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Decline Thin Project Environmental Assessment

Chapter 1 —Purpose and Need

Introduction

The Decline Thin Environmental Assessment (EA) documents analysis of the environmental effects of the proposed action and three alternatives including no action. An interdisciplinary team (ID Team) of resource specialists conducted the analysis. It consisted of field reconnaissance, public involvement, effects analysis, and assessment of project purpose and need, opportunities, issues, alternatives, effects, and standards and guidelines of the Mt. Baker-Snoqualmie National Forest Land and Resource Management Plan, as amended[1] (referred to as the Forest Plan, as amended).

Each alternative, if implemented, would affect the environment differently, deliver different resource outputs and opportunities, and require different expenditures. The EA analyzes the site-specific environmental effects that would result from implementation of the proposed action and alternatives. The document gives sufficient detail to the public and the decisionmaker to provide an understanding of the environmental effects (consequences) of the alternatives, and to provide the decisionmaker with enough information to make a reasoned choice among the alternatives. The responsible official will use the EA as the basis for a decision and will document it with a Decision Notice.

Proposed Action

The Mt. Baker-Snoqualmie National Forest (MBS) is proposing to harvest timber through a commercial thinning timber sale located within the Darrington Ranger District. The proposed action would thin approximately 300–400 acres of timber stands within the 927-acre Decline Thin Project area. It would yield approximately 6 to 7 million board feet (mmbf) of commercial timber. All timber would be harvested using ground-based or cable logging systems. A variable density thinning prescription would be employed with "skips" and "gaps." Retention of residual large trees and minor tree species including species such as cherry and yew would promote stand diversity. Riparian Reserve treatment and Late Successional Reserve (LSR) treatments would be conducted to reduce the high stocking level in the 40- and 70-year-old stands within the project area.

The proposed action would include connected actions associated with timber harvest: approximately 14.0 to 16.0 miles of maintenance and reconstruction of existing Roads 24, 2430, 2432, and 3 existing spurs, connecting from Road 2430. It would also include construction of approximately 1.0 mile of temporary road, which would be closed[2] following sale activities. There would be landings necessary for ground-based, cable logging systems; and the piling and burning of logging slash.

Associated with the proposed action would be decommissioning 2.5 miles of the upper portion of Road 2430, and upgrading a culvert to a bridge at the Conn Creek crossing of Road 2430.

If implemented, the Decline Thin Project would likely be sold in early 2008. Timber harvest is planned to begin in summer 2008, and would be expected to continue for three to five operating seasons. Road 2432 would be closed following firewood sales and slash pile burning.

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1 USDA Forest Service 1990, USDA Forest Service and USDI Bureau of Land Management 1994. See section titled "Relationship to Forest Plan."

2 Closed could require the removal of bridges, culverts, ditches, ruts, berms, outslope, and block the road to vehicular traffic and build cross ditches and water bars. Associated fill would be removed to the extent necessary to permit normal maximum flow of water.

Figure 1. Vicinity Map Decline Thin

Decline Thin Project Environmental Assessment

Purpose and Need

The purpose and need of the Decline Thin Project proposal is four-fold:

1. **Decrease stocking in dense stands to maintain or promote increased growth, promote horizontal and vertical diversity, and retain health and vigor of the forest stands.**

Units of Measure:

- Trees per acre
- Basal area per acre
- Acres of stands treated to recommended stocking levels

Figure 2. Photo of Decline Thin Stand

The stands within the project area are prime forestland. The Forest Plan, as amended, includes a Forest-wide goal to "maintain prime forestlands in timber production" (USDA 1990, pp. 4–5).

The health and vigor of trees in these stands are currently good, although they are beginning to show evidence of declining vigor and suppression-related mortality due to competition in their overstocked condition.

Overstocked stand conditions result in trees with narrow crown widths and decreased diameter growth due to competition. Overstocked stands are more susceptible to insects and pathogens than less-stocked stands, and the trees in them tend to grow taller, but without sufficient proportionate diameter increase. This can lead to instability from windstorms or snow loading (Oliver and Larson 1996).

The stands are currently in the stem exclusion stage of stand development. Mortality in intermediate and suppressed trees is evident, and both dominant and co-dominant trees are growing at a reduced rate due to competition. There is a need for improved stand health and vigor and enhanced tree growth that would maintain long-term site productivity and spatial diversity in stand structure. Improving stand growth, vigor, and diversity would improve the stands' resilient to adverse effects of insects, disease, climatic changes, and other agents. The reduction of the number of trees per acre in the treated areas would also result in timber volume to meet other management objectives.

2. Manage Riparian Reserves for desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives (USDA Forest Service and USDI Bureau of Land Management, 1994, ROD (hereafter, referred to as "ROD"), p. C-32).

Units of Measure:

- Retention of desired canopy cover in treated areas of Riparian Reserves
- Amount (percent) of the stand represented by a diversity of tree species (Douglas-fir, Pacific silver fir, western red cedar)
- Vegetation composition change

  The project area includes Riparian Reserves with close spacing (high stocking levels). Such stand densities cause competition between trees, which causes slower growth in tree diameter and volumes (USDA Forest Service 2001, p. 69). In this forest type, closely spaced trees become susceptible to damage from forest insects, diseases, windstorms, and snow breakage (Oliver & Larson 1996). Development of large woody material for riparian areas is delayed. The project proposal provides an opportunity to increase residual tree growth and promote desired vegetation characteristics. "Apply silvicultural practices for Riparian Reserves to control stocking, reestablish and manage stands, and acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives" (ROD p. C-32).

3. Manage Late Successional Reserves to maintain a functional, interacting, late-successional and old-growth forest ecosystem (ibid, p. C-11)

Units of Measure:

- Achievement of recommended stocking levels for LSR development
- Retention of desired canopy cover in treated areas of Riparian
- Amount (percent) of the stand represented by diversity of tree species (Douglas-fir, Pacific silver fir, western redcedar)

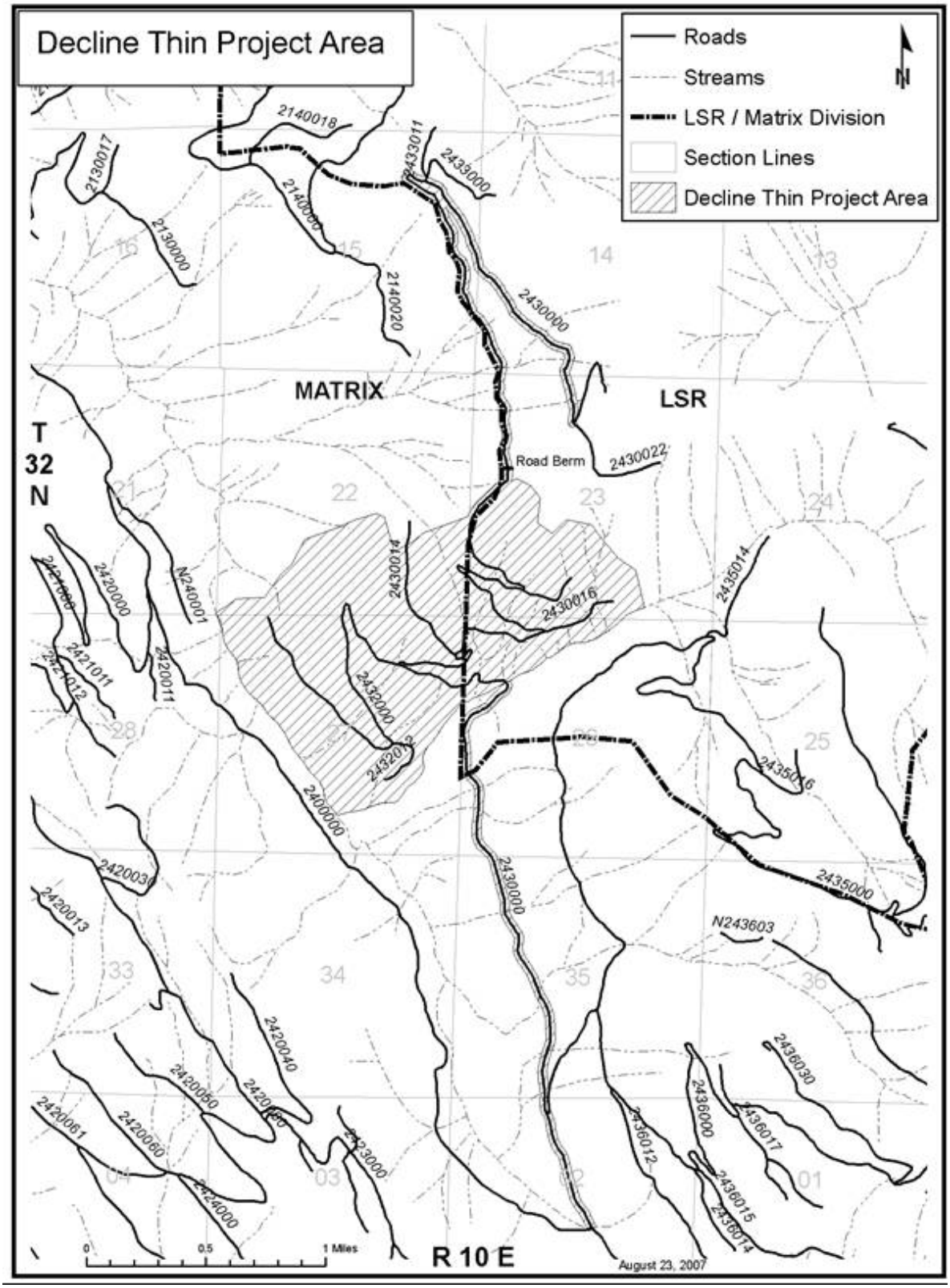
  The project area includes Late Successional Reserves with high stocking levels. As with Riparian Reserves, the project proposal provides an opportunity to control stocking and promote desired vegetation characteristics. Thinning these stands can have the same benefit as in Riparian Reserves. Thinning these stands can open up the forest canopy, thereby increasing diversity of plants and animals, and hastening transition to a forest with mature characteristics. (ROD p. C-12). Manage Late Successional Reserves to maintain a functional interactive late-successional and old-growth forest ecosystem (ibid p. C-11).

4. Provide commercial wood fiber products consistent with the 1990 Mount Baker–Snoqualmie Forest Plan, as amended in 1994 by the Northwest Forest Plan.

Unit of Measure:

- Timber volume sold (mmbf)

Figure 3. Decline Thin Project Area



Rationale for the Proposed Action

Late Successional Reserves (LSR)

The Northwest Forest Plan (USDA Forest Service Record of Decision (ROD) 1994) recognizes one of the objectives of LSR as enhancement of late successional and old-growth forest ecosystems. West of the Cascades, it limits thinning to stands less than 80-years-old. The Mt. Baker-Snoqualmie Forest-wide Late Successional Reserves Assessment (LSRA) (USDA Forest Service 2001) identifies as a key objective the evaluation of the potential for silvicultural treatment to benefit the development of late successional and old-growth forest characteristics in stands less than 80 years of age. A gradual increase in abundance and diversity of understory vegetation may not occur for 100 to 200 years without intervention (D.R. Thysell and A.B. Carey, 2000). The Sustainable Ecosystem Institute (SEI) report on the status of northern spotted owl (S. P. Courtney; J. A. Blakesley and others 2004) states: "Losses of habitat typically occur in a tangible time frame, such as with harvesting or catastrophic fire, while habitat development does not. Management activities designed to accelerate development of new habitat are becoming an important part of forest management. Retention of legacy (snags and course woody debris) in current areas of timber harvest will shorten the time necessary for those areas to achieve the habitat complexity deemed to be suitable Northern Spotted Owl habitat." Stands considered for treatment by this project are less than 80-years-old (USDA Forest Service 1994). Treatments in stands within LSR in this project would further these objectives.

Riparian Reserves

The Northwest Forest Plan standards and guidelines for Riparian Reserves regulate activities that retard or prevent attainment of the Aquatic Conservation Strategy (ACS) objectives. It recognizes that application of silvicultural practices is appropriate to control stocking, manage stands, and acquire desired vegetation characteristics needed to attain ACS objectives (ROD p. C-32). Stands in Riparian Reserves considered for treatment by this project are also less than 80-years-old and would respond favorably to thinning. Treatments in such stands would further these ACS objectives. Treatment of stands in Riparian Reserves helps meet ACS objectives for spatial and temporal connectivity within and between watersheds, fulfilling life history requirements of riparian and aquatic species (ACS objective 2),species composition and structural diversity (objective 8), and well-distributed populations of native plant, invertebrate, and vertebrate riparian species (objective 9).

Matrix

The Matrix contains prime forestlands. Most scheduled timber harvest takes place in the Matrix land allocation (USDA Forest Service 1994 p. C-39), and most harvest and other silvicultural activities would be conducted in that portion of the Matrix with suitable forest lands according to standards and guidelines (ibid). The Forest Plan, as amended (USDA Forest Service 1994), has a Forest-wide goal to maintain prime forestlands in timber production (USDA Forest Service 1990, pp. 4–5). The Matrix stands have good health and vigor but are beginning to show declining tree vigor and increased mortality due to competition from overstocking, making them more susceptible to insects and pathogens.

Approximately 603 acres (65% of the project area) fall within the Matrix land allocation[3]. The Matrix land allocation along with six other allocations was adopted in the 1994 *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl* to comply with the requirements of federal law, to protect the long-term health of the federal forests. The desired outcome of Matrix lands is to provide a steady supply of timber sales that can be sustained over the long-term without degrading the health of the forest or other environmental resources (ROD pp. 3 and 4).

The existing condition of forest stands within the Decline Thin analysis area is described in more detail in Chapter 3 –Environmental Effects, and the Project Record. The areas proposed for harvest are commercial forestlands suitable for timber production, as defined in the Forest Plan, as amended. Field examination, review of stand exams, and silvicultural analysis of stocking levels and tree size all indicate the stands are appropriate for commercial and non-commercial thinning harvest at this time.

Decision Framework

The Forest Supervisor for the Mt. Baker-Snoqualmie National Forest is the Deciding Officer for this project. The Forest Supervisor will consider three questions as parts of the decision:

- Whether to select the proposed action, or an alternative to the proposed action; and
- What management requirements and mitigation measures to apply, and
- What monitoring and evaluation to require for project implementation and effectiveness.

The Forest Supervisor will document his decision and rationale through a Decision Notice (DN) and Finding of No Significant Impact (FONSI) and will establish findings as required by NEPA. The Decision Notice will address consistency with the Forest Plan as amended.

Scoping, Public Involvement

Environmental analysis, including scoping[4], began several years ago for the proposed Decline Thin Project. In June 2005, letters were mailed to Tribes and then to persons on District mailing lists, requesting comments on the proposed Decline Thin Project. In July of 2005, District staff organized two field trips to the Decline Thin Project area. Members from Pilchuck Audubon, North Cascades Conservation Council, as well as local citizens attended this field review. Additional scoping of Tribes and interested public took place in 2007. On March 13, 2007, the Darrington Ranger District hosted an open house to discuss this and other projects with more than 50 people in attendance. The Forest Service received a total of 12 written responses to the 2005 and 2007 scoping efforts. (Refer to Appendix A of this EA for consideration of issues). The ID Team has considered comments received in response to the 2005 and 2007 scoping letters, the two field trips, the 2007, and comments received during the District open house.

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3 Matrix consists of those National Forest System lands outside of Congressionally Reserved Areas, Late-Successional Reserves, Adaptive Management Areas, Managed Late-Successional Areas, Administratively Withdrawn Areas, and Riparian Reserves. Most scheduled timber harvest (that contributing to the probable sale quantity (PSQ)) and other silvicultural activities will be conducted in this allocation (USDA, USDI 1994, pp. 7 and C-39).

4 Scoping is the procedure by which the Forest Service identifies important issues and determines the extent of analysis necessary for an informed decision on a proposed action (40 CFR 1501.7).

Copies of the EA have been mailed to those who have participated in the scoping process or who had requested a copy of the EA, including individuals, groups, and Tribal councils. Legal notice of the availability of the EA was published in the Seattle-Post Intelligencer, initiating the 30-day pre-decisional comment period. The Forest Service sent a post card to the project's mailing list advising the public of availability of the EA on the Forest Web site.

The ID Team and the Responsible Official will consider substantive comments received (as per 36 CFR 215), and as appropriate, improve the analysis in response to those comments. Copies of the comments received and documentation of the agency's consideration of those comments will be available in the Project Record.

Significant Issues

Throughout the public involvement process for Decline Thin Project, a number of considerations were raised. In addition to those public comments, and the preliminary issues identified in early scoping, the ID Team completed inventories and field reconnaissance, and reviewed District resource maps and other information to recommend the key ("significant") issues for the Responsible Official's approval.[5] Identifying the significant issues early in the analysis process serves to sharpen the focus of the environmental analysis, allowing impacts to be discussed in proportion to their significance (40 CFR 1500–1502). The two significant issues that survived reiterative review, are listed below.

These issues were used to finalize alternatives; to prescribe management requirements and mitigation measures; and/or to track environmental effects. Refer to Appendix A–Public Comments Involvement for a discussion of all issues raised by the public, and how they were used during the environmental analysis process. Included for each significant issue is a brief discussion, followed by unit(s) of measure for tracking in Chapter 3, –Environmental Effects further describes how the alternatives addresses the issues.

Issue 1: Economic Viability

The Decline Thin Project may turn out to be not economical for a purchaser to harvest.
There is a concern that the proposed timber harvest would result in a deficit timber sale. "Deficit sales" are defined as sales where the "average indicated advertised rate" is less than the "average base rate." As a result, depending on actual market conditions at the time of sale, the sale may not receive viable bids, and the sale may not be sold. The market value for timber fluctuates seasonally and yearly. Financial analysis of the proposed project will provide an estimate of timber sale viability. The financial analysis will estimate bid rate of the timber sale based on log values, logging costs, and contractual requirements. An estimated bid rate that is less than the minimum advertised rate for a timber sale would indicate a deficit sale (using today's costs and values). In a changing market, price scenarios vary, and small changes in wood product values may turn a deficit sale into a positive one, or vice versa.

Units of Measure

- Volume of timber sold (mmbf)

5 Refer to the Project Record for this documentation. "Significant issues" are defined in 40 CFR 1500.4, and differ in meaning from "significant effects" as defined in 40 CFR 1508.27.

- Estimated PNV
- Estimated benefit:cost Ratio
- Expected bid rate

Issue 2: Watershed Processes—Peak Flows and Sediment Yield

Thinning and road building activities may affect soil erosion and water quality and quantity in the project area and downstream.
The Proposed Action includes thinning harvest operations (300—400 acres), haul road reconstruction of existing permanent roads (7.7—10.6 miles), and temporary road construction (0.9 mile).

Particularly in areas susceptible to rain-on-snow events, the above activities can influence the timing and quantity of flows, soil erosion, and the rate and quantity of sedimentation to aquatic habitats. Reconstruction of roads and associated drainage features, especially those that currently pose a risk to aquatic resources, can also help restore natural drainage patterns and benefit aquatic and riparian conditions. Decommissioning of roads with continuing hydrologic risk can have long-term benefits to watershed conditions.

Units of Measure

- Length of haul road reconstruction (miles of road upgraded)
- Length of temporary road construction
- Percentage of soil disturbance
- Percentage of vegetation disturbance
- Percent changes in sediment
- Miles of high-risk road decommissioned or put into storage

The parameter "percentage of vegetative disturbance" is used as an indicator of potential risk of peak rain-on-snow events rather than as a direct indicator of water quality changes.

Relationship to the Forest Plan

This EA has been prepared in accordance with regulations for implementing the National Environmental Policy Act of 1969 (NEPA), located at 40 CFR 1500–1508. It is tiered to the Final Environmental Impact Statement (FEIS) for the Mt. Baker-Snoqualmie Land and Resource Management Plan (USDA Forest Service 1990), as amended. Major plan amendments include:

- *Final Supplemental Environmental Impact Statement on Management of Habitat for Late Successional and Old-growth Forest Related Species Within the Range of the Northern Spotted Owl,* as adopted and modified by the April 1994 record of Decision, which provides additional standards and guidelines (USDA Forest Service, USDI Bureau of Land Management 1994, and commonly known as the ROD or Northwest Forest Plan)

- *Record of Decision Amending Resource Management Plans for Seven Bureau of Land Management Districts and Land and Resource Management Plans for Nineteen National Forests Within the Range of the Northern Spotted Owl to Clarify Provisions Relating to the Aquatic Conservation Strategy* (USDA Forest Service, USDI Bureau of Land Management 2004); and
- *Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines* (USDA Forest Service, USDI Bureau of Land Management 2001), as reinstated by U.S. District Court Order (January 9, 2006), as the ROD was amended or modified as of March 21, 2004.[6]

The 1994 ROD includes seven land allocations, which amend the allocations in the 1990 Forest Plan.[7] There is considerable overlap among some allocations, and more than one set of standards and guidelines may apply. Where the standards and guidelines of the 1990 Forest Plan are more restrictive or provide greater benefits to late-successional forest-related species than do those of the 1994 ROD, the existing standards and guidelines apply. The 1994 Forest Plan amendment also includes Forest-wide standards and guidelines, in addition to those in the 1990 Plan, and an Aquatic Conservation Strategy, designed to help improve the health of the aquatic ecosystem.[8]

Land Allocations

The following land allocations are found in the project area (see Figure 4). For additional details, refer to either the 1994 ROD or the 1990 Forest Plan.

Table 1. Forest Plan Allocations within Project Area

Land Allocation	Acres	Notes
Riparian Reserve	Accounted for in other land allocations.	Riparian Reserves overlay all other allocations, and include approximately 330 acres within the project area
Matrix	603	Matrix acres overlay MA 17 Timber Management Emphasis 583 acres of MA 17 (20 acres other management area)
Late Successional Reserve	324	LSR #115–Suiattle—41,867 acres LSR in project area is 0.8 % of total LSR
Total acres in project area	**927**	Forest Stands: 800 acres, Daylighting 60 acres, Road decommissioning 67 acres

6 This same Court Order set aside the 2004 ROD, which removed or modified the survey and manage mitigation measure standards and guidelines.
7 The MBS National Forest has no Managed Late Successional Reserves allocations.
8 The Aquatic Conservation Strategy (ACS) has four components; Riparian Reserves, key watershed, watershed analysis, and watershed restoration.

Note: Riparian Reserves mapped in Figure 5 were generated using Geographic Information System (GIS) buffers along the perennial drainage systems, and with buffers to meet Aquatic Conservation Strategy objectives on intermittent drainages identified on the ground. The GIS buffer does not distinguish at what point a fish-bearing stream is non-fish bearing, or if the drainage feature has a definable channel with evidence of annual scour or deposition. As a result, when verified on the ground, final Riparian Reserve boundaries may vary some from mapped areas in Figure 5.

Riparian Reserves: This allocation includes areas along all streams, wetlands, ponds, lakes, and unstable or potentially unstable areas. Riparian Reserves generally parallel the stream network, but also include other areas necessary for maintaining hydraulic, geomorphic, and ecological processes. Riparian Reserves overlay all other management areas, and the Riparian Reserve standards and guidelines apply wherever Riparian Reserves occur. Figure 5 shows the Riparian Reserves covering the analysis area, as mapped in the Northwest Forest Plan.

Matrix: Matrix lands consist of those federal lands outside the other categories of designated areas specified in the Northwest Forest Plan. Most scheduled timber harvest and other vegetation management activities are conducted in that portion of the Matrix with suitable forest lands. Matrix may also include non-forested areas and lands that are technically unsuited for timber harvest. In the Decline Thin Project area, the 1990 Forest Plan allocations in the Matrix is Timber Management Emphasis (Management Area 17).

Late-Successional Reserves (LSR): The main objectives for these reserves, in combination with other land allocations and standards and guidelines, is to maintain a functional LSR and old-growth forest ecosystem as habitat for late-successional and old-growth related species.

Tier 1 Key Watershed: Key Watersheds are one component of the Aquatic Conservation Strategy. The Sauk River is a Tier 1 Key Watershed, designated for its direct contribution to conservation of at-risk anadromous salmonids, bull trout, and resident fish species, and for its high potential for being restored. There should be no net increase in the amount of roads in Key Watersheds. Key Watersheds have the highest priority for watershed restoration.

Figure 4. Merged Forest Plan Land Allocations

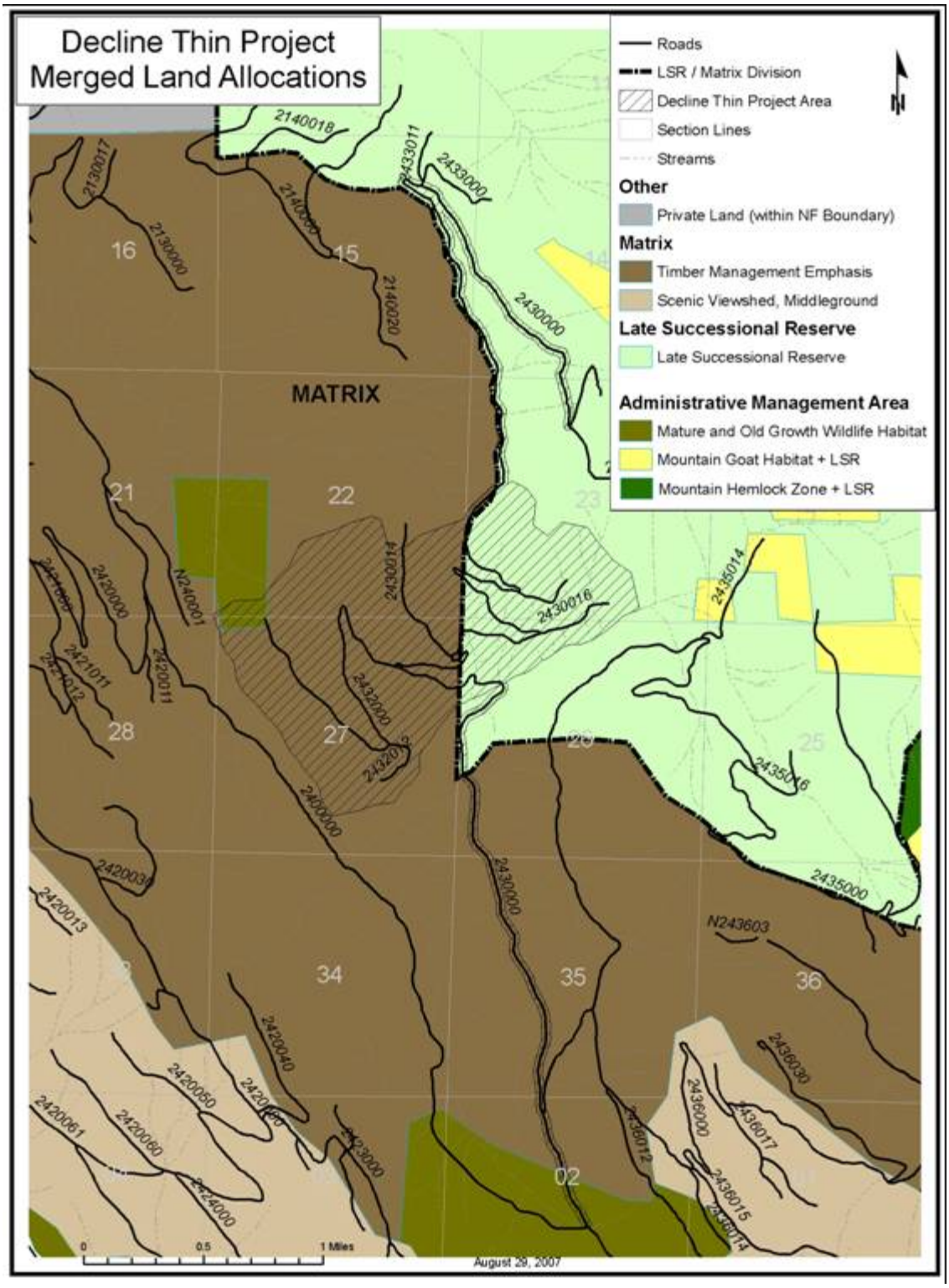
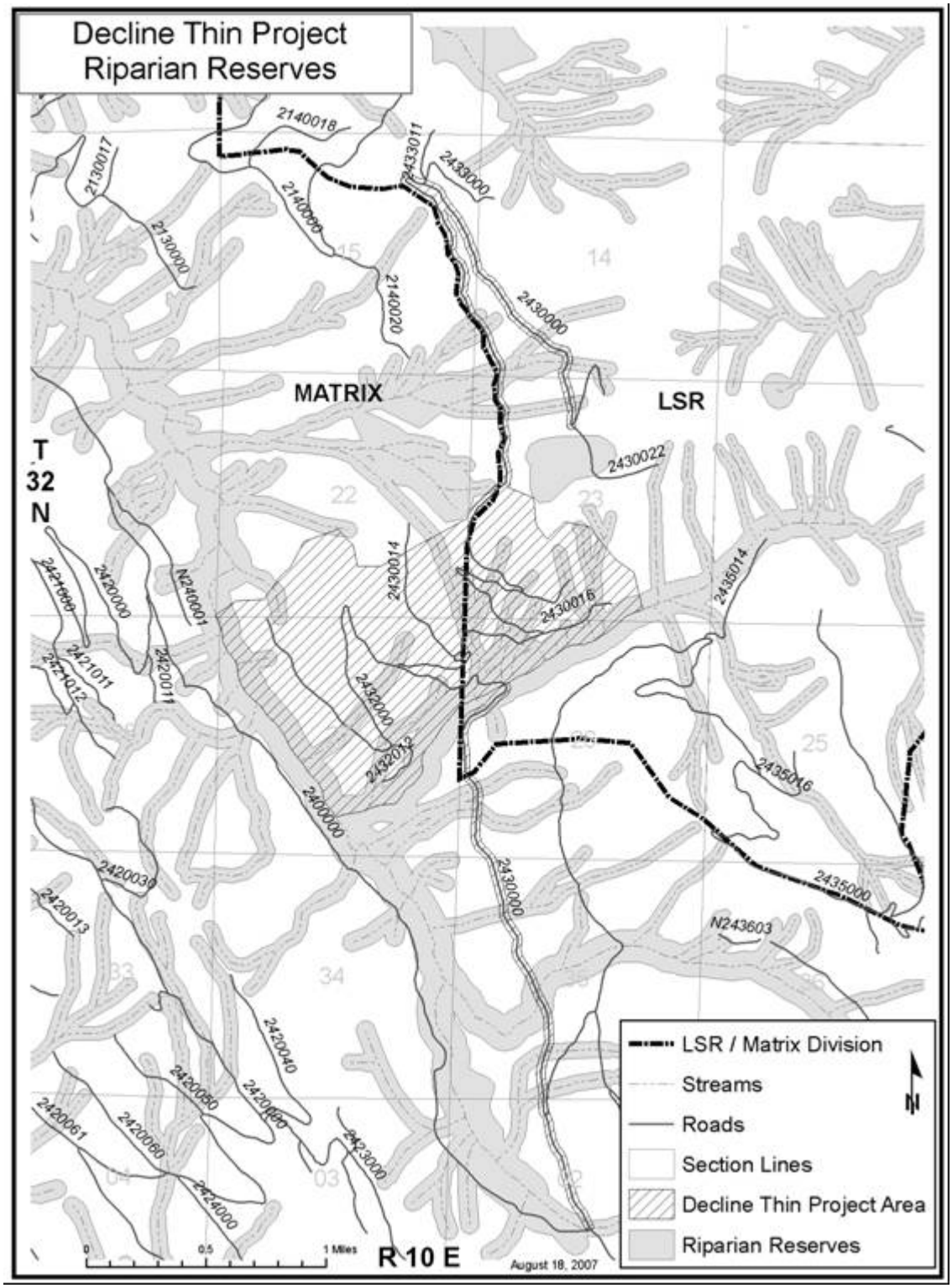


Figure 5. Riparian Reserves



Selected Forest Plan Standards and Guidelines

Some Forest-wide standards and guidelines are repeated below. Those listed are particularly applicable to this project. Refer to the 1990 Forest Plan and 1994 ROD, for all standards and guidelines.

From the 1990 Forest Plan

In addition to standards and guidelines for the above management allocations, forest-wide goals and standards and guidelines for land uses and facilities (roads) apply including:

Soil, Air, Water, and Riparian Areas: No more than 20 percent of an activity area may be severely burned, compacted, puddled, or displaced as a result of the activity. Only permanent features of the transportation system will remain in a detrimentally compacted, puddle, and/or displaced condition (USDA Forest Service 1990 pp. 4–117).

Wildlife: Provide highest levels of deer and elk habitat capability possible while still meeting other primary resource objectives (ibid 1990, p. 4–124).

Timber: Provide for the production of timber on lands classified as suitable for timber production consistent with various resource objectives, environmental constraints, and considering cost efficiency (ibid 1990, p. 4–130—Timber Management Goal). A full range of silvicultural practices should be allowed. The Standards and guidelines for the timber production, Management Prescription 17 shall apply to this management prescription (MA 2B). Visual quality objective of partial retention should be retained. Areas of ground disturbance should be rehabilitated to natural appearance (ibid 1990, p 4–174).

From the 1994 ROD Amending the Forest Plan

Riparian Reserves

Timber Management

TM-1 Prohibit timber harvest, including fuel woodcutting, in Riparian Reserves, except as described below. Riparian Reserve acres shall not be included in calculations of the timber base.

Apply silvicultural practices for Riparian Reserves to control stocking, reestablish and manage stands, and acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives.

Road Management

RF-2: For each existing or planned road, meet Aquatic Conservation Strategy objectives by:

Minimizing road and landing locations in Riparian Reserves

Completing watershed analyses (including appropriate geotechnical analyses) prior to construction of new roads or landings in Riparian Reserves.

Preparing road design criteria, elements, and standards that govern construction and reconstruction.

Minimizing disruption of natural hydrologic flow paths, including diversion of streamflow and interception of surface and subsurface flow.

RF-3: Determine the influence of each road on the Aquatic Conservation Strategy objectives through watershed analysis. Meet Aquatic conservation Strategy objectives by:

Reconstructing roads and associated drainage features that pose a substantial risk.

Prioritizing reconstruction based on current and potential impact to riparian resources and the ecological value of the riparian resource affected.

Closing and stabilizing, or obliterating and stabilizing roads based on the ongoing and potential effects to Aquatic Conservation Strategy objectives and considering short-term and long-term transportation needs.

RF-4: Existing culverts, bridges and other stream crossings determined to pose a substantial risk to riparian conditions will be improved, to accommodate at least the 100-year flood, including associated bedload and debris. Crossings will be constructed and maintained to prevent diversion of streamflow out of the channel and down the road in the event of crossing failure.

RF-5: Minimize sediment delivery into streams from roads. Outsloping of the roadway surface is preferred, except in cases where outsloping would increase sediment delivery to streams or where outsloping is unfeasible or unsafe. Route road drainage away from potentially unstable channels, fills, and hillslopes.

Matrix

Provide Specified Amounts of Course Woody Debris in Matrix Management

Manage to provide a renewable supply of large down logs well distributed across the matrix landscape in a manner that meets the needs of species and provides for ecological functions

Coarse woody debris already on the ground should be retained and protected to the greatest extent possible from disturbance during treatment.

Emphasize Green-tree and Snag Retention in Matrix Management

On the Mt. Baker-Snoqualmie National Forest, site-specific prescriptions should be developed to maintain biological diversity and ecosystem function, including retention of green trees (singly and in patches), snags, and down logs.

Other Laws, Direction, and Analyses

Endangered Species Act: Section 7 (a)(2) of the Endangered Species Act of 1973 as amended, requires federal agencies to review actions authorized, funded, or carried out by them, to ensure such actions do not jeopardize the continued existence of federally listed species, or result in the destruction or adverse modification of listed critical habitat.

The Forest Service consults with the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) if projects could potentially affect listed species or critical habitat. The Forest currently has three programmatic consultation documents with these regulatory agencies that cover much of the Forest's program of activities for several years.

Magnuson-Stevens Fishery Conservation and Management Act: The Magnuson-Stevens Fishery Conservation and Management Act as amended by the Sustainable Fisheries Act of 1996, requires Federal action agencies to consult with the Secretary of Commerce (NMFS) regarding

certain actions. Consultation is required for any action or proposed action authorized, funded, or undertaken by the agency that may adversely affect essential fish habitat (EFH) for species managed in Federal Fishery Management Plans. For this project, the Pacific Coast Salmon Plan manages for chinook, coho, and pink salmon. According to EFH regulations, 50 CFR section 600.920(a)(1), EFH consultations are not required for completed actions or project-specific actions with a signed decision under the National Environmental Policy Act, and these regulations enable Federal agencies to use existing consultation and environmental review procedures to satisfy EFH consultation requirements.

National Historic Preservation Act of 1966, Executive Order 11593, 36 CFR 800.9 (Protection of Historic Properties): Section 106 requires documentation of a determination of whether each undertaking would affect historic properties. The MBS operates under a programmatic agreement between the Washington State Historic Preservation Officer and the Advisory Council on Historic Preservation for consultation on project determination.

Clean Air Act: The Clean Air Act Amendments of 1977 gives federal land managers an affirmative responsibility to protect the air quality related values (including visibility) within Class 1 areas.

Clean Water Act: The Clean Water Act (CWA) of 1977 and subsequent amendments, established the basic structure for regulating discharges of pollutants into the waters of the United States. It gives the Environmental Protection Agency (EPA) the authority to implement pollution control programs, and to set water quality standards for all contaminants in surface waters. The Act makes it unlawful for any person to discharge any pollutant into waters of the United States, unless a permit has been obtained under its provisions. The EPA delegated implementation of the CWA to the States; the State of Washington recognizes the Forest Service as the Designated Management Agency for meeting CWA requirements on National Forest System lands.

Washington State Department of Ecology MOA: Section 303(d) of the Federal Clean Water Act requires Washington State (Department of Ecology) to periodically prepare a list of all surface waters where pollutants have impaired the beneficial uses of water (for drinking, recreation, aquatic habitats, etc.). Types of pollutants included high temperatures, fecal coliform, excess nutrients, low levels of dissolved oxygen, and toxic substances. The current Washington State list for these Water Quality Limited Water bodies is dated 1998; a new list is in preparation but has not yet been approved by the EPA. The Forest Service Pacific Northwest Region 6 and the Washington State Department of Ecology meet this management mandate under a Memorandum of Agreement (MOA) with emphasis on reducing effects of roads on water quality.

Washington Department of Fish and Wildlife MOU: Memorandum of Understanding between USDA Forest Service and Washington Department of Fish and Wildlife for Hydraulic Permits. This MOU lists conditions under which the Forest Service may complete projects affecting waters of the State without completing an HPA application.

Invasive Species Management: The 1999 Executive Order on invasive species (direction found in Forest Service Manual 2080) the National and Regional strategies for noxious weed management, and the Mediated Agreement of May 24, 1989, identify prevention as the preferred strategy for managing competing and unwanted vegetation. In addition to treatment of known infestations, measures intended to prevent further infestations and weed-spread would be incorporated into the construction contract. These measures include cleaning of construction equipment, prompt re-vegetation of disturbed sites, and treatment of known weed sites before they become larger. These measures come from the Forest Plan, Forest-wide Standards and

Guidelines, Prevention Strategies, and Best Management Practices (BMPs) for noxious weeds (MBS Forest Plan Amendment #14, 1999).

A Record of Decision was signed for the Pacific Northwest Region Invasive Plant Program: Preventing and Managing Invasive Plants, Final Environmental Impact Statement (USDA Forest Service 2005). This document amends all Forest Plans in Washington and Oregon with goals, objectives, and standards related to invasive plants that complement the Best Management Practices already in effect on the MBS. The 2005 ROD standards also prescribe prevention, cleaning of equipment, use of weed-free straw and mulch, use of weed-free rock and gravel sources, and prompt revegetation with native species or non-invasive non-natives. This EA is tiered to this broader-scale analysis (the FEIS), and all activities proposed are intended to comply with the new management direction.

Programmatic Analyses

Sauk River Watershed Analysis: The Sauk River and Sauk River Forks Watershed Analysis was completed in 1995 and the report was finished in 1996 (USDA Forest Service 1996). The watershed analysis describes the 1995 condition of the watershed; compares historic and current conditions; describes how ecosystems have functioned and are currently functioning; and given current direction, describes how they are likely to function into the future. The analysis identifies findings and recommendations that serve to highlight desired conditions and the corresponding resource needs that may be addressed through vegetation management activities. Note that the Sauk Watershed Analysis was conducted 12 years ago; some hydrologic conditions have changed; and additional fieldwork and analysis have taken place since, and in some cases provide additional and updated information.

Forest-wide Roads Analysis, Mt. Baker-Snoqualmie National Forest (USDA Forest Service 2003) Roads analysis, a requirement of 36 CFR 212.5, has been completed at the Forest level. The Forest wide analysis is an interdisciplinary, science-based process that provides the Responsible Official critical information needed to identify and manage a minimum road system that 1) is safe and responsive to public needs and desires; 2) is affordable and efficient; 3) is in balance with available funding for needed management actions; and 4) has minimal adverse effects on ecological processes and ecosystem health, diversity, and productivity.

Forest-wide Late Successional Reserve Assessment (USDA Forest Service 2001): The Forest has completed a series of Late Successional Reserve Assessments, including the Forest-wide assessment in September 2001. Its purpose is to determine how well the portion of the LSR network on this Forest is functioning, and if any management strategies are necessary to sustain the network for the individual LSRs. Portions of the LSRs currently contain large expanses of young forest regenerated following timber harvest, which may require many years for the development of a functional, interactive, late successional forest. The Forest-wide LSR Assessment provides guidance for potential treatment including thinning.

Project Record

This EA hereby incorporates by reference the Project Record (40 CFR 1502.21). The Project Record contains Specialist Reports and other technical documentation used to support the analysis and conclusions in this EA. These Specialist Reports are for Soil and Water, Aquatic Resources, Wildlife, Vegetation, Fuels, Air Quality, Botany, Heritage Resources (District files), Socio-Economics, Roadless, Unroaded, and Recreation for the Decline Thin Project. The Reports

also contain the Affected Environment section of the environmental analysis, which helps establish the basis for the environmental effects section in Chapter 3 of this EA. An affected environment chapter is not a requirement of an EA (40 CFR 1508.9).

Relying on Specialist Reports and the Project Record helps implement the CEQ Regulations' provision that agencies should reduce NEPA paperwork (40 CFR 1500.4). The objective is to furnish enough site-specific information to demonstrate a reasoned consideration of the environmental impacts of the alternatives and how these impacts can be mitigated, without repeating detailed analysis and background information available elsewhere. The Project Record is available for review at the Darrington Ranger District.

Maps and Acres Precision

Note: *All map boundaries and acre figures are approximations based on best available information at the time, and actual implementation may differ slightly to better reflect on-the-ground conditions.*

All volumes, miles of roads, and exact unit boundaries and acreages are estimates based on aerial photography and map interpretation and may change slightly for Alternatives B, C, and D with final ground verification and project layout.

Chapter 2 –Alternatives to the Proposed Action

Introduction

This chapter describes and compares four alternatives for the proposed Decline Thin Project, including a No Action Alternative. Each of the action alternatives represents an option to meet the project's purpose and need, and implement the objectives of the Forest Plan as amended (Chapter 1 G-167). This section presents the alternatives in comparative form, displaying the differences between each alternative and providing a basis for choice by the decisionmaker.

Chapter 2:

- describes how the alternatives were developed, including a summary of the forest stand inventory and preliminary alternative design process;
- describes the alternatives considered but eliminated from detailed study;
- describes the four alternatives considered; and
- compares the alternatives in relation to the significant issues.

Alternative Development Process

The ID Team prepared a strategy for developing a full range of alternatives, including no action. In addition to meeting Forest Plan direction, the range of alternatives responds to the project's purpose and need, and addresses the significant issues.

Site-specific resource information about the project area and affected areas was collected in the development of the four alternatives. This included information on timber stands and other vegetation, wildlife use and habitat, soil type and slope stability, watershed condition, existing and potential road locations, and heritage resources.

Stand year-of-origin maps and aerial photographs were initially examined to identify areas for potential stand treatment. Stands that had reached 40 years of age were reviewed for their potential benefit from a thinning (density adjustment) and provide a commercial wood product. Once potential treatment areas were identified, vegetation was examined using standard Regional guidelines for stand examinations, using a systematic sample of stand exam plots to record tree species, diameter, height, defect etc., and understory vegetation information (see p. 45

Based on the information collected and interpreted, along with information from other resource specialists' reconnaissance, two general areas (stands based on age class) were initially delineated for consideration in alternative development. The Alternative maps delineate the proposed harvest units within the two timber stands. Proposed Units 1 through 9 are in Stand 1, which has trees approximately 70-years-old (hereafter called 70-year-old stands). Proposed Units 10 through 13 are in Stand 2, which has trees approximately 40 years old (hereafter called 40-year-old stands).

Alternatives Considered, but Eliminated from Detailed Study

In addition to the four alternatives discussed in this chapter, five other alternatives or approaches were considered, but were not developed fully because they failed to meet the purpose and need of the project, and/or to address the significant issues. These alternatives and approaches are described below along with the reasons they were not considered in detail.

