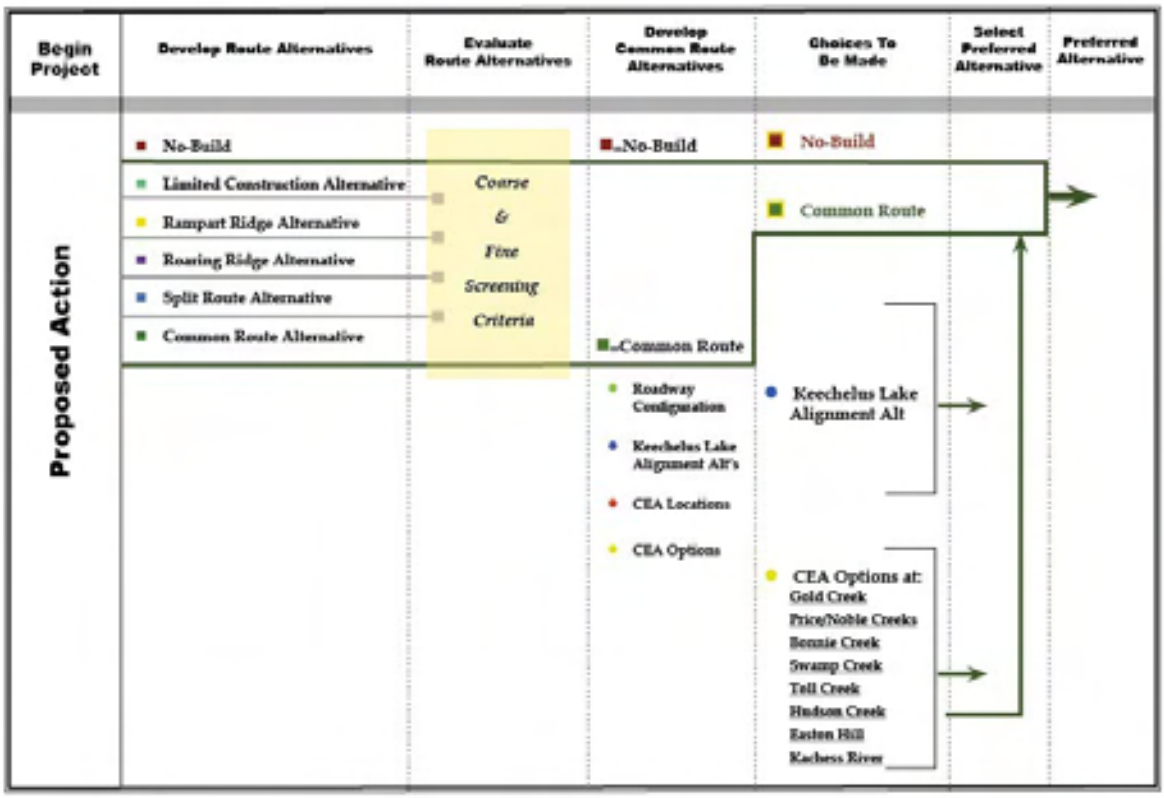


Figure 2-8. Process of Development, Evaluation, and Selection of Route Alternatives and Connectivity Enhancement Options

2.6 What environmental consequences may be expected from this project?

For most environmental resource areas, impacts can be avoided by incorporating specific measures into the design of each proposed alternative (i.e., "mitigation by design") and mitigation required by regulatory requirements. Mitigations required by regulation or agency guidance include permit requirements, Best Management Practices (BMPs), Washington regulatory requirements for fugitive dust and noise, burn permits, and Memorandum of Understanding between agencies.

During the initial development of this project, mitigation measures were included in the design parameters. Avoiding new impacts to natural resources was one of the top priorities guiding the development of the alternatives carried forward for further analysis. Specifically, mitigation by design for this project includes using approximately 70 percent of the existing 15-mile I-90 footprint, developing Improvement Packages to offset any new impacts from the project, providing for a vegetated median strip, and incorporating BMPs and other reasonable measures to address any environmental impacts during and after construction. Furthermore, integrating connectivity features throughout the corridor will reduce environmental consequences (i.e., by building bridges where earthen fill was originally proposed). Mitigations by design and regulatory permits are discussed in Chapter 3 for each resource area.

