Oregon State Highway 35

Mount Hood Loop
Oregon Forest Highway 49

Feasibility Study

Prepared by:

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In partnership with:

The Mount Hood National Forest, Hood River Ranger District,of the United States Forest Service

and

The Oregon Department of Transportation

and

The Federal Highway Administration, Oregon Division

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Executive Summary

The Oregon Department of Transportation and the United States Forest Service requested that the Western Federal Lands Highway Division of the Federal Highway Administration conduct a feasibility study for seven damage prone sites along Oregon State Highway 35. This study was conducted in response to growing concern over the ongoing need for the emergency repair of debris flow damage along a 32 km (20-mile) stretch of Highway 35 between White River at milepost 61.7 and Baseline Road at milepost 80. Damage caused by debris flows emanating from the slopes of Mount Hood above Highway 35 has resulted in the need for frequent and costly repairs over the last 20-30 years. The repairs have placed a severe burden on the limited resources available for undertaking road maintenance activities and have had negative impacts on the natural environment. The study included the following seven historically damaged sites: White River (MP 61.7), Clark Creek (MP 65.9), Newton Creek (MP 67.5), The Narrows (MP 73), Polallie Creek (MP 74), Dog River (MP 78), and Baseline Road (MP 80). Refer to Figures i and ii.

The purpose of the study was to identify and evaluate feasible alternatives for each site that would either reduce the severity of the debris flow problem or completely eliminate it. The study included a wide range of solutions including both on site solutions, alternative alignments, and alternative routes. A 'feasible alternative' is defined as an alternative that could be built within the framework of the project objectives. The project objectives, against which the alternatives for each site are evaluated, are as follows:

- enhance and protect the White River Wild and Scenic River;
- enhance the natural floodplain;
- minimize impacts to visual resources;
- minimize impacts to terrestrial habitat;
- reduce maintenance and emergency repair;
- improve safety;
- optimize life cycle costs; and
- maintain travel time.

This study is intended for planning purposes and is not considered a decision document as defined under the National Environmental Policy Act. It is intended for use by the Oregon Department of Transportation and the United States Forest Service as a 'spring board' for future projects in the study area. The Oregon Department of Transportation and the United States Forest Service may select some of the conceptual alternatives identified in this report for further analysis. Alternatives selected for further analysis would fit into one of two categories: 1) likely to qualify for federal emergency relief funds, 2) requiring funding mechanisms/strategies other than federal emergency relief funds. Alternatives that are likely to qualify for federal emergency relief funding could be designed, placed 'on the shelf', and be ready for implementation at the time of an event. Alternatives that require funding mechanisms other than federal emergency relief funds, and which are likely to be more complex solutions (such as realignments), could be pursued concurrently and implemented proactively.

All seven of the study sites have required maintenance/emergency repair as a result of debris flows/flooding within the last five years. Land managers are guided by existing management plans for the road corridor and surrounding land. Management plans include the White River National Wild and Scenic River Management Plan and the Oregon Department of Transportation's Highway 35 Corridor Plan. Both of which discuss the existing impediment of floodplain functions by Highway 35. The White River Wild and Scenic River Management Plan states 'if the Highway 35 Bridge should be severely damaged or destroyed through a natural event, the bridge should be reconstructed in a manner that allows for the relatively unimpeded flow of debris torrents and glacial outwash floods that normally influence the river channel and the river's hydrologic regime' (USFS 1994, Pg. 31). The Highway 35 Corridor Plan identifies one of the management objectives for the Highway 35 corridor as 'to identify and evaluate long-term programs to restore fish populations and improve water quality including the feasibility of relocating Highway 35 away from the river' (ODOT 1999, Pg. III.26).

The study sites are shaped by geological, meteorological, and hydrological processes originating primarily on Mount Hood that result in debris flows, floods, and rock fall. Local weather conditions including, long term and cyclic changes in climate that affect the advance and retreat of the glaciers are also extremely important in the development of events that impact the study sites.

Major resource issues that need to be considered when analyzing the alternatives identified for each of the study sites are: The East Fork Hood River and its tributaries are habitat for protected fish species including steelhead, coho, and cutthroat trout. A rare and endemic plant species, violet suksdorfia, is present in The Narrows. Late Successional Reserve and northern spotted owl nest sites are present in close proximity to several of the study sites. The Barlow Road National Historic District, part of the Oregon Trail, is located in the vicinity of the White River site. Pete's Pile, a unique and irreplaceable climbing area, is located in The Narrows.

In developing the alternatives, the study team utilized the expertise of the United States Geological Service, the United States Forest Service, the Oregon Department of Transportation, and the Federal Highway Administration in the fields of geomorphology, geology, hydrology, environment, and highway design. In addition, the study team contacted other key agencies and potentially affected interests for their comments and input on the study. All comments received from agencies and other potentially affected interests were considered by the study team, incorporated into the alternatives as appropriate, and addressed. Key issues were the desire to improve the floodplain functions and protect the road by moving it out of the East Fork Hood River and White River floodplains, and concern that travel time along the highway should not be extended.

Alternatives were developed at a conceptual level based on a reconnaissance level of data collection. Once identified, alternatives were analyzed relative to their predicted impacts on existing resources and rated relative to the study objectives. The alternatives identified for each site and their estimated project development and construction costs are given in the following tables. Those that appear to best meet the objectives are marked with an astrix. In undertaking the analysis, all objectives are valued equally.

Alternatives: White River	**Objectives**	Enhance & protect the WR WSR	Enhance the natural floodplain	Minimize impacts to visual resources	Minimize impacts to terrestrial habitat	Reduce maintenance & emergency repair	Improve safety	Optimize life cycle costs	Maintain travel time	**Estimated Cost ($)**
1) Maintain Existing Condition		○	○	◖	●	○	○	◖	●	1,500,000/20 yrs
2) Preventative maintenance		○	○	◖	●	○	○	◖	●	2,000,000/20 yrs
* 3) Raise Road and Lengthen Bridge		●	◖	◖	●	◖	●	○	●	14,100,000
4) Realign Upstream		◖	◖	◖	○	◖	●	○	◖	17,100,000
5) Tunnel		●	●	◖	◖	○	◖	○	●	29,900,000
6) Encased Highway		●	●	◖	◖	○	◖	○	●	25,900,000
7) Realign 1 Km Downstream		◖	◖	◖	○	◖	●	○	◖	35,100,000
8) Realign 4 Km Downstream		◖	◖	◖	○	◖	●	○	◖	22,000,000
9) Bypass		●	●	◖	○	○	◖	○	○	31,500,000

● = best meets objective; ◖ = partially meets objective; ○ = does not meet objective

Alternatives: Clark Creek / Objectives	Enhance & protect the WR WSR	Enhance the natural floodplain	Minimize impacts to visual resources	Minimize impacts to terrestrial habitat	Reduce maintenance & emergency repair	Improve safety	Optimize life cycle costs	Maintain travel time	Estimated Cost ($)
1) Maintain Existing Condition	N/A	○	◖	◖	○	○	◖	●	280,000/ 20 yrs
2) Riprap Existing Stream Bank and Culverts	N/A	○	◖	◖	○	○	◖	●	330,000
3) Armored Dry Channel	N/A	○	○	○	◖	◖	○	●	2,000,000
* 4) Bypass	N/A	●	●	○	●	●	○	◖	13,400,000
* 4A) Bypass	N/A	◖	●	○	●	●	○	◖	14,700,000
* 5) Raised Roadway with Intermittent Channel Crossings	N/A	◖	◖	◖	◖	◖	○	●	4,900,000
* 6) Raised Roadway on Permeable Embankment	N/A	◖	◖	◖	◖	◖	○	●	3,700,000
* 7) Bridge	N/A	◖	◖	●	◖	◖	○	●	900,000
Alternatives: Newton Creek Note: Alternatives 3), 4), 4A), 5), and 6) would address both the Newton and Clark Ck sites.									
1) Maintain Existing Condition	N/A	○	◖	◖	○	○	◖	●	3,000,000/ 20 yrs
2) Riprap Existing Stream Bank and Culverts	N/A	○	◖	◖	○	○	◖	●	3,080,000
3) Armored Dry Channel	N/A	○	○	○	◖	◖	●	●	1,200,000
* 4) Bypass	N/A	●	●	○	●	●	○	◖	13,400,000
* 4A) Bypass	N/A	◖	●	○	●	●	○	◖	14,700,000
* 5) Raised Roadway with Intermittent Channel Crossings	N/A	◖	◖	◖	◖	◖	◖	●	2,900,000
* 6) Raised Roadway on Permeable Embankment	N/A	◖	◖	◖	◖	◖	◖	●	2,200,000
Alternatives: The Narrows Note: Alt. 5) would affect both the Polallie and Narrows sites; Alt. 4 would affect four sites (Narrows, Polallie, Dog River, and Baseline.									
1) Maintain Existing Condition	N/A	○	◖	●	○	○	◖	●	750,000 / 20 yrs
2) Raised Roadway with Retaining Wall	N/A	○	◖	●	◖	◖	○	●	6,700,000
3) Half-Bridge	N/A	◖	◖	○[1]	◖	◖	○	●	16,000,000
4) Bypass on 44 & 17	N/A	●	◖	○	○	●	○	◖	53,300,000
* 5) Bypass to West	N/A	●	◖	○	●	●	○	●	14,100,000

● = best meets objective; ◖ = partially meets objective; ○ = does not meet objective

1 This alternative would impact a rare plant growing on the east canyon wall.

Alternatives: Polallie Creek (Note: Alt. 5) would affect the Polallie and Narrows sites; Alt. 4) would affect the Narrows, Polallie, Dog River, and Baseline) — **Objectives**	Enhance & protect the WR WSR	Enhance the natural floodplain	Minimize impacts to visual resources	Minimize impacts to terrestrial habitat	Reduce maintenance & emergency repair	Improve safety	Optimize life cycle costs	Maintain travel time	**Estimated Cost ($)**
1) Maintain Existing Condition	N/A	○	◖	●	○	○	◖	●	200,000/ 20 yrs
2) Debris Control Structure	N/A	○	○	○	○	●	○	●	3,100,000
* 3) Realign Road and 90m Bridge	N/A	●	◖	◖	●	●	○	●	3,500,000
4) Bypass on 44 & 17	N/A	●	◖	○	○	●	○	◖	53,300,000
* 5) Bypass to West	N/A	●	◖	○	●	●	○	●	14,100,000
* 6) 30 m Bridge Existing Alignment	N/A	◖	◖	●	◖	◖	○	●	1,400,000
* 7) Two 30m Bridges (Hwy 35 & Realigned Approach)	N/A	◖	◖	◖	◖	◖	○	●	2,500,000
* 8) Raise Roadway and 90m Bridge - Existing Alignment	N/A	◖	◖	◖	◖	◖	○	●	3,200,000
Alternatives: Dog River (Alts 2 & 3 would affect Dog River & Baseline; Alt. 4 would affect Narrows, Polallie, Dog River, & Baseline)									
1) Maintain Existing Condition	N/A	○	◖	●	○	○	◖	●	300,000/ 20 yrs
* 2) Realign to East	N/A	●	◖	○	●	●	○	●	5,400,000
* 3) Realign to West	N/A	●	◖	○	●	●	○	●	8,200,000
4) Bypass on 44 & 17	N/A	●	◖	○	○	●	○	◖	53,300,000
5) Barbs and Armour	N/A	○	○	●	◖	◖	◖	●	420,000
6) Raise Road with Retaining Wall	N/A	◖	◖	◖	◖	◖	○	●	3,000,000
Alternatives: Baseline Drive – Site 1 (Alts 1, 2, 3, & 4 affect both Baseline sites; Alts 2 & 3 affects Dog River; Alt 4 affects Narrows, Polallie, Dog River, & Baseline)									
1) Maintain Existing Condition	N/A	○	◖	●	○	○	●	●	250,000/ 20 yrs
* 2) Realign to East	N/A	●	◖	○	●	●	○	●	5,400,000
* 3) Realign to West	N/A	●	◖	○	●	●	○	●	8,200,000
4) Bypass on 44 & 17	N/A	●	◖	○	○	●	○	◖	53,300,000
* 5) Riprap Bank	N/A	○	◖	●	◖	◖	●	●	280,000
6) Realign and Riprap Bank	N/A	○	◖	◖	◖	◖	●	●	140,000
Alternatives: Baseline Drive - Site 2									
1) Maintain Existing Condition	N/A	○	◖	●	○	○	●	●	250,000/ 20 yrs
* 2) Realign to East	N/A	●	◖	○	●	●	○	●	5,400,000
* 3) Realign to West	N/A	●	◖	○	●	●	○	●	8,200,000
4) Bypass on 44 & 17	N/A	●	◖	○	○	●	○	◖	53,300,000
5) Retaining Wall	N/A	◖	◖	◖	◖	◖	○	●	1,700,000
6) Remove Island	N/A	○	○	○	◖	◖	●	●	320,000
7) Viaduct	N/A	◖	◖	●	○	◖	○	●	9,200,000
8) Re-channel Stream	N/A	○	○	○	◖	◖	●	●	250,000
* 9) Barbs	N/A	○	○	●	◖	◖	●	●	250,000

● = best meets objective; ◖ = partially meets objective; ○ = does not meet objective

Due to the reconnaissance level of data collection, it was not possible to provide a more detailed method of rating the alternatives. The ratings, "does not meet" or "best meets" can be thought of as being equivalent to scores of 0% and 100% respectively. The rating "partially meets" represents the continuum between "does not meet" and "best meets" (10% to 90%). It is expected that with further analysis, the degree to which the alternatives currently rated as "partially meets", meet the objective(s), will be substantially better defined, potentially changing how the alternatives compare to one another. Due to the limitations of the rating system, no attempt is made to rate alternatives relative to one another. However, a group of alternatives at each site that rate the most highly for the objectives overall are identified (those that are marked with an astrix) and recommended for further study. It is also anticipated that reassessment of the environmental, social and economic issues at the time of project development may result in the need to update the list of objectives and revaluate the alternatives.

Recommendations for further studies include geotechnical investigations, detailed site specific hydraulic / hydrologic analysis, a study to determine the natural rate of aggredation at the proposed crossing locations on White River, surveys for spotted owl nest sites, surveys for other flora and fauna protected under the Northwest Forest Plan and the Mount Hood Forest Plan, wetland investigations and delineations, cultural resource surveys, Endangered Species Act Section 7 assessments, and determinations of 'direct and adverse effect' under the Wild and Scenic Rivers Act for project proposals located in the Wild and Scenic River corridor.

Projects that develop out of this study and that result in the loss or degradation of terrestrial or aquatic habitat or that displace existing recreation resources will need to mitigate for these impacts by enhancing remaining habitat appropriately / by creating new recreation opportunities. Any habitat enhancement activities would need to be planned and coordinated with the resource management agencies namely, the United States Forest Service, National Oceanic and Atmospheric Administration – Fisheries Department, the Oregon Department of Fish and Wildlife, and the United States Fish and Wildlife Service.

As part of the analysis of the alternatives an attempt was made to predict the likely eligibility of each alternative for Emergency Relief Program funding based on 1) the size and scope of previous events and 2) the anticipated cost of repair after a catastrophic event. This analysis is provided in Section 6.10. However, it is imperative to note that Emergency Relief Program eligibility for a particular alternative cannot be made with any certainty and would be determined when an event occurs based on the damage to the facility. Funding sources other than the Emergency Relief Program have also been identified and should be pursued, particularly for alternatives that are deemed desirable but which are highly unlikely to qualify for the Emergency Relief Program. Federal funding sources other than the Emergency Relief Program are the National Highway System Program, the Federal Aid Surface Transportation Program, the Public Lands Highways Program (Discretionary and Forest), the Highway Bridge Replacement and Rehabilitation Program, and the Transportation Enhancement Program. State funding sources are the Oregon Transportation Initiative Act and the Oregon State Transportation Improvement Plan. Funding sources that may be available for projects that enhance aquatic ecosystems are the Bonneville Power Administration Salmon Recovery and Habitat Restoration Funds, the United States Army Corps of Engineers Section 206 Aquatic Ecosystem Restoration Funds, the Northwest Power Planning Council Funds, National Oceanic and Atmospheric Administration Restoration Program Funds, and the Oregon Watershed Enhancement Board Funds.

Projects implemented with funds other than Emergency Relief Program funds would require permits/coordination under the National Environmental Policy Act, Endangered Species Act, Clean Water Act, and the National Historic Preservation Act. Projects implemented under emergency conditions would only have to meet the requirements of the Endangered Species Act.

It is imperative to remember that geological, meteorological, and hydrological processes that result in debris flows, floods, and rock fall have occurred for millions of years, and will occur for millions of years to come. They are naturally occurring phenomena that with current technology cannot be completely stopped or controlled. Thus, the best that can be hoped for is to minimize the destructive, highway–closing impacts of events at the study sites. The only possible means of completely negating the impacts of these events on Highway 35 is to move the highway to a location beyond the zone of influence of these events.

Acronyms

AASHTO	American Association of State Highway & Transportation Officials
ADT	Average Daily Traffic
BPA	Bonneville Power Administration
DEQ	Oregon Department of Environmental Quality
ER Program	Emergency Relief Program
ESA	Endangered Species Act
EFHR	East Fork Hood River
FHWA	Federal Highway Administration
ha	Hectare
km	Kilometer
km/h	Kilometer(s) per hour
LSR	Late Successional Reserve
m	Meter
m^2 / m^3	Square meter / Cubic meter
MHFP	Mount Hood Forest Plan
MP	Milepost
mph	Miles per hour
NEPA	National Environmental Policy Act
NOAA-Fisheries	National Oceanic and Atmospheric Administration – Fisheries Department
NWFP	Northwest Forest Plan
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
ROS	Recreation Opportunity Spectrum
ROW	Right-of-way
USACE	United States Army Corps of Engineers
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
VQO	Visual Quality Objectives
WFLHD	Western Federal Lands Highway Division
WSR	Wild and Scenic River

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REGIONAL MAP

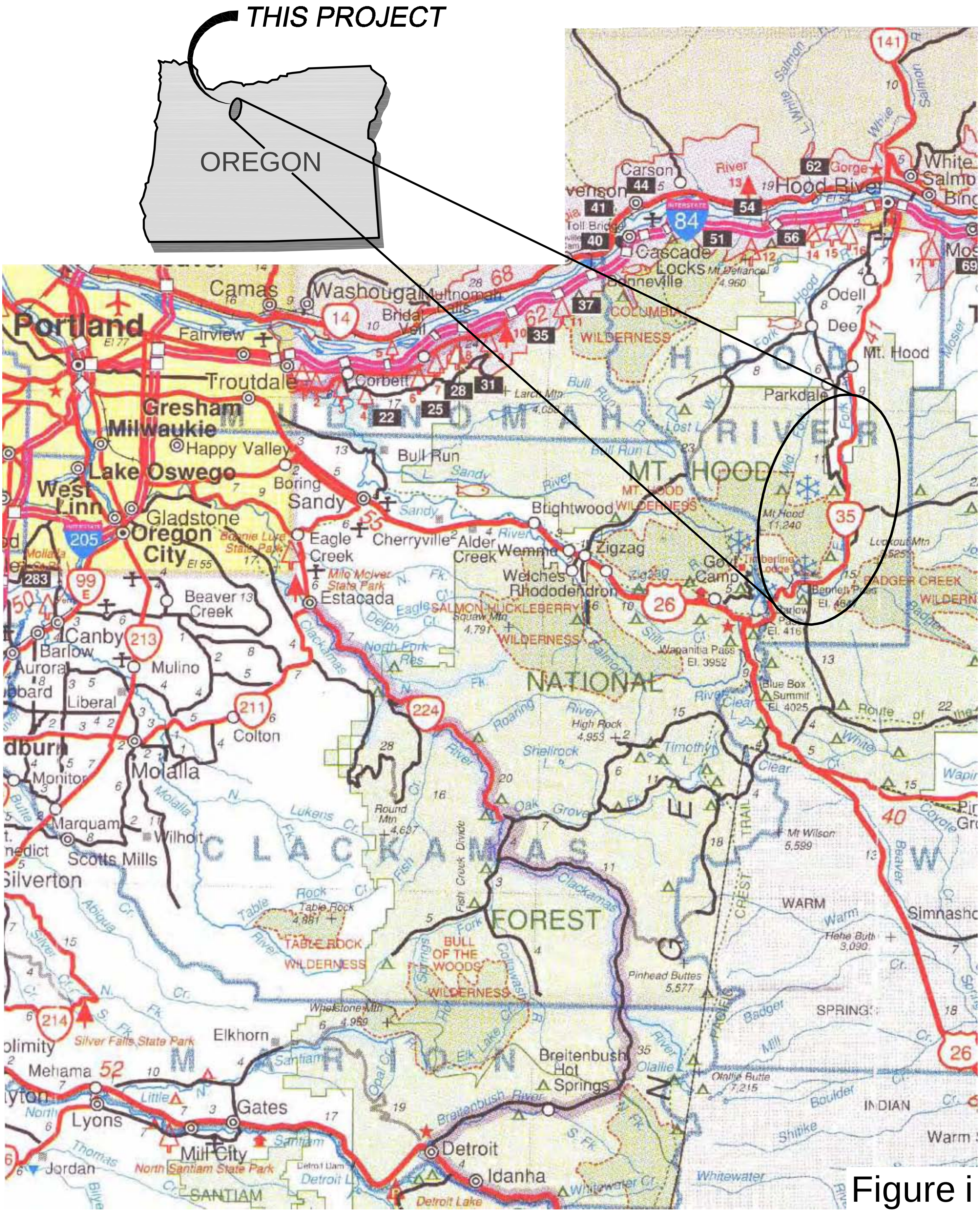

Figure i

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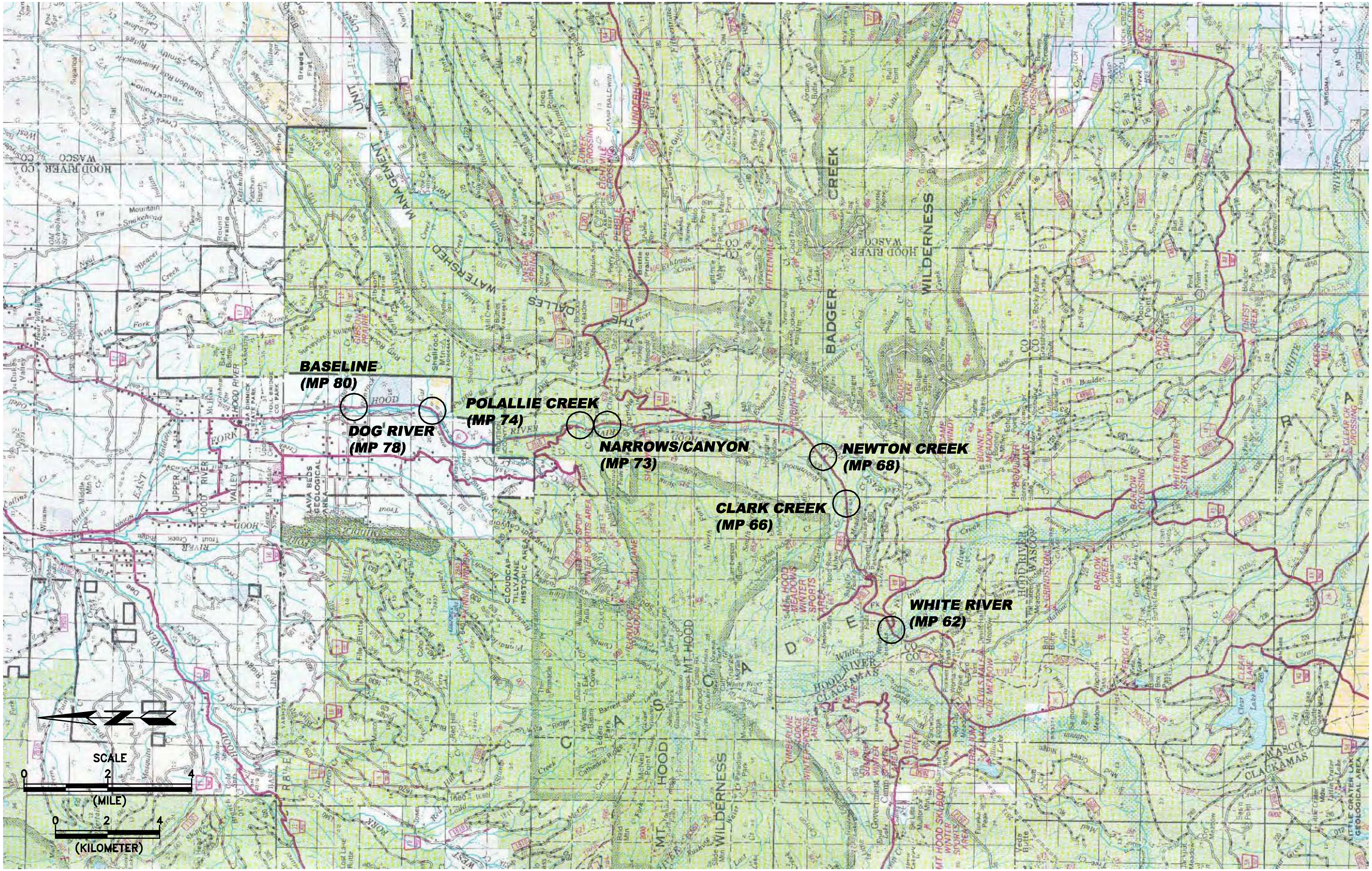

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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

STUDY AREA LOCATIONS
Figure i i

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1. Introduction

1.1 Purpose of the Study

1.1.1 Study Background, Purpose, and Scope

The Oregon Department of Transportation (ODOT) and the United States Forest Service (USFS) requested that the Western Federal Lands Highway Division (WFLHD) of the Federal Highway Administration (FHWA) conduct a feasibility study for seven damage prone sites along Oregon State Highway 35. This study was conducted in response to growing concern over the ongoing need for the emergency repair of debris flow damage along a 32 km (20-mile) stretch of Highway 35 between White River at milepost 61.7 and Baseline Road at milepost 80. Damage caused by debris flows emanating from the slopes of Mount Hood above Highway 35 has resulted in the need for frequent and costly repairs over the last 20-30 years. The repairs have placed a severe burden on the limited resources available for undertaking road maintenance activities and have had negative impacts on the natural environment. The study included the following seven historically damaged sites: White River (MP 61.7), Clark Creek (MP 65.9), Newton Creek (MP 67.5), The Narrows (MP 73), Polallie Creek (MP 74), Dog River (MP 78), and Baseline Road (MP 80).

The purpose of the study was to identify and evaluate feasible alternatives for each site that would either reduce the severity of the debris flow problem or completely eliminate it. The study included a wide range of solutions including both on site solutions, alternative alignments, and alternative routes. For the purposes of this study, 'a feasible alternative' is defined as an alternative that could be built within the framework of the project objectives. All feasible alternatives identified by the study team are presented and evaluated in this document.

The study identifies a range of conceptual engineering alternatives to address the ongoing maintenance and resource degradation problems within the study area, identifies potential environmental, social, and economic impacts associated with each alternative, and provides some feedback from potentially affected interests for use by the USFS and ODOT in future decision-making concerning the management of Highway 35.

1.1.2 Desired Outcomes

This study is intended for use by the ODOT and the USFS as a 'spring board' for future projects. In order to meet the concerns of both the USFS and ODOT, the study identifies two categories of alternatives: 1) likely to qualify for Emergency Relief Program (ER) funds, and 2) requiring funding mechanisms/strategies other than ER funds (refer to Section 1.4). The ODOT and the USFS may select some of the conceptual alternatives identified in this report for further analysis. Alternatives that are likely to qualify for ER funding could then be designed, placed 'on the shelf', and be ready for implementation at the time of an event. Alternatives that require funding mechanisms other than ER funds, and which are likely to be more complex solutions (such as realignments), could be pursued concurrently and implemented proactively as financing allows.

1.1.3 Objectives

The conceptual alternatives are evaluated based on the eight objectives described below. The objectives are not ordered for preference or importance and are weighted equally. In Section 6, the alternatives are rated as "best meets objective", "partially meets objective", or "does not meet objective". The rationale used in rating the alternatives relative to the objectives is also discussed for each objective. Due to the reconnaissance level of data collection, it was not possible to provide a more detailed method of rating the alternatives. The ratings, "does not meet" or "best meets" can be thought of as being equivalent to scores of 0% and 100% respectively. The rating "partially meets" represents the continuum between "does not meet" and "best meets" (10% to 90%). Therefore the value of the rating system is limited by the quality of the data from which it is derived. It is expected that with further analysis, the degree to which the alternatives currently rated as "partially meets", meet the objective(s), will be substantially better defined, potentially changing how the alternatives compare to one another. Due to the limitations of the rating system, no attempt is made in this study to rate alternatives relative to one another. However, a group of alternatives at each site that rate the most highly for the objectives overall are identified with an astrix and recommended for further study.

Objective 1 - Enhance and protect the White River Wild and Scenic River (WSR): This objective is defined as enhancing and protecting the White River's free flowing characteristics and its geology, hydrology, botany, fish habitat, wildlife habitat, historic resource, recreation, and scenic resource values as identified in the White River National Wild and Scenic River Management Plan.

When evaluating alternatives against this objective the following factors were taken into consideration: a) would the alternative enhance the free flowing character of the WSR and if so would it completely remove the need for a structure in the river; b) would maintenance in the river still be required and at what frequency relative to the current frequency; c) would the alternative impact historic resources of the WSR as identified in the Management Plan.[2]

Alternatives that do not improve the free flowing character of the WSR are rated as "does not meet the objective". Alternatives that improve the free flowing character of the WSR but that still require maintenance in the river and/or that require new roadway construction (therefore increasing the likelihood of impacting historical resources) are rated as "partially meets the objective". Alternatives that completely remove the roadway from the river's floodplain and that would not require ongoing maintenance to take place in the river are rated as "best meets the objective".

<u>Objective 2 - Enhance the natural floodplain:</u> This objective is defined as enhancing the ability of river channels to perform fluvial geomorphologic processes in a more natural manner, minimizing impacts to aquatic habitat, and enhancing aquatic habitat for all aquatic species including protected fish species.

When evaluating alternatives against this objective the following factors were taken into consideration: a) does the alternative reduce constrictions/structures in the river; b) does the alternative widen the floodplain; c) does the alternative allow the floodplain to function in a more natural way; and d) would maintenance in the river still be required and at what frequency relative to the current frequency. It is assumed that widening the floodplain and allowing the river to function in a more natural way are intrinsically linked to improving aquatic habitat.

Alternatives that do not reduce constrictions/structures in the river, widen the floodplain or improve the natural functioning of the floodplain are rated as "does not meet the objective". Alternatives that reduce constrictions/structures in the river, widen the floodplain, improve the natural functioning of the floodplain, and reduce the need for maintenance/emergency work in the river, are rated as "partially meets the objective". Alternatives that remove the roadway from the river's floodplain, allowing the river to be unrestricted and significantly reducing the need for ongoing in stream maintenance/emergency work are rated as "best meets the objective".

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2 Impacts on the other resource values of the WSR were not specifically evaluated for the following reasons. Impacts to geology and hydrology are implicitly tied to the free flowing character of the river, although the tunnel alternative(s) would impact ground water flow. Fish habitat is addressed by the second objective. Scenic resources are addressed by the third objective. Botany and wildlife habitat are addressed by the fourth objective. None of the alternatives would change the recreational classification of this section of the river and impacts to recreation resources would be relatively easily mitigated. Finally, to take all of these factors into consideration under one objective is unwieldy and reduces the value of the rating for comparative purposes.

Objective 3 - Minimize impacts to visual resources: This objective is defined as minimizing impacts to view sheds both from the road and of the road.

When evaluating alternatives against this objective the following factors were taken into consideration: a) the view from the road (influenced by whether or not views from the road would be shielded, the location of the structure within different land use categories (e.g. wood products emphasis areas, scenic view sheds), and the height of the structure); b) the view looking toward the road (influenced by the size of the structure, and the visibility of the structure (e.g. would it be buried, shielded by vegetation, or highly obvious from surrounding view points). It was assumed that the more visible the structure, the more negative the impact); c) the need to create large cut slopes/scars in the landscape.

Alternatives that rated highly for a) and low for b) (and vice versa) were rated as "partially meets the objective". Alternatives that rated highly for a) and b) but not for c) were also given an overall rating of "partially meets the objective". Alternatives that rated low for a), b), and c) were given an overall rating of "does not meet the objective". Alternatives that rated highly for a), b), and c) were given an overall rating of "best meets the objective".

Objective 4 - Minimize impacts to terrestrial habitat: This objective is defined as minimizing the clearing of terrestrial habitat during construction, and minimizing the long-term fragmentation and net loss in area of terrestrial habitat over the long term.

When evaluating alternatives against this objective the following factors were taken into consideration: a) does the alternative stay on the existing alignment therefore involving minimal vegetation removal; b) will the alternative require new road construction or substantial road widening (when evaluating alternatives against this criteria, the land designation in the area (such as LSR), the age of the vegetation, the relative size of the area that would need to be cleared, and the degree of fragmentation to the landscape were taken into consideration).

Alternatives that stay on the existing alignment were rated as "best meets the objective". Alternatives that involve minimal new road construction (e.g. of bridge approaches) through mature vegetation/terrestrial habitat were rated as "partially meets the objective". Alternatives that require substantial road widening particularly through areas designated as LSR, or substantial road realignment through mature vegetation were rated as "does not meet the objective".

Objective 5 - Reduce maintenance and emergency repair: This objective is defined as reducing or minimizing maintenance and/or emergency repair to the roadway and within the stream channel after each event that is similar to or smaller than the past events. Additional routine maintenance costs are based on roadway miles. The longer the roadway, the greater the maintenance cost. Lengthening or shortening the roadway would affect the annual maintenance costs.

When evaluating alternatives against this objective the following factors were taken into consideration: a) will the alternative reduce maintenance to the roadway following events similar to past events; b) will the alternative require emergency repairs to the roadway following events similar to past events; c) will maintenance/repair be required within the stream channel; and d) will the alternative add significant length to the roadway and thereby increase the annual maintenance costs.

Alternatives that do not reduce roadway repair / river channel work following major events, or add significant maintenance cost, are rated as "does not meet the objective". Alternatives that reduce roadway maintenance and emergency repairs, reduce the amount of river channel work, and do not significantly increase maintenance cost, are rated as "partially meets the objective". Alternatives that no longer require additional maintenance and/or emergency repairs to the roadway, or river channel work following events similar to past events and do not significantly increase maintenance cost, are rated as "best meets the objective".

Objective 6 - Improve Safety: This objective is defined as improving the safety to the traveling public and reducing safety hazards that may exist at the sites following large events, such as road washouts, roadway overtopping and deposition of debris on the roadway, and bridge structural damage.

When evaluating alternatives against this objective the following factors were taken into consideration: a) will the alternative eliminate the possibility of a road wash-out; b) will the alternative stop the river from overtopping the roadway and depositing debris on the roadway; c) will the alternative eliminate structural damage to bridges, retaining walls, or other structures; d) will the alternative introduce new hazards.

Alternatives that maintain the probability of roadway sections washing out, the river overtopping the roadway and depositing debris, or damage to structures as a result of events similar to past events, are rated as "does not meet the objective". Alternatives that reduce the probability of roadway wash out, the river overtopping the roadway, and structural damage but introduce new hazards, are rated as "partially meets the objective". Alternatives that protect the roadway from washout, prevent the river from overtopping the roadway, and involve structures that would not be damaged by flows similar to the past events are rated as "best meets the objective".

It is assumed that safety standards regarding sight distance, stopping sight distance, horizontal and vertical curvature, and other design features would be included in the final design of each alternative. Alternatives would be designed to meet AASTHO design criteria and roadside safety design standards.

<u>Objective 7 - Optimize Life Cycle Costs</u>: This objective is defined as optimizing the initial cost of the alternatives weighed against the total value of the alternative over its lifetime based on operating and maintenance costs, and the value of money. The following equation is useful for determining life-cycle costs: Life-cycle cost = initial price + (annual cost x estimated life x discount factor). A detailed life-cycle analysis was not completed for each of the alternatives, however, the following factors where taken into consideration when rating the alternatives. Life cycle cost factors considered include initial construction costs, inflation (discount factor), time value of money, operating costs and maintenance costs. For a roadway, the life cycle is typically 20 years, while for a bridge or other structure it is often 50-75 years. The life of the alternative is an important aspect of this objective. For example, an alternative that has a life of 20 years may be half the cost of an alternative with a life of 75 years, yet the 20 year alternative would need to be replaced 2 times during the lifetime of the 75 year alternative.

When evaluating alternatives against this objective the following factors were taken into consideration: a) will the cost of the alternative be less than the annualized maintenance cost over the life of the alternative; b) can costly major emergency repairs be avoided by constructing the alternative; c) does the alternative significantly reduce the amount of routine maintenance that is needed on the roadway; d) what would be the time value of money over the projected life of the alternative.

If the current dollar initial cost of the alternative is significantly more than the annualized maintenance costs plus the cost of emergency repairs is not reduced (based on past event history) over the life of the alternative, then the alternative is rated as "does not meet the objective". Alternatives that have current dollar initial costs approximately the same as the annualized maintenance costs plus the cost of emergency repairs is similar to current costs (based on the past event history) over the life of the alternative, are rated as "partially meets the objective". Alternatives that have current dollar initial costs that are less than the annualized maintenance costs plus reduced emergency repairs (based on past event history) over the life of the alternative are rated as "best meets the objective".

Objective 8 - Maintain Travel Time: This objective is defined as not lengthening the current travel time between major points of interest such as communities, main campgrounds, ski areas and other established recreational areas.

When evaluating alternatives against this objective the following factors were taken into consideration: a) does the alternative significantly increase the length of the current roadway between the beginning and end of the improvements; b) does the alternative slightly to moderately increase the length of the roadway between the beginning and end of the improvements; c) does the alternative maintain or shorten the length of the roadway between the beginning and end of the improvements.

An alternative that significantly increases the length of the roadway is rated as "does not meet the objective". Alternatives that slightly or moderately increase the length of roadway are rated as "partially meets the objective". Alternatives that reduce or maintain the overall length of roadway are rated as "best meets the objective".

1.2 Study Area Description

1.2.1 Study Area Location

The study area is located on Highway 35 in Hood River County, Oregon. Highway 35 extends from its junction with Oregon State Highway 26 (Highway 26) at Government Camp, northward around Mount Hood to its junction with Interstate 84 in Hood River, Oregon. The study area consists of a 32 km (20-mile) section of Highway 35, extending from White River (milepost (MP) 61.7) to Baseline Road (MP 80). The study focuses on seven flood and debris flow prone sites. These sites are located at: White River (MP 61.7), Clark Creek (MP 65.9), Newton Creek (MP 67.5), The Narrows (MP 73), Polallie Creek (MP 74), Dog River (MP 78), and Baseline Road (MP 80). The legal geographic area within which the study area is located is: Township 10 S Range 10 E Sections 9, 16, 20, 21, 29, 32; Township 20 S Range 10 E Sections 5, 8, 17, 20, 29, 32; Township 30 S Range 10 E Sections 5, 6, 7, 8; Township 30 S Range 9 E Sections 11, 12, 14, 15, 16, 21, 22. Refer to the regional and vicinity maps provided in Figures i and ii.

1.2.2 Current and Future Use

The project area is situated within the Mount Hood National Forest (National Forest) and private land. Land use within the National Forest is detailed in the Mount Hood National Forest Land & Resource Management Plan (1990) and includes the harvest of timber, firewood, Christmas trees, boughs, and mushrooms, berry picking, forage for livestock, and water for irrigation. The largest non-consumptive land use within the project area is recreation. Hood River County is a popular destination for recreationists from Portland and half of all visitors to Hood River County engage in outdoor recreation activities (USFS, 1996). Recreational uses within the project area occur year-round and include skiing, hiking, kayaking, camping, fishing, hunting, viewing wildlife, botany, horseback riding, mountain biking, and off road vehicle riding. Land use on private land within the project area is rural residential.

Highway 35 is utilized by a range of vehicles including forest service vehicles, logging trucks, cars with trailers (campers/horse carts/boats), off road vehicles, RVs, and bicycles. There are three traffic-recording stations in the vicinity of the project area. Their locations and counts for 2001 were provided by ODOT and are as follows:

Mile post	Recorder location	Average Daily Traffic Volume (ADT)
57.99	Mt. Hood Meadows (east of US 26)	1800
70.64	South of Lookout Mountain Loop Road	1300
80.07	South of Base Line Road	1500

The most notable change for the future use of the project area is that the demand for recreational use is expected to increase (USFS, 1996; ODOT, 1999).

1.2.3 System Linkage

Highway 35 extends from its junction with US Highway 26, north around Mount Hood to intersect with Interstate Highway 84 in Hood River. Highway 35 is a primary road access into and through the White River sub basin and the East Fork Hood River sub basin. It also provides the primary access to the townships of Parkdale, Middle Valley, Odell, and Pine Grove and is currently essential to accessing the Meadows Ski Resort, Coopers Spur Ski Resort, several sno-parks, hiking trails, Boy Scout camps, a popular rock climbing site, and campgrounds. Most of the recreation traffic visiting the National Forest comes from Portland via Highway 26 and Highway 35 or via Interstate 84 and Highway 35. Highway 35 also links into FS 48, 44, and 17 which are key to accessing resources in other parts of the National Forest and to the Barlow Road, important for its historic significance as part of the Oregon Trail.

1.2.4 Socioeconomic

The project is located within Hood River County. Census data shows that the population of the county in 1995 was 18,700 and in 2000 the population was 20,411 (a growth of 11% in 5 years). The per capita income for Hood River County is below the state average with 14.2% of the population living below the poverty line (US Census Bureau, 2000). The economy is built on agriculture, services, and manufacturing. The largest employer in close proximity to the project area is the Mount Hood Meadows Ski Resort, which employs approximately 1000 staff during its peak season (*pers. comm.* David Riley, 2002). The closest rural centers to the project area are Mount Hood and Parkdale (located approximately 6 and 10 km (4 and 6 miles) north of the project area respectively).

1.3 Jurisdiction

The Oregon Department of Transportation (ODOT) has jurisdiction over the road corridor. The United States Forest Service (USFS) has jurisdiction over the land adjacent to the road within the study area from the southern end of the study area (White River, MP 61.7) north to MP 76. Within the study area between MP 76 and MP 80, the land adjacent to the road corridor is privately owned.

2. History of the Study Corridor

2.1 General

Current archeological studies suggest that humans have been utilizing the project area for the past 8000 to 12000 years although they only began road-building activities in it 150 years ago. Up until 4000 years ago, humans utilizing the project area probably had a mobile lifestyle after which they became semi-sedentary. Contact between Indigenous Americans and Euro Americans along the Northwest coast began in the late 1700s. However, little Euro American use of the project area occurred prior to the 1840s. In 1845 Samuel Barlow blazed the Barlow Road route, which was then used by people emigrating from the east coast of North America. Settlement in the project area by Euro Americans began in 1880 and Parkdale was established in 1906.

The Mount Hood Loop, completed in 1925, was largely constructed adjacent to the East Fork main stem channel. The current route from Parkdale up the Cooper Spur road to Highway 35 and south along Highway 35 to Bennett Pass is approximately the same alignment as the original Loop Highway. Thus, the portion of Highway 35 within the study area is part of the initial alignment although it was straightened in the 1960s during development of the Mount Hood Meadows Ski area. Furthermore, the portion of the highway north of Polallie Creek and south of Dog River was reconstructed above the floodplain after a debris flow in 1980.

The Mount Hood Loop included a crossing of the White River in approximately the same location that the bridge is in today (refer to the photograph log in Appendix A). Between 1925 and 1954 the White River Bridge was a wooden structure 80 m (261 feet) in length and consisting of 9 spans each being 9 m (29 feet) wide. It was reportedly repaired on a regular basis and was replaced by a reinforced concrete deck girder bridge in 1954. The wooden bridge was much lower than the replacement concrete structure, so that when debris flow problems occurred, debris filled a span or two and did some damage to the bridge, then jumped channel into another of the spans. The local thinking at the time was that a shorter bridge should replace it and the channel would scour deeper in that smaller floodplain (*pers. comm.* Charles Sciscione). In 1966 the reinforced concrete deck girder bridge was raised by 2 m (6 feet) to accommodate more bed load transport.

2.2 Events and Maintenance

Mount Hood National Forest geologist Tom DeRoo has compiled data, provided in Appendix B, on the historical occurrences of debris flows on Mount Hood. These data, collected by the USFS since the mid 1970s, constitute a fairly comprehensive historical record of Mount Hood debris flows. Data prior to that is anecdotal based on oral histories and newspaper reports (*pers. comm.* Tom DeRoo, USFS). Preliminary data indicates that at least 30 floods, glacial outbursts, and debris flows have emanated from the Zigzag, Sandy, Coe, Eliot, and White River Glaciers, and from the Sandy River, Zigzag River, White River, Ladd Creek, Polallie Creek, and Newton and Clark Creek drainages during the past hundred years or so. Although debris flows from the Zigzag, Sandy, and Coe Glaciers would not impact the Highway 35 study sites, the historical record of debris flows from those glaciers serves to further illustrate the long-term, dynamic environment that has existed and that will continue to exist, on the slopes of Mount Hood. Refer to Figure 2.2.1, which shows debris flows on Mount Hood over the last 5 years.

Major debris flows have emanated from the White River Glacier and the channel of White River at least as far back as 1907. Debris flows of 1961, 1998, and 2000 each exceeded a volume of 300,000 cubic meters (400,000 cubic yards). Debris flows have emanated from Newton-Clark Glacier at least since 1978, with the flow of October 2000 exceeding 200,000 cubic meters (300,000 cubic yards) (DeRoo, 2002). A photograph log showing some of the sites before and after specific debris flow events is provided in Appendix A.

Endangered Species Act (ESA) consultation is required on all projects with a federal nexus. Normally consultation takes place prior to a project being built and measures to minimize and avoid impacts to listed species are incorporated into the project. In the event of an emergency, ESA consultation takes place after the repairs have been done and regulatory agencies can require additional mitigation for the impacts of repairs on listed species. This has been the case at the seven sites where repairs have had federal funding or have required a federal permit. This regular occurrence of emergency ESA consultation has several disadvantages: 1) Projects that take place under an emergency may not be able to develop and incorporate minimization and avoidance measures prior to undertaking the emergency repair(s). Thus impacts to species are likely to be greater than would otherwise be the case, while the project proponent would not have had the opportunity to avoid costly terms and conditions required by the regulatory agencies. 2) ESA requires that all federal departments and agencies use their authorities to conserve/recover-listed species. Emergency repairs that take place on a predictable basis do not facilitate the conservation and recovery of listed species.

2.2.1 White River (MP 62)

Debris flows on the White River drainage occurred in: August 1907; August 1926; October 1926; 1927; October 1930; 1935; October 1947; 1949; September 1959; October 1959; September 1961; January 1966; January 1967; September 1968; September 1981; September 1998; and October 2000. Maintenance on the White River Bridge has been ongoing since its construction in 1925. The most recent event occurred in October 2000. Precipitation caused a debris slide (composed of material sized from silt to large boulders) in the White River drainage. The material deposited in the channel and filled the underside of the bridge causing debris and water to back up behind the bridge. The river subsequently jumped channel, flowing around both sides of the bridge. Approximately 6.1 meters (20 feet) of roadway at the north approach to the bridge was washed out. Heavy machinery was later placed in the channel to remove the material that had built up under the bridge and redirect the river flow. The river was re-channeled a mile upstream in order to return it to its original channel. The river had jumped back into the channel it formed during the October 2000 event by October 2002. According to the USFS, re-channeling the river is unlikely to be permitted again (*pers. comm.* Stuart Fletcher). Access to the Boy Scout Lodge located just west of the White River Bridge was also damaged.

An earlier maintenance history of the White River Bridge has been collated by ODOT and is as follows. Large debris flows, equivalent to the 2000 event, occurred in 1940 and 1947 when the wooden bridge was in place. Large events also occurred in 1957, 1959 and 1968 when the reinforced concrete deck girder bridge was in place. "An ODOT hydraulic report written in 1987 stated that at least two different bridges at this site have been completely destroyed by massive flows of mud, rocks and boulders. In addition, the approaches have been damaged or washed out numerous times. Paul Stout, Maintenance Foreman at Parkdale from 1935 to1971 recalls approximately 12 to 15 events during which such damage occurred. Complete washouts of the bridge or the approaches have occurred every 10 to 15 years" (*pers. comm.* Charles Sciscione).

2.2.2 Clark Creek (MP 66)

Debris flows in the Clark Creek drainage are known to have occurred in 1997, in November 1999, and in October 2000. The most damaging event at the Clark Creek site occurred in November 1999. Clark Creek jumped channel upstream from Highway 35 and diverted approximately half of the stream flow through the egress road of the snow park. Part of the flow was carried across Highway 35 by a 600mm (24 inch) culvert located just upslope of the egress road and the remainder flowed down the ditch line to the original Clark Creek crossing (the site of the existing double culverts). The northern section of the snow park was severely damaged and has since been repaired.

2.2.3 Newton Creek (MP 68)

Debris flows in the Newton Creek drainage occurred in August 1978, in November 1991, in 1995, in July 1998, and in October 2000. During the most recent event (October 2000) a landslide near the glacier transformed into a 6-mile long debris flow that caused the creek to jump channel approximately 1.2 – 1.6 kilometers (0.75 – 1 mile) upstream of Highway 35. Water flowed in several braided meandering channels. The debris flow also blocked the existing box culvert and original channel (for approximately 1.6 km (1 mile) upstream of the culvert) at Highway 35 causing the creek to run alongside the road until it rejoined the East Fork of the Hood River downstream of the Robin Hood Bridge. About 1.6 km (1 mile) of Highway 35 (from center line to edge of road) was washed out between the Newton Creek Crossing and Robin Hood Bridge and debris was deposited on the remainder of the road. Furthermore, the footings of the existing box culvert at Newton Creek and the footings of the Robin Hood Bridge were undermined by the flows. The Robin Hood Campground was also damaged and has since been abandoned. Heavy machinery was used to consolidate the creek back into one new channel and redirect the flow of Newton Creek under the existing box culvert crossing.

2.2.4 The Narrows (MP 73)

In this area the road is located between an unstable rock face to the east and the dynamic East Fork Hood River to the west. Historically rock fall has been a maintenance and safety problem on the east side of the highway while the proximity of the river has been an ongoing maintenance problem on the west side of the highway. The road shoulder slopes directly into the east bank of the East Fork Hood River. Although the river has not submerged the highway in this area, bank scour has a history of undermining the road shoulder and has damaged portions of the pavement and bridge abutments. The most recent maintenance occurred in 2001 when the Highway 35 road embankment was restored with large rock riprap and the abutments at two bridge crossings were repaired.

2.2.5 Polallie Creek (MP 74)

Debris flows in the Polallie Creek drainage occurred in: December 1980, and October 1997. In 1980 a debris flow and channel jumping at Polallie Creek caused the loss of significant sections of the highway between Polallie Creek and Baseline. Rebuilding the roadway took over a year. This event also resulted in the death of a person camping close to the mouth of Polallie Creek. In October 1997, a channelized debris flow originating in the headwaters of Polallie Creek blocked the double barrel culverts at Highway 35. The area behind the culverts then filled up and the debris flow was rerouted northward along the Highway 35 ditch line. Approximately 0.8 km (0.5 miles) of ditch line was eroded. The flow exited the road prism at an out-sloped portion of the roadway. Debris deposited on the road surface at the junction of Highway 35 and Cooper Spur Road was approximately 1.2 to 1.8 m (4 to 6 feet) thick.

2.2.6 Dog River (MP 78)

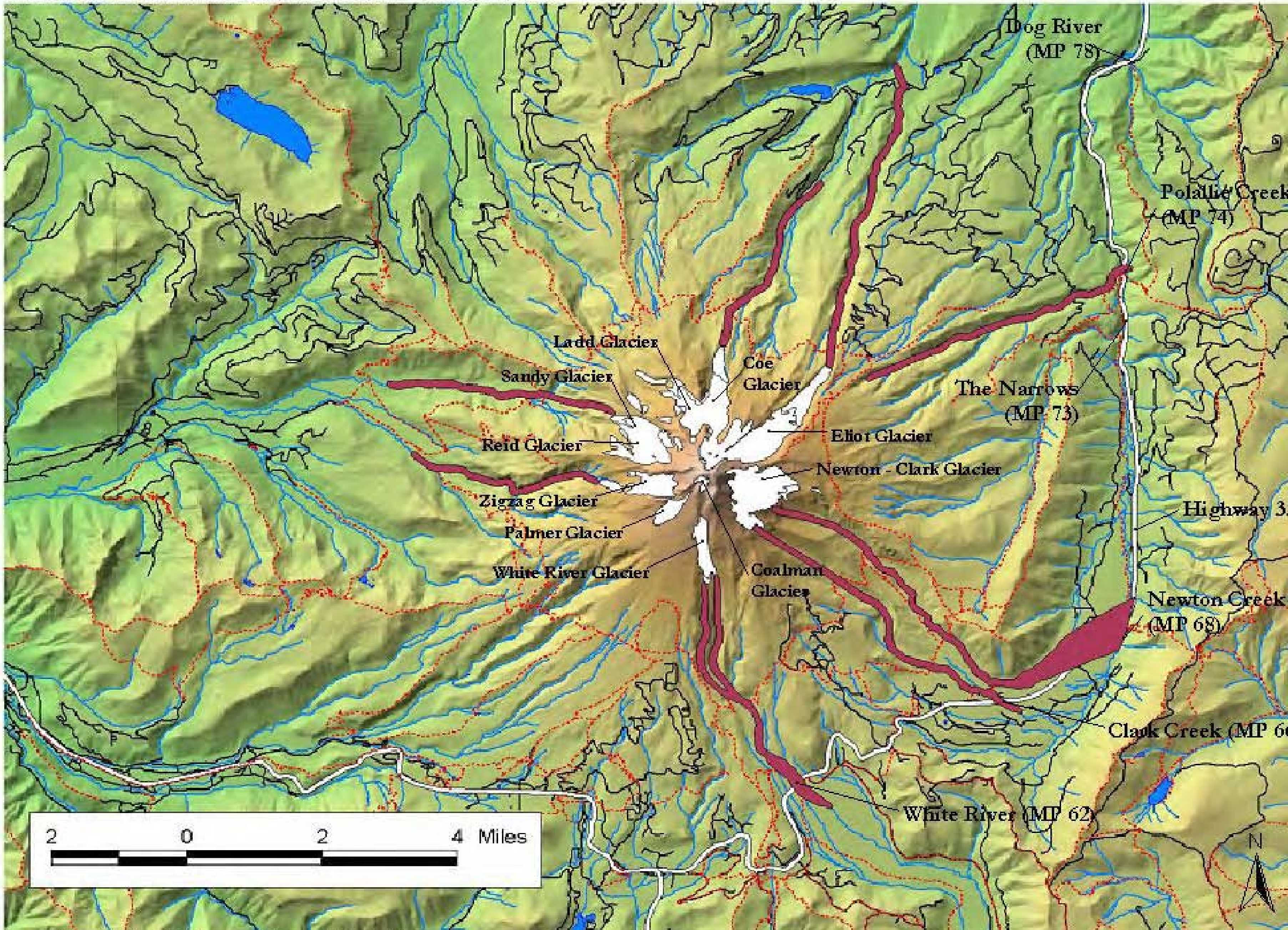
Debris flows and flooding originating in the tributaries of the EFHR have caused road maintenance problems along the highway in the vicinity of Dog River. Repairs to Highway 35 in the vicinity of Dog River and Baseline Drive were undertaken in 1965, 1974, 1980, 1997, and 1999. In addition numerous other road maintenance activities resulting from the interaction of the EFHR with the highway have taken place. In 1980 the Polallie debris flow destroyed approximately 13 km (8 miles) of highway between Polallie and Baseline. Subsequently the road between Polallie and Baseline was raised by about 1.5 m (5 feet). Furthermore, the road was realigned farther out of the floodplain between Polallie and Dog River. After the 1980 event, dikes designed to protect the road during future events by directing flows away from the roadway were also installed adjacent to the river and downriver from the confluence of Dog River.

In November 1999 a section of the road located at the confluence of Dog River and the EFHR was damaged. Moderate flooding created a secondary channel of the EFHR along the road (in place of the ditch) near Dog River. The secondary channel was created when the EFHR broke through a natural levee (75 meters or 250 feet) below its confluence with Dog River. It then ran along the road for approximately 945 meters (3100 feet) until it reached another dike where it was redirected back into the main channel of the EFHR. Approximately 170 meters (550 feet) downstream from the entrance to the channel the river passed between the road and the dike built to contain the river (refer to Appendix A).

2.2.7 Baseline Drive (MP 80)

As discussed in Section 2.2.6, debris flows and flooding originating in the tributaries of the EFHR have caused road maintenance problems along the highway in the vicinity of Baseline Drive. Events have tended to affect the Dog River and Baseline sites simultaneously. The November 1999 event caused a bank failure along a section of the highway located just south of Baseline Drive. Subsequently, repair of Highway 35 involved armoring the riverbank with riprap in an attempt to protect it from future failures.

FIGURE 2.2.1: Debris flows on Mount Hood (within the last 5 years).



Source: Tom DeRoo, USFS - reproduced with permission

3. Existing Management Plans

Plans and guidance documents have been developed to direct management activities in the National Forest and on the Oregon State Highway network. These documents are: the Mount Hood National Forest Land and Resource Management Plan (1990), the Northwest Forest Plan (1994), the White River National Wild and Scenic River – Management Plan (1994), the White River Watershed Analysis (1995), the East Fork Hood River & Middle Fork Hood River Watershed Analysis (1996), the State Highway 35 Viewshed Management Guide (1991), and the Hood River – Mount Hood (OR 35) Corridor Plan (1999).

3.1 Mount Hood National Forest Land & Resource Management Plan (1990)

The Mount Hood National Forest Land and Resource Management Plan (1990) is administered by the USFS. The plan has been amended by the Northwest Forest Plan (1994) and the White River National Wild and Scenic River Management Plan (1994). The Resource Management Plan direction is divided into two categories, 1) Forest wide Standards and Guidelines and 2) Management Prescriptions for "Management Areas" (land allocations).

Management areas are classified as A (these allow timber harvest to occur other than in A2 (wilderness) lands but not regulated timber production), B (the primary goals are not timber production but timber production is a secondary goal), and C (the primary goal is timber production). The plan requires open road densities to be reduced to 1.5 km per square km (1.5 miles per square mile) in the White River National Wild and Scenic River (A1), Scenic Viewshed (B2), and Deer and Elk Winter Range (B10) land allocations. Refer to Figure 3.1.1 for a map showing the land allocations within the project area.

Forest wide standards and guidelines detail the protection and enhancement of cultural resources, floodplains, wetlands, riparian vegetation, water quality, rivers, scenery, fish habitat, and wildlife. One of the specific stipulations of the plan is that the management of access and maintenance of roads should provide for public safety and protect natural resources.

3.2 State Highway 35 Viewshed Management Guide (1991)

The State Highway 35 Viewshed Management Guide (1991) is administered by the USFS and provides guidelines for landscape management within the viewshed of Highway 35 from the Parkdale Ranger

Station to Bennett Pass. The 'viewshed' is defined as the 'land potentially seen from a specific location or travel route'. The Viewshed Management Guide provides guidelines for detailed project planning and implementation in line with the viewshed management standards established by the Mount Hood National Forest Land and Resource Management Plan (1990).

Existing scenic conditions and future objectives are detailed for many sites within the project area. Scenic conditions are defined in terms of visual quality objectives (VQOs) (preservation, retention, partial retention, and modification) and distance zones (foreground = up to 0.8 km (0.5 mile), middle ground = 0.8 to 8 km (0.5 to 5 miles), and background = beyond 8 km (5 miles)). Scenic resource objectives for sites within the study area or potentially affected by the alternatives described in the study are reiterated below:

<u>Narrows</u>: Retention Foreground. Retain diversity of cover types depending on aspect. Emphasize large ponderosa pine in areas where this is a feasible seral stage, particularly on south facing slopes. Perpetuate large yellow barked pine in foreground as long as possible. Increase larch where feasible to enhance fall color. Promote ground cover, shrubs and within-stand age class diversity. Construction, maintenance and built features along the highway and river corridor should be designed, replaced or rehabilitated to better blend with the natural landscape. River enhancement work should aim to restore riverbank vegetation and the pool/drop features of a more stable river profile. Maintain views to and across the river from the Highway. Promote hardwoods along river and at seeps. Use fire to promote pine regeneration. Locate interpretive features emphasizing river management and fire ecology.

<u>Polallie</u>: Middle ground Partial retention from Hwy 44. Wilderness acres should meet Preservation VQO. Maintain areas of hardwoods and brush that provide textural diversity and fall color adjacent to trails and as viewed from roads. This area provides a visual foundation for views of Mt. Hood.

<u>Highway 44 (lower)</u>: Retention. Big tree management. Open park-like multi-storied ponderosa pine woods. Improve views of Mt. Hood. Improve scenic turnouts with interpretive facilities. Mix old growth Douglas fir and larch with pine. Favor shrub edge along road. Rehabilitate disturbed areas and cutbanks where appropriate.

<u>Highway 35 road corridor north and south</u>: Retention, Big tree management. Emphasize visual variety and distant views. Break up tunnel effect. Promote native wildflowers, grasses and shrubs on right of

way and in immediate foreground. Open views to Mt. Hood and surrounding ridges and to hardwoods along river. Emphasize multistory stands with large trees interspersed with small even-aged patches. Small clearings evident. Variety in age classes and species diversity of trees should be evident. Emphasize huckleberry patches. Break up straight-line tree edge along right of way. Do not open views of existing clear cuts. Schedule foreground treatments to screen existing clear-cuts until 20 feet in height. Enhance views of fall color into Horesethief Meadows. Thin dense pole stands where possible to promote growth. Open selected views to Mt. Hood from Highway 35 and Meadows ski area road. Rehabilitate road impacts at Bennett Pass. Replace guardrails with Corten and timber uprights, stone or post and cable. Develop guidelines for signage and for possible road realignment. Maintain and improve views from ski runs and Nordic trails.

Sherwood: Canopy texture retention. Retain characteristic landscape and natural appearance of conifer-dominated slopes. Seed vine maple in some areas if not present. Do this at a small scale and monitor to determine if appropriate for larger areas. Maintain mixed texture of stands and age classes. Openings associated with timber harvest activities should be designed to blend into the natural context and scale of the tree-covered slopes. Maintain and enhance fall color with larch and vine maple.

Bennett Pass Road: Big tree management. Retention of old growth noble fir. Enhance shrub and ground cover. Maintain scenic quality of views from ski trail, use roads and units for skiing opportunities.

Pocket Creek: Maintain natural appearing canopy texture. Texture, shape, scale and distribution of any created openings are key design issues. Maintain existing natural mix of canopy textures and colors. Allow existing harvest impacts to diminish before new entries. Protect thin screening adjacent to Highway 35 to mitigate view of recently harvested units.

Teacup: Retain natural appearance of diverse species and age class as viewed in middle ground from Highway 35. Retain forest character from cross-country ski trails. Plan for cross-country ski opportunities. Increase visibility of western larch.

3.3 Northwest Forest Plan (1994)

The Northwest Forest Plan (1994) is administered by the USFS and amends the Mount Hood National Forest Land and Resource Management Plan (1990). It requires agencies to utilize an ecosystem management approach for federally administered lands within the range of the northern spotted owl.

The plan specifies standards and guidelines for all activities (from road construction to visitor information rules) within National Forests and BLM lands and overrides the standards and guidelines of existing plans unless they are more restrictive or provide greater benefits to late successional forest related species. The plan also outlines the Aquatic Conservation Strategy, which aims to restore and maintain the ecological health of watersheds and aquatic ecosystems on public lands.