Regeneration Harvest

Within the matrix areas, a variety of harvest techniques is possible. Regeneration harvest is one option for stand management harvesting, and would produce more wood volume as well as leaving the site in a condition conducive to the regeneration, growth, and development of Douglas-fir, a desirable economic and shade-intolerant species. This alternative was not fully developed because even though it would meet the purpose and need of the project, the stand has yet to reach culmination of mean annual increment in growth. In addition, due to past harvest patterns, maintaining a 60 percent or greater residual canopy closure through other stand treatments other than regeneration harvest would help mitigate impacts to the hydrologic condition of the Dan Creek subwatershed.

Non-Commercial Restoration Only

A restoration-only alternative includes such actions as removal and restoration of Forest Service roads, control of exotic invasive species, and control of sediment sources. It was not fully considered because it would not meet the underlying purpose and need to harvest commercial timber from Matrix lands; or provide timber volume to the marketplace. This alternative was not economically viable because currently there are limited funds available for stand treatment to retain stand health and vigor, and to enhance tree growth for long-term site productivity and spatial diversity in stand structure.

Harvest in the North Half of Section 22

North of Decline Creek, and within the Matrix area, in T.32N, R.10E, Section 22 (between Roads 2432 and 2140020), there is older forest that could provide additional wood volume. This area has not been previously harvested or roaded.

An alternative to enter this area for commercial timber harvest was not developed in order to pursue an alternative with a potential exchange of second-growth forest in LSR for old forest Matrix lands to better accommodate LSR objectives below.

LSR-Matrix Exchange Alternative

This alternative would include a Forest Plan amendment to implement an exchange of LSR and Matrix land allocations. It would result in exchanging approximately 1,200 LSR acres for 1,200 acres of Matrix. This allocation exchange would make the LSR system more functional and effective, and consolidate timber and road management in areas that are already roaded and previously harvested. (See Decline Thin Matrix to LSR Conversion Map, in the Project Record.) The exchange would incorporate old forest stands located in the Matrix land allocations of the Dan Creek and Decline Creek drainages into the LSR network and shift forest stands in roaded LSR allocations of the

Dan Creek drainage to Matrix. The 30- to 40-year-old stands within the project area would then be within Matrix allocation, and stand treatment would emphasize thinning the densely stocked stands for future timber volume. The thinning treatment would be more widely spaced than thinning in LSR to decrease competition for residual trees, and maximize mean annual increment in growth.

The ID Team considered this exchange alternative at length, but the alternative was eliminated it from detailed study after the U.S. Fish and Wildlife Service (FWS) announced a new revised proposal for critical habitat designation for the northern spotted owl (Federal Register, June 12, 2007 p. 32450). The proposal could have implications for the Forest's LSR system and its management. In addition, a change in LSR and Matrix land designations would require additional time and analysis, along with a Forest Plan amendment. Such a change is a programmatic and could be conducted as part of a programmatic or Forest-wide assessment such as a Forest Plan revision.

Alternatives Considered in Detail

The ID Team considered the underlying project purpose and need, as well as the significant issues, in developing four alternatives to analyze in detail for environmental effects.

Figure 6. Stand with snags left

Components Common to All Action Alternatives

Two sets of components are the same the four alternatives considered in detail. summarizes and compares the Elements of each alternative. These are explained in more detail in the box on the next page, along with explanation for some elements. Table 3 lists the Management Requirements and Mitigation Measures that are integral parts of each alternative.

Table 2. Elements by Alternative

Project Elements		Alternative			
		A	B	C	D
Forest Stands					
70-year-old stands Units 1–9	**Thin to % canopy cover**	No treatment	60% canopy	70% canopy	Same as Alternative C
	Acres thinned & allocation	0	214 acres 100% Matrix	Same as Alternative B	Same as Alternative B
40-year-old stands Units 10–13	**Thin to 60–70% canopy**	No treatment	No treatment	Thin and leave material Units 10–11 Thin and leave material Units 12–13	Thin and remove material Units 10–11 Thin and leave material Units 12–13
	Acres thinned & allocation	No treatment	No treatment	166 acres 85% LSR	166 acres (136 Units 10–11, 30 acres Units 12–13) 82% LSR Units 10–11 100% LSR Units 12–13
Riparian Treatment 14 acres in Alternatives C, D		No treatment	No treatment inner gorge, 70% canopy closure 10 acres 70-year-old stand	Same as Alternative B Also: 4 acres in 40-year-old stand	Same as Alternative C
Timber Volume (mmbf)		0	7.19	5.33	7.24
Roads					
Upper Road 2430		No treatment	No treatment	No treatment	Decommission: Remove 6–7 culverts Remove sidecast fill along 530 feet of sloughing areas
Road 2430016 **Road 2430017**		No treatment	No treatment	Decommission following thinning	Same as Alternative C
Road 2432 **Road 2430014**		No treatment	Treat and close (ML1) following thinning	Same as Alternative B	Same as Alternative B
Haul-route road daylighting		No treatment	3.5 miles of Road 2430 50' from center line	Same as Alternative B	Same as Alternative B
Culvert-to-Bridge Replacement		No replacement	No replacement	No replacement	Replace Conn Creek culvert with a bridge (Road 2430 MP 1.48)
Fuels					
Fuels treatment		No treatment	Pile and burn slash in landings	Same as Alternative B Also: Pull back slash along open road, pile, and burn Build fire handline	Same as Alternative B

Elements Common to All Action Alternatives

Forest Stands

70-Year-Old Stands

The 70-year-old stand is densley stocked, and competition between trees has begun to slow diameter and height growth (J.A. Henderson 1992; USDA Forest Service, UDSI BLM 1994, p. C-11). The rationale for thinning is to reduce stocking to retain growth, site productivity, health, and horizontal and structural diversity in overstocked stands (USDA Forest Service 2001). Thinning overstock stands would also provide to the economy commercial timber volume from Matrix lands.

Prescription: Thinning from below to a certain trees per acre with variable spacing is the general prescription in all units and alternatives. All action alternatives would employ no-cut buffers in the inner gorge portions of Riparian Reserves.

In the Matrix land allocation, Douglas-fir would be favored over other species for commercial timber purposes. Species such as Pacific yew and cherry would be retained as well as dominant trees, with retention of trees greater than 26-inches diameter breast height (dbh). Western redcedar would also be favored, to release suppressed trees. Large, deformed green trees would be retained for wildlife habitat.

Logging Systems: Skyline and ground-based harvest systems (processor or forwarder) would be used.

40-Year-Old Stands

LSR Treatment: The rationale for thinning in LSR stands is similar to the rationale for thinning 70-year-old stands (above). Thinning would increase residual tree growth, open up the forest canopy, increasing diversity of plants and animals, and accelerate the development of a forest with mature characteristics (USDA Forest Service 2001).

Riparian Treatment: The rationale for entering Riparian Reserves is that riparian area thinning would reduce stocking levels and further develop stand characteristics to support Aquatic Conservation Strategy objectives of maintaining and restoring species composition and structural diversity (USDA Forest Service, USDI BLM 1994). The prescription would retain 70 percent canopy to maintain and restore habitat to support well-distributed populations of native plants, and invertebrate and vertebrate riparian–associated species. Riparian thinning would adjust stocking, and distribute tree species within the stand to support well-distributed populations of flora and fauna (biodiversity).

Roads

Road actions include road upgrade, temporary construction, storage and closure, and decommissioning.

Fuels

Fuels treatment includes slash piling at landings, pile burning, etc.

Alternative Descriptions

Alternative A—No Action

A "No action" alternative is required by the National Environmental Policy Act (NEPA), and serves as the environmental baseline for analyzing effects. Existing processes and trends within the project area would continue.

Forest stands: There would be no timber harvesting or removal in the 70-year-old stand or stand adjustment in the 40-year-old stands.

Roads: There would be no road reconstruction. Existing roads would continue to receive maintenance at current operational levels (Chapter 3, Roads and Transportation) as funding allows. There would be no road treatments of decommissioning or upgrade.

Fuels: There would be no fuels treatment or related activities at this time.

Alternative B

Alternative B is the proposed action that focuses on the forest stand conditions and economics. This alternative responds to the purpose and need Element 1, reduce stocking levels in densely stocked stands to maintain, promote, growth in the stands. It meets Element 2, support Aquatic Conservation Strategy objectives in Riparian Reserves. It would thin nine units of densely stocked conifers. It responds to Issue 1, economic viability of the sale by focusing thinning to the larger 70-year-old stand. See Figure 8.

Forest Stands

70-Year-Old Stands

Alternative B would thin 214 acres of the Matrix 70-year-old stand. This alternative would retain an average 60 percent canopy cover.

Prescription: Alternative B would thin to approximately 130 trees per acre. This alternative would retain trees greater than 26 inches dbh. There would be no specified skips or gaps. Douglas-fir would be favored over other species. The thinning treatment would yield about 7.2 million board feet (mmbf) of commercial timber. All action alternatives would employ no-cut buffers in the inner gorge portions of Riparian Reserves.

Species such as Pacific yew and cherry would be retained as well as dominant trees, through a thinning prescription with a 26-inch upper diameter limit for take trees. Western redcedar would also be favored for release suppressed trees. Large, deformed green trees would be retained for wildlife habitat.

Logging Systems: Alternative B would use cable and ground-based harvest systems, primarily located along existing roads or skid trails, with approximately 50 percent of the trees removed with skyline yarding, and 50 percent removal with ground equipment such as a processor or forwarder.

40-Year-Old Stands

The project area's densely stocked 40-year-old stands would not be treated in Alternative B.

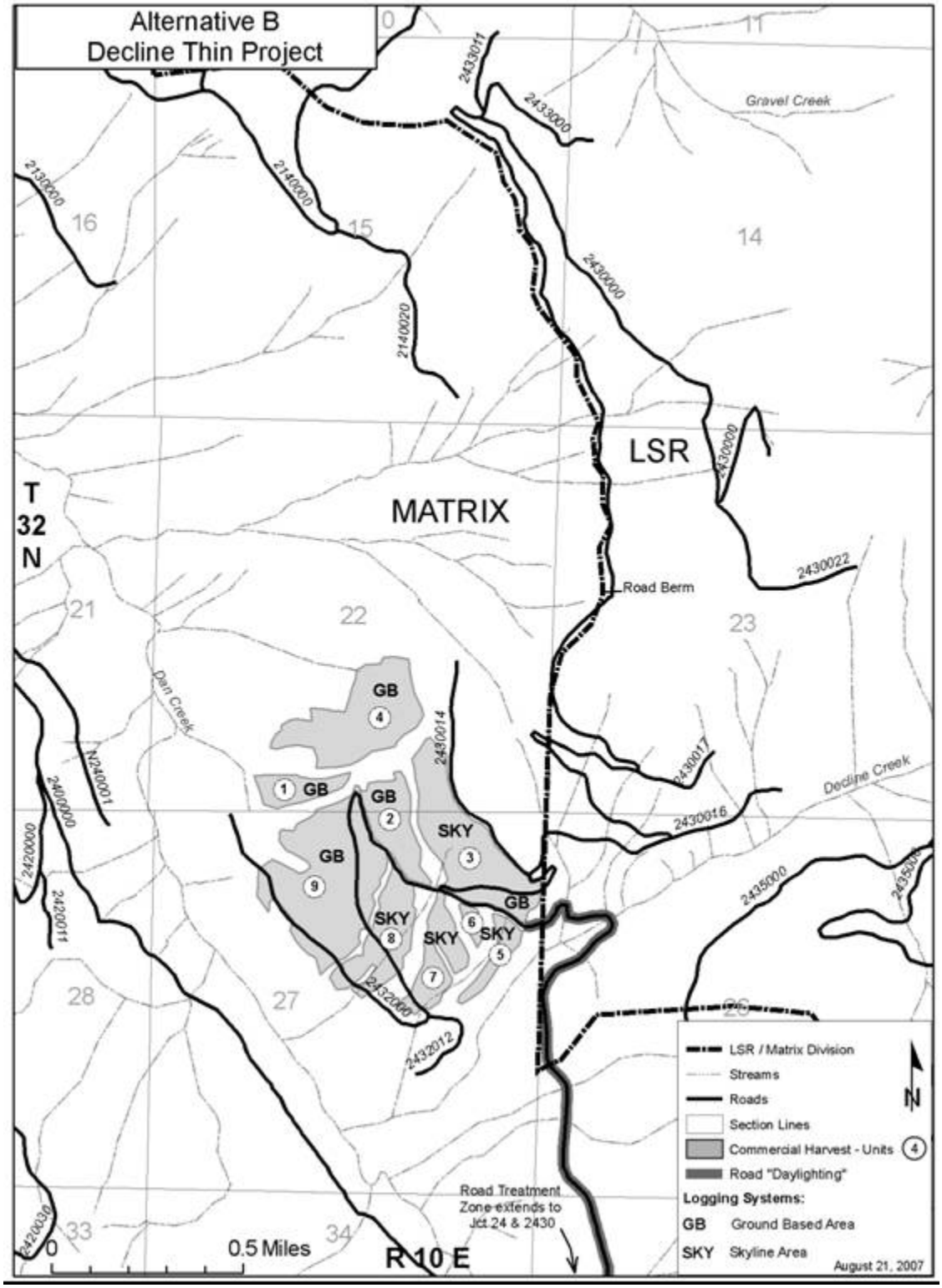
Riparian treatment: Ten acres of riparian area would be thinned, retaining 70 percent canopy.

Roads: Alternative B would upgrade 13.7 miles of existing road, which comprises the timber haul-route. Of that, 2.3 miles of road would be stored and closed following timber sale activities. If needed, 0.9 mile (4,700 feet) of temporary road would be constructed. All temporary roads would be decommissioned following timber sale activities.

Fuels: Following timber harvest, slash treatment would include removing slash from, or burning slash piles on, all log-landing areas.

Figure 7. Decline Thin 40-Year-Old Stand

Figure 8. Alternative B



Alternative C

Alternative C focuses on stand conditions, not only in Matrix, but also in LSR and retains canopy cover for hydrologic considerations. This alternative, as in Alternative B, responds to Purpose and Need Element 1 and 2 to reduce stocking levels to promote increased growth rate in dense stands Matrix and Riparian Reserve. It also responds to Purpose and Need Element 3, the need to maintain a functional, interacting, late-successional and old-growth forest ecosystem in LSR. It would thin 214 acres of 70-year-old stands, and 166 acres of the 40-year-old stands that are primarily LSR. See Figure 9.

Forest Stands

70-Year-Old Stands

Alternative C would thin 241 acres of the Matrix 70-year-old stand. It would retain a canopy cover averaging 70 percent, 10 percent denser than Alternative B. The purpose would be to reduce stocking levels sufficient to maintain dominant and co-dominant trees growth and provide additional canopy in the residual stands for hydrologic cover.

Prescription: Unlike Alternative B, Alternative C would thin to approximately 150 trees per acre across 80 percent of the area. This alternative would thin from below. Approximately 10 percent of the area would remain in skips with another 10 percent of the area would be gaps (skips refers to uncut areas, gaps refers to created openings.)

Harvesting fewer trees would result in a yield of approximately 5.3 mmbf of commercial timber.

40 Year-Old Stands

Unlike Alternative B, Alternative C would thin the 40-year-old stands (approximately 166 acres, Units 10—13) to promote steady growth in tree height, diameter, and community structure that would lead towards an old forest condition.

This alternative would thin to approximately 235 trees per acre across approximately 60 to 80 percent of the area. Approximately 10 to 20 percent of the area would remain uncut in skips, and 10 to 20 percent of the area would be gaps.

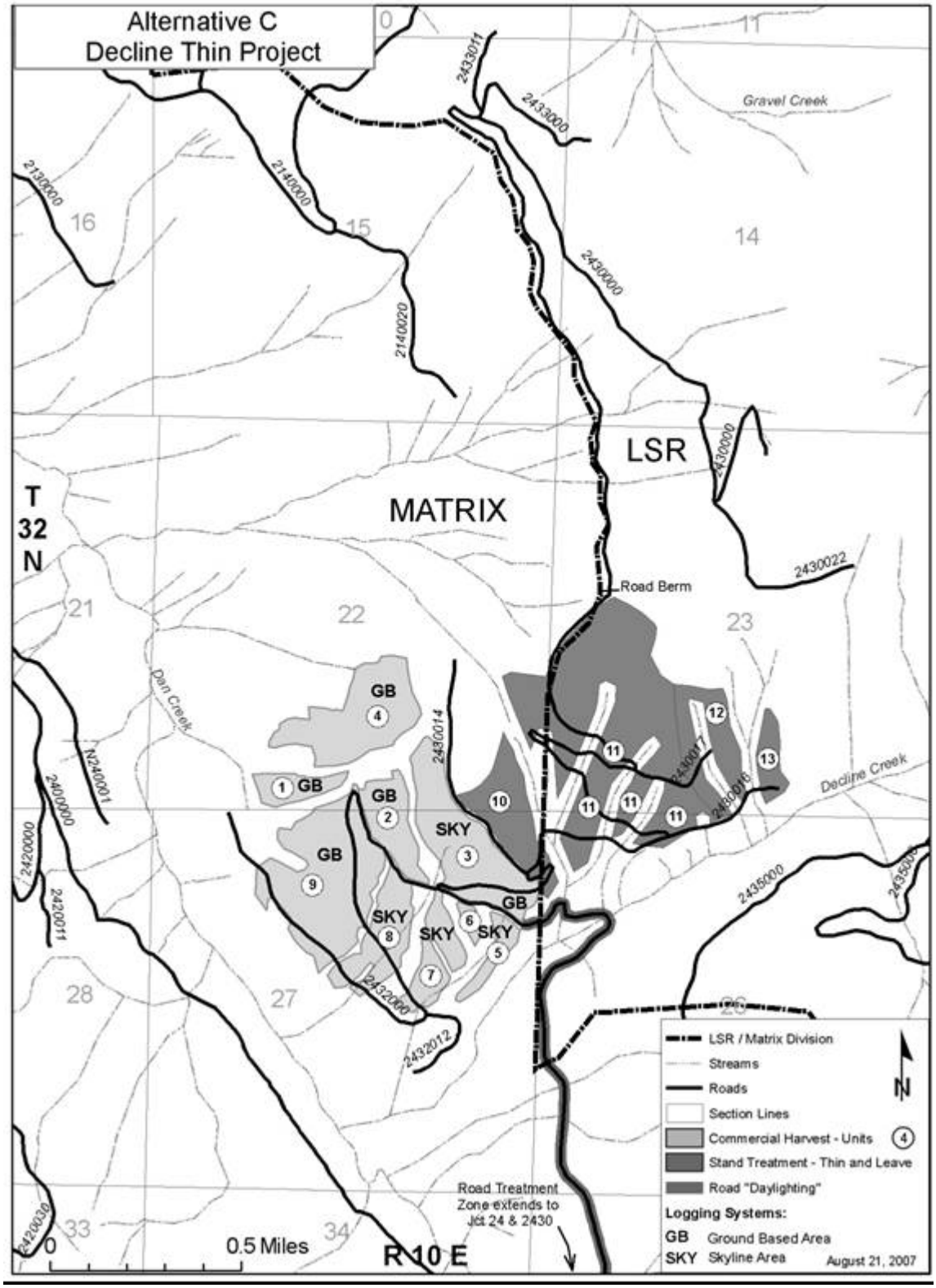
Skips and gaps would be concentrated in the LSR portion of the project area and where stand stocking is high. Skips would include portions of the Riparian Reserves, with 80 to 100 percent canopy retention for mesic conditions, promoting dispersal habitat for ROD species of concern. Approximately 70 percent average residual canopy closure would be retained.

Riparian Treatment: Proposed riparian stand treatment is limited. Ten acres of Matrix and four acres of LSR riparian area would be thinned to 70 percent canopy.

Roads: Road actions would be the same as Alternative B, but would also include decommissioning 0.4 mile of existing Roads 2430016, 2430107.

Fuels: treatment would be the same as Alternative B in the 70-year-old stand (Units 1 through 9). In the 40-year-old stand (Units 10 through 13), 160 acres of thin-and-leave material that would create additional slash accumulations (heavy fuel loading) requiring treatment. Fuels reduction would consist of constructing fire-control handlines, pulling back slash from open roads, and burning the pile accumulations (Units 3,5,6,7,10,11).

Figure 9. Alternative C



Alternative D

Alternative D would provide the same thinning treatment in the 70-year-old stands (Units 1 through 9) as Alternative C. Thus, it meets Purpose and Need Elements 1 and 2, the need to maintain tree growth, and responds to Purpose and Need Element 3, the need to maintain a functional, interacting, late-successional and old-growth forest ecosystem in Late Successional Reserves. It also addresses Issue 2, watershed processes and sediment yield, by replacing an old culvert with an open-bottom bridge structure; and decommissioning 2.5 miles of Road 2430 with culvert removal and pull back of sidecast material. See Figure 11.

Forest Stands

70-Year-Old Stands

As with Alternative C, Alternative D would thin 214 acres of the Matrix 70-year-old Stands with an average 70 percent canopy cover the residual stand.

Prescription: This alternative would thin to approximately 150 trees per acre across 80 percent of the area. As with Alternative C, approximately 10 percent of the area would remain in skips and 10 percent in gaps.

With the added timber removal from the 40-year-old stands, this alternative would yield approximately 7.2 mmbf of commercial timber.

40 Year-Old Stands

Alternative D would reduce stocking in the 40-year-old stands similar to Alternative C. In Units 10 and 11, the stands would be thinned with commercial sized stems (boles) removed. In Units 12 and 13, the trees would be thinned and left in the stand.

This alternative would leave approximately 235 trees per acre across 60 to 80 percent of the area. Certain trees (approximately 30 per acre) would be favored as release trees with heavy thinning around them. Ten to 20 percent of the area will remain in skips and 10 to 20 percent in gaps.

Skips and gaps would be concentrated in the LSR portion of the project area and in high-density stands. Skips would include portions of the Riparian Reserves, with 80 to 100 percent canopy retention for mesic conditions.

Roads: Alternative D would use the same roads as in Alternative B and C with the addition of 2.3 miles of Road 2430 upgraded for use in thinning Units 10 and 11, as well as 0.2 mile of Road 2430016 and 0.2 mile of Road 24300167, for a total of 16.4 miles of existing road reconstructed. Of that, 2.3 miles of road would be stored and closed following timber sale activities. About 0.9 mile (approximately 4,700 feet) of temporary road would be constructed if needed. All temporary roads would be decommissioned following thinning.

This alternative differs from the other action alternatives by decommissioning 2.5 miles of the unused portion of Road 2430 north of the thinning units. Road 2430 is the boundary between current LSR allocations upslope on Prairie Mountain and Matrix downslope to Dan Creek. The road would be decommissioned between milepost 6.2 and 8.7. Those road miles would be removed from the Forest Service's maintained road system.

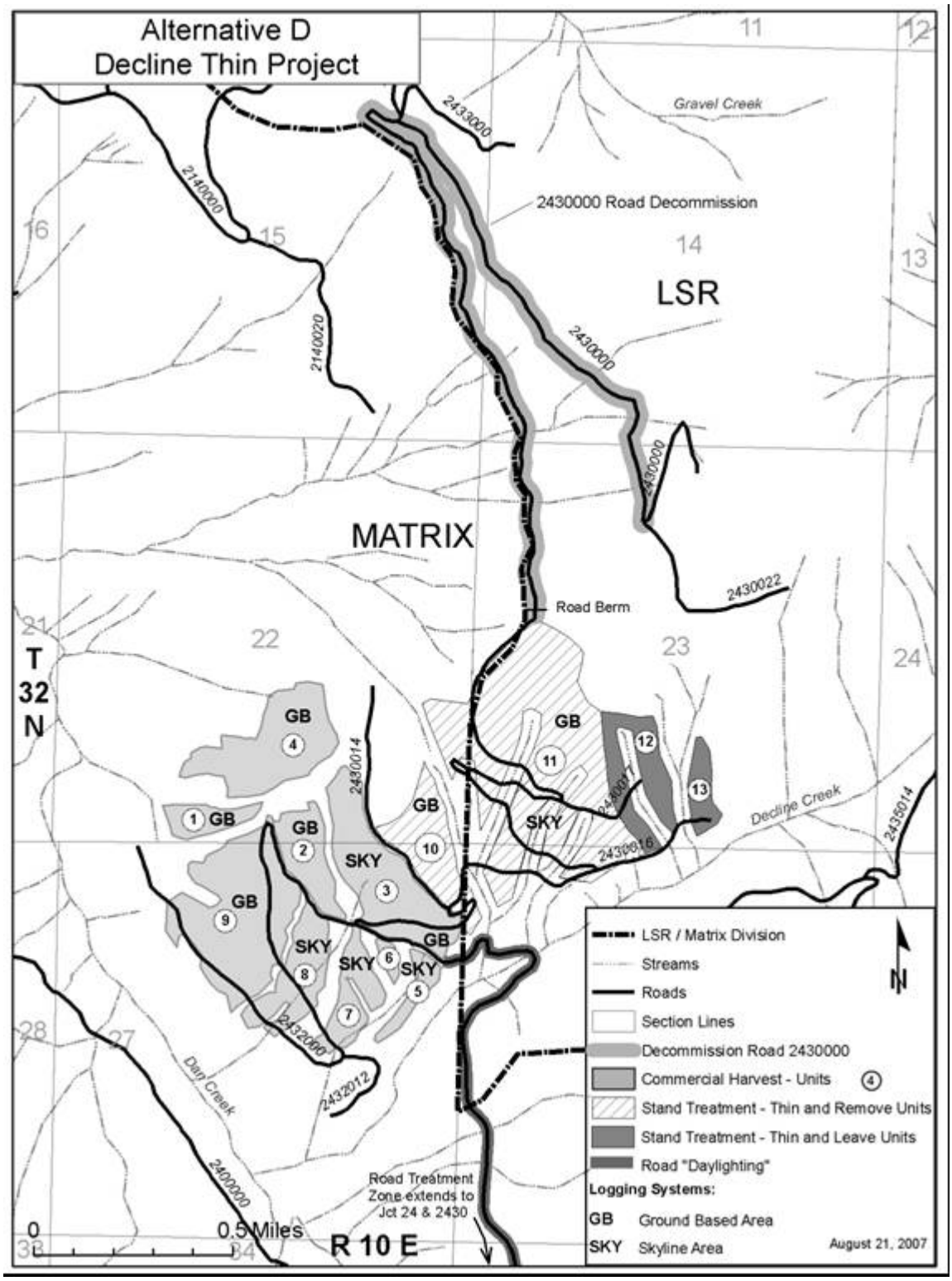
Another difference with Alternative D is the culvert replacement on Road 2430 at the Conn Creek crossing. The deteriorating culvert would be removed and replaced with a larger bridge, to reduce future risk of failure and adverse aquatic impacts.

Fuels: The fuels treatment would be the same as Alternative B.

The three action alternatives (Alternatives B, C, and D) are shown in Figure 8, Figure 9, and Figure 11.

Figure 10. Decline Thin Tight Stand Compared to Nearby Thinned Forest

Figure 11. Alternative D



Mitigation Measures

Mitigation Measures and Management Requirements

Mitigation measures or management requirements are designed to avoid, reduce, eliminate, rectify, or compensate for undesirable effects from proposed activities. Unless noted otherwise in the decision document, these measures and requirements are mandatory if the Responsible Official selects an action alternative for implementation. The mitigation measures and management requirements listed in Table 3 are practices the ID Team developed during this project analysis to address site-specific environmental concerns and to meet Standards and Guidelines from the Forest Plan, as amended. Each measure includes a description, the objective, applicable Standard and Guideline, an effectiveness rating along with the basis for that rating, and the enforcement mechanism and person(s) responsible for enforcement. The National Environmental Policy Act regulations (40 CFR 1508.20 Mitigation) state the following:

"Mitigation" includes:

- Avoiding the impact altogether by not taking a certain action or parts of an action,
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation,
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment,
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action, and
- Compensating for the impact by replacing or providing substitute resources or environments.

Mitigation effectiveness is rated as follows for this project:

High. The mitigation is highly effective (estimated at greater than 90 percent) at meeting the objective, and one or more of the following types of documentation is available:

- Research or literature,
- Administrative studies,
- Experience: professional judgment of an expert, or
- Fact: evident by logic or reason.

Moderate. The mitigation is moderately effective (estimated at 60 to 90 percent), and its effectiveness is supported either by evidence or logic. Implementation of this mitigation needs to be monitored, and the mitigation may be modified if needed to achieve its objective.

Low. The mitigation is somewhat effective (estimated at less than 60%), but its effectiveness is not supported by substantial evidence; or professional judgment indicates limited success in implementation or meeting objectives. Implementation of this mitigation needs to be monitored, and the mitigation may be modified if necessary to achieve its objective. Table 3 below lists the standard management requirements (from the Forest Plan, as amended) and the mitigation measures (developed by the ID Team for this project). They apply to each action alternative (Alternatives B, Figure 8, Alternative C, Figure 9 and Alternative D).

Table 3. Management Requirements and Mitigation Measures

Mitigation Measure or Project Design Feature	Objective	Effectiveness and Basis	Forest Plan Standard & Guideline	Enforcement
Soil & Water				
Reduce erosion and sediment transport using: straw bales, silt fencing, filter fabric, temporary sediment ponds, check dams of pea gravel-filled burlap bags or other material, and/or immediate mulching of exposed areas	Prevent silt-laden water from entering streams	MODERATE (Brown 2002)	BMPs: R-9 (USDA Forest Service 1988)	Timber sale contract, Sale Administrator
When decommissioning temporary roads where runoff has potential to enter surface waters, apply treatments including: water-barring, pulling culverts, scarifying to depth of 12 inches, mulch with weed-free mulch, and/or seeding with approved seed mix. Erosion control measures must be in place prior to normal heavy rainfall period.	Increase roads' water energy dissipation prior to closure; reduce or eliminate erosion; improve water filtration	MODERATE: (Luce 1997) Burroughs (1989) (Erosion and Sediment Delivery Following Removal of Forest Roads. Earth Surface Processes and Landforms, Brown 2001)	ROD S&G RF-2, RF-3, RF-5; BMPs R-3, R-12, R-23, T-13; and Fish Biological Assessment Forest Plan S&Gs Water Resources and Riparian Reserves #3	Timber sale contract, Sale Administrator
Use existing skid trails and landings to the extent practicable	Minimize soil disturbance and compaction from skid trails in the project area	HIGH (Avoids additional compaction from equipment)	BMPs: T-11 (USDA Forest Service 1988)	Timber sale contract, Administrator
Ground-based yarding would be performed with low ground pressure equipment. Travel on slash to minimize soil disturbance.	Protect soil resources, minimize soil compaction and displacement.	MODERATE (Experience elsewhere on the Forest)	ROD p. C-44	Timber sale contract, Sale Administrator
Directionally fall away from streams unless full suspension of trees can be achieved over both banks during yarding.	Protect stream bank integrity and aquatic resources	HIGH (Avoidance)	Forest Plan S&Gs Water Resources and Riparian Reserves #s 2, 5, 8; BMPs T8, T11, T12	Timber sale contract, Sale Administrator

Mitigation Measure or Project Design Feature	Objective	Effectiveness and Basis	Forest Plan Standard & Guideline	Enforcement
Do not locate any landings within Riparian Reserves.	Protect stream bank integrity and aquatic resources	HIGH (Avoidance)	Forest Plan S&Gs Water Resources and Riparian Reserves #s 2, 5, 8; BMPs T10; ROD S&G: RF-2	Timber sale contract, Sale Administrator
Do not remove instream logs. Leave in place trees accidentally felled or dropped into a wetted channel.	Protect stream bank integrity and aquatic resources	HIGH (Avoids damage that would occur if trees were removed)	Forest Plan S&Gs Water Resources and Riparian Reserves #s 2, 7, 8	Timber sale contract, Sale Administrator
Pull back approach fill to an angle of natural repose when removing culverts.	Protect stream bank integrity and aquatic resources	MODERATE (MBS Forest roads experience)	N/A	Road treatment contract; Contract Administrator
Do not yard logs through stream channels.	Protect stream resources	HIGH (Fact; MBS Forest roads experience)	ROD RF-2, BMPs T-8, 11 and 12; Forest Plan S&Gs Water Resources and Riparian Reserves #2	Timber sale contract
Haul along all roads restricted during rainy periods as necessary to minimize the potential for downstream sedimentation. Road 2430 is of particular concern for delivering sediment to Conn and Decline Creeks	Disconnect road drainage from stream channels	MODERATE (Sale Administrator has used for many years on, numerous sales with good results)	ROD RF-5, 7, BMPs R-3, 20; T-5 and 13	Timber sale contract
Curtail harvest operations when soils are excessively wet (when rutting and other damage are occurring as determined by the Sale Administrator) unless a thick mat of slash can be maintained to run equipment over.	Avoid rutting and compaction damage to susceptible wet soils	MODERATE (Avoid activity when impact would occur)	Forest Plan S&Gs Soils; #s 1, 2, 3	Timber sale contract sale administrator

Mitigation Measure or Project Design Feature	Objective	Effectiveness and Basis	Forest Plan Standard & Guideline	Enforcement
Minimize roads in Riparian Reserves. The location, design, and reconstruction of necessary crossings should minimize disruption to natural hydrologic paths and adverse effects to aquatic resources. Avoid sidecasting of loose material. Accommodate at least the 100-year flood, and associated bedload and debris.	Maintain surface hydrology and Riparian Reserve function and integrity	HIGH (Avoidance)	ROD S&G RF-2, RF-4; BMPs T-8, T-10, T-11, R-1, R-6, R-11, R-12, R-14; Forest Plan S&Gs Water Resources and Riparian Reserves #6	Timber sale contract, Sale Administrator
Place large woody material removed from an existing culvert inlet into the stream channel downstream of the culvert unless doing so would cause habitat degradation	Maintain routing of large wood in channel network	LOW (Experience shows wood is often broken during removal and placement is often difficult)	ACS Obj. 6	Road maintenance or timber sale contract, and administration
For temporary roads identified to remain in place over the winter, use drainage features (culverts and/or water bars) that would accommodate a 100-year flood	Prevent erosion and/or mass wasting and road damage	MODERATE (Relatively new requirement, but based on permanent road requirements)	ROD S&G RF-4	Sale Administrator
Conduct construction activities in or adjacent to perennial streams during summer low-flow season	Limit sediment delivery to streams from the road surface	LOW	BMPs R-12; Forest Plan S&Gs Water Resources and Riparian Reserves #2	Timber sale contract, Sale Administrator

Mitigation Measure or Project Design Feature	Objective	Effectiveness and Basis	Forest Plan Standard & Guideline	Enforcement
When constructing or decommissioning roads or landings: Outslope the roadway surface unless outsloping would increase sediment delivery to streams or where outsloping is infeasible Route road drainage away from channels and potentially unstable hill slopes. Crown landings and staging areas to prevent concentrated runoff. Where necessary, install water bars to route water away from streams to allow removal of fine sediment and other contaminants before discharge to the stream	Limit water accumulation and/or concentration, erosion, sediment delivery to streams' protect water quality	MODERATE (Years of use by agency)	ROD S&G RF-5; BMPs R-1, R-3, R-4, R-5, R-7, R-8, R-9, R-11, R-12, R-14; BA	Timber sale contract, Sale Administrator
When heavy equipment is present: Make a hazardous spill plan and clean-up materials available on-site Conduct any machinery maintenance involving potential contaminants (fuel, oil, hydraulic fluid, etc.) at an approved site or outside the Riparian Reserve Prior to starting work each day, check all machinery for leaks and make all necessary repairs	Prevent and minimize effects to water quality	MODERATE (Implementation of spill plans are an industry standard)	BMPs T-21, W-4; BA	Timber sale contract, Sale Administrator
Install waterbars or other structures (including scattered woody material) on temporary roads and skid trails at a spacing and number determined by the Forest Service Require all drainage treatment and controls to be in place by the end of normal operating season	Control water discharge from temporary roads and skid trails, and disperse water on the hill slope	HIGH (Water bars are an industry standard and have been shown to be effective on closed roads and skid trails)	BMPs T-16, T-18, T-19, R-1, R-2, and R-9	Timber sale contract, Sale Administrator

Mitigation Measure or Project Design Feature	Objective	Effectiveness and Basis	Forest Plan Standard & Guideline	Enforcement
Alternatives B, C, and D: In units where Riparian thinning would occur, establish location of unit boundaries adjacent to perennial and intermittent channels and drainage features based on location of inner gorge, slope break into a stream channel or drainage feature, location of mesic plant communities, and location of species characteristic of wetlands	Maintain water and aquatic conditions in Riparian Reserves	HIGH (10+ years District thinning experience)	BMPs T-6, 7, 8, 12	Timber sale contract, Sale Administrator
Fisheries				
Perform work in or near streams that may generate sediment to those streams only during the WDFW in-water window	Minimize sedimentation to fish-bearing waters	HIGH (Logic)	BMP: R-3 (USDA Forest Service 1988) MOU between FS and WDFW for hydraulic projects (2005)	Contracting Officer, COR, and engineer preparing contract for roadwork
When replacing culverts associated with wetlands, such as the culvert on Road 24 at MP 7.885, place new structure at elevation high enough to not drain wetland habitat upstream, even if fish passage is not improved	Maintain wetland habitat in this project area Maintain a fish-bearing wetland in upper Dan Creek where upstream passage is blocked, while retaining wetland features already used by fish	HIGH (Logic)	Considers RF-6 (FS and BLM 1994), but recognizes overall greater benefit to fish	Contracting Officer, COR, and engineer preparing contract for roadwork

Mitigation Measure or Project Design Feature	Objective	Effectiveness and Basis	Forest Plan Standard & Guideline	Enforcement
Wildlife				
Restrict to between April 1 and August 5 project activities adjacent to suitable murrelet nesting habitat that generate noise above background ambient levels. Between August 6 and September 15, activities should occur between two hours after sunrise and two hours before sunset (Unit #4)	Eliminate sources of disturbance during the critical breeding period	HIGH (MBS Forest experience, references in Biological Opinion [USDI USFWS 2002])	Biological Assessment (USDA USFS 2002) Biological Opinion (USDI USFWS 2002)	Timber sale contract, Sale Administrator
Suspend thinning activities in the spring when sap flow begins	Minimize harvest impacts to residual trees during sap flow. Avoid additional disturbances to adjacent stands during critical breeding period of spotted owl and marbled murrelet	HIGH (USDI USFWS 2002)	Forest Plan (USDA USFS 1990) p.4–245 Commercial Thin harvest protection	Timber sale contract; Sale Administrator
Leave on-site specified down logs and especially concentrations of larger rotten undisturbed logs if possible	Retain down woody material diversity and habitat values	HIGH (9 previous thinning sales on the District)	Forest Plan ROD p. C-40	Timber sale contract; Sale Administrator
Retain small clumps (1–2 acres) of hardwoods un-thinned in some stands (as determined through marking guides)	Provide for a diversity of species and provide for future snag recruitment of intermediate age class of snags for cavity nesters while stand matures and conifer snag component develops	HIGH (10 + years of thinning on District)	Forest Plan ROD p. C-41	Timber sale contract; Sale Administrator
Vegetation And Plants				
For known infestations of noxious weeds, schedule appropriate weed treatments including R6-approved herbicides, using KV funds until all plants are gone.	Eradicate known infestations	HIGH (USDA Forest Service 2005)	Forest Plan S&G #16, USDA Forest Service 2005	District Botanist

Mitigation Measure or Project Design Feature	Objective	Effectiveness and Basis	Forest Plan Standard & Guideline	Enforcement
Actions conducted or authorized by written permit by the Forest Service that would operate outside the limits of the road prism require the cleaning of all heavy equipment prior to entering National Forest System Lands.	Prevent introduction of weeds	MODERATE (USDA Forest Service 2005)	Forest Plan S&G #2, USDA Forest Service 2005	Timber sale contract; Sale Administrator
All gravel, fill, sand, and rock must be from weed-free sources.	Prevent introduction of weeds	MODERATE (USDA Forest Service 2005)	Forest Plan S&G #7, USDA Forest Service 2005	Timber sale contract; Sale Administrator, District Botanist
Use weed free straw and mulch for all projects conducted or authorized by the Forest Service on NFS lands.	Prevent introduction of weeds	HIGH (USDA Forest Service 2005)	Forest Plan S&G #3, USDA Forest Service 2005	Timber sale contract; Sale Administrator
If weeds are present in the project area, all equipment and gear must be cleaned before leaving the area to avoid spreading the infestation further.	Prevent weed spread	HIGH (Logic)	Forest Plan Best Management Practices, USDA Forest Service 2005a	Timber sale contract; Sale Administrator
Seed all exposed soil with the approved seed mix followed by one to two inches of weed free mulch or straw	Prevent introduction and spread of weeds	HIGH (USDA Forest Service 2005)	Forest Plan Best Management Practices, USDA Forest Service 2005a	Timber sale contract; Sale Administrator
For Alternatives C and D—all sites with known noxious weeds should be areas where “skips” are placed to maintain canopy cover over shade intolerant weeds	Prevent weed spread	MODERATE (Experience)	Forest Plan Best Management Practices, USDA Forest Service 2005a	Timber sale contract

Mitigation Measure or Project Design Feature	Objective	Effectiveness and Basis	Forest Plan Standard & Guideline	Enforcement
Heritage Resources				
Specify requirements for railroad grade segment 14C: fall trees parallel to or away from the grade; do not cross the grade with equipment; do not yard logs across the grade; do not use the grade for transportation; designate the grade as the yarding system boundary in units 7 and 8 between the skyline system and the ground-based system	Protect the features of railroad grade segment 14C	MODERATE (Experience)	Forest Plan, Archaeology Protection, p. 4–99	Timber sale contract; Sale Administrator
If a previously unidentified resource is discovered during project implementation, or if an identified resource is affected in an unanticipated way, the Heritage Specialist would be notified and the Forest would fulfill its responsibilities in accordance with the Programmatic Agreement	Protect the features of railroad grade segment 14C of the Sauk River Lumber Company Historic District.	MODERATE (Experience)	Forest Plan, Archaeology Protection, p. 4–99	Timber sale contract; Sale Administrator
The following note shall be added to the sale area map: The excavation, removal, or damage of historic resources (cable, metal, lumber, etc.) is prohibited	Protect the cultural resources associated with the Sauk River Lumber Company Historic District	MODERATE (Experience)	Forest Plan, Archaeology Protection, p. 4–99	Timber sale contract; Sale Administrator

Comparison of Alternatives

Table 4. Alternative Comparison with Purpose and Need and Issue Indicators

Purpose & Need Element and Indicator		Alternative			
		A	B	C	D
1. Manage forest stocking to maintain or promote increased growth rate	Trees per acre (above 7” diameter):				
	70-Year Stand (700 trees >1” diameter)	275	128	150	150
	40-Year Stand (840 trees >1” diameter)	370	370	325	325
	Basal area per acre:				
	70-Year Stand	359	200	230	230
	40-Year Stand	360	360	195	195
	Acres of stands treated to recommended stocking levels	0	214	379	379
2. Manage Riparian Reserves for desired vegetation characteristics	Retention of desired canopy cover in treated areas of Riparian	Yes	Yes	Yes	Yes
	Amount (percent) of the stand represented by a diversity of tree species (Douglas-fir, Pacific silver fir, western red cedar)	95%	70%	70%	70%

	70 Year Stand	WH decreases slightly DF increases Cedar decreases	WH decreases DF increases Cedar increases from 12% to 22%	WH decreases DF increases Cedar increases from 12% to 22%	WH decreases DF increases Cedar increases from 12% to 22%
	40 Year Stand	Same as above	Same as A	Same as above except Cedar increases from 1% to 2%	Same as C
3. Manage Late Successional Reserves to maintain forest ecosystem	Achieves recommended stocking levels for LSR development	No	No	Yes	Yes
	Retention of desired canopy cover in treated areas of Riparian	Yes 95%	Yes 70%	Yes 70%	Yes 70%
	Amount (percent) of the stand represented by diversity of tree species (Douglas-fir, Pacific silver fir, western redcedar)	Same as 40 year stand above	Same as 40 year stand above	Same as 40 year stand above	Same as 40 year stand above
4. Provide commercial wood fiber products	Timber volume sold (mmbf)	0	7.19	5.33	7.24

Significant Issue and Indicator			Alternative			
			A	B	C	D
1. Economic Viability	Timber volume sold (mmbf)		0	7.19	5.33	7.24
	Estimated PNV	High	$0	$212,753	$79,200	-$384,500
		Average	$0	$162,749	$40,636	-$440,173
		Low	$0	$112,745	$2,072	-$495,790
	Expected Bid Rate	High	N/A	$76.27	$67.99	$28.25
		Average	N/A	$72.23	$63.80	$23.79
		Low	N/A	$68.19	$59.60	$19.33
2. Watershed Processes—Peak Flows and Sediment Yield	Length of haul road reconstruction		0	7.7	10.2	10.4
	Length of temporary road construction		0	0.9	0.9	0.9
	Percentage of soil disturbance		5.4	6.9	6.9	7.3
	Percentage of vegetation disturbance:					
	5th field hydrologic unit		13.1	13.2	13.3	13.3
	6th field hydrologic unit		16.5	17.2	17.5	17.5
	Percent changes in sediment:					
	5th field hydrologic unit		0	0.3	0.3	0.5
	6th field hydrologic unit		0	2.0	1.8	3.2
	Miles of road decommissioned		0	0	0.5	3.0

Note: The Decline Thin Project Silvicultural Prescription will be finalized following the Preliminary EA 30-day comment period. The monitoring plan will be updated at that time.