For some resource areas, additional mitigations are proposed and are discussed in Chapter 4. These are proposed because impacts occur to resource areas that were not addressed by project design. Specific proposed mitigations are:

- Wetlands. WSDOT will create, restore, or enhance wetlands to compensate for wetlands lost or significantly degraded as a result of the project.
- Fish, aquatic habitat, and threatened and endangered fish. WSDOT will restrict the size of explosive charges used in proximity of the Keechelus Lake shoreline, to minimize noise impacts to the federally threatened bull trout and other aquatic species. Furthermore, measures will be taken to exclude bull trout and other fish from pile-driving sites, and to minimize adverse impacts to bull trout habitat during and after construction.
- Historic, cultural, and archaeological resources. Depending on the chosen alternative, mitigation measures may be required for the Keechelus Lake Snowshed, which is on the National Register of Historic Places. Furthermore, archaeologists will monitor areas with high archaeological sensitivity during construction.
- Recreation resources. The Price Creek Sno-park would need to be relocated if connectivity enhancement option A or B were constructed at the Price/Noble Creek CEA. If one of these options is selected, the Price Creek Sno-park will be closed and replaced by expanding an existing Sno-park or by building a new Sno-park at one of several locations

currently being evaluated. Other Sno-parks along the corridor are at or near capacity on busy weekends. Full use of these facilities will be maintained during winter months.

- Table 2-7 summarizes the significant environmental impacts associated with the Keechelus Lake Alignment Alternatives and the Improvement Packages. For some resources, temporary construction-related impacts can be expected under all action alternatives and are summarized in Table 2-8. Many of these short-term impacts will be mitigated by design and regulatory permits. Under the No-Build Alternative, construction-related impacts are not anticipated although routing surfacing and maintenance operations would occur.

For many ecological resources, the long-term benefits of the Keechelus Lake Alignment Alternatives and the Improvement Packages far outweigh the short-term impacts of construction. For water resources, wetlands, and aquatic species, these benefits include increased hydrologic connectivity; improved sediment transport; greater stream migration and channel stability; decreased stream velocities; increased floodplain area; and improved groundwater flow and recharge in floodplains. Benefits to wildlife include increased habitat and ecological connectivity; improved habitat conditions; facilitation of movement under the highway with bridges and culverts; and improved wildlife access to Keechelus Lake in the tunnel alternatives.

Table 2-7. Summary of Impacts
(Page 1 of 7)

KEECHELUS LAKE ALIGNMENT ALTERNATIVES					IMPROVEMENT PACKAGES		
No-Build Alternative	***Alternative 1: Long Tunnels***	***Alternative 2: Short Tunnels***	***Alternative 3: Short Tunnel Westbound, No Tunnel Eastbound***	***Alternative 4: Traffic around Slide Curve***	***A***	***B***	***C***
GEOLOGY AND SOILS							
Avalanche hazards would continue, especially near the Slide Curve. Hazards due to slope degradation would continue. Impacts to soft and loose soil conditions from maintenance activities would continue.	No adverse impacts. Total disturbed footprint would be 50 acres; 38 acres of abandoned roadway would be reclaimed. Rockfall protection is needed at the tunnel portals.	No adverse impacts. Total disturbed footprint would be 82 acres; 21 acres of abandoned roadway would be reclaimed. Rockfall protection is needed at the tunnel portals and at areas described where there are rockfall hazards.	No adverse impacts. Total disturbed footprint would be 99 acres; 13 acres of abandoned roadway would be reclaimed. Rockfall protection is needed at the tunnel portals and at areas described where there are rockfall hazards.	No adverse impacts. Total disturbed footprint would be 94 acres; 5 acres of abandoned roadway would be reclaimed. Rockfall protection is needed at areas described where there are rockfall hazards.	No adverse impacts. Total disturbed footprint would be 377 acres, while 29 acres of abandoned roadway would be reclaimed.	No adverse impacts. Total disturbed footprint would be 405 acres, while 16 acres of abandoned roadway would be reclaimed.	No adverse impacts. Total disturbed footprint would be 405 acres, while 7 acres of abandoned roadway would be reclaimed.
AIR QUALITY							
Predicted increases in carbon monoxide (CO) and toxic air pollutants due to increased traffic would remain below National Ambient Air Quality Standards (NAAQS).	No adverse impacts. No operational emissions would exceed ambient air quality standards. Predicted increases in CO and toxic air pollutants due to increased traffic would remain below NAAQS.	No adverse impacts. No operational emissions would exceed ambient air quality standards. Predicted increases in CO and toxic air pollutants due to increased traffic would remain below NAAQS.	No adverse impacts. No operational emissions would exceed ambient air quality standards. Predicted increases in CO and toxic air pollutants due to increased traffic would remain below NAAQS.	No adverse impacts. No operational emissions would exceed ambient air quality standards. Predicted increases in CO and toxic air pollutants due to increased traffic would remain below NAAQS.	No adverse impacts.		