Management direction under the Northwest Forest Management Plan is based on seven land allocations (Congressionally Reserved Areas, Late Successional Reserves (LSR), Adaptive Management Areas, Managed Late Successional Areas, Administratively Withdrawn Areas, Riparian Reserves, and Matrix) and defined management objectives for each. The project area contains Congressionally Reserved Areas, Late Successional Reserves, Administratively Withdrawn Areas, and Matrix land allocations. Please refer to Figure 3.3.1 for a map showing the land allocations within the project area.

Lands are further categorized as Tier 1 Key Watersheds, Tier 2 Key Watersheds, and non Key Watersheds. Watershed analysis is required prior to determining how proposed land management activities meet the Aquatic Conservation Strategy objectives. The standards and guidelines for Key Watersheds (Tier 1 and Tier 2) stipulate that: "Inside Roadless Areas – no new roads will be built in remaining unroaded portions of inventoried (RARE II) roadless areas. Outside Roadless Areas – Reduce existing system and non-system road mileage. If funding is insufficient to implement reductions, there will be no net increase in the amount of roads in Key Watersheds." Within the project area, the White River sub watershed is classified as a Tier 2 Key Watershed and the East Fork Hood River is classified as a non-Key Watershed (USFS, 1994). Please refer to Figure 3.3.2 for a map showing the Key Watersheds and Roadless Areas within the project vicinity.

3.4 White River National Wild and Scenic River Management Plan (1994)

The White River National Wild and Scenic River Management Plan (November 1994) is administered by the USFS and amends the 1990 Mount Hood National Forest Land and Resource Management Plan (1990) and complies with the Northwest Forest Plan (1994). The plan was prepared in accordance with the National Wild and Scenic Rivers Act of 1968, which established a nation wide system of outstanding free-flowing rivers. The act's main purpose is to balance river development with protection and conservation. The act prohibits hydropower development and requires managing agencies to protect and enhance the values, which are river related and are rare, unique, or exemplary from a regional or national perspective. Rivers are classified as wild, scenic, or recreational[3] depending on the level of development at the time of classification. White River was designated as a Wild and Scenic River in 1988 through the Omnibus Oregon WSR Act of 1988. The Management Plan describes conditions, which need to be achieved or maintained in order to protect and enhance the river's values. It also stipulates the standards and guidelines for governing activities within the WSR designated corridor boundary. Furthermore, the plan designates the WSR viewshed.

The WSR corridor boundary is described as a rim-to-rim boundary (refer to Figure 3.4.1) emphasizing the logical ecosystem and landscape ecology principles in its delineation. The designated viewshed of the WSR includes viewpoints looking out from the river itself plus viewpoints looking into the river canyon (e.g. from USFS 48, Bonney, and Barlow Buttes). Six management segments are designated for the White River WSR from the rivers headwaters (Segment A) to the river's confluence with the Deschutes River. The project area is within a segment classified as 'recreational' (Segment B). Within the study area, the White River is protected for the following values: geology, hydrology, botany, fish habitat and protection, wildlife habitat and protection, historic resources, recreation, and scenic resources.

The following standards and guidelines for the management of the White River WSR corridor are outlined in the Plan. This list is not all-inclusive but highlights those most relevant to the study area.

- All management activities shall protect and/or enhance the identified outstandingly remarkable values.
- The free-flowing characteristics of the river shall be protected.
- Management activities shall be consistent with prescribed recreation opportunity spectrum (ROS)[4] classes.
- All developed recreational facilities; such as campgrounds, parking etc. shall be properly located relative to the outstanding remarkable values for the river.
- All management activities shall achieve the following visual quality objectives: views from Highway 35/White River Sno-Parks, Barlow Road, White River, the top of Bonney Butte, and the top of Frog

[3] WSR classifications: Rivers protected as Wild and Scenic Rivers are classified (often on a segmental basis) as either wild, scenic, or recreational depending upon the use of the river at the time of designation. Wild WSR segments are situated in the most natural settings while recreational WSR segments are situated in the least natural settings.

[4] ROS: A method of recreation planning used to provide for a variety of recreational user tastes. It does so by combining social, managerial and environmental factors in a range of ways to produce a spectrum of recreation opportunity settings, ranging from natural, undeveloped and low-population density settings to unnatural, developed and high population dense settings.

Lake Butte shall meet the VQO of retention in the foreground and partial retention in the middle ground and background.

- Scenic waysides with safe parking facilities may be constructed to provide views to Mount Hood and White River along Forest Road 48.
- Streams should provide high quality amphibian and aquatic insect habitat.
- Water quality shall be maintained or enhanced.
- Techniques or procedures should be used to provide for the optimal flow regime needed to maintain or enhance the outstanding remarkable values, with an emphasis on native fish and the minimum flow energy needed for channel maintenance.
- New roads may be constructed in Segment B.
- No additional road construction shall be permitted within Segment A other than for some exceptions within the Mount Hood Meadows permit boundary.
- If the Highway 35 Bridge should be severely damaged or destroyed through a natural event, the bridge should be reconstructed in a manner that allows for the relatively unimpeded flow of debris torrents and glacial outwash floods that normally influence the river channel and the river's hydrologic regime.
- Wheeled ATVs and street legal vehicles shall be prohibited on Road 48 north of its junction with Road 43 between Nov. 15 and April 1.
- Road 48 between White River East Sno-park and the junction with Road 4890 shall be closed to snowmobiling. Roads 43 and 4890 should remain open to snowmobiling.
- Open road density in the White River National Wild and Scenic River corridor (A1) should not exceed 1.5 km per square km (1.5 miles per square mile).

The Forest Service is the river-administering agency for the White River WSR and the Regional Forester is the official who has the responsibility for ESA compliance within the WSR corridor. The WSR Act prohibits federal agencies from conducting, assisting, or funding projects that have direct adverse effects to a WSR. In the case that a construction design, which avoids direct and adverse effects to a WSR, cannot be found, the only option is congressional action. A definition of 'direct adverse effect' is not given in the WSR Act. Each determination is based on the status and characteristics of the individual WSR, its outstandingly remarkable values, and the project proposed. A project would have a direct and adverse effect on a designated river if the project altered the river's free-flow as defined in Section 16 of the WSR Act *(P.L. 90-542, as amended)*, or if the project had any direct and adverse effects on the outstandingly remarkable values for which the river was designated. In addition, emergency repairs are exempt from requirement of an Army Corps of Engineers permits or other federal agency permits or licenses. The WSR Section 7 authorities are triggered in the WSR Act by water resources projects that require federal permits or licenses. Emergency situations are not included in the agency definition of water resources projects and are typically exempt from license or permit requirements. (*pers. comm.* Susan Sater)

3.5 White River Watershed Analysis (1995)

The White River Watershed Analysis (1995) was prepared by the USFS and describes a reference condition (1900), current condition and desired future condition for the White River Watershed in terms of use, geology, vegetation, wildlife, access, and water quality. It also outlines management objectives for the watershed. Management objectives discussed include redesigning four campgrounds located in the WSR corridor to meet WSR management objectives, restoring Gate Creek/Road 48 off road vehicle trails, and rebuilding stream crossings on many roads (including Road 48) in order to allow the passage of large wood, fish and salamanders, and to meet the 100 year flood requirement.

3.6 East Fork & Middle Fork Hood River Watershed Analysis (1996)

The East Fork Hood River & Middle Fork Hood River Watershed Analysis (1996) was prepared by the USFS and describes reference conditions (1900), current conditions and desired future conditions for the watershed in terms of use, geology, vegetation, wildlife, and water quality. It also outlines key issues and management objectives for the watersheds. Four key issues are discussed in the document: 1) fish populations have declined; 2) a holistic approach to forest management has not been implemented (included is the landscape affect of Highway 35 and National Forest road placement and maintenance); 3) the quantity and distribution of late seral habitat has placed some late seral dependent species at risk; 4) the growing demand for recreation is affecting the quality of the recreation experience. Furthermore the document specifically states, "Highway 35 is a repeated impact to the natural flow of the East Fork Hood River and the biota that maintain the health of the stream system".

The watershed analysis calls for holistic management (a landscape view) within the watershed, improved habitat connectivity, the control of weeds, proactive highway maintenance and planning, and recreation planning. Recommended projects potentially relevant to this study include a connective trail from Polallie Ridge Trail #644 to Highway 35, fish habitat improvement between the mouth of Polallie Creek and the northern end of The Narrows and the main stem East Fork Hood River.

3.7 Hood River – Mount Hood (OR 35) Corridor Plan (1999)

The Hood River – Mount Hood (OR 35) Corridor Plan (1999) is administered by ODOT and lays out ODOT's management objectives for the Highway 35 corridor. These cover the management of scenic and natural resources, energy, air quality, and water quality. Environmental, social, and economic objectives outlined in the plan and relevant to this study are: integrating vegetation management measures into road management and maintenance, using transportation improvement projects to rectify negative impacts to previously impacted natural resources, identifying and evaluating long-term programs to restore fish populations and improve water quality including the feasibility of relocating Highway 35 away from the river, designing transportation system improvements to preserve community livability, the promotion of the Interstate84/Highway35 as an alternative route from Portland to Mount Hood recreation areas, and the improvement of access to a range of recreational opportunities.

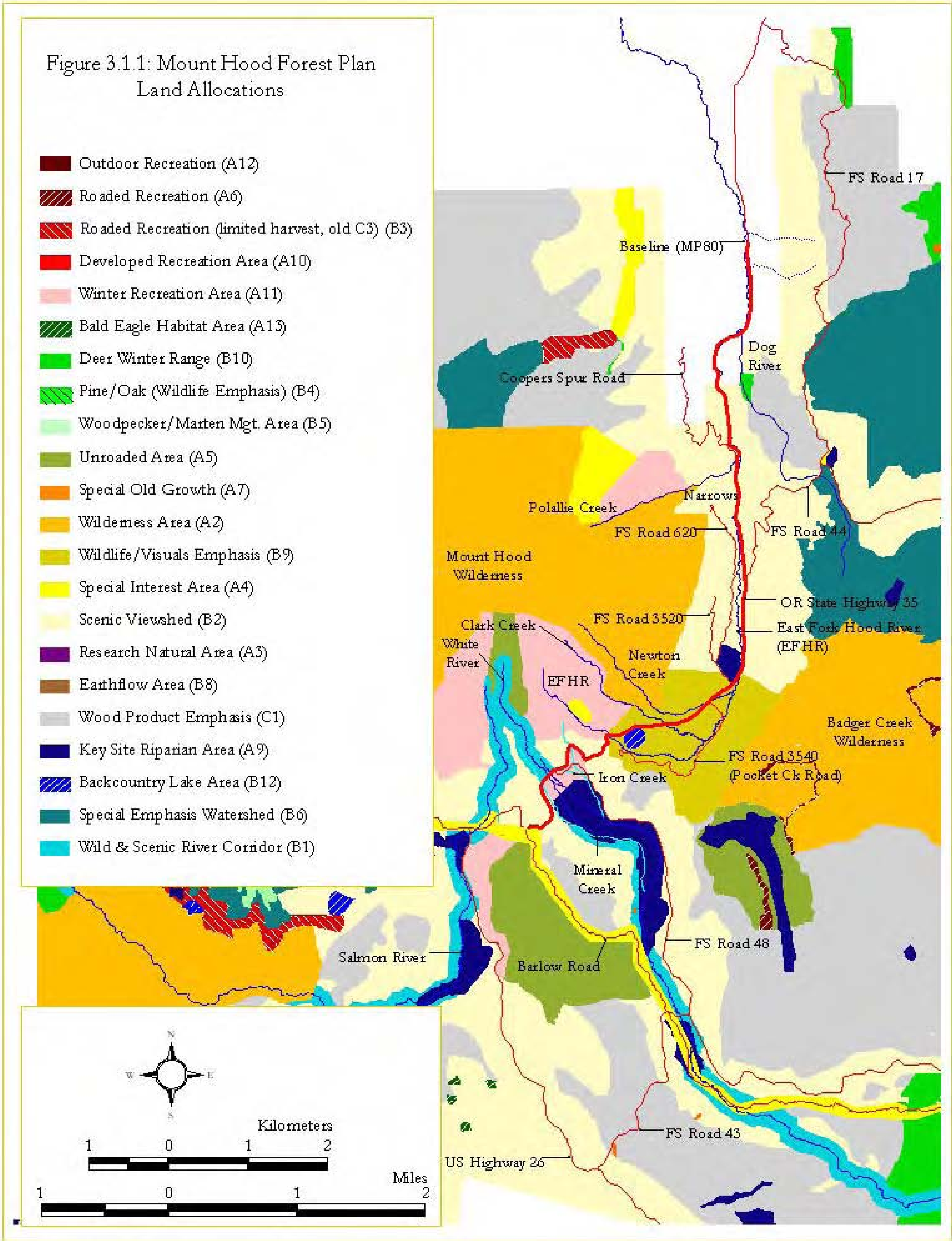


Figure 3.1.1: Mount Hood Forest Plan
Land Allocations
Outdoor Recreation (A12)
Roaded Recreation (A6)
Roaded Recreation (limited harvest, old C3) (B3)
Developed Recreation Area (A10)
Winter Recreation Area (A11)
Bald Eagle Habitat Area (A13)
Deer Winter Range (B10)
Pine/Oak (Wildlife Emphasis) (B4)
Woodpecker/Marten Mgt. Area (B5)
Unroaded Area (A5)
Special Old Growth (A7)
Wilderness Area (A2)
Wildlife/Visuals Emphasis (B9)
Special Interest Area (A4)
Scenic Viewshed (B2)
Research Natural Area (A3)
Earthflow Area (B8)
Wood Product Emphasis (C1)
Key Site Riparian Area (A9)
Backcountry Lake Area (B12)
Special Emphasis Watershed (B6)
Wild & Scenic River Corridor (B1)
FS Road 17
Baseline (MP80)
Dog River
Coopers Spur Road
Narrows
Polallie Creek
FS Road 620
FS Road 44
Mount Hood Wilderness
OR State Highway 35
FS Road 3520
Clark Creek
East Fork Hood River (EFHR)
White River
Newton Creek
EFHR
Badger Creek Wilderness
FS Road 3540 (Pocket Ck Road)
Iron Creek
Mineral Creek
FS Road 48
Salmon River
Barlow Road
FS Road 43
US Highway 26
N
W
E
S
Kilometers
1 0 1 2
Miles
1 0 1 2

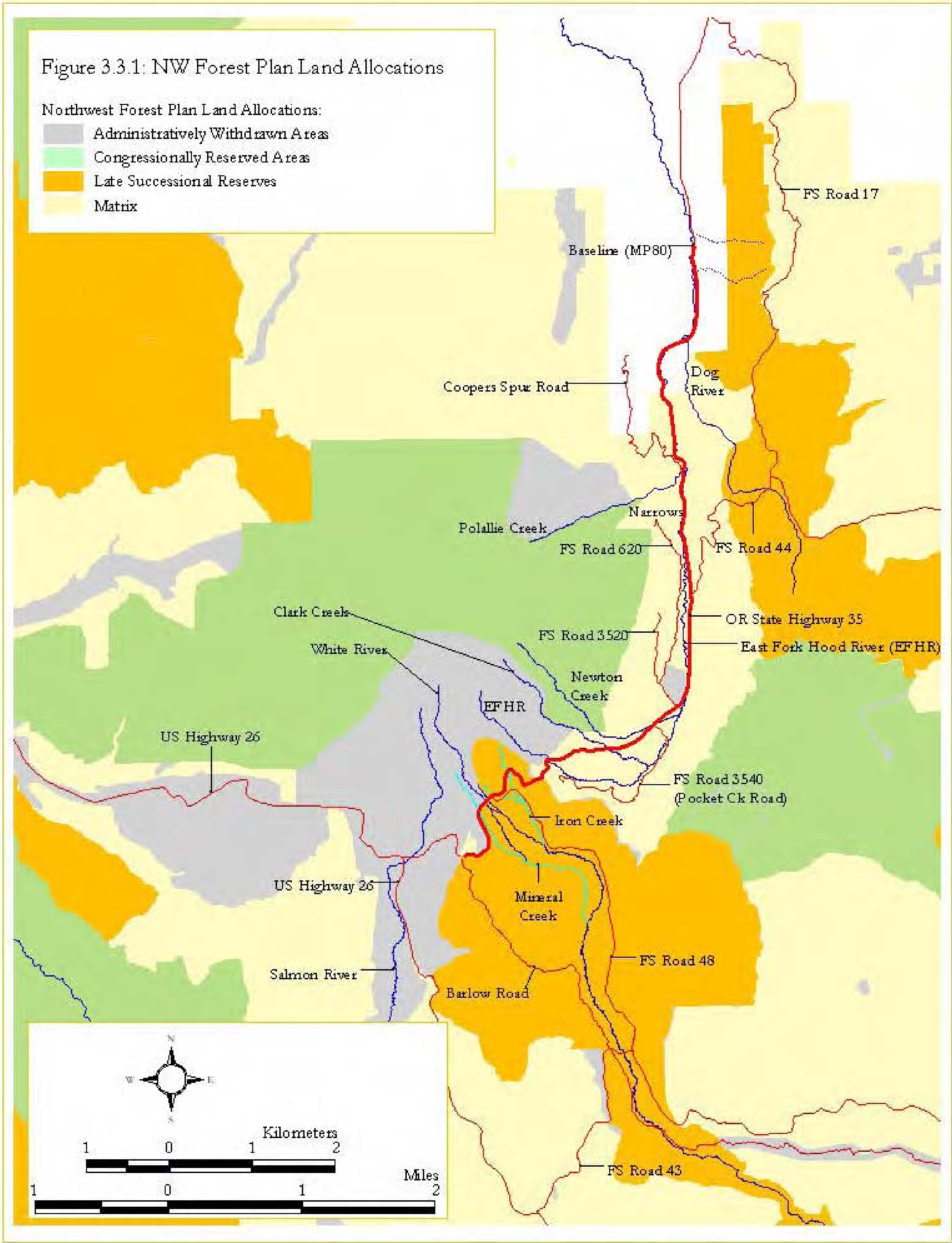


Figure 3.3.1: NW Forest Plan Land Allocations
Northwest Forest Plan Land Allocations:
Administratively Withdrawn Areas
Congressionally Reserved Areas
Late Successional Reserves
Matrix
FS Road 17
Baseline (MP80)
Dog River
Coopers Spur Road
Narrows
Polallie Creek
FS Road 620
FS Road 44
OR State Highway 35
Clark Creek
FS Road 3520
East Fork Hood River (EFHR)
White River
Newton Creek
EFHR
US Highway 26
FS Road 3540 (Pocket Ck Road)
Iron Creek
US Highway 26
Mineral Creek
FS Road 48
Salmon River
Barlow Road
N
W
E
S
Kilometers
1 0 1 2
FS Road 43
Miles
1 0 1 2

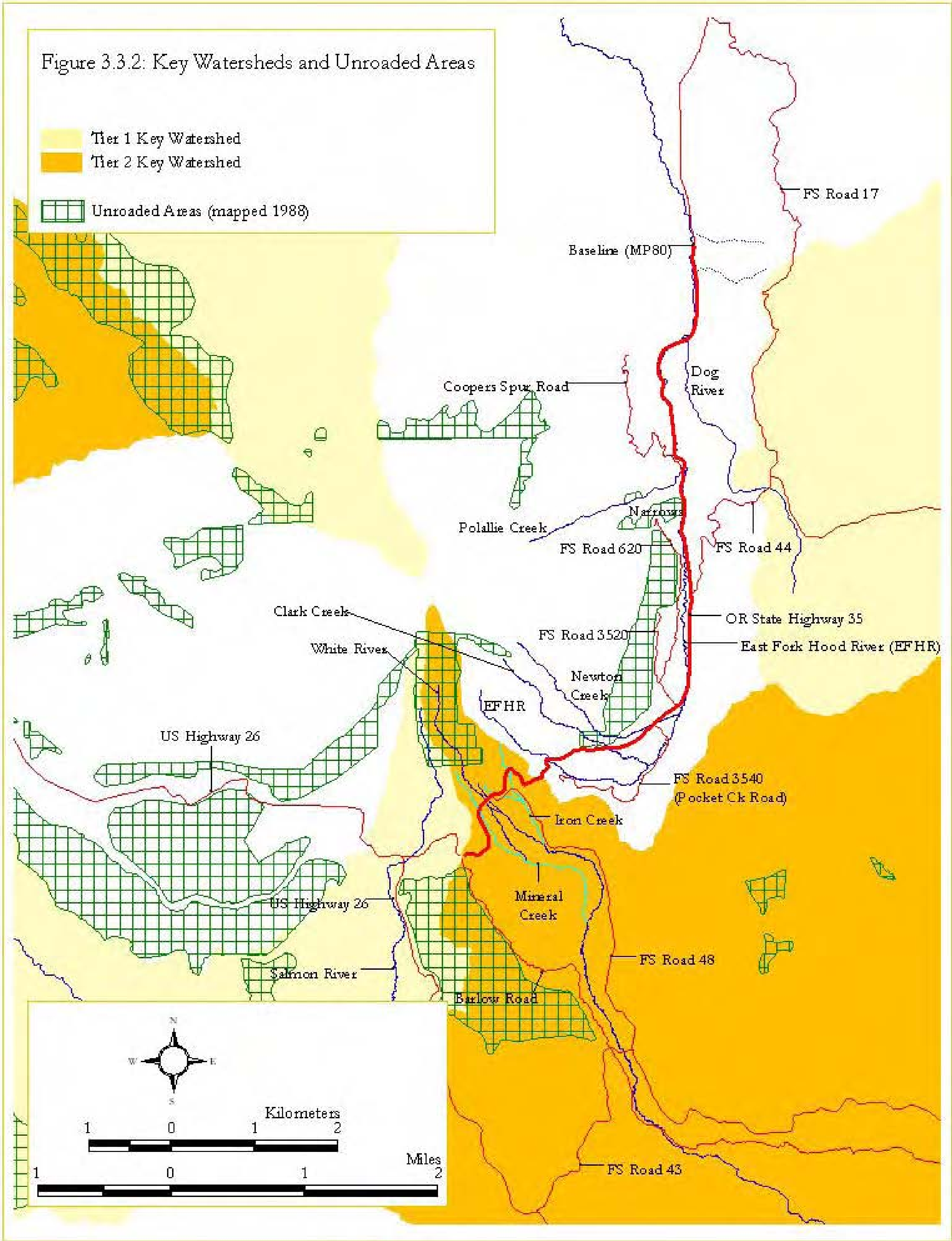


Figure 3.3.2: Key Watersheds and Unroaded Areas
Tier 1 Key Watershed
Tier 2 Key Watershed
Unroaded Areas (mapped 1988)
FS Road 17
Baseline (MP80)
Dog River
Coopers Spur Road
Narrows
Polallie Creek
FS Road 620
FS Road 44
Clark Creek
OR State Highway 35
FS Road 3520
White River
East Fork Hood River (EFHR)
Newton Creek
EFHR
US Highway 26
FS Road 3540 (Pocket Ck Road)
Iron Creek
Mineral Creek
US Highway 26
FS Road 48
Salmon River
Barlow Road
N
W
E
S
Kilometers
1 0 1 2
Miles
1 0 1 2
FS Road 43

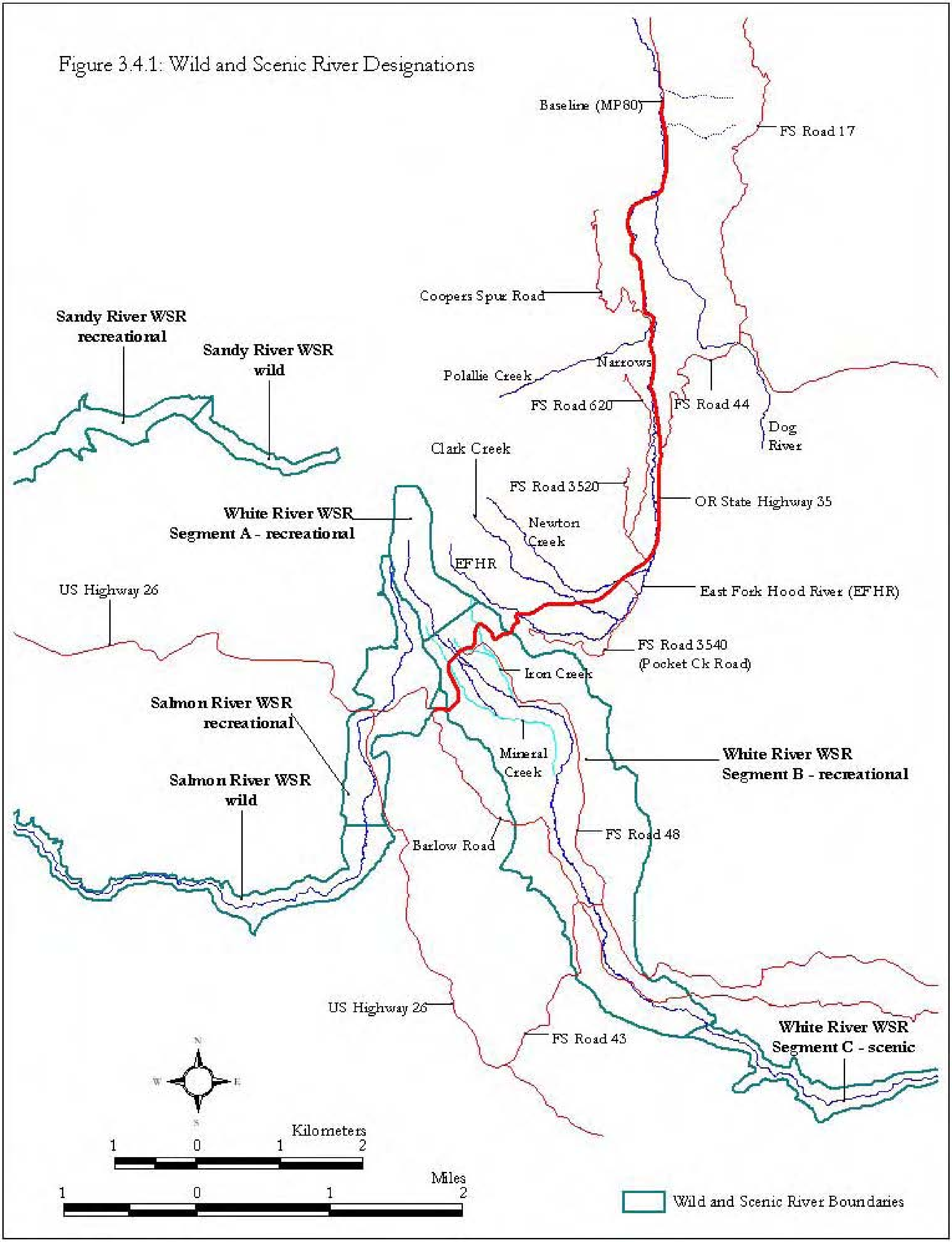


Figure 3.4.1: Wild and Scenic River Designations

4. Existing Conditions in the Study Corridor

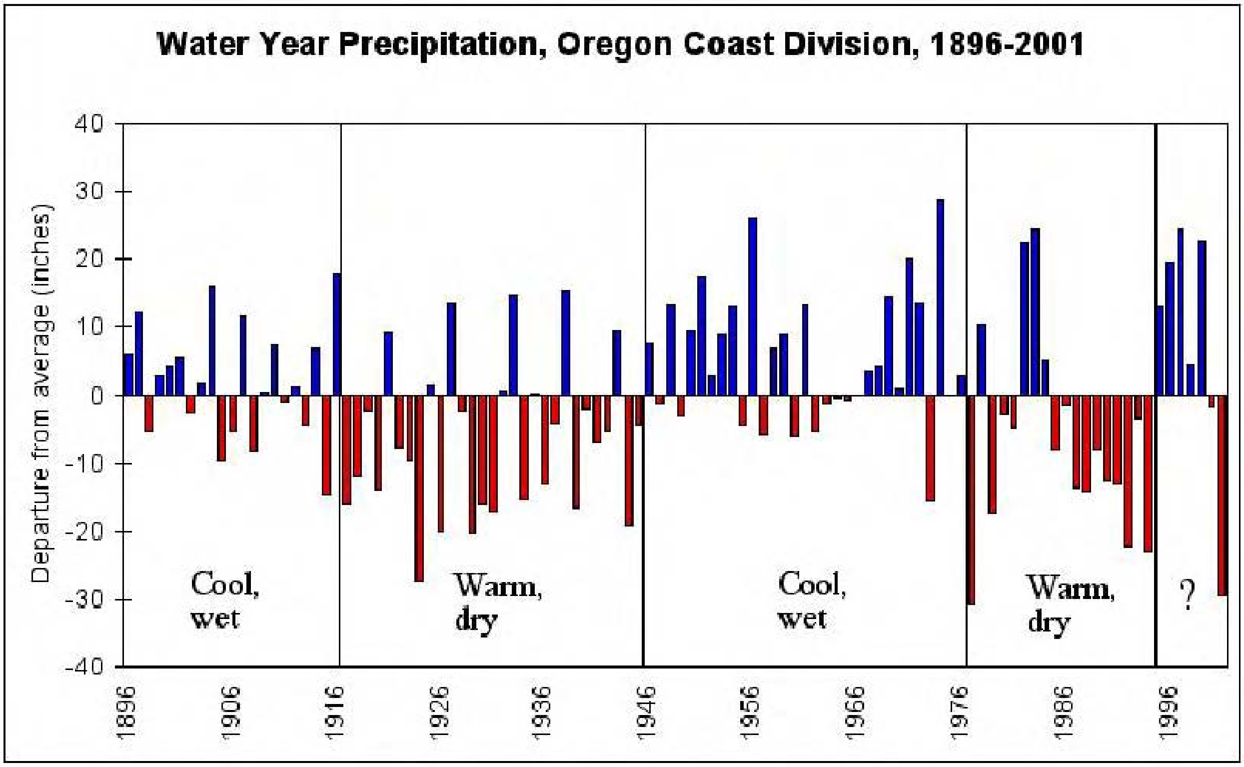
4.1 Dynamic Forces Shaping the Study Sites

The flooding and debris flows at the study sites are caused by a unique combination of meteorological, geologic, geomorphologic, and hydrologic conditions that exist on Mount Hood. Hydrological conditions are associated with the channeling and down slope movement of water derived from precipitation, snowmelt, and the melting of glacial ice. Local weather conditions are also extremely important in the development of events that impact the study sites, as are long-term changes in climate that affect the advance and retreat of the glaciers. Geological conditions consist of volcanic and glacially derived materials such as lava flows, pyroclastic flows, ash deposits, and glacial outwash materials that exist on the slopes of Mount Hood, as well as their degree of weathering, consolidation, and the angle of repose of loose, granular materials. Geomorphologic conditions include features such as stream channels, glacial outwash planes, ridges, valleys, ravines, glacial cols, arêtes, and steep cliffs that give the mountain its shape.

4.1.1 Meteorological Setting

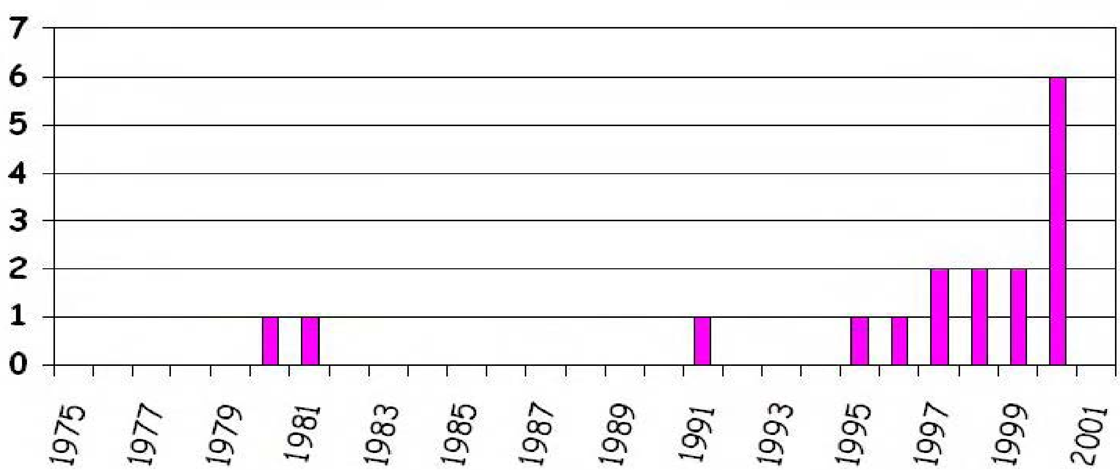
Like the rest of the more northerly Cascade volcanoes, Mount Hood is situated in a cool, maritime climatic region. The maritime climate provides cool, wet winters that produce heavy snows on the upper slopes of the mountain. Tens of meters of snow often accumulate during a given winter. At the highest elevations, snowfall contributes to the accumulation of glacial ice. Farther down slope, snow accumulates as deep, seasonal snow cover on the flanks of the mountain, and farther still down slope, most precipitation falls as rain, frequently heavy.

The Pacific Decadal Oscillation Theory proposed by George Taylor, Oregon State Climatologist, suggests that the Pacific Northwest in general experiences a cyclic wet/dry weather pattern that is approximately 20 years long (Refer to Figure 4.1.1). The period from 1975 to1995 was classified as a dry period during which glacial retreat was accelerated on Mount Hood. In 1995, the Pacific Northwest is thought to have entered a 20-year wet period characterized by the mobilization by glacial streams of loose glacial material exposed during the preceding dry period. As is evident from Figure 4.1.2, the number of debris flow events originating on Mount Hood has increased significantly since 1995, further supporting this theory (*pers. comm.* Tom DeRoo).



Source: George Taylor, Oregon State Climatologist, reproduced with permission.

Figure 4.1.1: Precipitation trends on the Oregon Coast from 1896 to 2001



Source: Tom DeRoo, USFS Geologist, reproduced with permission.

Figure 4.1.2: Number of major debris flow events on Mount Hood between 1975 and 2001

4.1.2 Geological/Geomorphologic Setting

Mount Hood is one of about a dozen volcanoes in the Cascade Range of Washington, Oregon, and northern California. The volcano, which is classified geologically as a stratovolcano, is made up of a geologically complex assemblage of lava flows, pyroclastic rock (fragmental volcanic rock, ash, and glass erupted explosively from volcanic vents), and volcanic ash. The mountain owes its shape to both the manner in which the volcanic materials were deposited during eruptive episodes and to the erosional processes that have acted (and continue to act) upon it. Mount Hood has not erupted in recent history and is considered to be a dormant volcano, meaning that it is likely to erupt again in the future.

Mount Hood does not have the classical, upside-down cone shape that is typical of many stratovolcanoes; rather, it has a more rugged, uneven, and sharp-topped silhouette that is the result of extensive erosion that has occurred since the volcano became dormant. The mountain reaches a maximum elevation of 3,400 m (11,239 feet), and is extensively glaciated near the peak.

There are twelve glaciers or named snowfields located above 2,100 m (6,900 feet) level on Mount Hood containing approximately 0.35 cubic kilometers (0.09 cubic miles) of ice (Driedger and Kennard, 1986). According to Tom DeRoo of the USFS the glaciers on Mount Hood have been in retreat since the middle of the 18th century. The glaciers have incised the volcanic deposits and the streams that emanate from the glaciers have eroded deep, narrow valleys and ravines in the volcanic ash and pyroclastic deposits that comprise much of the material on the slopes of the mountain. Lacustrine siltstones from near terminus periglacial lakes plaster valley walls just upstream from the mouth of Polallie Creek. Highway 35 crosses White River near the location of the maximum extent of Frasier Glacial Episode Ice, evidenced by the prominent left lateral moraine just upstream of the bridge (Swanson *et al.,* 1989). Glacial retreat from the neo-glacial maximum has released large volumes of outwash, forming debris fans in White River and East Fork Hood River.

4.1.3 Hydrologic Setting

The study area is primarily located on the southeast flank of Mount Hood. Two major drainages, White River and the East Fork Hood River, are located in this area. The White River drainage starts high up on the mountain and includes White River, Iron Creek, and Mineral Creek. Iron Creek and Mineral creek run parallel to White River before merging into it. White River terminates at the Deschutes River near Tygh Valley State Wayside in Wasco County. The majority of discharge into the White River drainage is glacial in nature. The EFHR also originates high up on the mountain and flows southeast before turning to a northerly direction and terminating into Hood River at Winans. The majority of streams originating on the east flank of Mount Hood terminate into the EFHR. Seventeen sub watersheds join the EFHR watershed before it joins with the Middle Fork Hood River to define the start of the mainstream Hood

River that flows into the Columbia River (USFS, 1996). The majority of discharge into the EFHR drainage is also glacial in nature with the exception of Dog River and a few small streams located west of the Badger Creek Wilderness Area. Polallie Creek originates at a spring high up on Mount Hood that provides base flow to the stream; however, major debris flow events on Polallie Creek are glacial in nature.

The combination of glaciers, deep snow cover, and heavy rain, along with deep, over steepened deposits of loose, pyroclastic debris and volcanic ash creates a perfect geological and hydrological environment for the development of landslides, debris flows, and floods that are unpredictable in nature and have led to the problems experienced on Highway 35. It is important to keep in mind that these processes are somewhat gradational from one to another, and that they may operate singly, or in concert. It is likely that most often, a series of individual, lesser events and processes combine quickly over a short time period to produce a major event.

4.1.4 Debris Flows and Flooding

Published scientific and engineering literature specifically addressing debris flows on Mount Hood is limited to a USGS report discussing the 1980 Polallie event, 'The 1980 Polallie Creek Debris Flow and Subsequent Dam Break Flood, East Fork Hood River Basin, Oregon', by Gary L. Gallino and Thomas C. Pierson. Published literature that discusses the processes that lead up to debris flows and flooding in glaciated streams is also available. During the preparation of this report, several discussions were held with scientists and engineers who are currently studying debris flows and flooding in the Mount Hood area or on other glaciated volcanoes in the Cascade Range. The following discussion is based on the available literature and on interviews conducted with Tom DeRoo (Mount Hood National Forest, Sandy, Oregon), and with Tom Pierson, Dick Iverson, John Major, and Carolyn Dridger (Cascade Volcanoes Observatory, U. S. Geological Survey, Vancouver, Washington).

Debris flows, which are rapid down slope movements of mixtures of water, soil, rock, and vegetation, have been the primary cause of major highway damage at the White River, Newton, Clark, and Polallie study sites, and have indirectly caused damage by flooding at Dog River and Baseline. Debris flows are triggered by the rapid saturation of steeply inclined, loose, granular volcanic materials and glacial and/or fluvial deposits. Rapid saturation of those materials can result from heavy precipitation, rapid snowmelt (either by warm temperatures or rain-on-snow events), rapid melting of glacial ice leading to glacial outbursts, or the breaching of landslide-created dams by ponded backwater. The Newton-Clark event of

November 2000, for example, was triggered by a huge landslide that occurred in an over steepened slope near the terminus of the Newton-Clark glacier. The landslide dammed the melt water from the glacier, forming a temporary lake that ultimately breached the dam and initiated a major, destructive debris flow. The rapid saturation of granular material caused the debris to flow downhill like a fluid. Gallino and Pierson (1980), describe debris flows as having the consistency of slurry, which can also be described as "resembling wet concrete". They also state that debris flows contain relatively little water, usually only 10 to 20 percent by weight, and that the solid component is a poorly-sorted mixture of clay-size to boulder-size particles.

As it moves down slope, a debris flow often grows rapidly in areal extent and volume as it assimilates vegetation, soil, and additional granular material from the stream channel. Gallino and Pierson (1980) state that debris flows can be "hundreds of feet wide, tens of feet deep, and flow at many tens of feet per second". When a debris flow reaches flatter ground, it slows abruptly and deposits its bed load. If the deposited bed load raises the elevation of the stream channel, the channel is said to be aggrading. The aggrading channel creates a lobe of debris at the front of the flow that can dam the stream behind it, causing the stream to seek another path around the lobe by jumping its channel. If the stream is successful at finding another path, that new path or channel may bypass an existing drainage culvert or bridge. Conversely, if the stream is not successful at finding a new pathway around a debris dam, a large pond or lake may develop behind the lobe, ultimately breaching the lobe and causing major flood damage below the lobe. This was the case in the 1980 debris flow and flood at Polallie Creek, in which a debris dam at the mouth of Polallie Creek broke and sent ponded flood waters down the East Fork Hood River Canyon, destroying 8 km (5 miles) of Highway 35, a state park, a campground, and three bridges, and resulting in 13 million dollars in damage.

Flooding impacts the study sites by scouring away the highway embankment and pavement and by depositing rock and vegetation debris on the roadway. There are several weather conditions that can lead to flooding. If warm rains fall on deep accumulations of recent snow, as often occurs during the spring months, extremely high surface runoff conditions can develop rapidly. Such weather conditions, referred to as rain-on-snow events, can result in the sudden onset of flooding.

Flooding can also be initiated by the rapid melting of snow and glacial ice caused by a combination of heavy precipitation and unseasonably warm weather. An example of such a weather condition occurred in early October 2000, when 75 mm (3 in.) of rain fell on Mount Hood in a short time period. That event triggered extremely destructive floods that damaged and closed the entire 32 km (20 mile) section of Highway 35 between U. S. highway 26 and Baseline Road, resulting in over a million dollars in damage.

Major flooding from glacial outbursts can also occur solely as a result of the rapid melting of glacial ice during prolonged periods of warm weather and very high freezing levels. Such conditions can lead to the impoundment of glacial melt water behind ice dams high on the mountain, and to the storage of large volumes of water in glacial caverns, crevasses, and other conduits in the glacial 'plumbing'. If excessive hydraulic forces on an ice dam or within a glacier develop faster than can be dissipated by drainage, a glacial outburst flood can occur. For example, debris flows and surges that occurred in the Upper White River Valley in early September 1998, resulted from rapid glacial melting that occurred following several days of unseasonably warm weather. During that event, U. S. Geological Survey scientists determined that had these conditions persisted for another day or two, a glacial outburst flood of up to 500,000 cubic meters (650,000 cubic yards) of water and debris could have occurred from White River Glacier. Fortunately, temperatures dropped and the glacial outburst flood did not occur (DeRoo, Appendix B).

4.1.5 Rock Fall / Landslide Risk

USFS geologists have mapped landslide risk within the project area. Steeper slopes are considered to have a relatively high risk of landslide development. Flatter slopes have a relatively lower risk of landslide development. Figure 6.3.6 shows the landslide risk areas relative to the existing and proposed alignments. Note that no active landslides are mapped within the existing or proposed alignments. The section of highway that passes through the Narrows, and a section between Bennett Pass and White River, are designated as 'high' risk areas; however, with the exception of the rock fall hazard at the Narrows, no areas of slope instability were observed along the route during the study site reviews. It should be kept in mind that the relative risk assessment in this portion of the forest is based on slope steepness and not on known, mapped slide areas. Therefore, in general, areas mapped as having high landslide risk do not necessarily imply the probability of slope stability problems. The proposed alternative alignments are discussed relative to Figure 6.1.6 in Section 6.

Rock fall constitutes a significant hazard to motorists at the Narrows site. The cause of the rock fall is the highway's proximity to a steep, rocky hillside adjacent to the highway. Rock fall generates from fluvial deposits of loose, boulder material at the south end of the section and from a steep cliff of highly jointed and fractured basalt rock at the north end of the section. Boulders of up to a cubic meter or more in size fall from the fluvial deposits, and fresh scars on the rock cliff high above the roadway suggest that huge blocks of columnar basalt have fallen from the cliff in the recent past.

4.1.6 Peak Flow Estimates

Typically regression equations developed for eastern and western Oregon are used to model the magnitude and frequency of floods in the State. This information is then used in designing stream/river crossings for particular flood events, such as the 100-year flood event. However, this method of modeling and prediction cannot be effectively applied to the stream systems originating on Mount Hood for the following reasons:

1. The study area is located at the junction of North Central Region, Eastern Cascades Region, and High Cascades Region as defined in USGS reports developed for estimating the magnitude and frequency of floods in Oregon (USGS WRIR 82-4078, 1983 and USGS OFR 79-553, 1979). Since regression analysis is based on gaging station data and there are no gaging stations on the upper reaches of the streams in study area, the regression equations do not apply to these upper reaches of stream. In addition, peak discharge estimates for streams located at confluence of multiple hydrological regions tend to be more error-prone.
2. The study sites are located at the upper reaches of the streams and therefore the regression equations are unable to provide a realistic estimate of the magnitude of the flood discharge (based on analysis undertaken by Amit Armstrong, Hydraulic Engineer, FHWA).
3. The high amount, velocity, size, and erosive nature of bed load carried in these streams over a very short period of time during debris flows means that the current design issues at the stream crossings are not governed by the amount of water discharging into these streams. As the peak discharge attained during these events is orders of magnitude higher than the discharge associated with a typical rainfall-runoff event for the drainage area.

To verify the inapplicability of the regression equation method of calculating the magnitude and frequency of floods, calculations using these equations were done and are included in Appendix B. It is evident from the results, which show a range of values within an order of magnitude for the same location, that the USGS regression equations are not suitable for these sites and should not be used for predicting peak discharge. The drainage area ratio method is generally considered less accurate for estimating peak discharges than the regression equations but is considered valuable for comparative purposes. Calculations made using the drainage area ratio method of calculation are also given in Appendix B. The results of this method vary significantly (an order of magnitude) from the results obtained using the regression equations. Thus it is concluded that typical methods for predicting peak flows are not appropriate for the stream systems within the study area. It is further concluded that the impact of debris flows on the highway is not fundamentally a hydraulic problem and therefore hydraulic modeling cannot be used to identify solutions to the problem. The only permanent solution that avoids damage from these debris flows is to move the highway out of the floodplain(s).

4.1.7 Future Events

It is undeniably certain that major debris flows and floods will continue to occur on Mount Hood, and the Highway 35 study sites will continue to be the foci of events that occur in the White River, Newton-Clark, Polallie Creek, and East Fork Hood River drainages. Furthermore, data compiled by the USFS suggests that the Pacific Northwest may be entering a 20-year cycle of increased precipitation. If that is the case, the frequency of major events might actually increase during that time period.

During an interview with Tom Pierson and Dick Iverson of the U. S. Geological Survey's Cascades Volcano Observatory in Vancouver, Washington, the question of relating the frequency and magnitudes of debris flow events to recurrence intervals was posed to the USGS scientists. Their response was that debris flows have been relatively common during historical time, and that debris flows of a magnitude sufficient to damage the highway at the study sites could be expected to occur on the order of at least once a decade.

4.2 Biological

Biological baseline conditions are discussed in terms of fish presence and use, terrestrial wildlife species presence and use, vegetation, and wetlands.

4.2.1 Fish Presence and Use

Information on fish presence and use within the study area was obtained through personal communications with Gary Asbridge and Chuti Fielder (fish biologists, Hood River Ranger District, USFS), David Landsman and Art Martin (fish biologists, NMFS), and Steve Pribyl (fish biologist, ODFW), the EFHR Watershed Analysis (USFW, 1996), the White River Watershed Analysis (USFS, 1995), and the Draft Fisheries Desired Future Conditions Report (USFS, 2002). Information on fish presence, use, and passage at each of the study sites is summarized in Tables 4.2.1 and 4.2.2 and discussed in the following sections.

Table 4.2.1: Summary of fish species presence at each study site

Site	Watershed	Fish species confirmed present (✓) or potentially present (?)							
		Bull Trout (T)	**Steelhead** -Lower Columbia River ESU **/Rainbow Trout (T)**	**Cutthroat Trout (S)**	**Coho Salmon** - Lower Columbia River ESU **(C, S, State E)**	**Chinook Salmon** - Lower Columbia River ESU **(T)**	**Redband Rainbow Trout (S) (endemic – dist. popn)**	**Sculpin**	**Brook Trout**
White River	White River						✓	✓	
Clark Ck	EFHR		?	✓					
Newton Ck	EFHR		?	✓					
Narrows	EFHR		✓	✓	?	?			
Polallie Ck	EFHR		✓	✓	?	?			
Dog River	EFHR		✓	✓	✓	✓			
Baseline Dr	EFHR		✓	✓	✓	✓			
Downstream of study area	EFHR	✓	✓	✓	✓	✓		✓	✓

Note: T = listed as Threatened under the ESA; Prop. T = Proposed for listing as Threatened under the ESA; C = a Candidate species for listing under the ESA; State E = listed as Endangered under the Oregon Endangered Species Act; S = Forest Service Region 6 sensitive species.

Table 4.2.2: Summary of existing fish passage and habitat at each study site

Site	Crossing type	Passage	Habitat type
White River	Multi span bridge	Yes	Upper limit of distribution, foraging
Clark Ck	Double culverts	No – juveniles; ? – adults	Spawning, rearing
Newton Ck	Box culvert	Probably – however passage may be impeded by head cutting downstream (See Section 4.10.3.3)	Foraging
Narrows (EFHR)	Open river reach	Yes	Migration corridor, rearing
Polallie Ck	Double culverts	No	Spawning, rearing
Dog River /EFHR	Double box culvert / Open river reach	Yes / Yes	Spawning, rearing / rearing
Baseline Dr (EFHR)	Open river reach	Yes	Rearing

Note that three of the sites addressed by this study, White River, Clark Creek, and Newton Creek are fed by glacial melt. The East Fork Hood River (Baseline, Dog Creek, and The Narrows) is also influenced by glacial melt flowing into the system from Newton and Clark Creeks. The influence of glacial melt and sediment load on anadromous fish runs has not been determined. However, it is important to realize that the fish evolved in conjunction with this system. It is thought that non-glacial base flow streams, such as Polallie Creek, are and were probably important rearing areas during late summer (high glacial sediment loading periods).

4.2.1.1 East Fork Hood River Watershed

Fish species that have been documented as being present or are considered to be potentially present in the upper East Fork of the Hood River watershed within the project area are discussed below.

- Rainbow trout / steelhead – Lower Columbia River ESU (*Oncorhynchus mykiss*): Rainbow/steelhead trout are found in the watershed, primarily downstream from the Narrows. Winter steelhead that ascend into the East Fork Hood River are a mixture of hatchery and wild fish but all are derived from native Hood River stock. Based on limited radio telemetry studies conducted in the early 1990's and historical reports, there are relatively few steelhead that travel as far upstream as the National Forest boundary/project area. Steelhead have been documented as far upstream as Polallie Creek and there are anecdotal reports of steelhead in Cold Springs Creek and as far upstream as Clark Creek. There are no known barriers to upstream migration in the main stem

East Fork Hood River between the National Forest boundary and Sahalie Falls near Bennett Pass.

- Cutthroat trout (*O.clarki*): Cutthroat trout are found throughout the watershed but are more prevalent above the limits of anadromy, hence their strongholds are in the upper watershed above the Narrows. Sea run cutthroat trout were historically present in the watershed and adults are occasionally captured at Powerdale Dam in the main stem Hood River. Based on historical information most sea-run cutthroat are believed to ascend into the East Fork Hood River. Their population size is unknown but believed to be quite small.
- Coho salmon (*O.kisutch*)- Lower Columbia River ESU: Indigenous coho are probably extinct. Coho entering the system are thought to be strays from other river systems and may spawn naturally in the lower portions of the East Fork Hood River up to Dog River. Personal communications with USFS fish biologists indicate that coho have spawned in Dog River near its mouth.
- Chinook salmon (*O. Tshawtscha*)- Lower Columbia River ESU: Spring chinook salmon juveniles have been documented in the lower watershed and some rearing habitat for this species is available in the lower East Fork watershed. It is currently thought that this species distribution extends upriver to approximately 0.5 a mile downstream of the study area (0.5 mile downstream from Baseline Road). However, there are no known natural barriers in the East Fork mainstream river and therefore anadromous fish have access to the upper watershed. Chinook salmon present in the Hood River watershed are all descendants of hatchery fish. It is thought that the native run has been extinct since the early 1970s.
- Bull trout (*Salvelinus confluentus*): Bull trout are not believed to reside in the East Fork of the Hood River, although there have been one or two incidental sightings in the lower watershed. However, the adjacent watershed (Middle Fork of the Hood River) is a stronghold for bull trout. As no barriers exist between the two watersheds, it is possible that bull trout could move into the East Fork system.
- Brook trout (*S.fontinalis*): The only known populations of brook trout in the East Fork Hood River watershed are in Doe and Tilly Jane Creeks and Cold Springs Creek. Since there are no downstream migration barriers it is possible they are present in the East Fork Hood River and possibly other tributaries. Generally, naturally occurring brook trout are not found below 2,500 feet in elevation.
- Sculpin (*Cottus* sp.): Sculpin are found in the main stem East Fork Hood River and it is likely that they are present in many tributaries but no formal surveys have been conducted thus their distribution is not completely described.

High quality clear water fish habitat (for cutthroat and steelhead) is also present in the EFHR upstream from Clark Creek.

Major issues for fish population health in the EFHR watershed are irrigation practices, the loss of in-stream wood, and the location and maintenance of Highway 35. Currently during late summer the East Fork Irrigation District reduces water flow within the EFHR at times taking out all water and subsequently blocking fish passage due to both low water levels and high water temperatures. High water temperatures are a concern due to their impacts on fish. Studies show that higher water temperatures result in delays in spawning, difficulties in oxygen uptake, and ultimately death. Other causes of increased water temperatures, aside from irrigation withdrawals, include the loss of riparian vegetation (and therefore shade). An essential component of fish habitat is in-stream wood. The loss of in-stream wood and the loss of potential for future recruitment of wood is of key concern as the stability of the system is primarily a function of the structure provided by large wood within key stream reaches. Depositional areas with wide flood prone areas and low gradients (such as the EFHR just upstream from the mouth of Polallie Creek) are more likely to collect wood and dissipate stream velocity providing ideal conditions for fish spawning and rearing. The construction and maintenance of Highway 35, particularly in the vicinity of the Narrows, Dog River and Baseline Drive, constrains it to a smaller portion of its original floodplain and significantly alters the ability of the EFHR main stem to stabilize within the valley floor. Habitat capable of supporting historic population levels of anadromous fish is currently limited in the project area and the system is out of balance as indicated by downcutting, floodplain abandonment, and aggrading stream channels (USFS, 1996). The presence of culverts acting as fish passage barriers is also an issue. As detailed in Table 4.2.2, the culvert crossings at Clark Creek and Polallie Creek are both identified as fish barriers.

4.2.1.2 White River Watershed

Fish species present in the upper White River watershed include redband/inland rainbow trout (*Oncorhynchus mykiss gairdneri)* and sculpin (*Cottus* sp.). The White River redband rainbow trout is genetically distinct from other rainbow trout and is known to be present in the Mineral Creek and White River drainages although the site of the existing White River Bridge is thought to be at the upper limit of its distribution. It is assumed that fish species seasonally use the streams within the study area, depending on flow and habitat availability. Few fish surveys have been completed in the White River watershed within the study area. The existing habitat is marginal for aquatic species due to the steep terrain, thick glacial turbidity during the summer months, and lack of cover and holding areas.

Anadromous species such as steelhead and chinook salmon are found over 35 river miles downstream of the study area as the White River falls (located at river mile 2) act as a barrier to upstream movement by anadromous fish species.

4.2.1.3 Desired Future Conditions

The ODFW and the NMFS identified fish passage improvement priorities within the study area. They stated that allowing fish passage into Polallie Creek and Clark Creek is a high priority from a basin wide perspective. Note that under the ODFW Fish Passage Regulations and House Bill 3002, any major work (defined as any work that extends the life of the culvert/crossing structure) must address fish passage.

A fisheries report was prepared by the USFS (April, 2002) and details the desired future conditions at each of the project sites. These are described below:

- White River: 1) allow White River, Iron Creek, and Mineral Creek plus their braided side channels to meander and dissipate energy/bed load across the entire natural valley floor; and 2) reduce the need for maintenance which is currently creating sediment pulses at unnatural times of the year.
- Clark and Newton Creeks: 1) allow both Newton and Clark Creeks, along with their extensive braided side channels to again meander and dissipate energy/bed load across the entire natural alluvial fan; and 2) allow for natural wood recruitment and deposition to create complex spawning, holding and rearing fish habitat downstream.
- The Narrows: 1) restore the EFHR's natural channel capacity; 2) allow for recruitment and retention of habitat forming materials (large wood, boulders, and slow water spawning gravel pockets); and 3) minimize upstream and downstream disruptions to hydraulic processes.
- Polallie Creek: 1) restore flood plain functions at the mouth of Polallie Creek by allowing the stream to move under the highway within its natural channel.
- Dog River and Baseline: 1) restore the EFHR and mouth of the Dog River flood plain functions by allowing the river to occupy the entire valley floor as it did before the construction of Highway 35; and 2) allow for deposition and natural wood and gravel recruitment to create complex habitat for spawning, holding and rearing fish.

Fielder *et al.* (April, 2002) further prioritized the restoration of these zones based their potential contribution to the overall salmonid population and habitat recovery. The zones are listed in the following order of priority: Dog River and Baseline; Clark and Newton Creeks; Polallie Creek; The Narrows; and White River.

4.2.2 Vegetation

Information on special management status botanical species and noxious weeds within the study area was obtained through personal communications with Susan Nugent (botanist, Hood River Ranger District, USFS), and the EFHR Watershed Analysis (USFW, 1996). General vegetation information was obtained from the White River Watershed Analysis (USFS, 1995), and GIS data layers available on the Mount Hood Forest Service Data Distribution Facility web site (USFS, September 2001).

4.2.2.1 Vegetation Trends

The primary influences on vegetation within the project area have been volcanic eruptions, glacial movement, climate change, fire, and the fruit industry. Current vegetation zones within the EFHR and White River watersheds within the National Forest boundary range from high alpine non-vegetated types on the slopes of Mount Hood, to Ponderosa pine and Douglas fir dominated forests in the lower parts of the watersheds. Prior to 1900, the general landscape within the project area is thought to have been covered with a matrix of mid seral forest which has currently shifted to slightly more developed stands, larger in size and not as open. Fragmentation between late seral patches has also increased.

Noxious weeds are a serious threat, competing with native plants for nutrients and displacing entire native plant communities. State designated noxious weeds (bull thistle, Canada thistle, diffuse knapweed, meadow knapweed, scotch broom, spotted knapweed, St.Johns wort, tansy ragwort, yellow toadflax, purple loosestrife, houndstounge) are present along all major roadways, along trails, power lines, and in most timber sale units within the National Forest.

4.2.2.2 Protected Species

Currently there are at least fifteen special management status plant species that are protected under the Northwest Forest Plan – (Survey and Manage species list) in the general project area. The Northwest Forest Plan (NWFP) Standards and Guidelines focus on management of late-successional and old growth forests that are 80 years to greater than 600 years old and prohibit impact to 267 Survey and Manage botanical species. USFS Policy also requires surveys for 35 species listed on the 1999 R6 Sensitive Species List (Mount Hood Forest Plan). The R6 Sensitive Species List is currently being updated and will be finalized in 2003. No botanical species currently listed under the ESA are thought to be potentially present in the project area at this time.

4.2.2.3 Site Specific Analysis

The dominant vegetation zones and known protected species are described in the following table relative to each of the study sites and proposed alternative routes.

Table 4.2.3: Vegetation zones and protected species presence at each study site

White River: Mountain hemlock
Clark Creek: Mountain hemlock / Pacific silver fir
Newton Creek: Mountain hemlock / Pacific silver fir
Narrows: Grand fir / Eastside Douglas fir; ***Protected species:*** violet suksdorfia (*Suksdorfia violacea*)
Polallie Creek: Grand fir / Ponderosa pine
Dog River: Eastside Douglas fir
Baseline Drive: Eastside Douglas fir
43/48 Route: Pacific silver fir
44/17 Route: Eastside Douglas fir / Grand fir / Ponderosa pine
Clark/Newton Bypass: Mountain hemlock / Pacific silver fir
Narrows Bypass: Grand fir / Eastside Douglas fir

The plant species, violet suksdorfia (*Suksdorfia violacea*), normally associated with mossy rocky shady cliffs is listed as a R6 Sensitive Plant species and is known to be present on the face of the cutslope on the east side of the Narrows study site. This plant is classified as rare and is also locally endemic. The population of violet suksdorfia within the project area is at the most southern end of the species range and subsequently this site is particularly important for the future adaptation and survival of the species under changing environmental conditions such as global warming. No other protected plant species are known to be located in the immediate proximity of any of the study sites or proposed alternative routes.

4.2.3 Terrestrial Wildlife

Information on terrestrial wildlife within the study area was obtained through personal communications with Richard Thurman (wildlife biologist, Hood River Ranger District, USFS) and Diana Hwang (wildlife biologist, USFWS), the EFHR Watershed Analysis (USFW, 1996), the White River Watershed Analysis (USFS, 1995), and GIS data layers available on the Mount Hood Forest Service Data Distribution Facility web site (USFS, September 2001).

4.2.3.1 Wildlife Trends

Prior to 1900 terrestrial species that are thought to have been plentiful and well distributed within the project area include: large home range late successional species such as the spotted owl, pine marten, fisher, wolverine, goshawk, and pileated woodpecker. Peregrine falcons, bald eagles, grizzly bear, gray wolf, cougar, lynx, and black bear were probably also present as were condor and mountain goats with riparian associated species such as turtles, harlequin ducks, wolverine, and Cope's giant salamander occurring in the lower portions of the watersheds.

Conditions for terrestrial wildlife species in the project area have changed substantially since the early 1900's. Within the project area the spotted owl is still present but not in abundance, wolverine sightings have been reported particularly in the upper watersheds, and pine martens are abundant. Prime habitat for pine martens is located in the upper elevations especially in stands that are not fragmented, such as around Mt Hood Meadows Ski area and in the upper portions of Polallie sub-watershed. Harlequin ducks are known to be present from above Robin Hood campground to below Tollbridge Park and have been observed nesting in the vicinity of the Baseline Drive study area. Deer and elk migrate through the watershed in spring and fall (in a north south direction along the EFHR and in an east west direction between the EFHR and Middle Fork Hood River). Their summer range includes the upper portion of EFHR (Meadows, Clark and Upper East Fork sub watersheds). Bald eagles are not permanent inhabitants due to depleted fish runs however; they do forage in the EFHR and White River watersheds in winter. Other species, which are no longer present, include the grizzly bear, mountain goat, gray wolf, Californian condor, painted and pond turtles. Peregrine falcons migrate through the area; however, there are currently no known nests within the Highway 35 study area. The EFHR (and Surveyors Ridge which defines the eastern and southern boundaries of the watershed) is potentially important as a southward migration corridor for raptors.

4.2.3.2 Protected Species and the Study Sites

Wildlife species in the project area are protected under the ESA, the Oregon ESA, the Northwest Forest Plan – survey and managed species list, and the Forest Plan – Region 6 sensitive species list. Three species listed under the ESA are potentially present in the project area. Northern spotted owl (*Strix occidentalis)* nest sites are known to be present in close proximity to the Polallie Creek and Narrows study sites and suitable habitat for this species is present throughout most of the study area. Spotted owl surveys were last undertaken in the study area in 1994 (for the Mt. Hood Meadows access road project). Late Successional Reserve designated under the NW Forest Plan is present in the study area (refer to Figure 3.3.1). The Canada lynx *(Lynx canadensis)* is thought to be transient in the corridor area and not a resident species. Bald eagles (*Haliatus leucocephalus*) are not resident but do forage in the EFHR and White

River watersheds in winter. Species protected under the Northwest Forest Plan and potentially present in the study area are the larch mountain salamander (*Plethodon larselli*), which is associated with talus slopes, the harlequin duck (*Histrionicus histrionicus*), and mollusk species (refer to Table 4.2.4).