Monitoring

Silvicultural Treatment Monitoring

The monitoring items below will serve to verify whether the prescribed treatments were effective in meeting the objectives described in the Environmental Assessment and prescription objectives. The results of monitoring would be taken into consideration in planning future silvicultural treatments.

Monitoring would be accomplished using appropriated funds, as funding and Forest staffing allow. Data is to be collected from 1/40-acre plots, with approximately 1 plot per 10 acres treated.

Canopy Closure—Short and Long-Term (within 3-5 years)

Assess canopy closure within 10 percent of 70 percent canopy closure in thinned units, and within 10 percent of 70 percent in Riparian Reserve.

Measure—systematically locate 1 plot per ten acres. Measure at plot centers using densiometer. GPS the plot location

Growth of Residual Stands—Short and Long-Term (within 3-5 years)

Assess effectiveness of intended stocking level reduction with growth measurements, compare to stocking tables.

Measure - Systematically locate 1 plot per ten acres across all units treated, (including LSR and Riparian Reserve and Matrix land allocations), and measure radial growth rate per decade on trees over 7 inches dbh within $1/40^{th}$ acre plots. GPS the plot location

Vegetative Species Diversity

Assess effectiveness of treatment on increasing species diversity across treated stands.

Measure - Systematically locate 1 plot per ten acres across all units treated, (including LSR and Riparian Reserve and Matrix land allocations), and estimate percent cover of all species present on $1/40^{th}$ acre plot. GPS the plot location

Chapter 3 –Environmental Effects

Forest Vegetation Environmental Effects

The analysis area for direct and indirect forest vegetation effects was the defined Decline Thin Project area, which includes both the 70- and 40-year-old stands, and the haul route of Road 2430.

The Decline Thin Project area covers 927 acres on the Darrington Ranger District. Areas proposed for timber harvest include two stand age classes, hereafter called 70-year-old stands, Units 1 through 9 and another area hereafter called 40-year-old stands, Units 10 through 13. Specific and detailed stand data can be found in the Project Record. The treatment proposed employs variable density thinning across all of the stands.

Figure 12. Decline Thin Late-Successional Reserve

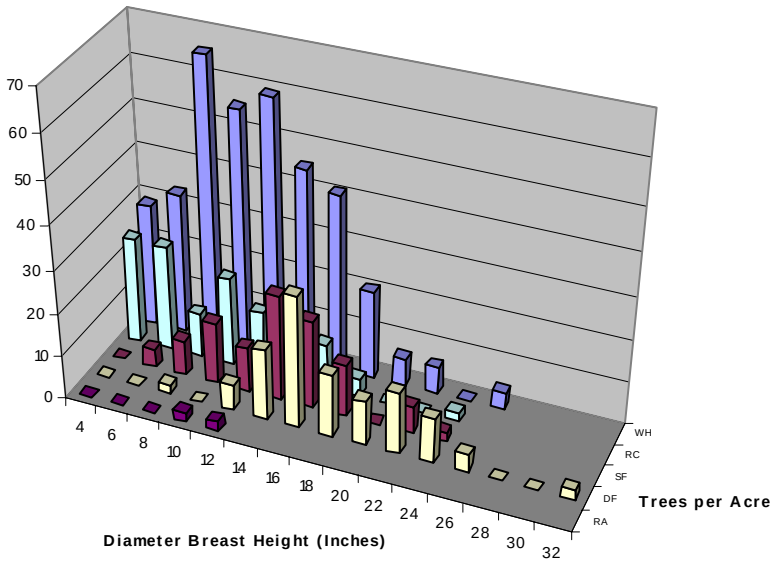
History

A portion of the 70-year-old stand was included in an experimental selective logging project of old growth in 1936 (West Coast Lumberman 1936). This logging project included some of the last railroad logging operations in the Gold Mountain area of the Sauk River drainage, and the also some of the first caterpillar logging operations (cat trails are still evident in the north part of the project area). In the mid-1940s, this area is reported to have been subject to a windstorm that blew down timber. Subsequently, the Forest Service offered the blown down timber as salvage including the area selectively cut in the 1930s. This was followed with both natural regeneration and planting. The 40-year-old-stands were clear cut logged in the 1960s, and hauled with trucks. Those areas were planted following the removal of timber.

Stand Structure

All forest stands in this project are currently in the stem exclusion structural stage (Oliver 1996). They have developed into an even-aged pattern in the past 45 to 70 years. Dominant and co-dominant trees are apparent and have expanded into growing space occupied by less competitive trees. Intermediate trees are still present but under high competition from dominant and co-dominant trees, with some suppressed trees dying due to lack of light in their overtopped state. Small diameter litter and residue from the previous logging operations dominate the forest floor, as little understory vegetation survives in this low light environment.

Figure 13. Tree Species Composition, 2007 in the 70-Year-Old Stands (Units 1–9) by Trees per Acre by Diameter Class



70-year-old stands

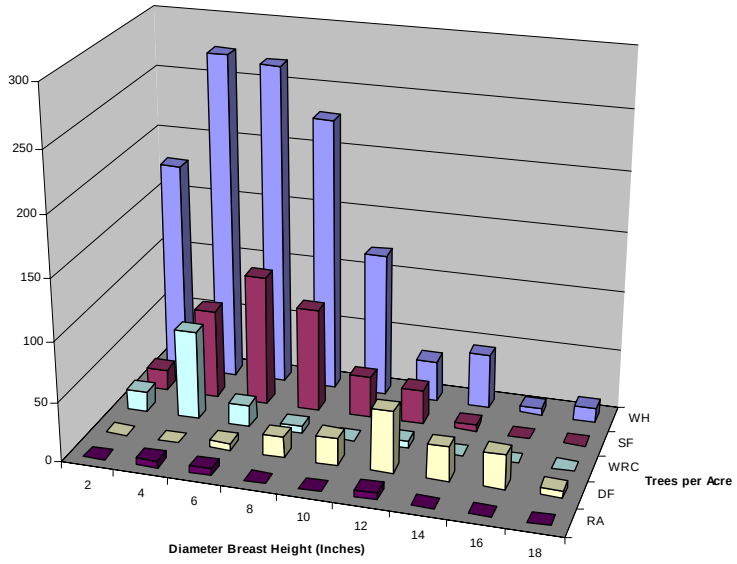
These stands are similar in composition, size, and structure. The age of the dominant and co-dominant trees ranges from 66 to 76 years. Diameter growth of the best growing trees for the last ten years averages 1.1 inches, with the trend in diameter growth declining compared to the previous years. Units 8 and 9 include several larger trees compared to the stand average. These range from 22 to 33 inches dbh and occur in patches near the bottom of the stand (towards Dan Creek).

Stand density averages 700 trees per acre (including trees in all diameter classes) across these stands, but varies greatly with the occurrence of regeneration. Trees greater than 7-inches dbh, average 276 per acre. Basal area averages 360 square feet per acre. Stand density index (SDI) is at 666, which is 95 percent of maximum SDI for this combination of species. The major species in these stands are western hemlock, Pacific silver fir, Douglas-fir and western redcedar. Laminated root rot, red-brown butt rot, and Armillaria root disease are present, but uncommon, as is hemlock dwarf mistletoe.

The forest floor is depauperate of plants in much of the area and has a substantial covering of litter and residual downed wood from the previous logging operations (logs up to 30 inches diameter). In pockets or small open areas where understory plants are established several species are present including swordfern, oak fern, deer fern, red huckleberry, salmonberry, devil's club, vine maple, thimbleberry, salal, foamflower, twinflower, and several mosses and lichens.

The average species composition of trees 7 inches dbh and larger is 55 percent western hemlock, 12 percent western redcedar, 19 percent Pacific silver fir, and 7 percent Douglas-fir. There are also small amounts of red alder, black cottonwood, pacific yew, Sitka spruce, and vine maple. Current and past tree competition for growing space within the stands has resulted in overtopping and competition-related mortality. These standing snags are generally smaller trees, most of which are twelve inches diameter or less. Some remnant large snags are present but uncommon. The approximate numbers of snags per acre in the overstory are 22 Douglas-fir, 20 Pacific silver fir, 22 western hemlock, and 6 western redcedar.

Figure 14. 40-year-Old Stands (Units 10- 13) in 2007, Tree Species Composition Measured by Trees per Acre by Diameter Class



40-year old stands

The dominant trees in these stands are approximately 40 to 45 years old, regenerated from clearcut harvesting. Most of the area was not pre-commercially thinned following the harvest resulting in a high stem density of 840 trees per acre (including trees less than 7 inches dbh), and a basal area of 297 square feet per acre.

Trees greater than 7-inches dbh, average 370 per acre. Stand density index (SDI) is at 588, which is 85 percent of maximum SDI for this combination of species. Fifty-five percent maximum SDI is where density related mortality begins (Drew and Flewelling 1979). Diameter growth within the past ten years is 1.12 inches, showing a declining trend from previous years. Dead trees are reported as 23 per acre: 11 western hemlock, 6 Douglas-fir, and 6 Pacific silver fir.

The average species composition of trees 7 inches dbh and larger is shown in Figure 14. There is also a component of red alder, vine maple, and black cottonwood in this stand. Understory vegetation varies greatly, but occurs mainly in gaps. The majority of the densely stocked areas have no plants in the understory. In small openings, the following plants were noted: devil's club, salmonberry, salal, huckleberry, twinflower, Oregon grape, sword fern, oak fern, lady fern, queen's cup beadlily, and foamflower. There is litter and downed wood present throughout these stands, though less total accumulation and smaller in diameter than found in the older 70-year-old stands (units 1 through 9).

Table 5. Stand Data

Stand Age (Years)	Unit #	Canopy Cover (%)	Basal Area (Sq. Ft./Ac.)	QMD (Inches in overstory)	Trees per acre-above 1 inch diameter	Trees per acre-above 7 inches	SDI (all tree size classes)	Volume per acre (MBF)
70	1–9	95	350	14.7	700	276	659 (95%of Max SDI)	86
40	10–13	95	243	10.4	840	370	591 (85% of Max SDI)	41

The analysis area for direct and indirect forest vegetation effects was the defined Decline Thin Project area that includes both the 70 and 40-year-old stands, and the haul route of Road 2430.

Alternative A—No Action

Canopy Cover and Structure

Canopy cover in both age classes within the project area stands is currently estimated to be 95 percent.

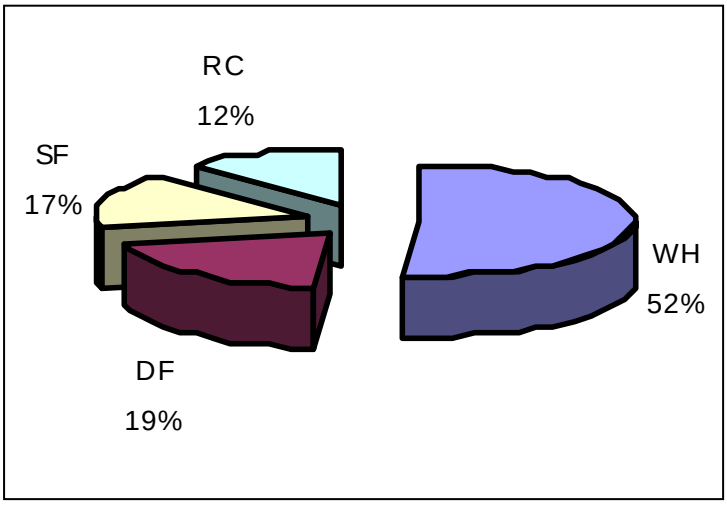
70-year-old stands: The tight overstory canopy (Units 1 through 9) would slowly decrease through time as dead trees create gaps and as light enters parts of the stand over decades. Understory vegetation would develop with established shade tolerant species such as western redcedar and western hemlock supplemented with other forbs and shrubs. As trees decline in vigor, die, and are removed from the canopy, the upper canopy layer would be reduced to approximately 66 percent cover over several decades.

40-year-old stands: The 40-year-old stand (Units 10 through 13) would also become less uniform with time. Canopy cover in the overstory would likely decrease from 95 to 70 percent due to similar developmental pathways. Without disturbance, these stands would lose the uniform even-aged structure through attrition and eventually develop another canopy layer as adequate light reached the forest floor. Competition in uniform stands can delay this process if there is a delay in the expression of dominance in the trees of the stand.

Species Composition

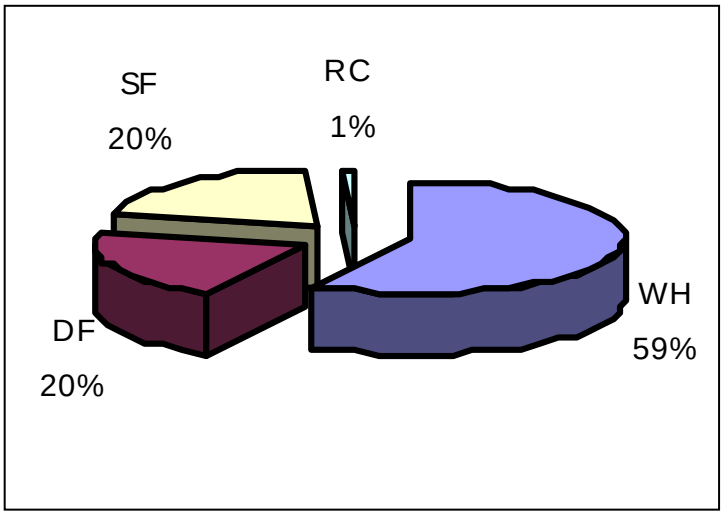
Live overstory tree species composition across the stands is shown in Figure 15 and Figure 16. Douglas-fir would be expected to increase proportionately over time, because that species is a dominant or co-dominant tree species in the stand. Western hemlock is expected to decrease, with more of this species proportionately in the less successful small diameter size class. Silver fir and western redcedar would continue in current proportions. In time, hardwoods within the stands would be reduced as their access to light diminishes from competition. Without disturbance, conifers would overtop and out-compete hardwoods and shade-intolerant trees within the stands. Forest stands are expected to be more resilient to changes in climate and other disturbances when they retain a broad range of species, and density is kept low enough to resist susceptibility to drought stress. Recently emerging strategies for coping with future climate scenarios include maintaining a wide variety of species adapted to the site, and moderate stocking levels (see Appendix E, Climate Change Implications).

Figure 15. Alternative, A, 70-Year-Old Stands (Units 1–9) Overstory Species Composition



Over time, individual tree growth of all stands within the Decline Thin Project area would slow. Over several decades, the older stand's (Units 1 through 9) annual growth would decrease by 134 board feet per year. Likewise, mean annual increment for the younger stand (Units 10 through 13) would predictably decline steadily with no treatment. Decreased growth is an indicator of stand health and competition-related mortality.

Figure 16. Alternative A, 40-Year-Old Stands (Units 10 -13) Overstory Species Composition



Over time, overall tree size would slowly increase as small trees die from competition and larger trees take over available growing space. Competition within even-aged stands for trees to establish dominance may influence the period for stand variation to develop.

In the simulation, modeling of the forest stands it would take decades for stand response with increased growth.

Late Successional Reserve

40-year-old stands: Units 10 through 13, with more than 800 trees per acre, and with 360 square feet of basal area (all size classes included), fall outside the area of "normal" stocking described in the Empirical Stocking and Growth relationships graph for the Western Hemlock/Swordfern-Salal Plant Association Group (PAG) (USDA Forest Service 2001)

These stands are on a very slow trajectory towards developing old-growth structure—in approximately 175–250 years (USDA Forest Service 2001). Using this estimation, the Late Successional Reserve (LSR) portion of the Decline Thin Project area would not be expected to develop old-growth structure characteristics until early 2100.

Density-related mortality would influence the structure and species composition of these stands. Shade-tolerant species would increase and shade-intolerant species would decrease. Dense stocking conditions leads to increased tree height to diameter ratios with trees more susceptible to snow breakage and windthrow, especially in this rain-on-snow zone.

Mortality

As time goes on, attrition within the stand is expected to continue and increase. Currently, mortality is predicted through the simulation models to average approximately 150 trees per acre per decade within the next two decades for Units 1 through 9. In Units 10 through 13, 145 trees per acre would succumb within that same timeframe. Units 1 through 9 have a projected loss of trees to competition that represents 300 cubic feet per year to 200 cubic feet per year within the next 90 years. Units 10 through 13 are projected to consistently lose 230 cubic feet per year.

Riparian Reserve

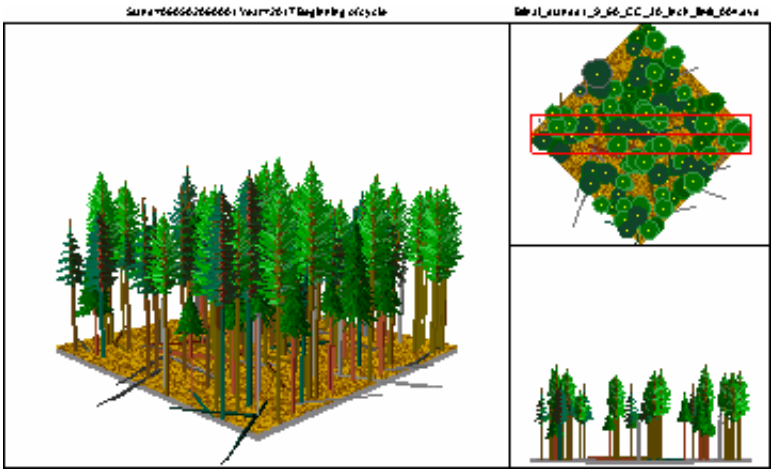
Currently, the Riparian Reserve areas within the project area have stand conditions comparable to the stand conditions described above since past logging operations harvested across the intermittent and active stream in much of the 70 and 40-years stands. Portions of the Riparian Reserves are in dense stocking levels that influence long-term tree health and vigor. Over time, tree mortality would provide a short-term increase in dead wood available to streams. This recruitment of down wood into the Riparian Reserve would be a much smaller diameter wood than desired (see large wood debris recruitment in the Sauk River and Sauk Forks Watershed Analysis USDA Forest Service 1996). There would be a future long-term gap in large dead wood recruitment while the stand grows large-diameter trees.

Effects Common to all Action Alternatives

Road 2430—Daylighting: Overhanging red alder and cottonwood trees would be removed from the haul route from within the project on Road 2430 from the junction of Roads 24 and 2430 to the junction of 2430 and 2430014. The road surface would receive more sunlight, and the result would be an increase in public safety on the road system, and a decrease in road maintenance needs and costs as the ditches would fill and flood less often.

Other forest products: Availability of western redcedar for post and poles would be limited, as thinning is designed to retain that tree species. Firewood availability would increase in the short-term after harvest as thinning slash becomes available, but then would decrease as natural tree mortality in thinned stand decreases. Access for mushroom and berry collecting would remain unchanged.

Figure 17. Alternative B Example of Units 1–9 Following Treatment



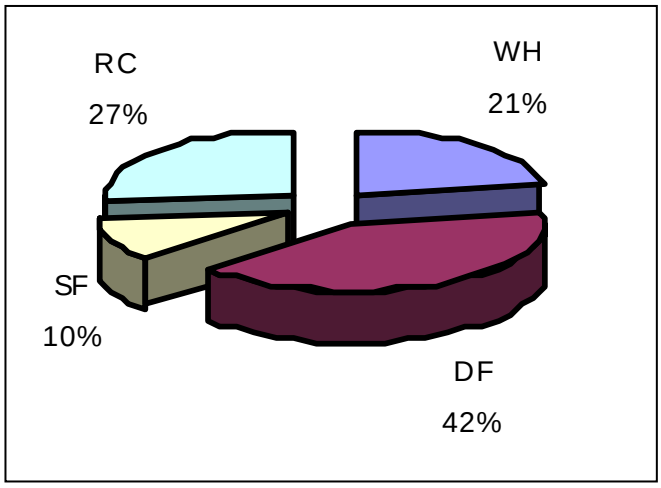
Alternative B

70-year-old stands: Thinning to 60 percent canopy cover in Units 1 through 9 would increase growth of individual trees, reduce density-related mortality, and allow more light for understory plant establishment. Following the thinning treatment, the overstory would include more large trees and fewer small trees. The residual overstory conifer tree species is displayed in Figure 18.

Western redcedar representation in the stand would increase from 12 percent to 22 percent, indicating an increased representation of minority species components within the residual stand. Species richness would increase, although Douglas-fir would be disproportionately favored over other species. Understory vegetation would increase in abundance and in diversity due to additional light reaching the forest floor. This type and degree of change in species composition would likely increase the stand's ability to cope with shifts in climate. This alternative's thinning would increase diverse species representation on the landscape and reduce stocking levels, which are strategies consistent with management options for coping with climate change (Appendix E—Climate Change Implications).

This treatment would increase overall tree size as indicated by QMD changing from 14.7 to 17.0 inches in trees greater than 7-inches dbh. It would reduce trees per acre (TPA) from 276 to 128 (greater than 7-inches dbh), and reduce basal area to 220 square feet per acre. Mortality would decrease from approximately 170 trees per acre per decade to approximately 8 trees per acre per decade following the treatment in Alternative B.

Figure 18. Alternative B, 70-Year-Old Stands Overstory Composition (Units 1–9) Following Thinning



Following harvest, residual trees would have more growing space than currently available. Generally, the stand's residual trees would be the largest, most vigorous, and capable of taking advantage of the increased growing space. Eventually, tree crowns would increase in size as open growing space is occupied.

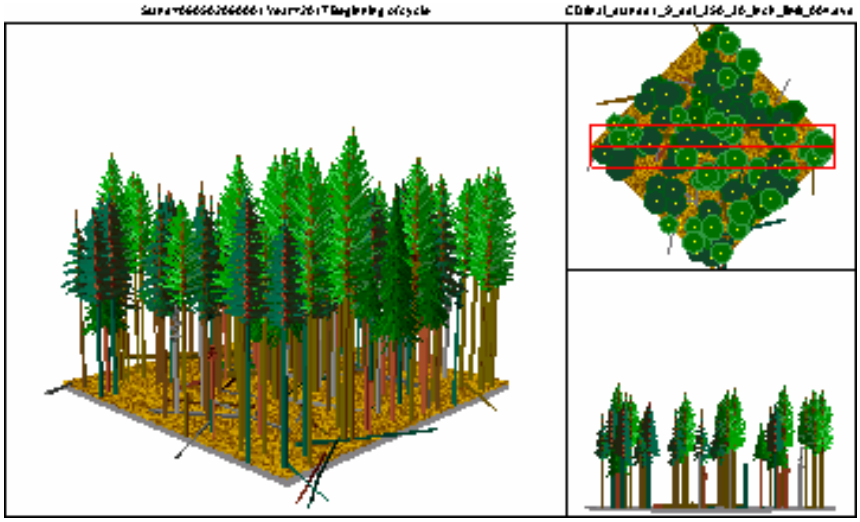
Alternative B would result in thinning 214 acres of dense forest stands, all in Matrix, and 10 acres of Riparian Reserve, which is imbedded within the Matrix allocation. It would involve removing approximately 140

trees per acre (TPA) and 33 thousand board feet (MBF) of timber per acre.

40 year-old stands: There would be no thinning in the 40-year-old stands (Units 10 through 13) so Alternative B would have the same results as described in Alternative A for Units 10–13. Late Successional Reserve objectives would remain unaddressed in these areas.

Riparian Reserves: The thinning in the 10 acres of the Riparian Reserve would retain a canopy cover of 70 percent, so the effects of the riparian thinning would be similar to the adjacent upland areas, of 60 percent canopy, but with more trees retained. (See Alternative C).

Figure 19. Alternative C Example of Units 1–9 Treated



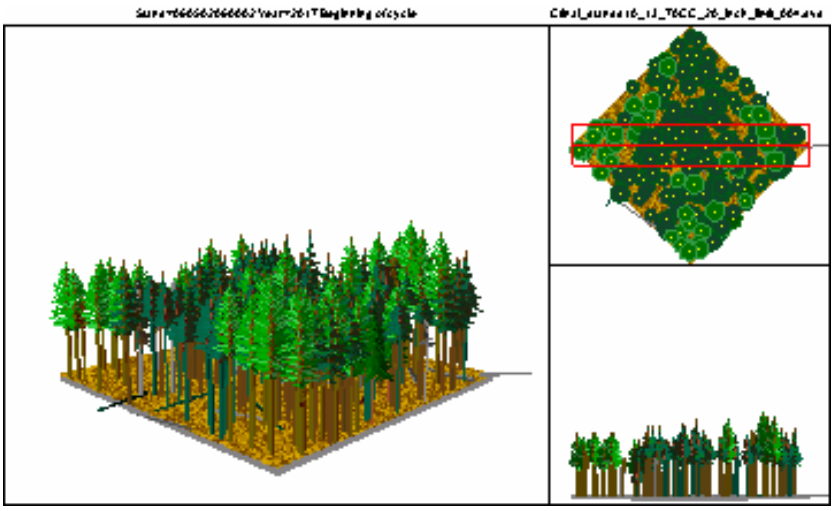
Alternative C

Reducing canopy closure to 70 percent within both groups of stands would result in increased tree growth, although less so in Units 1 through 9 when compared to implementing Alternative B. Density would be reduced in Riparian Reserves in the same manner as the other stands.

70-year-old stands: In Units 1 through 9, density would be reduced to approximately 150 trees per acre and 250 square feet of basal area. The treatment employs variable density thinning across all of the stands. Openings created by the thinning would release large trees or hardwoods and create or enhance gaps in the main canopy layer. The resulting conifer species composition displayed above, and highlights key changes in minority species. Species representation within the residual stand is more even than in Alternative B.

This type and degree of change supports the stand's ability to cope with insect, disease and shifts in climate. Western redcedar would increase, and Douglas-fir would be more proportionate to the other species. Conifer species are well-represented in the overstory and the understory would increase in species abundance as well. Light intensity to the forest floor would become more increase and diversify, resulting in more understory vegetation and furthering species diversity. Mortality in Units 1 through 9 would decrease to approximately 18 trees per acre following treatment compared to 150 trees per acre without treatment.

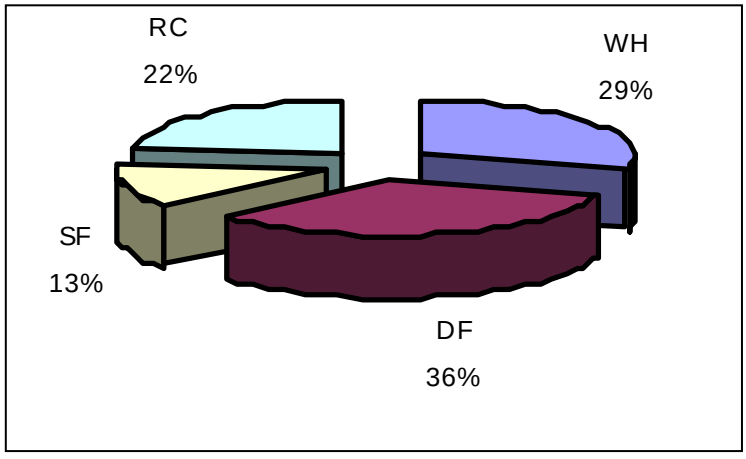
Figure 20. Alternative C Example of Units 10–13



40-year-old stands: The intent of the prescription for Units 10 through 13 would be to assist in meeting LSR objectives over time. Implementing Alternative C would include a thinning prescription with skips and gaps in approximately 20 percent of the stand, as well as the release of individual trees. This would result in a change to the stand structure, which is currently a uniform single canopy layer across some of the area with more variability in structure over time. Structure variability includes enhancing large tree growth, development of patches of understory vegetation and retention of densely stocked stand conditions in other areas.

Riparian Reserves: The thinning in 4 additional acres of the Riparian Reserve would retain a canopy cover of 70 percent, so the effects of the riparian thinning would be similar to the adjacent upland areas, of 70 percent canopy.

Figure 21. Alternative C, 70-Year-Stand Overstory Species Composition (Units 1- 9) Following Thinning

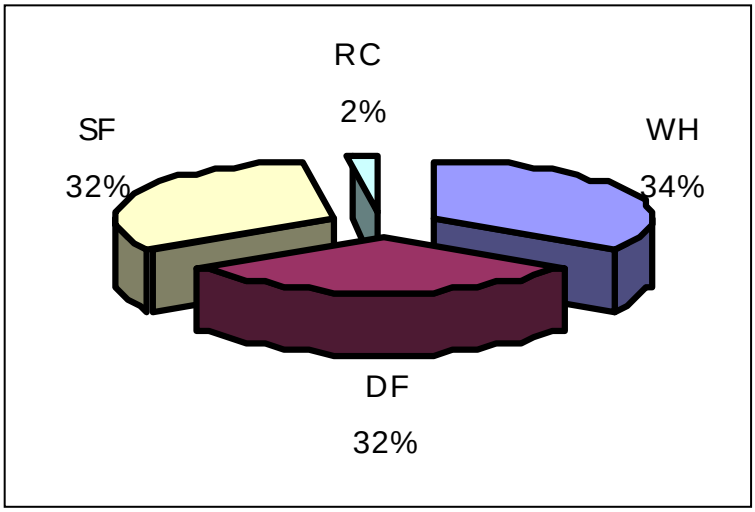


In Units 10 through 13, stand density would be reduced to 325 trees per acre across all size classes (235 trees per acre more than 7 inches), and 185 square feet of basal area per acre. Skips and gaps would produce a variety of stand structures within the LSR portion of the project area. Approximately 10 percent of the area would remain in its current condition with low-light conditions; 10 percent would be very open in high light conditions, with the remaining area having variable densities ranging from approximately 100 trees per acre to 300 trees per acre. Some hardwoods would be targeted as reserve trees, as would western redcedar to increase the variety of species present across the landscape. Species richness across the stand would increase with this alternative. Density reduction would leave this stand in an improved condition for resiliency to shifts in climate and other disturbances such as insects and disease.

Figure 22. Alternative C, 40-Year Stand Overstory Species Composition (Units 10—13) Following Thinning

Alternative C would result in the treatment of a total of 380 acres of forest stands, with 244 acres in Matrix of which 10 acres are also in Riparian Reserve, and 137acres in LSR of which 4 acres are in the Riparian Reserve.

Thinning Units 10 through 13 would involve cutting or girdling approximately 500 trees per acre thereby reducing stocking. The thinned acres of Units 10 through 13 would leave all cut or girdled material on site.



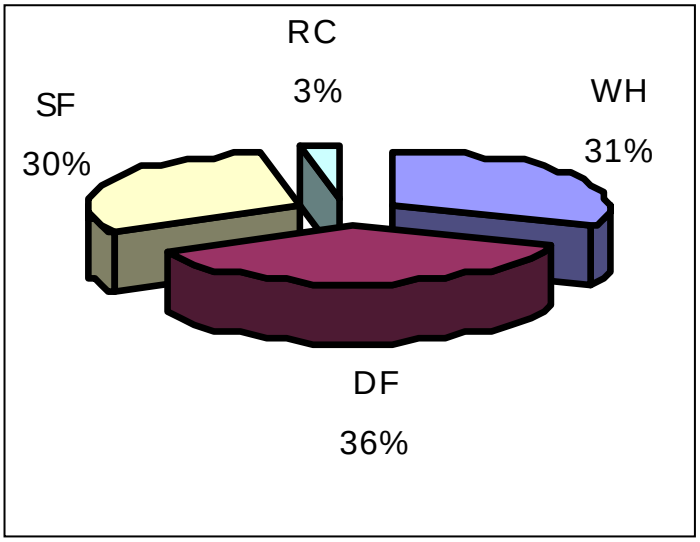
Alternative D

Alternative D would have the same thinning prescription for the 70-year-old stands (Units1–9) and for the 40-year-old stands (Units 12 and 13) as Alternative C. Stand growth, density, structure, canopy cover and mortality for those stands would be as described in Alternative C. The difference in Alternative D (Units 10-11) would be the removal of cut material in the 40-year-old stands. While Units 10 and 11 would have the same thinning prescription as Alternative C, both of those units would include removal of stems greater than 7 inches in diameter. This would reduce slash accumulations within the stands and provide for more light to the forest floor.

40-year-old-stands (Units 10–11): The thinning prescription would provide a residual stand with 344 trees per acre across all size classes (160 trees per acre greater than 7 inches dbh) with skips and gaps, with a species mix as displayed in Figure 20. As in Alternative C, ecosystem resiliency to insect, disease, disturbance and environmental changes such as climate would be improved from the increase in minority species representation on the landscape and in the reduced stocking level leading to increased vigor in the residual trees. Targeted leave tree species such as western redcedar, hardwoods, shrubs, and forbs would increase in variety and abundance. Basal area per acre would be 195 square feet.

Reducing stocking to recommended levels on 135 acres of Units 10 and 11, would result in 12.3 MBF per acre of timber volume. Mechanical removal of the cut stems would result in less slash, more growing space for understory vegetation development for more diversity in the stand following thinning and slash treatments.

Figure 23 Alternative D, 40-year-stand overstory species composition (Units 10-13) following thinning



Forest Vegetation Cumulative Effects

Area of cumulative effects analysis: The analysis area for cumulative effects was the 6th field watershed, which is the boundary of the Dan Creek drainage.

Past actions: Timber harvest in the Dan Creek drainage has been occurring through the past 85 years. Over that time, 26,141 acres have been harvested (see Appendix C, Cumulative Effects Information) with some of this harvest occurring on the same area, as new entries treat stands created from the early harvest activities. Timber sales dating back to the 1920s were considered in this analysis.

Figure 24. Alternative D example of Units 10 through 13 following treatment

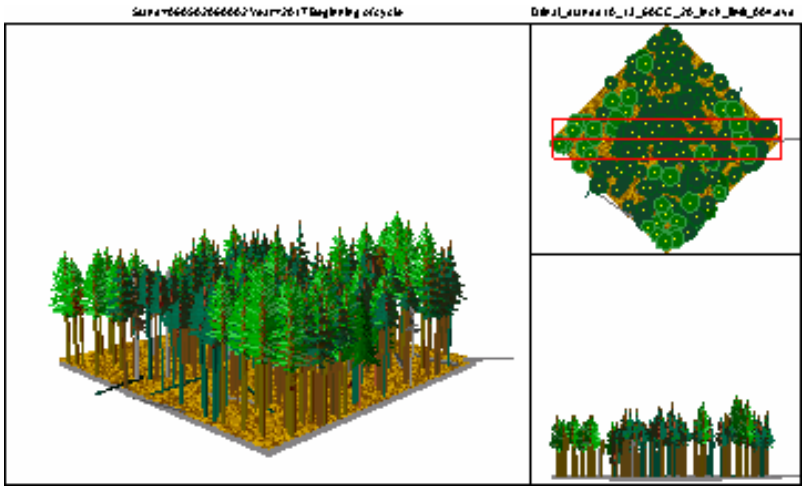


Table 6. Acres Thinned within the Dan Creek Drainage

Project	Alternative			
	A (acres)	B (acres)	C (acres)	D (acres)
Dan Creek Thin (future)	0	450	450	450
Decline Thin (future)	0	214	214	324
All other harvest in the Dan Creek drainage (from 1922 to present)	26,141	26,141	26,141	26,141
Total	26,141	26,805,	26,805	26,591

Special Forest Products

Availability of western redcedar for post and poles would be limited, as the thinning is designed to retain that tree species. Firewood availability would increase in the short-term after harvest as thinning slash becomes available, but then would decrease as natural tree mortality in thinned stands decreases. Access for mushroom and berry collecting would remain unchanged.

Forest Plan Consistency

All alternatives would be consistent with the standards and guidelines for forest vegetation management in the Forest Plan, as amended.

Project Record

This EA hereby incorporates by reference the Forest Vegetation Specialist Report (40 CFR 1502.21). The Forest Vegetation Specialist Report is located in the Project Record and contains the detailed data, Affected Environment, analysis, references, and technical documentation that the Silviculturist relied upon to reach the conclusions in this EA.

Fire and Fuels Environmental Effects

The analysis area for direct and indirect effects is the project area. The Fire Behavior Prediction System utilizes 13 fuel models to represent fuel conditions. This project involves the following four models (see below).

The fuel models are used to calculate potential fire rates of spread (ROS), and flame lengths (FL). Referred to as the two “fire behavior indicators,” these are used below to compare pre-harvest and post-harvest surface fuel conditions.

Table 7. Fuel Model Descriptions

Description	Fuel Model
Closed Timber Litter	8
Timber	10
Medium Logging Slash	12
Heavy Logging Slash	13

Alternative A—No Action

Fuels and Fire Hazard

In the absence of a disturbance such as a fire or windstorm, surface fuel loading would initially remain light in both the 40-year-old and 70-year-old stands. Surface fuels would be limited to compact needle cast and small diameter fuels consistent with a closed timber litter fuel model (FM 8).

Over time, as stands grow to maturity in approximately 120 years, fuel loading would increase gradually without substantial change in the two fire behavior indicators. Predicted rate of spread and flame length during periods of elevated fire danger (defined as 90th percentile fuel conditions) would generally not exceed initial attack capability; most unplanned ignitions would be suppressed during initial attack. A gradual shift in fuel loading would result in heavier timber conditions represented by a timber fuel model as the stand reaches maturity, and stand succession occurs, creating more surface fuels. The fire behavior indicators would gradually increase, resulting in increased resistance to control for initial attack.

Risk of fire starts within the project area is generally low. Lightning and human starts have been a factor in fire occurrence in the surrounding area (5th field hydrological unit), and some of these starts have become large fires. Current use patterns, fuel conditions, and fire history represent a relatively low-risk for unplanned ignitions.

Alternative B

Fuels and Fire Hazard

Alternative B would harvest timber and produce sufficient slash within Units 1 through 9 to change surface fuel conditions from a closed timber litter fuel model toward a medium logging slash fuel model. Surface fuels would be shaded and generally composed of limb wood and needles.

During periods of elevated fire danger, maximum rate of spread and flame length would exceed initial attack capability given ideal burning conditions combined with wind or steep slopes. This means a higher probability fires would escape initial attack. In 3 to 7 years after harvest, surface fuel conditions would change as fine fuels (0–1/4-inch) decay and the fuel bed compacts; this would result in a decrease in the fire behavior indicators. In 7 to 25 years following harvest, further dampening of expected fire behavior would occur as the fuel bed continues to decay and compact, resulting in fuel conditions represented by a timber fuel model. In addition, over story and under story development would further reduce fire behavior potential through additional shading of the fuel bed and by dampening fire potential by providing a heat sink resulting from the moisture content provided by live fuels. The probability of successful initial attack would increase as fuel conditions become less conducive to fire spread.

Risk of lightning and human-caused fire starts within the project area would be somewhat higher than in Alternative A due to the addition of unshaded fine fuels. The risk of lightning starts would increase slightly due to an increase in the amount of these receptive fuels. The risk of human caused starts would increase moderately due to unshaded fine fuels immediately adjacent to Road 2430. Risk of fire starts from logging operations would be low given adherence to established requirements outlined in the industrial fire precaution level regulations of the timber sale contract. Burning landing piles would reduce the risk for human starts in heavy fuels concentrated near the road system resulting from logging operations. The risk of fire starts is moderately higher than Alternative A.

Alternative C

Fuels and Fire Hazard

Fuel conditions in Alternative C would be the same as Alternative B for Units 1 through 9. The additional treatment of Units 10 through 13 would change surface fuel conditions from a closed timber litter fuel model to a heavy logging slash model.

During periods of elevated fire danger, maximum rate of spread and flame length would exceed initial attack capability. Fires initiated in these fuels would exhibit fire behavior beyond the capability of initial attack, and would have a greater probability of escaping initial attack than the fuels in either Alternatives A or B. Surface fuel conditions would change after harvest as fine fuels (0–1/4-inch) decay and the fuel bed compacts. Approximately 10 years following harvest, this would result in decreased fire behavior indicators consistent with a medium logging slash fuel model. From 10 to 25 years following harvest, further dampening of expected fire behavior would occur as the fuel bed continues to decay and compact, resulting in fuel conditions represented by a timber fuel model. Further reduction in fire behavior potential would result from additional shading of the fuel bed and by dampening fire potential by providing a heat sink from the moisture content provided by live fuels. This alternative would elevate fuel loading substantially from Alternative A conditions, and would increase the fire hazard and resistance to control. Over time, these conditions would moderate to a level consistent with adjacent stands of older forests (stands over 120 years in age).

This alternative has similar risk of fire starts as Alternative B in Units 1 through 9, but also creates additional acres of a heavy logging slash fuel model in Units 10–13. The risk of lightning caused fires would increase slightly due to additional acres of receptive fuels compared to Alternative B. The risk of human starts would increase slightly due to the addition of approximately 1.0 mile of heavy fuel loading along Road 2430. In addition to the landing pile burning included in Alternative B, this alternative would pile and burn slash 150 feet above and 50 feet below Road 2430. Removing these fuels would reduce the potential for human-caused fire starts. Further, removing fuels adjacent to the road system would change the fuel bed from medium and heavy logging slash fuel models back to conditions approximating a closed timber litter fuel model. This change would reduce the two fire behavior indicators and increase the probability of successful initial attack of human starts along the road system. This alternative has a slightly higher risk of lightning starts and a moderate reduction in risk of human starts compared with Alternative B.

Alternative D

Fuels and Fire Hazard

Fuel conditions in Alternative C would be the same as Alternative B for Units 1 through 9. This alternative includes treatment of Units 10 through 13, but removes stems (boles) greater that 7 inches dbh in Units 10 and 11. Removing those stems would result in a more compact fuel bed than Alterative C and thus would reduce fire behavior indicators to conditions consistent with Alternative B in those units. Fuel conditions in Units 12 and 13 would be the same as in Alternative C.

The risk of lightning and human caused fire starts is similar to Alternative B in Units 1 through 9. The risk of lightning caused fires in Units 11 through 13 is similar to Alternative C. Units 10–11 add untreated slash accumulations along Road 2430 and thereby would moderately increase the likelihood of human starts compared with the other alternatives. The probability of fire starts escaping initial attack along the road system is moderately higher compared to the treated acres in Alternative C.

Fire and Fuels Cumulative Effects

The analysis area for cumulative effects is the Dan Creek subwatershed (the 6th field hydrologic unit). The addition of the Decline project to the upper Dan Creek drainage would add to the cumulative effect of other projects that have changed fuel conditions in the drainage (see Appendix C, Cumulative Effects Information).

Past actions: Currently, approximately 1,665 acres in the upper Dan Creek subwatershed have been commercially thinned in the Wishbone, Rib, and Too Thin Timber Sales (1992–1998) and the Funnybone portion of the Skull/Funnybone Timber Sale (2001–2005). These acres have been converted from a closed timber litter fuel model to a medium logging slash fuel model.

Future actions: The proposed Dan Creek timber sale plans another 400 to 500 acres for 2009. The additional effect of the proposed Decline Thin Project is the addition of 214 acres (Alternative B) to 380 acres (Alternatives C and D) of medium and heavy logging slash fuel models to the upper Dan Creek drainage along the Road 2430 system. In the long term, subsequent decay, fuel bed compaction, and under story development would gradually reduce the potential fire behavior toward conditions consistent with a timber fuel model. The result of these changes over time would be conditions where more acres have fuel conditions resistant to initial attack. This change would slightly increase the probability of a large fire in the upper Dan Creek subwatershed. Risk of fire start due to logging activities is low and would be mitigated through adherence to industrial fire precaution requirements. The number of non-industrial human starts in the Dan Creek subwatershed has been relatively low during the recent past; however, this drainage is adjacent to the local community. Opening timber stands along with other past and proposed treatments may expand human activities such as firewood cutting temporarily. Increasing population and reductions in road access to the Forest may also increase human use of the Dan Creek area road system. The risk of human starts in the upper Dan Creek subwatershed would increase proportionately with additional human use of the area over time.

Forest Plan Consistency
All alternatives are consistent with the standards and guidelines for management of activity fuels and fire intensity levels in the Forest Plan, as amended.

Project Record
This EA hereby incorporates by reference the Fire and Fuels Specialist Report (40 CFR 1502.21). The Fire and Fuels Specialist Report is located in the Project Record and contains the detailed data, Affected Environment, analysis, references, and technical documentation that the Fire and Fuels Specialist relied upon to reach the conclusions in this EA.

Air Quality Environmental Effects

Alternative A—No Action
There would be no effects to air quality for this alternative.

Alternative B
Air quality would be temporarily reduced by timber harvest, log hauling, and slash treatment in Alternative B. Harvest and hauling would increase dust during dry conditions. Equipment use and slash burning would increase dust and smoke levels within the Dan Creek subwatershed. Smoke from slash treatment would be limited to levels consistent with clean air regulations.

Alternative C
Alternative C would have additional effects on air quality than Alternative B. This alternative includes more acres that would increase dust and smoke related to harvest activity. In addition, Alternative C includes slash pile burning along Road 2430. The additional smoke from pile burning would be regulated as outlined in Alternative B.