Table 2-7. Summary of Impacts
(Page 2 of 7)

KEECHELUS LAKE ALIGNMENT ALTERNATIVES					IMPROVEMENT PACKAGES		
No-Build Alternative	***Alternative 1: Long Tunnels***	***Alternative 2: Short Tunnels***	***Alternative 3: Short Tunnel Westbound, No Tunnel Eastbound***	***Alternative 4: Traffic around Slide Curve***	***A***	***B***	***C***
WATER RESOURCES							
Existing impacts to water resources from highway operation and maintenance would continue. Environmental degradation associated with stream instability due to poor road condition would continue.	No adverse impacts. 11.7 acres of aquatic and shoreline habitat would be filled in Keechelus Lake. The total disturbed footprint would be 50 acres. 38 acres of abandoned roadway would be reclaimed. The exposed impervious surface would be 22 acres.	No adverse impacts. 16.2 acres of aquatic and shoreline habitat would be filled in Keechelus Lake. The total disturbed footprint would be 82 acres. 21 acres of abandoned roadway would be reclaimed. The exposed impervious surface would be 40 acres.	No adverse impacts. 21.1 acres of aquatic and shoreline habitat would be filled in Keechelus Lake. The total disturbed footprint would be 99 acres. 13 acres of abandoned roadway would be reclaimed. The exposed impervious surface would be 46 acres.	No adverse impacts. 17.5 acres of aquatic and shoreline habitat would be filled in Keechelus Lake. The total disturbed footprint would be 94 acres. 5 acres of abandoned roadway would be reclaimed. The exposed impervious surface would be 52 acres.	No adverse impacts. 5.8 acres of aquatic and shoreline habitat would be filled in Keechelus Lake. 0.6 acre would be filled in Lake Easton. The total disturbed footprint would be 377 acres. 29 acres of abandoned roadway would be reclaimed. The exposed impervious surface would be 170 acres.	No adverse impacts. 5.2 acres of aquatic and shoreline habitat would be filled in Keechelus Lake. 0.6 acre would be filled in Lake Easton. The total disturbed footprint would be 405 acres. 16 acres of abandoned roadway would be reclaimed. The exposed impervious surface would be 170 acres.	No adverse impacts. 4.3 acres of aquatic and shoreline habitat would be filled in Keechelus Lake. 0.6 acre would be filled in Lake Easton. The total disturbed footprint would be 405 acres. 7 acres of abandoned roadway would be reclaimed. The exposed impervious surface would be 170 acres.
WETLANDS							
No wetland loss.	5.3 acres of Category II and 0.4 acre of Category III wetlands would be impacted.	4.7 acres of Category II and 0.5 acre of Category III wetlands would be impacted.	7.7 acres of Category II and 0.6 acre of Category III wetlands would be impacted.	4.4 acres of Category II and 0.5 acre of Category III wetlands would be impacted.	0.8 acre of Category I, 5.5 acres of Category II, and 2.3 acres of Category III wetlands would be impacted.	0.6 acre of Category I, 4.7 acres of Category II, and 2.1 acres of Category III wetlands would be impacted.	1.0 acre of Category I, 4.1 acres of Category II, and 2.1 acres of Category III wetlands would be impacted.