Table 4.2.4: Protected species potentially present in the study area

Listed or Proposed under the ESA	bald eagle *(Haliatus leucocephalus)*
	northern spotted owl *(Strix occidentalis caurina)*
	Canada lynx *(Lynx canadensis)*
Listed or Proposed Under the Oregon ESA	wolverine *(Gulo gulo luteus)*
	American peregrine falcon *(Falco peregrinus anatum)*
R6 Sensitive Species (Mount Hood Forest Plan)	Californian wolverine *(Gulo gulo luteus)*
	Baird's shrew *(Sorex bairdii bairdii)*
	Pacific fringe-tailed bat *(Myotis thysanodes vespertinus)*
	Pacific fisher *(Martes pennanti)*
	peregrine falcon *(Falco peregrinus anatum)*
	Larch Mountain salamander *(Plethodon larselli)*
	harlequin duck *(Histrionicus histrionicus)*
	bufflehead (*Bucephala albeola)*
	horned grebe (*Podiceps auritus)*
	Gray flycatcher *(Empidonax wrightii)*
	Cope's giant salamander *(Dicamptodon copei)*
	Cascade Torrent salamander *(Rhyacotriton cascadae)*
	Oregon slender salamander (*Batrachoseps wrighti*)
	Oregon spotted frog *(Rana pretiosa)*
	northwestern pond turtle *(Clemmys marmorata marmorata)*
	painted turtle (*Chrysemys picta)*
Protection Buffer Species (Mount Hood Forest Plan)	white-headed woodpecker *(Picoides albolarvatus)*
	black-backed woodpecker *(Picoides arcticus)*
	pygmy nuthatch *(Sitta pygmaea)*
	flammulated owl *(Otus flammeolus)*
	Great gray owl *(Strix nebulosa)*
Survey and Manage (C3) Species (NW Forest Plan)	Dalles Sideband *(Monadenia fidelis minor)*
	Puget oregonium *(Cryptomastix devia)*
	Columbia oregonium *(Cryptomastix hendersoni)*
	Evening fieldslug *(Deroceras hesperium)*
	Crater Lake tightcoil *(Pristiloma arcticum crateris)*
	Larch Mountain salamander *(Plethodon larselli)*

4.2.4 Wetlands

Information on the presence of wetlands was obtained from the National Wetlands Inventory (NWI) database and is mapped in Figure 4.2.1 in relation to each of the study sites and proposed alternative routes.

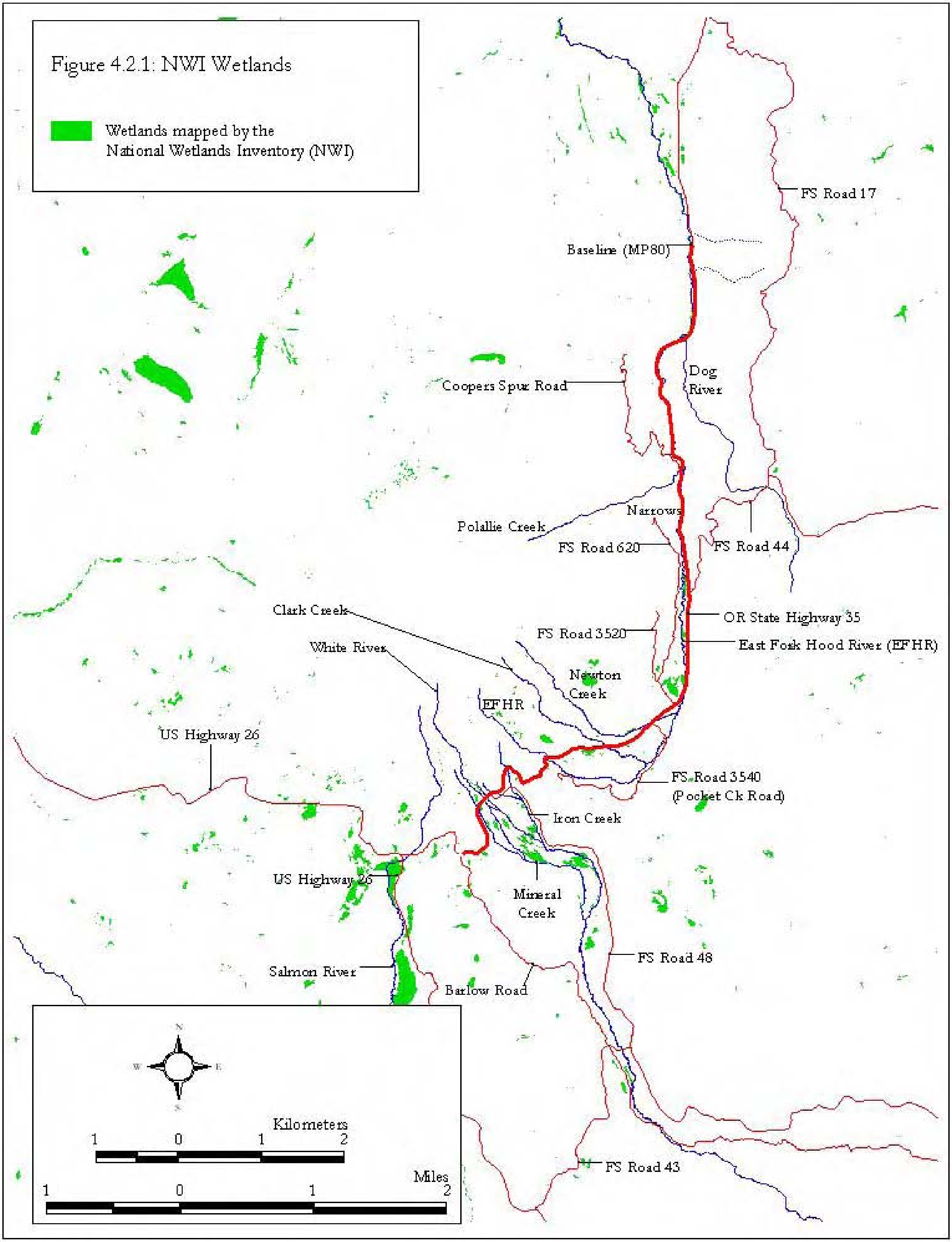
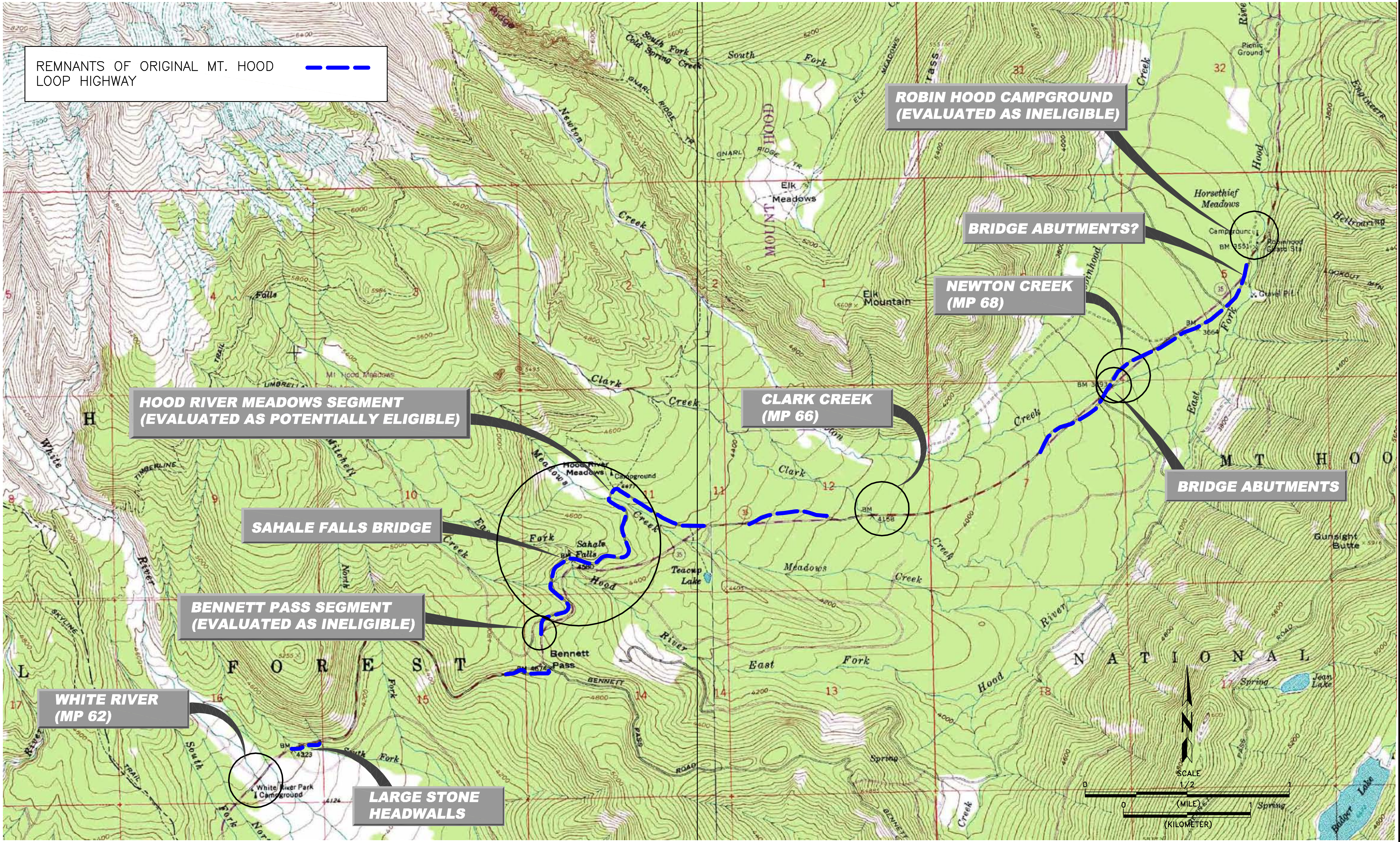


Figure 4.2.1: NWI Wetlands
Wetlands mapped by the National Wetlands Inventory (NWI)
FS Road 17
Baseline (MP80)
Dog River
Coopers Spur Road
Narrows
Polallie Creek
FS Road 620
FS Road 44
Clark Creek
OR State Highway 35
FS Road 3520
East Fork Hood River (EFHR)
White River
Newton Creek
EFHR
US Highway 26
FS Road 3540 (Pocket Ck Road)
Iron Creek
US Highway 26
Mineral Creek
Salmon River
FS Road 48
Barlow Road
N
W
E
S
Kilometers
1 0 1 2
Miles
1 0 1 2
FS Road 43

4.3 Archeological/Historic

Information on cultural sites within the study area was obtained through personal communications with Margaret Dryden (cultural resource specialist, Hood River Ranger District, USFS), the EFHR Watershed Analysis (USFW, 1996), the White River Watershed Analysis (USFS, 1995), the ODOT OR 35 corridor study (1999), and the White River WSR Management Plan (1994).

An archaeological assessment of the Highway 35 road corridor was conducted by ODOT in January 1998 and identified 16 archaeological sites within the study area along the Highway 35 corridor between MP 57.59 and MP 80.08 (ODOT, 1999). Personal communications with the USFS indicated that three culturally significant sites are known to be present within close proximity of the study sites. These are the Mount Hood Loop Highway, the Barlow Road National Historic District, and a water fountain. The original alignment of the Mount Hood Loop Highway is currently being surveyed and evaluated by ODOT and the USFS for historic significance. It is considered likely that Sahallie Falls will be one of the most significant portions of the Loop Highway. The highway was completed in 1925 and was largely constructed adjacent to the EFHR main stem channel (refer to the photograph log in Appendix A). The current route from Parkdale up the Cooper Spur road to Highway 35 and south along Highway 35 to Bennett Pass is approximately the same alignment as the original Loop Highway. Thus, the portion of Highway 35 within the study area is part of the initial alignment (refer to Figure 4.3.1). The Barlow Road National Historic District has National Register status due to its history as part of the Oregon Trail and is located in close proximity to the White River study site (refer to Figure 4.3.2 for a map of the Barlow Road National Historic District). A historic fountain used in the early 1900's for filling the radiators in Model T Ford cars is located at Sherwood Campground in close proximity to the Narrows study site.



BY	DATE	REVISION DESCRIPTION

DESIGN VA PROJ. NO. 4495
DRAWN ML DATE 6/02
CHECKED SURVEYED

DJ&A, P.C.
CONSULTING ENGINEERS & LAND SURVEYORS

FEASIBILITY STUDY
WHITE RIVER TO BASELINE

REMNANTS OF ORIGINAL
MT. HOOD LOOP HIGHWAY
Figure 4.3.1

SHEET 1 OF 2

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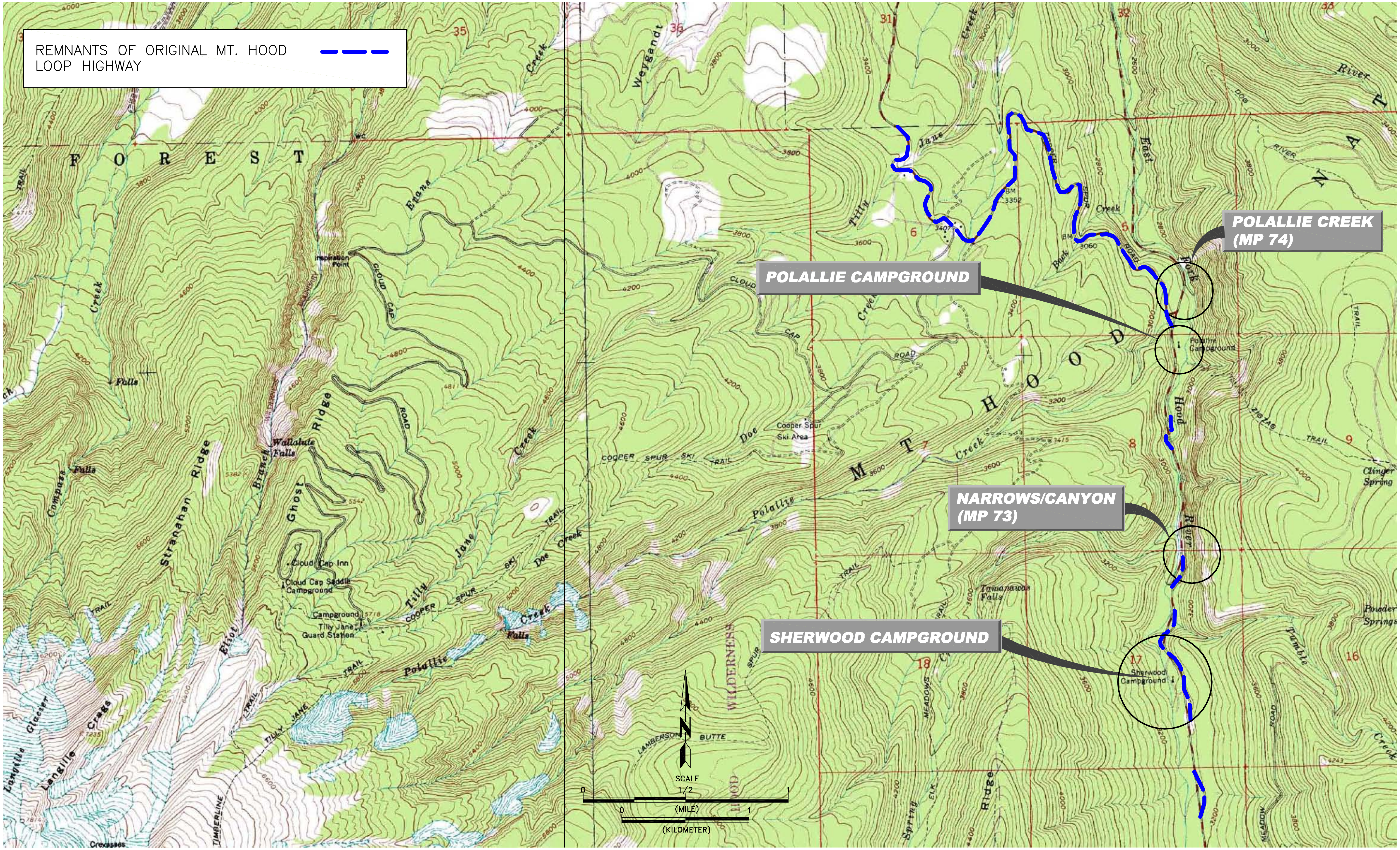

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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

REMNANTS OF ORIGINAL
MT. HOOD LOOP HIGHWAY
Figure 4.3.2

SHEET 2 OF 2

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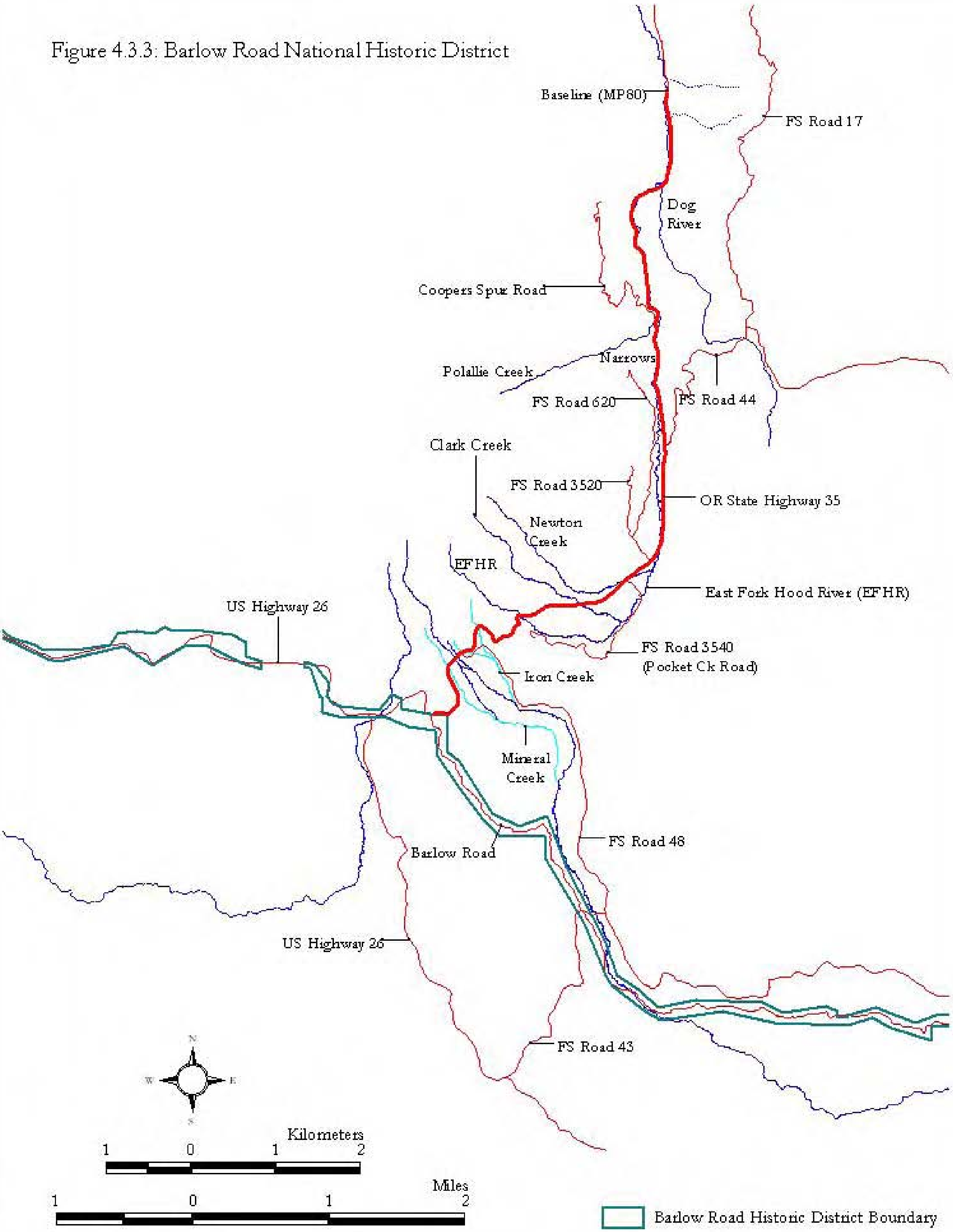
Figure 4.3.3: Barlow Road National Historic District



4.4 Recreation

Information on recreational resources within the study area was obtained through personal communication with Kevin Slagle (recreation resource specialist, Hood River Ranger District, USFS), the EFHR Watershed Analysis (USFW, 1996), the White River Watershed Analysis (USFS, 1995), the White River WSR Management Plan (1994), and GIS data layers available on the Mount Hood Forest Service Data Distribution Facility web site (USFS, September 2001).

Recreation opportunity spectrum classes are designated throughout the National Forest. Within the project area ROS classes are 'Roaded Modified' and 'Roaded Natural' [5]. Recreation sites located in close proximity to the study sites, and potentially affected by projects that may arise out of this study, are detailed below.

Table 4.4.1: Recreation resources relative to the study sites

Site	Existing Recreation Resources
White River	East and West White River Sno-Parks; Mineral Jane ski and hiking trail (north and south on the west side of the bridge); Boy scout lodge (on the west side of White River Bridge); Hood Meadows ski area (the entrance is located between the White River site and the Clark Creek site)
Clark Ck	Clark Creek Sno-Park (receives low use); Elk Meadows trail head (1 of 2 – the other is at the Meadows access road and is the one the USFS prefer people to use); Clark Creek and Newton Creek ski trails; Teacup lake groomed snow trails (25+ km) maintained by the Oregon Nordic Club
Newton Ck	Clark Creek and Newton Creek ski and hiking trails; Pocket Creek trail
Narrows	Pete's Pile – a unique rock climbing site; Zigzag trail head (located at the N end) – trail traverses Surveyors Ridge
Polallie Ck	Rouston Park – owned by the County and located at the Forest boundary N of

[5] Roaded Modified: areas that are characterized by naturally appearing environments with high evidence of humans. Resource modification and utilization practices are evident but may not harmonize with the natural environment. Conventional motorized use is allowed and incorporated into construction standards and facility designs; Roaded Natural: areas that are characterized by naturally appearing environments with moderate evidence of humans. Resource modification and utilization practices are evident but harmonize with the natural environment. Conventional motorized use is allowed and incorporated into construction standards and facility designs (USFS, 1990).

	Polallie Coopers Spur Ski Area
Dog River	Dog River Trail (trail head located at the Dog River crossing of Highway 35)
Baseline Dr	None
43/48 Route	Groomed snow trail system;
44/17 Route	Rouston Park – owned by the County and located at the Forest boundary N of Polallie; Dog River Trail (trail head located at the Dog River crossing of Highway 35); Pete's Pile – a unique rock climbing site; Little John Sno-Play and Nottingham Campground (located just S of the intersection of FS 44 and Highway 35); Gibson Prairie Horse Camp; Surveyors Ridge trail; Boy Scouts of America – Camp Baldwin is primarily accessed from FS 44; Elk Meadows Trail (located on the ridge on the west side of the EFHR); Sherwood Campground (located ¼ mile south of the Narrows); Tamanawas Trail – most popular trail heads E to Tamanawas Falls (trail head located at Sherwood Campground)
Clark/Newton bypass	Teacup lake groomed snow trails (25+ km) maintained by the Oregon Nordic Club; Clark Creek Sno-Park (receives low use); Elk Meadows trail head (1 of 2 – the other is at the Meadows access road and is the one the FS prefer people to use) – popular for hiking and mountain biking; Pocket Creek Sno-Park and trail system (located on Pocket Ck Road
Narrows bypass	Elk Meadows Trail (located on the ridge on the west side of the EFHR); Sherwood Campground (located ¼ mile south of the Narrows); Tamanawas Trail – most popular trail heads E to Tamanawas Falls (trail head located at Sherwood Campground)

Please refer to the map given in Figure 4.4.1 illustrating the study sites relative to ROS classes, trail systems, sno-parks, and campgrounds.

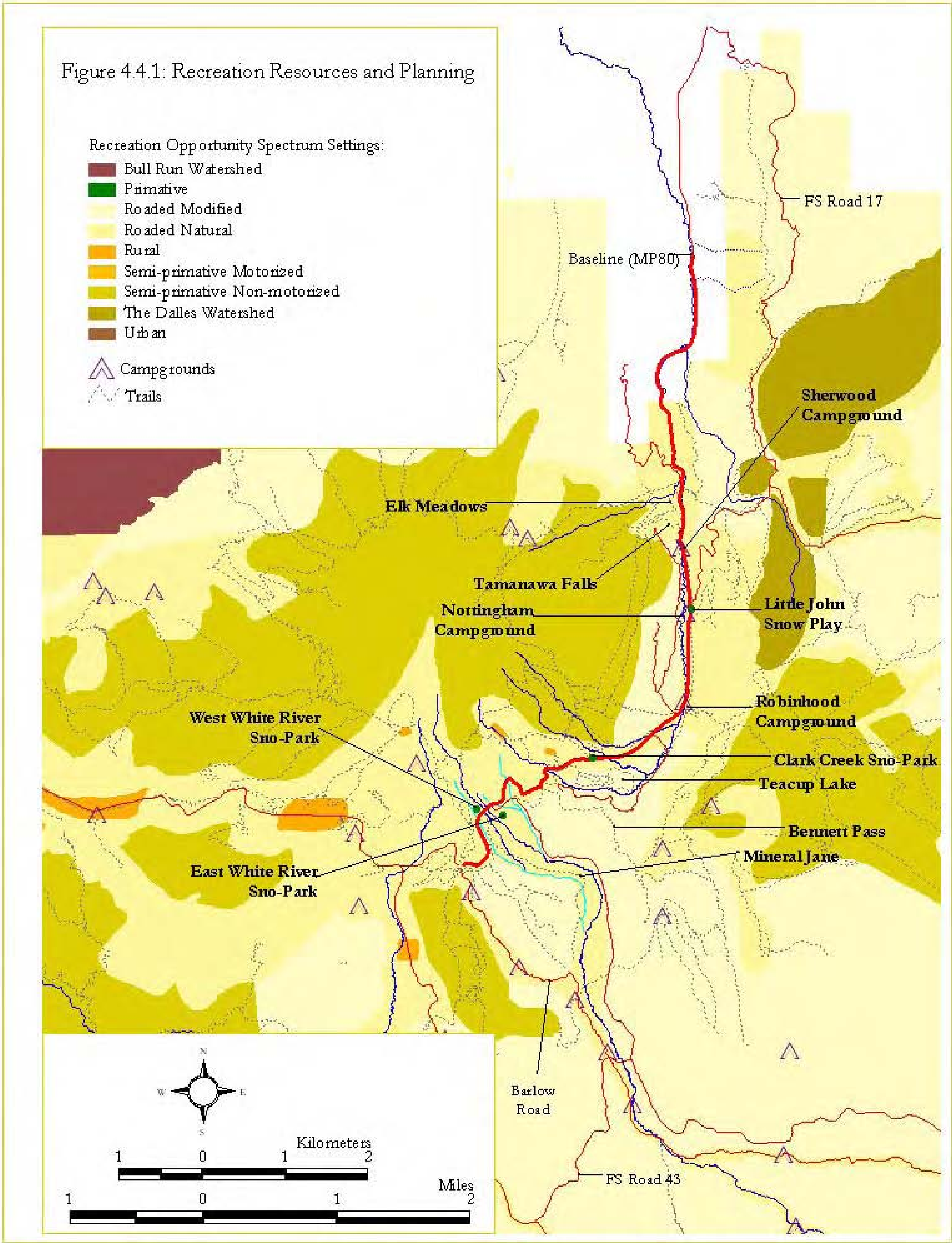


Figure 4.4.1: Recreation Resources and Planning
Recreation Opportunity Spectrum Settings:
Bull Run Watershed
Primative
Roaded Modified
Roaded Natural
Rural
Semi-primative Motorized
Semi-primative Non-motorized
The Dalles Watershed
Urban
Campgrounds
Trails
FS Road 17
Baseline (MP80)
Sherwood Campground
Elk Meadows
Tamanawa Falls
Nottingham Campground
Little John Snow Play
Robinhood Campground
West White River Sno-Park
Clark Creek Sno-Park
Teacup Lake
Bennett Pass
Mineral Jane
East White River Sno-Park
Barlow Road
FS Road 43
N
W
E
S
Kilometers
1
0
1
2
Miles
1
0
1
2

4.5 Noise

No known noise studies have been conducted within the project area and none of the planning documents written to date specifically address the existing or futuristic characteristics of the noise environment within the project area.

Sensitive noise receptors that could be affected by alternatives identified in this study are residents located along FS 17, users of recreation facilities (Pete's Pile rock climbing site, trail systems, campgrounds, and sno-parks) located in the vicinity of Highway 35, FS 48, FS 43, FS 3540, FS 44, and FS 17, and inhabitants (including wildlife such as the spotted owl) of the forest and Mount Hood and Badger Creek Wilderness Areas.

Typically, noise experienced within the project area is associated with the road corridor and off road vehicles. Other noise sources in the project area are aircraft, electricity generators, and chain saws. It is estimated that the difference in decibel levels between 'natural quiet' in the project area and average noise levels would be in the order of 10 - 70 decibels (equivalent to a 2 – 130 fold increase in perceived loudness). This calculation is based on a natural sound level of 10 – 55 dBA (dependant on factors such as wind, time of day, proximity to water) (Bowlby *et al.,* 1990), average peak decibel levels for single engine propeller aircraft overflights of 66 dBA (Tabachinck *et al*., 1994), and the average decibel level for a medium sized truck of 80dBA (FHWA, website). The duration of noise experienced is also a significant factor in characterizing impacts from noise. ADT levels on the road are relatively low (1800) for a State Highway and therefore noise impacts from highway traffic may be expected to be lower than on other State Highways. However, noise impacts are also dependant on the context of the noise. As Highway 35 is located in a relatively sensitive setting (a National Forest valued among other things for natural quiet) the equivalent level, type and duration of noise is expected to have greater impact than it would in a less sensitive setting.

4.6 Visual

The White River Wild and Scenic River Plan describes the scenery in the White River watershed as being regionally important and appreciated in all seasons. Outstanding viewsheds cited in the plan include: views within the WSR corridor from White River, views from Barlow Road, and views from White River East Sno-park (USFS, 1994). The Highway 35 Viewshed Management guide further emphasizes the importance of viewsheds in the project area stating, "The Mount Hood Loop is one of the most important recreational drives in Oregon". The perceived importance of the scenic resources along

Highway 35 is further demonstrated by the nomination of the Highway for National Scenic Byway status under the USDA Scenic Byway Program (USFS, 1991). North of Robin Hood Campground (and the Newton Creek study site) and between Iron Creek and the southern most EFHR crossing, the land adjacent to the road is classified under the Mount Hood Forest Plan as Scenic Viewshed. Between the Robinhood campground and the southern most EFHR crossing, the land adjacent to the road is also managed for it high visual qualities (classification: Wildlife/Visuals Emphasis). Refer to Figure 3.1.1.

The EFHR and White River watershed analyses discuss the visual quality objectives (VQOs) for each watershed. Those that occur in or in close proximity to the project area include the viewsheds from Timberline Lodge, US Highway 26, Or Hwy 35, FR 48, and the White River WSR. These viewsheds are stated to greatly influence the VQOs in the Crest Zone of the WSR corridor, which is primarily allocated to Late Successional Reserve (LSR) and B2 scenic viewsheds. Therefore the aim in these areas is to meet 'Retention' (Natural Appearing) and 'Partial Retention' (Slightly Altered) VQOs. Within the project area, the VQOs in the White River watershed have been described as 'Moderately Altered' in areas of scattered timber sales including along the White River floodplain and FS 48 near Hwy 35 and 'Natural Appearing' in four main areas including the White River floodplain. Within the EFHR watershed, prominent viewsheds in the project area are Highway 35 and FS 44. (USFS, 1995; USFS, 1996)

4.7 Air Quality

Little data is available on air quality in the project area. However, the Highway 35 Corridor Plan (1999) published by ODOT does briefly discuss existing air quality conditions. According to the ODOT report, air quality in the corridor is believed to be relatively high due to the topography, low density of development and climate (winds, seasonal precipitation, and temperature changes) resulting in a relatively low level of air pollutant emissions coupled with a low likelihood of experiencing periods of prolonged air stagnation.

4.8 Water Quality

Water quality information for the project area was collated from the White River Watershed Analysis (1995), the EFHR Watershed Analysis (1996), and data collected on the EFHR in 1998 by the Oregon Department of Environmental Quality (DEQ). Water quality in the study area is discussed below relative to the two watersheds.

4.8.1 White River Watershed

No records of water quality or quantity monitoring in the immediate vicinity of the project area have been found although the USFS undertook temperature monitoring in the White River at the forest boundary and at the White River Falls in 1993 – 1994. Water temperatures at these two sites exceeded the State Water Quality baseline standards of 14.4 ^{o}C (58 ^{o}F). Little monitoring has been done to address the impacts of irrigation withdrawals. Irrigation ditches withdraw water from most of the perennial streams in the upper White River Sub basin and all of the perennial streams in the lower sub basin reducing summer flows in some streams (Clear, Jordan, and Badger Creeks) and de-watering others (Threemile, Rock, Gate, Lost, and Frog Creeks) during the irrigation season (USFS, 1995). Furthermore no monitoring of sediment/turbidity, conductivity, agricultural chemicals, or dissolved oxygen levels appears to have been done.

4.8.2 East Fork Hood River Watershed

According to the EFHR Watershed Analysis (1996), water temperature data has been collected at several sites within the watershed over the past ten years and high temperatures have been recorded in the lower EFHR watershed. Data collected on the EFHR in the Mount Hood Meadows Permit Area indicates a highly variable flow regime and sediment pulses. Furthermore, conductivity is inversely related to flow and increases during fall rains and through winter. Conductivity changes were traced to releases from the wastewater treatment plant.

Water quality data was collected by the DEQ on the EFHR at the county gravel pit, downstream from the project area at RM 0.75 in June, August, and October 1998. Criteria for pH, temperature, and dissolved oxygen were met during each sampling period. However conductivity criteria were not met in June and August (refer to the data sheets provided in Appendix B).

4.9 Accident History

The accident rate along the study corridor is higher than the State average (Refer to Table 4.9.1). The accident history along the study corridor was provided by ODOT for a five-year period from 1997 through 2001 and is given in Table 4.9.2. The accident numbers shown are for areas extending 1 mile either side of the individual project sites. Note that some sites were combined due to their close proximity to one another.

Table 4.9.1: Accidents per million vehicle miles

Description	Average	Max	Min	No. Miles
Oregon State Highway System - Non Freeways	0.93	0.96	0.91	6167.91
Mt. Hood Highway – Sandy to Hood River	0.86	0.94	0.81	69.61
Mt. Hood Highway - MP 59.67 to MP 85.03	1.87	2.1	1.57	25.36

Table 4.9.2: Accident history in the study corridor (1997 – 2001)

Study Site	Number of Accidents	Causes of Accidents
White River (MP 62)	32	Too Fast (25) Loss of Control (2) No Yield (3) Animals (2)
Clark Creek (MP 66) Newton Creek (MP 67)	26	Too fast (19) Loss of Control (4) No Yield (2) Following too close (1)
Narrows (MP 73) Polallie Creek (MP 74)	29	Too Fast (21) Loss of Control (2) No Yield (2) Animals (2) Following too close (2)
Dog River (MP 78)	18	Too Fast (14) Animals (2) Following too close (1) Loss of Control (1)

The primary reasons for accidents along this segment of roadway are: traveling too fast for road conditions, loss of control of the vehicle (due primarily to road conditions), not yielding to oncoming traffic at intersections, collision with animals that are foraging alongside or crossing the roadway, and following too close to the vehicle in front.

The majority of accidents on this segment of roadway are related to excessive speed for the current road conditions. That is similar to accidents on other segments of roadway, however, this area receives very high amounts of snow and ice and the storms can create very hazardous driving conditions. The roadway is very mountainous and steep compared to most other segments of highway with which this area is compared. The majority of the accidents involved poor road conditions due to the steep mountainous terrain and the snowy or icy road conditions. These storms can occur during the early fall and late spring seasons also, when the travelers do not have their winter tires installed and do not have the proper equipment for snowy or icy conditions.

The roadway itself meets the required geometric designs but the combination of steep grades, wintry driving conditions and people driving faster than the wintry road conditions allow create an abnormally high rate of accidents in this area. It should be noted that there are very low numbers of fatalities along this segment of highway, primarily due to the slower speeds during the winter months when most of the accidents occur.

4.10 Existing Road Conditions

Existing road conditions were assessed in terms of road surface conditions, geometries, safety appurtenances, drainage structures, hydrologic and hydraulic conditions, and geotechnical deficiencies. A summary of the existing conditions is given below followed by a site-by-site assessment.

The general surface condition of the roadway throughout the study area is good. Most of the study sites have been recently repaired due to the flood/debris events washing out portions or entire sections of the roadway. Road surface condition information was obtained from the ODOT 2001 roadway condition report and through visual analysis of the existing roadway. Geometric information on the roadway has been developed through a generalized comparative analysis of the roadway width, shoulder width, and existing horizontal and vertical alignment. The horizontal and vertical alignment at each of the sites appears to be adequate and it is not recommended to modify these sections due to geometric concerns. Sight distance is good throughout all of the sites except for the Narrows. The width of Highway 35 generally consists of two 3.65-meter (12-foot) travel lanes with variable width shoulders. The shoulders vary from 1.2 –1.8 meters (4-6 feet) at most of the sites, but are reduced to 0.6 meters (2 feet) at some locations. All the study sites have appropriate safety features currently in place. The future design of any roadway modifications at the sites and along the road corridor generally should include appropriate safety appurtenances. Existing drainage structures are in good structural condition at all sites, however; they are not functioning as needed to prevent damage to the road during debris flows events.

The seven study sites are situated in locations where Highway 35 closely parallels or crosses the active channels and broad, glacial outwash planes of several major drainages, including White River, Newton Creek, Clark Creek, Polallie Creek, Dog River, and the East Fork Hood River.

4.10.1 White River (MP 62)

4.10.1.1 Surface Conditions

The surface condition of the roadway at White River is generally good and no immediate repairs are needed. The last repairs were made in 2000 and the existing bridge was constructed in 1954 and raised in 1966. Further details are provided in Appendix B.

4.10.1.2 Geometrics / Safety Appurtenances

The White River site is on a crest vertical curve and stopping sight distance is a concern due to the past washouts that have occurred at this location. The crest makes it difficult to see sections of roadway that may be washed out during a flood event far enough in advance to allow for stopping. This makes it difficult to raise the road grade, which is needed at this site, without adjusting the grades for a considerable distance on each side of the existing bridge. The vertical alignment at this location should be redesigned during any modifications that may be made, to provide for better sight distance.

Width:	12.2 m width (2.4 m shldr, 3.6 m lane, 3.6 m lane, 2.4 m shldr) [40' width (8' shoulder, 12' lane, 12' lane, 8' shoulder)]
Grade:	Gentle
Horizontal Alignment:	Tangent between two right curves
Vertical Alignment:	Top of crest vertical curve

The existing signs, approach guardrail, bridge rail and other safety appurtenances are adequate at this site. However, ideally the guardrail should be continued throughout the section of roadway that crosses the floodplain of the White River.

4.10.1.3 Drainage Structures

The existing White River Bridge (MP61.71; ODOT #01383A) consists of cast-in-place concrete girders with a concrete deck. The bridge has 3 spans totaling 47.6 meters (156 feet) in length. The superstructure is continuous over the piers. The ODOT records indicate the bridge was built in 1954 and modified in 1966. It appears that in addition to raising the bridge at that time, the superstructure was widened to its present configuration. A 100 mm (4 in.) utility line is attached to the underside of the upstream deck overhang. Structurally, the bridge is in good overall condition. The current inspection report notes some abrasion damage on the upstream side of the existing pier walls. No other deficiencies are noted at this time.

4.10.1.4 Hydrologic and Hydraulic Conditions

The hydrology of the White River Bridge site is dominated by the geomorphology of the alluvial stream system. The broad glacial outwash fan located downstream of the existing bridge site resulted from previous pyroclastic flows and/or debris torrents. The fan was created at this location due to flattening of the stream gradient and floodplain. The current aggradation of the stream channel above the bridge may be attributable at least in part to the presence of the bridge itself, which seems to be acting as a dam and inhibiting the transport and dissemination of bed load material through and below the bridge; however, the geomorphology of the stream and its depositional fan suggests that the river channel had been aggrading long before the construction of the bridge. Mount Hood National Forest geologist Tom DeRoo has stated that, "The slope (of the river channel) may be steep but the volume of material being transported from further up the mountain overwhelms any tendency to downcut at the crossing. Even if the bridge were not present the valley would still be aggrading at the bridge site. The valley has been aggrading for 200 years at this site and is likely to continue for another 100 years before some equilibrium is established". The aggradation of the stream channel has necessitated repeated raising of the bridge, and the stream channel, highway, and bridge are now located on the top of a vertical curve in the outwash plane. Due to the aggradation, the stream channel is meandering within its natural floodplain to account for the gradient differential. At some time in the future, it is likely that the stream will jump to a new, lower channel on the side of the aggraded channel, possibly to either Iron or Mineral Creek. Indeed during the October 2000 event, White River forked and a fork of the stream did jump to Mineral Creek but was re-channeled back into its previous channel.

The existing bridge is not designed to pass debris torrents. The current bridge crosses only a small portion of the White River floodplain, which is 200-meters (656 feet) wide at the bridge location. From a highway perspective, a bridge is typically designed to pass a 50 or 100-year discharge of water with a prescribed freeboard. However, the bridge designs for alluvial systems also require them to span over the natural floodplain and to provide sufficient capacity to pass bed load debris. The existing bridge is lacking in both these respects.

4.10.2 Clark Creek (MP 66)

4.10.2.1 Surface Conditions

Surface Conditions a the Clark Creek site are good with no cracking except for transverse cracks on both sides of the culverts. The last repairs were made in 1998. For further detail refer to Appendix B.

4.10.2.2 Geometrics / Safety Appurtenances

Width:	12.2 m width (2.4 m shldr, 3.6 m lane, 3.6 m lane, 2.4 m shldr)
	[40' width (8' shoulder, 12' lane, 12' lane, 8' shoulder)]
Grade:	Moderate to steep
Horizontal Alignment:	Tangent
Vertical Alignment:	Uniform grade

4.10.2.3 Drainage Structures

The Clark Creek crossing (MP 65.88; ODOT #03637A) consists of a pair of steel multiplate pipe culverts (2900x1955 mm) (114x77 in.). ODOT records indicate that these pipes were installed in 1966. The floors on these culverts have been lined with a synthetic sheeting apparently to minimize wear damage. These culverts appear to be in good condition with no apparent structural damage. The culverts are not aligned to match the stream alignment at this location. The culverts are aligned perpendicular to the centerline of the roadway, while the stream is at an approximate 10-15° skew. This results in the outlet of these culverts being aimed directly at a small clump of trees east of the road.

4.10.2.4 Hydrologic and Hydraulic Conditions

Highway 35 currently crosses the middle of the alluvial floodplain of both Clark and Newton Creeks. Clark Creek joins the East Fork Hood River (EFHR) approximately 2 miles below the point where it leaves the steeper canyon reaches and enters the more gently sloping alluvial floodplain. Highway 35 is located approximately halfway between this point and the EFHR and runs diagonally across the middle of the floodplain. The existing stream channels at Clark and Newton Creek are two of many channels that the streams have historically occupied. During periods of high discharge the streams tend to migrate within the mile-wide alluvial plain, creating new channels or occupying historical channels. Highway 35 intercepts the flows.

The existing culverts at Clark Creek are designed on the basis of estimated discharge from the regression equations discussed in Section 4.1. As discussed in Section 4.1, the stream's discharge cannot be accurately predicted using these equations. The long, narrow, and steep drainage area associated with the stream will exhibit a hydrograph with a narrower and higher peak when compared to other similar sized drainage areas. Additionally, the unvegetated, steep stream banks will result in high bed load and debris during periods of high discharge. The existing misaligned and undersized drainage structures are not able to handle this flow. Furthermore, the original drainage design did not account for the drainage changing channel upstream. Even if larger culverts or a bridge existed at this crossing, debris flows could cause the stream to jump channel farther above the roadway and divert the flow to a section of roadway where there are no structures that would allow the passage of water and debris.

4.10.3 Newton Creek (MP 68)

4.10.3.1 Surface Conditions

Surface Conditions at the Newton Creek site are good with no cracking. The last repairs were made in 2000. For further detail refer to Appendix B.

4.10.3.2 Geometrics / Safety Appurtenances

Width:	12.2 m width (2.4 m shldr, 3.6 m lane, 3.6 m lane, 2.4 m shldr)
	[40' width (8' shoulder, 12' lane, 12' lane, 8' shoulder)]
Grade:	Moderate to steep
Horizontal Alignment:	Tangent
Vertical Alignment:	Uniform grade

4.10.3.3 Drainage Structures

The existing Newton Creek Bridge (MP 67.25; ODOT #03638A) is a single span cast-in-place concrete slab supported on vertical abutment walls. The bridge is 9 meters (30 feet) long and 3 meters (10 feet) high. The crossing is at a severe skew to the road. (ODOT records indicate that the skew angle is 45°.) Records indicate that the bridge was built in 1964. The bridge is in good structural condition and no significant deficiencies are noted.

In Fall 2001, the USFS observed a 1.8-2.4 meter (6-8 foot) high headcut in Newton Creek located 140 – 180 meters (150-200 yards) downstream from the existing crossing (*pers. comm.* Stewart Fletcher, 2002). This is likely to eventually undermine the riprap protecting the downstream side of the bridge from scour and is also potentially acting as a fish barrier.

4.10.3.4 Hydrologic and Hydraulic Conditions

Highway 35 currently crosses through the alluvial floodplain of both Clark and Newton Creeks. The existing stream channels at Clark and Newton Creek are two of many channels that the streams have historically occupied. During periods of high discharge the streams tend to migrate within the mile-wide alluvial plain, creating new channels or occupying historic channels. Highway 35 intercepts the flows.

The existing bridge at Newton Creek is designed on the basis of estimated discharge from the regression equations discussed in Section 4.1. As discussed in Section 4.1, the stream's discharge cannot be accurately predicted using these equations. The long, narrow, and steep drainage area associated with the stream will exhibit a hydrograph with a narrower and higher peak when compared to other similar sized drainage areas. Additionally, the unvegetated, steep stream banks will result in high bed load and debris during periods of high discharge. The existing misaligned and undersized drainage structure is not able to handle this flow. Furthermore, the original drainage design did not account for the drainage changing channel upstream. Even if a larger bridge existed at this crossing, debris flows could cause the stream to jump channel farther above the roadway and divert the flow to a section of roadway where there are no structures that would allow the passage of water and debris

4.10.4 The Narrows (MP 73)

4.10.4.1 Surface Conditions

Surface Conditions at The Narrows site are good with minor areas of cracking and some spot damage from rock fall. The last repairs were made in 2000. For further detail refer to Appendix B.

4.10.4.2 Geometrics / Safety Appurtenances

Within the Narrows study site, the road shoulders are reduced to 0.6 meters (2 feet) (compared to 1.2-1.8 meters (4-6 feet) at the other sites). The narrowing at this site occurs due to the tight constraints with the river on one side and the rock cuts on the other. This site also has concrete barrier rail along both sides of the roadway to prevent vehicles from entering the river and to help keep rock fall off the highway.

The Narrows has some locations where site distance is reduced due to a combination of the concrete barrier rails and the horizontal and vertical alignment. This makes it difficult to see rocks in the roadway. Visibility for vehicles is adequate.

Width:	9.1 m width (0.6 m shldr, 3.6 m lane, 3.6 m lane, 1.2 m shldr)
	30' width (Guardrail, 2' shoulder, 12' lane, 12' lane, ' shoulder)
Grade:	Moderate
Horizontal Alignment:	Numerous reverse curves
Vertical Alignment:	Uniform grade

Although it is not a debris flow hazard location, the Narrows is the site of a significant rock fall problem that constitutes a major safety concern. The steep cut slopes above the roadway, and the near vertical basalt cliffs above the cut slopes produce rock fall that varies from gravel, cobble, and small, boulder-size material to larger boulders and small rock masses of up to several meters in size. The rock fall constitutes a major hazard, particularly during the fall, winter, and spring, when heavy rains and diurnal freeze-thaw conditions result in frequent rock fall. Rock fall occurs intermittently along the entire length of the section and constitutes a major hazard between mileposts 72 and 73. In this location, steep bouldery slopes and high rock cliffs adjacent to the highway combine to produce dangerous rock fall conditions over a distance of approximately 900 m (3000 ft.).

The ODOT has implemented some rock fall protection measures, which include the scaling of loose rock from the cut slopes; the creation of a wide, sand-filled rock catchment ditch with a concrete 'Jersey' barrier to prevent rock from bouncing onto the roadway where it impacts the ditch; and rock bolting in a short section of volcanic rock from which several large blocks have fallen. The ODOT is also currently in the process of advertising a $3 million dollar contract for construction of additional rock fall protection between mileposts 72.70 and 73.18 of the Mount Hood Loop highway. The project, called the 'Hood River Canyons Rock fall Project', will include the installation of 540 m (1771 ft.) of rock fall protection fence. The type of rock fall fence system to be constructed was not specified in the contract, but it will probably be a system similar to the system manufactured by Geobrugg® and sold by Brugg Cable Products Inc. The Geobrugg® rock fall fence system utilizes very high strength wire ropes, woven into a net-like configuration supported by steel posts anchored in concrete and tied to anchors behind the fence for additional support. Such fences are designed to slow down and stop large, high-energy boulders. It is believed that the rock fall fence to be installed at the Narrows will provide a considerable amount of additional protection against rock fall.

Developing alternatives to further address the rock fall problem at the Narrows site is beyond the scope of this study, as the problem is independent of the debris flows originating on Mount Hood. Nevertheless, additional mitigation measures for the Narrows rock fall problem have been identified and are discussed in Appendix C of this report.

4.10.4.3 Drainage Structures

The East Fork Hood River Bridge (MP 73.26; ODOT #03640A) is located at the north (downstream) end of the Narrows study site. The bridge consists of cast-in-place concrete girders with a concrete deck. The bridge has three spans, the main span crossing the stream (19.8 m) (65 feet), and two cantilevered end spans over the embankments (5.3 m each) (17 feet). The bridge was built at a 15° skew to the road. ODOT records indicate that it was built in 1962. No structural deficiencies are noted. The abutments from the previous bridge at this location are still present immediately upstream of the current structure. Both the solid wall piers and rigid frame construction of this bridge contribute to its resistance to stream flow damage. The opening of the main span is over a well-defined stream channel. The flow makes a turn through this stretch, with a significant flow aimed at the north pier and embankment. The north abutment of the previous structure ties the rock wall of the canyon to the existing bridge, providing good scour protection to the north embankment. Downstream of the bridge, the slope has been reinforced with riprap; apparently to repair more recent scour damage.

4.10.4.4 Hydrologic and Hydraulic Conditions

Through the Narrows generally, Highway 35 is wedged into a canyon with a steep rock face on the east side and the East Fork Hood River on the west side. The river runs parallel to the highway with the road embankment encroaching into the river and constituting the east side of this highly constricted channel. The river does not have a floodplain throughout this section and the main channel is about 10-15 meters wide. The top of the road pavement is just above the 100-year water surface elevation. The high water levels and high velocities that are generated in the narrow, tightly constricted stream channel cause scour of the highway embankment at flood stage.

4.10.5 Polallie Creek (MP 74)

4.10.5.1 Surface Conditions

Surface Conditions on the north half of the Polallie Creek site are good. Surface Conditions on the south half of the Polallie Creek site are fair with slight to moderate cracking parallel to the roadway. The last repairs were made in 1997. For further detail refer to Appendix B.

4.10.5.2 Geometrics / Safety Appurtenances

Width:	11.0 m width (1.8 m shldr, 3.6 m lane, 3.6 m lane, 1.8 m shldr)
	36' width (6' shoulder, 12' lane, 12' lane, 6' shoulder)
Grade:	Moderate
Horizontal Alignment:	Tangent between reverse curve
Vertical Alignment:	Gentle crest vertical curve

4.10.5.3 Drainage Structures

The Polallie Creek crossing (MP 75.84; ODOT #0P458 and 0P459) consists of twin metal culverts, the main culvert (3861mm×2464mm multi-plate steel pipe)(12.5 X8.0 ft) and an overflow pipe (2134mm CMP) (7.0 ft). ODOT records indicate that these pipes were installed in 1983. The main pipe has been lined on the bottom with concrete. This lining has worn considerably, exposing the wire mesh reinforcing in some spots, and the metal pipe in other areas. Neither of these pipes shows signs of structural damage at this time.

4.10.5.4 Hydrologic and Hydraulic Conditions

The existing culverts at Polallie Creek are designed on the basis of estimated discharge from the regression equations discussed in Section 4.1. As discussed in Section 4.1, the stream's discharge cannot be accurately predicted using these equations. The long, narrow, and steep drainage area associated with the stream will exhibit a hydrograph with a narrower and higher peak when compared to other similar sized drainage areas. Additionally, the unvegetated, steep stream banks will result in high bed load and debris during periods of high discharge. The existing misaligned and undersized drainage structure is not able to handle this flow.

4.10.6 Dog River (MP 78)

4.10.6.1 Surface Conditions

Surface Conditions at the Dog River site are fair with considerable parallel cracking as well as transverse cracks. The last repairs were made in 1999. For further detail refer to Appendix B.

4.10.6.2 Geometrics / Safety Appurtenances

Width:	12.2 m width (2.4 m shldr, 3.6 m lane, 3.6 m lane, 2.4 m shldr)
	40' width (8' shoulder, 12' lane, 12' lane, 8' shoulder)
Grade:	Gentle - Moderate
Horizontal Alignment:	Large sweeping curve
Vertical Alignment:	Uniform, with slight grade change at beginning of site

4.10.6.3 Drainage Structures

The East Fork Hood River Bridge (MP79.68; ODOT #16006) is located just south (upstream) of the Baseline Drive section of the study area, where Dog River joins the East Fork Hood River. The existing bridge consists of cast-in-place concrete girders with a concrete deck. The bridge has three spans, the main span crossing the stream (27.4 m) (90 ft), and two cantilevered end spans over the embankments (7.6 m each) (25 ft). The bridge was built at a 15° skew to the road. ODOT records indicate that this bridge was built in 1961. The bridge is in good structural condition. The stream flow is fully contained between the piers. Some meander is evident in this reach.

There is a concrete box culvert located at the crossing of Dog River at Highway 35 (MP79.82; ODOT #0M038). The structure is a cast-in-place concrete box culvert consisting of two barrels 3.0m × 1.2m (10 ft × 4 ft) each. ODOT records indicate that the culvert was built in 1961. The culvert is in good structural condition. The most recent inspection report mentions that there are a few cracks in the barrels, but no corrective work is recommended. The culvert is sufficient to carry the peak discharge from Dog River as the majority of water is diverted upstream of the culvert for water-supply use.

4.10.6.4 Hydrologic and Hydraulic Conditions

At Dog River and Baseline the highway is located within the floodplain of the East Fork Hood River. During flood stage, the river tries to occupy its former floodplain channel(s), causing scour and over-topping of the highway. Past efforts at protecting the highway have been primarily aimed at preventing the river from scouring the highway embankment by reinforcing the embankment with riprap, directing the river away from the highway with rock dikes and berms, and raising the highway grade. Following the damage caused by the 1980 Polallie Creek debris flow and flood, the highway grade was raised about 1.5 m (5 ft.) between Dog River and Baseline.

4.10.7 Baseline Drive (MP 80)

4.10.7.1 Surface Conditions

Surface conditions at the Baseline Drive site are fair with moderate parallel cracking throughout. Transverse cracks are located at approximately 50-60 foot intervals. The last repairs were made in 1999. For further detail refer to Appendix B.

4.10.7.2 Geometrics / Safety Appurtenances

Width:	Site 1	11.0 m width (1.8 m shldr, 3.6 m lane, 3.6 m lane, 1.8 m shldr)
		36’ width (6’ shoulder, 12’ lane, 12’ lane, 6’ shoulder)
	Site 2	11.6 m width (2.4 m shldr, 3.6 m lane, 3.6 m lane, 1.8 m shldr)
		38’ width (Guardrail, 8’ shoulder, 12’ lane, 12’ lane, 6’ shoulder)
Grade:		Gentle

Horizontal Alignment: Gentle curve into a tangent

Vertical Alignment: Gentle uniform grade

4.10.7.3 Drainage Structures

At the northern end of the study area, Baseline Road crosses the East Fork Hood River just before it joins with Highway 35. The bridge across East Fork Hood River is a three span cast-in-place concrete girder bridge (ODOT #09231) consisting of a single 17m (56 ft) main span and two cantilevered end spans. Total length of the bridge is 27m (89 ft). ODOT records show that the bridge was built in 1964.

The bridge is in good condition. The most recent inspection report notes some minor spalls and cracks in the girders, but nothing that merits repairs. The records also indicate that this is a scour critical structure, however no current scour is noted. The footings for the piers are probably spread footings set slightly below the streambed elevation. Based on analysis, these footings would be susceptible to undermining in the event of a significant stream flow event.

Although this bridge is just outside the study area and it has not been a problem in the past, it is included in this discussion in light of the fact that some of the proposed alternatives for this site could significantly alter the stream flow characteristics at this bridge and poses a future risk to its performance. As a minimum, the approach embankments at either end of the bridge could be damaged or removed if the main flow of the East Fork Hood River were shifted upstream from this crossing.

4.10.7.4 Hydrologic and Hydraulic Conditions

At Dog River and Baseline the highway is located within the floodplain of the East Fork Hood River. During flood stage, the river tries to occupy its former floodplain channel(s), causing scour and over-topping of the highway. Past efforts at protecting the highway have been primarily aimed at preventing the river from scouring the highway embankment by reinforcing the embankment with riprap, directing the river away from the highway with rock dikes and berms, and raising the highway grade. Following the damage caused by the 1980 Polallie Creek debris flow and flood, the highway grade was raised about 1.5 m (5 ft.) between Dog River and Baseline.

5. Coordination with Agencies and Potentially Affected Interests

Coordination with other agencies and potentially affected interests (PAIs) was initiated on March 18, 2002 with a public notice (provided in Appendix D). The notice invited interested parties to provide us with written comments on the study or to contact us for a personal meeting. The notice was sent to the following list of agencies and PAIs as identified by the study team. Agencies: US Fish and Wildlife Service, National Marine Fisheries Service, US Army Corps of Engineers, Oregon Department of Fish and Wildlife, Oregon Division of State Lands (DSL), Oregon Parks and Recreation Department, Oregon Economic Development Department, Hood River County, and the Confederated Tribes of the Warm Springs. PAIs: The Hood River Watershed Council, Mount Hood Meadows Ski Resort, Hood River Grower-Shipper Association, Boy Scouts of America, Crystal Springs Water District, Melody Johnson (scenic byway interest), Portland General Electric, Cascade Utilities, Sprint, Wapanitia Inc. (utility interest), Charles and Jennie Sperr (utility interest), Robert and Helga Finn (utility interest), and Eric Stork (utility interest).

The letters sent to Wapanita Inc. and Eric Stork were returned and marked as being undeliverable. Further investigation revealed that the utilities (waterlines) connected to these PAIs are no longer in use. On the 24th of April 2002, telephone comment from Sprint was received notifying us that they do not have any facilities that would be affected by the project. Written responses were received from three interested parties, the Cascade Pacific Council of the Boy Scouts of America, the Hood River Watershed Council, and the ODFW. The general manager of the Mount Hood Meadows Ski Resort requested a personal interview, which was held on the 19th of April 2002. Comment via email was received from the DSL (Mike McCabe, 23rd of July 2002) and a site visit with representatives from the ODFW, the USFWS, and the NMFS was undertaken on the 29th of July 2002. These responses are provided in full in Appendix D and summarized below. A presentation of the draft report was made to the Hood River Watershed Council on the 24th of September 2002. The notes from that meeting are provided in Appendix D.

5.1 Cascade Pacific Council of the Boy Scouts of America

The Cascade Pacific Council of the Boy Scouts of America provided us with written comments dated

March 26, 2002. They have two facilities that have been affected by flooding events at the White River crossing. 1) The Aubrey Watzek (White River) Winter Lodge located just west of the White River Bridge was affected by the 2000 event on White River. The closure of Highway 35 prevented access to the lodge during a critical time. An alternative access route was established at the cost of approximately $35,000. 2) Camp Baldwin, located east of Dufur is primarily accessed via Highway 35 and Forest Road 44 although other, longer, access routes are available. The Cascade Pacific Council of the Boy Scouts of America concluded that they would like a long-term solution, which allows Highway 35 to be open year round while also allowing full access to all areas along Highway 35.

The study identifies and assesses a wide range of alternatives including long-term solutions, which would allow Highway 35 to be open year round. The location and accesses of the Boy Scout camps have been included in the assessment of the alternatives (Please refer to Section 6).

5.2 Mount Hood Meadows Ski Resort

On the 19th of April 2002, George Fekaris and Mary Hamilton met with David Riley, General Manager, Mount Hood Meadows Ski Resort. The Meadows Ski Resort is accessed from Highway 35 via either US Highway 26 (H26) or Interstate 84 (I84) and approximately 400,000 recreationists visit the resort per year. The Meadows access road is located between the White River study site and the other six sites therefore problems on the highway are effectively divided into those that affect White River (closing the access from H26) and those that affect any of the other six sites (closing the access from I84). Fall and early winter are critical periods for the resort. The October 2000 flood event had the greatest affect on the resort of any event experienced by David Riley in the last 10 years. This event closed both access routes to the resort for 4-days and occurred while a job fare was taking place and approximately 1000 people needed to access the Meadows. A 2-hour, 4WD detour utilizing FS 44 and Bennett's Pass was used as an emergency access route to the resort. However, generally the road has only been closed from one of the access points at a time and on average this has occurred over 2 days every 2 years. Wash out events on Highway 35 have not caused severe hardship to the Meadows Resort, as they have not happened during the ski season.

As detailed in Appendix D, David Riley made some recommendations for fixing the sites. He prioritized the order in which the sites should be addressed as follows: White River, Newton, Clark, Narrows, Polallie, Dog River, and Baseline. At the White River site his preferred alternative is for ODOT to undertake regular maintenance at the bridge (this alternative has been addressed in Section 6.1). David

Riley stated that he is firmly against rerouting the road to avoid the White River crossing. He further stated that adding significant distance to the roadway would be unacceptable due to increases in travel time. David Riley also stated that he does not see any need to upgrade the detour used during the 2000 event for future use during emergency situations. He recommended several potential fixes for the Clark Creek/Newton Creek sites. His preferred long-term solution is to create dikes upstream (in the forest) where channel braiding is obvious and thereby direct the river to the largest culvert (this alternative is addressed in Section 6.2). According to David Riley, the key at these sites is maintenance so that the dikes and culverts do not get blocked with woody debris. He also stated that a bypass makes more sense at this site than at any of the other sites and made the point that if a bypass were to be built it would need to be on the east side of the East Fork of the Hood River in order to avoid the problem (this alternative is addressed in Sections 6.2 and 6.3). In reference to the Polallie Creek site, David Riley stated that it had not been a problem within the last ten years. He suggested increasing the size of the culvert or putting in a bridge as a fix at this site (this alternative is addressed in Section 6.5). Mr. Riley did not consider that the Narrows site needs fixing. In regard to the Dog Creek/Baseline site, Mr. Riley stated that he feels that the dikes built by ODOT were probably a good strategy and these could be further improved (this alternative is addressed in Sections 6.6 and 6.7).

David Riley also stated that any alternative at Polallie should consider effects to the resort at Coopers Spur. He stated that any work that takes place at the Polallie Creek site would need to ensure that access from Highway 35 to Coopers Spur Road is maintained and also suggested that adding collection lanes for traffic turning left into and out of Coopers Spur Road would improve safety and traffic flow. All alternatives for Polallie are addressed in Section 6.4 and all maintain access to Coopers Spur Road. As the design for these alternatives is only conceptual at this stage, the specifics regarding collection lanes are beyond the scope of this study.

5.3 Hood River Watershed Council

Comments dated the 28th of May 2002 were received from the Hood River Watershed Council, an active volunteer forum for agencies, landholders, and citizens with an interest in natural resources. The Soil and Water Conservation District is the fiscal sponsor for the group (*pers. comm.* Holly Coccoli). The group's focus is on the study sites located in the East Fork Hood River Drainage. They support this study and stressed the need to restore floodplain habitat and proper functioning of natural river processes. They further state that the study approach should examine the seven sites in the context of watershed-scale fluvial geomorphology (taking a holistic approach).