Alternative D
Alternative D would have similar effects on air quality as Alternative B. The alternative would add acres to the project area and include dust from decommissioning Road 2430, thus slightly increasing the amount of dust and smoke generated by the project. Although there are more acres treated, the impact to air quality would be similar to Alternative B.

Air Quality Cumulative Effects

The analysis area for cumulative effects on air quality is the Dan Creek subwatershed (6^{th} field hydrologic unit). Logging, hauling and pile burning from the Decline Thin Project combined with other sources on Federal, State, and private land (see projects listed in Appendix C, Cumulative Effects Analysis) would have an incremental contribution to cumulative effect on air quality. However, these effects, including dust from logging operations and smoke from pile burning, would be limited in time and would not extend beyond the Dan Creek subwatershed. Wildfire effects on air quality are also possible additions to cumulative effects in summer and fall, but specific wildfire timing, scale, and nature of smoke effects are not predictable. However, beyond that, there would be no discernible contribution to cumulative effects to air quality in the Dan Creek subwatershed resulting from this project.

Forest Plan Consistency

All alternatives would be consistent with the standards and guidelines for air quality in the Forest Plan, as amended.

Project Record

This EA hereby incorporates by reference the Air Quality Specialist Report (40 CFR 1502.21). The Air Quality Specialist Report is located in the Project Record and contains the detailed data, Affected Environment, analysis, references, and technical documentation that the Air Quality Specialist relied upon to reach the conclusions in this EA.

Access and Travel Management

Alternative A—No Action

Implementing Alternative A would result in the roads in the project area remaining in their current condition, with no reconstruction, brush removal, or surfacing. Roads would continue to be closed seasonally, with snow accumulations, and open typically between May and November to vehicle traffic. The Forest Service would continue to provide routine road maintenance. Closed roads such as the upper portion of Road 2430 would continue to re-vegetate naturally. Road access would continue to be maintained at assigned maintenance levels.

Effects Common to All Action Alternatives

With Alternatives B, C, or D, Road 24 would operate as the timber sale haul-route between the junction with the county road (Sauk Prairie side) and the junction of Road 2430. Roads 2430, 2432, and 2430014, would provide access to the timber sale Units 1 through 9[9].

Roads 24 and 2430 would benefit from the increase of spot rock to the existing road surface, lengthening the life of the existing surfacing. Culverts that have reached their life span and are rusting out would be replaced, lessening the risk of a drainage failure that would lead to road washouts. Brushing would create a safer road for traveling.

The planned reconstruction of Roads 2432 and a portion of 2430014 to a Maintenance Level (ML 2) standard would result in improved drainage runoff and the removal of brush buildup that is currently blocking drains and creating the risk of failures. At project completion, these roads would be placed back into a storage ML 1 condition and closed.

Road maintenance for this project would provide opportunities to maintain these roads through this project's funding. This would allow the District to use annual road maintenance funds elsewhere within the District.

Other work such as roadway fillslope stabilization would reduce the risk of resource damage, and daylighting of hardwood overhang would create a safer traveled way. All road upgrades and maintenance would increase the life of the existing National Forest roads within this project area while protecting the resources and reducing the risk for road prism failures.

9 The Mountain Loop Highway, Road 22, and Road 24 could provide an alternate route to the area if necessary, but would not be the logical route because it is a longer travelway. Currently this route is not available due to road damage and bridge outage.

Approximately 0.9 mile (4,700 feet) of temporary road would be constructed to provide access to the sale units (Units 2, 4 and landings off Road 2432 in Units 7 and 8). Temporary roads would be closed[10] upon completion of the timber sale activities.

Alternative B

Roads 2430016 and 2430017 would remain in their current condition, because there is no thinning activity planned for the 40-year-old stands accessed these two spur roads. No road treatment would take place on these roads.

Alternative C

If Alternative C were implemented, the stand treatment in the 40-year-old stand trees would be thinned and slash left on the ground (similar to pre-commercial thinning) for Units 10 through 13. Because there is no removal of thinned stems, there is no need for Roads 2430016 or 2430017 Timber sale generated Knutson-Vandenberg[11] funding or other funding sources would be used to treat and decommission these roads following timber sale activities.

Alternative D

Like Alternative C, Alternative D would also thin in the 40-year-old stands of Units 10 through 13. In this alternative, Units 10 and 11 would be thinned and stems (boles) removed (portions of the stems larger than 7 inches in diameter). Besides Roads 2430 and 2430014, this thinning removal would use Roads 2430016 and 2430017.These roads would be treated and closed (ML1) following timber activities.

Road 2430 would be decommissioned from MP 6.2 to the road's end at MP 8.7. Six to seven culverts would be removed along this portion of the road. In addition to culvert removal, approximately 530 feet of fill sidecast material would be removed to prevent resource damage from potential fill failure.

With Alternative D, a new bridge would be installed at Conn Creek on Road 2430. The existing 8-foot diameter culvert is serviceable, but damaged from rust (two small holes). The bridge would provide a new, long-lasting structure across this stream, meeting Standards and Guidelines for 100-year flows. Embankment material for a bridge is less than what exists with the current structure.

Installing a bridge would reduce the risk of large amounts of erosion loss during a flood event that would normally compromise a culvert crossing. The bridge life span would be triple that of a culvert installation and provide a larger opening for floodwaters and debris to pass through during a major flood event.

10 Closing a temporary road means that after the road has served its purpose, the purchaser would be required to remove bridges and culverts, eliminate ditches, outslope roadbed, remove ruts and berms, and effectively block the road to normal vehicular traffic and build cross ditches and water bars as designated by the Forest Service. When bridges and culverts are removed, associated fills would also be removed to the extent necessary to permit normal maximum flow of water.

11 Federal law that allows the U.S. Forest Service to collect money from a timber sale for resource enhancement, protection, and improvement work in the timber sale vicinity.

Table 8. Decline Thin Proposed Road Activity Data Details by Alternative

**Repairs made with funds other than KV collections.*

		Alternative			
Decline Road Activities	**Road #**	**A Miles**	**B Miles**	**C Miles**	**D Miles**
Maintenance Miles by Road	24	0	6.0	6.0	6.0
Reconstruction Miles by Road	24	0	2.0	2.0	2.0
	2430	0	3.5	3.5	5.8
	2432	0	1.7	1.7	1.7
	2430014	0	0.5	0.5	0.5
	2430016	0	0	0	0.2
	2430017	0	0	0	0.2
Total Reconstructed Maintenance Miles	**Total**	**0**	**13.7**	**13.7**	**16.4**
Decommissioned Miles by Road (KV Collections or Other Funds)	2430016	0	0	0.3	0.3
	2430017	0	0	0.2	0.2
	2430	0			*2.5
Total Decommissioned Miles	**Total**	**0**	**0.0**	**0.4**	**2.8**
Storage Miles by Road (ML1)	2432	0	1.7	1.7	1.7
	2430014		0.5	0.5	0.5
Total Storage Miles	**Total**	**0**	**2.3**	**2.3**	**2.3**
Estimated System Road Costs (Total cost/cost per mile)[12]	**Activity Type**	**Alternative A**	**Alternative B**	**Alternative C**	**Alternative D**
	Maintenance	0	$26,400 ($1927/mi)	$32,400 ($2,298/mi)	$36,000 ($2,195/mi)
	Reconstruct		$84,000 ($10,909/mi)	$114,000 ($14,805/mi)	$129,000 ($12,403/mi)
	Treatment		$30,000 ($13,043/mi)	$40,000 ($14,814/mi)	$85,000 ($16,666/mi)
Estimated Temporary Road Construction (sq. feet/miles)[13]	**Totals**	**Alternative A**	**Alternative B**	**Alternative C**	**Alternative D**
		0	**4,700 feet/ 0.9 miles**	**4,700 feet/ 0.9 miles**	**4,700 feet/ 0.9 miles**
Estimated Temporary Road Cost		0	**$15,000**	**$20,000**	**$20,000**
Estimated Upgrades to Undersized Culverts (capacity sized to handle 100-year floodwaters)		0	30	30	40
Conn Creek Culvert Replacement Costs	**Total**	**0**	**0**	**0**	**$170,000**
Total Estimates All Road	**Activity**	**Alternative A**	**Alternative B**	**Alternative C**	**Alternative D**

[12] Costs include reconstruction and proposed post sale treatment (such as, decommission Road 2083021 and reducing maintenance level (ML) on Road 2083020 from ML2 to ML1)

[13] Temporary roads would be decommissioned by removing culverts, reestablishing natural drainage, removal of unstable or sidecast fills, ripping the surface, blocking the road, and revegetation as needed.

Costs (by alternative and type of construction activity)[14]	**Maintenance**	**0**	**26,400**	**32,400**	**36,000**
	Reconstruct	**0**	**84,000**	**114,000**	**129,000**
	Treatment	**0**	**30,000**	**40,000**	**85,000**
	Temporary	**0**	**15,000**	**20,000**	**20,000**
	Conn Creek Culvert/ Bridge	**0**	**0**	**0**	**170,000**
	Total Cost	**0**	**155,400**	**206,400**	**$440,000**

Table 9. Cost of Maintenance and Reconstruction

Activity	Alternative			
	A	B	C	D
Road Reconstruction Miles	0	7.7	7.7	10.4
Road Maintenance Miles	0	6.0	6.0	6.0
Temporary Road (miles) [15]	0	0.89	0.89	0.89
Number of culverts to upgrade to meet 100-year event	0	30	30	40
Estimated System Road Costs[16]	0	$140,400	$186,400	$270,000
Conn Creek Bridge	0	0	0	$170,000
Estimated Temporary Road Cost	0	$15,000	$20,000	$20,000
Total Road Cost		$155,400	$200,400	$440,000

Roads and Transportation Cumulative Effects

The ultimate cumulative effects analysis area for roads and transportation is the Gold Mountain area and adjacent drainages.

The road reconstruction would assist with safe harvest and removal of timber from the project area. The reconstruction and placement of segments of roads into ML1, or decommissioning, would contribute toward the cumulative management of the MBS system roads, which, in turn, would contribute towards a better alignment of road maintenance levels with projected budgets for road maintenance. Roads identified as unnecessary to the road system, would be decommissioned, which would contribute to the continuing cumulative decrease in road mileage on the Forest.

There are several other projects in the Dan Creek to Sauk River drainage area that contribute to cumulative effects on access and road management.

[14] Construction activity includes the reconstruction and maintenance work of forest roads.
[15] As per standard timber sale contract clauses, all temporary roads would be decommissioned following use. Decommissioning would include removing culverts, reestablishing natural drainage, removal of unstable or sidecast fills as necessary, ripping the road surface, blocking the road to motorized action, and revegetation
[16] Costs include reconstruction and proposed post sale treatment (such as, decommissioning and maintenance).

Past actions: Past projects include the Wishbone and Too/Rib Timber Sales, Sauk Roads Restoration–Phase I, Road 2430 Emergency Relief for Federally Owned Roads (ERFO) project (located within the Decline Thin Project area).

Also included are Road 24 ERFO project, located at MP 2.6, Gold Mountain Phase I ERFO repair on Road 2400023, Road 24 switchback repair located at MP 1.7, and the Gold Mountain communications tower project located on Road 2420014. These projects include culvert replacements, fill failure repairs and general road maintenance projects such as but not limited to road blading, ditch cleaning, brushing, and road surface treatments.

Present actions: Current and ongoing projects are the Skull/Funnybone Timber Sale located along Road 24 and Forest Road Maintenance of project area roads.

Future actions: Future projects in the area include the proposed Dan Creek Thin, road restoration (Sauk Roads Restoration—Phase II), White Chuck Bridge ERFO repair, and Gold Mountain ERFO Phase II repairs on Road 22 and 2210. Snohomish County plans to perform ERFO repairs along the North Sauk Road adjacent to the Sauk River. General Forest road maintenance will continue along the Gold Mountain and Decline Creek roads as according to the Darrington Ranger District's future road maintenance plans.

Cumulatively, these projects support road repairs that would lead to re-establishing the main road systems, including upgrades to existing road system to meet road standards and guidelines according to the Forest Plan, as amended.

New culverts, road realignments, ditch clean-outs, and other stream crossings would improve appropriate channeling of hydrologic flows to minimize sediment delivery to fish bearing waters. Thinning and salvage sales in the area have also contributed toward road upgrades. Temporary roads have already been or are scheduled to be treated for decommissioning, which would result in no increase in road miles.

The cumulative effects of this project, together with other thinning or salvage projects, the flood repair projects such as (road repairs, upgrades of culverts, and a bridge), result in upgrading the proposed road systems to current standards, closing and placing roads in storage or decommissioning roads. This would result in a road system better situated to meet the needs of recreationists, emergency responders, fire management staff, and general administration of the Forest.

Forest Plan Consistency

In Alternatives B, C, and D, the road treatments utilized and described in this analysis would meet Environmental Effects road maintenance standards and guidelines of the Forest Plan, as amended.

Project Record

This EA hereby incorporates by reference the Air Quality Specialist Report (40 CFR 1502.21). The Air Quality Specialist Report is located in the Project Record and contains the detailed data, Affected Environment, analysis, references, and technical documentation that the Air Quality Specialist relied upon to reach the conclusions in this EA.

Hydrology and Soil

Alternative A—No Action

Hydrology

The forest in the project area would continue to mature and rain-on-snow effects on peak flows would continue to diminish as the forest canopy closes on a greater portion of the landscape. Vegetation disturbance is used by the Forest as a surrogate measure for the risk of peak flow increases. Percent disturbance is used to account for the effects of forest cover, soil compaction, and roads on runoff rates. Twelve percent vegetation disturbance is a threshold of concern used on the Forest to assess hydrologic conditions that may lead to increase erosion or increased peak flows from rain-on-snow storm events. Hydrologic maturity of stands is based on stand age with young stands (less than 25 years of age in the western hemlock zone) not having sufficient canopy to fully intercept precipitation in the rain-on-snow zone, and therefore contribute to a landscape more susceptible to rapid runoff and increased erosion potential.

The current vegetation disturbance (immature forest cover) level is 14.1 percent of the forested lands in the Lower Sauk 5th field watershed. This level would drop to 13.1 by 2009 and below 12 percent by 2012. For the Dan Creek Sixth-field subwatershed, the vegetation disturbance level is 17.6 percent, with an expectation that the disturbance level would drop to 16.5 in 2009 and below 12 percent by 2017 (Figure 25 and Figure 26). Stream channels do not show adverse effects of this level of vegetation disturbance. There is some stream channel scour from recent large storm events, but that level of scour is not uncommon from natural channel erosion during floods. Accelerated erosion within the project area appears related to insufficient road drainage.

Stream channels in the area would be subjected to lower stream energy during storm events as the risk of increased rain-on-snow runoff decreased. Alteration of surface and subsurface flows by roads would continue, resulting in culvert plugging and road erosion during storm events. Blocked culverts prevent the passage of runoff such that additional road erosion and failure occurs, sending large quantities of sediment into the channels where it damages fish and/or fish habitat.

Soils

The extent of soil compaction and displacement from previous management activities would remain unchanged. . Soil compaction recovers slowly with time and is influenced by plant root development, worms and other soils microbes, frost and freeze thaw cycles, and other agents. The average soil disturbance across the proposed harvest units is five percent. (Figure 25 p. 71). The actual amount of existing soil disturbance is difficult to quantify due to the broken nature of the ground. Historical records indicate that there was considerable ground disturbance from the railroad logging. Much of those effects are not now measurable except in a few pockets. Old skidding corridors are noticeable in Unit 10, with compacted trails still noticeable. Four soil disturbance transects in Unit 10 measured an average soil disturbance (compaction and displacement) level of 39 percent. The Region 6 soil quality management standard for detrimentally affected soil is 25 percent. Soil compaction reduces the infiltration rate of the soil, which can increase the amount of water that runs off during storm events. Compaction also lowers water-holding capacity and restricts root growth, both of which reduce soil productivity.

Removal of the surface duff and organic layers of the soil exposes the soil to erosion and loss of nutrients. Disruption of mycorrhizal associations in the surface soil, by mechanical displacement

or scarification, causes a reduction of nutrient availability and exchange between the plants and soil.

While the surface duff layer has accumulated to depths of ten to twelve centimeters in the 70-year-old stands, it remains about half that in the 40-year-old stands and in areas of higher impact by earlier logging, such as skidding in Unit 10. The surface organic layer may recovery in a few more decades. Recovery of compacted soils, in this area where soil freezing is uncommon, may take a century or more.

Surface erosion related to concentrated road drainage runoff would continue in isolated areas. Soil churning by rodents (mountain beaver), which is very common in landing and road fill material, would continue. In some areas, the risk of mass soil movement, similar to one from the landing at the end of Road 2430017, could increase due to rodent activity in overburden material. The disturbed ground at small failure areas (0.25 acre) have lost productivity because the subsoil is exposed and the nutrients and soil structure of the organic surface soil layer is removed. These sites would remain in early seral vegetation for several years, depending on the stability of the site and the site's susceptibility to repeat failures. These disturbed areas may deliver sediment to stream networks depending on location and vegetative recovery.

Water Quality

Within the Dan Creek subwatershed, there are no waters listed on the State of Washington Polluted Waters (Clean Water Act, section 303(d)) list (Washington State Department of Ecology 2007). Therefore, there are no total maximum daily loads (TMDL) established.

Sediment generated on site has low potential to enter the stream network, except at road stream crossings and from mass wasting in or near inner gorges. Some fine sediment washes from the hillslopes and roads during storms. There would be no road haul reconstruction or temporary road construction to create a short-term increase in erosion. Inadequate road drainage on Road 2430 would continue to cause a minor amount of hillslope erosion below the road. Undersized culverts would continue to be at risk of plugging during flood events; causing road erosion and possibly fill failure.

The tree canopy in Riparian Reserves would continue to develop toward late successional characteristics and microsite conditions would be more favorable for cool water temperatures desired by aquatic organisms. Stream temperature effects within the project area are generally not of concern because, with the exception of two small channels, the channels are intermittent or ephemeral and do not contribute to the stream network during the temperature sensitive season (late summer).

The risk of mass wasting from the closed portion of Road 2430 would remain moderate to high due to cracking sidecast fills and aging culverts. Failure of these fills would deliver sediment to the channel network; a small percentage of this sediment could travel to Dan Creek where it could affect fish spawning gravel and rearing habitat.

Alternative B

Hydrology

Vegetation canopy would be reduced in the 70-year-old stands to less than 70 percent. The result would be a slight increase in the amount of the forest area with more open or immature canopy. This would cause a slight increase in the vegetation disturbance level in the Dan Creek subwatershed, but not materially slow the recovery of vegetation disturbance in Dan Creek. By

2009, when the alteration of the tree canopy would be completed, the vegetation disturbance level in Dan Creek would be 17.2 percent compared to 16.5 percent under Alternative A (Figure 25). This would delay the recovery of the vegetation disturbance level (mature canopy cover) to 12 percent by one year, but not cause an appreciable increase in rain-on-snow peak flows in the analysis area or Dan Creek. At the fifth-field watershed scale, the vegetation disturbance level in the lower Sauk River watershed would not measurably change from Alternative A. There would be 13.2 percent of the landscape with immature canopy cover with Alternative B compared to 13.1 percent with Alternative A. There would be no appreciative delay in hydrologic canopy recovery with Alternative B.

Road improvements related to preparing roads (Roads 2430000, 2430014, and 2432000) for haul would lessen the effects of the road network on interception and re-routing of surface flow. Additional culverts would drain water off the roadway onto the slopes in more frequent intervals than occurs now. This would reduce the management effects on peak flows and partially offset the effects of vegetation removal. Removal of alder along the haul-route (Road 2430) would have no effect on the peak flows within Dan Creek because deciduous vegetation does not affect the rain-on-snow dynamics within the stand, and particularly along the road corridor.

Soils

Soil compaction and displacement in the harvest units would increase some over the no action alternative. Temporary roads and skidding corridors would impact soils, however, the use of the skyline yarding system and low ground pressure equipment driving on slash in the ground-based yarding areas, would minimize soil compaction and displacement. Overall soil disturbance would increase from 5.4 percent in Alternative A to 6.9 percent under Alternative B (Figure 25). The maximum individual unit disturbance would be 10.8 percent in Unit 5—the smallest harvest unit.

Water Quality

There would be no measurable effect on water quality. Retaining 70 percent canopy closure in Riparian Reserves and keeping the no cut zones around all areas with identifiable channel scour (including the ephemeral and intermittent streams) would maintain shade levels, provide for adequate filtering by vegetation near streams, maintain a continuous root network to protect stream banks, and maintain a source of woody debris for the channels.

Within the Dan Creek subwatershed, erosion from the project area would increase by 2.8 percent over Alternative A; with erosion mitigation for roads, this would decrease to 2.0 percent (Figure 25). At the Lower Sauk River watershed scale, the erosion increase would not be detectable at 0.3 percent.

There would be 7.7 miles of road haul reconstruction and 0.9 miles of temporary road construction, that could create a short-term increase in erosion. The intact riparian vegetation would provide a filter such that only small amounts of sediment would enter streams as a direct result of activities in the project area. This would be diffuse sediment from the isolated locations of soil disturbance and from roads. Road 2430 would be the most likely source of road-related sediment and turbidity since it does cross perennial streams at Conn and Decline Creeks. Disturbed soil areas would revegetate in a year and erosion would return to background levels in three to five years. Some road erosion would remain for as long as the road remains open.

The risk of mass wasting from the closed portion of Road 2430 would remain the same as under Alternative A.

Alternative C

Hydrology

Vegetation canopy retention in the 70-year old stands at 70 percent would minimize the effect on rain-on-snow processes. Observations of past thinning sales in the Gold Mountain noted areas canopy cover was reduced by snow and wind breakage, windthrow, and disease; resulting in a reduction in the canopy density for a number of years. Thinning of the younger stands (Units 10–13) to 60 to 70 percent canopy closure would have a small effect on rain-on-snow processes. Taking all of the above into account, the vegetation disturbance level under Alternative C for the Dan Creek 6th field watershed would be 17.5 percent in 2009 (Figure 25), compared to 16.5 percent for Alternative A. The vegetation disturbance level would drop below 12 percent of forest acres in the subwatershed by 2020. No appreciable increase in rain-on-snow peak flows would occur in the small drainages in the project area or Dan Creek by implementing this alternative because the vegetation would continue to recover, just at a slower rate. There does not appear to be adverse effects on rain-on-snow processes occurring under the current vegetation disturbance level of 17.6 percent.

At the 5th field watershed scale, the vegetation disturbance level, or maturity of canopy cover, in the lower Sauk River watershed would not measurably change from Alternative A. With Alternative C, there would be 13.3 percent of the watershed in less than mature canopy cover compared to 13.1 percent in Alternative A. There would be no appreciative delay in hydrologic canopy recovery with Alternative C.

There would be no change in the road treatment from Alternative B, except for the decommissioning of Roads 2430016 and 2430017 after the sale. Decommissioning of these already closed roads would lessen the effects of the road network on interception and re-routing of surface flow, but not measurably so.

Soils

Soil compaction and displacement in the harvest units would be the same as under Alternative B. Treatment of Roads 2430016 and 2430017 after the sale would correct surface water drainage that is causing erosion along the road and downslope in at least one location. Decommissioning would reduce the overall risk of mass wasting from these two short spur roads (one-half mile total length).

Water Quality

There would minor differences between Alternative B and C that affect water quality, but, similar to Alternative B, there would be no measurable effect to water quality. Retaining 70 percent canopy closure in the older stands (compared to 60 percent in Alternative B) and Riparian Reserves, and 60 to 70 percent in the young stands would maintain shade levels, provide for adequate filtering by vegetation near streams, maintain a continuous root network to protect stream banks, and maintain a source of woody debris for the channels.

Within the Dan Creek subwatershed, erosion from the project area would increase by 3.7 percent from that with Alternative A. Implementing erosion mitigation for roads, would decrease that to 1.8 percent (Table 10). This compares to 2.8 percent and 2.0 percent under Alternative B. At the Lower Sauk River watershed scale, the erosion increase would not be detectable at 0.3 percent.

The effect of roads on water quality would be the same as under Alternative B because the road treatments are the same except for decommissioning the two spur roads (Roads 2430016 and 2430017). The decommissioning activity could create a short-term increase in erosion when the

ground is first disturbed. Erosion control BMPs would minimize the potential. Only small amounts of sediment would enter streams as a direct result, and the sites would revegetate in a year.

The risk of mass wasting from the closed portion of Road 2430 would remain the same as under Alternatives A and B.

Alternative D

Hydrology

The effect of Alternative D on the hydrology would be the same as Alternative C (Figure 25) with the exception that 2.7 more miles of Road 2430 would be reconstructed for haul from the 40-year-old stands (Units 10 through 13), and 2.5 miles of Road 2430 beyond the 40-year-old stands would be further decommissioned. The drainage improvements would lessen the effects of the road network on peak flows.

The replacement of the currently serviceable Conn Creek culvert with a bridge on Road 2430 would allow for passage of 100-year flood flows and improve passage of debris at the crossing. This would meet Forest Plan standards (ACS Objective No. 6) and Department of Ecology requirements (under the Clean Water Act) for culvert sizing.

Soils

Soil compaction and displacement in the 70-year-old stands (Units 1 through 9) would be the same as under Alternatives B and C; however, the additional use of ground equipment in Units 10 and 11 would increase the soil disturbance to 7.3 percent across the project area (Figure 26). Soil disturbance in Unit 10 is high from past harvest activities. Four soil disturbance transects in Unit 10 measured an average soil disturbance (compaction and displacement) level of 39 percent.

Ground skidding under this alternative could potentially disturb 27.5 percent of Unit 10 because the unit is small and elongated necessitating numerous short skid roads to remove the material. Much of this skidding would be across already disturbed ground, so the disturbance would not be completely additive. Maintaining a layer of slash on the ground to travel on would greatly minimize the soil disturbance. Unit 5, the smallest unit, would have the next highest individual unit disturbance of 10.8 percent.

Treatment of Roads 2430016 and 2430017 after the sale would correct surface water drainage that is causing erosion by concentrating water, and reduce the overall risk of mass wasting from these two short spur roads (one-half mile total length).

Water Quality

The effect on water quality under this alternative would be similar to the other alternatives, but with the following difference:

Within the Dan Creek subwatershed, erosion from the project area would increase to 5.2 percent over Alternative A (Figure 25); with road erosion mitigation, this would decrease to 3.2 percent. At the Lower Sauk River watershed scale, the erosion increase would not be detectable at 0.5 percent. The 10.4 miles of road haul reconstruction and 0.9 miles of temporary road construction, could create a short-term increase in erosion, but because these road segments have limited connection to perennial streams, there would be little delivery of sediment to surface water. The first storm runoff would flush loose material from the road surface and ditchlines.

The risk of mass wasting from the closed portion of Road 2430 would be reduced by removing unstable sidecast fills and adding additional drainage dips. Treatment would mean there would be less material at risk of failing that could deliver sediment to the channel network where it could affect fish spawning and rearing habitat in Dan Creek.

Table 1. Summary of Vegetation Disturbance, Erosion, Soil Disturbance, and Road Miles by Alternative.

Change	Watershed	Alternatives			
		A	B	C	D
2009 Vegetation Disturbance (%/year recovered to 12% or less)	Dan Creek (6th Field)	16.5/2017	17.2/2018	17.5/2020	17.5/2020
	Lower Sauk River (5th Field)	13.1/2012	13.2/2012	13.3/2012	13.3/2012
Erosion Increase from Action (% above background)	Dan Creek (6th Field)	0	2.0	1.8	3.2
	Lower Sauk River (5th Field)	0	0.3	0.3	0.5
Soil Disturbance (average percent over harvest area)		5.4	6.9	6.9	7.3
Miles of road reconstruction and temporary road construction	Timber Haul-Route Reconstruction	0	7.7	7.7	10.4
	Temporary Roads	0	0.9	0.9	0.9

Figure 1. Dan Creek Subwatershed Vegetation Disturbance 6th Field Watershed

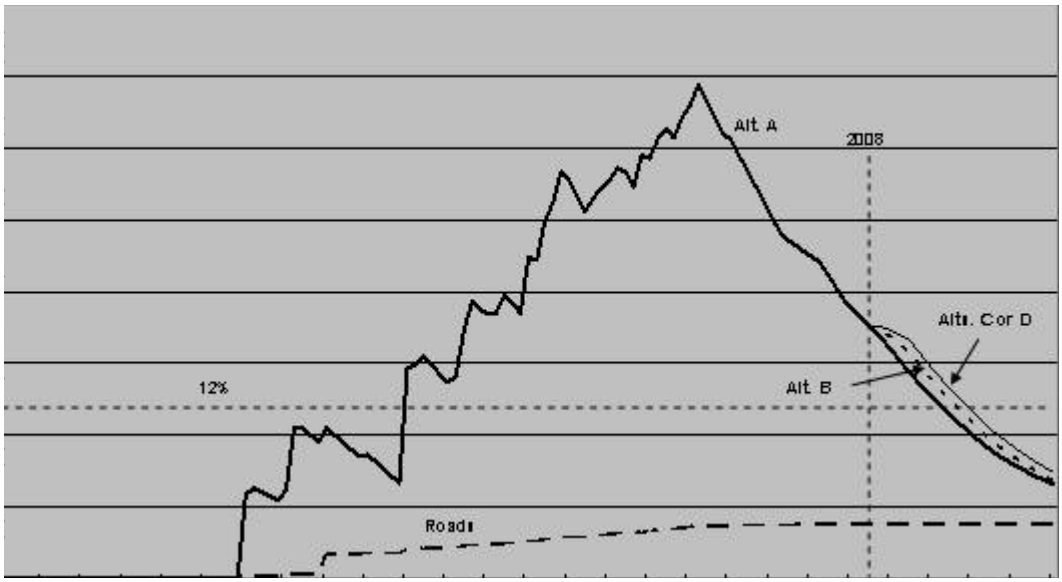
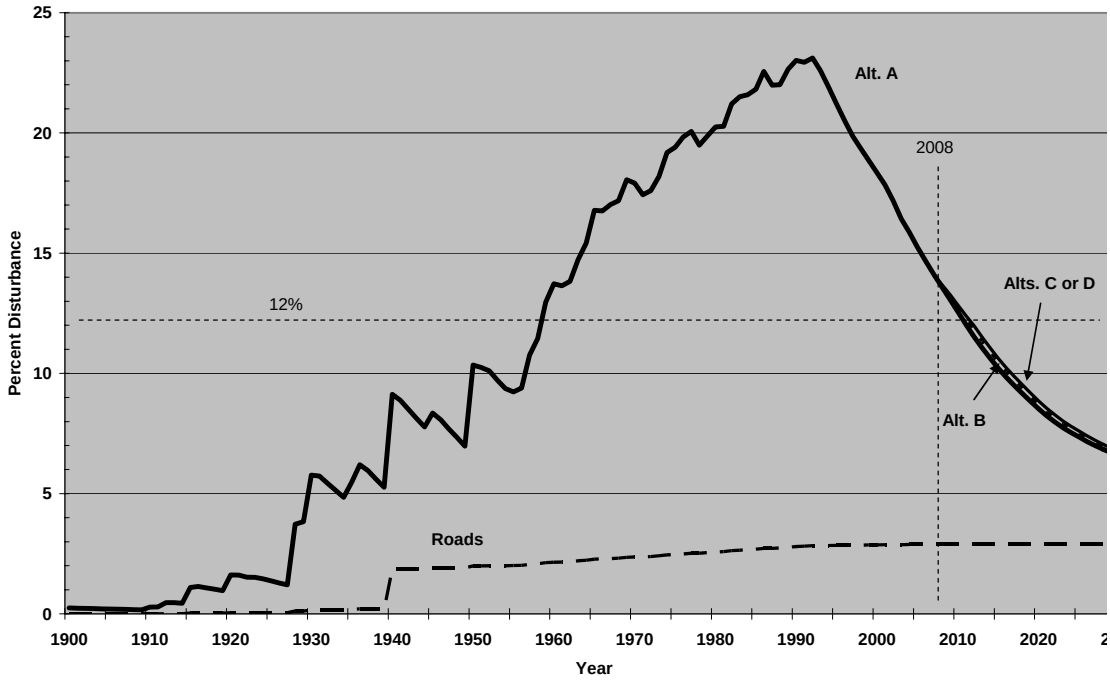


Figure 1. Lower Sauk River Vegetation Disturbance 5th Field Watershed



Hydrology and Soils Cumulative Effects

Assumptions

Hydrology Cumulative Effects Area

Hydrology and water quality cumulative effects would become additive moving downstream in a 6th field watershed, among 6th field watersheds and eventually among 5th field watersheds. As the area increases, the ability to identify and quantify individual effects becomes more difficult and dilution effects begin to mask effects. The lower Sauk River 6th field watershed includes the confluence with the Suiattle River, but not the Suiattle River watershed, another 5th field watershed. Because the Suiattle River masks conditions in the Sauk River below the confluence, the cumulative effects analysis for hydrologic effects is limited to activities in the Sauk River upstream of the Suiattle River. The cumulative effects analysis area for runoff effects (rain-on-snow) is the Lower Sauk River 5th field watershed upstream of the Suiattle River, and the Dan Creek 6th field sub-watershed. Maps of these watershed units are available in the Project Record.

The effects of vegetation alteration on rain-on-snow and other runoff processes would persist until the vegetation reaches a condition of hydrologic maturity. This condition assumably occurs when canopy closure reaches 70 percent. The length of time for this condition to occur depends on the vegetation zone; western hemlock reaches 70 percent canopy closure at 25 years of age, Pacific silver fir at 40 years (extrapolated from age to 60 percent canopy closure in: Peter, 1993). Openings in the canopy created by roads persist until the road is decommissioned, at which time revegetation occurs.

in: Peter, 1993). Openings in the canopy created by roads persist until the road is decommissioned, at which time revegetation occurs.

Soils Cumulative Effects Analysis Area

Soil cumulative effects are assessed on a site basis, and for this analysis, the project area. Soil effects are analyzed for each harvest unit; therefore, activities would only have cumulative effects if occurring within the same area. Soil compaction and displacement effects last for decades to centuries, so the overlap in time may be very long.

Water Quality Cumulative Effects Analysis Area

The geographic area for water quality cumulative effects is based on the following:

- No measurable stream temperature effects would occur from the Decline Thin Project (see Consequences section above); therefore, there would be no measurable cumulative stream temperature effects.
- Sediment effects from the project area could combine with sediment from other activities. The geographic area for sediment cumulative effects is based on sediment travel distance information from Bunte and MacDonald (1998). Travel distance varies by the type of sediment:

  Suspended sediment,—(20 km, 12.4 miles per year)
  Bedload (Sand and gravel)—(2 km, 1.2 miles per year)

- Suspended sediment is an assumed 30 percent by volume of project-generated sediment, sand and gravel are 65 percent, and cobbles comprise five percent.

Using this information, the cumulative effects analysis area for sediment is the entire Dan Creek 6th field subwatershed and the portion of the lower Sauk River 5th field watershed from the White Chuck River to the Suiattle River.

Long-term sediment has two sources: a) floods and future road washouts, and b) remobilization of sediment in the channel network.

Sediment effects from site erosion are short term—rates fall dramatically in one to two years as revegetation occurs; then persist at low levels up to six years for logging activities and road decommissioning, and indefinitely for open roads.

Hydrology and Soils Cumulative Effects Assessment

Hydrology

The vegetation disturbance model takes into account all past activities on National Forest System lands that affect vegetation cover and structure, so the effects analysis above covers the cumulative effects of timber harvest and fire prior to the proposed Decline Thin Project. Activities and events that affect the forest canopy and that overlap in time and space with the proposed Decline Thin Project are:

- Forest Service thinning sales: Funnybone, Wishbone, Rib, Too, Dubor, and Dontbor
- Gold Hill wildland fire
- Dan Creek Thin

- Future timber harvest on state and private lands

The Forest Service thinning sales and Gold Hill wildfire do not reverse, or materially change, the rate of vegetation recovery in the subwatershed (Dan Creek Figure 27) or watershed (Lower Sauk River Figure 28). A short plateau on the recovery curve for the Dan Creek subwatershed evidences Wishbone and Rib Thins.

The proposed Decline Thin Project would not have a measurable effect on rain-on-snow processes in Dan Creek or the Lower Sauk River, and therefore would not contribute a measurable cumulative effect on peak flows from rain-on-snow events. At the fifth-field watershed scale, the vegetation disturbance level is decreasing relatively unaffected by the proposed project (Figure 27). Vegetation disturbance in the Dan Creek subwatershed is above, and would remain above, the 12 percent threshold level for up to 8 years under Alternative C or D, three more years than under the No Action Alternative A, No Action. However, channel and slope conditions observed in the field do not indicate that rain-on-snow effects are occurring at the current 17 percent disturbance level. Therefore, while the disturbance level is projected to stay above 12 percent for the next several years, there does not appear to be a detrimental elevation of rain-on-snow peak flows.

Because the Dan Creek Thin, proposed for 2009, (Figure 28) is still conceptual, the combined vegetation disturbance shown in Figure 28 is the maximum expected based on the entire Dan Creek Thin project area. As the Dan Creek Thin project is more defined, the acres of disturbance would decrease as Riparian Reserves and other areas are dropped from the actual harvest area. However, because Dan Creek Thin would be within the Dan Creek watershed, it and the proposed project would have cumulative effects on vegetation disturbance and hence the risk of rain-on-snow effects.

Future State and private timber harvest cannot be quantified for this analysis; however, the location of these actions would generally be outside of the Dan Creek subwatershed (there are few State or private lands within Dan Creek). Therefore, there would be a low potential for measurable cumulative effects within Dan Creek. For State and private land activities in the Lower Sauk 5th field watershed, the proposed Decline Thin would not measurably contribute to cumulative effects.

Considering the past, present and foreseeable future projects, and the combined vegetation disturbance level in Dan Creek could increase to 19 percent with thinning all 450 acres under consideration. The change would be less as the actual harvest acres are decreased for Riparian Reserves and other factors. Road drainage improvements, as those for Decline Thin, could also mitigate some of the runoff concerns.

Figure 27. Dan Creek Subwatershed Vegetation Disturbance, 5th Field Cumulative Effects

Figure 28. Lower Sauk River Subwatershed Vegetation Disturbance 6th Field Cumulative Effects

Soils

Soils cumulative effects are measured on site and therefore none of the projects in the Cumulative Effects, Table 11 would overlap in space. A journeyman watershed specialist inspected the soil conditions in each proposed harvest unit to determine the existing level of soil disturbance. Transects were used to determine the existing average percent disturbance in the harvest units. As discussed above, previous harvest activities in the Decline Thin area left relatively high soil disturbance as a legacy. Soil disturbance as high as 29 percent in Unit 10 may have lingering effects on soil productivity for decades to come.

Previous harvest activities disturbed the soil in several ways. Displacement and scarification removed the surface duff layer in many areas and compacted soils along skid trails. The duff layer has recovered to 7 or 8 centimeters in the 70-year-old stands; (Units 1 through 9) but to only 3 to 4 centimeters in the 40-year-old stands. Recovery of the duff layer in the 40-year-old stands may take several more decades. Compaction may be persistent in the soil for even longer periods. Skid trails from past activities are common in Units 4 and 10 and are present in other units. Freeze and thaw churning is not common in these soils, so plants penetrating the compacted layer primarily break down compaction. Most of the ground cover plants do not penetrate this layer, so the area between trees remains compacted for decades or longer. Diligent use of existing skid trails and driving over slash would minimize the soils cumulative effects.

Water Quality

Onsite effects to water quality would be minimized by protecting the Riparian Reserves within the Decline Thin harvest area. These include shade retention for water temperature and vegetation buffers to filter onsite generated sediments. This cumulative effects analysis, centers on sediment and turbidity that might combine with sediment from other projects to create undesirable conditions within Dan Creek or the Sauk River. The no-cut zones around the channels within the project area and retention of 70 percent canopy cover throughout Riparian Reserves would prevent any measurable effect on stream temperature.

The White Chuck River is approximately 15 river miles upstream of the confluence of Dan Creek and the Sauk River. Projects upstream of the White Chuck River are, therefore, too far away (more than 12.4 miles) for suspended sediment overlap with projects in Dan Creek. Projects within Dan Creek would need to be within two miles upstream or downstream of Decline Creek to overlap with bedload generated from the project area.

Washington State water quality standards include a narrative standard for sediment and numeric criteria for turbidity. The narrative standard prohibits sediment levels that would impair conditions for beneficial uses (which in the case of Dan Creek and the Sauk River, salmonid spawning and rearing). The turbidity standard[17] addresses the amount of suspended and/or dissolved material within the water column, measured in Nephlometric Turbidity Units (NTUs). An NTU is a measure of the reduction of light intensity when a light passes through a sample of the water. The water quality criteria differ depending on the background turbidity (whether it is less than or greater than 50 NTUs). There are no turbidity measurements near the project area, but the summer low flow conditions would likely be less than 50 NTUs, and

17 Washington State Department of Ecology Class AA Water Quality Standard for turbidity: shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.

winter runoff conditions and storm flows would be expected to exceed 50 NTUs. Samples taken on the Sauk River near Rockport in 2004 ranged from 3 NTUs to 2200 NTUs (Washington Department of Ecology 2006).

At the times when turbidity is high in the Sauk River—during summer when glacier melt is high and during fall and winter storms—small increases from Decline Thin and other projects would not be discernable.

The minor amount of suspended sediment (99 tons of erosion times 0.1 delivery coefficient times 30 percent suspended sediment proportion equals 3.0 tons for Alternative D) expected from the Decline Thin Project area would travel to Dan Creek but would not be measurable at the confluence with the Sauk River approximately six miles away. Not all of this material would enter the water at the same time. During project activities, with low streamflow conditions and with dry intermittent channels, any sediment that would be generated during a rainstorm would not move into the water unless it was transported in a road ditch to a watercourse. During the first heavy fall rains, additional mobilization of sediment would occur in combination with the background turbidity of the streams. The greatest increase in sediment (3% above background the first year for Alternative D) would not create a measurable change in turbidity. Additional erosion would occur over the winter and the next year or so until disturbed sites revegetate. This small change in suspended sediment within the ecosystem would not have a measurable effect on stream channel processes or aquatic organisms.

Sand and gravel from the project area (99 tons of erosion times 0.1 delivery coefficient times 65 percent suspended sediment proportion equals 6.4 tons for Alternative D) would travel slowly through the intermittent channels within the project area, possibly remaining for several years. Only portions of the six tons would enter the channel system at any time. Once the sand and gravel entered Decline, Conn, or Dan Creek, it would travel readily during high flows through the narrow canyon of Dan Creek (where there is limited gravel bar development) and likely be deposited in the lower two miles of Dan Creek where the gradient and channel confinement are less. In this portion of the channel, gravel bars are more prevalent. Very limited amounts of sand and gravel from the project area would eventually be transported to the Sauk River.

The effects of sand and gravel size sediment are again on aquatic organisms and to some extent on channel morphology. Sands and gravels fill in pools and simplify the streambed. A more uniform bed means more stream energy for bed and bank erosion. The amount of sand and gravel expected from the proposed project is small enough that there would be no effect on channel morphology.

The following projects, identified from Appendix C Cumulative Effects Analysis, are analyzed against the above distance criteria and time of implementation and project effects to determine the potential for cumulative effects (Table 11). Activities marked with an asterix (*) are described in more detail following the table.