Table 2-7. Summary of Impacts
(Page 3 of 7)

KEECHELUS LAKE ALIGNMENT ALTERNATIVES					IMPROVEMENT PACKAGES		
No-Build Alternative	***Alternative 1: Long Tunnels***	***Alternative 2: Short Tunnels***	***Alternative 3: Short Tunnel Westbound, No Tunnel Eastbound***	***Alternative 4: Traffic around Slide Curve***	***A***	***B***	***C***
FISH, AQUATIC HABITAT, AND THREATENED AND ENDANGERED FISH SPECIES							
No aquatic and shoreline habitat would be lost in Keechelus Lake or Lake Easton. No riparian habitat would be lost. No improved conditions to hydrologic connectivity or habitat for fish and other aquatic species. Continued short-term adverse effects from periodic maintenance. Continued use of high levels of traction sand and deicers, which can migrate into aquatic habitats and negatively impact fish.	Potential impacts to federally threatened bull trout and habitat in Keechelus Lake due to noise from blasting or pile driving. 11.7 acres of aquatic and shoreline habitat would be filled in Keechelus Lake. 0.9 acre of riparian habitat would be lost. Minimal use of traction sand and deicers.	Potential impacts to federally threatened bull trout and habitat in Keechelus Lake due to noise from blasting or pile driving. 16.2 acres of aquatic and shoreline habitat would be filled in Keechelus Lake. 1.0 acre of riparian habitat would be lost. Moderate use of traction sand and deicers.	Potential impacts to federally threatened bull trout and habitat in Keechelus Lake due to noise from blasting or pile driving. 21.1 acres of aquatic and shoreline habitat would be filled in Keechelus Lake. 1.0 acre of riparian habitat would be lost. Moderate to heavy use of traction sand and deicers.	Potential impacts to federally threatened bull trout and habitat in Keechelus Lake due to noise from blasting or pile driving. 17.5 acres of aquatic and shoreline habitat would be filled in Keechelus Lake. 0.6 acre of riparian habitat would be lost. Heavy use of traction sand and deicers.	No adverse impacts. 5.8 acres of aquatic and shoreline habitat would be filled in Keechelus Lake. 0.6 acre would be filled in Lake Easton. 1.7 acres of riparian habitat would be lost.	No adverse impacts. 5.2 acres of aquatic and shoreline habitat would be filled in Keechelus Lake. 0.6 acre would be filled in Lake Easton. 1.2 acres of riparian habitat would be lost.	No adverse impacts. 4.3 acres of aquatic and shoreline habitat would be filled in Keechelus Lake. 0.6 acre would be filled in Lake Easton. 1.6 acres of riparian habitat would be lost.

Table 2-7. Summary of Impacts
(Page 4 of 7)

KEECHELUS LAKE ALIGNMENT ALTERNATIVES					IMPROVEMENT PACKAGES		
No-Build Alternative	***Alternative 1: Long Tunnels***	***Alternative 2: Short Tunnels***	***Alternative 3: Short Tunnel Westbound, No Tunnel Eastbound***	***Alternative 4: Traffic around Slide Curve***	***A***	***B***	***C***
TERRESTRIAL SPECIES							
No loss of terrestrial habitat. No improved conditions for species movement or habitat connectivity.	No adverse impacts. 35 acres of terrestrial habitat would be lost, including 1 acre of mature forest. Potential increase in roadkill due to widened roadway and increased design speeds.	No adverse impacts. 53 acres of terrestrial habitat would be lost, including 3 acres of mature forest. Potential increase in roadkill due to widened roadway and increased design speeds.	No adverse impacts. 61 acres of terrestrial habitat would be lost, including 3 acres of mature forest. Potential increase in roadkill due to widened roadway and increased design speeds	No adverse impacts. 54 acres of terrestrial habitat would be lost, including 2 acres of mature forest. Potential increase in roadkill due to widened roadway and increased design speeds.	No adverse impacts. 214 acres of terrestrial habitat would be lost, including 24 acres of mature forest.	No adverse impacts. 210 acres of terrestrial habitat would be lost, including 22 acres of mature forest.	No adverse impacts. 212 acres of terrestrial habitat would be lost, including 24 acres of mature forest.
TRANSPORTATION							
More frequent and substantial congestion and delays would be expected into the future due to roadway rehabilitation, routine maintenance, and increased traffic growth. Avalanche control would continue.	No adverse impacts. High tunnel maintenance requirements. Increased snowplowing with increased lanes and bridges. No avalanche control needed.	No adverse impacts. High tunnel maintenance requirements. Increased snowplowing with increased lanes and bridges. Infrequent avalanche control.	No adverse impacts. High tunnel maintenance requirements. Increased snowplowing with increased lanes and bridges. Infrequent avalanche control.	No adverse impacts. Increased snowplowing with increased lanes and bridges. Infrequent avalanche control.	No adverse impacts. Significant increased maintenance efforts at new bridges.	No adverse impacts. Moderate increase in maintenance efforts at new bridges.	No adverse impacts. Minor increase in maintenance efforts at new bridges.