The study identifies and assesses a wide range of alternatives including alternative alignments (see Section 6). In developing these alternatives, the study team utilized the expertise of the USGS, USFS, ODOT, and FHWA in the fields of fluvial geomorphology, geology, hydrology, environment, and highway design. One of the eight objectives by which the alternatives are assessed is to 'enhance the natural floodplain'. The study group concluded that this objective encompasses both restoring floodplain habitat and functions, and improving the ability for natural fluvial geomorphologic processes to take place.

A presentation of the draft report was made to the Hood River Watershed Council on the 24th of September 2002. Approximately thirty people attended the presentation. A question and answer session was held at the end of the presentation and that dialogue is provided in Appendix D. The USFS provided a copy of the final draft of the feasibility study (dated March 2003) to the Hood River Watershed Council and their comments are also provided in Appendix D.

5.4 Oregon Department of Fish and Wildlife

Comments dated the 2nd of May 2002 were received from the ODFW. In their letter, the ODFW state that the East Fork Hood River has a long history of being impacted by Highway 35 and that in many areas Highway 35 confines the stream channel and prevents proper stream function. They further state that they have long recommended that the truly meaningful approach to a long-term solution is to relocate the highway out of the floodway and floodplain of the EFHR and away from tributaries with high glacial activity. They cite the example of the relocation of a portion of Highway 35 farther out of the floodplain between Polallie Creek and Dog River after a glacial event in 1980. This resulted in reduced maintenance needs and improved stream channel functioning supporting salmonid rearing habitat.

The study identifies and assesses a wide range of alternatives including alternative alignments (see Section 6). In developing the alternatives, the study team utilized the expertise of the USGS, USFS, ODOT, and FHWA in the fields of geomorphology, geology, hydrology, environment, and highway design. One of the eight objectives by which the alternatives are assessed is to 'enhance the natural floodplain'. The study group concluded that this objective encompasses both restoring floodplain habitat and functions, and improving the ability for natural fluvial geomorphologic processes to take place.

5.5 Oregon Division of State Lands

Both the DSL and US Army Corps of Engineers were contacted and asked to comment on the study. Comments were received via email from DSL stating that they would need to know the wetland impacts of any projects that develop out of the study and that compensatory wetland mitigation may be necessary if wetlands cannot be avoided.

5.6 Comments received during the NMFS, USFWS, ODFW site visit

An on site review was held on July 29, 2002 between George Fekaris (FHWA), Diana Hwong (USFWS), Art Martin (NMFS), David Landsman (NMFS), Steve Prible (ODFW) and Mary Hamilton (Widener & Associates). The notes from this meeting are provided in Appendix D and the comments received have been incorporated and cited throughout the document but particularly in the analysis of the alternatives (Section 6). The key points made by agency staff during this meeting were: 1) The problem sites are likely to move over time due to the dynamic nature of the system, thus some of the alternatives may not provide as much benefit as they would under other circumstances; 2) It is important to connect the alternatives both in terms of the road and in terms of ecological functions while properly functioning conditions are key to improving floodplain function; 3) This is a rare opportunity for significant and proactive habitat restoration as required under the ESA; 4) In general, employ the principle of keeping the floodplain as wide as possible; 5) Having plans 'on the shelf' and available for implementation when an event occurs is a very good idea.

6. Description and Analysis of Alternatives

6.1 Funding

As the route is part of the Federal Aid Highway system and the Oregon Forest Highway system, it is eligible for the following appropriated funding sources:

- National Highway System Program
- Federal Aid Surface Transportation Program
- Federal Emergency Relief (ER) Program
- Public Lands Highways Program (Discretionary and Forest)
- Highway Bridge Replacement and Rehabilitation Program
- Transportation Enhancement Program

State funding sources that may be available for these projects include:

- Oregon Transportation Initiative Act
- Oregon State Transportation Improvement Plan

Other funding sources that may be available if the projects enhance aquatic ecosystems are:

- Bonneville Power Administration (BPA) Salmon Recovery and Habitat Restoration Funds
- US Army Corps of Engineers (COE) Section 206 Aquatic Ecosystem Restoration Funds
- Northwest Power Planning Council Funds
- NOAA Restoration Program Funds
- Oregon Watershed Enhancement Board

All alternatives that include habitat restoration within aquatic ecosystems are likely to be eligible for COE Section 206 funds. Alternatives involving salmon habitat restoration at sites along the EFHR are also likely to be eligible for BPA and NOAA Restoration Program Funding. These funding sources should be explored with the administering agency during project development to determine applicability to specific alternatives.

In analyzing the alternatives, alternatives expected to qualify for ER Funds have been identified. To date, repairs to Highway 35 that are a result of large debris flows off Mount Hood, have been funded through the ER Program. ER Funds are intended to aid states in repairing road facilities, which have suffered widespread serious damage resulting from a natural disaster over a wide area or serious damage from a catastrophic failure. There are two types of eligible repairs under the ER Program: 1) replacement in kind which is defined as replacement of the existing facility to current design and environmental standards; and 2) betterments such as relocation, replacement, upgrading or other added features not existing prior to the disaster, and which are economically justified to prevent future recurring damage. Economic justification must weigh the cost of the betterment against the risk of recurring damage and the cost of future repair (CFR 23 668.105). Damage caused by less substantial events has been repaired using previously programmed state maintenance funds. A discussion on ER eligibility of the alternatives is included in the following sections and a table showing the cost of repairs to date is given in Section 6.10.

Funding sources, other than ER Funds, would require projects to compete on a state wide or regional basis. Project proposals would be submitted to program administrators and evaluated against the program criteria and rated relative to other proposals. Project proposals would typically be instigated by the agency with jurisdiction over the road (in this case ODOT) and/or the adjacent land managers (in this case the USFS).

6.2 Cost Estimates

Estimated total cost is included in the description of the alternatives for each site and a break down of the costs is provided in Appendix B. Costs have been estimated using standard preliminary estimating procedures based on general rules of costs for these various types of construction. General square foot or lineal foot cost figures were used in the development of the overall costs. These estimates also include the Project Engineering (PE) costs (design and environmental compliance) and the Construction Engineering (CE) costs for these improvements. The construction costs used in the estimates are based on the following: \$1,850/M^2 (\$172/SF) for normal bridge construction; \$2,150/M^2 (\$200/SF) for moderately difficult bridge construction; \$2,690/M^2 (\$250/SF) for difficult bridge construction; \$650/meter (\$198/foot, \$1,000,000/mile) for normal road construction, \$950/meter (\$290/foot, \$1,500,000/mile) for moderately difficult road construction, and \$1250/meter (\$381/foot, \$2,000,000/mile) for difficult road construction. The PE costs are estimated at 20% of construction costs and the CE costs are estimated at 10% of construction costs. These costs are based on current dollars and should be adjusted for construction that will take place in the future.

Routine maintenance costs vary greatly on roadways through mountainous terrain. Maintenance costs such as snow removal can change significantly from year to year. For example, one year there may be a snow pack 250% of normal and the following year the snow pack could be 50% of normal. These wide variations in possible yearly maintenance costs make it very difficult to estimate routine maintenance costs reliably. ODOT has provided the most recent maintenance costs for the last events for several of the sites that have been evaluated. These have been included for comparison with the proposed construction costs for improvements. Again, these can vary greatly, depending upon the size and frequency of the events. Appendix B contains data detailing the cost comparisons for the alternatives considered at each site.

6.3 White River (MP 62)

Refer to Figures 6.3.1 to 6.3.5 for a graphical depiction of the alternatives discussed below. Refer also to Section 4.10.1.4 for a discussion of the fluvial geomorphic process in the White River drainage, which is pertinent to the following discussion of the White River alternatives.

1. Maintain Existing Condition

Description:

Currently, the USFS does not allow ODOT maintenance crews to go into the river on a regular basis and no channel maintenance takes place. After an emergency event, the ODOT would determine the proposed repairs and would coordinate with the USFS to assure the proposal would not have a "direct adverse effect" to the river. This last took place in 2000 when the river was re-channeled a mile upstream to redirect its flow under the bridge. Based on an event similar to the 2000 debris flow ($375,000) occurring once every five years, the estimated cost for a 20-year period is expected to be approximately $1,500,000.

Analysis:

Depending on the proposed repairs, the USFS could determine that the activities would have a "direct adverse effect" on the river. At the time of the last event, the USFS agreed to allow ODOT into the river provided that a study (this study) looking at other solutions was undertaken. Re-channeling the river is unlikely to be permitted by the USFS again particularly as the river recently jumped back into the channel it created (and was moved out of) in 2000 (*pers. comm.* Stewart Fletcher, 2002). This alternative would not improve the floodplain functions or the free flowing nature of the WSR. This alternative would have no new impact on terrestrial habitat and wildlife, cultural, or recreational resources but would not improve safety on the roadway. This alternative can be expected to have minor visual impacts as a result of work taking place in the floodplain after an event occurs.

This alternative did not handle the last major event. There would be no change from the existing condition for this alternative and substantial channel maintenance would likely be necessary after major events.

2. Preventative Maintenance

Description:

Under this alternative ODOT would maintain the existing crossing by undertaking preventative maintenance to remove debris in the vicinity of the bridge on a regular basis. This alternative would involve implementing changes to the permissible activities within the White River WSR designation. Under this alternative the existing facility would still be at risk during larger debris flows and any damage to the bridge and road would be replaced in kind. Material removed could be used for road maintenance material needs. The time frame for implementing this alternative would be dependent on the time necessary to implement changes to the permissible activities within the White River WSR designation. Based on an event similar to the 2000 debris flow ($375,000) occurring once every five years and performing yearly maintenance efforts of $25,000, the estimated costs for a 20 year period is expected to be approximately $2,000,000.

Analysis:

As the river is designated as a WSR, in order for this alternative to be adopted the governor and regional forester would have to lobby congress for changes to the permissible activities under the White River WSR designation. This alternative would not improve the floodplain functions or free flowing nature of the WSR. This alternative would have no new impact on terrestrial habitat and wildlife, cultural, or recreational resources and would be expected to improve safety on the roadway. This alternative can be expected to have minor visual impacts as a result of work taking place in the floodplain on a regular basis.

This alternative would not have handled the last event, although it may have decreased the amount of damage to the roadway and bridge. By performing yearly maintenance on the channel and keeping the opening completely clear of debris, the interval at which a major event damages the roadway could be lengthened. However, the larger events will continue to fill the bridge opening and overtop the roadway, unless the opening is enlarged and lengthened.

3. Raise Road and Lengthen Bridge

Description:

Under this alternative, the existing roadway would be raised, a single bridge would span White River and Iron Creek, and a bridge would also be constructed over Mineral Creek. These structures would allow the passage of debris flows plus a projected amount of aggradation.

The White River/Iron Creek Bridge would be approximately 370 meters (1215 ft) in length and would span the White River/Iron Creek floodplains. The Mineral Creek Bridge would be approximately 90 m (300 foot) in length. Long spans would be used as much as possible to limit the amount of debris collection at the piers. The new roadway elevation would be 3 to 5 m (10-16 ft) higher than the existing grade. The length of the road improvements would be approximately 350 m (1150 ft) on each side of the bridges, which would keep the grade change to less than 1.5 percent.

Assuming this alternative is constructed independent of an emergency event, these improvements could be constructed most economically by shifting the alignment to allow the new bridges to be placed adjacent to the existing roadway. The existing highway could then remain open during construction with proper traffic control measures. Once the new structures are built, the existing roadway would be removed to the natural grade of the river. The stream channel immediately upstream of the crossing would be re-graded to remove the existing build-up of bed material, which is currently constricting stream flow under the bridge. This would include the removal of the White River Sno-Park, which would allow the channel to re-establish itself to a more natural meander and bed load carrying behavior.

Total cost for this alternative is estimated to be $14,100,000. The time frame for typical project development (design and environmental compliance) is expected to be 2 – 4 years. Construction is expected to take two years.

Analysis:

Design and construction of a 370 m (1215 ft) long bridge across White River and Iron Creek and a 90 m (300 ft) bridge across Mineral Creek would require an extensive geotechnical investigation. The foundation support for the structures could require difficult and expensive construction techniques. The removal of the existing roadway could be completed from the surface of the existing road, avoiding the need to place equipment in the river. Prior to undertaking this alternative, a study would be needed to determine the anticipated amount of channel aggradation at the bridge over the next 50-75 year period in order to determine the design height of the new bridge. The new bridge would be designed for a 50-75 year life span and would be built above the anticipated level of aggradation.

This alternative would allow the streams to meander back and forth across the channel and to dissipate energy and bed load across most of the natural valley floor. As this alternative involves work along the existing alignment, impacts to terrestrial habitat (including LSR), wildlife, noise environment, and recreational and cultural resources would be minimal; however, wetlands located adjacent to the Mineral Creek crossing could be impacted by the construction of this alternative (refer to Figure 4.2.1). Long-term maintenance of the structure and opening under the bridge would be required but at a lesser frequency than is the case with the existing bridge. This alternative is expected to improve floodplain functioning and the free flowing character of the WSR and be consistent with the goals and objectives of the WSR Management Plan which states that *"If the Highway 35 Bridge should be severely damaged or destroyed through a natural event, the bridge should be reconstructed in a manner that allows for the relatively unimpeded flow of debris torrents and glacial outwash floods that normally influence the river channel and the river's hydrologic regime."*; however, this alternative would still require maintenance of the opening under the bridge involving the use of heavy machinery within the river's floodplain, which is likely to conflict with the WSR designation. This alternative would also improve fish habitat although fish issues at this site are not significant as it is located at the upper limit of fish distributions. Work would need to take place within the timing restrictions for in water work and spotted owls. LSR is located adjacent to and south of the existing White River and Mineral Creek crossing and on both sides of the existing Iron Creek crossing. Due to the slight alignment shift proposed under this alternative, there could be a minor impact to the LSR. This alternative would probably eliminate the West White River Sno Park, as it is likely that the current parking area would be re-graded to stream elevation. A slight alignment shift to the south may also have a minor impact on the East White River Sno Park and Mineral Jane trailhead.

By raising the road grade high enough and extending the bridge to the full width of the floodplain, this alternative would handle consecutive events similar to the last event, without major maintenance within the channel. However, if the river jumped channel upstream and flowed into the Mineral Creek drainage, the White River / Iron Creek structure would be by-passed.

4. Realign Upstream

Description:

This alternative would move the bridge approximately 1400 meters (4600 feet) upstream from the existing bridge, in an attempt to span the White River at a narrower and more constricted portion of the floodplain. Although the topographic maps appear to show a narrower channel at this location, the aerial photography and field investigation indicated that the floodplain width is similar to the width at the existing location; therefore, a bridge length of 370 meters (1215 ft) is also recommended for this site.

The height of the bridge above the river would be determined based on a hydraulic analysis of the river and to allow the passage of debris flows. Approximately 3600 meters (11,800 feet) of new roadway would be required to place a crossing at this location. The new roadway would be placed at the interface of the mountain and the floodplain boundary and would climb from the existing White River bridge elevation up to the new crossing at a grade of approximately 8 percent. The existing roadway, bridge, and West White River Sno-Park would be removed. Cost is estimated to be $17,100,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 3 – 5 years. Construction is expected to take 2 - 3 years.

Analysis:

The new roadway segment would require the removal of vegetation and the construction of new cuts and fills next to the river floodplain. These would have continued erosion and sedimentation impacts until the slopes revegetate. The new roadway grades would be much steeper than the existing grades and less desirable. The road would also be at a higher elevation than the existing road. The heightened elevation and steeper (8%) grades are expected to increase icing on the roadway and safety concerns including the accident rate. Design and construction of a new, 370 m (1215 ft) long bridge would require an extensive geotechnical investigation. The foundation support for such a structure could be expected to require difficult and expensive construction techniques. A short portion of this realignment passes through an area mapped as having high landslide risk.

As this alternative involves work along a new alignment, impacts to terrestrial habitat (including LSR), wildlife, the noise environment, and possibly also cultural and visual resources would occur. This alternative would improve fish habitat although fish issues at this site are not significant as it is located at the upper limit of fish distributions. Work would need to take place within the timing restrictions for in water work and spotted owl. Due to the steeper grades and higher elevation, the new roadway is expected to require higher use of deicing chemicals and sand than the existing road, resulting in impacts to adjacent vegetation and water quality. This alternative would enhance the free flowing nature of the WSR however it would impact other values for which the White River is protected (wildlife habitat, botany, historic, recreation, and scenic resources) and could encroach into Segment A of the designation in which new road construction is prohibited as discussed in Section 3.4. Long-term maintenance of the structure and opening would be required but at a lesser frequency than is the case with the existing bridge. Maintenance of the opening under the bridge would involve the use of heavy machinery within the river's floodplain, which is likely to conflict with the WSR designation. Building this alternative would require creating a new roadway within a Tier 2 Key Watershed. Road-building activities within a Key Watershed but outside designated Roadless Areas must result in no net increase in the amount of road. If this alternative was chosen for further study, this requirement may be able to be achieved by decommissioning existing USFS roads within the Key Watershed. A short section of this alternative would also pass through LSR creating long-term fragmentation and displacement impacts. This alternative would eliminate the West White River Sno Park and impact wetlands adjacent to the Mineral Creek crossing. This alternative may also have visual impacts when looking from the mountain toward the new road particularly over the short term; however views from the road itself up and down the drainage are expected to be spectacular. This alternative is expected to change the noise environment by placing the road at a higher elevation and changing the location of the source of the noise. If this alternative were selected, access would have to be maintained to the Boy Scout winter lodge, East White River Sno Park, and Mineral Jane trailhead. This alternative would add approximately 2.1 km (1.3 miles) of out of direction travel, which would add approximately 2 minutes travel time.

This alternative would be able to handle an event similar to the last major event and all but a massive failure. Moving the crossing upstream would eliminate the impact of White River jumping channels and moving to the Mineral Creek drainage.

5. Tunnel

<u>Description:</u>

A tunnel would be constructed well below the natural grade of the stream channels of the White River and Iron Creek (refer to Section 4.10.1.4 for a discussion of aggradation processes at this site). The top of the tunnel would be about 3-6 meters (10-20 feet) below the existing stream channel. The tunnel would be constructed in a large open cut trench. The tunnel would be placed on a uniform grade to allow for proper drainage and drainage system would also be needed to remove water that enters the tunnel. Vents, access ports and outlets within the floodplain may also be required due to the length of the structure. Power would need to be brought to the site for lighting and ventilation systems. An air intake and exhaust system would be required. A ventilation building may also be required to house the ventilation system. To meet the *National Fire Protections Association Standard for Road, Bridges, and Other Limited Access Highways*, a fire line and water supply system capable of sustaining 1,900 liters/min (500 gallons/min) for one hour would be needed. It is estimated that the tunnel would need to be approximately 370 meters (1200 feet) in length and approximately 350 meters (1100 feet) of roadway improvements including retaining walls would be required at each end to provide the necessary connection to the existing roadway. The existing roadway, bridge, and the West and East White River Sno-Parks would be removed. The intersection with FS 48 would need to be reconstructed. Cost is estimated to be $29,900,000. Maintenance and operating costs are estimated at $200,000 to $400,000 per year. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 3 – 5 years. Construction is expected to take 2 - 3 years.

Analysis:

This alternative would incur substantial operating and maintenance cost due to the need for ventilation, drainage, fire protection, and illumination systems. Dewatering of the trench and trench excavation could be a problem due to subsurface flow. There would also be limitations on vehicle use, particularly those carrying hazardous or flammable loads. Design and construction would require an extensive geotechnical and hydraulic investigation.

The primary environmental impacts occurring during construction and would be largely attributed to de-watering operations, excavation for the tunnel, and bringing power for the ventilation to the site. This alternative is expected to restore floodplain functioning (including fish habitat) in the upper reaches of the White River and enhance the free flowing character of the WSR, allowing debris to flow over the roadway in an unrestricted manner. Assuming that the river is aggrading at this site (as discussed in Section 4.10.1.4) and is likely to continue doing so for the next 100 years, this alternative is not expected to inhibit natural geomorphologic processes at this site within the life expectancy of the tunnel. Work would need to take place within the timing restrictions for in water work and spotted owl. Impacts to terrestrial habitat (including LSR) and wildlife would occur over the short term. Over the long term, these resources would be reestablished. Depending on the length of retaining walls necessary at the tunnel approaches, these walls could become obstacles to wildlife. The West and East White River Sno-Parks would be eliminated. No impacts to cultural resources are anticipated. This alterative is expected to reduce traffic noise, however, additional noise impacts would occur due to the ventilation system. Views of the river would be improved however views from the roadway would be lost. This alternative would increase safety on the roadway in relation to danger created by debris flows but could decrease safety as a result of hazards within the tunnel such as roadway icing or fires.

This alternative would handle all of the foreseeable debris flow events but may need to be extended considerably farther on the Mineral Creek side to eliminate problems that could be caused by changes in the Mineral Creek channel.

6. Encased Highway

The encased highway alternative is similar to the tunnel alternative except that it would not be placed as deep. The top of the structure would be constructed at approximately the riverbed level and so would require less excavation. The encased highway would be constructed in a large open cut trench. Once constructed, material from the channel would be placed on the cover of the structure and the stream allowed to flow over it. Over the long term additional material would naturally deposit above the encased highway by aggradation until the riverbed reached equilibrium and was able to meander unrestricted above the highway. The encased highway would be placed on a uniform grade to allow for proper drainage and a drainage system would also be needed to remove water that enters the structure. Vents, access ports and outlets within the floodplain may also be required due to the length of the structure. Power would need to be brought to the site for lighting and ventilation systems. An air intake and exhaust system would be required. A building may also be required to house the ventilation system. To meet the *National Fire Protections Association Standard for Road, Bridges, and Other Limited Access Highways*, a fire line and water supply system capable of sustaining 1,900 liters/min (500 gallons/min) for one hour would be needed. The structure would be approximately 370 meters (1200 feet) in length and approximately 250 meters (800 feet) of road improvements including retaining walls would be required on each side of the structure. The existing roadway, bridge, and the West and East White River Sno-Parks would be removed. The intersection with FS 48 would need to be reconstructed. Cost is estimated to be $25,900,000. Maintenance and operating costs are estimated at $200,000 to $400,000 per year. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 3 – 5 years. Construction is expected to take 2 - 3 years.

<u>Analysis:</u>

This alternative would incur substantial operating and maintenance cost due to the need for ventilation, drainage, fire protection, and illumination systems. Dewatering of the trench and trench excavation could be a problem due to subsurface flow. There would also be limitations on vehicle use, particularly those carrying hazardous or flammable loads. Design and construction would require an extensive geotechnical and hydraulic investigation.

Construction of this alternative would not involve deep excavation but would require re-contouring the floodplain to its natural grade (eliminating the material built up on the upstream side of the bridge approaches). This alternative would allow debris to flow over the roadway in an unrestricted manner and would allow the White River to meander back and forth across its channel without any restrictions even during a large debris flow, improving floodplain functioning and fish habitat. Assuming that the river is aggrading at this site (as discussed in Section 4.10.1.4) and is likely to continue doing so for the next 100 years, this alternative is not expected to inhibit natural geomorphologic processes at this site within the life expectancy of the encased highway. Work would need to take place within the timing restrictions for in water work and spotted owl. This alternative would increase safety on the roadway in relation to the threats of debris flows but would decrease safety as a result of icing within the encased highway.

Environmental impacts would occur during construction and would be largely attributed to de-watering of the river. Large settling ponds would be required to filter the water prior to it re-entering the river and pumps would be working 24 hours a day. Due to the wide floodplain and meandering nature of the river it may be difficult to reestablish flow over the top of the encasement. Impacts to terrestrial habitat (including LSR) and wildlife would occur over the short term. Over the long term, these resources would reestablish. Depending on the length of retaining walls necessary at the encased highway approaches, these walls could become obstacles to wildlife. The West and East White River Sno-Parks would be eliminated. No impacts to cultural resources are anticipated. This alterative is expected to reduce traffic noise, however, additional noise impacts would occur due to the ventilation system. Views of the river would be improved however views from the roadway would be lost. This alternative would increase safety on the roadway in relation to danger created by debris flows but could decrease safety as a result of hazards within the tunnel such as roadway icing or fires.

This alternative would be similar to the tunnel alternative and would handle any foreseeable event in White River drainage as long as the river does not degrade significantly. Like the tunnel alternative, this alternative may need to be extended considerably farther on the Mineral Creek side of the drainage to bypass problems that could be caused by changes in the channel of Mineral Creek.

7. Realign 1 km Downstream

Description:

This alternative would relocate the river crossing approximately 1100 meters (3700 feet) downstream from the existing bridge to a location at the upper limits of the vegetated floodplain where there are several well-defined channels. Debris flows have not traveled to this point in the past several decades and it may be easier to bridge across the currently defined channels at this location than elsewhere; however, there are numerous smaller stream channels at this location and it is estimated that approximately 900 meters (3000 feet) of bridge, consisting of either one long bridge or several shorter-length bridges, would be needed to cross the entire floodplain. Approximately 2700 meters (8800 feet) of new roadway, half of which would be within the floodplain, would also be required for this alternative. A grade of approximately 8 percent at both ends of the new crossing would be required to connect it to the existing highway at the current White River bridge elevation. Access would be maintained to the Boy Scout Winter Lodge and West White River Sno-park. Cost is estimated to be $35,100,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 3 – 5 years. Construction is expected to take 2 - 3 years.

Analysis:

An extensive geotechnical investigation and analysis would be required for this alternative. Construction of multiple bridge foundations in the bouldery river deposits could be problematic. A short portion of this alternative passes through an area designated as 'high' risk for landslides. As this alternative involves work along a new alignment impacts to terrestrial habitat, wildlife, noise environment, cultural, and visual resources would be greater than for alternatives that stay on the existing alignment. This alternative is expected to improve floodplain functioning in the upper reaches but would impact functions in the vicinity of the new crossing. The free flowing character of the WSR would be improved by placing the roadway in an area of the river beyond the extent of the most recent debris flows. This alternative would improve fish habitat although fish issues at this site are not significant as it is located at the upper limit of fish distributions. Work would need to take place within the timing restrictions for in water work and spotted owl. Spotted owl nest sites are known to be present within 500 feet of the proposed alignment. Long-term maintenance of the structure(s) would be required but possibly at a lesser frequency than is the case with the existing bridge. Building this alternative would require creating a new roadway within LSR, a Tier 2 Key Watershed, a Key Site Riparian Area, and a Scenic Viewshed. Road-building activities within a Key Watershed but outside designated Roadless Areas must result in no net increase in the amount of road. If this alternative were chosen for further study, this requirement may be able to be achieved by decommissioning existing USFS roads within the Key Watershed. A substantial portion of this alternative would also pass through LSR and a Key Site Riparian Area creating long-term fragmentation and displacement impacts. Wetlands are likely to be impacted by this alternative. The western end of the new alignment could impact the Barlow Road National Historic District. This alternative may also impact the Mineral Jane trail. Aside from the short term visual impacts caused during construction, this alternative may also have long-term visual impacts as views from the new road up and down the drainage may be blocked by vegetation. Under this alternative the length of the highway would not change and no impacts to travel time are anticipated.

This alternative would have handled the last major event and the structure could be built high enough and long enough to handle all but a massive debris flow in the main channel areas. However, due to the braided nature of the floodplain, it would be necessary to construct the project in a manner that would direct water and debris flows to the bridge openings in order to prevent debris/sediment build-up that could eventually overtop the roadway.

8. Realign 4 km Downstream

Description:

This alternative involves building a new crossing approximately 3700 m (12,000 feet) downstream from the existing bridge just below where the floodplain narrows and becomes a uniform width again. At this location, the numerous stream channels have joined into two main channels (Iron Creek and White River). The floodplain is also more defined and well vegetated. The presence of well-established vegetation indicates that debris flows have not reached this area in recent time. The new crossing would consist of two bridges each approximately 200 meters (650 feet) long. These bridges would be built high enough to allow for clearance during a debris flow and would have long spans to minimize impacts to the river. New roadway would have to be constructed on the south side of the floodplain; however, on the north side much of the existing FS 48 could be widened and reused. FS 48 would need to be reconstructed to meet the standards for a state highway. The connection of FS 48 and Highway 35 would need to be reconstructed, as it is currently a tee-intersection. The grades would be less than 8 percent for this alternative. It is estimated that approximately 6800 meters (22,300 feet) of roadway construction (new and reconstruction) would be required. Cost is estimated to be $22,000,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 3 – 5 years. Construction is expected to take 2 - 3 years.

Analysis:

The construction of two, 200 m (656 ft) long bridges in the bouldery river deposits would require an extensive geotechnical investigation. Construction of the bridge foundations in the bouldery river deposits could be problematic. Approximately 1.5 miles of this realignment passes through an area mapped as having high landslide risk. The long-term maintenance needs would be more typical of structures located over more defined stream channels.

As this alternative involves work along a new alignment impacts to terrestrial habitat, wildlife, noise environment, cultural, and visual resources would be greater than for alternatives that stay on the existing alignment. This alternative is expected to improve floodplain functioning in the upper reaches but would impact functions in the vicinity of the new crossing. The free flowing character of the WSR would be improved by placing the roadway in an area of the river beyond the extent of the most recent debris flows. This alternative would improve fish habitat although fish issues at this site are not significant as it is located at the upper limit of fish distributions. Work would need to take place within the timing restrictions for in water work and spotted owl. Spotted owl nest sites are known to be present within 500 feet of the proposed alignment. Building this alternative would require creating a new roadway within LSR, a Tier 2 Key Watershed, a Key Site Riparian Area, and a Scenic Viewshed. Road-building activities within a Key Watershed but outside designated Roadless Areas must result in no net increase in the amount of road. If this alternative was chosen for further study, this requirement may be able to be achieved by decommissioning existing USFS roads within the Key Watershed. A substantial portion of this alternative would also pass through LSR and a Key Site Riparian Area creating long-term fragmentation and displacement impacts. Wetlands are likely to be impacted by this alternative. The western end of the new alignment could impact the Barlow Road National Historic District. This alternative may also impact the Mineral Jane trail. Aside from the short term visual impacts caused during construction, this alternative may also have long-term visual impacts as views from the new road up and down the drainage may be blocked by vegetation. This alternative would add approximately 3.0 km (1.8 miles) of out of direction travel, which would add approximately 3 minutes travel time. This alternative would have handled the last major event and would be able to handle all but a massive debris flow.

9. Bypass

Description:

This alternative would utilize US Highway 26 and sections of FS 43 and 48 to bypass the White River

Site. This alternative would include reconstructing sections of FS 48 and 43 to current state standards. This alternative begins at the junction of FS 48 and Highway 35 at approximately MP 61.8. The route parallels the northeasterly side of White River and is located along the hillside above the floodplain. The length of this segment is approximately 14 km (8.7 miles). The FS 48 segment of the bypass ends at a 'T' intersection with FS 43. The route continues along FS 43 in a westerly direction, crossing the White River then turning southwesterly and finally connecting with US Highway 26 at approx. MP 68.2. The length of the FS 43 segment is approximately 9.2 km (5.7 miles). The route continues north along Highway 26 for 17.1 km (10.6 miles). The total bypass measures approximately 40.2 km (25.0 miles).

FS 48 has a relatively high-speed vertical and horizontal alignment. The roadway cross section is uniform with adequate lane widths and paved shoulders. The cross sectional elements appear to be adequate to meet 'minimal' State highway standards. The existing pavement does not appear to be strong enough for truck loadings. Along FS 43 the roadway cross section is not uniform and the majority of the roadway segment does not meet 'desirable' ODOT standards.

This alternative would include upgrading FS 48 and 43 to 'desirable' ODOT cross sectional standards. This would include road widening, reconstructing roadside ditches and slopes, and providing adequate clear zones. The roadway surfacing would either be built up with a pavement overlay or totally reconstructed. This route would have maximum grades of 6%. Of the 23.2 km (14.4 miles) along FS 48 and FS 43, approximately 19.6 km (12.2 miles) of the bypass would follow the existing alignment. Approximately 3.6 km (2.2 miles) would be realigned, either due to sharp horizontal curves or steep vertical grades. This alternative would also include constructing an interchange at the existing junction of US Highway 26 and FS 43 provide for the free flow of traffic. The remaining portion of US Highway 26 would not require any additional work. The existing White River Bridge on Highway 35 and the West White River Sno-Park would be removed; however, the remaining roadway would need to be maintained to provide access to the Boy Scout winter lodge, Barlow Road, and existing trail systems. The existing FS 43 crossing of White River would be replaced. The cost of this alternative is estimated to be $31,500,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 3 – 5 years. Construction is expected to take 3 - 4 years.

Another possible bypass route was identified in which the FS 3560 near Barlow Butte would connect to FS 3530 (Barlow Pass Road) and FS 43 just west of the existing FS 43 crossing of White River. This bypass would be considerably shorter than the FS43/48 and Highway 26 bypass; however, it is not considered feasible because the grades would exceed State standards for this classification of highway. In addition, this route would also create significant impacts to the Barlow Road National Historic District. Therefore, this bypass was not considered for further evaluation.

Analysis:

A comprehensive geotechnical investigation would be required to obtain design information for widening and reconstruction of the existing Forest Service Roads. The major geotechnical aspects of the realignment would be cutslope design, embankment and retaining wall design, bridge foundation design, and pavement design. Approximately 3 miles of this route (along FS 48) is located adjacent to an area mapped as having high landslide risk. Although the alignment follows an existing roadway for most of its length, very large cuts and fills will be needed in many places. There are numerous stream and drainage crossings that would also be affected.

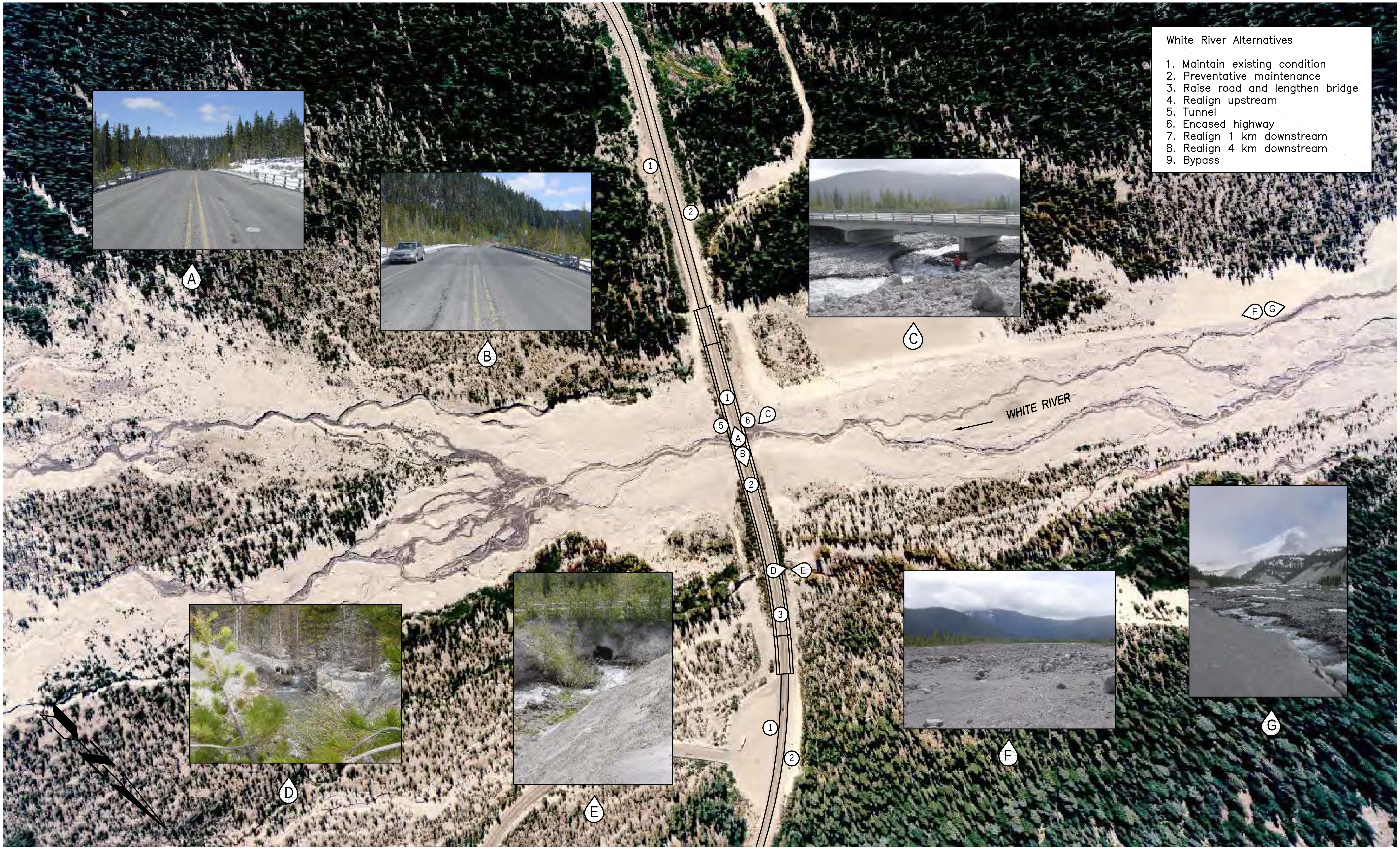
The route is adjacent to winter recreation areas and a Key Site Riparian Area, is located within LSR and a Tier 2 Key Watershed, and crosses the Barlow Road National Historic District. As this alternative involves work along existing alignments impacts to these land designations, terrestrial habitat, wildlife, noise environment, and recreational and cultural resources would occur due to the need to widen the roadway to current standards and the increase of traffic volumes on the roadway. Spotted owl nest sites are known to be present within 500 feet of the proposed alignment. No new habitat fragmentation impacts would occur. This alternative would restore floodplain functioning in the upper reaches of the White River and restore the free flowing character of the WSR at the existing Highway 35 crossing. This alternative passes through both the White River and Salmon River WSR corridors and the majority of the route is located within designated scenic viewsheds, which are expected to have a positive visual impact on the highway; however, the route also traverses a wood product emphasis land allocation for approximately 0.8 miles. Wetland impacts are expected to be minor. The West White River Sno Park would be eliminated by this alternative. As FS 48 and 43 are currently closed in winter and used as a snow trail system, this recreational opportunity would also be displaced. This alternative would result in 33.3 km (20.7 miles) of out of direction travel and 28 minutes of additional travel time. The addition of 33.3 km (20.7 miles) would substantially increase regular maintenance needs (such as snow plowing) along Highway 35, although the alternative would substantially reduce the probability for emergency repairs due to debris flows. This alternative would have handled the last major event and would also be able to handle all but a massive debris flow event at the bridge crossing on the existing FS 43 road.

Analysis Relative to the Study Objectives

A matrix rating the White River alternatives relative to the objectives is shown below. The alternatives that best meet the objectives and that are recommended for further evaluation are identified with an astrix. Cost information is also provided (more detailed cost data is provided in Appendix B). The rationale used in rating the alternatives relative to the objectives is provided in Section 1.1.3.

Alternatives for White River / **Objectives**	Enhance & protect the WR WSR	Enhance the natural floodplain	Minimize impacts to visual resources	Minimize impacts to terrestrial habitat	Reduce maintenance & emergency repair	Improve safety	Optimize life cycle costs	Maintain travel time	**Estimated Cost ($)**
1) Maintain Existing Condition	○	○	◖	●	○	○	◖	●	1,500,000/20 yrs
2) Preventative maintenance	○	○	◖	●	○	○	◖	●	2,000,000/20 yrs
* 3) Raise Road and Lengthen Bridge	●	◖	◖	●	◖	●	○	●	14,100,000
4) Realign Upstream	◖	◖	◖	○	◖	●	○	◖	17,100,000
5) Tunnel	●	●	◖	◖	○	◖	○	●	29,900,000
6) Encased Highway	●	●	◖	◖	○	◖	○	●	25,900,000
7) Realign 1 Km Downstream	◖	◖	◖	○	◖	●	○	◖	35,100,000
8) Realign 4 Km Downstream	◖	◖	◖	○	◖	●	○	◖	22,000,000
9) Bypass	●	●	◖	○	○	◖	○	○	31,500,000

● = best meets objective; ◖ = partially meets objective; ○ = does not meet objective



BY	DATE	REVISION DESCRIPTION

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DJ&A, P.C.
CONSULTING ENGINEERS & LAND SURVEYORS
3203 Russell Street, Missoula, Montana 59801-8591
Phone 406/721-4320 Fax 406/549-6371

FEASIBILITY STUDY
WHITE RIVER TO BASELINE

WHITE RIVER - MP 61.71
(2001 PHOTO)
Figure 6.3.1

SHEET 1 OF 3

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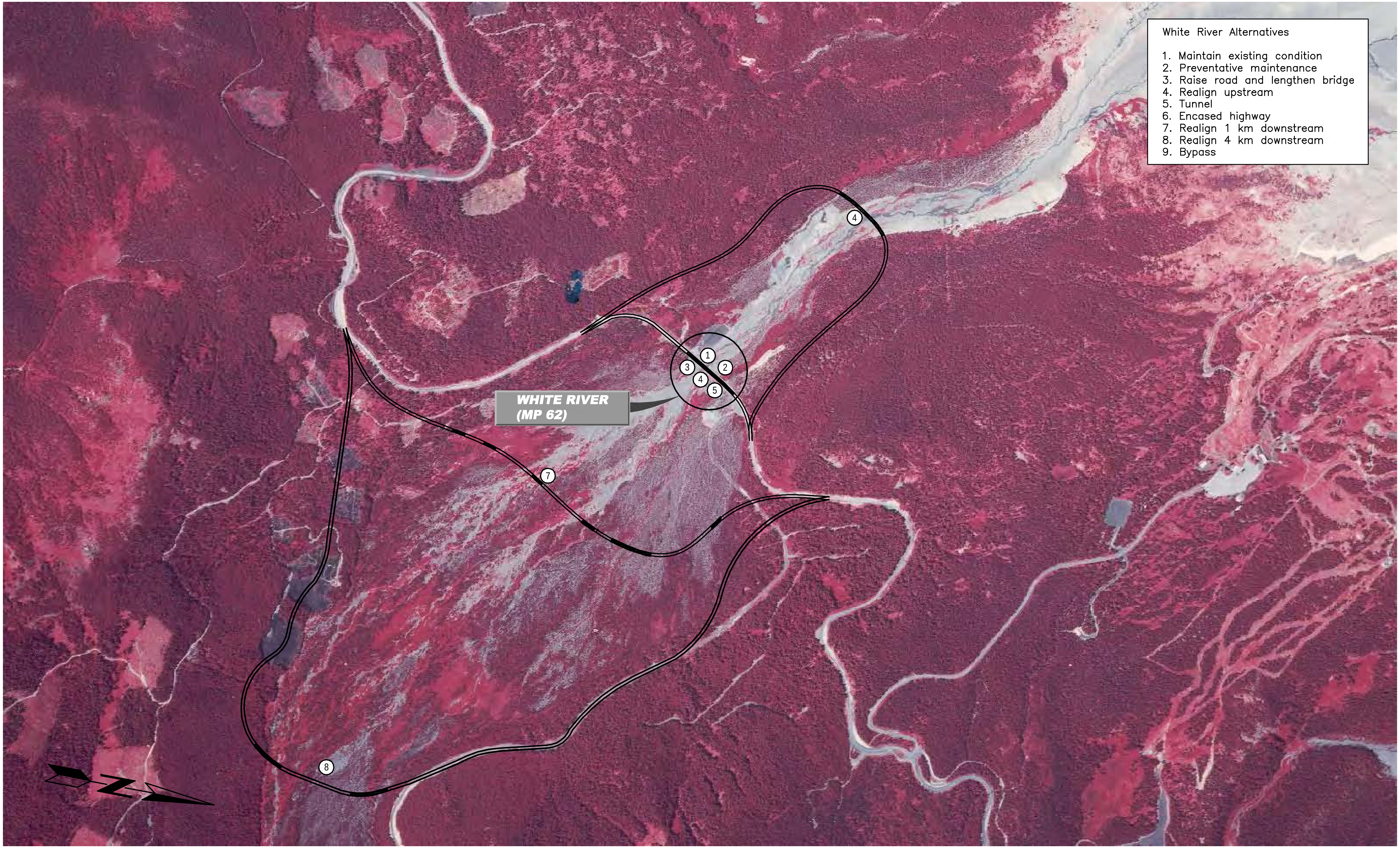

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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

WHITE RIVER - MP 61.71
(1989 INFRARED PHOTO)
Figure 6.3.2

SHEET 2 OF 3

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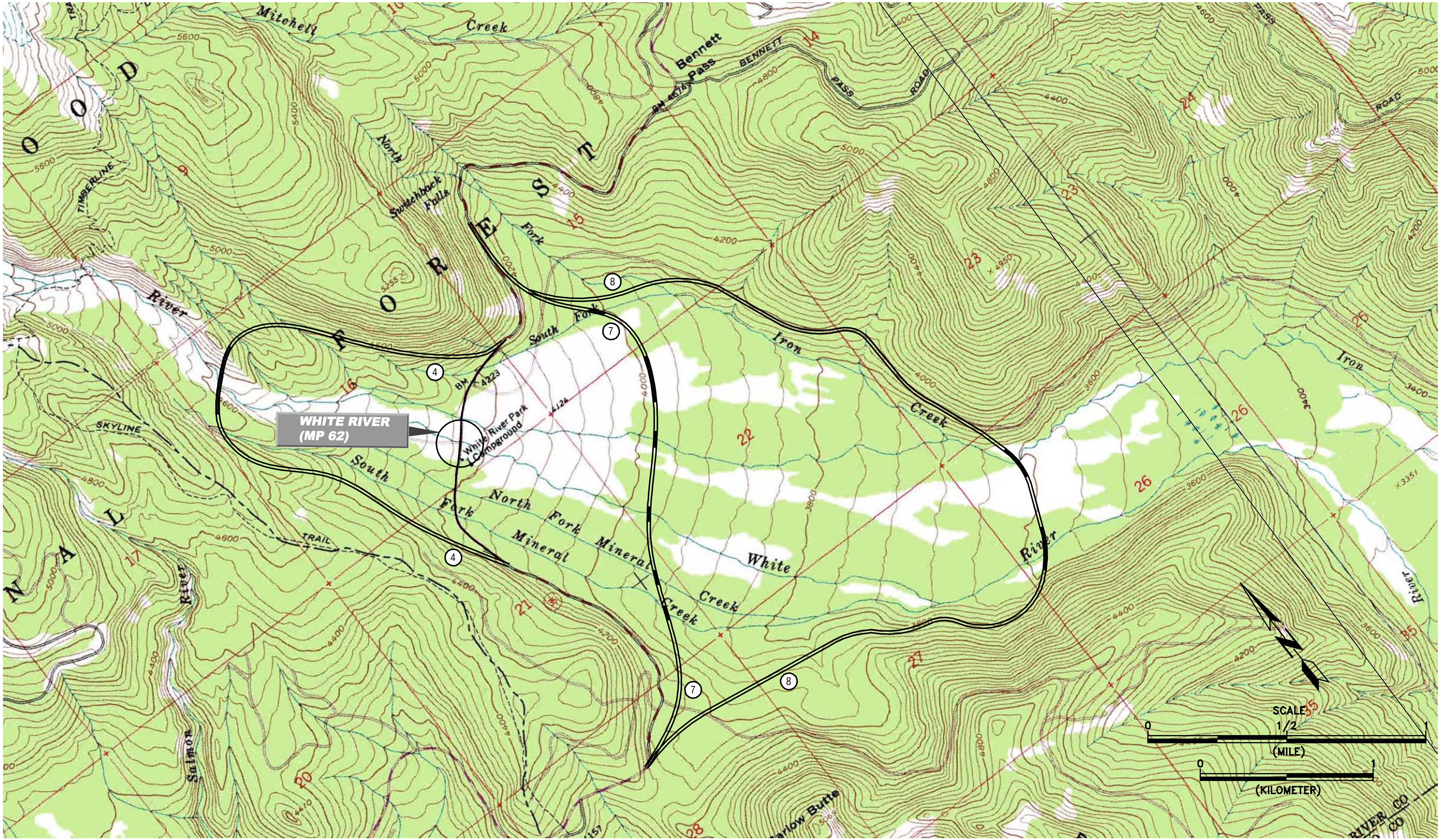

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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

WHITE RIVER
HIGHWAY 35 REALIGNMENT
Figure 6.3.3

SHEET 3 OF 3

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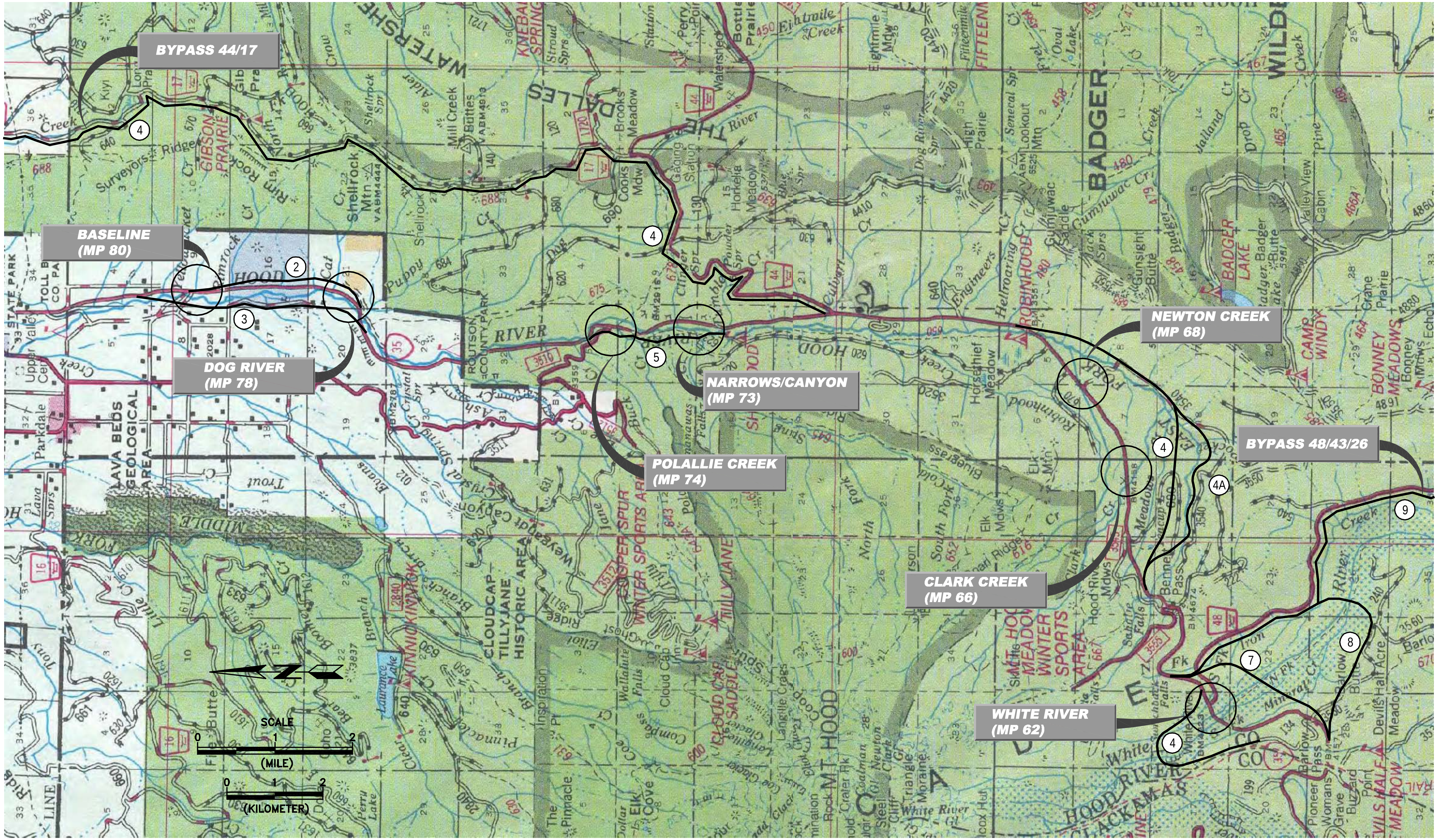

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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

BYPASS ALTERNATIVES
Figure 6.3.4

SHEET 1 OF 1

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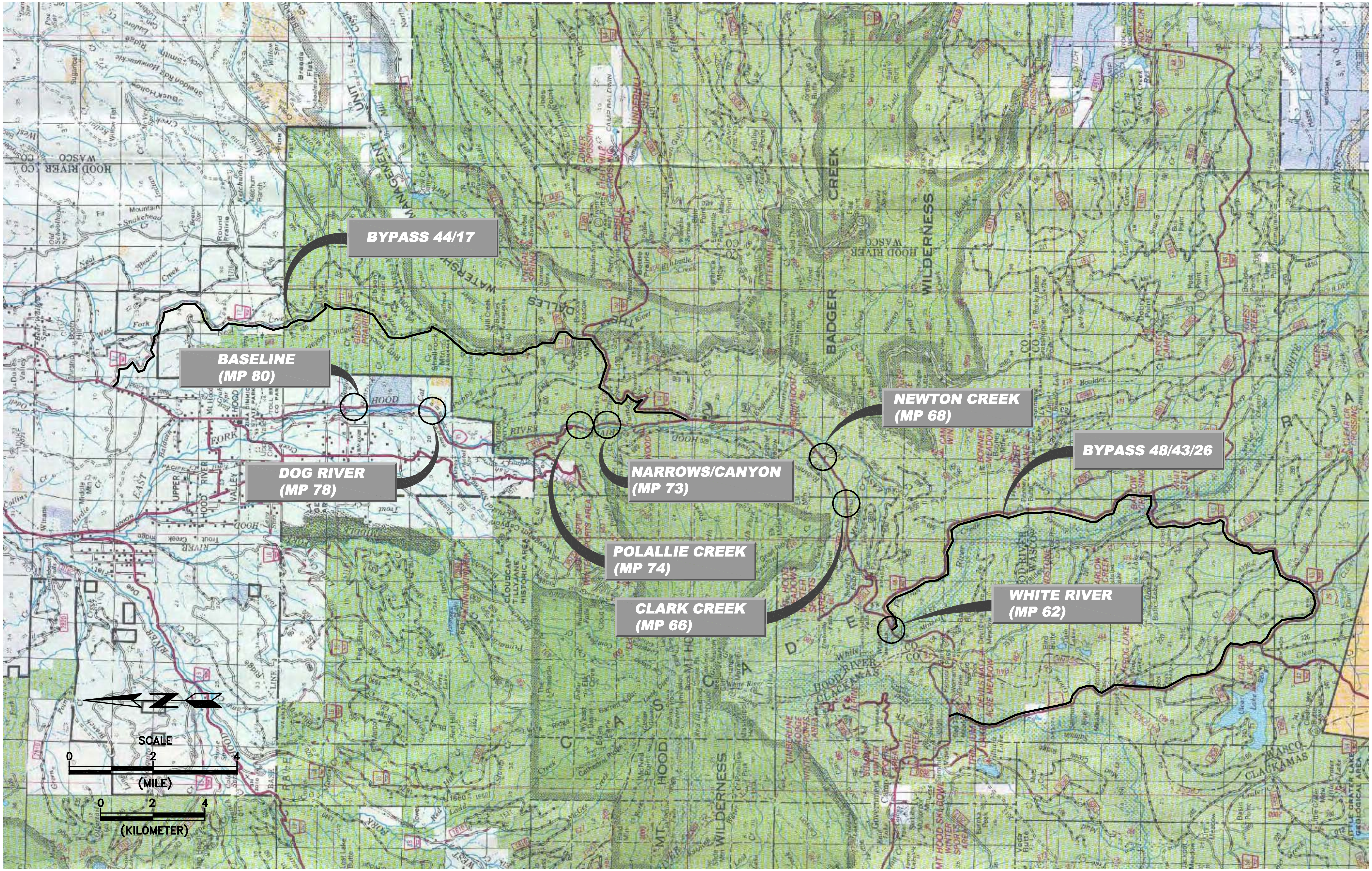

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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

BYPASS ALTERNATIVES
FOREST SERVICE ROADS 17, 43, 44, 48 AND HIGHWAY 26
Figure 6.3.5

SHEET 1 OF 1

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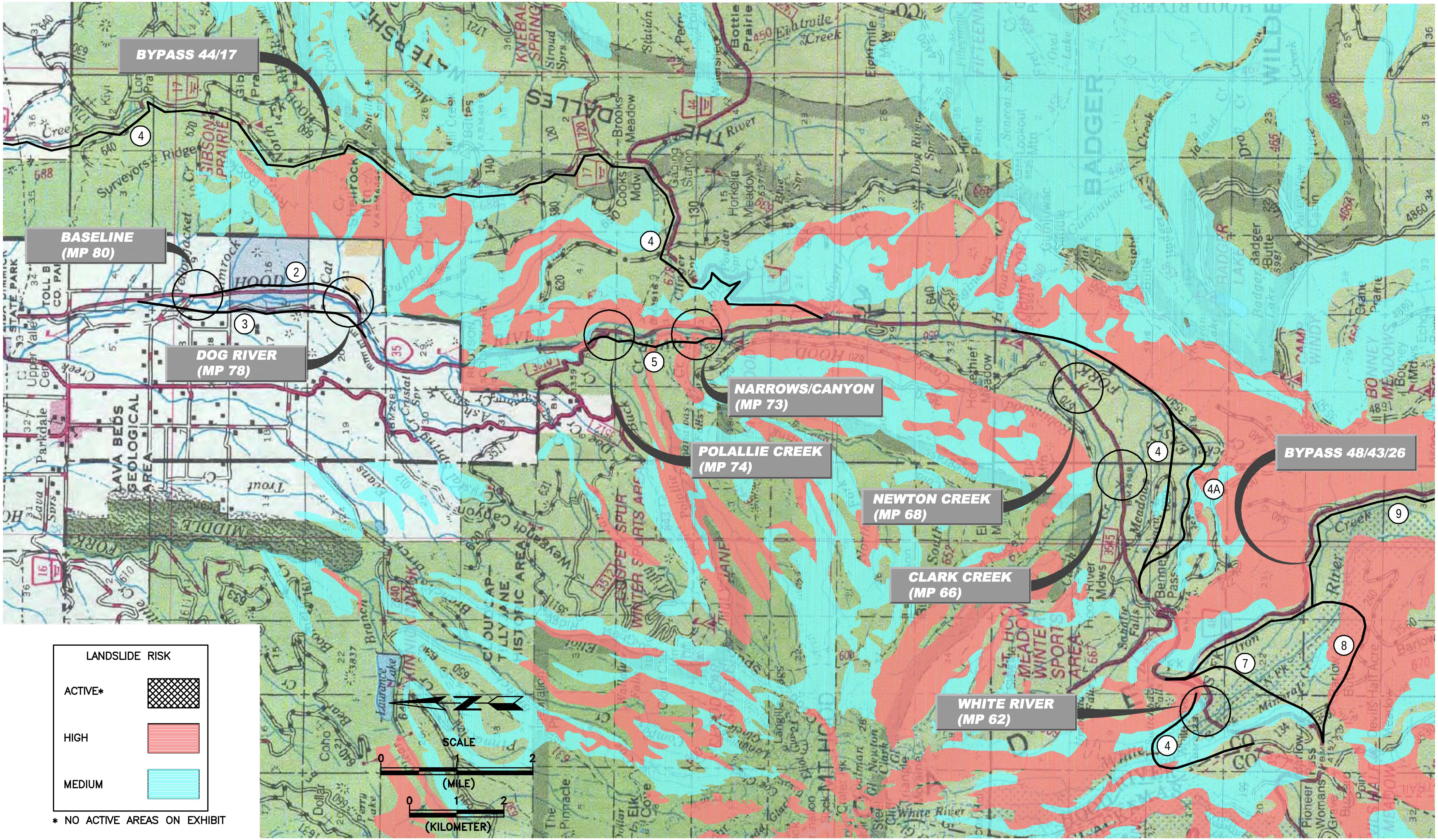

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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

LANDSLIDE RISK
Figure 6.3.6

SHEET 1 OF 1

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6.4 Clark Creek (MP 66)

Refer to Figures 6.4.1 – 6.4.4 for a graphical depiction of the alternatives discussed below.

1. Maintain Existing Condition

Description:

This alternative involves continued maintenance of the existing crossing, which is the current practice. This would require periodic monitoring of road conditions and making repairs as needed, especially following large flood events. Based on an event similar to the 1999 debris flow ($70,000) occurring once every five years, the estimated cost for a 20-year period is expected to be approximately $280,000.

Analysis:

As this alternative does not provide for the meandering nature of the stream, this alternative would necessitate re-channeling the stream as needed after debris flows to maintain it in its original crossing. This alternative would not improve floodplain functions (including fish passage at the crossing) or reduce the long-term emergency repair issues along this section of the highway. Land adjacent to the site is classified as wildlife/visuals emphasis and matrix. Over the short-term construction would not impact terrestrial habitat, wildlife, or wetlands. Over the long term, the need to re-channel the streambed after debris flows is expected to impact aquatic and terrestrial habitat, wildlife, wetlands, and the visual qualities of the area. Recreational trails and the Clark Creek Sno-Park would not be impacted over the short term but are likely to be impacted by future events in this area. Note that the only time the USFS authorizes work outside the road prism is when damage to the road is imminent or has already occurred (*pers. comm.* Stewart Fletcher, 2002). This alternative would not have handled the last major event. Major roadway clean up and channel re-shaping would be necessary after each event.

2. Riprap Existing Stream Bank and Culverts

Description:

Under this alternative, large riprap would be used to protect the stream bank and culverts from damage during future debris flows. The initial cost is estimated to be $50,000 for the placement of riprap along the stream bank and at the culverts. In addition, it is estimated that similar maintenance costs to those for Alternative 1 (maintain existing condition) would be required. Maintenance over a 20-year period is estimated at $280,000, giving a total estimated cost of $330,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 6 months - 1 year. Construction is expected to take place during one construction season.

Analysis:

As this alternative does not provide for the meandering nature of the stream, this alternative would necessitate re-channeling the stream as needed after debris flows to maintain it in its original crossing. This alternative would minimally reduce but not eliminate long-term emergency repair issues along this section of the highway by hardening the crossing. This alternative would not improve floodplain functions (including fish passage at the crossing). The ODFW and NMFS rate the study site at Clark Creek as a high priority for fish passage improvements. Land adjacent to the site is classified as wildlife/visuals emphasis and matrix. Over the short-term, construction would have minor impacts to terrestrial habitat and wildlife in the immediate vicinity of the crossing. No impacts to wetlands are anticipated, however, fish habitat would be impacted by the addition of riprap to the stream bank. Over the long term, the need to re-channel the streambed after debris flows is expected to impact terrestrial and aquatic habitat, wildlife, and wetlands. Recreational trails and the Clark Creek Sno-Park would not be impacted over the short term but are likely to be impacted by future events in this area. Note that the only time the USFS authorizes work outside the road prism is when damage to the road is imminent or has already occurred (*pers. comm.* Stewart Fletcher, 2002). This alternative would not have handled the last major event. Major roadway clean up and channel re-shaping would be necessary after each event.

3. Armored Dry Channel

Description:

Under this alternative a large rock armored trapezoidal channel would be constructed adjacent to the roadway to intercept debris flows and aid in protecting the roadway embankment. The channel would extend from south of Clark Creek, past Newton Creek to the East Fork Hood River in the vicinity of Robinhood Bridge. The channel would be approximately 3000 meters (10,000 feet) long. As the existing roadway is at almost the same elevation as the surrounding terrain, the channel would have to be depressed to intercept debris flows. The channel could either be constructed adjacent to the existing roadway or moved farther away from the roadway to leave a vegetative buffer between the road and the channel. Debris flows would be intercepted by the channel and diverted parallel to the roadway and into the EFHR downstream of the Robinhood Bridge. This alternative would include realigning the stream(s) after debris flows to maintain them in their original channels. Cost is estimated to be $2,000,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 1 - 3 years. Construction is expected to take 1 year.