Table 11. Potential Cumulative Effects of Decline Thin and Other Projects, for Sediment

Future Activity	Extent	Sediment Effect	Overlap?		Cumulative Effect?
			Time	Space	
Dan Creek Thin *	400–500 acres of timber thinned. 50–70% canopy retention (mid Dan, Sauk). Proposed 2009.	Suspended	Y	Y	Individual effects are small so cumulative effect not measurable
		Bedload	Y	Y	
Road 2140 Upgrade *	Culvert and drainage upgrade; planned for 2008	Suspended	Y	Y	These activities are undertaken to reduce sediment; a minor but not measurable cumulative effect may occur the first year.
		Bedload	Y	N	
County Road Reconstruction *	North side Sauk Road damaged during 2003 flood; replace crossings at Mouse & Bob Lewis Creeks on Sauk Prairie Road. Repair planned for 2007–2010	Suspended	Y	Y	At point where these effects combine in the Sauk River, they would not be discernible over background suspended sediment.
		Bedload	Y	N	
Sauk River County Bridge *	County replacing main Sauk River Bridge which is on Decline Thin haul route	Suspended	Y	Y	Erosion controls on project minimizing effect; cumulative effect not measurable
		Bedload	Y	N	
Road Maintenance *	Routine road maintenance activities on Roads 24, 2430, 2435. 12+ miles of grading in 2006. Approx. 13 additional miles on a rotation basis.	Suspended	Y	Y	Cumulative effect only when storms occur shortly after road blading is done. This is when road surface is susceptible to erosion. Effect lasts until road surface is re-compacted.
		Bedload	Y	Y	
Sauk Roads Treatment *	Roads 2420, 2421, 2411 and spurs. Culvert removal, restoration, and removing unstable fill. Ongoing from 2002.	Suspended	Y	Y	The purpose of these projects is reduction of road-related sediment; any cumulative effects would be very short term or beneficial.
		Bedload	Y	Y	
Future timber harvest on private and state lands *	Extent is unknown but there are private and state timberlands north and west of the forest boundary	Suspended	Y	Y	The potential for cumulative effects would depend on the timing of this harvest. Effects from the Decline Thin would diminish in 3 to 5 years.
		Bedload	Y	N	

Forgotten Thin Plus	400 acres planned for thinning, no Riparian Reserve treatment. Planned for 2007	Suspended	Y	N	Located too far upstream on the Sauk River for overlap in space. No measurable cumulative effect.
		Bedload	Y	N	
ERFO road repair & culvert replacement *	Rd. 2435 culvert replacements that drain into Dan Creek. Planned for 2007	Suspended	Y	Y	Project effects mitigated by BMPs and may be completed with effects no longer present.
		Bedload	Y	N	
Noxious Weeds Eradication	Treatment of known infestations along Road 24. Begun 2003 and ongoing	Suspended	NA	NA	No sediment related impacts from this activity
		Bedload	NA	NA	
Dan Horse Pasture (Mouse Creek) Restoration	5 acres treated of noxious weeds, and riparian plantings; 2006–2007	Suspended	Y	Y	Weed eradication and new plantings will reduce erosion and sediment. Cumulative effect is positive
		Bedload	Y	N	
		Suspended	NA	NA	
Timber Stand Improvement	Precommercial thinning and hardwood release on stands throughout the watershed	Bedload	NA	NA	No sediment related impacts from this activity
		Suspended	Y	N	
Gold Hill Road Repair, including White Chuck Bridge	Flood repair damage to Road 22 System on Gold Mtn. and White Chuck Bridge replacement	Bedload	Y	N	Located too far upstream on the Sauk River for overlap in space. No measurable cumulative effect.
		Suspended	N	Y	
Trail maintenance	Old Sauk, White Chuck Bench, Beaver Lake, Peek-a-Boo, Eight Mile repairs after 2003 flood. Additional work to be done from 2006 flood; maintenance on rotating basis	Bedload	N	N	There are no residual or expected effects that could combine cumulatively with effects from this project
		Suspended	N	Y	
Private Timber Land	Continued harvest and reforestation in accordance with State regulations; ongoing	Bedload	N	N	Timing and magnitude is uncertain, but State regulations would minimize effect.
		Suspended	N	Y	
State Timber Land	Continued harvest in accordance with State Habitat Conservation Plan; ongoing	Bedload	N	N	Timing and magnitude is uncertain, but State regulations would minimize effect.
		Suspended	Y	Y	

Private Land Development *	Construction of buildings, paving, and conversion of forest land into residential. Wright Gravel Pit, Hampton Lumber Mill, ongoing	Bedload	Y	N	See narrative
		Suspended	Y	Y	
Funnybone Thin*	431 acres of timber thinned. 25% in Riparian Reserves w/70% canopy (upper Dan, Sauk) 15 acres in 2001; 416 acres in 2005.	Bedload	Y	Y	Erosion effects from Funnybone very small by 2008, cumulative effect not measurable
		Suspended	N	Y	
Wishbone, Rib, Too, Thin Timber Sales	1,244 acres thinned. 10 acres in Riparian Reserves w/70% canopy retention (upper Dan Creek, Sauk River near White Chuck River). Completed 1992–98.	Bedload	N	Y	Sales no longer have sediment effects; no cumulative effects. Too and Rib Thins are in the Lower Sauk watershed at the extreme limits for sediment overlap in space.
		Suspended	N	Y	
Clear-cut Timber Harvest	Logging conducted from 1920 to 1996 within the Dan Creek subwatershed and Lower Sauk River watershed	Bedload	N	N	Older sales with no lingering sediment effects, no cumulative effect.
		Suspended	N	Y	
Road Reconstruction	Roads 24,2424,2420,for access to Skull-Funnybone Thin; completed 2001	Bedload	N	Y	There are no residual or expected effects that could combine cumulatively with effects from this project
		Suspended			
Gold Hill Fire Suppression	Blasting, fireline, road reconstruction, water and retardant air drops in 2003.	Bedload	N	N	There are no residual or expected effects that could combine cumulatively with effects from this project
		Suspended	N	Y	
Gold Hill Fire Salvage Timber Sale	16 acres of fire-killed trees salvaged.	Bedload	N	N	There are no residual effects that could combine cumulatively with effects from this project
		Suspended	N	Y	
Dubor and Dontbor Thins	600 acre thinning with 70% canopy closure; completed 1992 to 1995	Bedload	N	Y	There are no residual effects that could combine cumulatively with effects from this project
		Suspended	N	N	
Dutch Creek Bridge	Culvert to bridge for fish passage on Mtn	Bedload	N	N	Located too far upstream on the Sauk River for

		Suspended	N	N	
Gold Mtn. Communications Tower	A special use permit to Snohomish County in 2005	Bedload	N	N	No sediment effect and no cumulative effect
		Suspended	N	Y	
Road Decommissioning	Road 2080, road segments in Goodman and Helena Creek drainages, Prairie Mtn.—10 miles Completed in 1990 to 2004.	Bedload	N	N	There are no residual effects that could combine cumulatively with effects from this project
		Suspended	N	Y	
Instream Treatments and off-channel habitat creation or enhancements	Early Coho Creek (30 structures-1989); Skinny Sauk Pond (1.1 ac. 1987); Constant Channel (0.2 ac. 1991); Hyachuck Pond Complex (3 ponds, 4.5 ac. 1985 and 1990);	Bedload	N	N	There are no residual effects that could combine cumulatively with effects from this project

Additional Comments on Specific Projects*

Dan Creek Thin

The specific effects sediment of the proposed Dan Creek Thin are not known at this time. Erosion control BMPs similar to those to be used on the Decline Thin Project would be used for the Dan Creek Thin. Thus, there would be only minor increases in sediment, which when combined in Dan Creek, would not be measurable above the background sediment (turbidity) of Dan Creek. Road upgrades that would likely happen as part of the Decline Thin Project would also reduce road erosion and reduce cumulative effects.

Road 2140 Upgrade

These road upgrades would improve road drainage and reduce the amount of road sediment. This work could generate some sediment during and within the first runoff season (fall) following the work, but levels would return to pre-project sediment or lower. Because most of this sediment would combine with sediment from Decline Thin in the Sauk River below Dan Creek, there would be no measurable contribution to cumulative effects on water quality.

County Road Construction

This work is similar to ERFO and Forest Service road treatments to fix damage and reduce sediment from roads. These repairs would occur over a six-year period. Only those taking place within a year or two of Decline Thin would overlap in time. Erosion control during the projects would minimize sediment generated. The effects would combine with Decline Thin effects in the Sauk River, and there would be no measurable increment to cumulative effect.

Sauk River County Bridge

Erosion control and stormwater pollution prevention measures on this project would prevent any appreciable sediment from entering the Sauk River. The background turbidity in the river from glacier meltwater is masking whatever this project is generating. This effect would combine with the Decline Thin sediment effect at the mouth of Dan Creek. There would be no measurable increment to cumulative effects.

Road Maintenance

Road maintenance (grading) creates a highly erodible road surface that lasts for a few days to a few weeks, depending on the traffic volume and moisture content at the time of grading. Road maintenance in the within the sediment cumulative effects assessment area would have to occur in the first two years of implementation of the Decline Thin Project to overlap. In addition, a storm would need to occur when the road surface is most susceptible to erosion for erosion to occur. Given the many variables, it is unlikely that an overlap in time would occur in the two years following the proposed Decline Thin Project. If the projects did overlap in time, the small quantities of sediment generated by either activity would not contribute a measurable increment to cumulative effects.

Sauk Roads Treatments

These treatment effects are similar to road maintenance—small and short lived (weeks to months), with the long-term effect being a reduction in erosion. The most likely cumulative effect would occur with the first runoff in the fall of 2008 or 2009, when there would be lingering erosion from the proposed Decline Thin Project and from any new treatments. After the first flush there would be no measurable sediment generated. The work on the Road 22 system is within the lower Sauk River watershed outside of Dan Creek, so those sediment effects would not be measurable at the confluence with Dan Creek. Work on the Road 24 system could combine with Decline Thin Project and contribute to cumulative effects that would not be measurable over background.

Future Timber Harvest on Private and State Lands

Timber harvest on private and state lands is managed under the Forest Practices Rules, and Forest and Fish Agreement with the State of Washington. These rules have strict requirements for sediment reduction so that only small amounts of sediment would enter the stream system from these activities. Given this and the fact that the point where effects would combine with Decline Thin is either near the mouth of Dan Creek or in the Lower Sauk River, there would be no measurable contribution to cumulative effects.

ERFO Road Repair and Culvert Replacement

This work is planned for 2007, so the initial sediment release associated with this project will have occurred prior to implementing the proposed Decline Thin Project (this would be a very small release because erosion control prevention BMPs would be used). Any residual sediment effects would be very small and possibly less than before the project when Decline Thin would be implemented. Therefore, there would not be a measurable contribution to cumulative effects where the effects combine in Dan Creek, below Decline Creek.

Private Land Development

Private land development is regulated under County, State, and Federal regulations, which require sediment controls. As with other ongoing activities, only those that would contribute measurable sediment within two years of the Decline Thin would have the potential for combined sediment cumulative effects. Generally, these developments are small, located more than six miles away from Decline Creek, and would not contribute to cumulative effects at the Sauk River scale. There would be no measurable increment to sediment cumulative effects from Decline Thin.

Funnybone Thin

Funnybone Thin would be three-years-old when the Decline Thin Project is scheduled to be implemented. Erosion and sedimentation effects from Funnybone Thin would be recovered to background levels or very slightly above background. Although the effects would overlap in space and time, there would be no measurable contribution to sediment cumulative effects.

Forest Plan Consistency

All alternatives are consistent with the Forest Plan, as amended

Project Record

This EA hereby incorporates by reference the Hydrology and Soils Specialist Report (40 CFR 1502.21). The Hydrology and Soils Specialist Report is located in the Project Record and contains the detailed data, analysis, references, and technical documentation that the Hydrology and Soils Specialist relied upon to reach the conclusions in this EA. Affected Environment, analysis, references, and technical documentation that the Hydrology and Soils Specialist relied upon to reach the conclusions in this EA.

Fisheries Environmental Consequences

The analysis area for direct and indirect effects to fisheries is the Dan Creek subwatershed (6th field hydrologic unit), which flows into an unnamed side channel in the lower Sauk River sub-basin. The side channel confluences with the Sauk River at river mile (RM) 16.8. The named streams through the project area include Decline and Conn Creeks, and the haul route crosses the fish-bearing streams Dan Creek, and tributaries 1087, 1088 and 1089. The numbered streams flow independently to the Sauk. Stream names and numbers are taken from Williams, and others 1975.

Effects of this type of project to fisheries are related to actions that may affect the timing or intensity of streamflows, sedimentation to spawning and rearing habitats, future riparian recruitment, and fish passage. See the Hydrology and Soils section for detailed analyses of effects to flows and sedimentation. A change in flow patterns could lead to scour of redds, change in bedload or debris transport patterns, or result in low summer flows that strand fish. Excessive sedimentation can bury a redd and suffocate the eggs, fill rearing pools, and irritate a fish's gills, which can kill or reduce the survival or health of a fish. Healthy riparian areas are important for many things, including providing a source of large wood to a stream. Large wood is important in creating and maintaining spawning and rearing habitats for fish, and providing cover from predators. Fish passage is more important for anadromous fish, but because resident fish will also travel up and down a stream, ensuring access to all useable habitats at all life stages (adults as well as juveniles) is optimal.

Alternative A—No Action

With Alternative A, no treatment of timber stands or roads would occur. Normal road maintenance (brushing, blading) would continue to be scheduled on rotation, but Roads 24, 2430, 2432, and spur Roads 2430014, 2430016, and 2430017 would not be upgraded, storm-proofed, closed, or decommissioned. Without road treatments, fine sediments from fill failures could reach fish-bearing waters, but these fine sediments would not measurably or observably affect these fish species of interest or their special habitats.

The fish species and special habitats of management interest in the Dan Creek subwatershed are shown in the Project Record. For federally listed fish and special habitats, there would be *No Effect* to federally listed Chinook, steelhead, or bull trout; *No Effect* to designated Chinook or bull trout critical habitat; and this alternative *Would Not Adversely Affect* essential fish habitats for Chinook, coho, or pink salmon.

For other fish species with special status (FS Sensitive and MBS management indictor species), there would be *No Impact* to coho, sockeye, coastal cutthroat, Salish sucker, pink, chum, or rainbow.

Alternatives B and C

The effects to fish and fish habitats would be the same with these action alternatives. Design considerations such as full Riparian Reserve buffers around Decline Creek, retaining no-cut buffers along streams and drainage features, and maintaining 70 percent canopy within Riparian Reserves treated (and 60–70% in other treated areas) would maintain watershed processes and routing of flows and large wood (see the Hydrology and Soils Environmental Consequences section), and maintain existing fish populations and habitats. Best management practices and conservation measures such as yarding away from streams and drainage features, checking equipment daily for leaks, and limiting activities when wet weather causes sedimentation, minimizes the likelihood of sediments and contaminants entering the stream network. Most of the drainage features in the project are intermittent or ephemeral, and do not carry flow sufficient to transport sediments to fish-bearing waters. Except for cutthroat just downstream of the project area (they inhabit Dan Creek above the anadromous barrier into its headwaters, and downstream of Road 2430 in lower Decline and Conn Creeks), all other fish and special habitats would have negligible effects from activities associated with these alternatives.

Road treatments for erosion control and to close or decommission system roads would potentially have short-term inputs of sediments while work occurred and for the next year afterwards, but incremental benefits to fishery, resources would result. These benefits would not likely be measurable in terms of improvements to fish habitat quality or quantity, or to fish populations. Fine and coarse sediments may enter fish-bearing waters (Dan Creek, lower Decline Creek, lower Conn Creek, and Tributaries 1087, 1088, and 1089) when treating roads or when hauling the timber off-Forest. However, with conservation measures and best management practices in place (see Chapter 2, Mitigation Measures and Management Requirements), the amount of these sediments would be minimized to the extent that they would not have detectable effects to fish survival or habitat. Intermittent Tributaries 1087, 1088, and 1089 are utilized by coho and cutthroat a third- to a half-mile downstream of the crossings.

Because these alternatives do not treat the upper portion of Road 2430, the potential exists for road failure and delivery of sediments to lower Dan Creek (3–5 miles downstream of the

project area) where they could incrementally degrade spawning and rearing habitats. These effects would likely be within annual variability of spawning and rearing success, however, and would not be definitively attributable to road failure upstream.

Any changes to recruitment of wood to fish-bearing streams would not likely be measurable, and may not change at all. The Riparian Reserves along fish-bearing streams would not be entered, and intermittent or seasonally flowing non-fish-bearing streams would all have no-cut buffers.

Upstream fish passage is blocked at the crossing of Road 2430 over Conn Creek, and at the Road 24 crossing of upper Dan Creek. Alternatives B and C would not replace the culvert at Conn Creek, and this structure would continue to block upstream passage.

For federally listed fish and special habitats, the effect determinations are *No Effect* for federally listed Chinook, steelhead, and bull trout; *No Effect* to designated Chinook or bull trout critical habitats; *No Effect* for Chinook, coho, or pink salmon essential habitat.

For the FS Sensitive and MBS management indictor species coho, sockeye, coastal cutthroat (anadromous), Salish sucker, pink, chum, and rainbow, project activities would have *No Impact*; for resident coastal cutthroat, the effect determination from project activities is *Impact Individuals, Not Likely to Trend Toward Listing.*

Alternative D

The effects to fish and fish habitats would be the same with Alternative D as with Alternatives B or C. In addition, further effects would result from reconstructing 2.7 more miles of Road 2430, further treating 2.5 miles of closed upper Road 2430 for drainage and stability, and replacing the existing Conn Creek culvert at Road 24 with a bridge to be made passable to fish and to 100-year flows and associated debris.

Treating upper Road 2430 would reduce the risk of mass wasting and potential delivery of sediments to spawning and rearing habitats in lower Dan Creek. Road drainage improvements would lessen the effects of the road network on peak flows that potentially could scour fish habitats. Benefits to fish would likely be within annual variability of spawning and rearing success, however, and would not be definitively attributable to these particular road treatments upstream.

Upstream fish passage is blocked at the crossing of Road 2430 over Conn Creek, and at the Road 24 crossing of upper Dan Creek. If the culvert over Conn Creek were replaced, passage would be restored. Fish presence in Conn Creek upstream of Road 2430 is suspected but has not been confirmed. The Road 24 crossing of upper Dan Creek cuts off the wetland headwaters to fish passage, but previous consideration to remove this barrier was dropped by Forest Service and WDFW fisheries personnel because the wetland would be drained and the ground would be substantially disturbed. Cutthroat have been found in Dan Creek upstream of Road 24, so they are already using available habitat.

Culvert replacements at Conn Creek and upper Dan Creek could input fine and coarse sediments during construction and within the first water year after construction, but these short-term negative effects would be minimized by best management practices and measures such as working in the WDFW in-water window and diverting water around the work site to work in the dry. Replacing this culvert with a bridge would lead to long-term benefits to the resident cutthroat population in Dan Creek by opening passage past an existing barrier. A larger structure would pass greater flows and more debris, would require less maintenance, and

would be less likely to contribute road-related sediments to Conn Creek (and potentially to Dan Creek) in the future. Resulting benefits to fish habitat downstream, and to the cutthroat population, would be minor and within normal variability of spawning and rearing success. These effects would not be quantifiable without intensive monitoring of the existing populations and habitat.

Fisheries Cumulative Effects

A cumulative effect is the effect on the environment that results from the incremental effect of the action, when added to the effects of other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes the other actions and regardless of land ownership on which the other actions occur. An individual action when considered alone may not have a significant effect, but when its effects are considered in sum with the effects of other past, present, and reasonably foreseeable future actions, the effects may be significant. They can occur when small, incremental amounts of habitat are lost (or gained) over time through a variety of management activities across a landscape (40 CFR 1508.7).

The fisheries cumulative effects areas consist of Dan Creek upstream of the natural barrier occupied by the resident cutthroat population (upper Dan Creek), and the habitat and species occupying Dan Creek and Tributaries 1087, 1088, and 1089 (lower Dan Creek and adjacent tributaries). However, because the fish utilizing habitats in lower Dan Creek (below the natural barrier) and Tributaries 1087, 1088, and 1089 are part of stocks that extend past these boundaries, the cumulative effects analysis summarized below also considers activities in the lower Sauk River watershed that were completed, are ongoing, or will be implemented beyond this area because they had or have effects to these fish either directly or through improvements to their habitats. The past, present (ongoing), and future projects considered in this cumulative effects analysis for fisheries are listed and described in Table 12.

Past actions: Types of past projects that have occurred and are still having indirect lingering effects to fishery resources include instream habitat restoration, riparian treatments, and fish passage projects. One past project has lingering effects that overlap in both time and space with the Decline Thin Project (see Table 12). On upper Dan Creek, the Forest Service removed a collapsed wood-stringer bridge in the late-1990s upstream of the Conn Creek confluence. That structure had formed a pool, but was also a partial passage barrier. While the Decline Thin Project would not measurably affect pool habitat, and the Conn Creek culvert is in a different location from that structure, replacing the Conn Creek culvert under Road 2430 with a bridge would indirectly improve fish numbers. However, because the collapsed bridge was not a total barrier and cutthroat may already be using Conn Creek upstream of Road 2430, the contribution to cumulative effects is likely negligible. Quantifying changes to the health or size of the population is also not practical, as baseline population, data does not exist and intensive monitoring of the population would be required.

Downstream in lower Dan Creek and adjacent areas, the Forest Service and organizations such as the Skagit River System Cooperative, the Skagit Fisheries Enhancement Group (SFEG), the Skagit Watershed Council, and the Washington Department of Fish and Wildlife have constructed instream habitat restoration projects, planted riparian areas, replaced barrier culverts, and stocked smolts into the Sauk River sub-basin (see Appendix C—Cumulative Effects Information). Because effects of the Decline Thin Project do not overlap in both time and space with these projects, or the type of activity is not the same, there is no cumulative effect.

Present (ongoing) and future actions: The agencies mentioned above continue to conduct these activities in the lower Sauk watershed, though locations and timing are not known. Known habitat and fish projects ongoing or to be completed include additional riparian plantings along Tributary 1089 by the Dan Horse Pasture, replacement of a partial fish barrier off-Forest in Tributary 1087, and annual smolt-stocking by WDFW. Only the effects of the fish passage project could overlap by type of activity in both time and space (see Table 12 and Appendix C—Cumulative Effects Information). For this project, the fish passage barrier removals in lower Tributary 1087 and in Conn Creek would affect different areas. The Conn Creek culvert replacement could incrementally increase resident cutthroat numbers in upper Dan Creek; if some of these fish passed downstream of the natural barrier on Dan Creek, they would also increase the Sauk River cutthroat, but overall effects to the populations would not be measurable. Decline Thin would have a negligible contribution to cumulative effects. While the proposed Dan Thin is not fully developed, the expectation is that fishery resources would be maintained due to stream buffers and all the similar best management practices that are being implemented with Decline Thin.

Additionally, floods from 2003 and 2006 negatively affected habitat for several fish species. Those effects are now resulting in reduced fish returns to the area, further confounding the ability to relate cause-and-effect of specific management actions.

Table 12. Selected Projects Considered For Fisheries Cumulative Effects

Past Projects	Influence	Overlap (Does Decline Thin overlap with the effects of these types of activities in time or space?)		Comments Resulting cumulative effect?
		Time/Type	Space	
Removal of collapsed wood-stringer bridge in upper Dan about RM 6 in late-1990s.	Pool habitat, fish passage and indirect increase in fish numbers	No-pool habitat; Yes-fish passage, fish numbers	No-pool habitat, fish passage Yes-fish numbers	Improved fish passage may continue to occur in upper Dan, and while the Conn Creek culvert replacement would also improve passage, the locations were different. Overall effects on fish numbers would not be measurable; negligible cumulative effect contribution
Instream treatments: R&T, 44 structures 1988; Clear Ck, 58 in 1983–86; Murphy Ck, 26 in 1984–1989; Dutch Ck, 5 in 1984	Spawning and rearing habitat quantity and quality	Yes/No	No	While some habitat projects may continue to improve spawning/rearing downstream, they do not overlap with effects from Decline Thin. No cumulative effect increment
Off-channel habitats: Constant Channel, 0.2ac 1991; Hyachuck Pond Complex, 3 ponds, 4.5ac 1985, 1990; Tributary 1089, 330ft, gravels, 1998–1999	Spawning and rearing habitat quantity and quality	Yes/No	No	While some habitat projects may continue to improve spawning/rearing downstream, they do not overlap with effects from Decline Thin. No cumulative effect increment
Fish passage: Dutch Creek, 1998; Hyachuck Pond Complex (TK and Hyatrib)	Increase/improve access to spawning and rearing habitats	Yes/Yes	No	Lingering benefits of fish passage, though not measurable to the affected stocks. Decline does not affect spawning/rearing for these stocks, so no cumulative effect increment
Riparian: Tributary 1089 riparian planting, 2006; Dan Creek riparian treatment, late-1990s	Spawn/rear quality/quantity by improving future wood recruitment	Yes/Yes	No	Benefits of riparian treatments extend into the future as trees grow and recruit to the channel. Decline Thin would not affect wood recruitment to Dan Creek (unlikely transport pathway) or to Tributary 1089; no cumulative effect increment

Stream/riparian exclusion: Tributary 1089 (stock exclosure), Murphy Ck (vehicle barriers)	Prevent bank and inchannel degradation	Yes/No	No	While there could be lingering beneficial effects of exclusion, Decline effects would not overlap with them because they are in a different area. No cumulative effect increment
Tributary 1089 riparian planting, 2007+	Spawn/rear quality/quantity by future wood recruitment	Yes/Yes	No	Any effects of Decline Thin to wood recruitment would not occur along lower tributary 1089; no cumulative effect increment
Tributary 1087 fish passage (private land)	Increase/improve access to spawning/rearing habitats in 1087; indirectly increase fish numbers	Yes/Yes-could happen same time and influence cutthroat	No-access Yes-fish numbers	Passage in lower 1087 and in Conn Creek would not affect the same areas. Conn Creek could incrementally increase resident cutthroat in upper Dan, which if passed downstream would join Sauk cutthroat, but with immeasurable effect; negligible cumulative effect increment
Smolt-stocking (annual for steelhead, others?) in Sauk	Directly increase fish numbers	Yes/No	No	While the timing of Decline may coincide with WDFW stocking, Decline is in the Dan subwatershed and also would not stock fish; no cumulative effect increment

The possible cumulative effects to hydrology and soils could also affect fish and fish habitats. The Hydrology and Soils Cumulative Effects section discusses the cumulative effects from projects influencing runoff and erosion processes. Effects from the Decline Thin Project on these processes are immeasurable and therefore negligible, even if they do overlap in both space and time. Past, present, and reasonably foreseeable projects considered for Hydrology and Soils are listed in Appendix C, Cumulative Effects Information, and in the Hydrology and Soils Cumulative Effects section.

Summary

The contribution of the Decline Thin Project alternatives would be negligible to the total cumulative effects to fish and fish habitats.

Forest Plan Consistency

All alternatives are consistent with the Forest Plan, as amended, Standards and Guidelines for fishery resources.

Project Record

This EA hereby incorporates by reference the Fisheries Specialist Report (40 CFR 1502.21). The Fisheries Specialist Report is located in the Project Record and contains the detailed data, Affected Environment, analysis, references, and technical documentation that the Fisheries Biologist relied upon to reach the conclusions in this EA.

Wildlife Environmental Consequences

Decline Thin wildlife issues are habitat related or disturbance concerns. Wildlife species included in the assessment are federally listed species of northern spotted owl, marbled murrelet, grizzly bear and gray wolf, and Regional Forester listed sensitive species of wolverine and Townsend's Big-eared bat (www.fs.fed.us/r6/sfpnw/issssp/). None of the proposed project area is within Designated Critical Habitat for the northern spotted owl, but a portion of the project area (approximately 180 acres) of the younger forest (40-year-old) is within Late Successional Reserves and is Designated Critical Habitat for the marbled murrelet.

The assessment considers Forest Plan Management Indicator Species (MIS) including pine marten, mountain goats, black-tailed deer (analyzed for cover/forage conditions), and pileated woodpeckers were reviewed in relation to snags and down wood.

Consequences were assessed for land birds, and species of concern (riparian species such as amphibians, mollusks and bats) from the Forest Plan, as amended (USDA Forest Service 1994) (http://web.or.blm.gov/records/ib/2004/ib-or-2004–106.htm).

Only the species and habitats listed above will be discussed further in this document. Based on review of available records of species observations, district files, and a lack of habitat, the following species were considered but found to not occur within or adjacent to the project area: lynx, Larch mountain salamander, Van Dyke's salamander, peregrine falcon, great gray owl, common loon, bald eagle and elk.

Threatened and Endangered Species

Informal Section 7 consultation on the Decline Thin Project was completed in August of 2007 with US Fish and Wildlife Service staff concurrence on the following effects calls. All action alternatives would result in *"no effect"* to lynx , northern spotted owl, gray wolf and bald eagles (delisted—August 2007) and would result in *"no effect"* to critical habitats designated for the recovery of the spotted owl and marbled murrelet.

All action alternatives would result in a *"not likely to adversely affect"* risk assessment for the following species federally listed as threatened or endangered: marbled murrelet and grizzly bear. With the proposed Decline Thin Project, there exists a potential for additions to grizzly bear core habitat that may be beneficial in the long term. There also exists a potential for noise disturbance to murrelets in one of the thinning units adjacent to old-growth forest (suitable nesting habitat). This potential disturbance has been consulted on with U.S. Fish and Wildlife Service (FWS) for conservation measures to minimize the potential impacts (See wildlife mitigation and effectiveness in Chapter 2).

The Biological Assessment prepared for consultation with FWS and the Biological Evaluation assessing impacts to the Regional Forester's Sensitive Species can be found in District files and Project Record at the Darrington Ranger District office.

Northern Spotted Owl and Spotted Owl Critical Habitat

While the project area proposed for thinning is not suitable nesting habitat, these forest stands do have structure that provides foraging and dispersal opportunities for spotted owls and barred owls.

The Sustainable Ecosystem Institute (SEI) report on the status of northern spotted owl reviewed information on spotted owl habitat associations (S.P. Courtney; J. A. Blakesley and others 2004). The SEI findings report that the owl's association with old forest structure is well understood and broadly confirmed. In parts of the northern spotted owl range, other forest components were found to be locally important, and forest stand heterogeneity (in some areas) were reported to favor demographic performance.

While there are old-growth western hemlock and Pacific silver fir forests adjacent to the project area, the closest historic location of spotted owls is approximately 1.0 mile west from the Decline Thin Project area in Dan Creek drainage, where a single spotted owl pair was detected during surveys in the 1990s of the Dan Creek and Decline Creek areas.

Within the project area, only barred owls were detected during surveys conducted in various years between 1991 and 2007. Given the history of barred owl detections, the project area is suspected as being occupied by barred owls verses spotted owls. Barred owls have been detected not only within the project area, but also within adjacent areas of Dan Creek and the Sauk River drainage, (both 0.5 mile to the north and south of the project area), and on Gold Mountain (2 to 3 miles to the west).

The SEI report (S.P. Courtney; J.A. Blakesley and others 2004) identified barred owls as a major threat in the evaluation of the status of the northern spotted owl and reported that there is some evidence of barred owl displacement of spotted owls, with barred owls using older forests as well as young forests. The SEI report found no evidence that fragmentation increases probability of barred owl invasion or predation of spotted owls (S.P. Courtney; J.A. Blakesley and others 2004, pp. 11–15 and 11–17).

Critical habitat: The analysis area is outside of any designated Critical Habitat Units (CHUs) for the spotted owl, with the closest CHU (WA-27) in upper Decline Creek, one mile to the east as part of the Suiattle Critical Habitat Unit. In 2007, the FWS announced a revised proposal for critical habitat designation for the northern spotted owl (Federal Register, June 12, 2007, p 32450). The FWS proposal could have implications for the role of the old forests and LSR system on National Forest System lands in continuing efforts to develop an effective spotted owl recovery strategy. (R.R. Pearson; K.B. Livezey 2007)

Alternative A—No Action

The No Action Alternative would have no direct effects to the northern spotted owl. This alternative would continue to meet spotted owl dispersal habitat conditions of 50 percent of the landscape with 40 percent canopy and 11-inch diameter at breast height (dbh) trees. Indirect effects of the No Action Alternative would be the retention of the landscape, with a high trees stocking in the 40-year-old stands, providing limited roosting cover or foraging potential. The roosting cover is limited due to tight canopy with little understory for prey species.

Tight canopy closure in this area has limited multi-storied canopy and understory vegetation development that would attract a prey base for spotted owls. A gradual increase in abundance and diversity of understory vegetation may not occur for 100 to 200 years without intervention (D.R. Tysell and A.B. Carey 2000). The 40-year-old densely stocked stands are projected to be on a trajectory of 175 years to reach old forest characteristics (USDA Forest Service 2001).

70-year-old stands: In these stands, nesting habitat would continue to be limited, with individual tree growth decreasing over time due to tree-to-tree competition. Large trees with

defect or snags for spotted owl nesting habitat would not be expected for another 100 years or more.

40-year-old stands: Retaining the tight canopy of the dense 40-year-old stands would limit roosting cover or foraging potential and provide. Tight canopy closure in this area limits multi-storied canopy and understory vegetation development that would attract a spotted owl's prey base. A gradual increase in abundance and diversity of understory vegetation may not occur for 100 to 200 years without intervention (D.R. Tysell and A.B. Carey, 2000).

The residual pockets of older forest in the landscape and adjacent old forest areas would retain potential spotted owl nesting and foraging habitat. It can be expected that owls would use these older stands and the second-growth stands as they mature in the next 50 years. No additional spotted owl nesting habitat is expected for the next 70 to 100 years.

Alternative B

70-year-old stands: In Alternative B, thinning the 70-year-old stands would result in the retention of a vigorous growth in tree diameter and height toward suitable nesting habitat. Nesting habitat would continue to be limited in the short term (next 50 years), but the dominant trees in the thinned stands would provide future nest sites as stands mature in 50 to 75 years. The 70-year-old stands proposed for thinning would be limited in scale and scope to 214 acres of Matrix land allocation, of which 14 acres are within Riparian Reserve. The thinning prescription for 70-year-old stands would proportionately provide a variety of tree species represented in the stand, with diverse sizes and canopy layers. Implementing Alternative B would also thin Riparian Reserve areas. This thinning treatment would promote heterogeneity of forest stands that would support a small prey base for spotted owls. It would also develop large diameter trees for future spotted owl nesting habitat, while retaining dispersal habitat cover. Heterogeneity in forests stands is encouraged with different pathways within and between stands.

40-year-old stands: Alternative B would be the same as the no action alternative for spotted owl habitat in the 40- year-old stands because no treatment is proposed for those stands at this time.

Seasonal restrictions are not required due to the detection of barred owls versus spotted owls within the project area and in the adjacent old forest, which means no additional mitigations for spotted owl are needed to minimize potential noise disturbances. During sap flow, thinning activities are typically suspended for the months of March and April to prevent impacts to residual trees. This restriction concurrently avoids noise disturbance during the spotted owl critical breeding period.

Alternative C

70-year-old stands Alternative C has similar effects as Alternative B in the 70-year-old stands, but differs by retaining an additional 10 percent canopy in the residual stand for a 70 percent canopy cover. This canopy retention is similar in effects to those described in Alternative B (60% canopy cover) for the spotted owl.

40-year-old stands: Alternative C differs from Alternative B with a thinning treatment of approximately 160 acres of the 40-year-old stand. There would be a beneficial indirect effect for future spotted owl habitat with reduction of stems in a densely stocked stand, which would promote diverse forest stand conditions and provide foraging and roosting habitat for spotted

owls. The thinning would reduce stand-stocking levels to levels conducive to developing older forest stands in 100 to 150 years (USDA Forest Service 2001 pp. 69–70).

In the 40-year-old stand, 130 of the thinned acres are within the Suiattle LSR 115. This LSR contains 41,850 acres with over 80 percent of the area comprised of old forest stands that contribute to potential nesting habitat for the spotted owl. Given the extent of older forest in LSR 115, Alternative B would not result in a short-term shift of owl use within the project or landscape scale.

The Forest-wide LSR assessment (USDA Forest Service 2001) recommended LSR 115 be a low priority for silvicultural treatment in comparison with other Forest LSRs. However, the assessment also identified potential treatments in the western portions of this LSR (Decline, Dan and Gravel Creeks) as being important for two reasons. 1) This area is isolated by Prairie Mountain from other suitable nesting habitat in rest of the LSR, and 2) it is located on the edge of the Prairie Mountain LSR. Improved stands conditions for spotted owl use may assist in owl dispersal and connectivity between the Prairie Mountain LSR (115) and the Finney Block (LSR 802). Reducing stems, especially in the intermediate and suppressed trees, would provide a more open stand with better dispersal conditions for the spotted owl both within the stand, and between LSRs. The improved stand conditions at the LSR edges would further promote conditions for spotted owl to fully utilize the stands and minimize dispersal distance between LSRs.

In the 40-year-old-old-stand, Alternative C would reduce stand stocking by removing numerous small diameter stems, thereby opening up the stand structure, which would provide better dispersal habitat. Alternative C would leave all thinned or girdled material on site. The addition of the heavy slash (see fuels discussion) would retard the understand growth for 7 to 10 years while material decays. Given this additional material on the forest floor, the reduction in stand stocking would only marginally enhance the development of multi-storied stands or understory vegetation that would be attractive to prey base species for spotted owls.

Alternative D

Alternative D would have effects similar to Alternative C with the thinning prescription for the 70- and 40-year-old stands. By reducing dense stocking levels, the thinned stands would be conducive to developing future old forest characteristics. Alternative D differs from Alternative C in the treatment of the thinned or cut material in the 40-year-old stands. In Alternative D, stems greater than 7 inches would be removed from the thinned stand, reducing the understory slash. This reduction in slash would enhance the development of multi-storied stands, and provide for the development of understory vegetation that would be attractive to prey base species for spotted owls.

Alternative D includes decommissioning of approximate 2.5 miles of Road 2430 and associated spur roads. This action would have no direct effects on the spotted owl, but would contribute over the long-term (Fifty to sixty years) to dispersal habitat. Once the road revegetates with trees filling in the road prism, an additional 10 acres of forested landscape would develop within LSR 115.

Northern Spotted Owl Cumulative Effects

Affected area: The analysis area for spotted owl cumulative effects is the 6th field watershed, concentrating on an area within 2 to 5 miles of the project area (high elevation topography above 5,000 ft was excluded). Appendix C is a list of past, present, and future projects within

the above analysis area and was reviewed for those projects with the potential for cumulative effects.

Cumulative effects considerations: The Sauk River and White Chuck River drainages were both reviewed for historic spotted owl centers, forest stand age, and past, present, and foreseeable projects. Four spotted owl use-circles and eleven barred owl detection sites were noted. All spotted owl sites were within old forest (>200 years of age).Commercially thinned stands are within the 50 to 70-year-old age class. While one of the barred owl detections was within old forests, the other 10 barred owl detection sites were in second-growth forests. Only barred owl detections (no spotted owls) were recorded in the second-growth stands of 50- to 70-year-olds of age. There is no indication that barred owls would leave the area following thinning treatments or other foreseeable projects.

Past actions and effects: Past timber harvests (from the 1920s to 1980s) clearcut suitable habitat, resulting in a change of suitable habitat within the Sauk River drainage as described in the Sauk River and Sauk River Forks Watershed Analysis (USDA Forest Service 1996). Because none of the action alternatives would result in a change in the stand year-of-origin, the proposed project would not measurably add to the residual effects from those actions, and therefore, would not contribute to the cumulative effects in the drainage. Since 1990, thinning of 2,200 acres of second-growth forests in the Sauk River drainage has resulted in a canopy cover and tree diameters, providing spotted owl dispersal habitat (50 percent of the landscape is forest stands with 40 percent canopy with an average tree diameter of 11-inch dbh).

Present action and effects: A current thinning sale in the 6th field watershed (Funnybone Timber Sale) provides canopy cover and trees diameters that meet spotted owl dispersal habitat. Road treatment would not change dispersal habitat conditions (see definition of dispersal habitat above).

Future actions and effects: There are no projects in the next 10 years that would result in changes to the old forests that meet the definition of northern spotted owl habitat. There are no known timber sales of old-growth forests on Federal, State or private timberland within the subwatershed of the Decline Thin Project. There are no known proposals for changes in dispersal habitat between Dan Creek and adjoining LSRs on State or private land.

There are an additional 400 to 500 acres of thinning planned by the Forest in the Dan Creek drainage within the next five years, which would add to the approximately 2,200 acres already thinned in the Sauk River drainage since 1990. The combined cumulative effects of thinning projects have resulted in a net increase in habitat conditions developing towards forest characteristics of nesting habitat within the next 50 to 100 years.

The recent past and foreseeable future forest management supports forest stand conditions (SEI report 2004) described to meet dispersal habitat in the second-growth forests. No planned projects would change old-growth forests with suitable nesting habitat. The 40-year-old stands would mature in the next 40 to 60 years, providing additional habitat (foraging, roosting, and dispersal habitat). No additional nesting habitat is expected for 100 to 175 years. Seventy-year stands will not provide nesting habitat for another 80 to 100 years.

Since the designation of the spotted owl as an endangered species, the trend in spotted owl habitat within the cumulative effects analysis area and within the Forest Service Pacific Northwest Region, there has been an increase in the maturity of forest acres, moving toward future nesting habitat. Habitat quality of designated conservation areas (within potentially suitable habitat zones) has also been increasing as previously harvested stands mature. The

cumulative effects of the projects within the analysis area are contributors to stand management, and toward desired habitat conditions for the northern spotted owl.

Marbled Murrelet and Murrelet Critical Habitat

The analysis area is the project area, located approximately 35 miles inland from saltwater. The second-growth forests within the project area do not meet established definitions of suitable murrelet nesting habitat. "All records of nests, eggs, eggshell fragments and downy chicks in Washington have been associated with old-growth forests." (General Technical Report PSW-GTR-152 1995, p. 170). While adjacent stands within 0.5 mile of proposed units have forest structure that would provide suitable murrelet nesting habitat, the closest historic murrelet detections are on Gold Mountain, approximately 1.5 mile to the west, with murrelet flight described at tree canopy level (Darrington Ranger District files). Murrelet detections in the Goodman Creek drainage five miles to the southwest are the closest historic murrelet detections with murrelet activity interpreted as being occupied nesting sites.

Two areas in the project vicinity (north of the 70-year-old stand and within the Riparian Reserve of Dan Creek) have been identified as suitable nesting habitat. These areas of older forest were identified on aerial photographs and verified with field reconnaissance. The proposed thinning units exclude the northern fringe of the 70-year-old stand from to avoid impacts to older trees that would provide potential nesting habitat and diversity of habitat. All of the alternatives retain the old-growth forest component that currently exists within the watershed.

Critical Habitat: Critical marbled murrelet habitat (WA-09-e, Federal register/Vol. 61:102) in the project area is coincidental with LSR #115. Within the project area, approximately 180 acres of 40-year-old stands are part of the Suiattle LSR 115 or are within marbled murrelet critical habitat. This LSR contain 41,850 acres with more than 80 percent of the LSR comprised of old-forest stands. Approximately 50 percent of the LSRA lies within the western hemlock zone, where habitat structure is most conducive to murrelet nesting. Of the western hemlock zone, 80 percent is in older forests, but much of this older forest in wilderness areas more than 40 miles from saltwater. Indirect impacts would be that the trajectory development of the 40-year-stands in the LSR would remain outside optimal stocking levels for stand development as per the empirical stocking and growth relationship modeled from Forest ecosystem plot data (USDA Forest Service 2001).

Alternative A—No Action

Implementing the No Action Alternative would have no direct effects on marbled murrelets. The indirect effect would be no change in current trajectory development of highly stocked forests of 40-year-old forest within critical habitat. Tight canopy closure in these stands has limited branching structure development, characterized as murrelet nesting habitat. Nesting habitat would continue to be limited, with growth development on individual trees decreasing over time due to tree-to-tree competition. Large trees with branch structure for marbled murrelet nesting are not expected for another 150 to 200 years or more. The residual older forest and adjacent areas would retain potential murrelet nesting platforms and may receive additional use, as the second-growth stands mature in the next 50 to 100 years, contributing to canopy height adjacent to suitable murrelet habitat.

Alternatives B

70-year-old stands: In the 70-year-old stands, nesting habitat would continue to be limited, but with stand thinning, growth development on individual trees would be retained over time, with less tree-to tree competition. Large trees with branching structure conducive to murrelet nesting habitat would not occur for another 100 years or more. Units' design eliminates the adjacent old forest where suitable murrelet nesting habitat would be retained and where there are mistletoe-infected trees that have large branching patterns. Thinning treatments are limited in scale and scope, with 214 acres of 70-year-old stands Matrix thinning and approximately 130 acres of 40-year-old thinning in the Suiattle Late Successional Reserve.

40-year-old stands: In Alternative B there would be no treatment of the 40-year-old stands so the indirect effect for the 40-year-old forest stands would be the same as described in the No Action Alternative above.

Critical habitat: There would be no thinning in the LSR so there is no change in Critical Habitat from Alternative A.

Riparian Reserve: Within the Riparian Reserve areas of the 70-year-stands, 10 acres would be thinned to provide a greater diversity of tree species and sizes, and canopy layers. Tight canopy closure in this area has limited the development of the branching structure characterized as murrelet nesting habitat. Thinning in the Riparian Reserve includes opening the stand to provide for the development of large diameter and larger lateral branches that are characteristic of more open-grown stands.

Mistletoe infested trees would be targeted for release from competition to promote the growth development of large lateral branches. Large trees with branch structure for murrelet nesting habitat are not expected for another 100 to 200 years or more. Platforms, a critical factor in defining suitable nesting habitat, correlated strongly with tree diameter. "In Washington forests, trees with diameters greater than 40 inches had a 50-percent or greater likelihood of having platforms." (USDA Forest Service 2005)

Mitigations: Potential noise disturbance in localized areas would be associated with thinning adjacent to suitable nesting habitat. Noise disturbance (Unit 4) would be mitigated with seasonal operating restrictions during the critical breeding period of April 1 through August 5, and daily operational restrictions would be in effect between August 6 and September 15.

Effects: Alternative B would retain 50 to 70 percent canopy cover in the residual stand. This cover meets values reported for high-probability murrelet use sites of a minimum value of 29 percent canopy closure and a mean 83 percent canopy closure (General Technical Report PSW-GTR-152, 1995 p. 170), this alternative would have no direct effect on murrelet use in the Dan Creek drainage. Indirect effects are limited to the 14 acres of Riparian Reserve thinning providing long-term management for habitat characteristics used by nesting murrelets. Due to the limited scale and scope of acres treated, this alternative would not change murrelet use in the watershed.

Alternative C

70-year-old stands: Alternative C thinning effects would be similar to Alternative B.

40-year-old stands: Alternative C differs from Alternative B, because it includes proposed thinning of the 40-year-old stand to reduce tree stocking within the LSR, providing critical habitat for the marbled murrelet. Reduced stocking levels of trees per acre are modeled to

promote growth of fewer residual trees resulting in large diameter trees with more pronounced crowns and developed lateral branches (USDA Forest service, 2001).