Table 2-7. Summary of Impacts
(Page 5 of 7)

KEECHELUS LAKE ALIGNMENT ALTERNATIVES					IMPROVEMENT PACKAGES		
No-Build Alternative	***Alternative 1: Long Tunnels***	***Alternative 2: Short Tunnels***	***Alternative 3: Short Tunnel Westbound, No Tunnel Eastbound***	***Alternative 4: Traffic around Slide Curve***	***A***	***B***	***C***
NOISE							
Vehicular circulation on I-90 will continue to increase, so traffic noise will increase annually.	No adverse impacts. Vehicular circulation on I-90 will continue to increase; future traffic noise levels were estimated to be similar to the No-Build Alternative.	No adverse impacts. Vehicular circulation on I-90 will continue to increase; future traffic noise levels were estimated to be similar to the No-Build Alternative.	No adverse impacts. Vehicular circulation on I-90 will continue to increase; future traffic noise levels were estimated to be similar to the No-Build Alternative.	No adverse impacts. Vehicular circulation on I-90 will continue to increase; future traffic noise levels were estimated to be similar to the No-Build Alternative.	No adverse impacts. Future traffic noise levels would be similar among Improvement Packages.		
HISTORIC, CULTURAL, AND ARCHAEOLOGICAL RESOURCES							
No adverse impacts.	Management of National Register of Historic Places (NRHP)-listed Lake Keechelus Snowshed Bridge will be coordinated with Washington SHPO.	Management of NRHP-listed Lake Keechelus Snowshed Bridge will be coordinated with Washington SHPO.	Management of NRHP-listed Lake Keechelus Snowshed Bridge will be coordinated with Washington SHPO.	Management of NRHP-listed Lake Keechelus Snowshed Bridge will be coordinated with Washington SHPO.	Potential impact to 1 NRHP-eligible archaeological resource.		
RECREATION RESOURCES							
Decreased user enjoyment expected in the future with continued deterioration of the roadway, and increasing traffic volumes and delays.	No adverse impacts.	No adverse impacts.	No adverse impacts.	No adverse impacts.	No adverse impacts. Price Creek Sno-park would be removed.	No adverse impacts. Price Creek Sno-park would be removed.	No adverse impacts.

Table 2-7. Summary of Impacts
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KEECHELUS LAKE ALIGNMENT ALTERNATIVES					IMPROVEMENT PACKAGES		
No-Build Alternative	***Alternative 1: Long Tunnels***	***Alternative 2: Short Tunnels***	***Alternative 3: Short Tunnel Westbound, No Tunnel Eastbound***	***Alternative 4: Traffic around Slide Curve***	***A***	***B***	***C***
LAND USE							
Land use patterns, ownership, plans, and regulations would not change.	No adverse impacts.	No adverse impacts.	No adverse impacts.	No adverse impacts.	No adverse impacts. One property in the Swamp Creek CEA would be potentially affected (1 building relocated, and ownership changed from private to public land).		
VISUAL QUALITY							
Visual quality rating of 5.31, on scale of 0 (very low visual quality) to 7 (very high visual quality).	No adverse impacts. Visual quality rating of 5.02. Lower rating due to views within tunnel.	No adverse impacts. High visual quality rating of 5.68.	No adverse impacts. High visual quality rating of 5.55.	No adverse impacts. High visual quality rating of 5.47.	No adverse impacts. High visual quality rating of 5.26, compared to baseline of 4.88.	No adverse impacts. High visual quality rating of 5.18, compared to baseline of 4.88.	No adverse impacts. High visual quality rating of 5.11, compared to baseline of 4.88.
SOCIAL AND ECONOMIC RESOURCES							
Existing socioeconomic trends would continue, including degradation of public services and increased cost of road closures.	No adverse impacts. Construction costs of $470 million would generate about 5,590 direct jobs and 13,890 total jobs over the life of the project. Total output generated to the state is estimated at $860 million.	No adverse impacts. Construction costs of $310 million would generate about 3,800 direct jobs and 9,460 total jobs over the life of the project. Total output generated to the state is estimated at $580 million.	No adverse impacts. Construction costs of $240 million would generate about 2,850 direct jobs and 7,090 total jobs over the life of the project. Total output generated to the state is estimated at $440 million.	No adverse impacts. Construction costs of $140 million would generate about 1,670 direct jobs and 4,140 total jobs over the life of the project. Total output generated to the state is estimated at $260 million.	No adverse impacts. Construction costs of $260 million would generate about 3,210 direct jobs and 7,980 total jobs over the life of the project. Total output generated to the state is estimated at $490 million.	No adverse impacts. Construction costs of $220 million would generate about 2,380 direct jobs and 5,910 total jobs over the life of the project. Total output generated to the state is estimated at $360 million.	No adverse impacts. Construction costs of $170 million would generate about 2,020 direct jobs and 5,020 total jobs over the life of the project. Total output generated to the state is estimated at $310 million.