Analysis:

This alternative would require maintenance to keep the channel clear of debris. Large debris flows may not be entirely diverted into the channel and could still cause damage to the roadway. Placing the channel next to the roadway would provide additional snow storage.

The construction of the channel would require the removal of mature vegetation within land classified as matrix and wildlife/visuals emphasis. If the channel were located farther from the roadway, visual impacts from the roadway would be minimal. This alternative would impact potential spotted owl habitat and it would not improve floodplain functions in the Newton and Clark Creek drainages. Water velocity in the channel would be high and is expected to prohibit fish passage and cause scouring where the channel enters the EFHR. If stream(s) were maintained in the channel over the long-term, fish habitat would be extremely poor (high temperature, low habitat complexity, high water velocity, and high turbidity). Recreational trails present in this area are likely to be impacted.

An armored dry channel would have handled the last major event and would re-direct all but a massive debris flow; however, clean up, maintenance, and reshaping the dry channel would be required after each major event. Re-shaping of the streambed would also be necessary following major events.

4. Bypass

Description:

Under this alternative, Highway 35 would be relocated to the east side of the EFHR in order to allow Clark and Newton Creek to meander within their floodplain. Two possible alignments, referred to as Alternatives 4 and 4A, have been identified for this bypass. Numerous drainage features would be required along the east portion of these alignments. Construction could be completed on either of these alignments while traffic remains on the existing roadway. Once the new roadway has been completed, the existing road surface would be removed and the area returned to its natural setting.

Alternative 4: The western end of Alternative 4 is located approximately 400 meters (0.2 miles) east of the intersection of Highway 35 with Sahalie Falls Road. The eastern end of Alternative 4 is located just north of the Robinhood Bridge. Alternative 4 is 7,300 meters (24,000 feet) long and bypasses 5,900 meters (19,400 feet) of Highway 35. From its eastern end, Alternative 4 would follow the southern side of the EFHR for approximately 4,000 meters (13,100 feet). The bypass would cross the EFHR 900 meters (3,000 feet) east of Pocket Creek and continue along the south side of the east-west ridge that borders the southwest side of the Clark Creek flood plain. To the extent possible, the road would be built slightly upslope to minimize the potential of debris and water washing over the road during major events. Of the bypass, 1,600 meters (5,250 feet) would follow the existing FS 5340 (Pocket Creek Road), which would need to be widened to State standards. The remainder of the bypass (approximately 5,700 meters (18,700 feet)) would require new roadway construction. A new bridge (approximately 50 meters (165 feet) long) would need to be constructed at the crossing of the EFHR. Cost is estimated to be $13,400,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 3 - 5 years. Construction is expected to take 1-2 years.

<u>Alternative 4A</u>: The western end of Alternative 4A is located approximately 200 meters (0.1 miles) east of the intersection of Highway 35 with Sahalie Falls Road. The eastern end of Alternative 4A is located just north of the Robinhood Bridge. Alternative 4A is 8,500 meters (27,900 feet) long and bypasses 5,900 meters (19,400 feet) of Highway 35. From its eastern end, Alternative 4A would follow the southern side of the EFHR for approximately 7,400 meters (24,300 feet). The bypass would cross the EFHR and Pocket Creek. After crossing Pocket Creek the bypass would continue along the south side of the east-west ridge that borders the southwest side of the Clark Creek flood plain. To the extent possible, the road would be built slightly upslope to minimize the potential of debris and water washing over the road during major events. 1,600 meters (5,250 feet) of bypass Alternative 4A would follow the existing FS 5340 (Pocket Creek Road), which would need to be widened to State standards. The remainder of the bypass (approximately 6,900 meters (22,600 feet)) would require new roadway construction. A small bridge of approximately 30 meters (100 feet) would also be needed for the EFHR crossing and another smaller bridge or large culvert (9 meters) (30 feet) would be needed at the Pocket Creek crossing. Cost is estimated to be $14,700,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 3 - 5 years. Construction is expected to take 1 – 2 years.

<u>Analysis:</u>

The northeast portion of both alternatives passes through an area designated as having 'high' landslide risk. The slide area is located at the toe of the slope on the east side of the flood plain, and it might be possible to construct the roadway entirely on the flood plain without impinging on the adjacent hillside in order to reduce land slide risk and the need for slope protection. However, this goal would conflict with that to build the road slightly upslope to minimize the potential of debris and water washing over the road during major events. These issues would need to be assessed more thoroughly once a geotechnical investigation for the proposed bypass was completed. According to USFS geologist Tom DeRoo, both Alternatives 4 and 4A would move the road out of the debris flow zone of Mount Hood and would be permanent solutions to the existing emergency repair problems, while restoring the floodplains of Clark and Newton Creek and their braided side channels. The eastern portion of 4 and most of 4A would be located on a north-facing exposure and could be expected to be ice and snow-covered for longer periods than the current alignment in the winter and spring. The western half of Alternative 4 has a southerly exposure, which would provide for better snowmelt. These alternatives pass through matrix and a wildlife/visuals emphasis area. Disturbance to wildlife would occur during construction through the removal of mature vegetation. Spotted owl and peregrine falcon nest sites are known to be present within 500 feet of the proposed alignment(s). Several existing recreation resources would also be impacted. Both alternatives would pass through a section of the Teacup Lake groomed snow trail system maintained by the Oregon Nordic Club. Access to the Teacup Lake area may also be affected. These alternatives would also bypass the Clark Creek Sno-Park. USFS personnel suggested moving the Clark Creek Sno-Park to the site of the ODOT highway maintenance shed (near the Meadows turnoff). This alternative would permanently displace the Pocket Creek Snow Park / Trail (located on Pocket Creek Road which is part of the proposed alignment for this alternative) and disrupt access to the Elk Meadows trailhead located at Clark Creek Sno-Park. Since a second trailhead is located at the Meadows access road, this would not be of high concern to the USFS. These alternatives would move the road onto a ridge and closer to the Badger Creek Wilderness, which may increase noise levels at the edge of the wilderness. By moving the road out of the floodplains of Newton Creek, Clark Creek, and the EHFR, the amount of sanding gravels and other road associated pollutants that enter those waterways would be reduced, which would improve overall water quality in the streams and have a positive impact on fish.

Both alternatives would remove two existing stream crossings. Alternative 4 would require the installation of one major river crossing structure and alternative 4A would require the installation of two major river crossing structures. Both alternatives would involve crossing numerous other small drainages. All new crossings would have to provide for fish passage. Alternative 4 would lengthen the highway by 1.4 km (0.87 miles) adding approximately 1 minute of travel time. Alternative 4A would lengthen the highway by 2.6 km (1.6 miles) adding approximately 2 minutes of travel time.

Moving the roadway outside of the floodplain would have handled the last major debris flow event and would eliminate the possibility of damage from future events. The lower section of the roadway would need to be raised several meters above the EFHR in order to protect it from a massive debris flow.

5. Raised Roadway with Intermittent Channel Crossings

Description:

Under this alternative, 3 km (1.9 miles) of the roadway would be raised on its existing horizontal alignment by approximately 2-3 meters (6 –10 ft). In addition, the north (upstream) side would be armored with large riprap, and box culverts, large steel culverts, or small bridges would be installed approximately every 300 meters (1000 feet) along the embankment (in the locations of identifiable historic channels). The intent of the raised roadway with intermittent crossings would be to prevent debris flows from overtopping the roadway while providing drainage beneath the roadway for the numerous meander channels of Clark Creek. The roadway embankment would also act to direct debris flows down slope, parallel to the roadway, and to the next crossing. Cost is estimated to be $4,900,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 2 - 4 years. Construction is expected to take 1 – 2 years.

A variation of this alternative that involved building the alternative incrementally, adding a new crossing/culvert whenever and wherever necessary to accommodate a new drainage channel was considered. However, due to the need to raise the road grade throughout the length of the entire section in order to install culverts or bridges, the alternative was not considered feasible from a constructability perspective and was dropped from further consideration.

Analysis:

This alternative could be constructed in phases to reduce the impacts to traffic on the roadway. A large material source would be needed for fill material. The White River floodplain may be a possible material source if an alternative that involves removal of the material accumulated upstream of the existing White River Bridge is selected for construction and if the White River and Clark Creek projects are sequenced together. Minimal geotechnical investigation would be required for this alternative. Depending on the size and location of future debris flow events, the USFS and other agencies would evaluate, at the time of the event, whether or not to channel the stream back to its original location or to maintain it through a new crossing. Maintenance of the crossings would be necessary both before and after an event. The larger the openings, the less maintenance would be required. As this alternative involves construction along the existing alignment, impacts to terrestrial habitat, wildlife, recreational, and potential cultural resources would be minimal. Visual impacts are also expected to be minimal. This alternative would impact vegetation downstream of the road, although, the river would naturally cut new paths through the forest anyway. Flood plain functioning would be better than the existing condition, by allowing the stream(s) to meander within their historical channels. All crossings would need to provide for fish passage. Over the long term, the embankment would essentially act as a dam to large debris, which would build up on the north side of the road.

The raised roadway alternative would have handled the last major debris flow event and would re-direct all but a massive future event. After major events, removal of debris flow material along the roadway and at the culverts would be needed. Re-shaping of the streambed would also be necessary to maintain the existing stream channel. In addition, maintenance would be needed following successive minor events to prevent build-ups of debris at the culverts.

6. Raise Roadway on Permeable Embankment

Description:

Under this alternative, 3 km (1.9 miles) of the roadway would be raised by approximately 2-3 meters (6 – 10 ft) on a permeable base constructed with large rock. In addition, box culverts, large steel culverts, or small bridges would be installed approximately every 300 meters (1000 feet) along the embankment (in the locations of identifiable historic channels). The intent of the raised roadway on permeable embankment would be to prevent debris flows from overtopping the roadway while providing drainage beneath the roadway for the numerous meander channels of Clark Creek. The roadway embankment would also act to direct debris flows down slope, parallel to the roadway, and to the next crossing. The permeable base would allow water to filter through the bottom of the roadbed but would not allow sufficient water passage to eliminate the need for culverts/bridges. Cost is estimated to be $3,700,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 2 - 4 years. Construction is expected to take 1 – 2 years.

A variation of this alternative that involved building the raised embankment incrementally, adding a new crossing/culvert whenever and wherever necessary to accommodate a new drainage channel was also considered, however, due to the need to raise the road grade throughout the length of the entire section in order to install culverts or bridges, the alternative was not considered feasible from a constructability perspective and was dropped from further consideration.

Analysis:

This alternative could be constructed in phases to reduce the impacts to traffic on the roadway. A large material source would be needed for embankment construction. Minimal geotechnical investigation would be required for this alternative. Depending on the size and location of future debris flow events, the USFS and other agencies would evaluate, at the time of the event, whether or not to channel the stream back to its original location or to maintain it through a new crossing. Maintenance of the crossings would be necessary both before and after an event. The larger the openings, the less maintenance would be required. A rock foundation at the bottom of the embankment would armor the embankment and provide more resistance to scouring and erosion by a debris flow than would a riprap-armored embankment. Because this alternative involves construction along the existing alignment, impacts to terrestrial habitat, wildlife, recreational, and potential cultural resources would be minimal. Visual impacts are also expected to be minimal. This alternative would impact vegetation downstream of the road, although, the river would eventually cut new paths through the forest. By allowing the stream(s) to meander within their historical channels, floodplain functioning would be improved. All crossings would need to provide for fish passage. Over the long term, the embankment would essentially act as a dam to large debris, which would build up on the north side of the road.

This alternative would have handled the last major debris flow event and would re-direct all but a massive future debris flow. Debris removal along the upstream side of the embankment would be necessary after each major event. The existing stream channel would need to be re-shaped whenever it jumped channel in order to maintain the existing stream location following debris flow events similar to past events. Maintenance would also be needed following successive minor events to prevent build-up of debris along the embankment.

7. Bridge

Description:

Under this alternative, the existing culverts at Clark Creek would be replaced with a 30-meter (100 foot) bridge. The road would also be raised slightly to provide greater clearance under the bridge. Cost is estimated to be $900,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 1- 2 years. Construction is expected to take 1 year.

Analysis:

This alternative would improve floodplain functioning by widening the stream channel, allowing some debris to pass underneath the roadway, providing a natural stream bottom, and by allowing fish passage at this site. The ODFW and NMFS rate the study site at Clark Creek as a high priority for fish passage improvements. However, this alternative does not provide for the meandering nature of the stream, and would necessitate re-channeling the stream as needed after debris flows to maintain it in its original crossing. Over the short-term, construction would cause minimal impacts to terrestrial habitat, wildlife, recreational, and potential cultural resources. In water work would be required during construction and would include creating a short stream detour. Over the long term, the need to re-channel the streambed after debris flows is expected to impact terrestrial habitat, wildlife, wetlands, and the visual qualities of the area. Note that the only time the USFS authorizes work outside the road prism is when damage to the road is imminent or has already occurred (*pers. comm.* Stewart Fletcher, 2002).

Replacing the existing culvert with a small bridge may have handled the last large event, as it would have allowed the passage of larger debris. However, the stream at this location could easily jump channel above the roadway crossing and completely miss the bridge. A bridge would be an improvement over the existing condition at the crossing, but the road would still be at risk and would continue to require maintenance after major debris flow events similar in size to past events. This maintenance effort would include re-shaping the stream channel following major events to maintain the existing stream location.

Temporary bridge (Clark and Newton)

This alternative was determined not to be feasible and therefore has not been pursued. It is described here for completeness. Under this alternative the existing culverts at Clark and Newton would be replaced with a low-cost replaceable superstructure set on deep foundations and hard abutments. This would consist of either a portable girder and deck (e.g. Hamilton or Big-R Bridge) or a panel bridge (e.g. Bailey, Acrow, or Mabey). The intent is that in a debris flow event, the superstructure could be salvaged and reset or replaced if it were stripped off the abutments by a debris flow. Portable girder and deck type structures are relatively rugged and might survive a debris flow event and still be salvageable. However, panel bridges would be damaged beyond use and would have to be replaced. There are several problems with this alternative. First, there could be a serious hazard to the public when the structure was damaged. The breach in the road might not be visible to drivers until they are unable to avoid driving into the gap. There would also be loss of service of the road until a replacement superstructure were erected. Second, these structures, while less expensive than a more permanent construction, are still too expensive to be considered 'disposable'. There is also no guarantee that the stream will continue to favor the crossing at the existing culvert location. If the stream crosses the road between Clark and Newton

Creek, as it has in the past, the bridge would be completely ineffective. Finally, given the debris flow history at this site, it is not likely that the superstructure would be salvageable. It is more probable that the structure would be carried off and either buried in the debris flow or damaged beyond salvage. It should also be noted that while the panel type bridges are available in two-lane configuration, girder and deck bridges are only available as a single lane bridge.

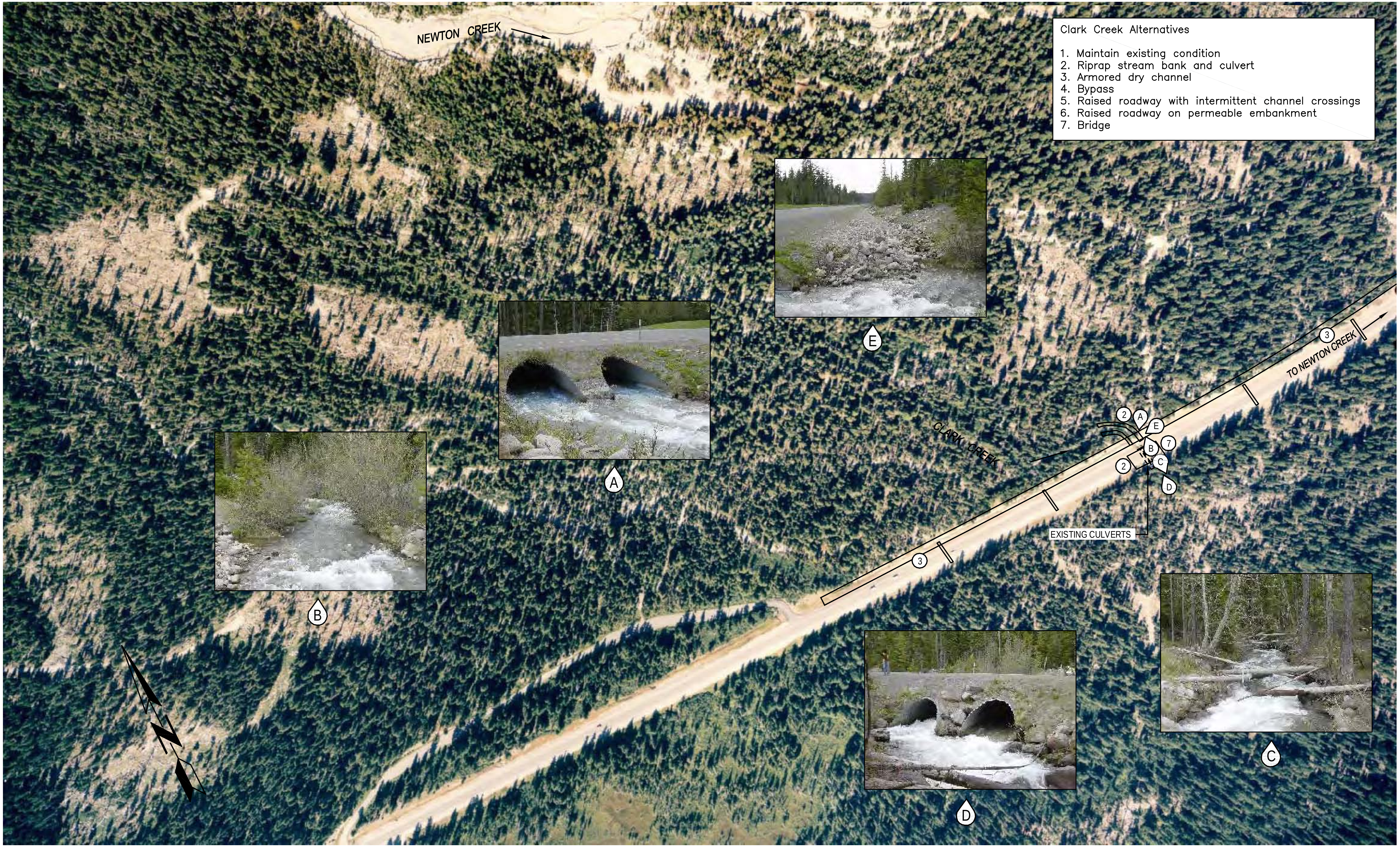
Analysis Relative to the Study Objectives

A matrix rating the alternatives for Clark Creek relative to the objectives is shown below. The alternatives that best meet the objectives and that are recommended for further evaluation are identified with an astrix. Cost information is also provided (more detailed cost data is provided in Appendix B). The rationale used in rating the alternatives relative to the objectives is provided in Section 1.1.3.

Alternatives for Clark Creek / **Objectives**	Enhance & protect the WR WSR	Enhance the natural floodplain	Minimize impacts to visual resources	Minimize impacts to terrestrial habitat	Reduce maintenance & emergency repair	Improve safety	Optimize life cycle costs	Maintain travel time	**Estimated Cost ($)**
1) Maintain Existing Condition	N/A	○	◖	◖	○	○	◖	●	280,000/ 20 yrs
2) Riprap Existing Stream Bank and Culverts	N/A	○	◖	◖	○	○	◖	●	330,000
3) Armored Dry Channel	N/A	○	○	○	◖	◖	○	●	2,000,000
*4) Bypass	N/A	●	●	○	●	●	○	◖	13,400,000
*4A) Bypass	N/A	◖	●	○	●	●	○	◖	14,700,000
*5) Raised Roadway with Intermittent Channel Crossings	N/A	◖	◖	◖	◖	◖	○	●	4,900,000
*6) Raised Roadway on Permeable Embankment	N/A	◖	◖	◖	◖	◖	○	●	3,700,000
*7) Bridge	N/A	◖	◖	●	◖	◖	○	●	900,000

● = best meets objective; ◖ = partially meets objective; ○ = does not meet objective

Note: Alternatives 3), 4), 4A), 5), and 6) would address both the Newton Creek and Clark Creek sites.



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DJ&A, P.C.
CONSULTING ENGINEERS & LAND SURVEYORS
3203 Russell Street, Missoula, Montana 59801-8591
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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

CLARK CREEK - MP 65.88
(2001 PHOTO)
Figure 6.4.1

SHEET 1 OF 1

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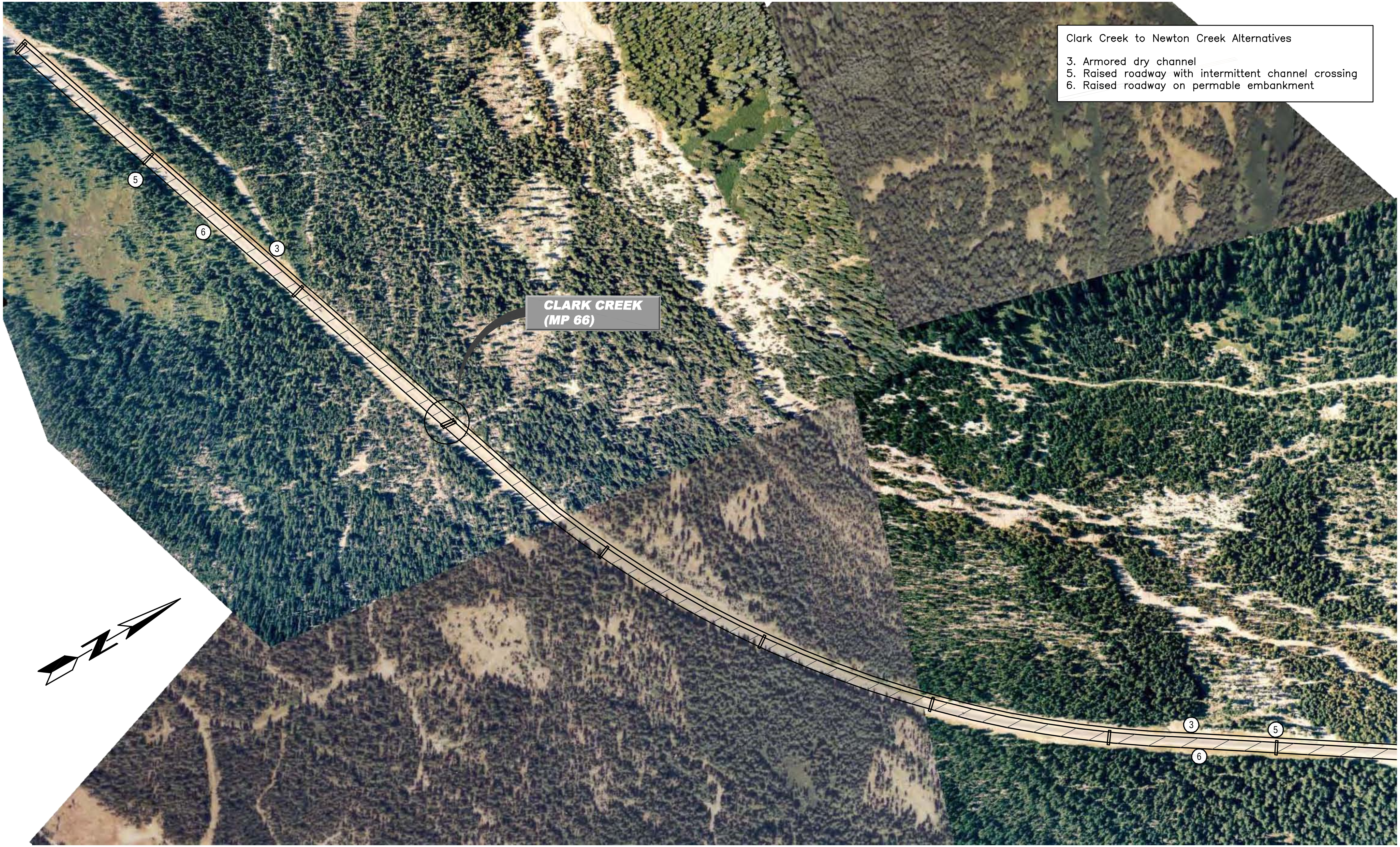

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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

CLARK CREEK (MP 65.88) TO NEWTON CREEK (MP 67.25)
CORRIDOR VIEW - (1995 PHOTO)
Figure 6.4.2

SHEET 1 OF 2

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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

CLARK CREEK (MP 65.88) TO NEWTON CREEK (MP 67.25)
CORRIDOR VIEW - (1995 PHOTO)
Figure 6.4.3

SHEET 2 OF 2

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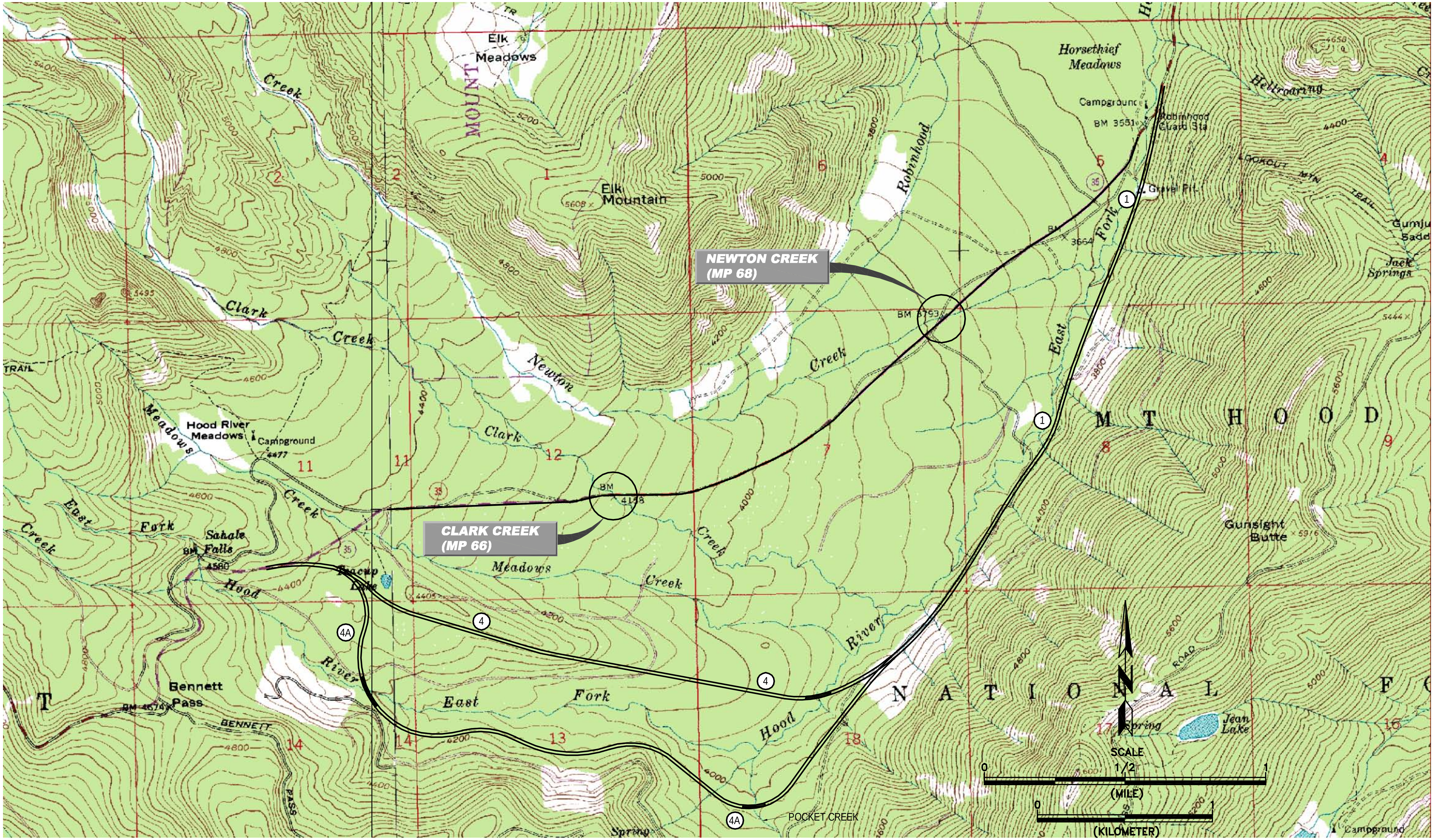

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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

CLARK CREEK TO NEWTON CREEK
HIGHWAY 35 REALIGNMENT
Figure 6.4.4

SHEET 1 OF 1

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6.5 Newton Creek (MP 68)

Refer to Figures 6.3.4, 6.3.5, 6.4.1 – 6.4.4, and 6.5.1 for a graphical depiction of the following alternatives.

1. Maintain Existing Condition

Description:

This alternative involves continued maintenance of the existing crossing, which is the current practice. This would require periodic monitoring of road conditions and making repairs as needed, especially following large flood events. Based on an event similar to the 2000 debris flow ($750,000) occurring once every five years, the estimated cost for a 20-year period is expected to be approximately $3,000,000.

Analysis:

As this alternative does not provide for the meandering nature of the stream, it would necessitate re-channeling the stream as needed after debris flows to maintain it in its original crossing. This alternative would not improve floodplain functions (According to NMFS, ODFW, and the USFS fish passage is not currently an issue at this crossing) or reduce the long-term emergency repair issues along this section of the highway. Land adjacent to the site is classified as wildlife/visuals emphasis and matrix. Over the short-term construction would not impact terrestrial habitat, wildlife, or wetlands. Over the long term, the need to re-channel the streambed after debris flows is expected to impact terrestrial and aquatic habitat, wildlife, wetlands, and the visual qualities of the area. Recreational trails would not be impacted over the short term but are likely to be impacted by future events in this area. Note that the only time the USFS authorizes work outside the road prism is when damage to the road is imminent or has already occurred (*pers. comm.* Stewart Fletcher, 2002). This alternative would not have handled the last major debris flow event. Substantial roadway clean up and channel re-shaping would be necessary after each event.

2. Riprap Existing Stream Bank and Bridge

Description:

Under this alternative, the stream channel would be widened and additional armoring would be added to the bridge. The initial cost is estimated to be $80,000 for the placement of riprap along the stream bank and at the bridge. In addition, it is estimated that similar maintenance costs to those for Alternative 1 (maintain existing condition) would be required. Maintenance over a 20-year period is estimated at $3,000,000, giving a total estimated cost of $3,080,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 6 months - 1 year. Construction is expected to take place during one construction season.

Analysis:

As this alternative does not provide for the meandering nature of the stream, it would necessitate re-channeling the stream as needed after debris flows to maintain it in its original crossing. This alternative would reduce but not eliminate long-term emergency repair issues along this section of the highway by hardening the crossing. This alternative would not improve floodplain functioning. Land adjacent to the site is classified as wildlife/visuals emphasis and matrix. Over the short-term, construction would have minor impacts to terrestrial habitat and wildlife in the immediate vicinity of the crossing but would have a negative impact on fish habitat through the placement of riprap in the stream channel. Over the long term, the need to re-channel the streambed after debris flows is expected to impact terrestrial and aquatic habitat, wildlife, and wetlands. Recreational trails would not be impacted over the short term but are likely to be impacted by future events in this area. Note that the only time the USFS authorizes work outside the road prism is when damage to the road is imminent or has already occurred (*pers. comm.* Stewart Fletcher, 2002). This alternative would not have handled the last major debris flow event. Substantial roadway clean up and channel re-shaping would be necessary after each event.

3. Armored Dry Channel

This alternative is the same as Alternative 3 for Clark Creek except that the length of dry channel would be 1,800 meters (5,900 feet) long. Note that a channel of this length would only address Newton Creek while the equivalent alternative for Clark Creek addresses Newton by default, as the alternative must extend to the Robinhood Bridge EFHR crossing, therefore incorporating the Newton site. The cost of this alternative is estimated to be $1,200,000.

4. Bypass

This alternative is the same as Alternative 4 and 4A for Clark Creek.

5. Raised Roadway with Intermittent Channel Crossings

This alternative is the same as Alternative 5 for Clark Creek except that the raised roadway would be 1,800 meters (5,900 feet) long. Note that a raised roadway of this length would only address Newton Creek while the equivalent alternative for Clark Creek addresses Newton by default, as the alternative must extend to the Robinhood Bridge EFHR crossing, therefore incorporating the Newton site. The cost of this alternative is estimated to be $2,900,000.

6. Raised Roadway on Permeable Embankment

This alternative is the same as Alternative 6 for Clark Creek except that the raised roadway would be 1,800 meters (5,900 feet) long. Note that a raised roadway of this length would only address Newton Creek while the equivalent alternative for Clark Creek addresses Newton by default, as the alternative must extend to the Robinhood Bridge EFHR crossing, therefore incorporating the Newton site. The cost of this alternative is estimated to be $2,200,000.

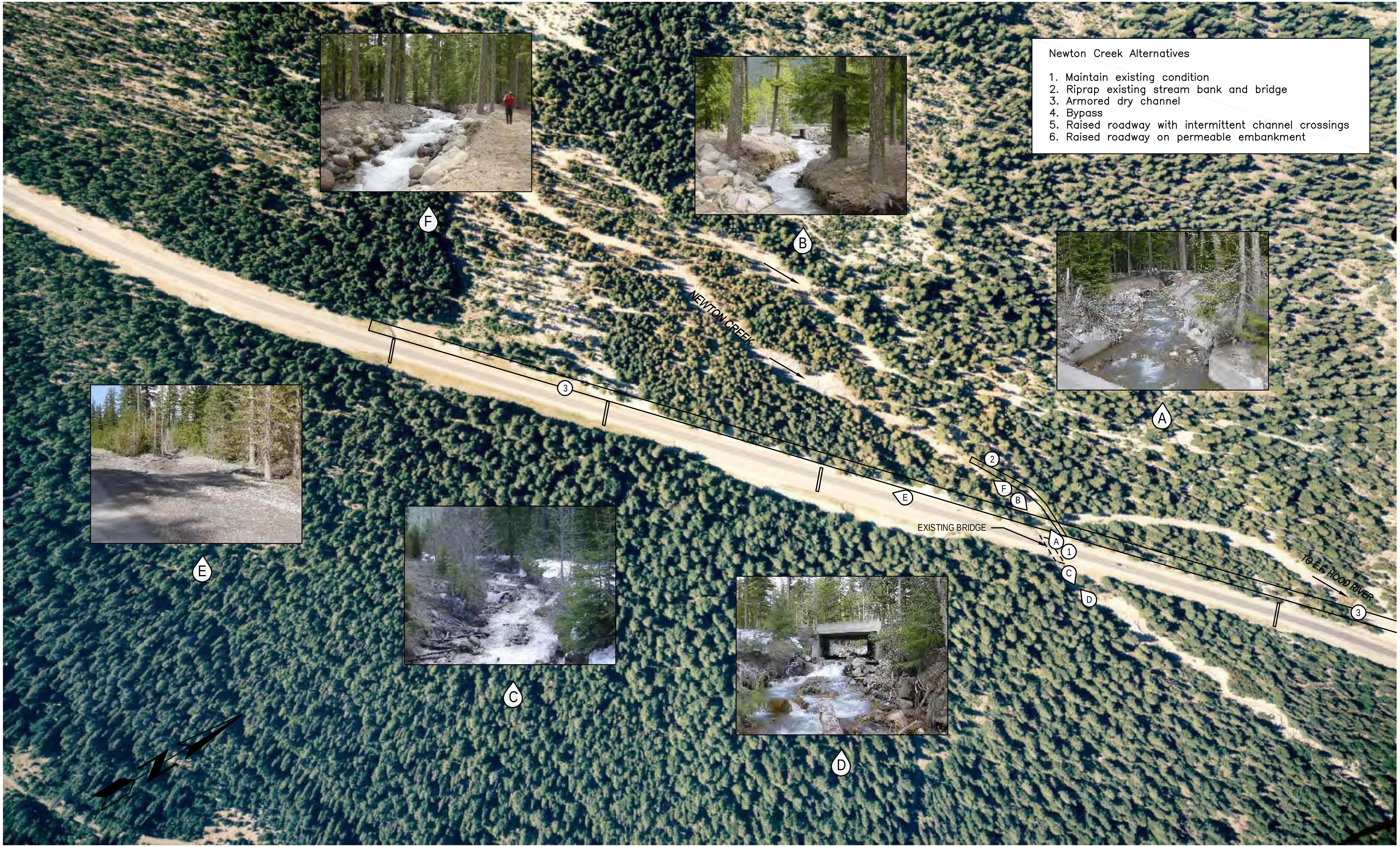
Analysis Relative to the Study Objectives

A matrix rating the Newton Creek alternatives relative to the objectives is shown below. The alternatives that best meet the objectives and that are recommended for further evaluation are identified with an astrix. Cost information is also provided (more detailed cost data is provided in Appendix B). The rational used in rating the alternatives relative to the objectives is provided in Section 1.1.3.

Alternatives for Newton Creek / **Objectives**	Enhance & protect the WR WSR	Enhance the natural floodplain	Minimize impacts to visual resources	Minimize impacts to terrestrial habitat	Reduce maintenance & emergency repair	Improve safety	Optimize life cycle costs	Maintain travel time	**Estimated Cost ($)**
1) Maintain Existing Condition	N/A	○	◖	◖	○	○	◖	●	3,000,000/ 20 yrs
2) Riprap Existing Stream Bank and Culverts	N/A	○	◖	◖	○	○	◖	●	3,080,000
3) Armored Dry Channel	N/A	○	○	○	◖	◖	●	●	1,200,000
*4) Bypass	N/A	●	●	○	●	●	○	◖	13,400,000
*4A) Bypass	N/A	◖	●	○	●	●	○	◖	14,700,000
*5) Raised Roadway with Intermittent Channel Crossings	N/A	◖	◖	◖	◖	◖	◖	●	2,900,000
*6) Raised Roadway on Permeable Embankment	N/A	◖	◖	◖	◖	◖	◖	●	2,200,000

● = best meets objective; ◖ = partially meets objective; ○ = does not meet objective

Note: Alternatives 3), 4), 4A), 5), and 6) would address both the Newton Creek and Clark Creek sites.



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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

NEWTON CREEK - MP 67.25
(2001 PHOTO)
Figure 6.5.1

SHEET 1 OF 1

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6.6 Narrows (MP 73)

Refer to Figures 6.3.4, 6.3.5, 6.6.1, and 6.6.2 for a graphical depiction of the following alternatives.

1. Maintain Existing Condition

Description:

Under this alternative, the existing riprap armor along the riverbank and the rock fall barriers and ditch would be maintained on a regular basis, as is the current practice. This would require periodic monitoring of road conditions and making repairs as needed, especially following large flood events. The riprap embankment would be inspected after each major storm. Rock fall would be monitored more frequently during the winter and spring months when frost and groundwater levels are highest. The rock fall ditch would be cleaned on a regular basis to remove accumulated material so that it can be maintained as deep as possible to maximize rock fall retention. Based on an event similar to the 2001 flood event ($75,000) occurring once every two years, the estimated cost for a 20-year period is expected to be approximately $750,000.

Analysis:

The roadway would be reduced to a single lane and traffic control measures would be implemented, during maintenance of the rock fall ditch. The embankment riprap would normally only require maintenance after a large event. However, inspection after all high water events and the completion of minor repairs as needed could prevent the loss of large quantities of bank protection riprap. Due to the location of this alternative along the existing alignment, no impacts to terrestrial habitat, recreational, or cultural resources are anticipated. This alternative would not enhance river functions at this site. The practice of placing riprap into the river would continue to impact fish habitat and the transport of woody debris, and would incrementally narrow the existing river channel. Although the Narrows is of relatively low importance compared to the other sites for fisheries, it is a migration corridor and an important transport corridor for moving large woody debris farther downstream. Continued maintenance of the roadway immediately adjacent to the river could result in sanding gravels or hazardous materials entering the river.

This alternative would protect the roadway from events similar to the last large event but would not be effective against larger events. Major debris flows could still damage the roadway due to the narrow constriction of the river channel in the Narrows. Continued roadway and embankment maintenance would be required after each major event.

2. Raised Roadway with Retaining Wall

Description:

Under this alternative, an approximately 500 meter (1700 feet) long retaining wall would be constructed along the eastern side of the river. Construction of the wall would involve raising the road by approximately 2-3 meters (6-10 ft) in some areas. The retaining wall footing would need to be placed below the streambed elevation or to bedrock, whichever is shallower, to prevent scour and undermining of the footing. Construction of the wall foundation below the stream elevation would require the construction of cofferdams and a dewatering system. The lower portion of the roadway in the Narrows is near flood elevation; therefore, the road grade would need to be raised at that location. The face of the wall would be located at the same location as the current toe of the embankment and the roadway would be shifted to the west without additional stream encroachment while providing a wider rock fall ditch on the east side of the roadway.

The retaining wall would be a concrete cantilever wall, or a mechanically stabilized earth (MSE) wall or soldier pile wall with concrete facing to protect the wall from battering by stream born debris and boulders during flood stage. As the wall would present a vertical drop-off to the river, guardrail would be required along its full length. The wall would be approximately 500 meters (1700 feet) in length and a height of 6 meters (20 feet). Cost for this alternative is estimated to be $6,700,000. The time frame for project development (design, environmental compliance, and permitting) is expected to be 2 – 4 years. Construction is expected to take place over 1 – 2 years.

Analysis:

The construction of a wall would require in-stream work along the entire roadway and would require the road to be closed to traffic. The wall could be difficult to build due to the frequency of flash flood events. A concrete cantilevered retaining wall, concrete-faced MSE, or soldier pile wall would be required in the high-energy environment of the Narrows. Specialized construction techniques would be required for below-water construction of the wall footing. There would be a high risk of rock fall damage to the railing.

The retaining wall alternative would maintain the current stream width while allowing the roadway to be moved farther west. Moving the roadway west would facilitate widening the rock fall ditch, which would enhance safety through this area. Due to the location of this alternative along the existing alignment, no impacts to terrestrial habitat, recreational, or cultural resources are anticipated. This alternative would not enhance river functions at this site and would require substantial in water work. This alternative would also result in a smooth wall face on the eastern side of the river, thus reducing habitat complexity (such as pockets of calmer water) for fish migrating through the corridor. Adding features of roughness, such as large riprap, could be used to mitigate for the reduction in habitat complexity. Continued maintenance of the roadway immediately adjacent to the river could result in sanding gravels or hazardous materials entering the river.

A retaining wall would protect the roadway from events similar to past flows, but might not protect it from larger flows that could damage the wall. These repairs would be expensive. The retaining wall and higher road grade elevation would increase the capacity of the channel.

3. Half-Bridge

Description:

Under this alternative, an approximately 750 meter (2500 foot) half-bridge would be constructed in the Narrows. The bridge would have its foundation along the eastern side of the canyon and would cantilever out over the river with piers for support. This would increase stream width by approximately 5 meters (16 feet). The construction of this alternative is expected to be extremely difficult. The bridge footing would need to be placed below the streambed elevation on bedrock, to prevent scour and undermining of the footing. Bridge rail would be included. Cost is estimated to be $16,000,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 3 – 5 years. Construction is expected to take place 1-2 years.

Analysis:

This alternative would be at high risk of damage due to rock fall. Rock falls pose a serious risk of causing extensive structural damage to the deck of a half-bridge. This damage would be time-consuming and expensive to repair. Construction of a half-bridge would require substantial in-water work and cause short-term impacts. In the long-term this alternative would improve floodplain functions by increasing stream width by approximately 5 meters (16 feet). This alternative would also result in a smooth wall face as part of its foundation on the eastern side of the river, thus reducing habitat complexity (such as pockets of calmer water) for fish migrating through the corridor. This could be mitigated for by adding features of roughness (large riprap). Continued maintenance of the roadway immediately adjacent to the river would result in the possibility of sanding rock or hazardous spill materials entering the river.

Because a half-bridge would encroach upon the east face of the canyon wall, this alternative has the potential to impact a protected plant species (*Suksdorfia violacea*) species (listed on the 1999 R6 Sensitive Species List (Mount Hood Forest Plan)) and Pete's Pile rock climbing site. Pete's Pile is a popular climbing site and has been identified by the USFS as the most important recreational site within the study area due to its irreplaceable nature.

This alternative would have handled the last large event. A half-bridge would also enlarge the channel and provide increased capacity and protection similar to the retaining wall. However, during very high water events, battering by boulders might damage the structure. Continued minor maintenance of the structure would be necessary on a regular interval and some sections could require major reconstruction following very large events.

Viaduct

A modification of the half-bridge option, a viaduct, was also considered but was determined not to be feasible and therefore eliminated from further consideration. Under this alternative, a concrete viaduct on pile-supported piers would be constructed through the Narrows. The pier-supported structure would allow the river to meander in and out of the piers. The piers would be supported by footings placed on bedrock, supported by drilled shafts or piles, the latter of which could be very difficult and expensive to install through the large boulders in the streambed. The piers would be at high risk of damage from high-energy stream-born debris and the bridge deck would also be at high risk of damage from rock fall.

4. Bypass on 44 & 17

Refer to Figures 6.1.4 and 6.1.5 (in the Section on White River).

<u>Discussion:</u>

This alternative bypasses the Narrows, Polallie, Dog River and Baseline sites using existing roadways. The southern extent of the bypass begins at the intersection of FS 44 with Highway 35 at approximately MP 70.7. It extends northeasterly until it connects with FS 17 at a "T" intersection. The bypass then follows FS 17 northerly, paralleling Highway 35 to the east. The bypass connects back into Highway 35 at approximately MP 91.3. The total bypass length is approximately 32.8 km (20.4 miles).

The roadway width and surfacing of FS 17 varies from a single lane gravel road to a two-lane paved roadway. Total reconstruction of the roadway, including aggregate base, surfacing, ditches, and side slopes would be necessary to permanently relocate the Highway 35 over this route. The pavement thickness would need to be increased to accommodate truck loadings. The portion of FS 44 that would be utilized on this alternative is wider than FS 17, but would also require reconstruction.

This alternative would include upgrading FS 44 and 17 to 'desirable' ODOT cross sectional standards, which would include widening the roadway, reconstructing roadside ditches and slopes, and providing adequate clear zones. The roadway surfacing would be reconstructed. The bypass alternative would have maximum grades of 6%. Of the 32.8 km (20.4 miles) along FS 17 and FS 44, approximately 11.4 km (7.1 miles) of the bypass would follow the existing alignment. Approximately 21.4 km (13.3 miles) would be realigned, either due to sharp horizontal curves or steep vertical grades. Sections of the roadway at the north end of FS 17 would be very difficult to reconstruct due to steep grades. The existing roadway would have to be maintained at least to the Forest boundary to provide access to the townships of Parkdale and Hood River, to private properties, and to Routson County Park. Whether ODOT or Hood River County maintained jurisdiction for this portion of the roadway would need to be resolved. Approximately 5 miles of Highway 35, from the Forest boundary to the southern end of the bypass, would be removed. This alternative would include fish passage improvements to 8 - 9 existing stream crossings along the route. Cost is expected to be $53,300,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 3 – 5 years. Construction is expected to take 3 - 4 years.

<u>Analysis:</u>

This alternative is expected to impact several local economies, private landowners, recreational and cultural resources, water quality in the Dalles Watershed, and LSR. It is also expected to have visual impacts due to the construction of steep hillside cuts. Approximately 2 miles at the northern end of the bypass and 1.5 miles at the southern end pass through areas designated as having high landslide risk.

This alternative is expected to impact the economies of the communities of Parkdale and Mount Hood plus businesses that are currently located along Highway 35, and which are dependent on the highway traffic for their livelihood. This alternative would affect 15 - 20 residences located along the northern ¾ mile of the bypass plus residences located on Highway 35. The need to maintain most of the existing highway for access would increase the amount of road maintenance for ODOT or Hood River County and would not enhance the EFHR floodplain throughout this reach of the river. Removal of 8 km (5 miles) of highway from the Forest boundary south would impact the following recreation sites: Dog River Trail, Pete's Pile, Little John Sno-Play, Nottingham Campground, Gibson Prairie Horse Camp, Surveyors Ridge trail, Sherwood Campground, Elk Meadows and Tamanawa Falls trailheads. Maintaining access to the Coopers Spur Ski Area may also be an issue, although an alternative access route from Parkdale is available. Camp Baldwin (Boy Scouts of America) is located off FS 44 and could be affected by changing use levels on the road. Within the National Forest, this alternative passes through land designated as scenic viewshed, wood products emphasis, and LSR. It also bisects and runs adjacent to a Tier 1 Key Watershed (The Dalles Watershed). The bypass could reduce water quality due to possible contamination by road-associated pollutants and the increase of fire risk in the Dalles Watershed. Furthermore, a section of the route parallels a stream and the Dog River aqueduct passes through FS 17. Other land uses adjacent to the road that would be impacted by this alternative include a long prairie grazing allotment to local ranchers and Brookes Meadow. Known cultural sites are present along the route. Minor wetland impacts are anticipated. This alternative would result in approximately 6.7 km (4.2 miles) of out of direction travel and an additional 6 minutes of travel time.

This bypass would add additional length and therefore increase maintenance costs for ODOT. The steep grades and higher elevation would require considerably more roadway maintenance during the winter months, including increased snow removal and additional sanding, than is currently required for Highway 35. The added roadway length would increase normal long-term summer maintenance programs such as chip sealing.

The bypass would eliminate the problem of debris flows damaging the roadway for the Narrows and Polallie Creek. However, the roadway at the Dog River and Baseline sites would still be vulnerable to damage from debris flows.

5. Bypass to West

Description:

This alternative addresses both the Polallie Creek site and the Narrows site. Under this alternative, the roadway would be relocated to the western side of the river, bypassing the Narrows site. The bypass would extend from the southern end of the Narrows to the northern end of the Polallie Creek site and would be approximately 2,700 meters (9,000 feet) long. This alternative would involve the construction of new roadway and three bridges (at the EFHR, Polallie Creek, and Cold Spring Creek). The roadway would be located on the hillside and grades would be a maximum of 6%. Long high bridges would be required at the river crossings. The bridges at the EFHR and Cold Spring Creek crossings would each be approximately 120 meters (400 feet) long. At Polallie Creek, a 90-meter (300 foot) bridge would be constructed approximately 60 meters (200 feet) upstream from the existing culverts. The Cooper Spur Road intersection would also be reconstructed to match the new Highway 35 grade. Once the new roadway was constructed, the bypassed section of Highway 35 would be completely removed. Cost is estimated to be $14,100,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 3 – 5 years. Construction is expected to take 1-2 years.

Analysis:

This alternative would eliminate the rock fall problem on the existing highway and would restore floodplain functioning of the EFHR through the Narrows to north of Polallie Creek. This alternative would also restore floodplain functioning (including fish passage) in Polallie Creek by removing the existing culverts and placing the crossing above the zone of alluvial deposition. The ODFW and NMFS rate Polallie Creek as a high priority for fish passage restoration work within the watershed. The southern portion of the bypass traverses areas designated as having high landslide risk. As this alternative involves work along a new alignment impacts to large tracts of terrestrial habitat, wildlife, the noise environment, and cultural, recreational, and visual resources are anticipated. Known spotted owl nest sites are located within the area of the bypass. This alternative is located within matrix and scenic veiwshed designated areas. Sections of it would traverse a currently 'unroaded" area. No wetland impacts are anticipated. This alternative would require large cuts, particularly in the vicinity of Polallie Creek, and would change the aesthetics of the Narrows area. Views from within the canyon would be lost; however, new views would likely be provided from the bypass. This alternative would move the roadway out of the canyon and onto the canyon ridge closer to the Mount Hood Wilderness, which may change the noise environment in the wilderness. This alternative would impact access to Pete's Pile, however, Pete's Pile is also accessible from the Dog River trail located above the climbing site. The Elk Meadows Trail is located on the ridge on the western side of the EFHR and would be directly impacted by this alternative. This alternative is expected to improve water quality by moving the road away from the river, thereby reducing the amount of sanding rock and other road-associated pollutants that enter the river. This alternative would improve safety by eliminating the hazard of rock fall in the Narrows and the risk of motorists being caught in a debris flow emanating from Polallie Creek. The bypass would not add roadway length or travel time to the existing route.

This alternative would have handled the last large event. The longer structures would provide better debris flow passage, adequately passing all but a massive debris flow. Moving the roadway beyond the channel would eliminate the need for continued maintenance along the river after major debris flows.

Analysis Relative to the Study Objectives

A matrix rating the Narrows alternatives relative to the objectives is shown below. The alternatives that best meet the objectives and that are recommended for further evaluation are identified with an astrix. Cost information is also provided (more detailed cost data is provided in Appendix B). The rational used in rating the alternatives relative to the objectives is provided in Section 1.1.3.

Alternatives for The Narrows / **Objectives**	Enhance & protect the WR WSR	Enhance the natural floodplain	Minimize impacts to visual resources	Minimize impacts to terrestrial habitat	Reduce maintenance & emergency repair	Improve safety	Optimize life cycle costs	Maintain travel time	**Estimated Cost ($)**
1) Maintain Existing Condition	N/A	○	◖	●	○	○	◖	●	750,000 / 20 yrs
2) Raised Roadway with Retaining Wall	N/A	○	◖	●	◖	◖	○	●	6,700,000
3) Half-Bridge	N/A	◖	◖	○[6]	◖	◖	○	●	16,000,000
4) Bypass on 44 & 17	N/A	●	◖	○	○	●	○	◖	53,300,000
*5) Bypass to West	N/A	●	◖	○	●	●	○	●	14,100,000

● = best meets objective; ◖ = partially meets objective; ○ = does not meet objective

Note: Alternative 5) would affect both the Polallie and Narrows site; Alternative 4 would affect four sites (Narrows, Polallie, Dog River, and Baseline).

6 This alternative would impact a rare plant growing on the east canyon wall.

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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

NARROWS/CANYON - MP 73
(1995 PHOTO)
Figure 6.6.1

SHEET 1 OF 1

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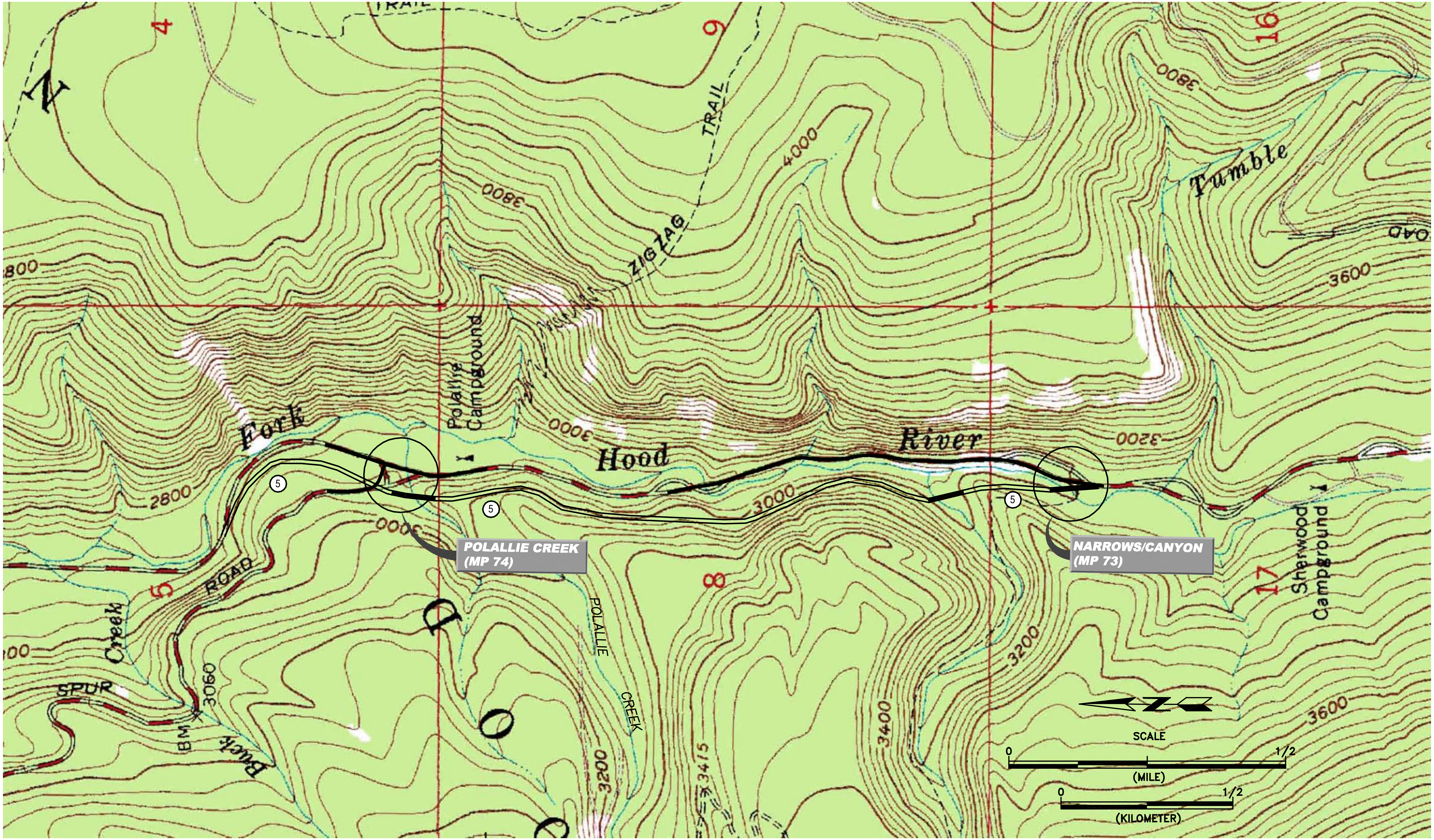

BY	DATE	REVISION DESCRIPTION

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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

NARROWS/CANYON TO POLALLIE CREEK
HIGHWAY 35 REALIGNMENT
Figure 6.6.2

SHEET 1 OF 1

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6.7 Polallie Creek (MP 74)

Refer to Figures 6.3.4, 6.3.5, 6.6.2, and 6.7.1 for a graphical depiction of the following alternatives.

1. Maintain Existing Condition

Description:

Under this alternative, the existing condition would be maintained, as is the current practice. This would require periodic monitoring of road conditions and making repairs as needed, especially following large flood events. In the event that a debris flow did destroy the culverts, ODFW would require that they be replaced with a structure that allows for fish passage. Based on an event similar to the 1997 debris flow ($20,000) occurring once every two years, the estimated cost for a 20-year period is expected to be approximately $200,000.

Analysis:

This alternative would not impact terrestrial habitat, wildlife, the noise environment, recreational, or cultural resources over the short term. However, debris flows would continue to be a hazard to road users and access to Coopers Spur during a debris flow would continue to be impacted. Floodplain functions (including fish passage) would not be improved and the continued maintenance of the channel would impact aquatic habitat and species. Long-term emergency repair issues along this section of the highway would be the same as the current condition. This alternative did not handle the last large event. Major roadway clean up and channel re-shaping would be necessary after each event.

2. Debris Control Structure

Description:

Under this alternative, a debris control structure would be constructed within the Polallie Valley approximately 120 meters (400 feet) upstream from the existing culverts. The structure would act to trap large debris flows in the catch basin behind the structure. The structure would be designed to allow fish passage. Cost is estimated to be $3,100,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 2 – 4 years. Construction is expected to take place over 1 - 2 years.

Analysis:

Debris control structures and associated catch basins have been successfully used in similar settings in Japan, Switzerland, and Canada (refer to photographs given in Appendix A). The structure would require maintenance to keep it cleared of debris and would be difficult to build due to the flash flood events that occur regularly on this stream. Removal of debris is also expected to be difficult due to the limited access to the narrow canyon. Environmental impacts are expected both during the construction of the structure and as a result of the continued maintenance needs. Both of which would require work to take place in the stream channel. The structure would also prevent debris (important to flood plain functioning) from being maintained within the floodplain. This alternative would not enhance the floodplain or improve fish passage at the existing culverts. The ODFW and NMFS rate Polallie Creek as a high priority for fish passage restoration work within the watershed. The northern spotted owl is present within 0.5 miles of the existing road and construction/maintenance activities would have to take place outside the breeding season. Land in this area is designated as matrix and scenic viewshed. This alternative is expected to be a visual intrusion on the landscape. Minor impacts to the Elk Meadows trail are also anticipated.

This alternative would be designed to protect against similar past events and would protect the roadway. However, extensive maintenance would be needed after each event within the channel to remove the debris trapped during the event. A very large waste area would be needed to deposit the excavated material after each event. It would also require a large amount of in-stream work after each large event.

3. Realign Road and 90m Bridge

Description:

Under this alternative, the roadway would be realigned and moved approximately 60 meters (200 feet) upstream from the existing culverts. A 90-meter (300 foot) bridge would be constructed to cross Polallie Creek on the new alignment. This alternative would require approximately 1000 meters (3300 feet) of roadway re-construction in addition to the new bridge and would create steep grades at the bridge approaches. The Cooper Spur Road intersection would also be reconstructed and would tie into Highway 35 north of the crossing. Cost is estimated to be $3,500,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 2 – 4 years. Construction is expected to take 1 - 2 years.

Analysis:

This alternative would enhance floodplain functioning (including fish passage) and would better allow the passage of debris flows as compared to the existing structure. The ODFW and NMFS rate Polallie Creek as a high priority for fish passage restoration work within the watershed. Although the bridge would not be located completely out of the depositional zone of the river, it would be located at a narrow section of the alluvial fan. It would therefore be more effective at passing debris flows and be at lower risk of damage as compared to structures located farther downstream. Construction would require in water work. Construction may affect the northern spotted owl, as nest sites are located within 0.5 miles of the site. Land in this area is designated as matrix and scenic viewshed. The roadway construction for this alternative would require some significant cuts to move the roadway upstream and is expected to impact the visual qualities of the area as well as terrestrial habitat.

Moving the roadway upstream to the mouth of the canyon would allow for the passage of all but a massive debris flow event. Minor maintenance may be required after major events to remove some debris at the piers.

4. Bypass on 44 & 17

Refer to The Narrows - Alternative 4.

5. Bypass to West

Refer to The Narrows - Alternative 5.

6. 30m Bridge Existing Alignment

Description:

Under this alternative, the existing culverts would be replaced with a 30-meter (100 foot) clear span bridge. The vertical grade of the bridge would be raised to facilitate the passage of debris. The bottom of the girders would be at the current roadway height or slightly higher. This alternative would also require the reconstruction of approximately 600 meters (2000 feet) of roadway to tie it into the higher grade of the bridge. The Cooper Spur Road intersection could remain essentially at the same location, but would be raised to meet the new Highway 35 grade. Cost is estimated to be $1,400,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 1 – 3 years. Construction is expected to take 1 year.

Analysis:

This alternative would enhance the floodplain and allow fish passage into Polallie Creek. The ODFW and NMFS rate Polallie Creek as a high priority for fish passage restoration work within the watershed. This alternative is expected to reduce but not eliminate emergency repair costs at this site as it would replace the existing culverts (which are hardened and have survived a past event) with a bridge structure located within the depositional zone of the stream. Due to its location, the bridge is expected to be susceptible to damage. Construction would require in water work. Construction may affect the northern spotted owl, as nest sites are located within 0.5 miles of the site. Land in this area is designated as matrix and scenic viewshed. This alternative is not expected to impact the visual qualities of the area.

This alternative may have handled the last large event. However, the existing alignment crosses the middle of the depositional fan of the streambed and the stream could jump channel and by-pass the bridge during larger events. A bridge would provide debris flow passage in all but extremely large events. Continued maintenance may be required after debris flows similar in size to past large event in order to maintain the stream channel at its current location.

7. Two 30m Bridges (Highway 35 and Realigned Approach)

Description:

Under this alternative, the existing culverts would be replaced with a 30-meter (100 foot) clear span bridge and the Cooper Spur Road would be re-aligned. The re-alignment of Cooper Spur Road would involve constructing an additional clear span bridge over Polallie Creek upstream of the existing culverts. Coopers Spur Road would then connect into Highway 35 south of the Highway 35 crossing. Both structures would be approximately 30 meters (100 feet) in length. The estimated length of roadway realignment on Highway 35 is approximately 600 meters (2000 feet) and the estimated length of roadway realignment on the Cooper Spur Road is approximately 300 meters (1000 feet). The bridges could be constructed using normal construction practices and could be built with the existing roadway in place either by shifting the alignment slightly or by utilizing a temporary portable detour bridge if the existing alignment was maintained. Cost is estimated to be $2,500,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 2 – 4 years. Construction is expected to take place over 1 - 2 years.