Riparian Reserve: Within the Riparian Reserve areas of the 70-year-stands, 10 acres would be thinned to provide a greater diversity of tree species and sizes, and canopy layers as in Alternative B. In Alternative C, there are 4 acres in the Riparian Reserve of the 40-year-stand that would be thinned. These stands with 800 trees per acre (1.0 inch dbh and above) provide a tight canopy closure that has limited the development of the branching structure characterized as murrelet nesting habitat. Thinning in the Riparian Reserve includes opening the stand to provide for the development of large diameter and larger lateral branches that are characteristic of more open-grown stands.

Critical Habitat: Alternative C would thin approximately 130 acres of LSR that would promote desired habitat characteristics for marbled murrelet critical habitat, opening the stand to provide development of large diameter trees and larger lateral branches that are characteristic of more open-grown stands.

Effects: Alternative C would have an indirect effect on future murrelet habitat by adjusting stocking levels of the 40-year-old stands. Thinning would shift the trajectory development of densely stocked second-growth forests within critical habitat to levels within the modeled range, of optimal spacing for stand development (see Figures III-1 to III-3 in USDA Forest Service 2001). Tight canopy closure in these stands has limited the development of the branching structure characterized as murrelet nesting habitat.

Nesting habitat would continue to be limited, although the retained individual trees would slowly develop, and tree-to-tree competition would decrease. Large trees with branch structure for marbled murrelet nesting would occur in approximately 175 years or more. The residual older forest in the landscape and adjacent areas would retain potential murrelet nesting platforms, and may provide additional use as the second-growth stands mature in the next 50 to 100 years, contributing to canopy height adjacent to suitable murrelet habitat.

Alternative D

Alternative D would have similar direct and indirect effects for marbled murrelets as described in Alternative C for the thinned 70-year-old stands, with 10 acres of Riparian Reserve thinning and the 40-year-old stands, with 4 acres of Riparian Reserve thinning. The effects for murrelet critical habitat would be the same as Alternative C. In Alternative D, approximately 2.5 miles of road would be decommissioned on the upper Road 2430 and associated spur roads. The long- term (fifty to sixty years) revegetation in tree cover of the road surface would have little or no benefits to murrelets due to the road's location within the Pacific silver fir and lower mountain hemlock zone, which provides marginal habitat for nesting murrelets.

Marbled Murrelet and Critical Habitat Cumulative Effects

Cumulative effects analysis area: The cumulative effects analysis area for the marbled murrelet was the project area in conjunction with Critical Habitat Area WA-09-e (Federal Register, Vol61, No. 102)

Past actions and effects: Past timber harvest from the 1920s to 1980s, that clearcut suitable habitat has resulted in a change of suitable habitat within the Sauk River drainage and is described in the Sauk River and Sauk River Forks Watershed Analysis (USDA Forest Service 1996). Because the project would not change stand year-of-origin for past harvest, none of the action alternatives associated with the proposed project were found to not measurably add to

the residual effects from those actions, or contribute to the cumulative effects in the analysis area.

Present action and effects: A current thinning sale in the 6th field watershed (Funnybone Timber Sale) includes in riparian area thinning to reduce stocking levels to contribute toward developing stand characteristics for future nesting habitat. Road maintenance and road treatments in the analysis area would not result in a change in murrelet habitat, and have no cumulative effects on marbled murrelets or critical habitat.

Future actions and effects: In the foreseeable future, there are plans to thin 400 to 500 acres in Dan Creek drainage, which is supportive of forest stand conditions described in recent monitoring reports (USDA Forest Service 2005). Reducing stocking in dense second-growth stands would contribute to promoting future nesting habitat for the marbled murrelet. No projects are planned in old-growth forests with suitable nesting habitat, and there would be no change or effects to murrelet critical habitat.

Within the 6th field and the Forest Service Pacific Northwest Region, the trend in murrelet habitat since designation as an endangered species, has been an increased in the maturity of forest acres toward future nesting habitat. Habitat quality within designated areas (within potentially suitable habitat zones) has been increasing as previously harvested stands mature. The cumulative effects for marbled murrelets, and critical habitat units within the analysis area, would be a minor shift in improved quality of future nesting habitat. This is based on the limited amount of riparian areas and the LSR area that has been thinned or projected to be thinned, so there are limited contributions to habitat enhancements in murrelet critical habitat

Bald Eagle—Delisted August 8, 2007

There are no known or historic eagle nest sites; and there are no known or historic bald eagle night roosts within the project analysis area of the upper Dan Creek drainage. This species will not be further discussed in this document.

Grizzly Bear and Gray Wolf

While no sightings, historic or present, have been reported for this area, the project area is within a greater analysis area of the North Cascades Grizzly Bear Recovery Zone, and for this project is within Grizzly Bear Management Unit (BMU) #11, the Prairie Mountain BMU (Figure 29). This BMU encompasses 90,000 acres, of which approximately 72 percent is Federally managed land. Core habitat (0.3 mile from open roads or high use trails) on Federal lands, comprises 44 percent of the BMU in the early season and 40 percent in the late season (at least 55 percent core habitat in a BMU is considered desirable by the Interagency Grizzly Bear Committee [IGBC 2001]). Core habitat is considered important for security for bears away from roads and associated human activity (including illegal take); bears are also more likely to use habitat in these areas (USDI 1997b). Effects were identified by potential impacts to core habitat acres/percentage by open road density impacts and patch size within core habitat. Figure 29 displays core habitat changes associated with each alternative.

Connectivity of the Prairie BMU with other portions of the recovery zone may be influenced by road systems that encircle this area, but much of the road system is gravel roads, found to have limited influence. The threshold for roads becoming barriers to grizzly bear movements is reported to be 2,400 vehicles per day or about 100 vehicles per hour (Waller and Servheen, 2005). The maximum expected motor vehicle use of the roads in the area would be considerably less than this threshold, based on the area's popular trailhead records.

Figure 29 Grizzly Bear Management Units

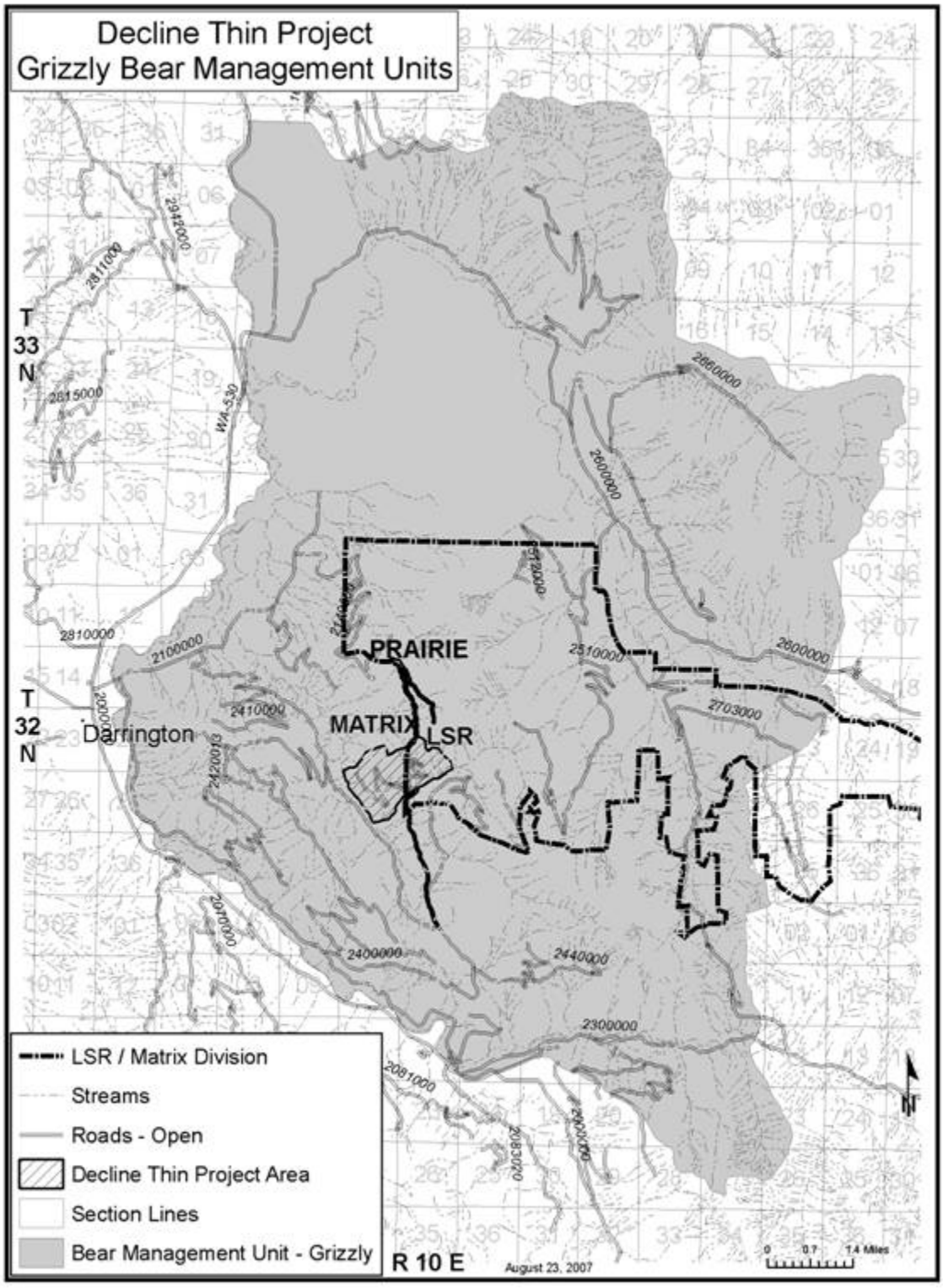


Table 13. Grizzly Bear Habitat by Alternative

	Alternative			
Habitat Changes	**A (No Action)**	**B**	**C**	**D**
Open Road Mileage changes	Road 2430 left to grow in (2.5 mi.)	Road 2430 left to grow in (2.5 mi.)	Road 2430 left to grow in (2.5 mi.)	Road 2430 decommissioned (2.5 mi.)
	2430014-drivable waterbars	2430014-close after thinning (0.6 mi.)	2430014-close after thinning (0.6 mi.)	2430014-close after thinning (0.6 mi.)
	2430016-closed	2430016-no change	2430016-no change	2430016-treat and close after thinning
	2430017-closed	2430017-no change	2430017-no change	2430017-treat and close after thinning
	2432-open	2432- close after thinning (1.9 mi.)	2432- close after thinning (1.9 mi.)	2432- close after thinning (1.9 mi.)
Short-term change of core habitat	0	0 acres	-48 acres	-48acres
Total core acres gain from project	0	+185 acres	+185 acres	+453 acres

Alternative A—No Action

The low percent of core habitat (43.3% early core and 39.3% late core) within this BMU reflects the high road density of a Matrix area managed for timber, and in the BMUs proximity to State and private land adjacent to the town of Darrington (6 linear miles). Early and late season foraging habitat within core habitat is present within the project area and towards Prairie Mountain, two miles to the east, where natural openings provide a variety of forbs and vegetative material.

There would be no change in current access, thereby, no change in core habitat areas. There would be no change in vegetation status, so there would be no change in forage within the area. Limited grizzly bear foraging opportunities in natural openings of Prairie Mountain would remain in the current state. Limited forage for ungulates would also limit the associated prey availability for wolves.

Alternatives B and C

Alternatives B and C would use the same road systems for thinning treatments, and would have the same impacts to core habitat caused by thinning. Temporary roads (approximately 4,700 feet) for harvest access in the project area would be located within the currently open roads zone (Roads 2430, 2432, and 2430014). All temporary roads and Road 2432 and 2430014 would be closed following the timber sale. These road closures provide along-term addition of 185 core acres to BMU #11 (Prairie Mountain).

The addition of 185 acres would be less than 0.5 percent and would not change early core habitat from 43% or late core habitat of 40% in the BMU. The Interagency Grizzly Bear Committee (IGBC white paper, 2000) has recommended a 55 percent core area for BMUs along the

periphery of the recovery area, and a 70 percent core area for interior BMUs. The project provides additional core habitat acres, but does not add sufficient acres to meet the desired minimum of 55 percent early core area.

There would be a short-term (1 to 2 seasons) increase in human access (timber sale operators) during sale operation within the project area. Current policy is to limit public traffic in active timber harvest areas due to safety concerns, and to have the operator close temporary roads (water bars, berm, or as specified in the contract) as the thinning is completed in order to meet best management practices, and to accomplish the road treatments in a timely fashion. While the roads are open for haul during the sale operations, operators frequently post guards to limit traffic into areas with equipment due to possible vandalism to equipment or impacts to the sale area that the operator could be responsible for such as litter.

Impacts to wildlife would include a temporary displacement of use of the area during the sale operations, typically 1 to 2 seasons. Given the surrounding areas of similar habitat (second-growth) where no harvest activity would take place, there is no effect expected from temporary road or timber sale activities to high mobility species, such as bears.

Following road closure (1 to 3 years), bears would use road corridors for travel, foraging, and bedding, and as the roads grow in. The temporary road would become less attractive for wildlife, as the road grows in. This situation was observed along the Road 2430022 system where wildlife trails avoided the road grown in with willow and a 20 to 30 foot tall tangle of conifers; game trails were found in the adjacent timbered areas or road slopes.

Alternative D

Alternative D would have the same impacts as Alternative B and C as far as the thinning in the 70-year-old stand with closing Roads 2432 and 2430014 following timber harvest activities. Alternative D differs from B and C, where 0.2 mile of Roads 2430016 and 2430017 would be opened, and then close the roads following thinning and road treatments. Alternative D would remove culverts and pull sidecast fill on the upper 2.5 miles of Road 2430 in order to decommission that road. While Road 2430 has grown in with trees, the decommissioning of 2.5 miles of Road 2430 would add 268 acres to the of core habitat database for the Prairie Mountain BMU, for a total of 453 acres of core habitat.

Mitigation for the short-term net loss of core habitat while working on Roads 2430016, 2430017 and the upper end of Road 2430 is accounted for in the 2005 Sauk Road Restoration project (see Appendix C) that closed Roads 2400015 and 2411000. Road 2430 is currently closed with a berm at 6.2 mile post, but there are culverts and sidecast fill beyond the berm proposed in Alternative D for removal as part of the decommissioning of the road. Spur roads 2430016 and 2430017 were identified for hydrologic treatment before leaving the roads in a storage status.

Grizzly Bear and Gray Wolf Cumulative Effects

Cumulative effects analysis area: For this project, the grizzly bear cumulative effects area review uses the analysis area of the project area with the area encompassed by BMU #11. Appendix C was reviewed for projects within the vicinity that had the potential for cumulative effects. The timeline of effects would be the inclusion of other past, present or reasonably foreseeable project that have or could result in a net change in core habitat with BMU #11.

Past actions and effects: This included the 2004–2005 Sauk Road Restoration treatments project. The Sauk Road restoration project (See Appendix C) provided an additional 1,729 acres of core habitat by either decommissioning or placing in storage up to four miles of road (ML 1 storage—closed to motorized access).

Current actions and effects: All current projects assessed (Appendix C) would result in no net change in bear management core acres.

Future actions and effects: An additional 400 to 500 acres of thinning is projected in the Dan Creek area, which would cause no net loss of core habitat. This project would be located in the roaded portions of Gold Mountain, already influenced by current open road density.

Core acres added under Alternatives B and C (185 acres) plus Sauk Roads Treatment (1,729 acres) would cumulatively increase core acres within BMU #11 by 1,914 acres or an additional 2 percent. Alternative D would add 453 acres plus Sauk Roads Treatment (1,729 acres), cumulatively increasing core acres within BMU #11 by 2,182 acres or an additional 2.5 percent core habitat in BMU #11. Cumulatively, there is a slight increase in the core acres where there is less potential of human disturbance for grizzly bear.

Regional Forester's Sensitive Species

The Forest's terrestrial wildlife species, from the Regional Forester's Sensitive Species list, and those not currently federally listed or proposed under the Endangered Species Act, are Larch Mountain salamander, VanDyke's salamander, common loon, peregrine falcon, Townsend's big-eared bat, great gray owl, and wolverine.

Habitat for loon (large lakes), peregrine falcon (cliff nesting area with nearby sufficient prey base), great gray owl (open forest/meadows) and Larch Mountain and VanDyke's salamanders (range south of Highway 2) is not present within or near the proposed project area There would be no impacts to these species with any of the alternatives. These species will not be discussed further in this document.

Wolverine

Wolverine is a rare carnivore, widespread in geographic distribution, but present in low-densities. Given the wide-ranging characteristics of this species, it may be present within the analysis area of the 6th field watershed. The primary mortality factor for wolverine is by trapping, consequently large refugia may be one of the best means for ensuring persistence of wolverine populations. The wolverine is generally described as opportunistic in feeding, and activities that increase availability of general food supply would affect wolverine positively, whereas those activities that reduce prey populations would affect wolverine negatively. The lack of extensive knowledge about wolverine habitat and ecology, leads to the use of conservation strategies for other large carnivores to provide for wolverine (Ruggiero and others 1994).

Effects Common to All Alternatives

Wolverines are generally found in upper elevations and remote areas with little human activity, but have also been recorded as dispersing or moving through lower-elevation areas. Wolverine could benefit from additional areas with fewer vehicles, less human access (mortality) and more prey. The addition of core habitat discussed for grizzly bear would also apply for wolverine with all action alternatives adding additional core habitat (see grizzly bear discussion above). Alternatives B, C, and D have reduction in the canopy cover promoting limited understory

development that would provide short-term forage for ungulates. This could have localized increase in the deer population, a wolverine prey-base, and a slight potential for additional forage for wolverine.

Wolverine Cumulative Effects

For this project, BMU #11 was used as the wolverine analysis area of cumulative effects. The cumulative effects for wolverine are as described in the grizzly bear and gray wolf discussions above. The timeline of effects includes other past, present, or reasonably foreseeable projects (Appendix C) that have or could result in a net change in core habitat with BMU #11. Other than the Sauk Road Treatments (past action) and the Dan Creek Thin (future action), there are currently no other past, present, or foreseeable projects that have or would result in a net change to core habitat within BMU #11. Cumulatively, there would be a slight increase in the core acres where there is less potential of human disturbance for wolverine.

Townsend's Big-Eared Bat

This species is strongly associated with caves or cave-like structures for winter hibernacula and nursery sites. Townsend's big-eared bats have been documented on the MBS in roosts on the underside of bridges and in a barn, and are associated with caves and mines. For the Decline Thin Project, the analysis area for this species is the 6th field watershed, which contains no known caves, mines or buildings used as maternal roosting sites. There are also no known day or night roost sites in the 6th field watershed, but the bats have been found under bridges on the District. The project area provides suitable foraging habitat; these bats are known to use both forested and non-forested areas, in both arid and moist regions of the Pacific Northwest (Nagorsen and Brigham 1993).

Effects Common to All Alternatives

All alternatives would maintain potential roost areas in old forests. There would be no changes in caves, or potential roost sites in buildings or bridges.

Townsend's Big-Eared Bat Cumulative Effects

Cumulative effects analysis area: The Appendix C list was reviewed for projects within the 6th field watershed of Dan Creek for potential cumulative effects.

Considerations: This species population distribution is suspected to be controlled by maternal roost site availability found primarily in caves, buildings or bridges. Foraging habitat includes a wide variety of conditions so is not considered a limiting factor to the species use of a particular area.

Past actions and effects: Timber harvest of more than 129,000 acres in the mid-Sauk drainages in NFS lands since 1900 has modified foraging habitat for this species but has not affected the availability of maternal roost sites (caves, buildings, or bridges). There are no other past activities known to have impacted maternal roost sites.

Present actions and effects: Road and stand management associated with Dan Creek and Funnybone Timber Sale would not affect the availability of maternal roost sites. Foraging habitat that includes a wide variety of forest conditions would be maintained.

Future actions and effects: The Dan Creek thinning project is proposed in second-growth timber, and would not affect the availability of maternal roosts and foraging habitat.

Cumulatively, because foraging habitat is not limiting and maternal roost sites are not known to have been affected by past, proposed, and foreseeable projects, there are no known cumulative effects to the Townsend's Big-eared bat's use of this analysis area.

Management Indicator Species (MIS)

Habitats for the MBS Forest "indicator" species of mountain goats, pileated woodpecker and pine marten, are expected to be maintained with implementation of any of the alternatives.

Black-Tailed Deer—Large Game Cover/Forage

The project was assessed for deer cover and forage within the Dan Creek 6th field (Dan Creek, Decline Creek, and Conn Creek). There is no Forest designated large game winter range (MA-14) within the project area or this analysis area, and the snow deposition in the project area deters heavy winter use by ungulates.

Ungulate cover and forage review was based on age of stands, canopy closure, and contributions to potential forage throughout the year. Forest Plan standard and guidelines (USDA Forest Service 1990) described desired forest conditions for deer as: 10 to 20 percent of the landscape in forage (1–20 years old forest vegetation), 40 to 45 percent thermal or hiding cover (21–-90 years-old forest vegetation), and 37 to 45 percent optimal cover (90 plus years of forest age). More recently, the influence of forest canopy closure on forage has been re-assessed with studies from westside forests, in which forage value was ranked by Cook and others (1998, 2003). Based on amount of forage (kg/ha), and digestibility (%), a study on Baker Lake basin elk habitat (Tressler, R. for Puget Sound Energy 2003) forage ranked as "good," only when the canopy cover was 0–20 percent (compared to 60–100 percent cover in the project area.) With the current Forest emphasis on older forests (Forest Plan, as amended), there is little opportunity to meet desired forage goals outside of very localized areas such as timber management Matrix area.

The Dan Creek drainage (Dan, Decline, and Conn Creek subwatersheds,) along with adjacent Everett and Gravel Creek subwatersheds have a history of timber harvest, resulting in approximately 62 percent of the area logged during the last 80 years (USDA Forest Service 1996). Currently, much of the forest stands in this area are in the 65 to70-year-old stand age class, with a high percentage of canopy closure (over 80 %). This provides hiding and thermal cover, but limited understory development for forage. Forage areas are found on the upper slopes of Prairie Mountain in natural openings, and where past harvested areas still have openings in the canopy. Table 14 shows overall changes in cover and forage for each alternative.

Table 14. Cover/Forage Adjustments by Alternative

Habitat Component	Alternative			
	A No Action	B	C	D
Forage (canopy 0–-20%)	No change	Landings/edges <10 acres	Landings/edges/gaps Slash—Units 10–13 10-15 acres	Landings/edges/gaps Open—Units 10–13, 10-15 acres Road 2430 decommission 20 acres
Cover(canopy >21%)	No change	-10 acres	-10-15 acres	-20-35 acres
Non-forest	No change	No change	No change	No change

Alternative A—No Action

The No Action Alternative would result in no change in the current cover or forage for large game. There would continue to be cover, but very limited forage for ungulates.

Effects Common to All Action Alternatives

All of the proposed alternatives would provide adequate cover, both thermal and hiding, but would lack adequate forage for more than localized populations of deer. The thinning prescription would retain forest stands with approximately 50 to 95 percent canopy cover across the landscape, so there would be no impact to thermal cover, and little forage development.

Alternative C and D

Both of these alternatives include thinning treatment in the 40-year-old stands with a prescription of skips (no thinning) and gaps (small openings). With the gaps limited to 0.25 to 0.5-acre openings in approximately 160-acre area, there would be little contribution to forage. These openings are so limited in scale and scope that there are no impacts to thermal cover within the Dan Creek drainage. While there are no studies of black-tailed deer in the immediate area, female summer home range size in Alaska is reported as less than 0.5 square miles (McCorquodale 1999). The small pocket openings from the skips and gaps prescription may increase habitat diversity within 160 acre area, but this represents a very limited opportunity for increases in forage. Any increases in forage potential would be very modest, and increases in deer populations would be limited to localized home range of few animals.

Black-tailed Deer—Large Game Cover and Forage Cumulative Effects

Cumulative effects analysis area: The deer cover and forage cumulative effects analysis area was the Dan Creek 6th field watershed (Dan Creek, Decline Creek, and Conn Creek).

Past actions and effects: Timber harvest on more than 129,000 acres in the mid-Sauk drainages of NSF lands since 1900 has modified foraging habitat increasingly for a period of 1–30 years, followed by an extended period of canopy closure with little understory and little forage. This would have provide for a boom or increase in the black-tail deer population with available forage available and the current bust or limited deer population related to little understory forage in the second-growth stands of 40- to 70-years-of-age.

Past thinning sales are within the adjacent areas analyzed for deer cover and forage. Wishbone, Rib, and Too Thin Timber Sales had portions of the sale areas with 50 to 60 percent canopy retention, and additional forage was created within a portion of the drainage. Increases in forage potential were limited in scope, and increases in deer populations were expected to be localized.

Present Actions and Effects: The road management in Dan Creek and the Funnybone Timber Sale would have slight impacts on the deer populations, based on forage being the limiting factor for deer populations. Foraging habitat that develops in canopy conditions of less than 20 percent canopy would be limited to the gaps created in thinning projects and represents a very small portion of the 6th field watershed.

Future actions and effects: The Dan Creek Thin project is proposed in second-growth timber and would have the potential to provide limited development of understory vegetation for 5 to 10 years until there is canopy closure.

Cumulatively, there would be small, localized changes in cover and forage within the drainage, but those changes are not expected to result in major changes in deer population habitat conditions or more than localized effects on deer numbers. Cumulative effects from recent past, present, or future projects when reviewed with the changes in cover and forage identified with the Decline Thin Project are expected to be limited to local area, and have little impact on current deer populations.

Mountain Goats

Although the project analysis area itself is not mountain goat habitat, Prairie Mountain and White Chuck Mountain (2 to 4 miles mile east of analysis area, respectively) were part of the mountain goat analysis area. These areas provides known mountain goat habitat with steep broken slopes, rock outcrops, and escape terrain from the lower forested slopes to the upland heather meadows. Areas identified in the 1990 Forest Plan as winter range management area for mountain goat are displayed in the merged land allocation maps (see Figure 4 in Chapter 2).

Early counts of mountain goats in this area are from diary narratives of Art Ryals, a former Forest Service employee and local hunter and trapper (USDA Forest Service 1996). Ryals' accounts of Prairie Mountain start in 1976, with 16 goats counted on the All Creek side of Prairie Mountain in the Suiattle River drainage. By 1990, his goat counts had decreased to 10 animals in the Prairie Mountain area, no goats in the upper Decline Creek drainage, and limited evidence of goats on the ridge between Prairie Mountain and White Chuck Mountain. In the mid 1990s, the Washington Department of Fish and Wildlife performed helicopter surveys of the Darrington area, with no detections of mountain goats on Prairie Mountain. Ryals' counts of mountain goats on White Chuck Mountain started in 1976 with a high of 57 goats, but counts plummeted to only 8 animals recorded in 1990. Since then, joint agency and Tribal studies from 2001 through 2006 have recorded 10 to 14 animals in the White Chuck Mountain area.

Effects Common to All Alternatives

Mountain goats use of the proposed project area would be minimal due to the lack of escape terrain. The project area lacks the rocky outcrops more common in the upslope habitat of Prairie Mountain. None of the alternatives would directly affect mountain goats or the current travel routes or forage conditions.

Alternatives A, B and C

These alternatives would retain the berm on Road 2430 that currently limits vehicle traffic on the upper portion of Road 2430. The indirect effect of this would be to minimize vehicular traffic and human access into upper elevation areas that may include use by the mountain goats.

Alternative D

Alternative D includes decommissioning approximately 2.5 miles of the upper portion of Road 2430 with associated spur roads on the slopes of Prairie Mountain. Historically there were reports of goats in the Prairie Mountain area, with connecting travel routes to White Chuck Mountain. Road 2430 accesses a portion of the historic Prairie Mountain range. The indirect effect would be a potential benefit to goats from lack of human disturbance when Road 2430 is decommissioned. In the short-term, the road decommissioning would reopen the area to potential foot traffic, but over the next 10 to 20 years, the road would grow in and become a less desirable travel path.

Mountain Goat Cumulative Effects

Cumulative effects analysis area: Appendix C was reviewed for projects that had the potential for cumulative effects for the mountain goat analysis area of the 6th field watershed and adjoining Forest Plan management areas for mountain goat winter range on Prairie and White Chuck Mountains.

Past actions and effects: Timber harvest in the Dan, Decline, and Conn Creek drainages of NFS land since the 1960s increased roads into mountain goat habitat during a time when the State had open hunting season in the area for mountain goats. The access provided by timber harvest roads would likely influenced hunting patterns, and potential take of mountain goats in the area. Since timber harvest was limited to mostly the western hemlock and Pacific silver fir zone, and avoided steep rocky areas, timber harvest direct impacts to mountain habitat was limited.
Present actions and effects: The road management in Dan Creek and the Funnybone Timber Sale would have no impacts on access to mountain goat habitat or on mountain goat habitat.

Note: The Decline Thin Project Silvicultural Prescription will be finalized following the Preliminary EA 30-day comment period. The monitoring plan will be updated at that time.

The Dan Creek Thin project is proposed in second-growth timber on mostly open road systems, and at an elevation not used by mountain goats in the analysis area. The road projects would not change the access to mountain goat areas.

Cumulatively, there would be no direct impact to mountain goat travel routes or forage conditions. The Decline Thin Project would have the potential to limit human disturbance factors (currently the area is not open to hunting) in the long-term, as the upper 2430 road revegetates to forest cover following decommissioning. Because other projects identified in the cumulative effects analysis would not impact mountain goats or their habitat, there would be no additional cumulative effects than disclosed with the Decline Thin Project.

Pine Marten

Pine marten may occur in area of the 6th field watershed analysis area. The higher quality habitat occurs in adjacent old-growth stands in the Pacific silver fir and mountain hemlock forest zones, than in the younger aged second-growth. Marten may use mid-seral stands for foraging or dispersing, so the upper elevation areas of the Decline Thin Project area would provide habitat for marten. Prey abundance and adequate cover may influence marten use of the area.

Effects Common to All Alternatives

All alternatives would maintain the suitable habitat currently identified as potential pine marten habitat. The proposed activities would provide variety in the habitat conditions for marten hunting in the thinned second-growth forest, but would not reduce forage potential or cover in the short-term (next 10 years).

Alternatives C and D

An additional 160 acres of mixed western hemlock and Pacific silver fir second-growth stands would be modified in the short-term (10 years). Thinned areas may provide additional habitat for mice and small prey, and would retain the down wood component for cover for subnivean (under-snow) hunting. In the long-term (50 plus years) stand treatment could benefit marten by promoting stand diversity and structure suitable for denning habitat (mature and older forest).

Since marten habitat is associated with the Pacific silver fir zone, and the majority of the project (80%) is within the western hemlock zone, the habitat changes with any of the action alternatives would not be expected to impact marten populations. Alternatives C and D would benefit pine marten habitat in the long-term with future large diameter tree development.

Pine Marten Cumulative Effects

Cumulative effects analysis area: Appendix C was reviewed for projects that had the potential for cumulative effects for the pine marten analysis area of the 6th field watershed.

Considerations: Since the pine marten was trapped for its fur, the cumulative effects for the pine marten are similar to those disclosed for the mountain goat above where the indirect effect of road access associated with timber harvest would likely have influenced trapping of this species.

Past actions and effects: Timber harvest in the Dan, Decline, and Conn Creek drainages of NFS land since the 1960s increased roads into the upper slopes of Prairie Mountain in the Pacific silver fir and mountain hemlock forest zones. The access provided by timber harvest roads likely influenced trapping patterns and potential takes of pine marten in the area. Timber harvesting would have reduced foraging and denning habitat within 300 to 400 acres of old forest of the 6th field watershed. Since the amount of timber harvest was limited in the Pacific silver fir zone, the change in denning and foraging habitat for the pine marten was limited in scale and scope.
Present actions and effects: The road and stand management in Dan Creek and the Funnybone Timber Sale are not within forest zones primarily used by pine marten.

Future actions and effects: The Dan Creek Thin project is proposed in second-growth timber on mostly open road systems, and at an elevation not typically used by pine marten in the analysis area.

Cumulatively, there would have been loss of limited foraging and denning habitat for the pine marten in the upper elevation of the 6th field watershed, with increase access to pine marten habitat for trapping. The Decline Thin Project would have the potential to limit human disturbance factors, as the upper 2430 road revegetates to forest cover following decommissioning. Because other projects identified in the cumulative effects analysis would not impact pine marten or its habitat, there would be no additional cumulative effects than disclosed with the Decline Thin Project.

Pileated Woodpecker and other Cavity Nesters

In timber emphasis areas (Matrix), the Forest Plan, as amended, requires that the Forest retain snags across the landscape at levels sufficient to support major westside Cascade cavity nesting birds at 40 percent of potential population levels, using guides from the Management of Wildlife and Fish Habitats in Forests of Western Oregon and Washington (Brown 1985). Since the 1990s, there has been additional information on cavity nesters habitat needs on a landscape scale, and the development of the DecAID advisory tool for evaluating species uses of snags and down wood (Mellen and others 2006). DecAID is a computer-based summary of current knowledge and available data on dead wood in the Pacific Northwest ecosystems that can help managers assess effects of forest conditions and existing or proposed management activities. http:///wwwnotes.fs.fed.us:81/pnw/DecAID/DecAID.nsf.

The Decline Thin Project is located within a 5th field watershed with more than 50 percent of the NFS land in older forests, but more than 50 percent of the total forested area (which includes

State and private lands in the lower Sauk River) have previously been logged. The project area on a Forest landscape scale, is within an area with sufficient large diameter snags to meet both the Forest Plan, as amended, 40 percent desired snag levels for woodpeckers' foraging and nesting needs. The combination of second-growth and old forest, provides snags in sufficient size and numbers (more than 8 trees per acre >20 inches dbh) to provide for snag habitat, meeting the Forest cavity nesters needs at the 50 percent tolerance level for snag densities (See DecAID Key below)as described in the DecAID advisor. However, snag patches are not uniformly distributed across the landscape, and areas will vary from the snag densities listed in example table.

Table 15. Examples of snag densities and coarse woody debris levels under the 80%, 50% and 30% tolerance levels.

Defined in the DecAID Advisor Tool for unharvested plots in the Westside lowland conifer-hardwood forest of Western Washington Cascades (Mellen and others 2006).

Tolerance Level	Snag Density for Unharvested Forest Plots	Coarse Woody Debris Cover
80%	36.4/acre ≥ 10" dbh (with at least 15/ac ≥ 20" dbh)	19% cover (all decay classes) with a mix of sizes (12—20" diam. and with some pieces between 24 and 32 " diameter)
50%	18.6/acre ≥ 10" dbh (with at least 8.1/ac ≥ 20" dbh)	11% cover (all decay classes) with a mix of sizes (8—12" diam. and with some pieces greater than 20" diameter)
30%	5.3/acre ≥ 10" dbh (with at least 4.8/acre ≥ 20" dbh)	6% cover (all decay classes) with a mix of sizes (8—12" diam. and with some pieces up to 16" diameter)

DecAID Key:

Tolerance interval—the range of values that represent a specific proportion or percentage of some sample or population (such as a 30%, 50%, or 80% tolerance interval), at a given level of confidence such as 95% or 90% confidence.

Tolerance level (limit)—the specific value at the edge of a tolerance interval. For example, if a 30% tolerance level of snag dbh used by wildlife species in a specific vegetation condition is, say, 40 cm, this means that 30% of all individuals of the wildlife populations used less than or equal to that size snag. An 80% tolerance level would correspond to 80% of the individuals using that corresponding size snag. A 100% tolerance level means all of the individuals would use that size snag (100% tolerance intervals correspond to the maximum observed values, such as the largest dbh snag observed to be used by a wildlife species).

Confidence interval—the range of values within which the average or mean value of some additional (or future) statistical sample of a population would occur, at a given level of confidence such as 95% or 90% confidence. The DecAID Advisor uses tolerance intervals instead of confidence intervals, because management questions pertain to wanting to know what percent of a wildlife population is afforded by particular sizes or amounts of snags and down wood, not what some future mean value would be.

The project is in a 6th field watershed where 62 percent of the area has been previously harvested, and is currently within a Forest allocation designated for timber management. The DecAID advisor acknowledges that timber management is likely to contribute to snag densities at lower levels (30% to 50% tolerance level), rather than the 80 percent level. Snag size, density and decay class are influenced by the age of the stand and impacts from disease, insects, or other

mortality elements. The regional web site (http://www.fs.fed.us/r6/nr/fid/data.shtml) was checked for mortality agents at work within this 6th field subwatershed. There are bear damage areas displayed for 2006 in the mid-portion of Decline Creek, the mid section of Dan Creek and the top of Gold Mountain. Bear damage to trees is typically a partial or total girdling of the young trees that happens in the spring when bears emerging from the den find scare forage. The bears bite the bark off trees to get at the cambium layer and sap flows. These girdled trees provide small diameter (usually less than 18 inches dbh) snags across the landscape in second-growth plantations.

Stand exam information from the project area, from other projects with second-growth forest stands in the Sauk River drainage, and Forest ecology plot information was reviewed for the snag information in the plant association group that most represented the project area. This information was compared to project stand information and the vegetation simulation modeling of mortality for the stands with the snag density and structural information from the DecAID program. Landscape distribution of snags in natural conditions was used as a target along with the pileated woodpecker as a specific wildlife species. Assuming snag levels in unharvested, natural conditions provided a description of desired structure meeting a 100 percent cavity nester population levels. Within the Matrix, this assessment reviewed conditions for meeting decayed wood at the 50 percent tolerance level, which would cover the Forest Plan, as amended, direction of 40 percent populations, as well as the 50 percent tolerance level for snag densities in the DecAID program.

Alternative A—No Action

The No Action alternative allows development in the 70-year-old stands (Units 1 to 9) to proceed with current forest stand stocking levels averaging 704 trees per acre in all diameter classes, and 276 trees per acre for trees greater than seven inches dbh. In the 40-year-old stands of Units 10 to13, tree stocking is heavier, averaging 842 trees per acre for all diameter classes. Mortality in these stands is predicted with the vegetation simulation model to be approximately 150 trees per acre per decade for the next two decades. Mortality in these stands with dense stocking levels (ranging from 530 trees per acre to over 1,000 stems per acre) would result from competition for growing space. Mortality of the less competitive trees would provide abundant small-diameter snags (<10-inch dbh), some medium sized snags (11- to 19-inch dbh), but few snags of 20 inches and greater in diameter. This snag development would provide foraging habitat for some birds, but nesting habitat for many of the primary cavity excavators would continue to be limited due to the current size class of the stand and the resulting snags created. Pileated woodpeckers would be expected to utilize adjoining older forest areas for roosting and nesting sties (40 to 60 inch diameter trees), but forage on stumps or within the second-growth stand.

As the stand matures, larger diameter snags would develop as dominate and co-dominate trees overshadow lesser trees. Large diameter tree development would not be expected for the next 30 to 50 years, and few large diameter snags (>20 inches dbh) expected for the next 50 to 100 years. (USDA Forest Service 2001). The second-growth stands would contribute to meeting conditions described as snag densities in the 30 to 50 percent tolerance level for snag densities as they progress over time through mid-seral to late seral stages.

Within the second-growth areas of the Decline Thin Project area, there are adequate snags for nesting Downey woodpeckers, and the red-breasted sapsucker, but the larger diameter soft snags for nesting hairy woodpecker, northern flicker, or hard large snags for pileated woodpecker are not yet developed in adequate numbers to support above 40 percent of the target primary

excavators. Snag numbers for pileated woodpeckers and other cavity excavators are met in older forest stands that make up approximately 30 percent of the project area. Older forest stands within the Dan Creek drainage are expected to have snag numbers to support 100 percent of the target primary excavators as described in the DecAID advisor within the western hemlock habitat and structural condition. On a landscape scale that includes both the older forests in Dan Creek drainage as well as the second-growth forests, there are sufficient areas of older forest to provide for the target woodpecker species at the 50 percent tolerance level for snag densities.

All Action Alternatives

All action alternatives are designed to maintain snag numbers at and above the 40 percent population level, and meet the 30 percent to 50 percent tolerance level of snag densities for west-side cavity associated species as per the DecAID review. Desired snag levels are managed at both at the project level and the 6th field watershed level with special emphasis on large diameter snag retention and creation due to the lack of this cohort in the second-growth stands. Large diameter snags are retained in unthinned older stands adjacent to project area and along Dan Creek, (approximately 300 acres or roughly 30 percent of the project area is in older forests).

Pockets of snags identified in the Region 6 damage and insect Web site would be retained in all action alternatives. These snag areas are located in mid portion of Decline Creek within the Riparian Reserve—northeast of Unit 13. Other bear damage occurs throughout the project area, but is concentrated in the 40-year-old stands. These damaged trees are both snags and live green trees supporting insect infestation that provide for foraging avian species. Bear damaged trees are candidates for retention as live or green wildlife trees. Root rot pockets can also provide short-term snags and are frequently included in leave areas for their contributions to soft snags and down wood. No noticeable areas of root rot were reported within the project area.

While snags are difficult to retain during logging due to the instability of snags and safety considerations to workers, live green trees with deformed tops or signs of decay are desirable leave trees for wildlife. Live, deformed green trees, greater than 26 inches dbh, provide dominant large diameter trees for future snags. Snags and green wildlife trees left standing following timber harvest may be more prone to wind and snow breakage if left standing alone. Protection for standing snags and green trees in all action alternatives would provide a basal area stocking that supports 60 to 80 percent canopy cover.

The resulting stand would retain wind firmness, and is usually less susceptible to storm damage. The District thinning program over the past 10 years has seen limited damage due to wind and snow breakage. There have been microbursts of wind, such as the storm in 1999 that resulted in approximate two acres of wind damage in the Too Thin Sale at the confluence of the White Chuck and Sauk Rivers. This same storm event also resulted in wind damage to old-growth stands in the same vicinity and in more extensive storm impacts in the old-growth stands in the Suiattle drainage.

All of the action alternatives concentrate activities in second-growth stands of 40 to 70 years of age, with retention of untreated riparian areas to meet variety in size of stand components. All alternatives retain adequate snags for nesting Downey woodpeckers, and the red-breasted sapsucker, but the larger diameter soft snags for nesting hairy woodpecker, northern flicker, or hard large snags for pileated woodpecker have not yet developed adequate numbers to support above 40 percent of the target primary excavators.

Snag retention in all action alternatives would contribute to meeting the 30 to 50 percent tolerance level of snag densities for cavity nesting species within the 6th field analysis area. This snag retention would also contribute to the 50 to 80 percent tolerance level of snag density on the landscape (5th field watershed) scale as described in DecAID analysis advisor for species associated with snags and down wood (Mellen and others 2006). The treated stands would contribute to meeting conditions described for snag densities in the 30 percent to 50 percent tolerance level, as they progress over time through mid-seral to late seral stages.

Alternative B

Alternative B limits harvesting to 214 acres of 70-year-old stands. Much of the potential tree mortality (future snags) would be captured with the proposed thinning. Tree mortality is modeled to decrease to approximately 18 trees per acre compared to 150 trees per acre without thinning treatment. This thinning would decrease the number of green trees and snags in the less than 10-inches diameter class, which is the most abundant snag class, and also reduce the green tree and snag moderate size class (11- to 19-inches dbh), as the thinning from below captures potential mortality, in that size class of trees.

The 214 acres thinned in Alternative B represents less than one-third of the 927-acre project area and is less than one percent of the 15, 677 acres in Dan Creek (6th field watershed). Even within the small project area or within the landscape view, the proportion of thinned to unthinned areas is of such a limited portion of the landscape that there would be a diversity of tree age classes, and creation of snags in all age classes over time from the old forests and unthinned forests. Alternative B would following thinning would contribute to a landscape that meets conditions of 30 to 50 percent tolerance level of snag densities for cavity-associated species as per the DecAID review advisory.

At the landscape scale of 5th field watershed, the numbers of snags are distributed in uneven pattern (state, private and NFL with various age-class forests), but meet between a 50 to 80 percent tolerance level for snag densities. This landscape assessment is based on the percentage of old forests and various aged second-growth forests in the Lower Sauk River watershed (USDA Forest Service 1996). Reduction of snags in Alternative B is primarily of a size-class (<12 inches dbh) that is well represented in the landscape of both the 6th and 5th field watersheds.

Alternative B retains adequate snags for nesting Downey woodpeckers, and the red-breasted sapsucker, but the larger diameter soft snags for nesting hairy woodpecker, northern flicker, or hard large snags for pileated woodpecker have not yet developed adequate numbers to support 100 percent of the target primary excavators. The thinning operations in Alternative B would promote stocking levels or conditions for development of large diameter trees.

As the thinned stands mature and dominate and co-dominate trees overshadow lesser trees, larger diameter snags would be created. Alternative B would require 30 to 100 years to develop trees in the larger diameter size classes and initiate recruitment of large diameter snags to meet an 80 percent tolerance level for snag densities.

Alternative C and D

Effects of Alternative C and D are similar to Alternative B on the 6th and 5th field landscape scale with an additional 160 acres of second-growth thinning in 40-year-old stands. As described in Alternative B, Alternatives C and D would decrease the number of green trees and snags during the thinning operations, and capture much of the future mortality that would be snags with the

thinning. Future mortality would decrease from 150 trees per acres to 18 trees per acre for the thinned sites. With thinning from below, Alternatives C and D would reduce the smaller size-class of less than 10 inches dbh snags and green trees.