Table 2-7. Summary of Impacts
(Page 7 of 7)

KEECHELUS LAKE ALIGNMENT ALTERNATIVES					IMPROVEMENT PACKAGES		
No-Build Alternative	***Alternative 1: Long Tunnels***	***Alternative 2: Short Tunnels***	***Alternative 3: Short Tunnel Westbound, No Tunnel Eastbound***	***Alternative 4: Traffic around Slide Curve***	***A***	***B***	***C***
HAZARDOUS MATERIALS AND WASTE							
No known hazardous materials sites are within 1 mile of the ROW.	No adverse impacts. No known hazardous materials sites are within 1 mile of the ROW.	No adverse impacts. No known hazardous materials sites are within 1 mile of the ROW.	No adverse impacts. No known hazardous materials sites are within 1 mile of the ROW.	No adverse impacts. No known hazardous materials sites are within 1 mile of the ROW.	No adverse impacts. Nine hazardous materials sites are within 2 miles of some CEAs. However, no identified sites have the potential to impact soil or groundwater during construction or operation.		
ENERGY							
No adverse impacts.	No adverse impacts.	No adverse impacts.	No adverse impacts.	No adverse impacts.	No adverse impacts.	No adverse impacts.	No adverse impacts.

Table 2-8. Summary of Potential, Temporary Construction-related Impacts

Resource Area	*Temporary Impacts*
Geology and Soils	Increased avalanche hazard; increased landslide hazards during tunnel excavation and cut-slopes; and increased water and soil erosion during tunnel construction.
Air Quality	Temporary and intermittent combustive and fugitive dust emissions and other odorous emissions. No operational emissions would exceed ambient air quality standards.
Water Resources	Flow alterations; increased runoff; decreased water quality; impaired channel function; and disturbance to floodplains.
Wetlands	Decreased water quality; disturbance to fringe wetlands at Keechelus Lake.
Fish, Aquatic Habitat, and Threatened and Endangered Fish	Increased sediment; ground disturbance to amphibians; habitat disturbance; and displacement of fish and other aquatic species during culvert replacement.
Terrestrial Species	Changes in habitat use to avoid disturbance, such as noise; displacement; increased stress; desertion of den or nest sites; mortality to small, less mobile species; and lakebed disturbance could reduce prey for bald eagle and osprey.
Transportation	Traffic congestion and delays expected during construction. Construction would require lane closures; detours April to October; traffic separated from construction zones during winter; and traffic to be stopped during blasting.
Noise	Noise levels due to construction equipment are estimated to be 88 A-weighted decibels (dBA) equivalent sound level (L_{eq}) and 91 dBA (L_{10}[3]) measured at 50 feet. Cabins near Wolfe Creek and Resort Creek are likely to experience increased noise during tunnel construction.
Recreation Resources	User enjoyment may decrease with construction-related impacts such as traffic delays; increased noise levels; exit closures and detours; and increased driving time.
Land Use	Temporary changes to access roads; Lake Easton State Park; and a WSDOT maintenance facility.
Visual Resources	Temporary impacts as a result of construction include visual elements including night construction lights, blasting, bridge scaffolding, construction signs, detours, fencing, and vegetation removal.