Analysis:

This alternative is expected to reduce but not eliminate emergency repair costs at this site. This alternative would replace the existing culverts (which are hardened and have survived a past event) with two bridge structures located within the depositional zone of the stream. Due to their location, the bridges are expected to be susceptible to damage. Construction would require in water work. Construction may affect the northern spotted owl, as nest sites are located within 0.5 miles of the site.

This alternative would enhance the floodplain and allow fish passage into Polallie Creek. The ODFW and NMFS rate Polallie Creek as a high priority for fish passage restoration work within the watershed. Land in this area is designated as matrix and scenic viewshed. This alternative is not expected to impact the visual qualities of the area.

A bridge of this size at these crossings may not have handled the last large event as the stream could jump channel and could by-pass the bridge. The river could jump channel after leaving the Coopers Spur Road bridge If the stream stayed within the channel, the bridges would allow for the passage of events similar to past flows, but would require continued maintenance within the channel to keep the stream located beneath the structure on Hwy 35. Larger events could damage the structures.

8. Raise Roadway and 90m Bridge Existing Alignment

Description:

Under this alternative, the existing culverts would be replaced with a 90-meter (300 foot) three-span structure with a long center span over the riverbed. Coopers Spur Road would be re-aligned to tie into Highway 35 north of the crossing (an additional crossing of Polallie Creek is not proposed under this alternative). The new bridge would be placed on the same Highway 35 alignment, but would be raised 2-3 meters to allow for sufficient clearance over the stream for debris flows. This alternative would require the reconstruction of approximately 600 meters (2000 feet) of roadway to match the higher bridge grades. Cost is estimated to be $3,200,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 2 – 4 years. Construction is expected to take place over 1 - 2 years.

Analysis:

A detour would be required for this alternative and could be placed on either side of the existing highway. This alternative would enhance floodplain functioning (including fish passage) and would better allow the passage of debris flows as compared to the existing structure. As the bridge would be located within the depositional zone of the river, it would be at risk of damage during larger debris flows. Construction would require in water work. Construction may affect the northern spotted owl, as nest sites are located within 0.5 miles of the site. Land in this area is designated as matrix and scenic viewshed. This alternative is not expected to impact the visual qualities of the area. The ODFW and NMFS rate Polallie Creek as a high priority for fish passage restoration work within the watershed.

A larger structure on Hwy 35 would greatly reduce the risk of the river bypassing the bridge after leaving the canyon and would have handled the last large event. However, due to the nature of the depositional fan of the river, it is possible that the river could still jump channel before the Hwy 35 crossing. The alternative would be adequate for all but extremely large events.

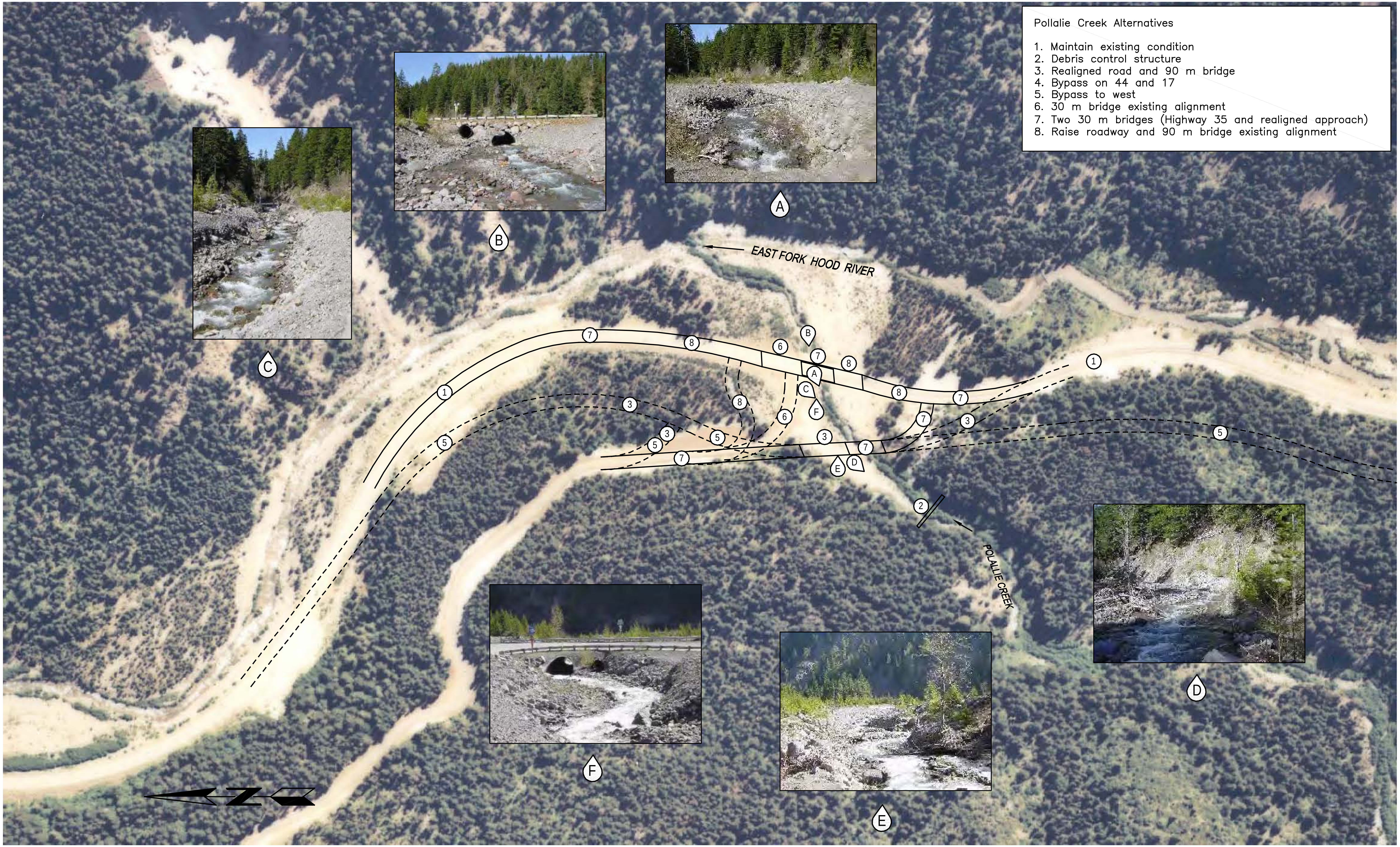
Analysis Relative to the Study Objectives

A matrix rating the Polallie Creek alternatives relative to the objectives is shown below. The alternatives that best meet the objectives and that are recommended for further evaluation are identified with an astrix. Cost information is also provided (more detailed cost data is provided in Appendix B). The rational used in rating the alternatives relative to the objectives is provided in Section 1.1.3.

Alternatives for Polallie Creek / **Objectives**	Enhance & protect the WR WSR	Enhance the natural floodplain	Minimize impacts to visual resources	Minimize impacts to terrestrial habitat	Reduce maintenance & emergency repair	Improve safety	Optimize life cycle costs	Maintain travel time	**Estimated Cost ($)**
1) Maintain Existing Condition	N/A	○	◖	●	○	○	◖	●	200,000/ 20 yrs
2) Debris Control Structure	N/A	○	○	○	○	●	○	●	3,100,000
*3) Realign Road and 90m Bridge	N/A	●	◖	◖	●	●	○	●	3,500,000
4) Bypass on 44 & 17	N/A	●	◖	○	○	●	○	◖	53,300,000
*5) Bypass to West	N/A	●	◖	○	●	●	○	●	14,100,000
*6) 30 m Bridge Existing Alignment	N/A	◖	◖	●	◖	◖	○	●	1,400,000
*7) Two 30m Bridges (Highway 35 and Realigned Approach)	N/A	◖	◖	◖	◖	◖	○	●	2,500,000
*8) Raise Roadway and 90m Bridge Existing Alignment	N/A	◖	◖	◖	◖	◖	○	●	3,200,000

● = best meets objective; ◖ = partially meets objective; ○ = does not meet objective

Note: Alternative 5) would affect both the Polallie and Narrows site; Alternative 4 would affect four sites (Narrows, Polallie, Dog River, and Baseline).



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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

POLALLIE CREEK - MP 73.82
(1995 PHOTO)
Figure 6.7.1

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6.8 Dog River (MP 78)

There are two distinct sites associated with this study area. However, the entire area is affected by a bend in the river and the natural tendency of the river to flow to the outside of the bend and against Highway 35. All alternatives relate to both sites. Refer to Figures 6.3.4, 6.3.5, 6.8.1, 6.8.2, 6.9.2, and 6.9.3 for a graphical depiction of the alternatives discussed below.

1. Maintain Existing Condition

Description:

Under this alternative the rock dikes installed by ODOT would be maintained and repaired as necessary. This would require periodic monitoring of road conditions and making repairs as needed, especially following large flood events. Based on an event similar to the 1999 debris flow ($75,000) occurring once every five years, the estimated cost for a 20-year period is expected to be approximately $300,000.

Analysis:

Due to the possibility of the river moving to a different location during the next large flood, the dikes could be rendered essentially ineffective for protecting the highway unless they were extended to cover the entire length of the roadway. This alternative would not improve floodplain functioning through this reach and would probably require the addition of more riprap into the river. Although this may aid in protecting the road, it would have negative impacts on the floodplain and its functioning. The NMFS and ODFW have indicated that they would not support an alternative that results in a net reduction in floodplain area. The NMFS and ODFW suggested that it would be better to move the dikes as far out of the river as possible (armor the road rather than the river) and stated that removing the dike material located farthest from the road could be part of ESA emergency consultation. In other words, the road would be repaired under the condition that the dike material is removed from the body of the river.

This alternative would not impact terrestrial habitat, wildlife, the noise environment, recreational, or cultural resources over the short term. However, floods / debris flows would continue to be a hazard to road users. Unless dike material is removed from the body of the river, floodplain functions (including fish passage) would not be improved. The continued maintenance of the channel would impact aquatic habitat and species. Long-term emergency repair issues along this section of the highway would be the same as the current condition.

This alternative would probably not be capable of handling the last large event. The existing dikes are only capable of redirecting the flows during smaller events as long as the channel remains at its current location. Any movement of the channel would render these dikes ineffective. Continued maintenance of the roadway would be required after each large event. This could vary from minor maintenance to complete rebuild of sections of the roadway.

2. Realign to East

Description:

This alternative addresses the Dog River and Baseline Sites. Under this alternative, the road would be realigned to the east from its intersection with Baseline Drive and would end just prior to the EFHR Bridge, south of the Dog River crossing. An estimated 3,900 meters (12,800 feet) of Highway 35 would be relocated farther east, to the outside edge of the floodplain.

At the northern (Baseline) end of the re-alignment (1250m/4100ft), the road would be constructed on an existing uniform bench. Construction would involve standard highway construction practices and the resulting cuts would be similar to the existing cuts due to the presence of a fairly uniform bench on the eastern side of the highway. Once the new roadway is completed, the old road section would be removed slightly above the existing main channel to maintain the low flow channel while allowing the high water channel to flow over the bank, eliminating the need for in water work.

At the southern (Dog River) end of the re-alignment (2600m/8500ft), it is proposed to raise the highway on a rock fill base. Placing the highway farther up the hillside is not recommended, as existing steep slopes would result in large unstable cut slopes. This alternative would maintain the highway above the elevation of the river and would allow the rock base to armor the roadway. It is estimated that the roadway would be elevated approximately 3 – 5 meters (10 - 15 feet) above the existing floodplain. The twin box culverts at Dog River would be replaced with a small bridge to provide a trapezoidal clear channel through this opening. The structure would be approximately 15 - 20 meters (50 - 65 feet) in long, depending on the height of the roadway above the river. The reconstruction of this portion of the roadway could be accomplished while maintaining traffic on the existing road. Dog River would need to be detoured during bridge construction. Once the new roadway is completed, the old road section would be removed slightly above the existing main channel to maintain the low flow channel while allowing the high water channel to flow over the bank, eliminating the need for in water work. Cost is estimated to be $5,400,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 2 – 4 years. Construction is expected to take 1 – 2 years.

A variation of this alternative would be to move the road eastward (away from the river) incrementally after each washout event. Thus, rather than putting the road back in exactly the same location, it would be moved away from the river as much as possible (perhaps by half a lane width, for example), in general, employing the principle that the floodplain should be kept as wide as possible.

Analysis:

A geotechnical investigation would be required to determine slope stability and design options for minimizing short and long-term erosion impacts. This alternative would allow the EFHR to utilize the full width of its floodplain, however, the river would continue to meander within its floodplain and is likely to run adjacent to the highway in the future. Armoring the roadway (or adding barbs) would protect it from future scouring which should be less damaging than the current condition due to the river's restored ability to meander and dissipate energy. Therefore, this alternative is expected to reduce long-term emergency repair and maintenance needs along this section of the highway. This alternative would impact the Dog River trailhead, private property, and mature vegetation located on the eastern side of the road. Access would need to be maintained to private properties located at the northern end of the realignment. Impacts to the EFHR would be minimal, as the construction would be completed outside the active floodplain; however, work at the Dog River crossing would require in water work. Replacement of the existing Dog River crossing would enhance fish passage at this site. Under this alternative there would be not net gain or loss in the number of stream crossings. This alternative would not lengthen the highway or add travel time to the route.

This alternative would give the river the full use of the floodplain and would protect the roadway from all events similar to past flows. The roadway embankment would need to be heavily protected as the river channel can meander in different directions during events.

3. Realign to West

Description:

This alternative applies to both Dog River and Baseline. Under this alternative, the highway would be moved to the western side of the EFHR and would be located completely beyond the river's floodplain. The bypass would extend from north of Baseline Drive to south of the EFHR crossing (south of Dog River). Two bridges would be removed from the stream channel. One would be the Highway 35 Bridge over the EFHR (south of Dog River) and the other would be the Baseline Road Bridge over the EFHR.

The Dog River crossing would also be removed under this alternative. One new bridge would be constructed at the northern most end of the bypass. It would be at a high elevation due to the highway elevation in this location and would be approximately 90 meters (300 feet) in length. The proposed length of realignment is approximately 4,500 meters (15,000 feet). The majority of this area is in private ownership and access would be maintained using portions of the existing roadway or by constructing a lower standard single lane access road farther east of the existing road (at the outside edge of the floodplain). Cost is estimated to be $8,200,000. The time frame for project development (design, environmental compliance, and permitting) is expected to be 2 – 4 years. Construction is expected to take 1 - 2 years.

Analysis:

This alternative would avoid future emergency repair needs along this stretch of the highway. This alternative would not allow the river to utilize the entire width of its natural floodplain, as the existing roadway would be maintained for access to private property. The location of the proposed new alignment would be through a mixture of woodland and farm fields. Construction through this area would have to address right of way issues but should otherwise be relatively straightforward involving standard highway construction techniques. The entire road section would be built while traffic is maintained on the existing roadway and there would be little impact to the traveling public. Construction would impact terrestrial habitat and may have to take place outside the spotted owl nesting period and within in water work periods. As a result of this alternative, the Dog River trailhead would probably need to be moved to the southeast side of Dog River to facilitate access to it and allow as much of the existing highway (including the crossing of the EFHR) as possible to be removed. Under this alternative three stream crossings (at Dog Creek and two crossings of the EFHR) would be removed and would be replaced with one crossing of the EFHR. This would be a benefit to floodplain functioning, water quality, and fish habitat. This alternative would not lengthen the highway or add travel time to the route.

This alternative would handle all future events as it substantially removes the highway from the river's floodplain, removes two structures overall, and opens the channel up to eliminate any other obstructions that may currently exist. The larger bridge at the end of the realignment would handle all but a massive debris flow event. Maintenance would be reduced to normal road maintenance efforts.

4. Bypass on 44 & 17

Refer to The Narrows – Alternative 4.

5. Barbs and Armor

Description:

Under this alternative, barbs (bendway weirs) would be constructed at bends in the river and along the edge of the highway to redirect the river back into the center of the stream channel. The barbs would be placed at angles pointing into the flow of the stream, forcing the water to cross over them in a perpendicular manner. The barbs would be constructed of large rock and would be tied into the rock armor at the bottom of the road embankment. Construction would consist primarily of machine placing riprap. The approximate length of rock armoring and barb construction at this site is 400 meters (1300 feet). Cost is estimated to be $260,000. In addition, it is estimated that the maintenance of the barbs and armor would cost approximately $40,000 every 5 years during their 20-year life span. The total estimated cost is therefore $420,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 1 – 2 years. Construction is expected to take 1 year. For a discussion on engineered logjams refer to the analysis below and Appendix B.

Analysis:

This alternative is expected to reduce emergency repair needs on the highway but would not improve floodplain functioning. This alternative is not expected to impact terrestrial habitat, wildlife, visual, cultural, or recreational resources. This alternative would not impede fish passage and would provide slow water, which could be utilized by fish. Root wads or other woody debris could be incorporated into the rock barbs to enhance fish habitat. Construction would involve in water work. At locations where the river is currently meandering away from the roadway embankment, construction would be undertaken in the dry. The NMFS and ODFW have indicated that they would not support an alternative that results in a net reduction in floodplain area. Therefore in order for them to support this alternative it would probably be necessary to combine it with an alternative that widens the existing floodplain. Widening the floodplain could be accomplished by constructing retaining walls to reduce roadway embankment within the floodplain.

The possibility of building the barbs from engineered log formations was considered but was determined not to be feasible for this site due to the high energy of the EFHR and subsequent likelihood of the barbs failing and causing damage downstream. Log formations usually require piling and cable connections to hold them in place during larger events. They also have the potential of causing damage to structures downstream if they fail, as they would be connected and travel as a mass rather than as individual logs (refer to Appendix B).

This alternative would be capable of handling an event similar to the last large event. Armoring the roadway would help protect the roadway from large events similar to past flows, but due to the relatively little difference in elevation between the roadway and the stream channel, the river could fill up and jump channel at numerous locations. The barbs would help redirect the flows during smaller events but the size of material carried in a larger event would destroy them. Maintenance would be reduced considerably for all but the extremely large events.

6. *Raise Road with Retaining Wall*

Description:

Under this alternative, the grade of the highway would be raised and a retaining wall built to protect the embankment and widen the floodplain. The length of the wall would be approximately 400 meters (1300 feet). The existing dikes would be removed once the wall had been constructed. Cost is estimated to be $3,000,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 1 - 2 years. Construction is expected to take 1 year.

Analysis:

The retaining wall would need to be strong enough to withstand the pounding of boulders and stream-born debris at flood stage. A concrete cantilevered wall is recommended for this environment. A welded wire-faced MSE retaining wall such as a Hilfiker™ wall would not be recommended at this site unless it were faced with CIP concrete or concrete panels. The footing of the wall would need to be placed below the scour depth of the stream and would need to be heavily armored. Either a spread footing wall foundation would be constructed below water or a driven pile or drilled shaft foundation would be required to support the wall.

No in water work would be required during the construction as the current dikes are keeping the river away from the roadway through this section. This alternative would widen the floodplain by about 10 meters (30 feet) through removal of the existing dikes, thus improving floodplain functioning through this bend in the river. However, this alternative would reduce fish habitat complexity adjacent to the wall, which could be mitigated for by inserting 'features of roughness' into the wall below OHW. This alternative is not expected to impact cultural or recreational resources. Impacts to vegetation are anticipated particularly as the wall would inhibit revegetation in the riparian corridor over the long-term.

Raising the roadway and adding a retaining wall would protect from events similar to the last large event but would only protect a small section of roadway. Other areas of the roadway would remain vulnerable. During larger events, the channel could shift to any location and similar repairs would be necessary at these sections of roadway. Very large events similar to past flows could carry debris that could also damage the retaining wall. This alternative would survive all but very large events at this location.

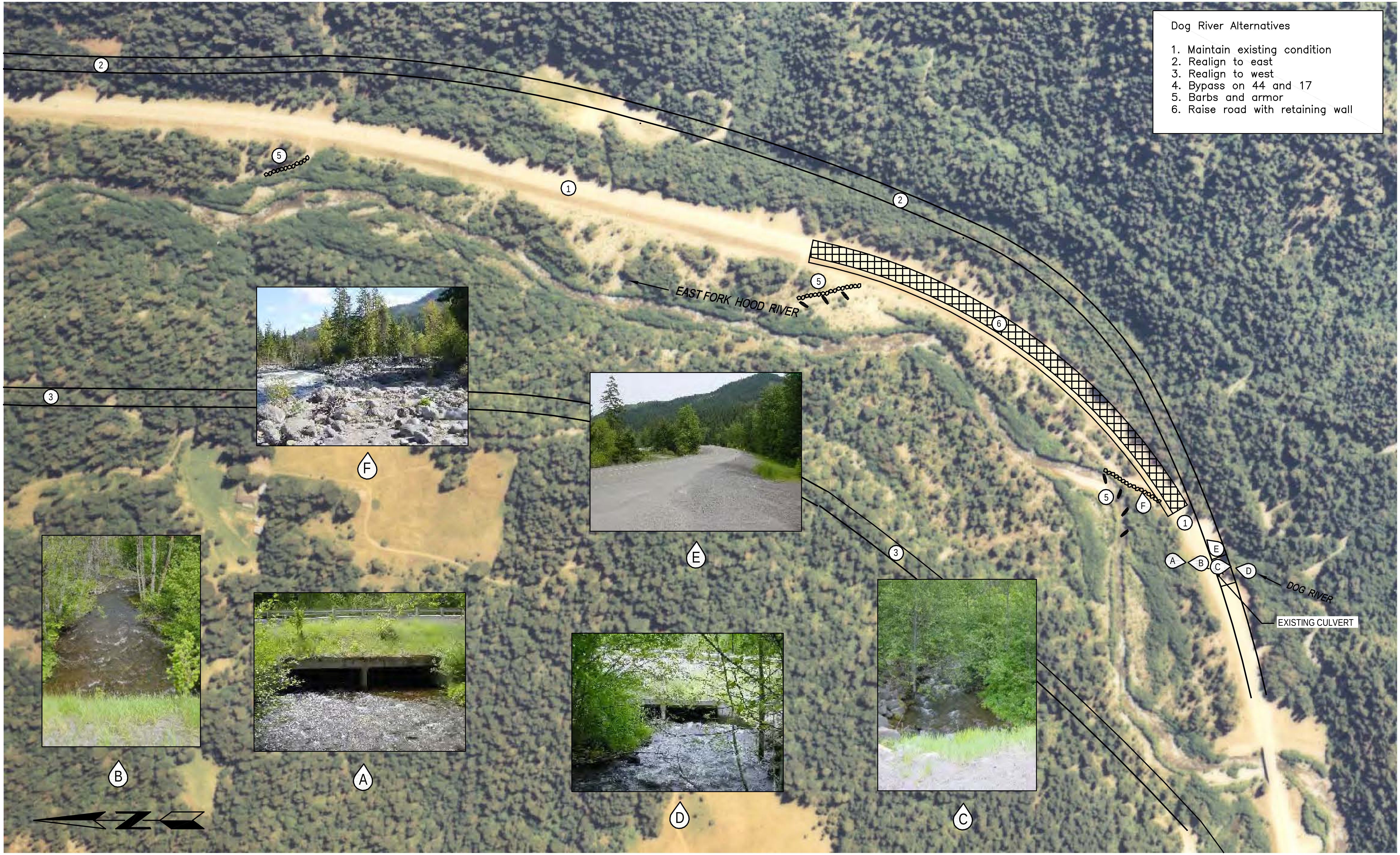
Analysis Relative to the Study Objectives

A matrix rating the Dog River alternatives relative to the objectives is shown below. The alternatives that best meet the objectives and that are recommended for further evaluation are identified with an astrix. Cost information is also provided (more detailed cost data is provided in Appendix B). The rational used in rating the alternatives relative to the objectives is provided in Section 1.1.3.

Alternatives for Dog River / **Objectives**	Enhance & protect the WR WSR	Enhance the natural floodplain	Minimize impacts to visual resources	Minimize impacts to terrestrial habitat	Reduce maintenance & emergency repair	Improve safety	Optimize life cycle costs	Maintain travel time	**Estimated Cost ($)**
1) Maintain Existing Condition	N/A	○	◖	●	○	○	◖	●	300,000/ 20 yrs
*2) Realign to East	N/A	●	◖	○	●	●	○	●	5,400,000
*3) Realign to West	N/A	●	◖	○	●	●	○	●	8,200,000
4) Bypass on 44 & 17	N/A	●	◖	○	○	●	○	◖	53,300,000
5) Barbs and Armour	N/A	○	○	●	◖	◖	◖	●	420,000
6) Raise Road with Retaining Wall	N/A	◖	◖	◖	◖	◖	○	●	3,000,000

● = best meets objective; ◖ = partially meets objective; ○ = does not meet objective

Note: Alternatives 2) and 3) would affect both the Dog River and Baseline sites; Alternative 4 would affect four sites (Narrows, Polallie, Dog River, and Baseline).



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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

DOG RIVER - MP 77.79
(1995 PHOTO)
Figure 6.8.1

SHEET 1 OF 1

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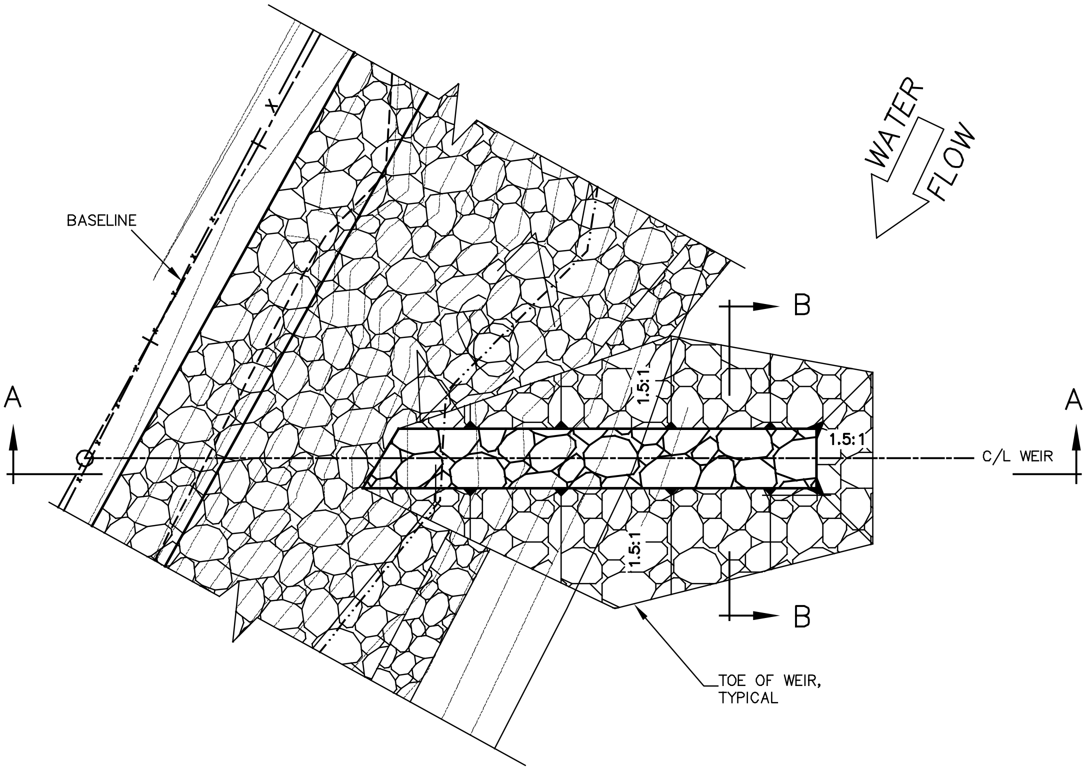
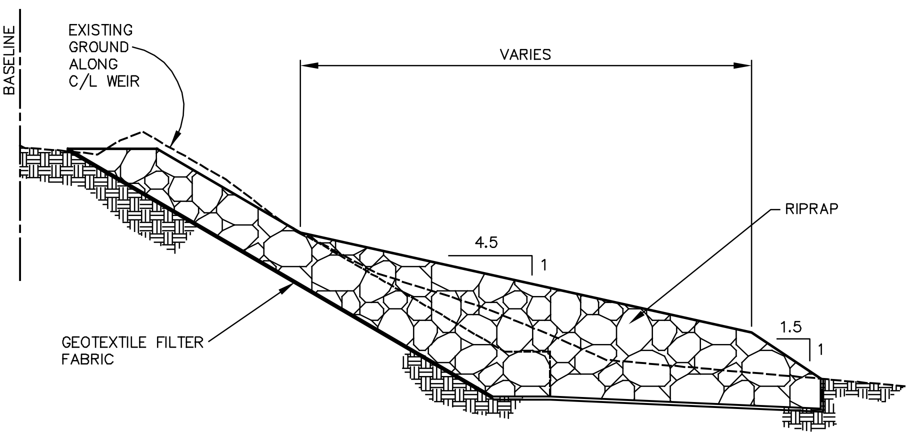
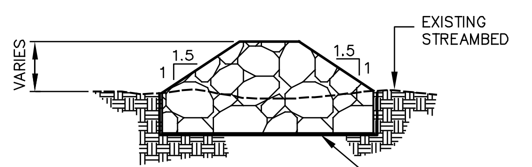
EXHIBIT 'A'



PLAN VIEW



SECTION A-A



SECTION B-B

BENDWAY WEIR DETAIL

NOT TO SCALE

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Figure 6.8.2

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6.9 Baseline (MP 80)

Two areas at Baseline have been problems in the past. The following alternatives are identified by these areas and are differentiated as 'Baseline - Site 1' and 'Baseline – Site 2'. Refer to Figures 6.3.4, 6.3.5, 6.8.2, 6.9.1, 6.9.2, and 6.9.3 for a graphical depiction of the alternatives discussed below.

Baseline - Sites 1 and 2:

1. Maintain Existing Condition

Under this alternative, the existing condition would be maintained, as is the current practice. This alternative would include maintaining the existing riprap embankment installed by ODOT at both Sites 1 and 2. This would require periodic monitoring of road conditions and making repairs as needed, especially following large flood events. Based on an event similar to the 1999 debris flow ($25,000) occurring once every two years, the estimated cost for a 20-year period is expected to be approximately $250,000.

Analysis:

This alternative would not impact terrestrial habitat, wildlife, the noise environment, recreational, or cultural resources over the short term. However, debris flows would continue to be a hazard to road users. Floodplain functions (including fish passage) would not be improved and the continued maintenance and repair would impact aquatic habitat and species. Long-term emergency repair issues along this section of the highway would be the same as the current condition.

Site 1 has received continued maintenance over the past several years, as can be seen by the different attempts to protect it. This ranges from normal riprap to poured concrete. The river bends at this location and the riprap has been placed to help turn the river back to the main channel. It is encroaching into the floodplain and will need additional maintenance in the future. The energy of the river is flowing against this embankment due to the curve in the channel. Additional riprap would encroach farther into the floodplain.

Site 1 would need continued maintenance after events similar to the last large event and large debris could significantly damage this section due to its protrusion into the floodplain. This would be similar to the past maintenance of adding additional riprap after each event.

The existing riprap embankment at Site 2 was installed after the last large flood event (1999) washed out a portion of the highway. Debris in the river diverted the water against the road embankment and approximately half of the roadway width was eroded away. The road was repaired by shifting the stream back to the main channel and large boulders placed on the outside of the embankment to protect against future floods. The river continues to flow against the riprap embankment through this section of the roadway. This alternative would not enhance floodplain functionality through this reach and would probably require additional riprap maintenance after large debris carrying flood events. The river could also divert above this section of riprap embankment and erode behind the protected section.

This alternative would be capable of withstanding an event similar to the last large event as long as the river does not divert above the riprap section. However, if the stream is blocked by debris and erodes the unprotected roadway above this section, the protected area would be compromised. Continued maintenance would be required after each large event and could vary from a minor amount of riprap replacement to entire roadway embankment replacement and protection.

2. Realign to East

Refer to Dog River - Alternative 2

3. Realign to West

Refer to Dog River - Alternative 3

4. Bypass on 44 & 17

Refer to Dog River - Alternative 4

Baseline - Site 1:

5. Riprap Bank

Description:

Under this alternative, additional riprap would be added to the bank to armor this location. Riprap would be keyed into the bottom of the streambed to further protect the bank. Very large rock would be needed as the river is flowing directly against this curve in the riverbank. The addition of two or three rock barbs integrated into the riprap armor are also recommended to help force the energy away from this point. Approximately 25 meters (80 feet) of bank would be armored. The cost of installing the riprap is estimated at $30,000 with additional maintenance requirements over a 20-year period estimated at $25,000 for each 2-year period. The total estimated cost is therefore $280,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 1 – 2 years. Construction should take place during 1 construction season.

Analysis:

This alternative would require in stream work or a temporary diversion of the stream while the riprap armor is keyed into the streambed. Short-term environmental impacts as a result of construction noise and in stream work are anticipated and no long-term environmental gains are expected. The NMFS and ODFW have indicated that they would not support this alternative as it results in a net reduction in floodplain area.

Protecting the embankment with large riprap at this location would have handled the last large event. The unprotected sections of the roadway would continue to remain vulnerable. This alternative does not improve the remaining portion of the roadway.

6. Realign and Riprap Bank

Description:

Under this alternative the small 'finger' that juts into the river would be removed to increase the width of the floodplain. The road embankment would also be strengthened with riprap. Approximately 45 meters (150 feet) of additional armoring would be required. Standard construction practices would be used. Material would be removed from the floodplain but would not be removed below the water level in order to avoid short-term erosion impacts. The estimated initial cost for realigning the bank and adding additional riprap is $40,000, with additional maintenance requirements over a 20 year period estimated at $25,000 for each 5 year period. The total estimated cost is therefore $140,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 1 – 2 years. Construction is expected to take place during one construction season.

Analysis:

This alternative would allow the river to utilize more of the floodplain but may not be a benefit to the road. The 'finger' currently acts to direct the river away from the road, and removing it is likely to cause the river to flow closer to the roadway between this site and the Baseline Bridge. This could also impact the bridge, as the river flow may no longer be aligned with it. The addition of barbs, integrated with the highway embankment armor, is also recommended at this location to keep the energy of the river away from the highway. This alternative may also cause existing riparian vegetation located between the 'finger' and the Baseline Bridge to be undermined as a result of bank erosion. It may also instigate the need for further road/bridge work in the vicinity of Baseline Road.

This alternative would protect this small segment of roadway from all but the very large events similar to past flows. However, it does not improve the remaining portion of the roadway and it would continue to be vulnerable.

<u>Baseline - Site 2:</u>

5. Retaining Wall

<u>Description:</u>

Under this alternative, the existing rock embankment would be replaced with a retaining wall to protect it and widen the floodplain. The estimated length of the wall would be approximately 240 meters (800 feet). Cost is estimated to be $1,700,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 1 - 2 years. Construction is expected to take 1 year.

<u>Analysis:</u>

The retaining wall would need to be strong enough to withstand the pounding of boulders and stream-born debris at flood stage. A concrete cantilevered wall is recommended for this environment. A welded wire-faced MSE retaining wall such as a Hilfiker™ wall is not recommended at this site unless it were faced with CIP concrete of concrete panels. The footing of the wall would need to be placed below the scour depth of the stream and would need to be heavily armored. Either a spread footing wall foundation would be constructed below water or a driven pile or drilled shaft foundation would be required to support the wall.

This alternative would provide a minimal increase in the floodplain width; however, this alternative would reduce fish habitat complexity adjacent to the wall, which could be mitigated for by inserting 'features of roughness' into the wall below OHW. This alternative is not expected to impact cultural or recreational resources. Impacts to vegetation are anticipated particularly as the wall would remove and inhibit the growth of riparian vegetation over the long-term.

Adding a retaining wall would protect this small section of the roadway from events similar to the last large event. Other areas of the roadway would remain vulnerable. During larger events, the channel could shift to any location and similar repairs would be necessary at these sections of roadway. Very large events similar to past flows could carry debris that could also damage the retaining wall. This alternative would survive all but very large events at this location.

6. Remove Island

Description:

Under this alternative the island located in the middle of the stream channel (and which currently forces the river against the road embankment) would be removed to river grade. This would be accomplished by direct haul from the western side of the river. The cost to remove the island is estimated at $170,000 with anticipated additional bank maintenance costs over a 20 year period of approximately $15,000 every 2 years. The total estimated cost is therefore $320,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 1 – 3 years. Construction is expected to take place during one construction season.

Analysis:

This alternative would allow debris to flow freely past this area and would allow the river channel to re-establish itself farther from the roadway. However, this would not improve natural floodplain functioning and would be a temporary solution to the emergency repair issues along this section of the highway. The river would continue to meander back and forth across the floodplain and is likely to re-establish islands of debris either in the same location or in another location, moving the problem. Construction would have sedimentation impacts and would also remove riparian vegetation. Removing the island is expected to modify the flow of the channel impacting the natural process of stream geomorphology. Protected fish species are present at this site and would be impacted by sedimentation and possibly by the loss of habitat complexity. Harlequin ducks are known to nest in this area and could also be impacted by this alternative.

This alternative would probably not be effective in handling an event similar to the last large event. This is a very local improvement and would only aid in keeping the river channeled away from the roadway at this location. This alternative does not protect the remaining portion of the roadway and even during very large events similar to past flows the meandering nature of the stream could shift against the roadway. Significant maintenance efforts are still very probable.

7. Viaduct

Description:

Under this alternative, an approximately 240 meter (800 foot) long viaduct would be constructed on the existing alignment, allowing the river to meander underneath the structure during high water events. Lowering the roadway to a point above the stream and constructing the substructure in the dry would avoid impacts to the river during construction. The river would be maintained in its existing channel during construction, but would be able to meander underneath the new structure during higher water events. Access to the bottom of the structure would be necessary to maintain the piers. Cost is estimated to be $9,200,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 3 – 5 years. Construction is expected to take 1 - 2 years.

Analysis:

This alternative would have a high continued maintenance cost compared to the existing roadway. The piers for the structure would act as traps for debris, which could damage the piers or create, scour holes that could cause the failure of the structure. Staying on the existing alignment and constructing in the dry would minimize in water work and sedimentation impacts during construction, and would minimize impacts to terrestrial habitat.

A viaduct may not be affective for events similar to past events as the piers for this alternative would trap debris and significant damage could occur to the structure. Major maintenance and repair would probably be needed after very large events.

8. Re-channel Stream

Description:

Under this alternative, the stream would be re-channeled to the western side of the island and away from the roadway. The cost to re-channel the stream is estimated at $100,000 with anticipated additional bank maintenance costs over a 20 year period of approximately $15,000 every 2 years. The total estimated cost is therefore $250,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 1 – 3 years. Construction is expected to take 1 construction season.

Analysis:

This alternative would not improve natural floodplain functioning and would be a temporary solution to the emergency repair issues along this section of the highway as the river's natural tendency to meander/jump channel would bring it back to run adjacent to the highway. Construction would have sedimentation impacts and would also remove riparian vegetation. Protected fish species are present at this site and would be impacted by sedimentation. A pair of harlequin ducks (protected species) is known to nest in this area and could also be impacted by this alternative.

Re-channeling the stream would not be effective in protecting the roadway from events similar to the last large event, as it is a very temporary measure due to the meandering nature of the streambed. This would not appreciably affect the level of maintenance that is required for this roadway as the stream could redirect the channel towards a different section of the roadbed during any event.

9. Barbs

<u>Description:</u>

Under this alternative, barbs (bendway weirs) would be constructed along the existing embankment to direct the river into the center of the channel and provide additional protection to the roadway. The barbs would be placed at angles pointing into the flow of the stream, forcing the water to cross over them in a perpendicular manner. The barbs would be constructed of large rock and would be tied into the rock armor at the bottom of the road embankment. Construction would consist primarily of machine placing riprap. The cost to construct barbs along the river bank is estimated at $100,000 with anticipated additional bank maintenance costs over a 20 year period of approximately $15,000 every 2 years. The total estimated cost is therefore $250,000. The time frame for typical project development (design, environmental compliance, and permitting) is expected to be 1 – 2 years. Construction is expected to take 1 construction season.

<u>Analysis:</u>

This alternative is expected to reduce emergency repair needs on the highway but would not improve floodplain functioning. This alternative is not expected to impact terrestrial habitat, wildlife, visual, cultural, or recreational resources. This alternative would not impede fish passage and would provide slow water, which could be utilized by fish. Root wads or other woody debris could be incorporated into the rock barbs to enhance fish habitat. Construction would involve in water work. The NMFS and ODFW have indicated that they would not support an alternative that results in a net reduction in floodplain area. Therefore in order for them to support this alternative it would probably be necessary to combine it with an alternative that also widens the existing floodplain.

The possibility of building the barbs from engineered log formations was considered but was determined not to be feasible for this site due to the high energy of the EFHR and subsequent likelihood of the barbs failing and causing damage downstream. Log formations usually require piling and cable connections to hold them in place during larger events. They also have the potential of causing damage to structures downstream if they fail, as they would be connected and travel as a mass rather than as individual logs (Refer to Appendix B).

This alternative would not be effective in handling events similar to the last large event, as it is site-specific and although it would help stabilize the existing roadway embankment at one location, it would not remove the threat to other portions of the roadway. This alternative would handle all but the very large events similar to past flows at this location.

Analysis Relative to the Study Objectives

A matrix rating the Baseline alternatives relative to the objectives is shown below. The alternatives that best meet the objectives and that are recommended for further evaluation are identified with an astrix. Cost information is also provided (more detailed cost data is provided in Appendix B). The rational used in rating the alternatives relative to the objectives is provided in Section 1.1.3.

Alternatives for Baseline Drive / **Objectives**	Enhance & protect the WR WSR	Enhance the natural floodplain	Minimize impacts to visual resources	Minimize impacts to terrestrial habitat	Reduce maintenance & emergency repair	Improve safety	Optimize life cycle costs	Maintain travel time	**Estimated Cost ($)**
Baseline – Site 1									
1) Maintain Existing Condition	N/A	○	◖	●	○	○	●	●	250,000/ 20 yrs
*2) Realign to East	N/A	●	◖	○	●	●	○	●	5,400,000
*3) Realign to West	N/A	●	◖	○	●	●	○	●	8,200,000
4) Bypass on 44 & 17	N/A	●	◖	○	○	●	○	◖	53,300,000
*5) Riprap Bank	N/A	○	◖	●	◖	◖	●	●	280,000
6) Realign and Riprap Bank	N/A	○	◖	◖	◖	◖	●	●	140,000
Baseline - Site 2									
1) Maintain Existing Condition	N/A	○	◖	●	○	○	●	●	250,000/ 20 yrs
*2) Realign to East	N/A	●	◖	○	●	●	○	●	5,400,000
*3) Realign to West	N/A	●	◖	○	●	●	○	●	8,200,000
4) Bypass on 44 & 17	N/A	●	◖	○	○	●	○	◖	53,300,000
5) Retaining Wall	N/A	◖	◖	◖	◖	◖	○	●	1,700,000
6) Remove Island	N/A	○	○	○	◖	◖	●	●	320,000
7) Viaduct	N/A	◖	◖	●	○	◖	○	●	9,200,000
8) Re-channel Stream	N/A	○	○	○	◖	◖	●	●	250,000
*9) Barbs	N/A	○	○	●	◖	◖	●	●	250,000

● = best meets objective; ◖ = partially meets objective; ○ = does not meet objective

Note: Alternatives 1), 2), 3), and 4) affect both of the Baseline sites; Alternatives 2) and 3) also affect the Dog River site; Alternative 4 would affect four sites (Narrows, Polallie, Dog River, and Baseline).

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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

BASELINE DRIVE - MP 80
(1995 PHOTO)
Figure 6.9.1

SHEET 1 OF 1

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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

DOG RIVER (MP 77.79 TO BASELINE (MP 80)
CORRIDOR VIEW - (1995 PHOTO)
Figure 6.9.2

SHEET 1 OF 1

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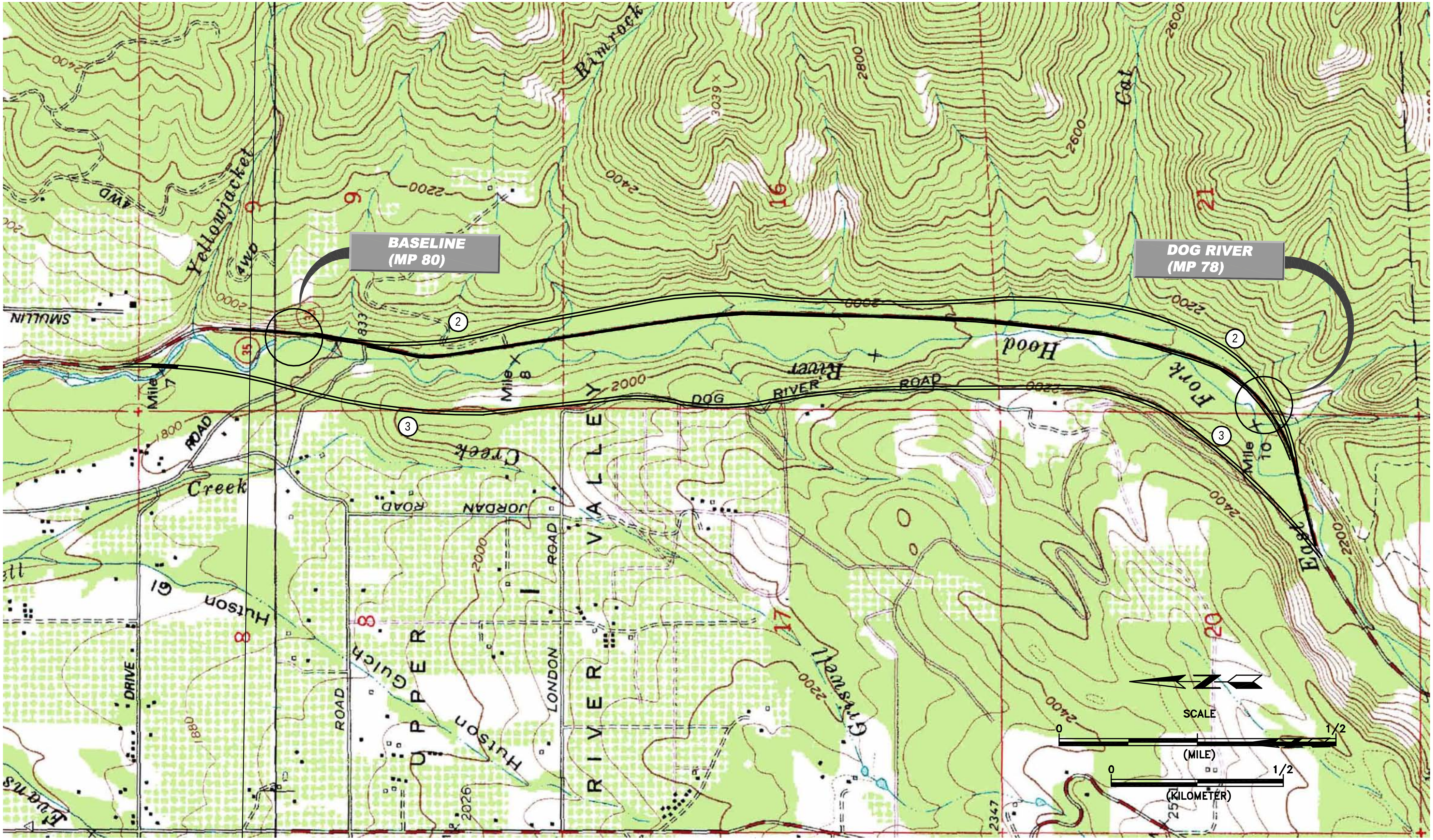

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FEASIBILITY STUDY
WHITE RIVER TO BASELINE

DOG RIVER TO BASELINE DRIVE
HIGHWAY 35 REALIGNMENT
Figure 6.9.3

SHEET 1 OF 1

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6.10 Emergency Relief Program Eligibility

This section discusses expected ER funding eligibility for the alternatives identified at each of the sites. The emergency relief funds become eligible for use on projects as a result of two types of events: 1) A wide spread natural disaster, 2) A catastrophic failure of an element or segment of the transportation system. The amount of damage necessary to receive ER funds in each failure or disaster is a minimum of $700,000. This amount is derived from the repair dollars needed and does not include other economic costs or benefits to a project. 'Betterment' to a project can be included in the costs of repair if future use of ER dollars at the disaster or failure location would be needed. The 'betterment' allowance is based on the ER dollars that would be necessary in the future to protect the location being considered.

Table 6.10.1: The most recent repairs undertaken at each site

Site	Year	Description of repairs	Construction Cost
White River	2000	Base and roadway damage. Mud and debris cleanup. Re-channel water under bridge. Rebuild area around guardrail and guardrail repair.	368,929
Clark Ck	1999	Clark Creek jumped channel, washed out egress of Sno-Park and 1000' ROW adjacent to hwy.	70,436
Newton Ck	2000	North approach E Fork Hood River Br destroyed. Mud and debris cleanup. Tree removal from road. Re-channel Newton Creek. Rebuild shoulder.	740,330
	1999	Large accumulation of tree debris near Robin Hood Bridge	8,391
The Narrows		Repairs in 2001 to embankment	75,000
Polallie Ck	1997	Debris removal	Est. 20,000
	1980	Road way realignment	Est. 3 million
Dog River	1999	Confluence of Dog River and East Fork of Hood River-breached dike, causing channel to change. Channel now running adjacent to highway on east bank.	73,573
Baseline Drive	1999	300' wash out 14' shoulder and undermined 2' into SB travel lane. Lost 20' of 36" cross culvert and 100' of guardrail	24,541

This assessment has been done primarily to identify the eligibility of alternatives under the 'betterment' clause. The life cycle for ER considerations was assumed to be a 50-year period, based on the typical life cycle cost of bridges. Each alternative is analyzed for ER funding eligibility based on: 1) the size and scope of previous events and the resulting damage to the facility, and 2) the anticipated cost of repair after a catastrophic event. Note that if there is an event that is larger than those used for this analysis then some alternatives described as "not eligible for ER funding" may become eligible. Although this section attempts to predict ER eligibility for the alternatives, actual ER eligibility cannot be made at this time and will be determined when an event occurs based on the damage it causes to the facility.

White River

ER funding eligibility analysis at White River is based on the following assumptions, 1) the occurrence interval is an average of once every 5 years (based on ODOT's maintenance records); and 2) the lifespan of a bridge is typically 50 years. Therefore 10 events are expected within the lifespan of the bridge. The cost to completely replace the existing structure is estimated at $1,800,000 and the cost to repair the bridge after the last event (which washed out the north approach) was $375,000. Based on a 1987 ODOT report (See Section 2.2.1), the structure has been completely destroyed twice. Thus assuming a recurrence interval of 5 years and a total of 10 events (one of which completely destroy the bridge and 9 of which are similar to the 2000 event), the cost of repairs during the next 50 years would be approximately $5,175,000. Therefore Alternatives 3 – 9 could not be fully funded by the ER Program. Alternative 2 would not be eligible for ER Funds because preventative maintenance activities are not covered.

A catastrophic event at White River is defined as an event that completely destroys the existing bridge, the culvert crossing at Mineral Creek, and 1407 meters of roadway. The cost to replace the road in kind after such an event is estimated to be $2,256,000. Therefore under a catastrophic event, Alternatives 3 – 9 could not be fully funded by the ER Program.

Clark Creek

ER funding eligibility analysis at Clark Creek is based on the following assumptions, 1) the occurrence interval is an average of once every 5 years based on known debris flows; 2) there was a substantial event in 1999 at Clark Creek but there are no records of other repairs at this site; 3) the lifespan of a bridge is typically 50 years; 3) geologists predict that further substantial event(s) originating off the Clark-Newton glacier are likely; 4) the cost of repairs at Clark Creek in 1999 was $70,000. Thus assuming a recurrence interval of 5 years and a total of 10 events, the cost to repair this site during the next 50 years is $700,000. Alternative 2 could be fully funded by the ER Program. Alternatives 3, 5, 6, and 7 could not be fully funded by the ER Program.

Newton Creek

ER funding eligibility analysis at Newton Creek is based on the following assumptions, 1) the occurrence interval is an average of once every 5 years based on known debris flows; 2) there was a substantial event in 2000 at Newton Creek but there are no records of other repairs at this site; 3) the lifespan of a bridge is typically 50 years; 3) geologists predict that further substantial event(s) originating off the Clark-Newton glacier are likely; 4) the cost of repairs at Newton Creek in 2000 was $740,000. Thus assuming a recurrence interval of 5 years and a total of 10 events, the cost to repair this site during the next 50 years is $7,400,000. Alternatives 2, 3, 5, and 6 could be fully funded by the ER Program.

<u>The Narrows</u>

ER funding eligibility analysis at The Narrows is based on the following assumption, 1) the occurrence interval is an average of once every 2 years (based on ODOT's maintenance records). Therefore 20 events are expected within 50 years. The cost to repair the site during the next fifty years would be approximately $1,500,000 dollars. Therefore, Alternatives 2 and 3 could not be fully funded by the ER Program.

A catastrophic event at the Narrows is defined as an event that completely destroys the EFHR Bridge and 1275 meters of roadway. The cost to replace the road and bridge in kind after such an event is estimated to be $1,817,000. Therefore under a catastrophic event, Alternatives 2 and 3 could not be fully funded by the ER Program.

<u>Polallie Creek</u>

ER funding eligibility analysis at Polallie Creek is based on the following assumption, 1) the occurrence interval is an average of once every 2 years (based on ODOT's maintenance records); 2) the cost to repair the site after the 1997 event was approximately $20,000 (although the 1980 event caused much greater damage at this site, it has not been used in this analysis, as the road was moved farther out of the floodplain after the 1980 event, changing the baseline conditions and theoretically the cost of future repairs). Therefore 25 events are expected within 50 years and the cost to repair the site during the next 50 years would be approximately $500,000 dollars. Under these assumptions, Alternatives 2, 3, 6, 7, and 8 could not be fully funded by the ER Program.

A catastrophic event at Polallie Creek is defined as an event that completely destroys the twin culverts, and 705 meters of roadway. The cost to replace the road and culverts in kind after such an event is estimated at $760,000. Therefore under a catastrophic event, Alternatives 2, 3, 6, 7, and 8 could not be fully funded by the ER Program.

Dog River

ER funding eligibility analysis at Dog River is based on the following assumptions, 1) the occurrence interval on this site is an average of once every 5 years (based on ODOT maintenance records); and 2) the cost of repairs in 1999 at Dog River was $75,000. Therefore 10 events are expected within 50 years and the cost to repair these sites during the next 50 years would be approximately $750,000. Under these assumptions, Alternative 5 could be fully funded by the ER program. Alternative 6 could not be fully funded by the ER Program.

A catastrophic event at Dog River is defined as an event that completely destroys the twin box culverts on Dog River, the EFHR Bridge, and 2457 meters of roadway. The cost to replace the road, bridge, and culverts in kind after such an event is estimated at $3,245,000. Therefore under a catastrophic event, Alternatives 5 and 6 could be fully funded by the ER Program.

Baseline

ER funding eligibility analysis at Baseline Site 1 is based on the following assumptions, 1) the occurrence interval at this site is an average of once every 2 years (based on ODOT maintenance records); and 2) the cost of repairs in 1999 was $25,000. Therefore 25 events are expected within 50 years and the cost to repair these sites during the next 50 years would be approximately $625,000. Under these assumptions, Alternatives 5 and 6 could be fully funded by the ER program.

ER funding eligibility analysis at Baseline Site 2 is based on the following assumptions, 1) the occurrence interval on this site is an average of once every 2 years (based on ODOT maintenance records); and 2) the cost of repairs in 1999 was $25,000. Therefore 25 events are expected within 50 years and the cost to repair these sites during the next 50 years would be approximately $625,000. Under these assumptions, Alternatives 6, 8, and 9 could be fully funded by the ER program. Alternatives 5 and 7 could not be fully funded by the ER Program.

A catastrophic event at Baseline is defined as an event that completely destroys the Baseline Bridge, and 2078 meters of roadway. The cost to replace the road and bridge in kind after such an event is estimated at $2,537,000. Therefore under a catastrophic event at Site 1, Alternatives 5 and 6, and at Site 2, Alternatives 5, 6, 8, and 9 could be fully funded by the ER Program.

Alternatives Common to Multiple Sites

The cost to repair both the Clark Creek and the Newton Creek sites during the next 50 years is estimated to be $8,140,000. Therefore, Alternatives 4 and 4A could not be fully funded by the ER Program.

A catastrophic event at Clark and Newton Creek is defined as an event that completely destroys the Newton Creek Bridge, the Clark Creek culvert crossing, the Robin Hood Bridge crossing the EFHR and 5016 meters of roadway. The cost to replace the road in kind after such an event is estimated to be $5,665,000. Therefore under a catastrophic event, Alternatives 2, 3, 5, 6, and 7 could be fully funded by the ER Program. Alternative 4 and 4A could not be fully funded by the ER Program.

The cost to repair the Narrows, Polallie Creek, Dog River, and Baseline sites during the next 50 years is estimated to be $4,000,000. Therefore, Alternative 4 could not be fully funded by the ER Program.

The cost to repair the Narrows, Polallie Creek, Dog River and Baseline sites after a catastrophic event is estimated to be $8,359,000. Therefore, Alternative 4 could not be fully funded by the ER Program.

The cost to repair the Narrows and Polallie Creek sites during the next 50 years is estimated to be $2,000,000. Therefore, Alternative 5 could not be fully funded by the ER Program.

The cost to repair at the Narrows and Polallie Creek sites after a catastrophic event is estimated to be $2,578,000. Therefore, Alternative 5 could not be fully funded by the ER Program.

The cost to repair the Dog River and Baseline sites during the next 50 years is estimated to be $2,000,000. Therefore, Alternatives 2 and 3 could not be fully funded by the ER Program.

The cost to repair at the Dog River and Baseline sites after a catastrophic event is estimated to be $5,782,000. Therefore, Alternative 2 could be fully funded by the ER Program. Alternative 3 could not be fully funded by the ER Program.

6.11 Summary of Alternatives and Anticipated Issues

The following table summarizes each of the alternatives and the issues associated with them. Table 6.9.2 compares the number of river crossings between the existing condition and the bypass alternatives.

Table 6.11.1: Analysis of Alternatives Summary

Alternatives	Anticipated issues associated with each alternative
White River	
1) Maintain Existing Condition	• No impact on terrestrial habitat and wildlife, cultural, or recreational resources • Negative impact on WSR – would not improve floodplain functioning • Would not improve safety or decrease maintenance needs
2) Preventative maintenance	• Would require an amendment to the WSR designation to allow ODOT to clear out the river preventing debris from building up under the bridge. • The governor and regional forester would have to lobby congress. • No impact on terrestrial habitat and wildlife, cultural, or recreational resources • Negative impact on WSR – would not improve floodplain functioning • Probably would not protect the bridge against wash out in major events, as the maintenance activities are creating dikes, which escalate debris build up on the upstream side of the bridge. • NMFS and the USFS indicated support as a short term solution for a limited period of time while a long-term solution is being developed
3) Raise Road and Lengthen Bridge	• In theory this would remove the existing constriction (the bridge and road may be acting as a dam and facilitating aggradation above the bridge) • May decrease the rate of aggradation by increasing the width of the floodplain • May need to spread out material that has built up behind the bridge for this alternative to be effective • Ideally need to find out the rate of natural aggradation – is there a point where the bridge will be high enough (assuming that it is long enough) • Would require significant geotechnical investigation and design of bridge foundation elements • May impact LSR and wetlands • Enhance WSR and floodplain functions • Impact West WR Sno-park
4) Realign Upstream	• Aim to gain height and get out of the depositional zone – however probably still in it – also within a higher velocity part of the floodplain • Higher elevation crossing but road steep and very long bridge (viaduct) • A short portion of this realignment passes through an area mapped as having high landslide risk • Depending on final alignment may be within Segment A of WSR designation • Impacts to LSR and Key Watershed designated areas • Wildlife and terrestrial habitat impacts due to vegetation clearing • Would improve floodplain functions • Noise and visual impacts anticipated plus impacts to West WR Sno-park and wetlands • Need to maintain access to Boy Scout winter lodge, Mineral Jane trailhead, and East WR Sno-park • Two crossings removed (White River and Mineral Creek), replaced with one crossing.