Alternatives C and D have a total of 380 acres thinned, but the additional 160 acres thinned does not appreciably shifts the amount of thinned and unthinned acres with the 6th and 5th field landscape. Since snag patches are not uniformly distributed across the landscape, and areas vary in snag densities, the landscape conditions would continue to contribute to conditions that meet the 30 to 50 percent tolerance levels for snag densities supporting west-side cavity excavator's needs.

As with Alternative B, Alternatives C and D retain adequate snags for west-side woodpeckers as described in Alternative B. Alternative C and D would require 50 to 100 years to develop trees in the larger diameter size classes and initiate recruitment of large diameter snags to meet an 80 percent tolerance level for snag densities.

Alternative C and D snag retention would meet the 30 to 50 percent tolerance level for cavity nesting species within the analysis area and the 80 percent tolerance level on the landscape (5th field watershed) scale as described in DecAID analysis process for species associated with snags and down wood (Mellen and others 2006). The thinned stands would contribute to meeting conditions described as snag densities in the 30 to 50 percent tolerance level for snag densities as stands progress over time through mid-seral to late seral stages.

Pileated Woodpecker and other Cavity Nesters Cumulative Effects

Cumulative effects analysis area: The Decline project cumulative effects were assessed within the project area, the Dan Creek 6th field watershed and the Lower Sauk River 5th field watershed Appendix C was reviewed for projects within the vicinity of Decline Thin Project that had the potential for cumulative effects.

Past actions and effects: Within the 6th field watershed, there has been past clear cut timber harvest on approximately 9,735 acres of the Dan Creek area since 1900, which has modified foraging and nesting habitat for woodpeckers and species that use snags and down wood, and since 1996, thinning in second-growth stands of approximately 60 years of age. Woodpecker and other cavity-associated species populations have likely decreased where harvest activities have occurred. While the habitat value of lands harvested more than 50 years ago is increasing for primary excavator species, as forest stands mature these stands would not reach maximum potential for hosting all cavity- associated species until larger diameter trees develop at 100 to 150 years of age. Alternatives B, C, and D would add to the short-term cumulative effects of past timber harvest for primary excavators, with reductions in small diameter snag numbers. There would be a short-term impact on the attrition of small diameter trees within the stand due to the capture of future mortality with the thinning (20–40 years). Over time, the thinned stands would have more growth developed on fewer trees leading to larger diameter future snags.

The cumulative thinning activities from Wishbone, Rib and Too Thin on the 6th field watershed scale still represent a minor portion of the landscape with reduction in snags numbers. The thinning primarily removed the smaller size of the snags (less than 12 inches dbh) which is a size class of snags currently fairly widely distributed across the landscape. These snag densities contribute to conditions that meet 30 to 50 percent tolerance level for snag densities, but lack the large diameter snags. In the 5th field watershed, approximately 35 percent of the watershed is State or private lands where forest lands have been previously harvested and fewer snag are

expected. This is in contrast to subwatersheds of the NFS land within the 5th field watershed where 50 to75 percent of the forest area is in old-growth forest.

Present actions and effects: The Funnybone Timber sale contributes approximately 300 acres of thinned second-growth to the cumulative effects. The Funnybone Timber Sale area had approximately one-third of the area in unthinned Riparian Reserves that is characteristic of the thinned acres within the 6th field landscape and the variability of stand conditions that contribute various snag sizes and concentration.

Future actions and effects: A future proposed thinning project of 400–500 acres is planned for Dan Creek drainage, would overlap in time and space and contribute to the reduction of smaller diameter snags in the 6th field watershed. The project would be subject to the Forest Plan standards and guidelines for retention of snags and wildlife green trees. The proposed action would contribute to meeting conditions for snag levels at a 30 to 50 percent tolerance level for snag densities on managed forest ands. No timber sales are known to be scheduled on private lands within the 6th field watershed so no additional cumulative effects would be expected to snags numbers at this landscape scale. Private and State land management in the 5th field drainage would likely continue to emphasize timber harvest rotations that would provide for small diameter snags, but few large diameter snags. Management of old forest on NFS land would continue to emphasize retention of old forests so no change in the 50 percent tolerance level for snag densities.

Cumulatively, past thinning operations and current projects in the 6th field watershed emphasize retention of large snags and retention of live green wildlife trees. All projects were and are being designed to maintain snag numbers at and above 30 to 50 percent tolerance level for cavity associated species.

The long-term cumulative effect from past and future thinning would be reduce stocking levels to conditions that favors large diameter green trees (>20 inches dbh) and future snag development, with the loss of a portion of the smaller diameter (<11 inches dbh) snag class. The small diameter snag class is found to be abundant due to the proportion of the 6th field drainage in second-growth, and the amount of second-growth and old forest area that is left untreated in Riparian Reserves, unstable slope areas, and other areas.

Down Wood

Based on District pre-harvest fuel inventories, and DecAID modeling, the distribution of woody material in the analysis area meets expected values for providing small woody debris ground cover and with the residual large diameter down pieces of wood left from the 1930s to 1960s timber harvest meets the desired proportion of large pieces of down wood.

Alternative A—No Action

The down wood biomass is estimated to range from 30 tons per acre in the sparse down wood areas to 50 to 80 tons per acre in portions of the stand with heavier concentrations of wood left from the railroad logging. This amount of down wood is expected to continue to provide adequate cover for amphibians and mollusk species throughout the stand. Most of the recent down wood is in size-classes less than 21-inches diameter, with recruitment of large diameter wood (>21 inches) not expected until the stand matures in the next 50 to 100 years. The progression of snags to down wood would contribute to the forest floor debris, but would be of a limited size-class to provide the cover and moisture retention of large diameter material.

All Action Alternatives

Some of the existing dead stems would be cut or knocked over during the thinning operation, and become part of the down woody component. Following thinning, the residual trees would be expected to have less competition and more of the stand biomass would be captured in fewer, larger diameter trees. Since the area is lacking in large diameter snags, the thinning from below prescription would retain dominant trees for future large snags, and marking of deformed green trees to retain for future wildlife trees. All action alternatives would be expected to have an increase recruitment of woody debris from the thinning slash that would be in the smaller diameter classes of less than 20-inches diameter. This down wood would provide a moist cover for a variety of mollusk and invertebrates with the retention of canopy closure (60 to 80%) that would support a mesic condition on the forest floor. As this material decays over the next several years (check fuels report), additional down wood would comes from storm, disease, insects and competition between the remaining trees. The thinning captures future mortality so there would be a reduction in numbers of trees per acre and, therefore, a reduction in potential down wood biomass from the removal of co-dominants and smaller diameter trees (<12 inches dbh).

Down wood, less than 21-inch diameter was well represented from the biomass estimates of current down wood. The thinning would remove material expected to die, as intermediates are shaded out, become snags, and then down wood over the next 50 to 100 years. This thinning and removing potential down wood would be compensated with typical snow breakage, windthrow, and disease within the remaining trees. The concentration of growth on fewer stems has the potential to result in larger pieces of down wood biomass when a remaining tree falls, and the recruitment of another age-class in the understory would provide for future small diameter wood debris. All action alternatives would meet the objectives of retention of the large diameter down wood, and the recruitment of future large wood.

Alternative C

Alternative C includes a fuels treatment along the open road systems that would pull the slash into burn piles and reduce the down wood component within several hundred feet of the road. This slash treatment is limited to several hundred feet from the road, and would not appreciably diminish the amount of additional wood from the thinning treatment that is being added to the forest floor.

Down Wood Cumulative Effects

Cumulative effects considerations: Appendix C was reviewed for projects within the vicinity of the 6th field watershed that had the potential for cumulative effects for the Decline Thin Project. Past, present and future projects with the potential to effect future down wood are those projects assessed for snags and are displayed in the section on Pileated Woodpecker and other Cavity Nesters Cumulative Effects. The effects on down wood quantities would correspond to management of snags, with snag densities and size influencing future down wood densities and down wood sizes.

Past timber harvest resulted in a reduction in recruitment stock for large diameter down wood. Present and future projects result in as pike of small diameter wood (slash) in the short term, followed by a period of several decades with intermittent delivery of various sizes of down wood, with long term, 50 to 100 years for large small diameter wood recruitment. Cumulatively, none of the projects would appreciably change the down wood accumulations in the near future.

Riparian Reserve Habitat—Aquatic Conservation Strategy

Alternative A—No Action

No adjustment in stand density or species mix would occur at this time. Forest stand development would occur through stand maturation, weather events, future fires and insect outbreaks, etc as described in the Forest Vegetation section of Alternative A—No Action. Over time, the 70 and 40-year-old stands are expected to move toward a more mature forest structure, with a trajectory path of development up to 175 years for the 40-year-old stands.

Wildlife habitat in the Riparian Reserves would be dominated by closed-canopy forests (100%) with forest stands continuing to develop, but at a decreasing rate over time due to tree-to-tree competition. The shade intolerant tree species would eventually be replaced with shade tolerant species. This would continue to provide a moist environment for amphibian species, but little development of larger diameter trees for recruitment as snags or down wood. Western redcedar would remain a suppressed species until natural disturbance agents provide openings and less competition in the overstory. These conditions would provide thermal cover for large game, dispersal habitat for spotted owl, and interior forest conditions preferred by some wildlife species, but little ungulate forage or diversity of plant species, especially in the understory.

The persistence of slow growing conditions may delay development of large diameter trees and stand diversity over time, with understory species being shaded out or becoming primarily shade-tolerant species until natural events open up gaps. Structure for marbled murrelet and spotted owl nesting would be slow to develop with the competition of numerous co-dominant trees.

Since stand response to thinning treatments is somewhat age-dependent, future treatments may not garner the growth response of residual trees that a current treatment could promote. With no vegetation treatment within Riparian Reserves along the smaller and intermittent streams, woody debris inputs would proceed on its existing course, with few large diameter pieces expected for decades.

Alternatives B

Alternatives B would provide thinning treatment of 10 acres in the 70-year-old stand within the outer portions of the Riparian Reserves and outside of the inner gorge of the drainage features. This represents less than 3 percent of the Riparian Reserve within the project area. This limited treatment provides areas of abundant recruitment of small diameter snags over time and diversity in the riparian stand structure for the 70-year-old stands.

Riparian treatments would favor the retention of dominant and co-dominant trees, with a target of over 70 percent canopy retention and creation of snags and downed wood. Current biomass growth rate would be maintained by capturing growth on fewer stems. The retention of 70 percent canopy would fully meet the desired dispersal conditions for spotted owl dispersal, maintain buffers areas for amphibian re-colonization of treated areas, retains plant or forest associations that provide diverse habitat and microclimatic conditions with temperature and moisture regimes that favor riparian associated species such as amphibians, mollusks, and bats..

The riparian thinning would promote development of western redcedar. This species responds well to release, and the riparian treatments would assist in retaining western redcedar as an important part of the diversity of the residual stand. This would contribute to meeting Aquatic Conservation Strategy objectives to maintain and restore the distribution, diversity and complexity of the watershed and landscape. Diverse forest stands with healthy stocking levels

are expected to be resilient and able to cope with disease, insects and climatic changes. (See Appendix E)

Hardwood components retained within the Riparian Reserve would continue to provide diversity in the short-term. Hardwoods would eventually be surpassed in growth by the conifers, and become snags as they are shaded out. The treatments would open the stand conditions slightly for understory development that could provide additional cover and forage for riparian species of concern, their prey, and Forest Management Indicator Species such as the black-tail deer and bear

Within treated acres of Riparian Reserves (10 acres), there would be a trade-off of short-term disturbance (10 to 50 years) and loss of a portion of small snags, for long- term (more than 50 years) benefits of structural development and adjustment of species mix. Long-term, over the next 100 years, large trees would mature, die, and become large pieces of down wood. As the large wood decays, these pieces provide a buffered environment from drying climatic conditions and are moist environment favored by some amphibians and mollusks. In steep inner gorges, these large trees help dissipate the scouring energy from peak flows of storm events.

Alternatives C and D

Both Alternatives C and D include the 10 acres of riparian thinning in the 70-year-old stands described in Alternative B, and have an additional Riparian Reserve treatment of four acres thinned in the 40-year-old stands. In Alternatives C and D, there would be a total of 14 acres of Riparian Reserve with a thinning treatment, less than 3 per cent of the project area Riparian Reserve.

The Riparian Reserve thinning effects for the additional 4 acres in Alternative C and D would be similar to those effects described in Alternative B for the Riparian Reserve treatment. The use of skips and gaps in Alternative C and D would interject additional variability in the stand structure, but an average of 70% canopy cover would be retained as in Alternative B.

Riparian Reserves Cumulative Effects

Cumulative effects analysis area: Appendix C was reviewed for projects within the Decline project area and within the 6th field watershed of Dan Creek that had the potential for cumulative effects.

Past actions and effects: Past timber harvest from the 1920s to the 1960s, that clearcut old forest often included timber harvest within and across the Riparian Reserves, resulting in stand initiation in the riparian forest structure. The proposed project would not change the stand year-of-origin, or the residual effects from those actions so those actions were reviewed and found to not contribute to the Decline Thin Project Riparian Reserve cumulative effects.

Recent thinning (1990s) of stands in the Wishbone, Too and Rib Timber Sales, included up to 25 percent of the Riparian Reserve thinned to meet Aquatic Conservation Strategy objectives. These areas were reviewed during Decline field trips with the public in 2005 and 2007; one scoping response noted the Wishbone riparian prescription appeared to leave sufficient canopy and habitat to minimize impacts from logging. Recent thinning activities are expected to shift conditions within the Dan Creek Riparian Reserves to a more diverse and resilient stand. All projects were designed to further the goals of the aquatic conservation strategy and no negative cumulative effects are expected.

The Sauk Roads Treatment areas were within Gravel Creek, Everett Creek, and the headwater areas of the Mouse and Bob Lewis Creek drainages that flow into the Sauk River separately from Dan Creek so there is little overlap in time or space of the Decline Sale with the Sauk Roads Treatment.

Present actions and effects: The14 acres of proposed Riparian Reserve vegetative treatment in the Decline Thin Project, was reviewed in regards to the Sauk Roads Treatment and the proposed Dan Creek Thin. The scale and scope of the riparian treatments represents less than one percent of the riparian area of the Dan Creek drainage, and the design of the treatment is to promote meeting the objectives of aquatic conservation strategy.

Future actions and effects: The proposed Dan Creek Thin of 400 to 500 acres could provide additional Riparian Reserve thinnings. Those treatments would meet the nine aquatic conservation strategies to protect the ecological integrity of the riparian system. Cumulatively, all projects are designed to further the goals of the aquatic conservation strategy.

Survey and Manage Species

A Court Order of January 9, 2006 reinstated the 2001 ROD (as amended as of March 21, 2004); this court order was further clarified with direction dated October 11, 2006. The October order clarified what projects need pre-disturbance surveys to be in compliance with the 2001 ROD (as amended or modified as of March 21, 2004). The list of species requiring pre-disturbance surveys have annual review and the species list is updated periodically. The current list of species and category assignments is from direction distributed in 2004. (http://web.or.blm.gov/records/ib/2004/ib-or-2004–106.htm).

There is only one mollusk that is listed for pre-disturbance surveys on the north half of the Mt. Baker-Snoqualmie National Forest, Puget Oregonian snail (*Cryptomastix devia*). This species is listed as a low to mid-elevation species found at 0 to 1500 feet above sea level. Given current standards and guidelines, the project area would not need mollusk surveys since Decline Thin Project area is located greater than 1500 feet in elevation above seas level; the project area is outside of suitable habitat.

Since field surveys within the project area were initiated in 2002, mollusk surveys were conducted in the Decline Thin Project area as per the 2001 ROD. Surveys were initiated in October of 2002 and completed in May of 2003 based on a more inclusive list (ROD 2001) of survey and manage species than current lists. Mollusk specimens were tentatively identified to genus, and to species when possible. Amphibians encountered in the mollusk surveys were also noted. Species of jumping slugs, *Hemphillia*, and common species of *Ariolimax* were found, snails species of *Haplotrema*, and *Monadenia*, but not the target Survey and Manage species, Puget Oregonian snail (*Cryptomastix devia*)..

All Alternatives

All alternatives provide habitat for mollusks, bats and amphibians as outlined in the Forest Plan, as amended (ROD B-13 1994). For all action alternatives, an average of 70 to 90 percent canopy closure would be retained within Riparian Reserves. This would maintain mesic environment conditions in buffer areas for amphibian re-colonization of treated areas. Plant or forest associations are promoted that may provide habitat for amphibian species or be associated with site conditions favored by those species, including temperature and moisture regimes that favor

amphibians and mollusks. Bat roosting sites within large diameter snags or in the bark of old trees would be limited by the maturity of the stand.

Alternative A—No Action

With No Action, there would be no change in the current stand structure in the project area. As forest stands mature, there would be continue to be a variety of habitat for mollusks, amphibians, bats and other wildlife species. A gradual increase in abundance and diversity of understory vegetation may not occur for 100 to 200 years without intervention (D.R. Tysell and A.B. Carey 2000). Wind throw, disease, and other agents would be expected to impact the stands and provide small openings with development of understory vegetation. Mollusks and amphibians would continue to utilize the pocket areas of suitable habitat and would migrate into areas with suitable down wood and vegetation for cover and forage. Bats would utilize natural openings within the stand for foraging, but may have roosting sites limited by lack of large diameter trees with suitable bark characteristics or snags.

All Action Alternatives

In all action alternatives the habitat for mollusks and species of concern are provided for in the Riparian Reserves and leave areas within the project area. Variable density thinning would provide a range of canopy closure, and potential for more light to reach the understory and additional development of understory vegetation that could provide cover and forage. Retention of down wood would also provide cover for amphibians and mollusks. Bats would utilize openings within the stand from the thinnings for foraging, but may have roosting sites limited by lack of large diameter trees with suitable bark characteristics or snags.

Survey and Manage Species Cumulative Effects

For the Decline Thin Project, the survey and manage cumulative effects area was the 6th field watershed and the cumulative effects are similar to those described in the Riparian Reserve cumulative effects discussions above.

Cumulatively, past timber harvest from the 1920s to 1980s that clearcut old forest resulted in a change in the forest structure that supported potential habitat for mollusks and species of concern, bats, and amphibians. The proposed project would not change the residual effects from those actions. Those actions were reviewed and found to not contribute to the Decline Thin Project cumulative effects for survey and manage species. Recent past thinning sales in the area have through variable density thinning, retained canopy closure at 50 percent and above, provided mesic conditions in Riparian Reserves, and the development of understory and residual stand growth for bat roost sites. Retention of down wood provides cover for amphibians and mollusks, while bats utilize openings from the thinnings for foraging. The proposed Dan Creek Thin is the only foreseeable project in the Dan Creek drainage with potential of cumulative effects and survey and manage guidelines would be applied to the proposed action so as to maintain or enhance stand conditions for Survey and Manage species of concern.

Other Species of Concern

Neotropical Birds or Land Birds

The MBS is located at the northern end of the Southern Pacific Rainforests physiographic area. The only priority habitat of this physiographic area that occurs on the MBS is coniferous forest.

There are 22 priority land bird species identified for this habitat, and all but five (mountain quail, Allen's hummingbird, Lewis' woodpecker, white-headed woodpecker, and Cassin's vireo) occur on the Forest. Twelve of these are Neotropical migrants.

The Monitoring Avian Productivity and Survivorship (MAPS) stations on the MBS from 1992 through 2007 have provided indices of adult bird population sizes and post-fledgling productivity, with trends summarized for population and productivity. The data from 1992 to 1994 indicated a rather stable period, with bird populations higher in 1994 to 1995, and remaining stable at higher levels until a moderate decline was noted in 1998. Generally, low years in species productivity are followed by declines in the subsequent years and vice a versa, reflecting a density dependent dynamic, although that pattern was not pronounced on the MBS stations, when compared with data at other MAP locations. The indices of adult population size for the years 1992 to 1999 showed a consistent and stable population for 4 of the 15 target bird species. Four species showed wide inter-annual fluctuations, and 6 species had increasing trends. Two species showed a declining trend, with the decline in the western flycatcher nearly significant and the decline in the song sparrow significant. Trends of all species pooled for the MBS showed increase, but the increases were non-significant. Within the Pacific Northwest Region, the data suggests that population sizes and productivity continues to remain at low levels, with concern for productivity declines in the 1999 numbers (P. Pyle and others 2000).

The 2005 report on Managing Landbird Populations in Forests of the Pacific Northwest Region (P. Nott and others 2005) highlighted population trends for selected bird species of regional conservation concern. On the MBS stations, species of concern included significant declines for the Hammond's flycatcher, winter wren, and dark-eyed junco. The report recommends that appropriate actions to reverse declines could be applied to the areas surrounding the survey stations. The report suggested that land managers create a shifting mosaic of successional or low canopy cover habitat (10 to 20% of the landscape) within extensive stands of uniformly shaped coniferous forest. Dark-eyed junco are reported as responding to heterogeneity among drier, high-elevation coniferous forests, with some populations thriving in managed areas where a mosaic of larger regeneration cuts had been created. Management for winter wren habitat is suggested as maintaining large uniform shaped patches of thinner-canopy evergreen forests in stream dense areas. In addition, smaller patches of mixed or deciduous forests (associated with riparian areas and covering greater than 10% of the area) should be maintained.

All Alternatives

All Alternatives retain a diversity of habitat within the coniferous forests with big-leaf maple, Pacific yew, cottonwood, vine maple, and alder patches providing variety in stand composition. Seep sites and rock outcrops with mixed conifers and hardwoods also provide habitat diversity.

Alternative A—No Action

In the No action alternative, there would be no change in the current stand structure in the project area. Avian species richness (number of species present and using the habitat) in the 40-year-old stands) is relatively low due to the high number of stems per acre and the lack any understory vegetation within the stands. The 70-year-old stand would have more avian species than the 40-year-old stand, but would still have low avian numbers due to lack of habitat diversity. As forest stands mature, there would shifts in the habitat for land birds. Wind throw, disease, and other agents are expected to impact the stands and provide small openings with development of understory vegetation, and shrubs. Landbirds would continue to utilize the coniferous forests,

with early seral species more abundant along edges, and openings, and few late seral species that are associated with cavities or old forest structure. Land bird utilization of the project area may be limited by structure of the forest, with limited natural openings and edges within the stand for foraging and understory shrubs for roosting and nest sites.

All Action Alternatives

In all action alternatives, the variable density thinning would provide a range of canopy closure, and potential for more light to reach the understory and additional development of understory and shrub vegetation for foraging and nesting habitat. Young stand thinning would result in short-term (5 to 10 year) habitat improvements for early seral species (such as rufous hummingbird). For species associated with older forest seral stages, such as Vaux's swift, the thinning treatments would result in long-term habitat structure.

Neotropical Birds or Land Birds Cumulative Effects

Cumulative effects analysis area: In the 6th field watershed (northern end of the Southern Pacific Rainforests physiographic area), a variety of habitat for neotropical birds would be maintained with past, present, and future projects. Appendix C was reviewed for projects within the Decline Thin Project area and the Dan Creek 6th field watershed for those projects that had the potential for cumulative effects.

Considerations: Habitat is weighted toward old forest coniferous conditions in the Riparian Reserve system, the Late Successional Reserves, and wilderness areas. Variety in age, forest age-classes and habitat is found along the various river systems, changes in plant associations with elevation, avalanche chutes, and through silvicultural practices in timber management lands.

Past actions and effects: Past timber harvest from the 1920s to 1980s that clearcut old forest often included harvest that resulted in a change in the forest structure for neotropical birds, shifting old forest to early seral vegetation. The residual effect from those actions is a current landscape with a variety of forest stand ages. The proposed action would not change the residual effect of those actions and, therefore, were found to not contribute to the Decline Thin cumulative effects for neotropical bird species.

Recent past thinning sales in the area have through variable density thinning, provided additional variety in habitat conditions for nesting and foraging birds. The effect of changes in habitat are local to the specific projects, and cumulative effects from thinning projects are a localized shifts in foraging and nesting habitat for early seral species for the 5 to 10 years following thins such as Wishbone (1996) and Rib Thin (1998). These sales, along with Decline Thin would provide for approximately a minor shift in habitat with the Dan Creek drainage to habitat with 60 to 80 percent canopy cover and early seral edges.

Present actions and effects: A current thinning sale in the 6th field watershed (Funnybone Timber Sale) provides canopy cover and variable density thinning that provides diverse trees diameters and promotes a variety of habitat conditions. Road treatment would maintain edge habitat conditions with early seral vegetation.

Future actions and effects: The proposed Dan Creek Thin project would reduce stoking level and canopy closure within 400 to 500 acre area. This project would also provide for diversity of habitat and cumulatively would contribute to variety in coniferous forest stand structure within the 6th field watershed.

Project Record
This EA hereby incorporates by reference the Wildlife Specialist Report (40 CFR 1502.21). The Wildlife Specialist Report is located in the Project Record and contains the detailed data, Affected Environment, analysis, references, and technical documentation that the Wildlife Biologist relied upon to reach the conclusions in this EA.

Botany

Environmental Effects

The analysis area for direct and indirect effects on plants is the project area.

Effects Common to All Alternatives

Species of Concern
Under all Alternatives, there would be *No Impact* to Sensitive or Survey and Manage species.

Noxious Weeds
In terms of weed spread, prevention, and control all Alternatives would have equivalent effects. They all would result in virtually the same level of residual canopy closure, road construction, and logging methods. Even under the No Action Alternative, the weeds on site would eventually be treated. Using KV funds generated by the sale allows this to happen more quickly. In Alternative D, re-opening Road 2430 for treatment would improve access to that site for a few years and make weed treatment easier.

The mitigation measures would likely keep weed introduction and spread at a level equal to what it would be in the absence of any activity in this area. The basis for the mitigation measures and their effectiveness are discussed at length in the Pacific Northwest Region Final Environmental Impact Statement for Preventing and Managing Invasive Plants, Chapter 4.2 and Appendix D (2005b).

Botany Cumulative Effects

Species of Concern
Because there are *no impacts* to Sensitive or Survey and Manage species, there would be no contribution to cumulative effects on plants in the project area.

Noxious Weeds
The area considered for the cumulative effects analysis of noxious weeds also consists of the project area, including the haul route and closed Road 2430, because roads are an effective vector for weed spread (Tyser and Worley; 1992 Roche′ and Roche′ 1988). The cumulative effects analysis table (see Appendix C) lists the specific cumulative effects actions considered with this project analysis. Documented noxious weeds exist along the haul route, adjacent to Road 24 within the first one-half mile from the Sauk Prairie Road. There is a small patch of knotweed that is well off the travel way.

The Nature Conservancy will begin treating it this year and continue until eradicated. There is a small infestation of tansy ragwort along the road shoulder that has been hand pulled each year for

several years and will continue to be pulled until the population is gone. Adjacent to Road 24 and Sauk Prairie Road junction is an old pasture with Canada thistle and blackberries. This site was treated with herbicide in 2006 and 2007 and the populations were down by approximately 90 percent by late summer 2007.

Treatment there will continue until the weeds are eradicated. With compliance with Forest Plan standards, timber haul on Road 24 is not likely to be a vector for additional weed spread. Because of the on-going treatment of all these sites and/or their distance from Road 24, and the application of Forest Plan standards, none of the action alternatives would subtract or add substantially to the cumulative effects from past, present, and other foreseeable actions to control noxious weeds.

Forest Plan Consistency

All Alternatives are consistent with the Forest Plan, as amended.

Project Record

This EA hereby incorporates by reference the Botany Specialist Report (40 CFR 1502.21). The Botany Specialist Report is located in the Project Record and contains the detailed data, Affected Environment, analysis, references, and technical documentation that the Botanist relied upon to reach the conclusions in this EA.

Recreation Environmental Effects

Dispersed Recreation Direct and Indirect Effects

The analysis area for direct and indirect effects on recreation is the project area.

Alternative A—No Action

There would be no change in the Recreation Opportunity Spectrum (ROS) Roaded Natural Class. The current low-level of dispersed recreation use in the analysis area would continue with little or no increase in use. Hunting and driving would continue on Road 2430 up to the current road closure. The other roads are currently closed or heavily grown in and have little or no tire tracks or other evidence of use.

Alternatives B, C, and D

There could be some short-term disruption of dispersed recreational use during the actual timber sale activities followed by increased firewood cutting opportunities. The current low-level of dispersed recreation use in the project area would continue with little or no increase in dispersed recreation opportunities or uses in the project area.

The thinning units would have more slash on the ground after logging and may not be attractive to hunters. For a short time, more people may drive to this area to look for deer or to see it after logging. Longer-term, little or no increase in recreation would occur.

Dispersed Recreation Cumulative Effects

The recreation cumulative effects analysis area is the Road 24 system, which provides access to dispersed recreationists in and around the project area. Activities listed in Appendix C,

Cumulative Effects Information that have or would affect the Road 24 system were considered in the analysis of cumulative effects on dispersed recreation.

Past actions: Past railroad logging in the 1920s, followed by more recent road-based timber sales in the 1960s, have established the infrastructure for access into and recreation of the project area. Road 24 provides access from Darrington and the Sauk River, and the network of roads branching and re-branching off Road 2430 provides access to the project area. The result is adequate roaded access mainly for higher-clearance vehicles.

Present and future actions: Current and future trail maintenance and repairs(only the White Chuck Bench Trail and White Chuck Boat Launch are accessed by the Road 24 system) also contribute to maintaining dispersed recreation opportunities and use. Past timber sales on the Road 24 system, such as Funnybone Thin, Wishbone Thin, Too Thin, and Rib Thin, have provided maintenance and reconstruction of the Road 24 system.

Future actions: Dan Creek Thin is a proposed future project that would probably provide road maintenance on Road 24, which would contribute toward continued upkeep for dispersed recreationists. Present and ongoing road maintenance and ERFO road repairs would also contribute to maintaining and restoring open roads as well as the replacement of the Sauk River County Bridge (necessary for access to Road 24).

Cumulatively, these projects would support road repair activities that would lead to maintaining, re-establishing, and upgrading the existing Road 24 system. The Road 24 system is key to providing access for dispersed recreation in this area.

With the increasing population in the Puget Sound Region, the demand for recreation use and number of users on the Road 24 system may also increase. The Washington State Interagency Committee for Outdoor Recreation (IAC) compiled a forecast of recreation resource demand for the State of Washington (IAC 2003). The IAC estimated increases in all outdoor activities except for fishing and hunting. More than half of the State's population participates in some form of outdoor recreation with roughly half of it local and the other half shared among State, Federal, and private providers.

In conclusion, dispersed recreation use in the Road 24 system area could increase, which is consistent with the regional population growth rate over time. The Decline Thin action alternatives would contribute little or no increase in recreation opportunities or use in the affected area and, therefore, would not contribute toward cumulative effects on dispersed recreation.

Visual Quality

Alternative A—No Action

The current visual quality in the analysis area would continue unchanged. The Visual Quality Objective—*maximum modification*—would be met as vegetation and landform alterations resulting from management activities may dominate the characteristic landscape. However, when viewed as background, the activities blend with the natural terrain.

Alternatives B, C, D

Implementing any of the action alternatives would meet the current *maximum modification* objective because vegetation and landform alterations resulting from management activities may

dominate the characteristic landscape. However, when viewed as background, the activities blend with the natural terrain. The thinned units would retain 60 to 70 percent canopy, which would continue to blend with the natural terrain and landscape.

Past commercial thin timber sales have demonstrated little impairment to visual quality at the landscape level, especially after a few years. This is particularly true of thins which retain a residual forest canopy. For example, Wishbone Thin is adjacent to this project area, and the only visual evidence is the reduction in canopy closure. Evidence of harvest activity would be noticeable from Road 2430; however, it would become visually subordinate at the landscape scale, because it would be hidden under the canopy when viewed from a distance (background viewshed).

Visual Quality Cumulative Effects

The analysis area for cumulative effects to visual quality is the Sauk River Watershed.

Past actions. Appendix C, Cumulative Effects Information, lists projects that have occurred and may occur in this viewshed and may be visible together with the Decline Thin. The majority of the trees in the Dan Creek and Sauk River valley were removed beginning in the 1920s, drastically changing the scenic landscape visually to what is defined above as *maximum modification*. These stands have grown up and now provide a natural appearing landscape. Clearcut harvests in the older forest stands above the project area created an artificial block mosaic pattern when first harvested. Now the trees have grown and created a more natural appearing landscape. Recent timber sales have affected the views of the overall area: Funnybone Thin, Skull Thin, Too Thin, Rib Thin, Bench Thin, Lyle Thin, Wishbone Thin, and Parallel Thin. They have changed the landscape very little

Future action: The approved Forgotten Plus Thin would not affect visual quality in this area. The proposed Dan Creek Thin near the Decline Thin Project area would thin somewhat more acres than the Decline project but would not be visually more noticeable. Road maintenance and ERFO road repairs would occur but would not affect visual quality.

The Decline alternatives would change the landscape little. Thinning would maintain a 60 to 70 percent canopy closure. As a result, past, present, and proposed timber thinning would change the landscape very little. Cumulatively, these timber sales and other activities, when combined with the Decline Thin Project (or alternatives), would not change the naturally appearing landscape in the Sauk River Watershed.

Forest Plan Consistency

All alternatives would meet the visual quality objectives and are consistent with the standards and guidelines for visual quality in the Forest Plan, as amended.

Forest Plan Consistency

Project Record

All alternatives would be consistent with the standards and guidelines for ROS and dispersed recreation in the Forest Plan, as amended. This EA hereby incorporates by reference the Recreation & Visual Quality Specialist Report (40 CFR 1502.21). The Recreation & Visual Quality Specialist Report is located in the Project Record and contains the detailed data, Affected

Environment, analysis, references, and technical documentation that the Recreation Specialist relied upon to reach the conclusions in this EA.

Heritage Environmental Effects

The analysis area for direct and indirect effects to heritage resources is the project area and immediate vicinity. During the field inventory for this undertaking, five resources were recorded. Four of the resources are historic railroad grades associated with the Sauk River Lumber Company, previously determined eligible as a discontiguous historic district (December 2, 2002 correspondence with SHPO, Log # 120202–51-USDA Forest Service 2002).

Within the context of the comprehensive evaluation plan prepared for the Sauk River Lumber Company (Gassaway 2005), the railroad grades were categorized into condition classes, related to their integrity and ability to convey the character of historic railroad logging activities. Based on this evaluation, Segment 14C, which includes an identifiable segment of "Decline" grade (for which Decline Creek is named) and its associated grade, appears to be a contributing element. The other railroad grade segments have been converted into truck roads and are non-contributing. Scattered throughout the area are stumps with springboard notches, cable, metal pieces, cans, and other items.

The located and inventoried fire shelter was thought to have been constructed by the Forest Service after the Sauk River Lumber Company pulled out of the Dan Creek District about 1936 and had been used in recent times by hunters and loggers. This fire shelter is not eligible for the national register. Two other reported shelters were not located within this analysis area and their reported location varied by source. No other heritage resources were located.

Alternative A—No Action

No Action would result in the continuation of natural processes and uses in the proposed project area. The trees would continue to grow larger and disrupt the railroad grade features. Constructed historic landscape features (such as railroad grades) would become more obscure and may slump or fail due to natural processes. Objects and features made of organic materials would continue to decompose (such as wood). Non-organic artifacts (such as metal cable) would deteriorate over time.

Alternatives B, C, and D

Effects would include those of Alternative A, above. In addition, there is some chance of effect to heritage resources from timber sale activities. The Forest Heritage Specialist has determined that none of the action alternatives would adversely affect characteristics that make the Sauk River Lumber Company Historic District eligible for the National Register, provided the mitigation for protecting the railroad grade (Segment 14C) in Units 7 and 8 is effective. The length of Segment 14C within the project area would be protected by incorporating measures to keep the grade intact, such as felling trees parallel to or away from the grade, not crossing the grade with skid trails or temporary roads, and preserving the earthwork features to the extent possible during harvest operations.

There are also items associated with the logging scattered throughout the area that would be more susceptible to damage during logging operations and removal by people associated with the logging. A note on the sale area map would remind people it is prohibited to remove these

resources. With these measures in place, the undertaking would have no adverse effect on the Sauk River Lumber Company historic district.

The other railroad grade segments have been converted to truck roads and do not contribute to the characteristics that may qualify the Historic District for the National Register of Historic Places.

This undertaking would have no adverse effect on properties on or eligible for the National Register of Historic Places. The Washington SHPO is being consulted on whether they concur with this finding (mailed on August 7, 2007). This project complies with Section 106 of the National Historic Preservation Act, under the terms of the Programmatic Agreement, once SHPO concurs with the finding.

The trees would continue to grow larger and disrupt the railroad grade features. Constructed historic landscape features (such as railroad grades) would become more obscure and may slump or fail due to natural processes. Objects and features made of organic materials would continue to decompose (such as wood). Non-organic artifacts (such as metal cable) would deteriorate over time.

Cumulative Effects

The analysis area for cumulative effects to heritage resources is the project area plus its context, the Sauk River Lumber Company district, eligible as a discontiguous historic district.

Past actions and natural events that preceded the creation of the National Historic Preservation Act of 1966 and other historic preservation laws have impacted an unknown number of heritage resources that might today qualify as national register historic properties. Several miles of railroad grade have been converted to roads, and no longer retain integrity of surface or width characteristic of pre-1950s logging railroads. Actions in the more recent past have resulted in effects to a relatively small number of known historic properties in the Sauk River watershed.

Since 1986, at least two Sauk River Lumber Company sites have been impacted as a direct result of timber harvest activities or in one case, vandalism, which may have been an indirect effect of timber harvest activities.

With the implementation of Alternatives B, C, or D, there would be no cumulative effects to known individual cultural resources in and around the project area.

Forest Plan Consistency

The alternatives would be consistent with the standards and guidelines for heritage resources in the Forest Plan, as amended.

Treaty Resources Environmental Effects

The analysis area for direct and indirect effects to Tribal resources is the project area and immediate vicinity. Gathering practices may include berries, roots, plants for dyes, and medicinal or spiritual plants that tribal members may be hesitant to identify or locate. Without specific information about locations, only general statements can be made regarding the project area and its support of treaty resources.

Salmon and large game are treaty resources highly valued by all federally recognized Tribes in the area. The Forest Service fulfills its general trust responsibilities through the proper

management of natural resources as determined in the Forest Plan, as amended, and through continued consultation with Indian Tribal governments. In keeping with this responsibility, the Forest Service contacted federally recognized Tribes that may be affected by the proposed action. Government-to-Government scoping letters were sent to the Upper Skagit, Sauk-Suiattle, Stillaguamish, Tulalip, Swinomish, and Samish Tribes. No major issues relating to treaty or other Tribal rights were brought forward.

Alternative A—No Action

This alternative would result in a continuation of the current use patterns of Tribes exercising their treaty rights of hunting, gathering, and fishing on National Forest System (NFS) lands. Under Alternative A, the current stand would continue to develop, increasing the canopy closure and decreasing the number of shade-intolerant Douglas-fir in favor of western redcedar and western hemlock over a long period of time. Western redcedar is a highly-valued resource for a variety of Tribal uses.

Alternatives B, C, and D

The western redcedar component would increase at different rates in the thinned stands (see the Forested Vegetation section above). The rights of Tribal members to access NFS lands and exercise Treaty rights would be unchanged except for Road 2432. The road is not very drivable now, but would be completely closed following sale activities although it would affect Tribal members' ability to access that area on foot. Any direct or indirect effects to the quality of the Tribal hunting, gathering and fishing experience would be related to changes in management, access, and the effects to fish, wildlife and plant resources.

Treaty Resources Cumulative Effects

The analysis area for cumulative to Tribal resources is the Dan Creek subwatershed. The closure of Road 2432 would add incrementally to the effect of other projects that have changed road access in the drainage (see Appendix C, Cumulative Effects Information). The rights of Tribal members to access NFS lands and exercise Treaty rights would be unchanged. Any indirect or cumulative effects to the quality of the Tribal hunting, gathering and fishing experience would be related to changes in management, access, and the effects to fish, wildlife and plant resources. Access trends highlighted in the Sauk River and Sauk Forks Watershed Analyses (USDA Forest Service 1996) include a reduction in road miles through decommissioning and closures. Some areas previously available to Tribal elders by car have become less accessible through road closures. For instance, Road 2432 is currently very brushy, and not very drivable and is indicated as one of the roads to be closed to vehicles following timber sale activities. The alternatives would contribute a small increment to the cumulative effects of road closures.

Forest Plan Consistency

All action alternatives would comply with Section 106 of the National Historic Preservation Act under the terms of the Programmatic Agreement once consultation with the State Historic Preservation Officer is complete. The alternatives are consistent with the archaeology Forest-wide Standards and Guidelines in the Forest Plan, as amended.

Project Record

This EA hereby incorporates by reference the Heritage Specialist Report (40 CFR 1502.21). The Heritage Specialist Report is located in the Project Record and contains the detailed data, Affected Environment, analysis, references, and technical documentation that the Heritage Specialist relied upon to reach the conclusions in this EA.

Inventoried Roadless Areas and Unroaded Characteristics

Inventoried Roadless Areas Environmental Effects

The nearest Inventoried Roadless Area is Prairie Mountain (3,822acres) RARE II #6060. It lies from 0.5 to 1.0 mile to the east of the project area.

All Alternatives

There would be no direct, indirect, or cumulative impacts on the Prairie Mountain Inventoried Roadless Area or its roadless characteristics if any of the alternatives were implemented, including no action.

The analysis area for direct and indirect effects on unroaded character is the project area.

Unroaded Characteristics

Alternative A—No Action

Alternative A would result in no changes to the area's current roaded or unroaded character, as there would be no construction of temporary roads or reconstruction of current roads in storage, nor would there be any decommissioning of any of the current roads within the project area.

Alternatives B, C, and D

The proposed Decline Thin Project and its alternatives would not change the roaded or unroaded character of the area because these alternatives would use current road systems with minimal temporary road constructed within areas that currently have open roads. About 0.9 miles of temporary road would be built, then decommissioned following timber sale activities.

Overall, the project area would continue to appear to have roaded characteristics, but roads would be more noticeable in the short-term during operations of the project within these units. Roads 2432 and 2430014, currently open, would both be put in storage following the timber sale with surfaces revegetating (growing in) over the next 3 to 20 years following activities (depending on road surface). Portions of the project area with open roads would continue to have roaded characteristics, such as the stands where Road 2430 switchbacks and winds through the forest stands.

Two short spur roads (2430016 and 2430017) would be decommissioned under Alternatives C and D, but this would not contribute to unroaded characteristics because of their short lengths. In addition, Alternative D would decommission 2.5 miles at the end of Road 2430. The decommissioning would consist of pulling 6–7 culverts at risk of failure and removing unstable fill from 530 feet of the upper part of Road 2430. This upper part of the project area would continue to appear roaded until the decommissioned roads revegetate and become less distinctive from surrounding forest.

Inventoried Roadless and Unroaded Cumulative Effects

The analysis area for cumulative effects on unroaded character is the Dan Creek subwatershed.

Past actions: Past projects over the last century have resulted in the current roadless condition.

Future actions. Cumulatively, other future timber management projects in the Dan Creek drainage (see Appendix C, Cumulative Effects Considerations) combined with the Decline Thin could result in short-term (10 to 20 years) changes of closed roads being converted to open roads for timber access. The Dan Creek drainage is located within a portion of National Forest System lands allocated to the Matrix land allocation (available for timber management). Roads within this areas would be retained as open roads or roads in storage until needed for future projects.

The future ERFO road repair projects described in the Cumulative Effects Analysis in Appendix C are all roads identified as part of the Darrington Ranger District's open road system, and would not contribute to or change the overall unroaded character within the cumulative effects analysis area (see map in Appendix C).

Forest Plan Consistency

No alternative has any affect on a roadless area, and all alternatives are consistent with the Forest Plan, as amended, for inventoried roadless areas and unroaded areas.

This EA hereby incorporates by reference the Heritage Specialist Report (40 CFR 1502.21). The Heritage Specialist Report is located in the Project Record and contains the detailed data, Affected Environment, analysis, references, and technical documentation that the Heritage Specialist relied upon to reach the conclusions in this EA.

Economics Environmental Effects

Table 16 displays the timber output, B:C ratio, PNV, and expected timber sale bid value for each of the alternatives. Worksheets are available in the Project Record.

Alternative A-No Action

Alternative A would provide no timber output, and would have no costs or revenues. Timber sale viability is irrelevant under this alternative because no timber sale would be offered. With no costs or benefits, the PNV would be zero and there would be no benefit:cost ratio.

Effects Common to All Action Alternatives

Certain costs would be the same for all action alternatives. Treatment of Units 1 through 9 would generate revenue under all alternatives, although the stand treatment in Alternative B would generate more volume per acres than either Alternative C or D. Road treatment costs on Road 2432 and 2430014 are the same in all alternatives, as are haul route road daylighting. Fuel treatment costs for piling and burning slash in landing piles are the same for all action alternatives.