5) Tunnel	• Water / drainage issues in construction and maintenance • Would improve the river's free flowing characteristics/floodplain functions • Long-term solution to maintenance concerns • Would require special geotechnical design and construction considerations and extensive geotechnical investigation • Issues regarding terrestrial habitat, wildlife, wetlands, recreational and cultural resources identical to those discussed for Alternative 3 • Positive impact on noise environment likely unless grades are very steep • Same access issues as discussed for Alternative 3
6) Encased Highway	• A tunnel that builds itself – eventually being covered by debris flows (assumes that aggradation will continue at this location. • Drainage and aesthetic issues • River would move freely above the road within its floodplain. • Changing river morphology may mean this won't work • Would require comprehensive geotechnical and hydraulic investigation and analysis and special design and construction considerations • Same environmental and issues as discussed for Alternative 3
7) Realign 1 Km Downstream	• Located at widest portion of the floodplain but in a location where the flows have lower kinetic energy and the size of the debris settling out is smaller. • A short portion of this alternative passes through an area designated as high risk for landslides • Length of highway would not increase • Mature vegetation removed - classified as LSR – fragmentation / wildlife impacts • Would require extensive geotechnical investigation, analysis, and design • Tier 2 Key Watershed, a Key Site Riparian Area, and a Scenic Viewshed • A new alignment therefore would change the noise environment • Wetlands mapped to the NW and in close proximity of the alignment • Western end of alignment encroaches on the Barlow Road National Historic District • Expected to displace sections of the Mineral Jane trail and the East White River Sno Park • Long-term visual impacts - views from the road blocked by vegetation • Need to maintain access to the Boy Scout Winter Lodge and West White River Sno-park • Wildlife and terrestrial habitat impacts due to vegetation clearing • Two crossings removed (White River and Mineral Creek), replaced with 6 crossings.
8) Realign 4 Km Downstream	• Would require extensive geotechnical investigation, analysis, and design • Approximately 1.5 miles passes through an area mapped as having high landslide risk • Long-term maintenance needs less than for Alternatives 1, 2, and 5 as the bridges for this alternative are located over more defined stream channels • LSR, Tier 2 Key Watershed, a Key Site Riparian Area, Scenic Viewshed • Wildlife and terrestrial habitat impacts due to vegetation clearing • Western end of alignment encroaches on the Barlow Road National Historic District • Expected to displace sections of the Mineral Jane trail and the East White River Sno Park • Long-term visual impacts - views from the road blocked by vegetation

	• Need to maintain access to the Boy Scout Winter Lodge and West White River Sno-park • Wetlands mapped along the proposed alignment • Two crossings removed (White River and Mineral Creek), replaced with 2 or 3 crossings.
9) Bypass	• Out of direction travel would be 20.7 miles • FS 48 and 43 would need to be upgraded to State Standards • The existing bridge crossing on 43 would need to be replaced • Approximately 3 miles located adjacent to an area mapped as having high landslide risk • The road would be out of the depositional zone of the river • Greatest benefit to the free flowing characteristics and floodplain of the WSR • Increase annual ODOT road maintenance needs • FR 48 and 43 currently used for winter recreation • Bridge replacement would require geotechnical investigation and foundation design; slope stability analysis required at locations where widening could impact the existing cut slope • Within LSR, a Key Watershed, and Scenic Viewshed • Adjacent to a key riparian site • Wildlife impacts due to vegetation clearing to widen the roadway • Potential positive visual impact and negative impact on the noise environment • Need to maintain access to the Barlow Road, extensive trail systems, the Boy Scout winter lodge, and the West White River Sno-Park. • Two crossings removed (White River and Mineral Creek) and none would be replaced, however, one existing crossing (of the White River on FS 43) may have to be upgraded
Clark Creek	
1) Maintain Existing Condition	• Does not improve fish passage • No impacts to terrestrial habitat or wildlife as a result of construction • Would not improve floodplain functions or solve the long-term maintenance issues • Does not solve the problem of the river's tendency to jump channel - blockage during debris flows still a problem
2) Riprap Existing Stream Bank and Culverts	• Does not solve the problem of the river's tendency to jump channel - blockage during debris flows still a problem • Impacts on fish habitat due to the addition of riprap to the stream bank. • Does not improve fish passage • No impacts to terrestrial habitat or wildlife during construction
3) Armored Dry Channel	• Very large debris flows may not be entirely diverted into the channel • Mature vegetation would need to be cleared – located in wildlife/visuals emphasis (B9) • Placing the channel next to the roadway would aid in snow removal and snow melt • Would require maintenance after events • Would not improve floodplain functions • Water velocity in the channel would be high and is expected to prohibit fish passage and cause scouring where the channel enters the EFHR. • If river was maintained in the ditch over the long-term, fish habitat would be extremely poor - temperature, habitat complexity, water velocity, and turbidity

	• Visual impacts from the road and/or the mountain • Recreational trails are present in this area and could be impacted
4) Bypass	• Long-term solution as the EFHR is the terminus for debris flows on Clark; thus the road would be permanently removed from its floodplain and braided networks • Would require extensive geotechnical investigation to assess present and future stability of existing slopes and proposed new cuts; possible need for several bridge structures and retaining walls. • Would require several miles of major new alignment construction • Impacts to Teacup Lake as route passes through southwestern portion of this recreation area. Maintaining access to the Teacup Lake area would be an issue. This alternative also bypasses the Clark Creek Sno-Park and displaces the Pocket Creek Snow Park / Trail • Changed noise environment – impacts to Badger Creek Wilderness • Numerous drainage features required along the east portion of alignment(s) • Existing road could remain open while construction is completed • Passes through an area designated as high risk for landslides – but may be possible to avoid it. • Would get the road out of the debris flow zone for Mount Hood • Short-term disturbance to wildlife (including the northern spotted owl) during construction • Improve water quality in Newton Creek, Clark Creek and the EFHR • Four crossings removed (at Clark, Newton, EFHR, Meadows) – replaced with one crossing (EFHR and Pocket Creek)
4A) Bypass	The issues for this alternative are almost identical to those for Alternative 4). The differences are highlighted below: • Possibility of using parts of FS 3540 but it would need a lot of work to bring it up to standards • Slightly longer route than 4) (above) • Four crossings removed (at Clark, Newton, EFHR, Meadows) – replaced with two crossings (EFHR and Pocket Creek)
5) Raised Roadway with Intermittent Channel Crossings	• This would involve increasing the number of drainage structures in the road and placing them where the road crosses definable historic channels. • No guarantee that the river wont jump to a new channel • During a major event the drainage structure would still get blocked – river may then run alongside the road until it finds another drainage structure • Culverts would require periodic maintenance after an event, but less than the current condition. The channel may also need to be re-constructed after each event for fisheries - otherwise, the stream could meander from crossing to crossing. • A large material source would be needed • Minimal geotechnical work would be required for this grade raise. • Impacts to terrestrial habitat, wildlife, recreational, and potential cultural resources would be minimal. • Flood plain functioning would be better than the existing condition • The embankment would essentially act as a dam to large debris, which would eventually build up on the north side of the road. • This alternative would impact vegetation downstream of the road; however, the river would naturally cut new paths through the forest anyway. • All crossings would need to provide for fish passage.
6) Raised Roadway on	• Similar to Alternative 5 but in addition to culverts, the embankment would be constructed with large rock on the bottom portion of the raised roadway to provide a permeable base. The rock

Permeable Embankment	foundation would provide more resistance to scouring and erosion than would a riprap-armored embankment • Same environmental issues as Alternative 5.
7) Bridge	• Does not solve the problem of the river's tendency to jump channel • Blockage during debris flows could still be a problem • Impacts to terrestrial habitat, wildlife, recreational, and potential cultural resources during construction would be minimal • Flood plain functioning better than the existing condition - enhancement of fish passage but the natural ability for geomorphologic processes to occur would not be improved
Newton Creek	
1) Maintain Existing Condition	Refer to Clark Creek – Alternative 1. Note that unlike Clark Creek, fish passage is not currently an issue at this site (based on consultations with USFS, ODFW, and NOAA Fisheries).
2) Riprap Existing Stream Bank and Culverts	• Does not solve the problem of the river's tendency to jump channel • Existing Bridge / box culvert already hard • Blockage during debris flows still a problem • Environmental impacts equivalent to Alternative 1 although the impacts on fish habitat would be greater due to the addition of riprap below OHW
3) Armored Dry Channel	Refer to Clark Creek – Alternative 3
4) Bypass 4A) Bypass	Refer to Clark Creek – Alternatives 4 and 4A.
5) Raised Roadway with Intermittent Channel Crossings	Refer to Clark Creek – Alternative 5.
6) Raised Roadway on Permeable Embankment	Refer to Clark Creek – Alternative 6.
The Narrows	
1) Maintain Existing Condition	• Involves continued work / maintenance in the river on a regular basis • No impacts to terrestrial habitat, recreational, or cultural resources are anticipated • Would not enhance river functions through this section and the practice of placing riprap into the river would continue to impact fish habitat and the transport of woody debris, and would incrementally narrow the existing river channel.
2) Raised Roadway with Retaining Wall	• Would improve rock fall clearance and maintain toe of fill in current location • Foundation for wall would need to be below scour depth • Constructing retaining wall in river environment would require special design and construction considerations, such as (1) dewatering, (2) foundation construction in boulders (possibly drilled shafts), and (3) wall system that can resist battering by stream-born debris • Strong rail (i.e. bridge rail) would be required along the full length of the wall. The risk of rock fall damage to the rail is significant • Construction would require in-stream work along the entire roadway • The current stream width would be maintained but the roadway would also be moved to the west allowing the construction of wider rock fall ditches

	• No impacts to terrestrial habitat, recreational, or cultural resources are anticipated • Reduce habitat complexity for fish due to the smooth wall
3) Half-Bridge	• Bouldery foundation material and deep scour zone will require special design and construction considerations such as drilled shaft foundation for half bridge • Would improve rock fall clearance and maintain toe of fill in current location • Not a long-term solution • Possible impacts to Pete's Pile and rare plant (listed on the 1999 R6 Sensitive Species List (MHFP) • High risk of damage due to rock fall - expensive to repair. • Involves continued work / maintenance in the river on a regular basis • Would increase the width of the floodplain. • Reduce habitat complexity for fish due to the smooth wall
4) Bypass on 44 & 17	• Out of direction travel approx. 4 miles • Much of the route would require realignment and widening • Northern end of FS 17 would require major cuts in steep rock slopes and retaining walls on steep fill slopes. Expensive construction with need for major geotechnical investigation. • Middle section of FS 17 at high elevation. Snow and ice a major problem in winter. • Steep grades last two to three miles of 44 Road before rejoining Highway 35 at south end of realignment section would be major problem for truck traffic during snow and ice conditions. • Would increase noise along this route • Expected to damage the economies of the communities of Parkdale and Mount Hood • Bisects and runs adjacent to a Tier 1 Key Watershed (The Dalles Watershed – issues of water quality and fire risk) and LSR • It is estimated that there are at least 8-9 stream crossings along this that need improved fish passage. • A section of the road parallels a stream and the Dog River aqueduct goes through the FS 17. There is also long prairie grazing allotment along FS 17. This route passes through Brookes Meadow (meadow habitat – rare) • Known cultural sites are present • Could affect 15-20 houses located along the first ¾ mile – access and ROW would be an issue • Maintaining the existing highway for access would increase the amount of road maintenance for ODOT or the County and would not enhance the EFHR floodplain throughout this reach. • Existing recreation sites expected to be affected are: Rouston Park, Dog River Trail, Pete's Pile, Little John Sno-Play, Nottingham Campground, Gibson Prairie Horse Camp, Surveyors Ridge trail, Boy Scouts of America – Camp Baldwin, Sherwood Campground, Elk Meadows and Tamanawa Falls trailheads. • Two crossings removed (on the EFHR and Polallie - assumes maintaining the existing road to Rouston Park) and none replaced, however, may need to improve 3 large existing pipe crossings.

5) Bypass to West	• Would remove 2 bridge crossings (EFHR, Polallie) and would install 3 new crossings (Polallie, EFHR and at Cold Spring Ck). • Could connect it with the realignment option 5 for Polallie • Would involve removing a lot of mature timber • Change in noise environment – may impact Mt Hood Wilderness • Long-term solution – road would be out of the bottom of the canyon • Would require extensive geotechnical drilling investigation of potential cut slopes, wall sites, and bridge crossings • Sections would traverse a currently 'unroaded' area • Would solve the existing rock fall problem on the highway. • The southern portion of this bypass traverses areas designated as having high landslide risk • Expected to improve water quality • Would change the aesthetics but could provide equally spectacular views • This alternative would move the road out of the canyon base and onto the canyon ridge closer to the Mount Hood Wilderness, which may change the noise environment in the wilderness. • Access would be maintained to Sherwood campground and access to Pete's Pile would have to be modified – possible from the Dog River trail located above the climbing site. • Impacts to the Elk Meadows Trail
Polallie Creek	
1) Maintain Existing Condition	• No short-term impacts terrestrial habitat, wildlife, noise environment, recreational or cultural resources • Impacts to recreational resources, safety (people camping, Elk Meadows trail), and access to Coopers Spur during a debris flow would be the same as under the current condition. • Would not improve floodplain functions – fish passage
2) Debris Control Structure	• High initial construction cost as well as high maintenance cost • Would not enhance the floodplain or allow fish passage • Would require work in the active stream channel for both construction and maintenance • Known spotted owl sites within 0.5miles • Land in this area is designated scenic viewshed – visual impacts • Minor impacts to the Elk Meadows trail are also anticipated.
3) Realign Road and 90m Bridge	• Aim to place the bridge above the fan (zone of deposition) • Would require steep grades for the approach connections and approx.1000 meters (3300 feet) of roadway re-construction • Intersection with Coopers Spur Road would need to be moved slightly • Roadway construction would however require some significant cuts into the hillside • Natural fan and floodplain functions should be restored • Restore fish passage • Environmental impacts during construction would be similar to those discussed in Alternative 1 • Vegetation clearing – terrestrial habitat impacts (including impacts to the spotted owl)
4) Bypass on 44 & 17	• Refer to The Narrows – Alt. 4

5) Bypass to West	• Refer to The Narrows – Alt. 5
6) 30 m Bridge Existing Alignment	• Would require regular maintenance - still located in the depositional zone of the floodplain • May need to raise grade to provide sufficient freeboard under bridge. • Would improve flood plain functions but not to ideal conditions • Restore fish passage
7) Two 30m Bridges (Highway 35 and Realigned Approach)	• Two crossings verses one (re. Alternative 6) • Would improve floodplain functions – allow fish passage • Environmental impacts during construction similar to those discussed in Alternative 1. • Vegetation clearing – terrestrial habitat impacts (including impacts to the spotted owl)
8) Raise Roadway and 90m Bridge Existing Alignment	• Future maintenance costs are expected to be less than the shorter bridge alternatives, as this alternative will handle larger debris flow events. • Need to compare relative safety of structural integrity as this option is still in the depositional zone • Would improve floodplain functioning and restore fish passage • Would require multi-span bridge with piers in floodplain • Environmental impacts during construction would be similar to those discussed in Alternative 1
Dog River	
1) Maintain Existing Condition	• Would not address maintenance or safety concerns • Would not improve floodplain functions / fish habitat • Net reduction in floodplain area- would probably require the addition of more riprap into the river over time. NMFS and ODFW indicated they would not support an alt. resulting in a net reduction in floodplain.
2) Realign to East	• Private land – ROW issues • Road almost out of flood plain, good for floodplain functioning, safety, and long term emergency repair concerns • Medium term impact on hillside vegetation/possible spotted owl habitat • Need to ensure toe of fill is not at Q2 • Need to assess new cut slopes for stable slope ratios and possible instability problems • The Dog River trailhead would be affected • Impacts to the EFHR minimal as construction would be completed beyond the active floodplain • In water work necessary for Dog River - probably be an enhancement for fish passage • Remove one crossing (at Dog River) and replace with one crossing (at Dog River)
3) Realign to West	• Road completely out of floodplain – good for floodplain functioning, safety, and long term emergency repair concerns • Private land – ROW issues • Need to maintain access to private properties at N end of realignment (existing Hwy 35) • May need to move the Dog River Trailhead • Would require the removal of mature forest vegetation and farmland

<table>
<tr><td></td><td>Remove three crossings (at Dog River, the EFHR, Baseline Bridge) and replace with one crossing (on the EFHR)
Standard highway construction - could maintain traffic on existing roadway during construction
No long-term environmental impacts are anticipated as a result of this alternative.
Short-term construction impacts primarily related to removing potential spotted owl habitat and in water work are expected.</td></tr>
<tr><td>4) Bypass on 44 & 17</td><td>Refer to The Narrows – Alt. 4</td></tr>
<tr><td>5) Barbs and Armour.</td><td>Would need to maintain barbs rather than the road
May save road but would not improve floodplain functioning
Barbs would not impede fish passage and would provide slow water, which could be utilized by fish.
Construction involves primarily machine placing riprap - some in water work.
NMFS and ODFW indicated they would not support an alt. resulting in a net reduction in floodplain - therefore probably necessary to combine this with an alternative that also widens the floodplain.
Few environmental impacts or gains</td></tr>
<tr><td>6) Raise Road with Retaining Wall</td><td>Increases river width by ~ 30 feet
Constructing retaining wall in river environment would require special design and construction considerations, such as (1) dewatering, (2) foundation construction in boulders, and (3) wall system that can resist battering by stream-born debris
Wall footing needs to be placed below stream scour depth and would need to be heavily armored.
Expensive construction techniques
Construction of the alternative would be away from the existing stream
A significant material source for large rock for the added fill would be required.
Issues for fish – habitat complexity at wall
Short term construction impacts - primarily as a result of construction noise.</td></tr>
<tr><td colspan="2">Baseline Drive - Site 1</td></tr>
<tr><td>1) Maintain Existing Condition</td><td>Would not address maintenance or safety concerns
Would not improve floodplain functions / fish habitat
Net reduction in floodplain area as would probably require the addition of more riprap into the river over time. NMFS and ODFW indicated they would not support an alt. resulting in a net reduction in floodplain.</td></tr>
<tr><td>2) Realign to East</td><td>Need to assess impact to Baseline Bridge / may need to replace the bridge
Refer to Dog River – Alt. 2</td></tr>
<tr><td>3) Realign to West</td><td>Refer to Dog River – Alt. 3</td></tr>
<tr><td>4) Bypass on 44 & 17</td><td>Refer to The Narrows – Alt. 4</td></tr>
<tr><td>5) Riprap Bank</td><td>Fish habitat not improved / Road still in floodplain
Net decrease in floodplain area – not supported by NMFS & ODFW
Would require in stream work or a temporary diversion of the stream
Short term environmental impacts due to construction noise / in stream work - no long-term gains</td></tr>
<tr><td>6) Realign and Riprap Bank</td><td>Loss of riparian vegetation –medium term impact
Would allow the river to utilize more of the floodplain but may not be a benefit to the road.</td></tr>
</table>

	• Changing flow characteristics could affect the bridge at Baseline Road
Baseline Drive - Site 2	
1) Maintain Existing Condition	• Would not address maintenance or safety concerns • Would not improve floodplain functions / fish habitat • Net reduction in floodplain area as would probably require the addition of more riprap into the river over time. NMFS and ODFW indicated they would not support an alt. resulting in a net reduction in floodplain.
2) Realign to East	• Refer to Baseline Drive – Site 1 – Alt. 2
3) Realign to West	• Refer to Baseline Drive – Site 1 – Alt. 3
4) Bypass on 44 & 17	• Refer to The Narrows – Alt. 4
5) Retaining Wall	• Constructing retaining wall in river environment would require special design and construction considerations, such as (1) dewatering, (2) foundation construction in boulders, and (3) wall system that can resist battering by stream-born debris • Minimal increase in the floodplain width • Concern for fish habitat complexity – could include features of roughness as mitigation • Would require removal of riparian vegetation that could not be replaced
6) Remove Island	• Removes debris trap and increases available floodplain for meandering • Temporary solution – may move problem farther downstream • High sedimentation impacts during removal • Harlequin ducks nest in the area • Removes riparian vegetation • Does not improve natural floodplain functions – a step backwards • Expected to modify the flow of the channel and impact protected fish species present at this site.
7) Viaduct	• Debris could still cause blockages/flooding • Bouldery foundation material and deep scour zone will require expensive foundation - expensive • Long-term maintenance could be worse than the current condition - access to base necessary • Construction impacts minimized by staying on existing alignment and constructing in the dry
8) Re-channel Stream	• Temporary solution – may move problem farther downstream • High sedimentation impacts during construction • Harlequin ducks nest in the area • Removes riparian vegetation • Does not improve natural floodplain functions – a step backwards • Expected to modify the flow of the channel and impact protected fish species present at this site.
9) Barbs	• Would need to maintain barbs rather than the road • May save road but would not improve floodplain functioning • Barbs would not impede fish passage and would provide slow water, which could be utilized by fish. • Construction involves primarily machine placing riprap - some in water work. • NMFS and ODFW indicated they would not support an alt. resulting in a net reduction in floodplain - therefore probably necessary to combine this with an alternative that also widens the floodplain.

Table 6.11.2: Summary of crossings removed and replaced/added for bypass alternatives

	Crossings Removed	**Crossings replaced/added**
White River		
4) Realign Upstream	2 – Mineral and White	1
7) Realign 1 Km Downstream	2 – Mineral and White	6
8) Realign 4 Km Downstream	2 – Mineral and White	2 or 3
9) Bypass	2 – Mineral and White	0, however, 1(White River on FS 43) may have to be upgraded
Clark/Newton Bypasses		
4) Bypass	4 – Clark, Newton, EFHR, Meadows	1 - EFHR
4A) Bypass	4 – Clark, Newton, EFHR, Meadows	2 – EFHR, Pocket Creek
4) Bypass on 44 & 17 **(Baseline, Dog River, Polallie, The Narrows)**	2 – EFHR, Polallie (assumes maintaining the existing road to Rouston Park)	0, however may need to improve 3 large existing pipe crossings
5) Bypass to West (Narrows and Polallie)	2 – EFHR, Polallie	3 – EFHR, Polallie, Cold Spring Ck
Dog River/Baseline Bypasses		
2) Realign to East	1 – Dog River	1 – Dog River
3) Realign to West	3 – Dog River, EFHR, Baseline	1 - EFHR

Note: A crossing is defined as a bridge or a culvert ≥ 2 meters (6.6 ft) in diameter. The analysis presented here does not include 'normal' drainage structures (pipes < 2 meters (6.6 ft) in diameter).

7. Permits/Coordination

Permits and other agency concurrences that may be needed for projects arising from this study are listed below.

7.1 Federal Permits/Coordination

- Clean Water Act, Section 404 Permit for fill material placed in wetlands or streams (issued by the Army Corps of Engineers)
- Coordination and Concurrence for species listed under the Endangered Species Act (as amended 1996) (US Fish and Wildlife Service and the National Marine Fisheries Service).
- Coordination for Essential Fish Habitat as protected under the Magnuson-Stevens Fishery Conservation and Management Act as amended 1996 (MSA) (National Marine Fisheries Service).
- Coordination under the Migratory Bird Treaty Act of 1918 (US Fish and Wildlife Service).
- Environmental Impact Assessment as required under the National Environmental Policy Act of 1969 as amended.
- Coordination with the Advisory Council for Historic Preservation under the National Historic Preservation Act of 1966.

7.2 State or County Agency Permits/Coordination

- Removal / Fill Permit (issued by the Division of State Lands)
- National Pollutant Discharge Elimination System Permit (issued by the Oregon State Department of Environmental Quality)
- Surface Mining Permit for the development of a material source (issued by the Oregon Department of Geology and Mineral Industries)
- Permit to Operate Power Equipment (issued by the Oregon Department of Forestry)
- Burn Permit (issued by the Oregon Department of Forestry)
- Coordination with the Oregon State Historic Preservation Office
- Coordination with the Oregon Department of Fish and Wildlife for compliance with the Oregon Endangered Species Act (496.170)
- Compliance with fish passage requirements under Oregon State House Bill 3002 (HB 3002-C)

8. Recommendations for Further Action

The conceptual alternatives identified by this study are evaluated based on the eight study objectives. The objectives are not ordered for preference or importance and are weighted equally. In Section 6, the alternatives are rated as "best meets objective", "partially meets objective", or "does not meet objective". The rational used in rating the alternatives relative to the objectives is also discussed for each objective. Due to the reconnaissance level of data collection, it was not possible to provide a more detailed method of rating the alternatives. The ratings "does not meet" or "best meets" can be thought of as being equivalent to scores of 0% and 100% respectively. The rating "partially meets" represents the continuum between "does not meet" and "best meets" (10% to 90%). Therefore the value of the rating system is limited by the quality of the data from which it is derived. It is expected that with further analysis, the degree to which the alternatives currently rated as "partially meets", meet the objective(s), will be substantially better defined, potentially changing how the alternatives compare to one another. Due to the limitations of the rating system, no attempt is made in this study to rate alternatives relative to one another. However, a group of alternatives at each site that rate the most highly for the objectives overall are identified with an astrix and recommended for further study.

Recommended studies and other factors that should be taken into consideration as part of future project planning are outlined below. As discussed above, it is expected that more detailed site-specific analysis will verify the degree to which alternatives currently rated as "partially meets", meet the objective(s). This will include verification of the constructability of the more complex alternatives (as a result of site specific geotechnical, geomorphic, and hydraulic studies) and may modify the estimated cost of construction, subsequently changing an alternative's rating. It is also anticipated that reassessment of the environmental, social and economic issues at the time of project development may result in the need to update the list of objectives and revaluate the alternatives. Furthermore, it is likely that other alternatives, beyond those included in this report, will be identified in the future.

8.1 Geotechnical Studies

The construction of retaining walls and new bridges would require subsurface geotechnical investigations for the foundation designs. Structures such as Sabo Dams or other debris flow retention barriers would also require geotechnical investigations, and more exotic mitigations such as tunnels, half-bridges, and long viaducts could be expected to require considerable geotechnical investigation and design efforts. If the highway is relocated onto one or more of the alternative alignments there would be a need for geotechnical investigations for the design of new cutslopes, retaining walls, bridges, large culverts, pavement structure, materials sources, waste disposal areas, embankments, and suitability of excavation materials for use in the new construction. The realignment of any sections of the highway(s) that would result in the creation of new cuts would require a thorough geotechnical evaluation of cut slope stability. Depending on the locations and heights of the proposed new cuts, the evaluation could consist of a visual site review and assessment of existing conditions, or it could require a comprehensive geotechnical investigation program including subsurface drilling.

8.2 Hydraulic and Geomorphic Studies

Detailed hydraulic and geomorphic studies will be required in order to design stream crossings at White River, Pollalie Creek, Newton Creek, the EFHR, and Dog River. For White River, a hydraulic model will be required for estimating bridge scour, sediment transport, and hydraulic capacity. In addition, long-term continuous topographic survey data should be collected at White River to determine the natural rate of aggradation at the proposed crossing locations. This would allow the rate of aggradation over the proposed design life (75 years) of a crossing to be calculated; thus, helping to ensure that new crossings are designed and constructed at appropriate heights above the existing floodplain elevation. For Pollalie Creek, Newton Creek, and Dog River a hydraulic model will be required for estimating bridge scour, sediment transport, and hydraulic capacity. For the EFHR, a hydraulic model will be required for the length of the stream where it runs parallel to Highway 35 and / or where it crosses Highway 35 to estimate bridge scour, sediment transport, and hydraulic capacity for the existing and proposed bridges. In addition, this model will also provide water surface elevation for the design discharge (i.e. 100-yr flow) along the Highway 35 corridor where it runs parallel to the EFHR.

8.3 Protected Species Surveys / Considerations

Under the Northwest Forest Plan surveys are required for 25 botanical species prior to undertaking any work within forested stands or associated habitats of forests that are 80 years or more in age within the National Forest. At the time of environmental planning, surveys and/or analysis would also be required to assess impacts within and beyond the National Forest boundary for 35 botanical species that are listed as R6 Sensitive, or for species that are protected under the ESA. Species that would need to be addressed would be based on current lists at the time of project planning. Note that the R6 Species list and The Northwest Forest Plan Survey and Manage list will be updated this winter (2002/2003).

Currently, any work along the project corridor would require surveys for northern spotted owls (a two year survey protocol), larch mountain salamanders (a one year survey protocol), and mollusks (a one year survey protocol). Depending on the status of species listings, the survey requirements may change and would have to be reassessed during the environmental planning process for a specific project.

The following work windows would have to be complied with if impacts to species are to be minimized.

Work window type	Time period when work is permitted
In water – EFHR watershed	July 15 to August 31
In water – White River watershed	July 15 to October 31
Spotted owl breeding (within LSR)	October 1 to February 28
Spotted owl breeding (general)	July 16 to February 28
Harlequin duck breeding	July 16 to April 30

In general, any projects that result in the loss or degradation of terrestrial or aquatic habitat will need to mitigate for these impacts by enhancing remaining habitat appropriately. Any enhancement activities would be planned and coordinated with the resource management agencies namely, the USFS, NOAA Fisheries, ODFW, and the USFWS.

8.4 Wetland Investigations

Proposed work at any of the sites would require a wetland investigation and as necessary a delineation in compliance with the Oregon Division of State Lands Fill and Removal Permit and Section 404 of the Clean Water Act. Impacts to wetlands would need to be mitigated for in accordance with state and federal requirements.

8.5 Cultural Resource Surveys

Any projects proposed as a result of this study would require cultural resource surveys to be undertaken within the proposed construction corridor. Cultural surveys would have to take place when the ground is free of snow. Coordination with the State Historic Preservation Office and possibly also with the Advisory Council for Historic Preservation would be necessary.

8.6 Wild and Scenic River Considerations

For projects at White River, as the river is classified as a WSR, it is protected by the WSR Act which means that in the case of the White River Bridge, replacement of the existing bridge is possible, particularly if the replacement is virtually exactly like the original. A replacement different from the original could also be allowed if the affects are an improvement (to the qualities for which the river was designated and to the free flowing characteristics of the river) over the affects of the old bridge. In the case that a design which avoids direct and adverse effects to the WSR cannot be found, the only option is congressional action as no federal agency can conduct, assist, or fund projects which have direct adverse effects to a WSR. The Forest Service is the river-administering agency for the White River WSR and the Regional Forester is the official who has the responsibility for WSR Section 7 of the ESA determinations. Therefore the USFS would have to do an independent ESA Section 7 determination for any projects within the WSR corridor (*pers. comm.* Susan Sater).

8.7 Recreation Considerations

Many of the alternatives impact recreation sites particularly those that involve relocations of the road. However, for most of these sites, this can be viewed as a chance to create new recreation opportunities. For example relocations of the road to higher elevations would provide good opportunities for early and late season sno-parks, and campgrounds currently easily accessible from Highway 35 could be converted to more primitive sites, which are currently rare on the National Forest. Of the existing recreation sites potentially impacted by projects that could develop from this study, the one of most concern to the National Forest is Pete's Pile as it is the only climbing site on the district and is irreplaceable.

8.8 Geological Time Scale

It is important to note that the geological, meteorological, and hydrological processes that result in debris flows, floods, and rock fall have occurred for millions of years, and will occur for millions of years to come. They are naturally occurring phenomena that with current technology cannot be completely stopped or controlled. Thus, the best that can be hoped for is to minimize the destructive, highway–closing impacts of events at the study sites. The only possible means of completely negating the impacts of these events on Highway 35 is to move the highway to a location beyond the zone of influence of these events.

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Personal communications:

Charles Sciscione, ODOT Region 1 District Manager, March – August 2002

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David Riley, General Manager, Mount Hood Meadows – April 2002

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Appendices

Appendix A: Photograph Log

Historic Photographs

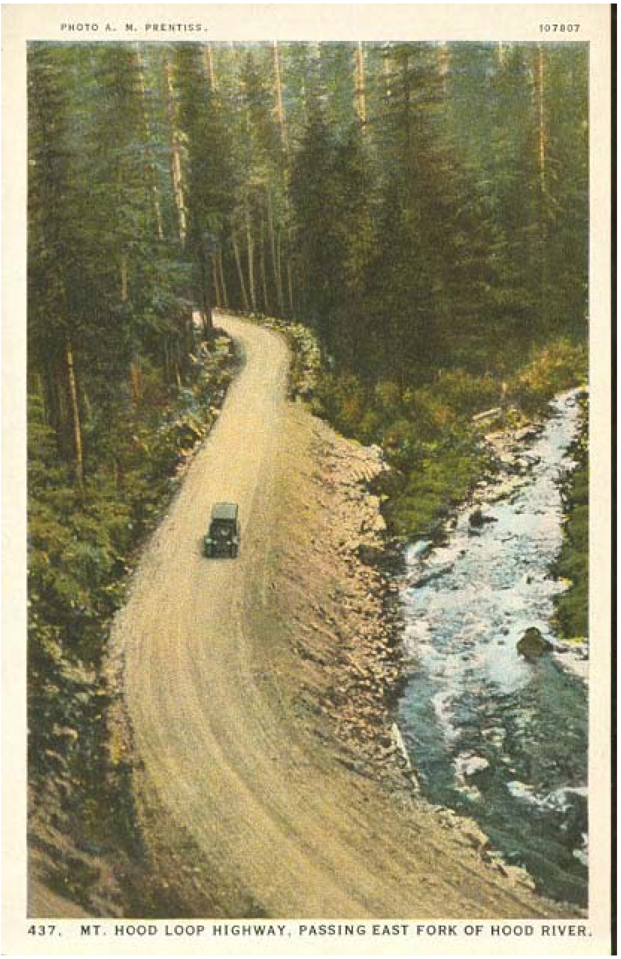


Photo 1: Mount Hood Loop Highway adjacent to the East Fork Hood River – date unknown however construction of the highway was completed in 1925

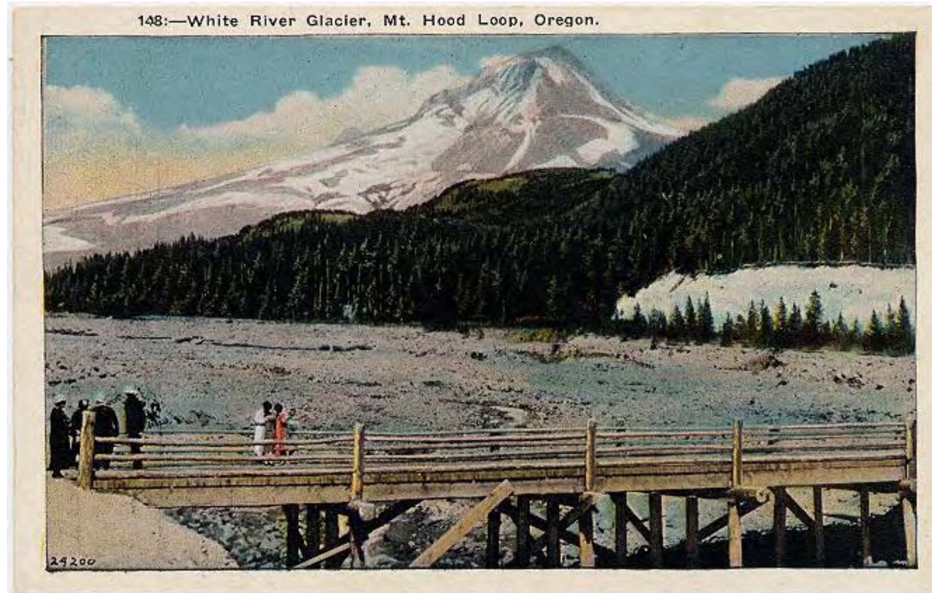


Photo 2: The first bridge at the existing White River crossing (1925 – 1954)

Photo 3: The West White River Snow Park and store at the White River crossing.

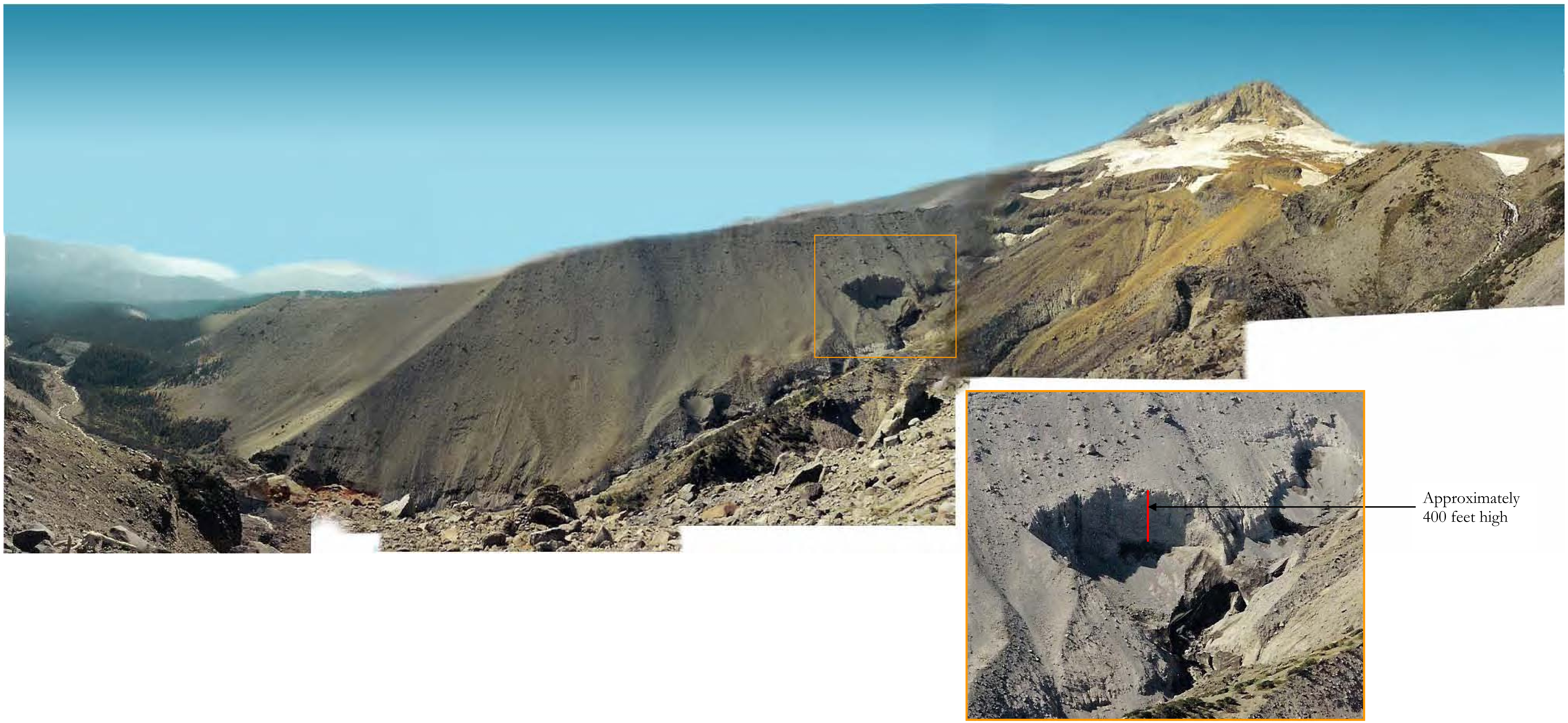


Photo 4: Panorama showing Newton Glacier, Newton Drainage, and the site of the main landslide that caused the October 2000 debris flow event. Taken on September 25 2002.

Pre and Post Event Photos

White River

Photos 5 & 6: White River Bridge after the Oct 2000 event

Photos 7 & 8: White River Bridge and Snow Park after the Oct 2000 event

Photos 9 & 10: White River Snow Park and the area downstream of White River Bridge (post 2000 event)

Newton Creek

Photos 11 & 12: Newton Creek downstream of Highway 35 – pre and post event (October 2000)

Photo 13: Highway 35 – post the October 2000

Photo 14: Highway 35 – post the October 2000

Photo 15: Newton Creek crossing after the creek jumped channel (October 2000)

Photos 16 & 17: Robin Hood Bridge on Highway 35 after the October 2000 event

Photo 18: Robin Hood Campground during the October 2000 event

The Narrows

Photo 19: High flow at the Narrows – taken in 1997 facing south

Photo 20: Rock fall at the Narrows – taken in 1997 facing north

Photo 21: The Narrows during normal flow - taken in October 2001 facing north

Polallie Creek

Photos 22 & 23: The Polallie Creek crossing after the October 1997 event

Photo 24: The Polallie Creek crossing during normal flow – taken in October 2001

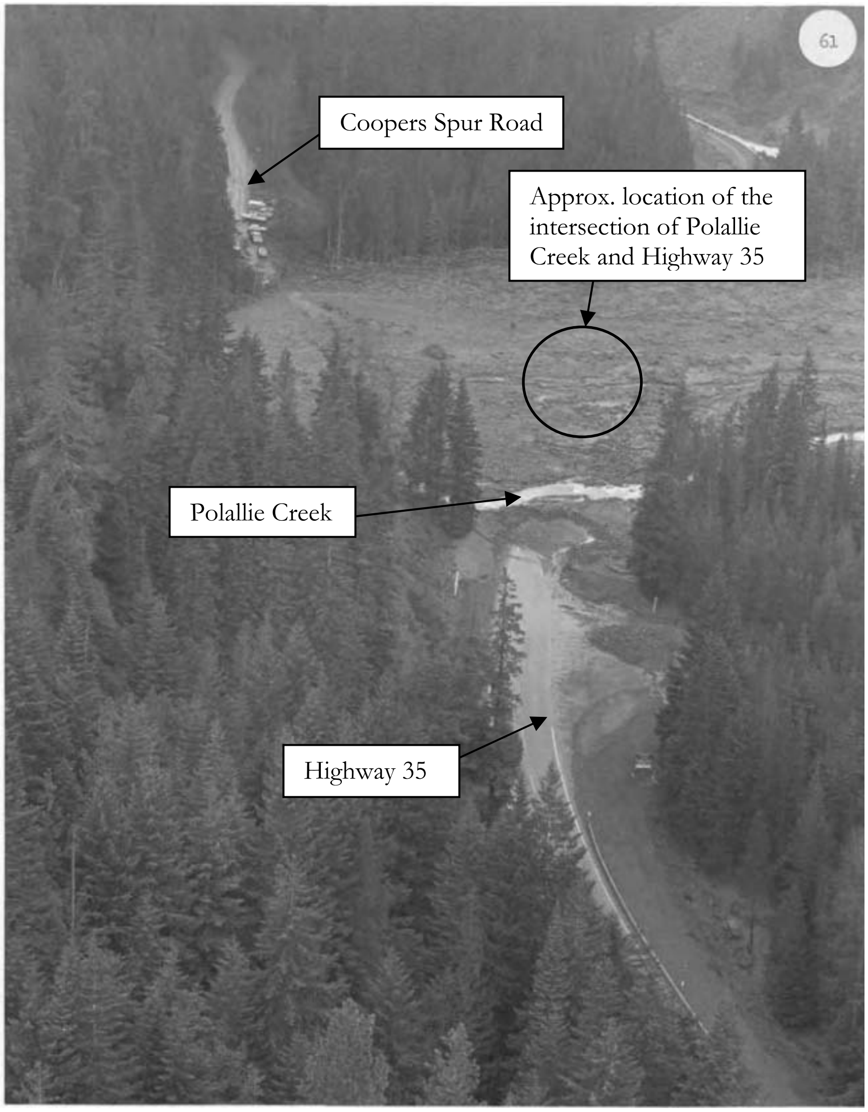


Photo 25: The Polallie Creek crossing after the 1980 Event

Dog River

Photo 26: Highway 35 adjacent to the EFHR and close to the Dog River crossing after the 1980 event

Photo 27: Secondary channel of the EFHR created in November 1999 when the river jumped out of the dike(s) constructed after the 1980 event and ran between the road and the dike.

Baseline Drive

Photo 28: The EFHR at the Baseline Drive site during the 1999 flood event

Photo 29: The EFHR at Baseline Drive (Site 2) during the 1999 flood event - facing south

Photo 30: The EFHR at Baseline Drive (Site 2) during the 1999 flood event - facing north

Debris Catchment Structures

Photo 31: Debris Dam

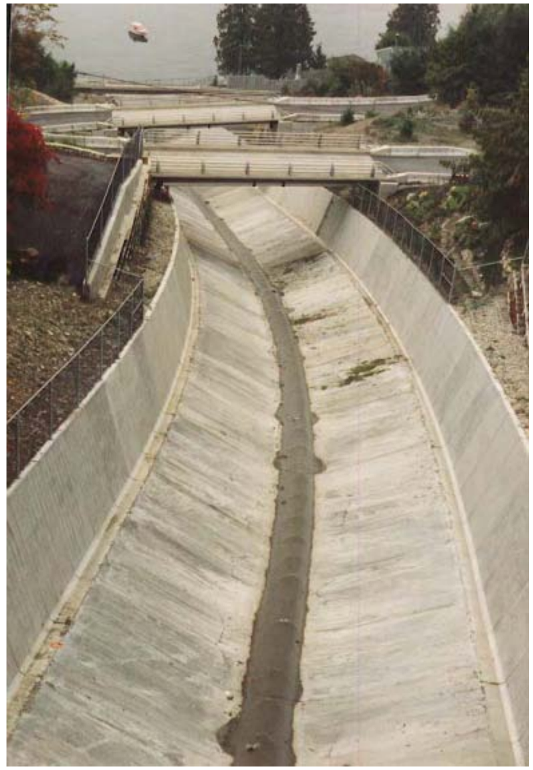


Photo 32: Debris channel

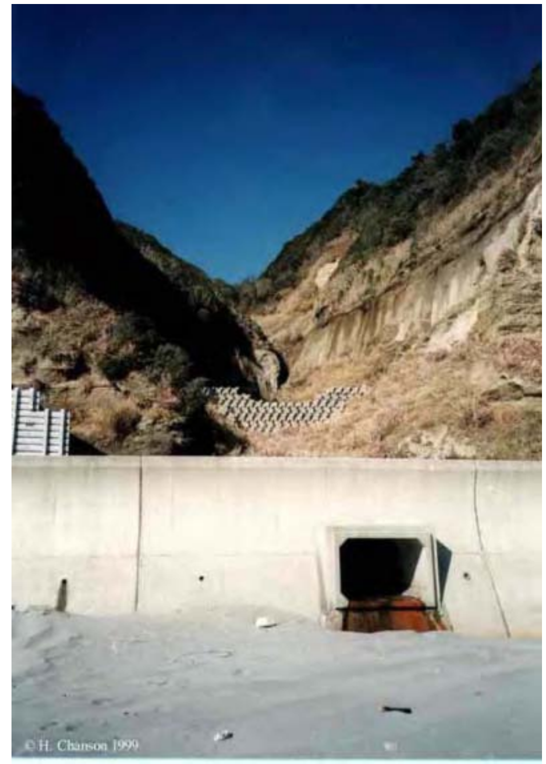


Photo 33: Permeable Sabo Dam, Japan

Rock Fall Fences

Photo 34: Crane installation of a rock fall fence on the slope above Banks-Lowman Highway, Idaho

Photo 35: Rock fall fence along Banks-Lowman Highway, Idaho

Appendix B: Supporting Data

Recent Debris Flows on Mt. Hood

(incomplete as of 4-8-02)

Year	Month	Drainage	Initiation Elev	Terminus Elev	Volume (CY)
1907	August	White	?	?	?
1926	August	White	?	?	?
1926	October	White	?	?	?
1927	?	White	?	?	?
1930	October	White	?	?	?
1935?	?	White	?	?	?
1947	October	White	?	?	?
1949	?	White	?	?	?
1959	September	White	?	?	?
1959	October	White	?	?	?
1961	September	Ladd	7000	2300	400,000
1961	September	White	?	?	?
1966	January	White	?	?	?
1967	January	White	?	?	?
1968	September	White	?	?	?
1978	August	Newton	?	?	?
1980	December	Polallie	6400	2800	120,000
1981	*September*	White	?	?	?
1991	November	Newton	?	4000	?
1995	?	Newton	?	4200	?
1996	?	Ladd	?	2400	?
1997	October	Polallie	6100	2900	50,000
1997	?	Clark	?	4400	?
1998	July	Newton	6600	6200	20,000
1998	September	White	7000	4200	220,000
1999	November	Eliot	6300	2600	130,000
1999	November	Clark	7400	4200	*40,000*
2000	*January*	Eliot	6300	2700	40,000
2000	October	Newton	7200	3500	300,000+
2000	October	Clark	8000	5400	10,000
2000	October	Eliot	6300	2700	40,000
2000	October	Sandy	7000	2600	90,000
2000	October	Muddy Fork	6000	2900	70,000
2000	October	Coe	6000	3600	*60,000*
2000	October	White	6800	4000	440,000

RECENT GEOLOGIC HISTORY OF THE UPPER WHITE RIVER VALLEY

About 12,000 years ago two major landscape-shaping processes were waning in the upper White River valley: a glacier from the last major ice age had either melted entirely or retreated substantially, and the Polallie eruptive period had ended. The White River was adjusting to the lahar deposits and pyroclastic-flow deposits which partially filled the valley. For most of the next 12,000 years the White River valley was probably free of major geologic changes. The river and slope processes developed a relatively stable valley which was forested up to at least 5500 feet elevation (Scott 1995), and probably resembled other major river valleys of the region.

About 200 years ago a remarkable change occurred. Lahars and pyroclastic flows from the Old Maid eruptive period partially filled the upper valley with large amounts of loose volcanic material, forming a depositional surface that extended roughly to the entrance to the narrow White River Canyon, about 2800 feet in elevation. At least one lahar reached Tygh Valley and covered the valley floor there (Cameron and Pringle 1987).

The loose material in the upper valley eroded rapidly. Runoff from intense rainstorms cut large gullies in the more steeply-sloped fill material in the upper valley. Most of the sediment was transported by debris flows which deposited the coarser-sized particles above 3400 feet elevation. Subsequent flood events and debris flows continued building an alluvial fill or fan that covered the valley floor. Smaller flood events deposited material at the head of the fan, larger events transported coarse material further down the fan, but generally not below 3400 feet. The evidence for this is a very thin and discontinuous soil horizon that is developing on the valley fill deposits beginning at about 3400 feet (Scott 1995). In addition, below this elevation, the channels of White River and Iron Creek are incised into the valley fill, indicating that they have been in these approximate positions for some time. In contrast, above 3400 feet to the present head of the alluvial fan near 5000 feet, there is little relief on the channel banks and the channels frequently migrate laterally in the manner of a braided stream.

Erosional remnants of the 200-year-old surface are still clearly visible in the upper valley above 4500 feet. Mesa Terrace, located between the westernmost and central drainages, is one of these remnant surfaces. Another surface of similar age is located between the central and easternmost drainages, further up-valley than Mesa Terrace. The aggrading fan head has covered the down-valley end of Mesa Terrace. The fan head is presently at 5000 feet in the westernmost drainage, 5450 feet in the central drainage, and 5400 feet in the easternmost drainage.

These remnant Old-Maid-age surfaces allow the graphical reconstruction of the valley floor as it appeared 200 years ago following the eruption. From this, it is possible to estimate the total volume of sediment transported from the upper valley to the alluvial fan since that time. Assuming an equal volume of sediment was transported from one year to the next, the average sediment production per year for the last 200 years is about 600,000 tons. If the total volume of sediment from 200 years were spread evenly over the alluvial fan surface, the thickness would be about 28 feet.

Because the original deposit was loose, over-steepened, and represented a change in river base-level, it eroded much more rapidly in the early years of the Old Maid eruptive period than it has since. Thus, 600,000 tons of sediment per year is probably an underestimate of the amount of sediment produced at first, and an overestimate of that produced now. Nevertheless, it may be considered an upper limit to the current annual level of sediment production. Estimates made with the Universal Soil Loss Equation suggest modern rates of sediment production to be about 200,000 tons per year.

VERY RECENT EVENTS IN THE UPPER WHITE RIVER VALLEY

On the morning of Thursday, September 3, 1998, a number of debris flow surges and/or small glacial outburst floods originated near the snout of the White River Glacier at approximately 7000 feet in elevation. These debris surges had the consistency of a wet cement slurry, floating small boulders and pushing larger boulders down the channels of the braided White River valley bottom. Typically a surge was 20 to 40 feet wide, 3 to 6 feet high at the snout, with a concentration of larger boulders at the front. Each surge deposited material at its flanks while the center continued to move down channel at an estimated 10 to 15 miles per hour. The net effect of the debris flow surges was to deposit material over the width of the valley bottom, raising the elevation of the valley bottom by 1 to 15 feet. These boulder-rich surges increased in frequency due to the increased glacial melt from multiple days of hot weather and the extremely high freezing level. Late in the day the size of the debris surges increased and the valley bottom elevation raised enough to allow a surge to spill into the White River Quarry where an Oregon Department of Transportation contractor was excavating sand. This particular debris surge covered the quarry floor and partially buried some equipment. The Oregon Department of Transportation shut down the quarry operations until further notice on Friday morning.

On Friday morning, the United States Geologic Survey in Vancouver, Washington, was notified of the activities that were taking place in the White River drainage. The debris surges continued to occur through Friday afternoon and Saturday. They began to dissipate in size and frequency by late Saturday and into Sunday. This was most likely a result of the cooler weather and the lower freezing level that began on Labor Day weekend and has lasted through Thursday, September 10, 1998. The Highway 35 bridge and the White River Quarry approach road were in danger of being overtopped, undermined, and breached by Friday morning. At this time, a D-9 bull dozer was brought in to try to channelize the White River under the center of the Highway 35 bridge and to protect the approach road from further damage. The attempt to channelize the stream on Friday was unsuccessful due to the unpredictable nature of the stream channel. On Saturday the human-created channel finally captured the White River and it is currently flowing under the bridge and has been re-established to its approximate location prior to the debris surge events. On Monday, the stream continued to readjust to its new channels from the glacier to the bridge and beyond. This gave a very dark brown appearance to the stream water. No debris surges were observed on Monday.

On Tuesday, September 8, 1998, the USGS surveyed the White River Glacier from the air and observed water ponding in some crevasses and minor ponding on top of the glacier. This is a sign that the glacial plumbing had been altered by glacial movement or that the plumbing could not handle the high runoff of the melting glacier from a number of record hot days in a row. This was enough evidence to convince the USGS Glaciologist and the Mt. Hood NF Geologists and Hydrologists that there was a potential for a glacial outburst flood. A glacial outburst flood is instigated when a glacier's "plumbing system" becomes clogged in one way or another and the glacial runoff water builds up in the mass of the glacier. At a critical point the glacial melt water build up will cause enough pressure to force a blow-out at the snout of the glacier. This would create a wave of water and debris that would propagate down the valley below until it reaches an unconfined portion of the valley where the glacial outburst flood power can dissipate and spread out. Based on quick and dirty USGS calculations, in the White River Valley, the power of a glacial outburst flood would begin to wane at the Timberline Trail crossing of the White River and would most likely terminate near or just beyond the Highway 35 crossing. The Oregon Department of Transportation allowed their contractor to begin work again in the White River Quarry on Tuesday.

On Wednesday, two Mt. Hood NF Geologists surveyed the White River drainages and located the drainage that was producing the debris surges. The West Fork was normal as well as the East Fork, but the Middle Fork was noticeably downcut and freshly disturbed by the four days of frequent debris surges. They climbed to the snout of the glacier and found a deeply eroded U-shaped drainage that was on average 50 feet wide by 100 feet deep. The west side wall of the drainage was glacial ice and the east side wall was glacial moraine material (loose boulders, cobbles, pebbles, and sand). This drainage was constantly calving off glacial ice on the one side or spalling rock and sand from the other side as the small stream would swing back and forth undercutting the gully slopes until they failed. At this point it was decided that Hood River Ranger District would be faced with a difficult decision to close portions of the Timberline Trail and Sno-Parks adjacent to Highway 35.

On Thursday, September 10, 1998, the Hood River Ranger District Ranger, with support from the Acting Mt. Hood NF Supervisor, decided that the prudent thing to do was to prepare a closure and public release based on the information that was currently available. The only question remaining was whether the glacier continued to pond or store water as the USGS Glaciologist witnessed on Tuesday's fly over of the White River Glacier and what the potential was for the Middle Fork to produce debris flow surges again when the predicted warm weather arrived on Friday, Saturday, and Sunday.

The USGS was contacted to do some calculations on a worst case scenario glacial outburst flood from the White River Glacier and how far it would be expected to impact the valley downstream. Simultaneously, a team of geologists, a hydrologist, and a public affairs officer ascended the mountain once again to confirm reports regarding the ponding water, and to assess the condition of the Middle Fork drainage and its potential to initiate any more debris flow surges. After assessing the Middle Fork and climbing to view points to visually examine the crevasses for ponded water, the team met to finalize their observations and hypotheses. We believe that the Middle Fork drainage was the most likely cause of the debris flow surges that occurred late last week and through the weekend. We also believe that the significant downcutting in this small drainage has created a high susceptibility for moderately to large debris flow surges to originate during the next high water event during a warming trend or possibly during a thunderstorm. We saw no ponded water on the surface and very little to no water in the crevasses that we could see into. There was a clean portion of the glacier surface near the snout that appeared to be the area that was ponding the water a few days prior. For this reason we felt that the potential for a glacial outburst flood was fairly low for the next couple of days. However, the next warming trend or thunderstorm may result in more debris flow surges similar in size or larger than those of late last week and during the Labor Day weekend. We are unsure whether the glacier plumbing has cleared or if it was just cool enough to allow the glacier to finally catch up with draining some of its runoff. The USGS estimated 500,000 cubic meters of water and debris from the potential worst case scenario glacial outburst flood. This volume would dissipate near the Highway 35 bridge or just below. These are the set of circumstances that led up to the Forest Service closure by Hood River District Ranger Kim Titus on Friday, September 11, 1998 until further notice.

We would like to thank the USGS for their quick calculations and assessment, the Mt. Hood Meadows for offering ski lift rides to expedite our investigation, the MHNF Forest Headquarters for their support and specialist personnel, and the Oregon Department of Transportation for their continued communication with the Hood River Ranger District during chaotic times.

Surface Condition of the Roadway at each Study Site

White River

Surface Condition	Generally Good - Minor areas of cracking
Overall Condition Index	80.2
Rut Index	97.0
Fatigue Index	88.7
Patch Index	98.4
No Load Index	94.7
Raveling Index	100.0
Last Repairs	2000
Bridge	Constructed in 1954, raised in 1966

Clark Creek

Surface Condition	Good – No cracking except at culvert crossings- transverse cracks on both sides of the culverts.
Overall Condition Index	80.2
Rut Index	97.0
Fatigue Index	88.7
Patch Index	98.4
NoLoad Index	94.7
Raveling Index	100.0
Last Repairs	1998

Newton Creek

Surface Condition	Good – No Cracks
Overall Condition Index	78.3
Rut Index	100.0
Fatigue Index	98.3
Patch Index	80.7
No Load Index	99.0
Raveling Index	100.0
Last Repairs	2000

The Narrows

Surface Condition	Good – New overlay – minor areas of cracking – spot areas of rock fall damage
Overall Condition Index	78.3
Rut Index	100.0
Fatigue Index	98.3
Patch Index	80.7
No Load Index	99.0
Raveling Index	100.0
Last Repairs	2000

Polallie Creek

Surface Condition	North half is Good, South half is Fair – slight to moderate cracking parallel with roadway – new overlay on the south half of the site.	
Overall Condition Index	78.3 N	57.0 S
Rut Index	100.0 N	99.0 S
Fatigue Index	98.3 N	66.8 S
Patch Index	80.7 N	99.4 S
No Load Index	99.0 N	86.0 S
Raveling Index	100.0 N	100.0 S
Last Repairs	1997	

Dog River

Surface Condition	Fair – considerable parallel cracking as well as transverse cracks.
Overall Condition Index	57.0
Rut Index	99.0
Fatigue Index	66.8
Patch Index	99.4
No Load Index	86.0
Raveling Index	100.0
Last Repairs	1999

Baseline Drive

Surface Condition	Fair – moderate parallel cracking throughout – transverse cracks at approx. 50-60 foot intervals.
Overall Condition Index	57.0
Rut Index	99.0
Fatigue Index	66.8
Patch Index	99.4
No Load Index	86.0
Raveling Index	100.0
Last Repairs	1999

Estimated peak discharge based on regression equations

Regression Equation	Q2 (cms/cfs)	Q5 (cms/cfs)	Q10 (cms/cfs)	Q25 (cms/cfs)	Q50 (cms/cfs)	Q100 (cms/cfs)
North Central						
White River	6/197	9/303	10/349	13/445	14/508	17/597
White River at Govt. Camp*	32/1147	46/1615	50/1778	62/2174	67/2372	77/2726
Clark Creek	5/161	7/250	8/289	11/372	12/426	14/502
Newton Creek	5/183	8/282	9/325	12/417	13/476	16/559
Polallie Creek	5/194	8/298	10/343	12/438	14/500	17/587
Dog River	24/830	33/1169	37/1296	45/1580	49/1745	57/2004
West Fork Hood River at Dee*	179/6305	234/8250	251/8853	294/10399	313/11061	353/12480
Eastern Cascades						
White River	1/13	2/63	2/79	3/95	3/111	4/127
White River at Govt. Camp*	1/30	13/472	15/546	17/602	19/668	21/732
Clark Creek	1/11	1/51	2/65	2/79	3/92	3/105
Newton Creek	1/12	2/57	2/72	2/87	3/102	3/116
Polallie Creek	1/12	2/60	2/75	3/91	3/107	3/121
Dog River	1/23	5/160	5/188	6/211	7/237	7/261
West Fork Hood River at Dee*	2/55	36/1267	39/1377	40/1416	43/1509	45/1598
High Cascades						
White River	4/152	8/270	11/382	15/531	19/669	23/818
White River at Govt. Camp*	31/1102	51/1792	70/2481	94/3302	115/4071	138/4871
Clark Creek	3/121	6/217	9/308	12/431	15/544	19/668
Newton Creek	4/140	7/249	10/353	14/491	18/620	21/759
Polallie Creek	4/149	7/264	11/374	15/521	19/657	23/804
Dog River	9/330	16/564	22/789	30/1076	38/1342	46/1625
West Fork Hood River at Dee*	42/1473	62/2203	82/2909	105/3713	126/4448	147/5175

Note: * = Gauged Sites

Estimated peak discharge based on drainage area ratio of gauged sites

Streams	Q100 Based on White River Gauging Station (cfs)	Q100 Based on West Fork Hood River Gauging Station (cfs)
White River	31/1107	63/2234
White River at Govt. Camp*	143/5060	289/10208
Clark Creek	26/931	53/1878
Newton Creek	29/1038	59/2095
Polallie Creek	31/1090	62/2199
Dog River	58/2052	117/4139
West Fork Hood River at Dee*	258/9121	521/18400

Note: * = Gauged Sites

Oregon State Highway 35 Feasibility Study (Metric)

White River (MP 62) Alternatives Cost Comparison

Alternative	Total	Length (m)			Cost			Bridge	Wall	Road	PE	CE
		Bridge	Wall	Road	Bridge(m^2)	Wall(m^2)	Road(m)					
1. Continued maintenance*	$1,500,000 ◊	—	—	—	—	—	—	—	—	—	—	—
2. Preventative maintenance	$2,000,000 ◊	—	—	—	—	—	—	—	—	—	—	—
3. Raise Road / Lengthen Bridge	$14,100,000	460	—	700	$1,850	—	$650	$10,380,000	—	$460,000	$2,170,000	$1,090,000
4. Realign upstream	$17,100,000	370	—	3600	$2,150	—	$950	$9,710,000	—	$3,420,000	$2,630,000	$1,320,000
5. Tunnel	$29,900,000	370	—	700	$4,950	—	$950	$22,340,000	—	$670,000	$4,610,000	$2,310,000
6. Encased highway	$25,900,000	370	—	500	$4,310	—	$950	$19,460,000	—	$480,000	$3,990,000	$2,000,000
7. Realign 1 Km Downstream	$35,100,000	900	—	2700	$2,150	—	$1,250	$23,610,000	—	$3,380,000	$5,400,000	$2,700,000
8. Realign 4 km Downstream	$22,000,000	400	—	6800	$2,150	—	$950	$10,490,000	—	$6,460,000	$3,390,000	$1,700,000
9. Bypass	$24,200,000	—	—	19600	—	—	$950	—	—	$18,620,000	$3,730,000	$1,870,000
	$7,300,000	50	—	3600	$1,850	—	$1,250	$1,130,000	—	$4,500,000	$1,130,000	$570,000

* Based on September 2000 event. ◊ 20 year period ($375,000 / 5 year period)

Clark Creek (MP 66) Alternatives Cost Comparison

Alternative	Total	Length (m)			Cost			Bridge	Wall	Road	PE	CE
		Bridge	Wall	Road	Bridge(m^2)	Wall(m^2)	Road(m)					
1. Maintain Existing Condition*	$280,000 ◊	—	—	—	—	—	—	—	—	—	—	—
2. Riprap existing bank/culverts	$330,000 #	—	—	—	—	—	—	—	—	—	—	—
3. Armored dry channel	$2,000,000	—	—	3000	—	—	$500	—	—	$1,500,000	$300,000	$150,000
4. Bypass	$13,400,000	50	—	7300	$1,850	—	$1,250	$1,130,000	—	$9,130,000	$2,060,000	$1,030,000
4A. Bypass	$14,700,000	30	—	8500	$1,850	—	$1,250	$680,000	—	$10,630,000	$2,270,000	$1,140,000
5. Raised road with culverts	$4,900,000	—	—	3000	—	—	$1,250	—	—	$3,750,000	$750,000	$380,000
6. Raised road/permeable bank	$3,700,000	—	—	3000	—	—	$950	—	—	$2,850,000	$570,000	$290,000
7. Bridge	$900,000	30	—	—	$1,850	—	—	$680,000	—	—	$140,000	$70,000

* Based on November 1999 event. ◊ 20 year period ($70,000 / 5 year period) # $50,000 plus $70,000 / 5 year period

Oregon State Highway 35 Feasibility Study (Metric)

Newton Creek (MP 68) Alternatives Cost Comparison

Alternative	Total	Length (m)			Cost			Bridge	Wall	Road	PE	CE
		Bridge	Wall	Road	Bridge(m^2)	Wall(m^2)	Road(m)					
1. Maintain Existing Condition*	$3,000,000 ◊	—	—	—	—	—	—	—	—	—	—	—
2. Protect existing bank/culverts	$3,080,000 #	—	—	—	—	—	—	—	—	—	—	—
3. Armored dry channel	$1,200,000	—	—	1800	—	—	$500	—	—	$900,000	$180,000	$90,000
4. Bypass	$13,400,000	50	—	7300	$1,850	—	$1,250	$1,130,000	—	$9,130,000	$2,060,000	$1,030,000
4A. Bypass	$14,700,000	30	—	8500	$1,850	—	$1,250	$680,000	—	$10,630,000	$2,270,000	$1,140,000
5. Raised road with culverts	$2,900,000	—	—	1800	—	—	$1,250	—	—	$2,250,000	$450,000	$230,000
6. Raised road/permeable bank	$2,200,000	—	—	1800	—	—	$950	—	—	$1,710,000	$350,000	$180,000

* Based on September 2000 event. ◊ 20 year period ($750,000 / 5 year period) # $80,000 plus $750,000 / 5 year period

Narrows/Canyon (MP 73) Alternatives Cost Comparison

Alternative	Total	Length (m)			Cost			Bridge	Wall	Road	PE	CE
		Bridge	Wall	Road	Bridge(m^2)	Wall(m^2)	Road(m)					
1. Maintain Existing Condition*	$750,000 ◊	—	—	—	—	—	—	—	—	—	—	—
2. Raise roadway/retaining wall	$6,700,000	—	500	500	—	$1,600	$650	—	$4,800,000	$330,000	$1,030,000	$520,000
3. Construct half-bridge	$16,000,000	750	—	—	$2,690	—	—	$12,310,000	—	—	$2,470,000	$1,240,000
4. Bypass on FS 44/17	$53,300,000	—	—	32800	—	—	$1,250	—	—	$41,000,000	$8,200,000	$4,100,000
5. Bypass to West	$14,100,000	330	—	2700	$1,850	—	$1,250	$7,450,000	—	$3,380,000	$2,170,000	$1,090,000

* Based on 2001 event ◊ 20 year period ($75,000 / 2 year period)

Polallie Creek (MP 74) Alternatives Cost Comparison

Alternative	Total	Length (m)			Cost			Bridge	Wall	Road	PE	CE
		Bridge	Wall	Road	Bridge(m^2)	Wall(m^2)	Road(m)					
1. Maintain Existing Condition*	$200,000 ◊	—	—	—	—	—	—	—	—	—	—	—
2. Debris Control Structure	$3,100,000	—	60	—	—	$4,000	—	—	$2,400,000	—	$480,000	$240,000
3. Realign Road & 90m Bridge	$3,500,000	90	—	1000	$1,850	—	$650	$2,030,000	—	$650,000	$540,000	$270,000
4. Bypass on FS 44/17	$53,300,000	—	—	32800	—	—	$1,250	—	—	$41,000,000	$8,200,000	$4,100,000
5. Bypass to West	$14,100,000	330	—	2700	$1,850	—	$1,250	$7,450,000	—	$3,380,000	$2,170,000	$1,090,000
6. 30 m Bridge Existing Alignment	$1,400,000	30	—	600	$1,850	—	$650	$680,000	—	$390,000	$220,000	$110,000
7. Two 30 m Bridges	$2,500,000	60	—	900	$1,850	—	$650	$1,350,000	—	$590,000	$390,000	$200,000
8. Raise Roadway & 90 m bridge	$3,200,000	90	—	600	$1,850	—	$650	$2,030,000	—	$390,000	$490,000	$250,000

* Based on 1997 event ◊ 20 year period ($20,000 / 2 year period)

Oregon State Highway 35 Feasibility Study (Metric)

Dog River (MP 78) Alternatives Cost Comparison

Alternative	Total	Length (m)			Cost			Bridge	Wall	Road	PE	CE
		Bridge	Wall	Road	Bridge(m^2)	Wall(m^2)	Road(m)					
1. Maintain Existing Condition*	$300,000 ◊	—	—	—	—	—	—	—	—	—	—	—
2. Realign to East	$5,400,000	20	—	3900	$1,850	—	$950	$450,000	—	$3,710,000	$840,000	$420,000
3. Realign to West	$8,200,000	90	—	4500	$1,850	—	$950	$2,030,000	—	$4,280,000	$1,270,000	$640,000
4. Bypass on 44/17	$53,300,000	—	—	32800	—	—	$1,250	—	—	$41,000,000	$8,200,000	$4,100,000
5. Barbs and Armour	$420,000 #	—	—	400	—	—	$500	—	—	$200,000	$40,000	$20,000
6. Raise Road & Retaining Wall	$3,000,000	—	400	400	—	$800	$950	—	$1,920,000	$380,000	$460,000	$230,000

* Based on November 1999 event. ◊ 20 year period ($75,000 / 5 year period) # $260,000 plus $40,000 / 5 year period

Baseline - Site 1 (MP 80) Alternatives Cost Comparison

Alternative	Total	Length (m)			Cost			Bridge	Wall	Road	PE	CE
		Bridge	Wall	Road	Bridge(m^2)	Wall(m^2)	Road(m)					
1. Maintain Existing Condition*	$250,000 ◊	—	—	—	—	—	—	—	—	—	—	—
2. Realign to East	$5,400,000	20	—	3900	$1,850	—	$950	$450,000	—	$3,710,000	$840,000	$420,000
3. Realign to West	$8,200,000	90	—	4500	$1,850	—	$950	$2,030,000	—	$4,280,000	$1,270,000	$640,000
4. Bypass on 44/17	$53,300,000	—	—	32800	—	—	$1,250	—	—	$41,000,000	$8,200,000	$4,100,000
5. Riprap Bank	$280,000 #	—	—	25	—	—	$500	—	—	$10,000	$10,000	$10,000
6. Realign & Riprap Bank	$140,000 +	—	—	45	—	—	$500	—	—	$20,000	$10,000	$10,000

* Based on November 1999 event. ◊ 20 year period ($25,000 / 2 year period) # $30,000 plus $25,000 / 2 year period + $40,000 plus $25,000 / 5 yr period

Baseline - Site 2 (MP 80) Alternatives Cost Comparison

Alternative	Total	Length (m)			Cost			Bridge	Wall	Road	PE	CE
		Bridge	Wall	Road	Bridge(m^2)	Wall(m^2)	Road(m)					
1. Maintain Existing Condition*	$250,000 ◊	—	—	—	—	—	—	—	—	—	—	—
2. Realign to East	$5,400,000	20	—	3900	$1,850	—	$950	$450,000	—	$3,710,000	$840,000	$420,000
3. Realign to West	$8,200,000	90	—	4500	$1,850	—	$950	$2,030,000	—	$4,280,000	$1,270,000	$640,000
4. Bypass on 44/17	$53,300,000	—	—	32800	—	—	$1,250	—	—	$41,000,000	$8,200,000	$4,100,000
5. Retaining Wall	$1,700,000	—	240	240	—	$800	$650	—	$1,150,000	$160,000	$270,000	$140,000
6. Remove island	$320,000 #	—	—	240	—	—	$500	—	—	$120,000	$30,000	$20,000
7. Via-duct	$9,200,000	240	—	—	$2,420	—	—	$7,090,000	—	—	$1,420,000	$710,000
8. Re-channel Stream	$250,000 +	—	—	240	—	—	$300	—	—	$70,000	$20,000	$10,000
9. Barbs	$250,000 +	—	—	240	—	—	$300	—	—	$70,000	$20,000	$10,000

* Based on November 1999 event. ◊ 20 year period ($25,000 / 2 year period) # $170,000 plus $15,000 / 2 year period + $100,000 plus $15,000 / 2 year period

Oregon State Highway 35 Feasibility Study (English)

White River (MP 62) Alternatives Cost Comparison

Alternative	Total	Length (ft)			Cost			Bridge	Wall	Road	PE	CE
		Bridge	Wall	Road	Bridge(ft^2)	Wall(ft^2)	Road(ft)					
1. Continued maintenance*	$1,500,000 ◊	—	—	—	—	—	—	—	—	—	—	—
2. Preventative maintenance	$2,000,000 ◊	—	—	—	—	—	—	—	—	—	—	—
3. Raise Road / Lengthen Bridge	$14,100,000	1509	—	2297	$172	—	$198	$10,380,000	—	$460,000	$2,170,000	$1,090,000
4. Realign upstream	$17,100,000	1214	—	11811	$200	—	$290	$9,700,000	—	$3,420,000	$2,630,000	$1,320,000
5. Tunnel	$29,900,000	1214	—	2297	$460	—	$290	$22,340,000	—	$670,000	$4,610,000	$2,310,000
6. Encased highway	$25,900,000	1214	—	1640	$400	—	$290	$19,420,000	—	$480,000	$3,980,000	$1,990,000
7. Realign 1 Km Downstream	$35,100,000	2953	—	8858	$200	—	$381	$23,590,000	—	$3,380,000	$5,400,000	$2,700,000
8. Realign 4 km Downstream	$22,000,000	1312	—	22310	$200	—	$290	$10,480,000	—	$6,460,000	$3,390,000	$1,700,000
9. Bypass	$24,200,000	—	—	64304	—	—	$290	—	—	$18,620,000	$3,730,000	$1,870,000
	$7,300,000	164	—	11811	$172	—	$381	$1,130,000	—	$4,500,000	$1,130,000	$570,000

* Based on September 2000 event. ◊ 20 year period ($375,000 / 5 year period)

Clark Creek (MP 66) Alternatives Cost Comparison

Alternative	Total	Length (ft)			Cost			Bridge	Wall	Road	PE	CE
		Bridge	Wall	Road	Bridge(ft^2)	Wall(ft^2)	Road(ft)					
1. Maintain Existing Condition*	$280,000 ◊	—	—	—	—	—	—	—	—	—	—	—
2. Riprap existing bank/culverts	$330,000 #	—	—	—	—	—	—	—	—	—	—	—
3. Armored dry channel	$2,000,000	—	—	9843	—	—	$152	—	—	$1,500,000	$300,000	$150,000
4. Bypass	$13,400,000	164	—	23950	$172	—	$381	$1,130,000	—	$9,130,000	$2,060,000	$1,030,000
4A. Bypass	$14,700,000	98	—	27887	$172	—	$381	$680,000	—	$10,630,000	$2,270,000	$1,140,000
5. Raised road with culverts	$4,900,000	—	—	9843	—	—	$381	—	—	$3,750,000	$750,000	$380,000
6. Raised road/permeable bank	$3,700,000	—	—	9843	—	—	$290	—	—	$2,850,000	$570,000	$290,000
7. Bridge	$900,000	98	—	—	$172	—	—	$680,000	—	—	$140,000	$70,000

* Based on November 1999 event. ◊ 20 year period ($70,000 / 5 year period) # $50,000 plus $70,000 / 5 year period

Oregon State Highway 35 Feasibility Study (English)

Newton Creek (MP 68) Alternatives Cost Comparison

Alternative	Total	Length (ft)			Cost			Bridge	Wall	Road	PE	CE
		Bridge	Wall	Road	Bridge(ft^2)	Wall(ft^2)	Road(ft)					
1. Maintain Existing Condition*	$3,000,000 ◊	—	—	—	—	—	—	—	—	—	—	—
2. Protect existing bank/culverts	$3,080,000 #	—	—	—	—	—	—	—	—	—	—	—
3. Armored dry channel	$1,200,000	—	—	5906	—	—	$152	—	—	$900,000	$180,000	$90,000
4. Bypass	$13,400,000	164	—	23950	$172	—	$381	$1,130,000	—	$9,130,000	$2,060,000	$1,030,000
4A. Bypass	$14,700,000	98	—	27887	$172	—	$381	$680,000	—	$10,630,000	$2,270,000	$1,140,000
5. Raised road with culverts	$2,900,000	—	—	5906	—	—	$381	—	—	$2,250,000	$450,000	$230,000
6. Raised road/permeable bank	$2,200,000	—	—	5906	—	—	$290	—	—	$1,710,000	$350,000	$180,000

* Based on September 2000 event. ◊ 20 year period ($750,000 / 5 year period) # $80,000 plus $750,000 / 5 year period

Narrows/Canyon (MP 73) Alternatives Cost Comparison

Alternative	Total	Length (ft)			Cost			Bridge	Wall	Road	PE	CE
		Bridge	Wall	Road	Bridge(ft^2)	Wall(ft^2)	Road(ft)					
1. Maintain Existing Condition*	$750,000 ◊	—	—	—	—	—	—	—	—	—	—	—
2. Raise roadway/retaining wall	$6,700,000	—	1640	1640	—	$147	$198	—	$4,820,000	$330,000	$1,030,000	$520,000
3. Construct half-bridge	$16,000,000	2461	—	—	$250	—	—	$12,300,000	—	—	$2,460,000	$1,230,000
4. Bypass on FS 44/17	$53,300,000	—	—	107612	—	—	$381	—	—	$41,000,000	$8,200,000	$4,100,000
5. Bypass to West	$14,100,000	1083	—	8858	$172	—	$381	$7,440,000	—	$3,380,000	$2,170,000	$1,090,000

* Based on 2001 event ◊ 20 year period ($75,000 / 2 year period)

Polallie Creek (MP 74) Alternatives Cost Comparison

Alternative	Total	Length (ft)			Cost			Bridge	Wall	Road	PE	CE
		Bridge	Wall	Road	Bridge(ft^2)	Wall(ft^2)	Road(ft)					
1. Maintain Existing Condition*	$200,000 ◊	—	—	—	—	—	—	—	—	—	—	—
2. Debris Control Structure	$3,100,000	—	197	—	—	$370	—	—	$2,400,000	—	$480,000	$240,000
3. Realign Road & 90m Bridge	$3,500,000	295	—	3281	$172	—	$198	$2,030,000	—	$650,000	$540,000	$270,000
4. Bypass on FS 44/17	$53,300,000	—	—	107612	—	—	$381	—	—	$41,000,000	$8,200,000	$4,100,000
5. Bypass to West	$14,100,000	1083	—	8858	$172	—	$381	$7,440,000	—	$3,380,000	$2,170,000	$1,090,000
6. 30 m Bridge Existing Alignment	$1,400,000	98	—	1969	$172	—	$198	$680,000	—	$390,000	$220,000	$110,000
7. Two 30 m Bridges	$2,500,000	197	—	2953	$172	—	$198	$1,350,000	—	$590,000	$390,000	$200,000
8. Raise Roadway & 90 m bridge	$3,200,000	295	—	1969	$172	—	$198	$2,030,000	—	$390,000	$490,000	$250,000

* Based on 1997 event ◊ 20 year period ($20,000 / 2 year period)

Oregon State Highway 35 Feasibility Study (English)

Dog River (MP 78) Alternatives Cost Comparison

Alternative	Total	Length (ft)			Cost			Bridge	Wall	Road	PE	CE
		Bridge	Wall	Road	Bridge(ft^2)	Wall(ft^2)	Road(ft)					
1. Maintain Existing Condition*	$300,000 ◊	—	—	—	—	—	—	—	—	—	—	—
2. Realign to East	$5,400,000	66	—	12795	$172	—	$290	$450,000	—	$3,710,000	$840,000	$420,000
3. Realign to West	$8,200,000	295	—	14764	$172	—	$290	$2,030,000	—	$4,280,000	$1,270,000	$640,000
4. Bypass on 44/17	$53,300,000	—	—	107612	—	—	$381	—	—	$41,000,000	$8,200,000	$4,100,000
5. Barbs and Armour	$420,000 #	—	—	1312	—	—	$152	—	—	$200,000	$40,000	$20,000
6. Raise Road & Retaining Wall	$3,000,000	—	1312	1312	—	$74	$290	—	$1,940,000	$380,000	$470,000	$240,000

* Based on November 1999 event. ◊ 20 year period ($75,000 / 5 year period) # $260,000 plus $40,000 / 5 year period

Baseline - Site 1 (MP 80) Alternatives Cost Comparison

Alternative	Total	Length (ft)			Cost			Bridge	Wall	Road	PE	CE
		Bridge	Wall	Road	Bridge(ft^2)	Wall(ft^2)	Road(ft)					
1. Maintain Existing Condition*	$250,000 ◊	—	—	—	—	—	—	—	—	—	—	—
2. Realign to East	$5,400,000	66	—	12795	$172	—	$290	$450,000	—	$3,710,000	$840,000	$420,000
3. Realign to West	$8,200,000	295	—	14764	$172	—	$290	$2,030,000	—	$4,280,000	$1,270,000	$640,000
4. Bypass on 44/17	$53,300,000	—	—	107612	—	—	$381	—	—	$41,000,000	$8,200,000	$4,100,000
5. Riprap Bank	$280,000 #	—	—	82	—	—	$152	—	—	$10,000	$10,000	$10,000
6. Realign & Riprap Bank	$140,000 +	—	—	148	—	—	$152	—	—	$20,000	$10,000	$10,000

* Based on November 1999 event. ◊ 20 year period ($25,000 / 2 year period) # $30,000 plus $25,000 / 2 year period + $40,000 plus $25,000 / 5 yr period

Baseline - Site 2 (MP 80) Alternatives Cost Comparison

Alternative	Total	Length (ft)			Cost			Bridge	Wall	Road	PE	CE
		Bridge	Wall	Road	Bridge(ft^2)	Wall(ft^2)	Road(ft)					
1. Maintain Existing Condition*	$250,000 ◊	—	—	—	—	—	—	—	—	—	—	—
2. Realign to East	$5,400,000	66	—	12795	$172	—	$290	$450,000	—	$3,710,000	$840,000	$420,000
3. Realign to West	$8,200,000	295	—	14764	$172	—	$290	$2,030,000	—	$4,280,000	$1,270,000	$640,000
4. Bypass on 44/17	$53,300,000	—	—	107612	—	—	$381	—	—	$41,000,000	$8,200,000	$4,100,000
5. Retaining Wall	$1,700,000	—	787	787	—	$74	$198	—	$1,165,000	$160,000	$270,000	$140,000
6. Remove island	$320,000 #	—	—	787	—	—	$152	—	—	$120,000	$30,000	$20,000
7. Via-duct	$9,200,000	787	—	—	$225	—	—	$7,080,000	—	—	$1,420,000	$710,000
8. Re-channel Stream	$250,000 +	—	—	787	—	—	$91	—	—	$70,000	$20,000	$10,000
9. Barbs	$250,000 +	—	—	787	—	—	$91	—	—	$70,000	$20,000	$10,000

* Based on November 1999 event. ◊ 20 year period ($25,000 / 2 year period) # $170,000 plus $15,000 / 2 year period + $100,000 plus $15,000 / 2 year period

Potential Damage Repair Costs - Catastrophic Event

White River		Quantity	Unit	Unit Cost	Cost
1455 m	Base	14180	Ton	$ 20.00	$ 283,600.00
	Asphalt	2300	Ton	$ 32.00	$ 73,600.00
	Bridge - White River (48 m)	571.2	m^2 Deck	$ 1,500.00	$ 856,800.00
	Embankment	76000	m^3	$ 5.00	$ 380,000.00
	Riprap	13180	m^3	$ 50.00	$ 659,000.00
	Culvert replacement (1)	22	m	$ 130.00	$ 2,860.00
	Construction/Closure time	24-30	months		$ -
				Total	$ 2,255,860.00

Clark-Newton		Quantity	Unit	Unit Cost	Cost
5055 m	Base	50530	Ton	$ 20.00	$ 1,010,600.00
	Asphalt	8180	Ton	$ 32.00	$ 261,760.00
	Bridge - East Fork Hood River (30 m)	364.8	m^2 Deck	$ 1,500.00	$ 547,200.00
	Bridge - Newton (9 m)	108	m^2 Deck	$ 1,500.00	$ 162,000.00
	Embankment	270850	m^3	$ 5.00	$ 1,354,250.00
	Riprap	46150	m^3	$ 50.00	$ 2,307,500.00
2.9x1.9 m	Culvert replacement (1)	22	m	$ 1,000.00	$ 22,000.00
	Construction/Closure time	6-12	months		$ -
				Total	$ 5,665,310.00

Polallie		Quantity	Unit	Unit Cost	Cost
705 m	Base	7110	Ton	$ 20.00	$ 142,200.00
	Asphalt	1150	Ton	$ 32.00	$ 36,800.00
	Embankment	38070	m^3	$ 5.00	$ 190,350.00
	Riprap	6850	m^3	$ 50.00	$ 342,500.00
3.8x2.4 m / 3.8x2.1m	Culvert replacement (2)	48	m	$ 1,000.00	$ 48,000.00
	Construction/Closure time	6-12	months		$ -
				Total	$ 759,850.00

Narrows		Quantity	Unit	Unit Cost	Cost
1305 m	Base	12840	Ton	$ 20.00	$ 256,800.00
	Asphalt	2080	Ton	$ 32.00	$ 66,560.00
	Bridge - East Fork Hood River (30 m)	364.8	m^2 Deck	$ 1,500.00	$ 547,200.00
	Embankment	68830	m^3	$ 5.00	$ 344,150.00
	Riprap	11980	m^3	$ 50.00	$ 599,000.00
	Culvert replacement (1)	22	m	$ 130.00	$ 2,860.00
	Construction/Closure time	12-24	months		$ -
				Total	$ 1,816,570.00

Potential Damage Repair Costs - Catastrophic Event

Dog River		Quantity	Unit	Unit Cost	Cost
2500 m	Base	24760	Ton	$ 20.00	$ 495,200.00
	Asphalt	4010	Ton	$ 32.00	$ 128,320.00
	Bridge - East Fork Hood River (43 m)	511.2	m^2 Deck	$ 1,500.00	$ 766,800.00
	Embankment	132700	m^3	$ 5.00	$ 663,500.00
	Riprap	22630	m^3	$ 50.00	$ 1,131,500.00
1.5x3.0 m	Culvert replacement (2)	50	m	$ 1,200.00	$ 60,000.00
	Construction/Closure time	12-24	months		$ -
				Total	$ 3,245,320.00

Baseline		Quantity	Unit	Unit Cost	Cost
2105 m	Base	20940	Ton	$ 20.00	$ 418,800.00
	Asphalt	3390	Ton	$ 32.00	$ 108,480.00
	Bridge - Baseline Drive (27 m)	325.2	m^2 Deck	$ 1,500.00	$ 487,800.00
	Embankment	112210	m^3	$ 5.00	$ 561,050.00
	Riprap	19210	m^3	$ 50.00	$ 960,500.00
	Culvert replacement (0)	0	m	$ 130.00	$ -
	Construction/Closure time	12-24	months		$ -
				Total	$ 2,536,630.00

Quantity Considerations and Assumptions

Roadway length	Assume catastrophic event destroying roadway and structures on full width of flood plain.	
Base	0.450 m thickness, 12.30 m average width	1.82 Ton / m^3
Asphalt	0.075 m thickness, 11.20 m average width	1.94 Ton / m^3
Bridges	12 m bridge deck width	
Embankment	1:2 sideslope, 3 m embankment depth, 12 m roadway width, for the length of the road minus bridge lengths	
Riprap	3 m depth, 3 m height, 1:2 slope for length of flood plain minus bridge lengths, plus 22 m through bridge and 6 m on downstream side at each abutment	
Culvert replacement	Length at bottom of embankment	
Construction / Closure	Time that the road will be closed during reconstruction - Detour necessary	

Department of Environmental Quality Laboratory

Water Quality Monitoring Section Datalogger Monitoring Report

STORET #	SITENAME	FILENAME	CASE #
405996	East Fork Hood River @ County Gravel Pit, near Trout Cr. Bridge	CUTHD153	
	June 01 to June 05, 1998		

NOTE: Logged data is reported in database-ready format. Data available via electronic transfer (floppy) upon request or can be retrieved from agency database/STORET.

ELEVATION 1090

TEMPERATURE AUDIT RESULTS

#	Audit	DS Value	Abs. Difference	Status
1	14.5	14.48	0.02	PASS
2	12.1	12.15	0.05	PASS
3	11.8	11.83	0.03	PASS
4	12.1	12.12	0.02	PASS

Criteria:

PASS	ESTIMATE	FAIL
<1.5	1.51 - 2.00	>2.01

pH AUDIT RESULTS

#	Audit	DS Value	Abs. Difference	Status
1	7.5	7.63	0.13	PASS
2	7.7	7.54	0.16	PASS
3	7.7	7.55	0.15	PASS
4	7.8	7.53	0.27	PASS

Criteria:

PASS	ESTIMATE	FAIL
<0.3	0.3 - 0.4	>0.4

CONDUCTIVITY AUDIT RESULTS

#	Audit	DS Value	Abs % Difference	Status
1	53	48.2	9	PASS
2	56	45.4	19	FAIL
3	53	45	15	EST
4	50	44	12	EST

Criteria:

PASS	ESTIMATE	FAIL
<10%	10% - 15%	>15%

DO AUDIT RESULTS

#	Audit	DS Value	Abs. Difference	Status
1	9.9	9.7	0.20	PASS
2	10.5	10.53	0.03	PASS
3	10.6	10.74	0.14	PASS
4	10.5	10.7	0.20	PASS

Criteria:

PASS	ESTIMATE	FAIL
<1.0	1.0 - 2.0	>2.01

RUN COMMENTS:

AUDIT RESULTS:

AUDIT #	STORET #	DATE (YYMMDD)	TIME (HHMM)	TEMP (deg C)	pH (SU)	CONDUCTIVITY (umhos/cm)	DO (mg/L)	DO SAT %	COMMENTS
1	405996	6/1/1998	1645	14.5	7.5	53	9.9		
2	405996	6/2/1998	1515	12.1	7.7	56	10.5		
3	405996	6/3/1998	1340	11.8	7.7	53	10.6		
4	405996	6/5/1998	1328	12.1	7.8	50	10.5		

Department of Environmental Quality Laboratory

Water Quality Monitoring Section Datalogger Monitoring Report

STORET #	SITENAME	FILENAME	CASE #
405996	E.Fork Hood River @ County Gravel Pit, off Hwy.281	NWTHD215	
	River Mile: 0.75		
	Aug. 3-7, 1998		

NOTE: Logged data is reported in database-ready format. Data available via electronic transfer (floppy) upon request or can be retrieved from agency database/STORET.

ELEVATION 1090

TEMPERATURE AUDIT RESULTS

#	Audit	DS Value	Abs. Difference	Status
	16.5	16.4	0.10	Pass
	20.5	20.3	0.20	Pass
	19.1	18.9	0.20	Pass
	17.2	17	0.20	Pass
	13.9	13.7	0.20	Pass

Criteria:

PASS	ESTIMATE	FAIL
<1.5	1.51 - 2.00	>2.01

pH AUDIT RESULTS

#	Audit	DS Value	Abs. Difference	Status
	7.8	7.7	0.10	Pass
	7.3	7.7	0.40	Est
	7.7	7.9	0.20	Pass
	7.8	7.9	0.10	Pass
	7.9	7.9	0.00	Pass

Criteria:

PASS	ESTIMATE	FAIL
<0.3	0.3 - 0.4	>0.4

CONDUCTIVITY AUDIT RESULTS

#	Audit	DS Value	Abs % Difference	Status
	58	49	16	Fail
	56	49	13	Est
	54	47	13	Est
	55	48	13	Est
	58	50	14	Est

Criteria:

PASS	ESTIMATE	FAIL
<10%	10% - 15%	>15%

DO AUDIT RESULTS

#	Audit	DS Value	Abs. Difference	Status
	9.5	9.2	0.30	Pass
	8.6	8.8	0.20	Pass
	8.9	9.2	0.30	Pass
	9.5	9.7	0.20	Pass
	10	10.5	0.50	Pass

Criteria:

PASS	ESTIMATE	FAIL
<1.0	1.0 - 2.0	>2.01

RUN COMMENTS:

AUDIT RESULTS:

AUDIT #	STORET #	DATE (YYMMDD)	TIME (HHMM)	TEMP (deg C)	pH (SU)	CONDUCTIVITY (umhos/cm)	DO (mg/L)	DO SAT %	COMMENTS
1	405996	980803	1305	16.5	7.8	58	9.5		
2	405996	980804	1705	20.5	7.3	56	8.6		
3	405996	980805	1550	19.1	7.7	54	8.9		
4	405996	980806	1510	17.2	7.8	55	9.5		
5	405996	980807	1210	13.9	7.9	58	10		

Department of Environmental Quality Laboratory

Water Quality Monitoring Section Datalogger Monitoring Report

STORET #	SITENAME	FILENAME	CASE #
405996	East Fork Hood River @ County Gravel Pit	SCUHR278	
	River Mile: 0.75		
	Oct. 5-9, 1998		

NOTE: Logged data is reported in database-ready format. Data available via electronic transfer (floppy) upon request or can be retrieved from agency database/STORET.

ELEVATION 1090

TEMPERATURE AUDIT RESULTS

#	Audit	DS Value	Abs. Difference	Status
1	8.4	8.5	0.10	Pass
2	10.8	10.7	0.10	Pass
3	11.1	11	0.10	Pass
4	10.4	10	0.40	Pass
5				

Criteria:

PASS	ESTIMATE	FAIL
<1.5	1.51 - 2.00	>2.01

pH AUDIT RESULTS

#	Audit	DS Value	Abs. Difference	Status
1	7.9	7.8	0.10	Pass
2	7.7	7.8	0.10	Pass
3	7.8	7.9	0.10	Pass
4	7.9	7.9	0.00	Pass
5				

Criteria:

PASS	ESTIMATE	FAIL
<0.3	0.3 - 0.4	>0.4

CONDUCTIVITY AUDIT RESULTS

#	Audit	DS Value	Abs % Difference	Status
1	73	64	12	Est
2	70	66	6	Pass
3	71	66	7	Pass
4	69	65	6	Pass
5				

Criteria:

PASS	ESTIMATE	FAIL
<10%	10% - 15%	>15%

DO AUDIT RESULTS

#	Audit	DS Value	Abs. Difference	Status
1	11.2	11.8	0.60	Pass
2	10.7	10.8	0.10	Pass
3	10.6	10.7	0.10	Pass
4	10.9	11.1	0.20	Pass
5				

Criteria:

PASS	ESTIMATE	FAIL
<1.0	1.0 - 2.0	>2.01

RUN COMMENTS:

AUDIT RESULTS:

AUDIT #	STORET #	DATE (YYMMDD)	TIME (HHMM)	TEMP (deg C)	pH (SU)	CONDUCTIVITY (umhos/cm)	DO (mg/L)	DO SAT %	COMMENTS
1	405996	981005	1330	8.4	7.9	73	11.2		
2	405996	981006	1610	10.8	7.7	70	10.7		
3	405996	981007	1502	11.1	7.8	71	10.6		
4	405996	981008	1347	10.4	7.9	69	10.9		
5	405996	981009	1010	9.0	7.8	71	11.5		

Bank Stabilization and Habitat Enhancement Pilot Project

NOOKSACK RIVER, WASHINGTON

Inter-Fluve was retained by Whatcom County to address severe erosion at two sites totaling 3,100 feet of riverbank. As a pilot project, the work was carried out to test the ability of non-riprap bank treatments to control bank erosion and to create salmonid habitat.

Bank treatments included barbs constructed of logs cabled to wooden piles, barbs consisting of a stone foundation and an upper surface of concrete dolos, and barbs built entirely of stone. Special provisions were made to maximize fish habitat in and around the barbs. Using hydraulic and geotechnical analyses, all of the barb variations were designed to withstand hydraulic forces and scour associated with the 10-yr flood event.

Design, permitting, and construction were fast-tracked. Inter-Fluve completed the construction approximately 10 weeks after the award of the contract. Following construction, Inter-Fluve prepared and implemented a detailed 3-year monitoring plan that provided for the evaluation of fish habitat availability and utilization, hydraulic performance of the barb structures, bank erosion, sediment deposition, woody debris accumulation, and vegetation establishment and survival.

Monitoring efforts have revealed regular and concentrated fish use of the constructed habitat, anticipated scour pool development at the tip of the constructed barbs, and significant woody debris recruitment at and between barbs along the banks.

PROJECT OWNER

Whatcom County Public Works Department

Bellingham, Washington

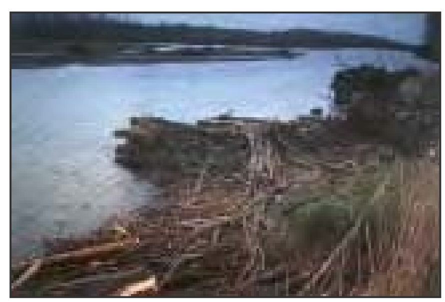
PROJECT ELEMENTS

Bank stabilization

Geomorphic and hydraulic analyses

Fast-tracked permitting and construction

Post-project monitoring



Appendix C: Rock Fall Mitigation Measures

Rock Fall Protection Measures for the Narrows and generally

The ODOT is currently in the process of advertising a $3 million dollar contract for construction of additional rock fall protection between milepoints 72.70 and 73.18 at the Narrows. The project, called the 'Hood River Canyons Rock Fall Project', will include the installation of 540 m (1771 ft.) of rock fall protection fence.

Rock fall protection fence such as the type manufactured by Geobrugg® could be installed on highway shoulders, and draped wire mesh made from high strength steel could be installed on selected slopes to minimize impacts from rockfall where they are an issue. The Geobrugg® rock fall fence system utilizes very high strength wire ropes, woven into a net-like configuration supported by steel posts anchored in concrete and tied to anchors behind the fence for additional support (refer to photographs 34 and 35 in Appendix A). Draped wire mesh could be anchored to the top of a cut with steel anchor pins grouted into pre-drilled holes and draped over the face of the cut. Rock fall could then roll down the face of the slope, between the mesh and the slope, and drop into a catchment ditch.

Rock fall protection fences are designed to slow down or stop the majority of rock fall of up to about a cubic meter in size. These could provide a considerable degree of additional rock fall protection although they would probably not stop the very large masses of rock (several meters or more in size) such as those that occasionally fall from the columnar basalt cliffs farther upslope at the Narrows. Such rock masses are too heavy and have too much kinetic energy to be completely contained by any existing type of rock fall fence. Draped wire mesh is very effective in keeping smaller sized rock fall from bouncing or bounding down a slope and becoming sufficiently airborn to fly out onto, or over, a roadway. If used in conjunction with a rock fall fence, and constructed at strategic locations determined by field investigation and observation of past rock fall, draped wire mesh could provide a very effective means of rock fall control in the Narrows and at other sites where rock fall is an issue. The installation of rock fall fencing and draped wire mesh is not expected to be difficult and would improve safety. However, it could require regular maintenance of the rock fall control structures and the ditch. Due to the work required to install rock fall control structures on the west face of the canyon wall at the Narrows, this activity has the potential to impact a protected plant species (*Suksdorfia violacea*) species (listed on the 1999 R6 Sensitive Species List (Mount Hood Forest Plan)). In order to minimize aesthetic impacts a colored wire mesh could be used to help blend it into the background.

There may also be locations that could benefit from the installation of rock bolts or dowels similar to those being used at the Narrows. It may also be possible to widen and deepen rock fall catchment ditches, which could help to keep rocks that fall into the ditch with high velocities from bouncing up and out of the ditch.

Appendix D: Agency / PAI Correspondence

U.S. Department
of Transportation

Federal Highway Administration

WESTERN FEDERAL LANDS HIGHWAY DIVISION
610 EAST FIFTH STREET
VANCOUVER, WA 98661-3801
(360) 696-7700 FAX: (360) 696-7846

March 18, 2002

Refer to: HFL-17
#23864L_MAH

To Interested Parties:

Public Notice

State Highway 35 (Mount Hood Loop) Feasibility Study

White River (Milepost 61.7) to Baseline Road (Milepost 80)
Hood River County, Oregon

The Federal Highway Administration (FHWA) in association with the US Forest Service (FS) and the Oregon Department of Transportation (ODOT) is undertaking a feasibility study to look into possible ways of improving a 20-mile section of State Highway 35.

State Highway 35 extends from its junction with State Highway 26 at Government Camp, northward around Mount Hood to its junction with Interstate 84 in Hood River. The 20-mile section of State Highway 35 that is being considered in the feasibility study extends from White River (Milepost (MP) 61.7) to Baseline Road (MP 80). Please refer to the enclosed map.

Within the study area, seven flood-prone sites have required regular emergency repairs over the last 20 – 30 years. These sites are located at: White River (MP 61.7), Clark Creek (MP 65.9), Newton Creek (MP 67.5), The Canyon / Narrows (MP 73), Polallie Creek (MP 74), Dog River (MP 78), and Baseline Road (MP 80). Emergency repairs at these sites have tended to have negative impacts on the natural environment and have also been a burden on the limited resources available for undertaking road maintenance. The purpose of the feasibility study is to investigate ways that the road could be improved in order to reduce the need to undertake emergency repairs on it.

FHWA, ODOT, and the FS want to ensure that all the issues with the road are identified as early as possible. We want to be sure that we haven't missed anything. You can help by sending us your comments on the project or by contacting us to arrange for us to meet with you in person.

The kind of information that would be most helpful includes answers to questions such as:

1. How have the closures that have occurred on Highway 35 as a result of flood events affected you?
2. What ideas do you have for possible solutions to this problem?
3. What do you think the environmental / economic / social impacts of improving the road would be?
4. If these are negative impacts what can be done to mitigate them?

Although these are suggested questions that you could address, please share all of your ideas and concerns about this project with us. To send us your comments or to arrange to meet with us in person, please contact:

George Fekaris
Federal Highway Administration
610 East Fifth Street
Vancouver, Washington 98661-3801
Phone: (360) 696-7766

Thank you for taking the time to help us do the best job possible on this project.

Highway 35 Feasibility Study

Notes from meeting with David Riley, General Manager, Mt Hood Meadows Ski Resort

19th April 2002

In response to the public notice sent out to potentially affected interests (PAIs) on the Highway 35 project. David Riley requested a meeting with George Fekaris (Oregon DOE, FHWA) to discuss the project. George Fekaris and Mary Hamilton met with David in Hood River on April the 19th, 2002.

Dialogue with David Riley:

Can you describe how the closures that have occurred on Highway 35 as a result of flood events have affected you and the Mount Hood Meadows Ski Resort?

Flood events causing road closures generally occur in the fall. Staff numbers at the resort range throughout the year from approximately 60 to 1000. Staff numbers start to increase from late August and full capacity is reached by Christmas. Fall and early winter are critical periods for the resort as staff numbers are increasing and training is taking place.

The meadows ski resort is accessed from Highway 35 via either US Highway 26 (H26) or Interstate 84 (I84). From Portland the route via H26 is approximately 20 miles shorter than coming via I84. Most of the recreationists visiting the Meadows come from Portland (approximately 400,000 per year) and use H26 although traffic congestion on this route is frequently a problem. Evidently it is not yet bad enough for people to choose the I84 route. The Meadows access road is located between the White River study site and the other six sites (Clark, Newton, Narrows, Polallie, Dog River, and Baseline) therefore problems on the highway are effectively divided into those that affect White River (closing the access from H26) and those that affect any of the other six sites (closing the access from I84).

The October 2000 flood event, which closed Highway 35 at both Polallie Creek and White River, occurred when a job fare was taking place at the resort and approximately 1000 people needed to access the Meadows. The 2000 event closed both accesses to the Meadows for four days, however, a 2-hour, 4WD detour utilizing FSRoad44 and Bennett's Pass was used by a few Meadows staff members as an emergency access route to the resort. After 4 days, due to the great job done by ODOT, Meadows staff were able to access the resort via the White River crossing. Access from the north (Polallie Creek) was opened for Meadows staff shortly thereafter. The 2000 event had the greatest affect on the resort of any event experienced by David Riley in the last 10 years. Generally the road has only been closed from one of the access points at a time and on average this has occurred over 2 days every 2 years (1 day per year). To date the wash out events on Highway 35 have not caused severe hardship to the Meadows Resort.

What recommendations do you have for fixing the sites described in the 'Hot Spot Summary'?

Recommended fixes for the White River site:

1. Preferred alternative: ODOT should undertake regular maintenance at the White River crossing, clearing out material so that it cannot build up under the bridge and thereby preventing future wash outs. David stated that until the White River was designated as a wild and scenic river (WSR) in 1994, ODOT undertook this type of maintenance and

the bridge did not blow out. David also stated that in order to do this, it may be necessary to amend the Wild and Scenic designation.

2. Build a larger bridge / via duct and buy time however the same problems would ultimately occur as the river aggrades.

David stated that he is firmly against rerouting the road to avoid the White River crossing. He stated that there would be a huge public outcry if this option were pursued, as people do not want to increase their travel time. Thus, this would decrease the economic feasibility of the Meadows Ski Resort and therefore David would fight against any proposal to reroute and lengthen the road. Any route that increased the length of road by more than half a mile would be totally unacceptable. Additionally significant environmental impacts would occur with a project to widen the road. These impacts would be more significant than simply maintaining the existing structures.

Would it be beneficial to upgrade the detour used during the 2000 event for future emergency use?

No, the existing route works well as an emergency route provided that regular maintenance is allowed. Therefore there is no need to improve it.

<u>Recommended fixes for the Clark Creek / Newton Creek sites:</u>
The primary problem at these sites is that the creeks have numerous historic channels, which are widely spread by the time they reach the road. Also there are trees within 3 feet of the existing creek channel above the Newton Creek crossing and these are being undermined by the stream and will eventually fall and block the culvert. David suggested the following fixes:

1. Preferred alternative: create dikes upstream (in the forest) where the channel braiding is obvious and direct the river to the largest culvert. The key at these sites is maintenance so that the dikes and culverts do not get blocked with woody debris.
2. Work within the road corridor (to reduce environmental impacts) and armor the road with rock on the west side so that if the creeks flood and jump to any of their historic channels, the road is less likely to be destroyed.
3. Move the river to run alongside the road.
4. If a bypass were to be built it would need to be on the east side of the East Fork of the Hood River in order to avoid the problem. This would be a longer-term solution however the terrain is steep and the impacts (including environmental) would be high.
5. Increase the size of the existing culverts.
6. Allow regular summer maintenance by ODOT upstream of the road.

<u>Recommended fixes for the Polallie Creek site:</u>
David stated that Polallie Creek had not been a problem within the last ten years. He suggested increasing the size of the culvert or putting in a bridge as a fix at this site and stated that a bypass was not applicable at this site. He also added that we should make sure the bridge or culvert is wide enough for a new collection lane in the middle at the Cooper Spur/Highway 35 intersection.

<u>Recommended fixes for the Canyon / Narrows site:</u>
David stated that this site is not a problem, as he has not witnessed the river crossing over the road here.

<u>Recommended fixes for the Dog River/Baseline sites:</u>
Events here have not occurred often but the site looks as though they should. The dikes built by ODOT in late 1999 / early 2000 were probably a good strategy and these could be further improved. There is no obvious place to move the road to unless it was put up on the side

(further East).

You have made it clear that you are firmly opposed to a bypass around the White River site, would a bypass on the north side of Meadows be okay?

Adding distance would be a problem on both sides as the population / growth is changing and over the long term the objective is to get people to access the Meadows from Hood River more often. If the road were to be moved at all, the Clark / Newton Creeks site is the one that would benefit most / makes the most sense.

Would a bypass affect summer recreationists?

A bypass would be a problem at any time of the year. Highway 35 / the Mount Hood Loop is a popular tourist destination. People come to the area from Portland for a scenic drive and the current crossing at White River is one of the most popular stops on the route.

Can you prioritize the order in which the sites addressed by the study should be fixed?

Yes, as follows:

1. White River
2. Newton
3. Clark
4. Narrows
5. Polallie
6. Dog River
7. Baseline

Could the project potentially affect Coopers Spur?

The Meadows is currently considering alternatives for developing a resort (which would include overnight accommodation) at Coopers Spur. Coopers Spur is located on both private and federal land and the primary access route to it is through Hood River. Guests at Coopers Spur would have the option of skiing at both Coopers Spur and the Meadows. The capacity of Coopers Spur would be less than that of the Meadows. The access road to Coopers Spur is located at the Polallie Creek study site. Any work that takes place at the Polallie Creek site would need to ensure that access from Highway 35 to Coopers Spur Road is maintained. However, traffic studies done to date suggest that the capacity of Coopers Spur would not exceed the capacity of the existing transportation facilities. David stated that Highway 35 is currently under capacity at its current service level. Nevertheless David suggested that adding collection lanes for traffic turning left into and out of Coopers Spur Road would improve safety and traffic flow.

David requested to be kept up to date as the project progresses. George Fekaris stated that we expect to get back to him with a range of alternatives in mid summer 2002. David recommended that we contact Keith Clymer (in charge of maintenance for Highway 35, ODOT).

Note: Mr. Riley was asked to comment on these notes; his edits have been fully incorporated in this version.

Cascade Pacific Council
Boy Scouts of America
2145 SW Naito Pkwy
Portland, OR 97201

RECEIVED
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02 MAR 29 AM 11:39
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George Fekaris
Federal Highway Administration
610 East Fifth Street
Vancouver, WA 98661-3801

March 26, 2002

Reference: HFL-17 #23864L1_MAH

State Highway 35 (Mt. Hood Loop) Feasibility Study
White River (Milepost 61.7) to Baseline Road (Milepost 80)

Dear George,

Enclosed are some thoughts about Highway 35 and the future plans to address the reoccurring flooding of the area.

BACKGROUND
We are the Cascade Pacific Council, Boy Scouts of America located in Portland, Oregon. We have two facilities that could and have been adversely affected at times by flooding of the White River. Any solutions that can be found that will enable highway 35 to remain open and allow access to all facilities and locations that are available at this time will be a positive one. Any and all future closures will always affect activities and commerce should alternative routes prove to be longer in distance and time. A solution has to be found that will prevent flooding and will allow full access to all areas along highway 35.

PREVIOUSLY AFFECTED LOCATIONS
#1 Aubrey Watzek (White River) Winter Lodge
Located just west of the White River Sno-Park and the bridge crossing the White River. In the Fall of 2000 the White River flooded. During this time it prevented access to our Winter Lodge during a critical time when we are preparing for our winter program of over 3,800 youth and adults. Had the road not re-opened in a timely manner we would have had to cancel our winter program which would mean our Scouts would miss out on their winter recreational opportunities.

While highway 35 was re-opened, in order to use our winter lodge we had to re-open a previously closed access point to our facility as it was determined that the main access would flood again in the future. To re-establish this road cost us in excess of $35,000 which is a great deal of money for a non-profit. Had we not been able to re-open a previously closed access point this would not have been possible.

#2 Camp Baldwin
Located east of Dufur, Oregon. Camp Baldwin is our second largest Boy Scout resident camp serving an average 1,500 youth each summer. One of the primary routes to Camp Baldwin is via highway 35 and then onto highway 44. This is convenient route for many of our Scouting units coming from the Portland metro area and Salem. Alternatively many units travel from Hood River onto highway 35 and then to highway 44. While other routes of travel do exist to Camp Baldwin, a closure of highway 35 would prove to be a major inconvenience to our units and on-site camp ranger as it would add time and distance for many groups.

While we have no adequate solution to present to you at this time, it is without a doubt time to find a long-term solution that will work for all users of highway 35 and appease the USFS, ODOT and other users.

503-226-3423-Portland ◆ 503-581-6601-Salem ◆ 360-693-1741-Vancouver ◆ E-mail: info@cpcbsa.org ◆ Fax: 503-225-5717

Insuring that the road will stay open year-round will help to alleviate concerns over planned programs and activities that are a part of our unit's annual planning calendar.

We would appreciate additional information on plans for the highway as they come available. Thank you for allowing us to share our concerns with your organization.

Sincerely,

Derrick Clark
Director of Camping and Properties
Cascade Pacific Council

2145 SW Naito Pkwy
Portland, OR 97201

503 225 5744
dclark@cpcbsa.org

Oregon
John A. Kitzhaber, M.D., Governor

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Department of Fish and Wildlife
Mid-Columbia District Office
3701 West 13th Street
The Dalles, OR 97058
(541) 296-4628
FAX (541) 298-4993

May 2, 2002

George Fekaris
Federal Highway Administration
610 East Fifth Street
Vancouver, WA 98661-3801

RE: State Highway 35 Feasibility Study

Dear George:

Thank you for the opportunity to offer these comments. These comments are made to help further the mission of the Oregon Department of Fish and Wildlife (ODFW) to preserve and enhance Oregon's fish, wildlife and their habitats for the use and enjoyment of this and future generations.

ODFW is pleased that the Federal Highway Administration, the US Forest Service and the Oregon Department of Transportation (ODOT) are undertaking this feasibility study and we support these agencies in their desire to identify ways to improve the 20 mile section in question. We look forward to working with the parties in the future.

ODFW is very familiar with the Highway 35 issue identified in your March 18, 2002 letter. We have a long history of working with ODOT during both routine and emergency repairs to Highway 35. We have been extensively involved with discussions with all parties during and after the events at White River and Newton Creek in October, 2000.

From ODFW's perspective as the state of Oregon agency charged with protection and enhancement of Oregon's fish and fish habitat, the East Fork Hood River has a long history of being impacted by Highway 35. In many locations in the study reach, Highway 35 serves to confine the river channel and prevents proper stream function. As an example, development of braided channels, high water channels and complex floodplain habitats used for adult spawning and juvenile rearing has been truncated or eliminated by the position of the road in relation to the stream.

There are reasons the subject section of Highway 35 has a long history of impacting the East Fork Hood River, White River and other steams. I believe that in many cases, the highway is sited in inappropriate locations in relation to the East Fork Hood River. Similarly, the road is subject to frequent problems associated with Newton and Clark creeks due to its location on the alluvial fan of those streams.

In recognition of this, ODFW has consistently recommended that the truly meaningful approach to a long term solution is to relocate the highway to locations out of the floodway and floodplain of the East Fork Hood River and away from tributaries with high glacial activity. While we understand that the subject study is a reconnaissance level work, we would encourage an examination of all alternatives and alternative road locations at this time.

For an example of the benefits of road relocation, one needs look no further than several sections of Highway 35 downstream from Polallie Creek. As you may recall, a glacial event from Polallie Creek in January 1980 caused extensive damage to Highway 35 for many miles downstream. During the subsequent road reconstruction, a decision was made to relocate the most poorly sited sections of the road to upland areas well away from the floodway and floodplain. The wisdom of this decision is evident today in both decreased road maintenance costs as well as a stream channel with an unconstrained floodplain that is free to develop the complex floodplain and side channel habitats so important for juvenile salmonid rearing. Recall that the East Fork Hood River throughout the study reach is a stronghold for steelhead currently listed as Threatened under the federal Endangered Species Act. Bull trout that use the East Fork Hood River and mainstem Hood River downstream from the study reach are also listed as Threatened under the federal Endangered Species Act and are affected by activities conducted in the study reach.

Thanks again for the opportunity to offer these comments. We look forward to being meaningful partners in the process of identifying possible ways to lessen the affects of Highway 35 on Oregon's aquatic resources.

Sincerely,

Steve Pribyl
Asst. District Biologist

HOOD RIVER
WATERSHED GROUP

"...to sustain & improve the Hood River Watershed through education, cooperation, & stewardship"

2990 Experiment Station Drive
Hood River, Oregon 97031
541-386-2275

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02 MAY 30 AM 11:23
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May 28, 2002

George Fekaris
Federal Highway Administration
610 East Fifth Street
Vancouver, WA 98661-3801

RE: State Highway 35 Feasibility Study (White River to Baseline Road)

Dear Mr. Fekaris:

The Hood River Watershed Group is a forum of landowners, irrigators, citizens, business, and government agencies interested in natural resources in the Hood River Valley. The Hood River Soil and Water Conservation District serves as its fiscal manager. Our members carry out cooperative projects for watershed health, water quality and fish recovery consistent with the Oregon Plan for Salmon and Watersheds, tribal fish rebuilding efforts, the Northwest Forest Plan, and the Columbia Basin Fish and Wildlife Program. Members include representatives of the Forest Service, Oregon Department of Transportation, Oregon Department of Fish and Wildlife and Confederated Tribes of the Warm Springs Reservation who are familiar with Highway 35 and the feasibility study.

We are writing in support of the study to look at ways of improving Highway 35 between the White River and Baseline Road. Our focus is on the highway segments in the East Fork Hood River drainage. We ask that the study include an open-minded examination of alternative alignments (or adjustments in existing alignments) that could potentially restore floodplain habitat and proper functioning of natural river processes. It is important that the study approach examine the 7 identified flood-prone problem sites in the context of watershed-scale fluvial geomorphology. While we understand this is just a reconnaissance-level study, we recommend that an independent specialist in fluvial geomorphology contribute to the study or review study results so that a comprehensive or holistic approach is utilized.

The affected area of the East Fork Hood River is confined by highway fill and riprap structures that limit channel migration. These structures prevent the deposition, sorting and transport of gravels, large woody debris movement, creation of secondary channels, and other natural processes that build and maintain fish habitat. As a result, development of braids, meander bends, and complex floodplain habitats important for juvenile salmonid rearing have been curtailed.

Flooding and debris flows originating on Mt Hood are so frequent that emergency road repairs have become a chronic occurrence in the last few decades. These chronic Highway 35 repairs adversely affect East Fork Hood River floodplain habitats used by ESA-threatened steelhead and other fish, and may undermine work being done in the Hood River subbasin for salmon and steelhead recovery. A recent example of the impact of emergency repairs on fish habitat occurred in April 2000, when the Oregon Department of Transportation cut off and eliminated a side channel-riffle complex that formed in an earlier flood, in order to protect the road. Oregon Department of Fish and Wildlife salvaged a significant number of juvenile steelhead from the side channel. Because of the emergency repair work, a significant amount of preferred juvenile rearing habitat is no longer available for steelhead.

We believe that planning for potential alternative road alignments would facilitate better use of emergency funds (i.e. FEMA funds) to rebuild flood-prone highway segments in safer locations. It is just a matter of time before future catastrophic natural events again wipe out flood-prone and alluvial fan road segments along Highway 35. Absent such an approach, it is likely that the highway will be rebuilt in harms way, year after year, with continuing impacts to aquatic life in the East Fork Hood River.

Thank you for considering our comments as the feasibility study proceeds.

Sincerely,

Chuck Gehling

Chuck Gehling
Chair
Hood River Watershed Group

July 29, 2002 - Notes from the Highway 35 On Site Meeting between George Fekaris (FHWA), Diana Hwong (USFWS), Art Martin (NMFS), David Landsman (NMFS), Steve Pribyl (ODFW), and Mary Hamilton (Widener & Associates)

General Comments:

- Funding sources could include: Corps of E 206 funds, NOAA restoration program funds, BPA funds
- The problem sites are likely to move over time. Therefore it is difficult to predict where the problem while the dynamic nature of the system may mean that some of the alts/typical fixes are not providing as much benefit as they would under other circumstances.
- NMFS: generally don't get projects like this where we are able to look at the affects of the project on the long-term recovery of a species. We should be considering the question of "how can FHWA make in roads into improving habitat restoration as required under the ESA". Properly functioning conditions are key to improving floodplain function. Short-term alternatives are not going to be able to meet some of the larger objectives. Need to consider how the alternatives affect 'properly functioning conditions' over the long term. Use the NMFS matrix to compare the alternatives.
- Alternatives that involve riprap need to consider that the river changes from depositional to transport over certain reaches and that it is aggrading.
- Need to address the long-term affects of climate change
- Need to connect alts both in terms of the road and in terms of ecological functions.
- Known sites of spotted owl throughout corridor – would require surveys.
- Generally, if an event happens over the short term, employ the principle that one should keep the floodplain as wide as possible.
- Generally there was high support for having plans 'on the shelf' and available for implementation when an event occurs.
- Need to check with the USFS to find out when their survey data for spotted owls was taken.
- Need to survey for the Larch Mountain Salamander on tallus slopes

Site Specific Comments:

Baseline

- A wild winter steelhead population (~1000 indiv) known to be present in the EFHR up to Polallie at least)
- Support for the realignment alternatives – get the road out of the floodplain
- NMFS: adding riprap would not fly – need to have no net gain of fill into the floodplain.
- At Site 1 would pulling out the 'knob' (Alt. 6) create enough long-term benefit to justify the $? Also need to ensure that the road is protected.
- ODFW: prepared to compromise – e.g. if undertook Alt. 6, would need to look at how to protect the Baseline Bridge
- Site 2: Removing island/material (Alt 6) would be a step backwards. The river does its own restorations much more effectively and cheaply.
- Site 2: viaduct alt – need to consider access for maintenance. Either need an access road or would have to lift maintenance equipment over the viaduct. Long-term maintenance could be worse than the current situation.
- Site 2: retaining wall alt – would still have maintenance issues. Would also be introducing a hard point and would loose riparian vegetation (existing) - may not be possible to re-establish vegetation with a wall in place.
- If we did build a retaining wall (straight structure) NMFS would also like to see features of roughness.
- Difference between barbs (designed to function for high and low water events) and groins (water cant flow over during any flow). Groins are a greater concern for NMFS. Which are we proposing?
- Logjams are preferred to barbs/groins because they involve placing wood rather than rock in the river.
- Short term: when an event happens, move the road over one lane rather than refill into the river.

Dog River

- Move the dikes back to the road (i.e. armor the road rather than the river) – get riprap out of the river – may need to leave part of the dikes at key sites to act as barbs. This should be implemented before an event occurs.
- Removing the dikes could be part of ESA emergency consultation – repair road and then come back and remove the dikes.

- Alt 6 (raise grade and build retaining wall) has no biological/ecological benefits – much better to get as far out of the floodplain as possible
- ODFW would like a longer bridge at the crossing of the EFHR
- Short term: when an event happens, move the road over one lane rather than refill into the river.
- If realign the road to 17 and 44 – the existing Hwy 35 would still have to be maintained for access – it would probably become a County Road – this scenario could be worse than the existing one.
- Rouston Park – a county park located between Dog River and Polallie at the forest boundary. It is expected that the county would want to keep this open.

Polallie Creek

- Should include the aerials of the 1980 Polallie Event – ask FS
- Request for a photo of a Sabo Dam
- Fish passage at Polallie is a high priority from a basin wide perspective
- Short-term: replace culverts with a bridge (allow fish passage). Note that House Bill 3002 requires that all new/replacement structures have fish passage – thus if the culverts washed out they would have to be replaced with a fish passage structure. Notably the culverts did not wash out in the last event – they blocked up and debris flowed over the road – therefore maintenance may not trigger the installation of a fish friendly crossing although this is a bit of a gray area (i.e. replacing the entire floor of the culvert would trigger it)
- NMFS does not like the use of baffles in culverts, prefers low gradient culverts.
- Fish are known to be upstream at Polallie

The Narrows/Canyon

- Long term: move road to the west – would have to work within a seasonal restriction for the spotted owl nesting season.
- Short term: none

Newton Creek/Clark Creek

- Short term: hardened ditchline and/or perforated highway then depending on the event size/location would evaluate at the time whether or not to channel the stream back to its original location or to put it through a new crossing.
- The only good solution long term is realignment or an elevated 5-10 mile long road.
- Another option may be 'rolling dips' – either a) have the perforations/dips in place b) move the water back to its original channel or create new crossings on an event by event basis.
- Newton Ck – has had fish in the past – cutthroat are known to come into the creek when the water is relatively clear – not a high priority but want to keep it open (currently passable).
- Clark Ck – fish are known to be upstream – cutthroat and possibly steelhead – culverts are currently impassible – 2nd highest priority to Polallie.
- At Clark Ck – short term 'fix': design for fish friendly passage however would be more interested in putting this stream back into its existing channel if it jumped than for Newton because don't want the populations to become fragmented (known fish presence and more established channel). However, management of the channel would also depend on the event. E.g. if the creek jumped to Newton – may want to keep it there – would prefer to assess this on an 'event by event' basis.

White River

- Definitely red-band present in the mineral and white river drainages
- Long term: longer higher bridge including Mineral Ck – same alignment (not enough benefit in going to a new alignment)
- Short term: maintenance when an event takes place as needed – provided that a long-term plan is being developed.

Meeting Notes

Date: 24 September 2002, 7 – 8 pm   Meeting Location: Hood River

Subject: Meeting with the Hood River Watershed Council

Attendees: George Fekaris (Oregon DOE, FHWA – Project Manager), Vaughn Anderson (Principal Engineer, DJ&A), Mary Hamilton (Environmental Specialist, Widener & Associates), Watershed Council Members (30 individuals).

Introduction by George (10 mins):

Points covered:

- The impetus for the project.
- The roles of WFLHD, Oregon Division of the FHWA, USFS, and ODOT in the study.
- WFLHD's functions generally.
- The project team and their areas of specialty.
- Other groups contacted for input and comment on the study.
- The scope of the study and level of data collection.
- The process of the study development and its current status.
- Potential funding options for projects that may develop out of the study.

Vaughn presented the alternatives (30 mins):

Vaughn used aerial photos in PowerPoint to illustrate the alternatives identified for the seven sites. Vaughn covered the six sites located along the EFHR in greater detail than the one at White River, as time was limited and the Watershed Council had indicated that they were primarily interested in the Hood River Watershed.

Question and Answer Session (20 mins):

Questions raised and responses given:

- For the bypass alternatives, would the existing road be removed? Response: Yes as much as possible. Access would have to be maintained to private properties and the County owned Rouston Park.
- Do landowners have any say when a road project is proposed adjacent to their property? Response: Yes, landowners do have a say and influence over projects. The project proponent is required to discuss the project with them to develop ways to avoid/minimize impacts to their property. If impacts cannot be fully avoided, property owners are compensated at fair market value.
- What is the public process? Response: Once a project is proposed, requirements under NEPA are triggered. NEPA requires public consultation to take place. The current study is not covered under NEPA as no projects are yet being proposed. Nevertheless, the project interagency team chose to solicit public input for this study. Therefore we contacted the groups, agencies, and individuals (PAIs) whom we thought would be most interested in the project and requested their input. We have addressed all of the comments we received in the document. The feedback has been used to 1) ensure that we have identified and captured the issues associated with each of the alternatives, 2) help develop the alternatives.
- What are the affects of the Baseline Bridge (it is acting as a constriction) on river functions (such as sediment accumulation and mixing) and could you ask a fluvial geomorphologist this question? Response: That is a question that has not been raised before and we will evaluate that as part of the report.
- Why are we only addressing the 7 sites rather than looking at the corridor as a whole? Response by Charlie Sciscione: The reason for the 7 sites is related to the funding source for the project. The Oregon Division of the FHWA were able to justify funding the study provided that it focused on sites where they had spent ER $ in the past.
- Is it possible to predict the size, timing, and location of the next event? No, we wish that it were.
- Could the Watershed Council review the objectives matrix for each of the sites? Yes, once the draft document is reviewed by the interagency team (FHWA, WFLHD of FHWA, ODOT and the USFS), a final version will be produced and will either be distributed by WFLHD to the PAIs and other agencies that provided input on the study or will be available from ODOT and the USFS.

George wrapped up the meeting by thanking everyone for attending and inviting people to contact us if they have any further questions/comments on the study.

Hood River Watershed Group

"…to sustain & improve the Hood River Watershed through education, cooperation, & stewardship"

May 9, 2003

Daina Bambe, District Ranger
U.S. Forest Service
Hood River Ranger District
6780 Hwy 35
Parkdale, OR 97041

RE: Oregon State Highway 35 Feasibility Study -- Final Draft March 2003

Dear Ms. Bambe:

Thanks very much for the opportunity to review this draft report. Watershed Group members have long been concerned about the impact of Highway 35 and its chronic repair on fish habitat in the East Fork Hood River, both on and off the National Forest. We cannot provide a detailed assessment of all the alternatives, analyses, and ratings of alternatives for each site, but instead offer these general comments:

1. We support those alternatives that restore a more natural floodplain and sediment transport/deposition functions. We feel that the objective of restoring floodplain and natural fluvial processes deserved greater weight in the report and analyses.

2. It is possible that other alternatives exist beyond those included in the report. It is important that the matrix ratings presented in the draft study are not used to prevent or bias against other options that may have superior benefits to the East Fork Hood River and the Highway in the future.

3. The Executive Summary statement on Page ii which reads "Alternatives that require funding mechanisms other than federal emergency relief funds, and which are likely to be more complex solutions (such as realignments)…" implies that any realignment alternative would not qualify for federal emergency relief funds. Is this correct? We understood that realignment may be justifiable under emergency funds in some circumstances, e.g., minor realignments, or should the entire road prism is lost by a major event.

4. Use of only the most recent repair for each site (e.g., Page 147. Table 6.10.1 and throughout Chapter 6) may underestimate the costs of the "Maintain Existing Condition" action alternative, especially for the Dog River site. The most recent repair at Dog River

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site occurred in 1999 at a cost of $75,000. But the1999 flood and repair was relatively minor. What did ODOT spend to repair Dog River in 1996 and in 1980? The estimated cost of maintaining the highway at this site is $300,000 over 20 years, based on having to spend $75,000 every four years. This figure may be too low, and create error in the analyses and in the ratings for realignment alternatives at this site.

Please keep us informed as the study is finalized and related efforts are undertaken. We look forward to working in partnership with the Forest Service, ODOT, and all other parties involved on projects that can improve the way Highway 35 and our rivers and streams co-exist.

Sincerely,

Holly Coccoli
Coordinator

Cc: Stuart Fletcher, USFS
HRWG

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