Alternative B

The timber sale offered under Alternative B, 7.19 mmbf, would be viable. Alternative B has the highest expected bid rate of the alternatives, indicating that it is the most likely of the three alternatives to remain viable in the event of large decreases in the market value of wood

products. Alternative B also has the highest present net value and benefit:cost ratios of the three alternatives, indicating that it would provide the greatest financial benefits for each dollar spent.

Costs of this alternative are identified above in the Effects Common to All Action Alternatives section.

Alternative C

The timber sale offered under Alternative C, 5.33 mmbf, would be viable. Alternative C has an expected bid rate that is at least $50 greater than base rates in average conditions, making it likely to remain viable in the event of large decreases in the market value of wood products. Alternative C also has a PNV and benefit:cost ratio between those of Alternatives B and D, indicating that it would be intermediate between the other action alternatives in providing financial benefits for each dollar spent.

Additional costs of this alternative include the non-commercial treatment of Units 10–13, as well as the decommissioning of Roads 2430016 and 2430017. Additional fuels treatments, including pullback of slash along open roads and construction of fire handline south of Units 3, 5, 6, 7, 10, and 11, are also included.

Alternative D

The timber sale offered under Alternative D, 7.24 mmbf, would be viable. Alternative D has the lowest expected bid rate of the alternatives, indicating that it is the least likely of the three alternatives to remain viable in the event of large decreases in the market value of wood products. Alternative D also has the lowest PNV and benefit:cost ratios of the three alternatives, indicating that it would provide the fewest financial benefits for each dollar spent.

Alternative D has harvest volumes similar to Alternative B, but the volume generated per unit is less. Units 10 and 11 add some additional volume that is not reflected in Alternative B. There are costs associated with the non-commercial treatments of Units 12 and 13. In addition, road costs are similar to Alternative C with the addition of decommissioning of the upper portion of Road 2430 and the replacement of the Conn Creek culvert with a bridge. Fuels treatment costs are the same as Alternative C.

Table 16. Expected Timber Sale Bid Rates Of Alternatives

	Alternative			
Timber Volume Output (mmbf)	A	B	C	D
Douglas-fir	0	0	0	0.3
Western Hemlock	0	5.2	3.9	5.0
Western redcedar	0	0	0.1	0.1
Pacific Silver Fir	0	2.0	1.3	1.8
Red Alder	0	0.1	0.1	0.1
Total Volume	0	7.3	5.4	7.3
Benefit/Cost Ratio—high market[18]	N/A	1.29	1.14	0.48
Benefit/Cost Ratio—average market	N/A	1.22	1.07	0.40
Benefit/Cost Ratio—low market	N/A	1.15	1.00	0.33
Present Net Value—high market	$0	$212,753	$79,200	-$384,500
Present Net Value—average market	$0	$162,749	$40,636	-$440,173
Present Net Value—low market	$0	$112,745	$2,072	-$495,790
Expected Bid Rate—high market	N/A	$76.27	$67.99	$28.25
Expected Bid Rate—average market	N/A	$72.23	$63.80	$23.79
Expected Bid Rate—low market	N/A	$68.19	$59.60	$19.33
Base Rate(per hundred cubic feet of timber)	N/A	$9.96	$10.15	$10.58

[18] To show the sensitivity of each alternative to log price, the present net value (PNV) and the Benefit/Cost Ratio were calculated using a range of stumpage values. The “average” values displayed in the table are based on average stumpage values for Forest Service sales in western Washington in the first quarter of 2007. The “high” value assumes a 10% increase in average stumpage values, and the “low” value assumes a decrease in average stumpage values. Worksheets are available in the Project Record.

Economics Cumulative Effects

The analysis area for cumulative effects is the regional economy that includes Snohomish County.

The incremental contribution of the Decline Thin Project to the regional economy would be very small.

Past timber harvest activities on all ownerships within the region have affected the viability of timber harvest to the extent that the present industrial infrastructure and workforce have developed as a result of past activities. The effects of individual activities on the viability of timber harvest are not measurable. The same would be true of currently ongoing, and foreseeable future timber harvests. Estimates for expected bid rates for the alternatives are within the range of rates experienced in western Washington within recent years. Because of the competitiveness of the market, and its global nature, none of the Decline Thin Project alternatives would contribute in a cumulative sense toward affecting prices, costs, or harvest viability of other present or reasonably foreseeable timber sales in the area.

Forest Plan Consistency

The Decline Thin Project complies with Forest Plan, as amended, Standards and Guidelines that the Forest Service considers financial efficiency in planning and implementing timber sales and other projects.

Project Record

This EA hereby incorporates by reference the Economics Specialist Report (40 CFR 1502.21). The Economics Specialist Report is located in the Project Record and contains the detailed data, Affected Environment, analysis, references, and technical documentation that the Forest Timber Program Manager relied upon to reach the conclusions in this EA.

Other Effects Analyzed

Aquatic Conservation Strategy (ACS) Review

The ACS is a primary component of the Forest Plan, as amended (USDA Forest Service 1994) for the protection of aquatic and riparian-dependent species. There are four components of the ACS:

- Riparian Reserves
- Key Watersheds
- Watershed Analysis
- Watershed Restoration

Riparian Reserves are recognized in the Decline Thin Project area with no cut areas around the streams and inner gorges and harvest prescriptions that acknowledge and maintain the functions of the Riparian Reserves.

Dan Creek is located within the Sauk River Tier 1 Key Watershed with Plan direction to complete watershed analysis prior to timber harvest and reduce the amount of system and non-

system roads through decommissioning. None of the alternatives to the proposed action adds any new permanent road. Road decommissioning has occurred in the watershed (see Appendix C Cumulative Effects Analysis). Under Alternative C, 0.5 miles of spur Roads 2430016 and 2430017 would be decommissioned, and under Alternative D, the last 2.5 miles of Road 2430 would receive additional decommissioning treatments to road closure work done in the early 1990s.

The Sauk River and Sauk River Forks watershed analysis was completed in 1996 (USDA Forest Service 1996).

Watershed Restoration has proceeded in several locations in the Sauk River (Appendix C). Restoration includes road reconstruction and drainage upgrades, decommissioning, noxious weed treatments, and instream treatments and off-channel aquatic habitat creation or enhancement.

In addition to the four components of the ACS, there are nine objectives that collectively assure the processes that Riparian Reserves are intended to protect function appropriately. Project consistency determinations under the requirements of the National Forest Management Act include a determination of consistency with these nine objectives as described in the Record of Decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl (USDA Forest Service, USDI Bureau of Land Management 1994) page B-10. In addition, court in *Pacific Coast Fed. of Fisherman's Assn. et al v. Natl. Marine Fisheries Service, et al and American Forest Resource Council, Civ.* No. 04–1299RSM(W.D. Wash)(*PCFFA IV*) ruled that project consistency reviews must include the project or site scale and the watershed scale. The following is an assessment of the Decline Thin Project against the nine ACS Objectives.

Objective 1: Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

The Decline Thin Project would have a restorative effect on Objective 1 by promoting the development of late-successional forest characteristics in second-growth stands.

The stands in the project area have developed an even-aged forest pattern over the last 40 to 70 years, and are currently in the stem exclusion stage. Growth rates have slowed due to high stocking levels and the forest floor is depauperate of plants in much of the area due to the low light levels within the stands. Diameter growth has slowed over the past ten years.

The Sauk River and Sauk River Forks watershed analysis (USDA Forest Service 1996 pp. 3b-16 through 3b-22) summarized the Regional Ecological Assessment (REAP)(Peter 1993) that compared current (1993) vegetation in the watersheds with the range of conditions between years 1600 and 1900. Mid-seral forest coverage in the Sauk River sub basin is above the natural range of variability (RNV) and late-seral forest coverage is below the RNV. This is the case in both riparian and non-riparian forest sites.

The thinning project would increase structural and compositional diversity by providing a broader distribution of minority species components, releasing and establishing understory vegetation, and promoting large diameters, crowns and limbs of residual trees. Skips within the harvest units would leave clumps of existing forest, to further promote forest complexity at project and landscape scales (see the Environmental Consequences, Forest Vegetation section). The stands would move more rapidly toward late-successional habitat features with increased

vegetative diversity, both within and outside of Riparian Reserves. The landscape composition of the forest would better reflect the RNV.

The proposed project meets Northwest Forest Plan Record of Decision (ROD) Standards and Guidelines for timber management in Riparian Reserves as outlined in the ROD C-32 with the application of silvicultural practices to control stocking, reestablish and manage stands, and to acquire vegetation characteristics needed to attain ACS Objectives.

No cut riparian buffer widths vary, depending on site conditions, to provide structural and spatial diversity while maintaining Riparian Reserve functions of shade cover, sediment and nutrient filtering, bank protection and large wood recruitment.

Objective 2: Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.

The Decline Thin proposed project would maintain the connectivity functions between Dan Creek and surrounding subwatersheds and within the Dan Creek subwatershed. The harvest units do not include the Riparian Reserves of Decline or Dan Creeks, thus preventing any alteration within those ecosystem components and maintaining connections at the landscape scale.

The Sauk River and Sauk River Forks watershed analysis (USDA Forest Service 1996 pp. 3b-51) states that the impacts to connectivity in the Riparian Reserves at the landscape scale are associated with major road systems. Under Alternative D, replacement of the culvert on Road 2430 at Conn Creek would restore aquatic passage at this barrier and provide connectivity with the small amount of resident fish habitat upstream. Replacement of the culvert would also improve the passage of water, wood and sediment past Road 2430 toward Dan Creek. Decommissioning Roads 2430016 and 2430017 under Alternatives C and D, and Road 2430 north of the sale under Alternative D, would correct some obstructions at intermittent and small perennial stream crossings and allow for unobstructed passage of storm flows across the roads using the natural drainage features for the landscape.

The proposed harvest units are upstream of fish distribution in the subwatershed and mostly involve intermittent and ephemeral streams near the top of drainage divides. The no-cut buffers along all streams would maintain a high-level of connectivity along streams. Some designated Riparian Reserves in the project area are wet areas that were likely created by previous harvest activities. The areas that allow non-fish riparian-dependent species to travel between drainages, are also protected by no-cut buffers.

Objective 3: Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

The Sauk River and Sauk River Forks watershed analysis (USDA Forest Service 1996 pp. 3b-53), notes that the Forest Plan (Forest Service 1990) reported that Dan and Decline Creeks were extensively scoured by the 1980 floods. There are still signs of this scouring event in Decline Creek today. No Decline Thin harvest units include any of the Riparian Reserves of Decline Creek so that the inner gorge of Decline Creek would continue to adjust and stabilize. The haul-route road treatments would improve road drainage such that intercepted subsurface water and road runoff would be routed to the hillslopes rather than concentrated in the intermittent drainages where the added water volume causes channel scour.

The Decline Thin Project would maintain the physical integrity of the aquatic system by using no cut buffers around all stream channels. Temporary road construction into Unit 4 would involve crossing a small stream. The temporary road would be removed after the sale and the physical aquatic features at the crossing restored. Decommissioning Roads 2430016 and 2430017 would have a restorative effect on the Objective 3 because two failed channel crossings would be restored.

Objective 4: Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

Decline Thin would contribute to maintaining the current water quality conditions in the project area and Dan Creek in the short term and improvement in the long term. Water quality protections are embedded in the designation of no-cut buffers along all channels and by implementing best management practices, management requirements, and required mitigation measures.

The Sauk River and Sauk River Forks watershed analysis (USDA Forest Service 1996 p. 3b-57 and 3b-58) discusses water temperature concerns in the Sauk River and reports stream temperature measurements in Dan Creek from July 1981 up to 13°C, and from June 1990 as high as 19°C. (Washington Department of Ecology temperature standard is 16°C). Those measurements are from the period when harvest levels in Dan Creek were the highest. Vegetation disturbance was 30 percent and harvest units included riparian areas along streams. The forests have recovered significantly in the past 17 years, and streamside shade has increased. The watershed analysis (USDA Forest Service 1996 Chapter 4) discusses the expected trend of older forest cover in riparian areas and less road sediment from road decommissioning. The Decline Thin Project would not affect stream temperatures because canopy closure in Riparian Reserves would be retained at 70 percent or greater, and most of the harvest units do not involve perennial stream channels (see Environmental Consequences Hydrology and Soils section). Designated stream buffers consider slope stability, shade cover, sediment delivery potential and water quality considerations.

No-cut buffers would also prevent most sediment generated from timber harvesting operations from reaching stream channels. Road treatments would reduce the amount of sediment derived from the road system in the project area. The sediment that may enter the stream system would not be measurable over the background sediment expected from a forested watershed.

Use of best management practices, management requirements, and required mitigation measures specifically outline requirements for roads, landings and skid trails to minimize and mitigate potential impacts to soil and water. The combination of these measures would be to limit and restrict sediment from reaching flowing waters during project implementation, especially during log haul in wet weather. Yet, at the project scale, some sediment from disturbance during project activities would mobilize during storms during or immediately after project implementation. This sediment would enter the intermittent streams in the harvest area but the small quantities would not measurably add to other sources. Sediment production or turbidity would be expected to be well within the range of what would typically occur during high winter flows or as a result of natural streambank erosion. In the long term, road decommissioning (Roads 2430016, 2430017 and 2430 north of the harvest units) would reduce road sediment and contribute to improving water quality in Dan Creek and the lower Sauk River.

Water quality would remain consistent with the current watershed conditions and project activities would not retard or prevent the ongoing water quality recovery within Dan Creek. Across the larger landscape scale, other activities in the lower Sauk River watershed include restoration activities designed to improve water quality by reducing road effects on runoff and sediment production (see Hydrology and Soils Cumulative Effects).

Objective 5: Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

The Decline Thin Project would contribute to restoring Objective 5 at the project scale, and promoting restoration at the watershed scale, by reducing the concentration of road runoff, de-coupling the road system from the channel network, reducing the risk of mass failure (treatments on Road 2430 north of the harvest units) and decommissioning existing roads to decrease sedimentation. Use of best management practices, management requirements, and required mitigation measures would minimize and mitigate potential impacts that would contribute to the sediment regime (see sediment discussion in Objective 4).

The Sauk River and Sauk River Forks watershed analysis (USDA Forest Service 1996 pp. 3c-52) discusses sediment transport and storage in the watersheds and notes that channel aggradation is occurring in the lower Sauk River north of Darrington due to land management activities. Several activities have occurred in the watershed to begin correcting erosion problems, restore the sediment regime. These include several road projects such as Sauk Roads Treatments and Road 2140 upgrade (see Appendix C). Similar road drainage upgrading would occur as part of the Decline Thin Project. In addition, road decommissioning after the sale would further reduce management-related sediment inputs and reduce the effect of roads on increased runoff.

At the watershed scale, changes in the overall sediment rates attributable to the Decline Thin Project would not be detectable given the high variability in natural rates of sediment input (see Environmental Consequences Hydrology and Soils section). Replacement of the Conn Creek culvert would result in a short (few hours) increase in turbidity when culvert removal and the channel dimensions are restored. Road treatment and road decommissioning with the proposed project would result in an overall decrease in sedimentation and risk of mass wasting following project implementation.

Objective 6: Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

The Decline Thin Project would contribute to maintaining stream flows. The Sauk River and Sauk River Forks watershed analysis (USDA Forest Service 1996 pp. 3c-10 through 3c-20) and this EA discuss vegetation disturbance levels and that the current level of disturbance (17 percent of the forested portion of the watershed with immature forest) is high enough to be of concern for increased rain-on-snow flood peaks. However, as shown in the Hydrology and Soil Environmental Consequences section, Decline Thin would not measurably change the recovery of the vegetation in the Dan Creek subwatershed or the Lower Sauk River watershed.

At the site scale, road treatments would reduce the effect of roads on runoff rates, by more closely matching the natural surface runoff pattern of the hillslopes. This would be accomplished by adding culverts and increasing culvert sizes so there is less potential for

erosion below the roads and less risk of stream capture by roads. This means that the timing and magnitude of flows from the project area would be less affected.

The short change in forest canopy may have a small and short-term effect on rain-on-snow processes. High canopy closure (60–70 percent) prescribed in the sale is the result of rain-on-snow concerns and intended to mitigate those effects. The small change in vegetation disturbance would not result in detrimental increases in rain-on-snow runoff.

At the landscape scale, the lower Sauk River watershed is recovering from a high vegetation disturbance level of 23 percent in the early 1990s to 13 percent in 2007 (details of the vegetation disturbance model are available in the Project Record). Decline Thin would not measurably alter the recovery of vegetation and the risk of rain-on-snow flow increases in the lower Sauk River watershed.

Objective 7: Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

The project would maintain the current floodplain inundation and water table conditions at both the project and the watershed scales due to the protection measures that would be implemented along all stream channels and wetlands.

At the project scale, floodplains are of limited size and extent in the small intermittent channels. No-cut riparian buffers and mitigation measures designed to protect stream channels and exclusion of equipment and yarding across Riparian Reserves, would maintain the physical characteristics of floodplains and channels. There would be no measurable effect on stream flows (See discussion for Objective 6).

Objective 8: Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

The Decline Thin Project would contribute to the restoration of Objective 8 at the project scale and the watershed scale. The project:

- Provides thinning prescriptions to reduce stocking levels that promote stand development toward old forest characteristics of large diameter trees,
- Promotes a distribution of tree species that favors a variety of tree species to increase resiliency of the stand to insect, disease, and climate shifts,
- Maintains no cut buffers for diverse plant communities on all streams and intermittent water courses,
- Retains stream side shading for adequate thermal regulation,
- Maintains channel processes with no new roads,
- Enhances recovery of species with road decommissioning along riparian areas, and
- Maintains and enhances coarse wood debris through retention of material on site and treatments to promote development of large diameter trees.

The Decline Thin Project requires no cut buffers along all riparian corridors and wetlands. These buffers encompass diverse plant communities, protect current shade levels for thermal regulation, protect stream banks from operational disturbances and ensure that eroded soil is not transported to streams or wetlands. Designated no cut buffers along units in the planning area, would also protect channel migration processes. One temporary road (into Unit 4) would cross a small stream channel (using a culvert), and the channel would be restored to near natural conditions after the sale. The proposed Road 2430 decommissioning would remove culverts and pull back sidecast to continue restoration on unstable slopes and along riparian corridors on the slopes of Prairie Mountain.

The proposed thinning treatments are designed to accelerate the development of late-successional characteristics in second-growth stands, and to provide heterogeneity in the landscape by the retention of cedars and minor hardwoods, and through retention areas or "skips" that allow for untreated stand conditions to provide different stocking levels and species composition. Skips also protect snags and coarse woody debris. Coarse woody material of all sizes would remain on site in treated areas. Large pieces of wood that are moved during temporary road construction would be replaced on scarified roads following the stand treatment and road decommissioning.

The harvest prescription provides retention of larger diameter trees, favoring Douglas-fir and western redcedar for their contributions to wildlife habitat, and diversity. Hardwoods and less abundant species are also favored for retention to provide a variety species in the landscape.

Objective 9: **Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.**

This project would contribute to restoration of this ACS objective through the following:

- Reduction of stand stocking to levels conducive to development of future habitat supporting nesting murrelets and spotted owls,
- Maintain microclimatic conditions for species associated with mesic conditions,
- Maintain and restore forest stand diversity and heterogeneity across the landscape, and
- Support native plants with treatments of invasive weeds

The Sauk River and Sauk River Forks Watershed Analysis (USDA Forest Service 1996) and the Forest-Wide Late Successional Reserve Assessment (LSRA) (USDA Forest Service 2001) characterized the Dan Creek complex of watersheds as a landscape with previous harvesting that is currently in the competitive exclusion stage (plantations) of forest development. A specific Riparian Reserves issue for owls is to provide dispersal habitat (ROD B-13). The riparian and 40-year-old stand thinning would reduce stocking levels to maintain diameter and tree height growth and development of forest stand characteristics suitable for nesting murrelets and spotted owls. The Riparian Reserves contribute to the connectivity of the thinned stands with suitable habitat within Dan Creek and connectivity with nearest adjacent LSR (Finney LSR 802).

At the site scale, the Decline project would require no cut buffers along riparian areas. This would maintain the existing microclimates that are important for species that are sensitive to changes in temperature and humidity, such as amphibians, mosses, mollusks, and certain types of vegetation. These conditions would provide for low mobility species associated with

riparian habitat to use these areas for dispersal. The Decline Creek Riparian Reserves contribute to landscape heterogeneity of both thinned and unthinned stands. The retention of cedars, Pacific silver-fir, minor hardwoods and untreated areas or "skips" would provide for different stocking levels and species composition. This variety of stand conditions would create a diverse range of habitats to support a variety of species within the Riparian Reserves and across the landscape.

Road 2430 has existing weed infestations that are proposed for treatment with the decommissioning. If there is no treatment of the invasives, these species would continue to spread and new infestations are likely, including into riparian areas. The project proposes weed spread prevention and eradication activities to be implemented before, during, and after project activities (See mitigation measures described in Chapter 2,Table 3) These activities would protect native species from further competition by invasive species and enhance the revegetation success of native plants.

The proposed action provides for the development of habitat conditions within the riparian areas and across the landscape to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species at the project and watershed scales.

Summary

Overall, the Decline Thin Project would help restore riparian vegetation and aquatic conditions within the project area by promoting the development of late-successional forest characteristics in second-growth stands both within and outside of Riparian Reserves and by improving road drainage, and decommissioning existing roads. The thinning treatments are designed to promote development of residual trees in the Matrix lands with relatively large diameters, crowns, and limbs and help meet the desired future LSR condition in the LSR stands. Because terrestrial vegetation and aquatic components and processes are so tightly inter-connected, meeting the Desired Future Condition for these land allocations would also contribute to abundant, well dispersed, high-quality habitat for riparian-dependant species.

The project would also help restore the long term natural sediment regime through road improvements such as restoring natural drainage patterns (routing water off road surfaces) and reducing the risk of mass failure. These activities would reduce the rate and volume of sediment from chronic surface erosion and episodic mass wasting that would have significant effects on water quality and downstream fish habitat.

Designated no-cut buffers along all stream channels; avoiding any new stream crossings when constructing temporary roads; and implementing Best Management Practices, management requirements, and required mitigation measures as part of the project would protect riparian areas and maintain the existing vegetation, connectivity, water flow, water quality, and habitat.

The Decline Thin Project would include some activities that would result in short-term increases in sediment production at individual sites. For example, culvert installations or upgrades, and road decommissioning work all have the potential to create short term sediment movement. Most culvert work would be done in dry (intermittent) channels. Any stream channel disturbances or adverse water quality impacts would be anticipated to be small, short-term, and localized. Construction sites may continue to produce small amounts of sediment throughout the first winter until the sites are fully revegetated and stable. Any short-term increases in sediment production or turbidity would be well within the range of what would typically occur during high winter flows or as a result of natural streambank erosion. At the

watershed scale, changes in water quality, turbidity, or sediment production would not be detectable.

Environmental Justice

In the past decade, the concept of Environmental Justice has emerged as an important component of Federal regulatory programs, initiated by Executive Order No. 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations.

This Executive Order directed each Federal agency to "make achieving environmental justice by avoiding disproportionately high or adverse human health or environmental effects on minority and low income populations" a part of its mission. This Order emphasized that Federally recognized Native Tribes or bands are to be included in all efforts to achieve environmental justice (Section 6.606).

In analyzing the social and economic effects of the proposed Decline Thin Project, the demographics of Snohomish County and the Darrington area were examined to determine the presence of minority, low income, or Tribal populations in the area of potential effect. Table 17 indicates the Snohomish County race and ethnic profile, compared to the entire state of Washington, as of the year 2000. This data was obtained from the Web site at: http://quickfacts.census.gov/qfd/states/53/53061.html. The Sauk-Suiattle Indian Tribe Reservation is located six miles north of Darrington.

Table 17. Race and Ethnicity Profile

Populations Year 2000	Snohomish County Population 606,024		Washington State Population 5,894,121	
Race or Ethnic Population Group	**Percentage**	**Persons**	**Percentage**	**Persons**
American Indian and Alaskan Native	1.4%	8,480	1.6	94,300
Black or African American	1.7	10,300	3.2	188,600
Asian	5.8	35,100	5.5	324,150
Hispanic or Latino	4.7	28,480	7.5	442,100
White	85.6	518,750	81.8	4,821,400
Other	0.8	4,950	0.4	23,580

Direct and Indirect Effects

With the Decline Thin Project alternatives, there would be negligible change in road access to the area. The alternatives would have no impact on current Tribal or recreation uses. The town of Darrington (the nearest community) is just a few miles away from the project area. There are no known areas of religious significance in the area. There are no known special places of minority or low-income communities within the project area. Individuals may work, recreate, gather forest products, or have other interests in the area. Effects would be similar to all population groups and not disproportionate to low-income or minority groups. Implementing any of the action alternatives would result in no adverse civil rights impacts.

Environmental Justice Cumulative Effects

Because none of the Decline Thin alternatives would be expected to disproportionately affect low-income populations or minority populations, there would be no contribution by the project to cumulative effects associated with environmental justice when added to other past, present or future projects.

Prime Forestland, Prime Farmland and Rangeland

The entire project area is prime forestland. Refer to the Forested Vegetation section for further discussion.

There is no prime farmland or rangeland within the project area, so there would be no direct, indirect and as a result—by definition—no increment to cumulative effects on these resources.

Irreversible and Irretrievable Commitment of Resources

An irreversible commitment of resources results from a decision to use or modify resources that is permanent or renewable only over an extremely long period. The actions described in this document would not cause an irreversible commitment of resources other than removing rock from a Forest Service owned pit or through a commercial source for road gravelling.

An irretrievable commitment of resources occurs when opportunities are foregone for the period of time of the commitment such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line right-of-way or ski-run. Under active management, irretrievable resource commitments are unavoidable, because managing resources for any given purpose necessarily precludes the opportunity to use those resources for other purposes.

Existing roads associated with the Decline Thin action alternatives and haul-route total about 25.7 miles (Road 24–12.0 miles, Road 2430–8.7 miles, Road 2430014–1.6 miles, Road 2430016–0.3 mile, Road 2430017–0.2 mile, and Road 2432–2.9 mile). This is an irretrievable commitment of resources and a temporary loss of timber production from about 100 acres (assumed clearing width of 30 feet).

Under Alternative A (No Action) and Alternative B, the 25.7 miles of road would continue to be irretrievably committed. For Alternative C, approximately 0.5 miles of road could be decommissioned while Alternative D would decommission approximately 3.0 miles of road. Eventually, the decommissioned road would become forested and return to productivity.

The use of rock from the commercial rock sources for gravelling in the road reconstruction would be an irreversible commitment of resources.

Potential Conflicts with Plans and Policies of Other Jurisdictions

Several governmental agencies including town, county, and Tribal representatives have been contacted in regards to this project (refer to Appendix A for Public Participation). There are no known conflicts between the alternatives discussed in this document and the plans and policies of these other jurisdictions.

Chapter 4—Agencies and Persons Consulted

The Forest Service consulted the following individuals, Federal, agencies, Tribes and non-Forest Service persons during the development of this environmental assessment:

Federal, State, and Local Agencies

National Oceanic and Atmospheric Administration, National Marine Fisheries Service
US Fish and Wildlife Service
State Historic Preservation Office

Tribes

Sauk-Suiattle Indian Tribe
Stillaguamish Indian Tribe
Tulalip Indian Tribes
Upper Skagit Indian Tribe
Samish Tribe
Swinomish Tribe

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Appendices

Appendix A – Public Involvement

Appendix B – References Cited

Appendix C – Cumulative Effects Information

Appendix D – Silvicultural Information

Appendix E – Climate Change and Implications

Appendix F – Monitoring Forms

Appendix G – Glossary and Common Terms

Appendix A–Public Comments Involvement

Scoping, Public Involvement

Environmental analysis, including scoping[19], began several years ago for the proposed Decline Thin Project. In June 2005, letters were mailed to Tribes and then to persons on District mailing lists, requesting comments on the proposed Decline Thin Project. In July of 2005, District staff organized two field trips to the Decline Thin Project area. Members from Pilchuck Audubon, North Cascades Conservation Council, as well as local citizens attended this field review. . Additional scoping of Tribes and interested public took place in 2007. On March 13, 2007, the Darrington Ranger District hosted an open house to discuss this and other projects with more than 50 people in attendance. The Forest Service received a total of 12 responses to the 2005 and 2007 scoping efforts. These responses are grouped below by concerns or areas of interest. The ID Team has considered these comments received in response to the 2005 and 2007 scoping letters, the two field trips and the 2007 public meeting.

The ID Team and the Responsible Official will consider substantive comments received (as per 36 CFR 215), and as appropriate, improve the analysis in response to those comments. Copies of the comments received and documentation of the agency's consideration of those comments will be available in the Project Record.

Concern or Area of Interest

All written responders (12) had comments on the proposed stand treatments and road treatments. There were eight comments on the proposed LSR/Matrix exchange, and a number of comments on restoration, stewardship contracting, thinning treatments in the Riparian Reserve and LSR thinning treatments.

1. Stand treatments characterization

- Appreciated clear purpose and need statement
- Both support for and against thinning treatments in the Matrix
- Various recommendations were made on the thinning treatments
    - Support for variable density thinning prescription with skips and gaps, but differing opinions on size of skips and gaps.
    - Keep thin light, less than 40 percent basal area, avoid complex stands, have a size limit for trees removed, leave legacy tree
    - Keep temporary access roads narrow and decommission thoroughly
    - Use existing roads

19 Scoping is the procedure by which the Forest Service identifies important issues and determines the extent of analysis necessary for an informed decision on a proposed action.

2. LSR/Riparian Reserve Thinning treatments:

- Concern for meeting objectives of LSRs and Riparian Reserves with any treatments
- Opposition to treatments focus on the position that there is not a need for the thinning
- If thinning occurs, recommendations to keep treatment light and not be commercial–leave material on site

3. Road Restoration:

- Support for upgrading roads
- Support for Road 2430 decommissioning
- Meet Forest Plan, as amended, Standards and Guidelines
- Treat unneeded roads with storage or decommissioning

4. LSR/matrix exchange:

- Appreciate creative thinking—worth further consideration
- Both support for exchange as logic and opposition since no exchange provides defacto old forest management in Matrix
- Support for exchange had provisions from different perspectives:
    - No additions to LSR that would need new roads, no recent clearcuts to LSR
    - Maintain same amount of land managed for timber

5. Stewardship contract:

- Interest from a number of responders in participation, but not in the leadership role
- Support for the restoration work that could be accomplished, especially with roads

The stand treatment considerations are covered in purpose and need and indicators. The road restoration concerns are covered in the hydrology issue and purpose and need indicators. The LSR/matrix exchange and stewardship contracting options are discussed in the alternatives considered and not further developed.

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Appendix C—Cumulative Effects Information

Definition

Cumulative impact is the impact on the environment, which results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor or collectively significant actions taking place over a period of time (40 CFR 1508.7).

Cumulative Effects Analysis

The analysis was guided by the June 24, 2005 memo, *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis*, Executive Office of the President, Council on Environmental Quality (Executive Office of the President, CEQ 2005). Briefly, the memo states that agencies are to use scoping to determine whether, and to what extent, information about the specific nature, design, or present effects of a past action is useful for the agency's analysis of effects of a proposed action and its reasonable alternatives. "Agencies are not required to list or analyze the effects of individual past actions unless such information is necessary to describe the cumulative effect of all past actions combined" (Executive Office of the President, CEQ 2005). The memo also noted that agencies can generally conduct an adequate cumulative effects analysis by focusing on the current aggregate (or remaining, residual) effects of past actions without delving into the historical details of past individual actions.

To begin the analysis of cumulative effects for the Decline Thin Project, the members of the Interdisciplinary Team (ID Team) first determined, for each resource, a cumulative effects analysis area; see the Affected Environment (Project Record), the Environmental Consequences section for each resource (Chapter 3) for a description. The area varies by resource, but in many cases, the boundary utilized was the Dan Creek subwatershed.

The ID Team then considered the direct and indirect effects on the environment that are expected to result from the proposed action and alternatives. Once these effects had been determined, the ID Team then considered, for each resource, the past, present, and reasonably foreseeable future actions that are relevant. That is, in the judgment of the resource specialists, they occur in the same cumulative effects analysis area for that resource, and may overlap in time and space with the direct or indirect effects from the Decline Thin alternatives.

The team then assessed the spatial extent of the effects of the alternatives, resource by resource, to determine if they would add to, modify, or mitigate the overlapping effects of the past actions, present actions, and expected future actions.

If there was no overlap in **time** (that is, any effects to that resource from past, present, and future projects occur at a different time from the alternative's effects), ***AND*** no overlap in **space** (that is, any effects are outside the cumulative effects analysis area for that resource), then the project had no contribution to cumulative effects for that resource. Examples are in Table 18.

The cumulative effects area varies by resource. For example, the area of potential cumulative effects for water quality is the Dan Creek sub-watershed (6th field hydrologic

unit), a tributary to the lower Sauk River watershed. For wildlife species with larger ranges, the area of potential effect would be larger, and for more localized resources, the area would be much smaller. Refer to the Affected Environment section (in the Project Record) for specific resource descriptions. Table 18 lists past, present, or reasonably foreseeable future actions within the vicinity of the Decline Thin Project that may have effects that spatially and/or temporally overlap with the estimated effects of the proposed Decline Thin Project; that is, where cumulative effects could occur. See the map at the end of this appendix showing activity locations.

Note: All distances from the Decline Thin Project area are estimated.

Table 18. Past, Present, and Foreseeable Actions for Cumulative Effects Analysis

Activity	Extent	Timing	Miles from Decline Project
Future Actions			
Dan Creek Thin	400–500 acres of thinning, 50–70% canopy retention in middle of Dan Creek, Sauk	Proposed for sale in 2009, planning begin 2007	2 air miles, more than 3 miles downstream
Road 2140 Upgrade	Culvert and drainage upgrade	2008	3 air miles, 5 miles downstream
Future timber harvest on private and state lands.	Extent is unknown, but there are private & state timberlands to the north and west of the forest boundary	Some as early as 2008 or 2009 depending upon access	Approximately 2 miles north and four miles west of the project area
Forgotten Thin Plus	400 acres of thinning, no riparian treatment, in Sauk River watershed	Under contract with logging expected 2007–2012	6 air miles, more than 16 upstream miles
ERFO road repair and culvert replacement	Road 2435 culvert replacements that drain into Dan Creek	Planned for 2007	1 mile upstream
Present Actions			
Road Maintenance	Brushing and blading Roads 24, 2430, & 2435	This action is ongoing. More than 12 miles of grading in 2006. About 13 additional miles on rotating basis	Within and around the project area
Timber Stand Improvement	Precommercial thinning and hardwood release on stands throughout the watershed	Ongoing	In and adjacent
Sauk Road Treatments	Roads 2210013, 2210, 2211, 2420, 2421, 2421011, 2421012, 2411, 2400015, 2140 system culvert removal or upgrade, remove unstable fill	Ongoing, started 2002 Skagit River Systems Cooperative	1–3 air miles
Sauk River County Bridge Replacement	County replacing main Sauk River Bridge, which is part of the haul-route.	Construction started, finish 2009	13 road miles, over 6 downstream miles
Gold Hill Road Repair, including White Chuck Bridge	Repair flood damage to the Road 22 System on Gold Mtn., including replacing the White Chuck River Bridge.	Some repairs completed 2006. More repairs and bridge replacement expected to occur in 2008–2009. Past repairs on Road 22 in 1974, 1980, 1990, 1996, 1999.	4 air miles, over 15 upstream miles
County Road Reconstruction	North-side Sauk Road damaged during 2003 flood, replace crossings at Mouse & Bob Lewis Creeks on Sauk Prairie Road	Snohomish County owns road. Repair planned for 2006–2010	2.0 to 6.5 miles from project area
Noxious Weeds Eradication	Treatment of known sites of infestation along Road 24	Treatment began in 2003 and is ongoing	About 4 miles northwest

Activity	Extent	Timing	Miles from Decline Project
Dan Creek Horse Pasture (Mouse Creek) Restoration	5 acres treated for noxious weeds and riparian plantings	2006–2007	2 miles downstream
Trail Maintenance	Old Sauk, White Chuck Bench, Beaver Lake, Peek-a-boo, Eight Mile, etc.	Repairs after 2003 flood, damage from 2006, future repairs, brushing and tread maintenance rotating basis	More than 8 miles upstream
Private Timber Land	Continued harvest and reforestation in accordance with State regulations	Ongoing	More than 3 miles downstream
State Timber Land	Continued harvest in accordance with State Habitat Conservation Plan	Ongoing	More than 4 miles downstream
Private Land Development	Construction of buildings, paving, and conversion of forest land into residential. Wright Gravel Pit, Hampton Lumber Mill, etc.	Ongoing	More than 3 miles downstream
Past Actions			
Funnybone Thin	431 acres of timber thinned; 25% of ac. In Riparian reserves with 70% canopy closure (Upper Dan, Sauk)	15 acres thinned in 2001; 416 acres thinned in 2005	0.5 miles upstream and across Dan Creek
Wishbone, Too, Rib Thin	1,244 acres thinned. 10 acres in Riparian Reserves with 70% canopy retention (upper Dan Creek, Sauk River near White Chuck River)	Completed in 1992 to 2000	Wishbone just up-stream. Too and Rib 3–4 air miles, over 15 upstream miles
Gold Hill Fire Salvage Timber Sale	16 acres of fire killed trees salvaged	This salvage has been completed and is replanted	3 air miles; over 14 upstream miles
Dubor and Dontbor Thins	600 ac; 25% within Riparian Reserves; 70% canopy closure.	Completed 1992 to 1995	4 air miles. 12 miles upstream
Clear-cut Timber Harvest	9,735 acres logged (62% of Dan Creek Complex. 2004 acres logged (11%) in Clear Creek Complex. 12,997 acres (40%) in Mid Sauk complex	Completed 1920–1996. From Watershed Analysis p. 3b-37	In and adjacent to Decline Thin Project area
Road Reconstruction	Roads 24, 2424, 2420 reconstructed for Funnybone Thin	Completed 2001	1–3 air miles. Road 24 along Dan Creek
Road Decommissioning	Road 2080 and segments in Goodman and Helena drainages and Prairie Mt. of 10 miles	Completed 1990 to 2004	More than 10 miles upstream
Dutch Creek Bridge	Culvert to bridge for fish passage on Mt. Loop Highway	Completed in 1998	More than 12 miles upstream

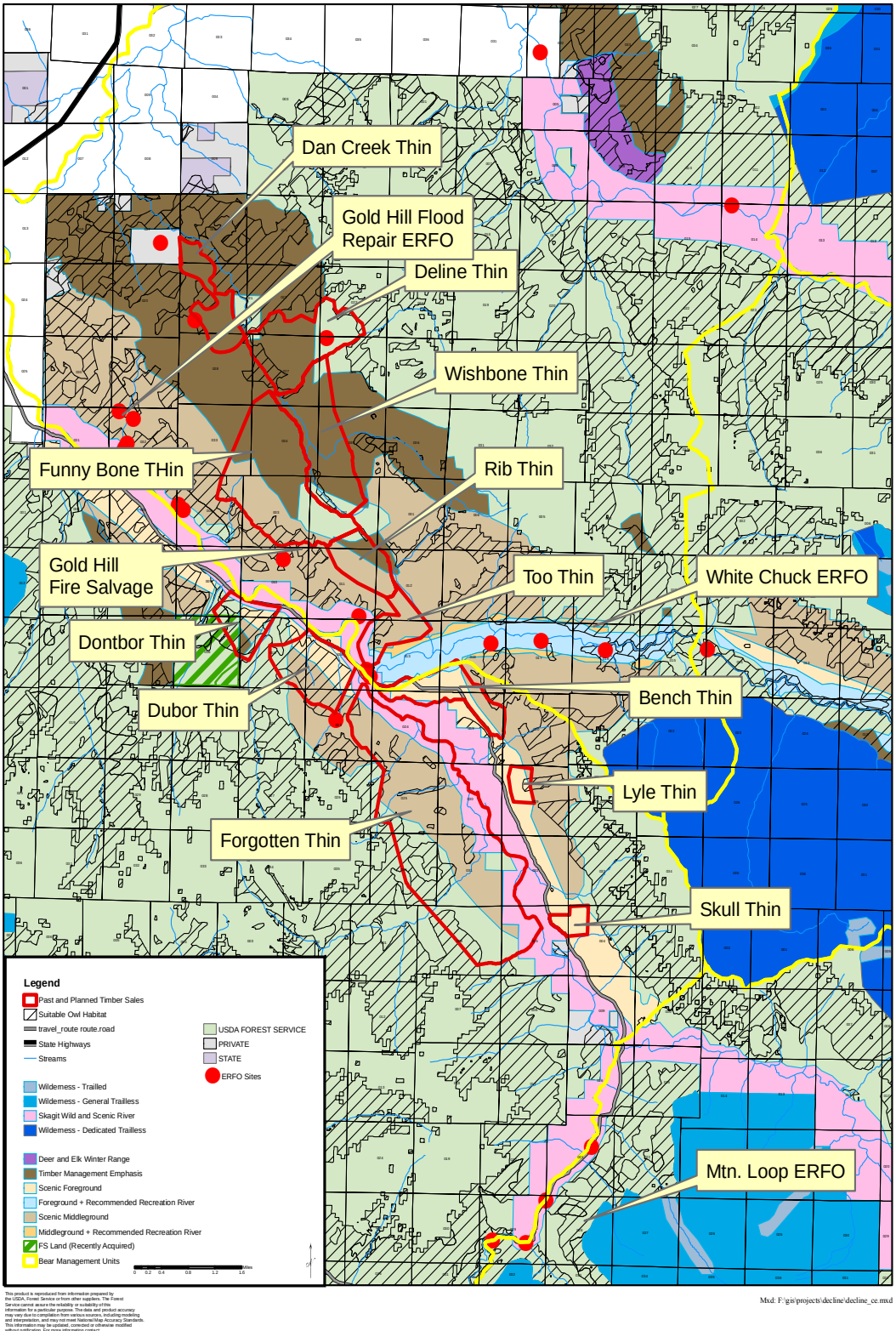
Instream Treatments and Off-channel habitat Creation or Enhancements	Early Coho Creek (30 structures—1989); Skinny Sauk Pond (1.1 ac–1987); Constant Channel (0.2 ac -1991); Hyachuck Pond Complex (3 ponds, 4.5 ac—1985 and 1990, constructed rearing ponds and added woody debris	Increased habitat diversity; increased quantity and quality for rearing and spawning	More than 8 miles upstream
Gold Hill Fire Suppression	Blasting, fireline, road reconstruction, water and retardant air drops.	2003	3 air miles, more than 10 upstream miles
Gold Mtn. Communications Tower	Special use permit to Snohomish County in 2005.	Constructed 2005	3 miles

Table 19 lists projects that have been known to occur in and around the mainstem Sauk River that were found not to contribute to potential cumulative effects. The main reasons are that these projects have long been completed or are far from the Decline Thin Project area and have no remaining, residual effects that could overlap both temporally and spatially with project effects from Decline Thin; effects of the projects were only site-specific to the location of that project; or the estimated effects from Decline Thin would not measurably add to any residual effects.

Table 19. Projects Reviewed and Found Not Contributing to Cumulative Effects

Project	Description	Rationale for Not Contributing
Past Actions		
Gold Hill Fire Suppression	Blasting, handline, road reconstruction, helicopter dipping, retardant drops in 2003.	Actions were mitigated or minimize by localizing retardant drops, water dipping, and sediment delivery. No overlap in time.
Clearcut Timber Harvests	9,735 acres logged (62% of Dan Creek Complex. 2004 acres logged (11%) in Clear Creek Complex. 12,997 acres (40%) in Mid Sauk complex (1950–1990)	Proposed project would not add to the residual effects from these activities (16 and 46 years ago) to hydrologic maturity or to spotted owl and marbled murrelet habitat, or to snag associated species.
Gold Mtn. Communications Tower	A special use authorization was issued to Snohomish County in 2005 to build and operate a radio tower on Gold Mountain.	Effects are limited and specific to the tower site.
Timber Stand Improvement	Hydrologic recovery of vegetation cover, and riparian and instream wood.	Effects are limited and specific to the TSI sites.
Forgotten Thin Plus	400 acres of thinning, no riparian treatment, in Sauk River watershed.	Beyond the area of potential cumulative effects for all resources.
Skull Thin	Completed thinning, no riparian treatment, in Sauk River watershed.	Upstream of the area of potential cumulative effects for all resources.
Dubor and Dontbor Thins	600 ac; 25% within Riparian Reserves; 70% canopy closure. Completed 1992 to 1995.	Effects are limited, recovery from actions has occurred.

Figure 30. Cumulative Effects Area



Appendix D—Silvicultural Information

Decline Thin Project Area Stand Diagnosis

Summary

This silvicultural diagnosis describes the biotic and abiotic features conditions of the Decline Thin Project stands. Management direction is taken from the Mount Baker—Snoqualmie National Forest Land Management and Resource Plan, as amended.

Stand Identity and Location

These stands were chosen for analysis based on the desire to provide commercial wood fiber to the economy and to change their overstocked condition to one, which promotes stand health and vigor.

The Decline Thin Project area is included in T. 32 N., R. 10 E. Sections 22, 23, 26, and 27, Willamette Meridian. It is located on the Darrington Ranger District, Mt. Baker-Snoqualmie National Forest.

The Decline Thin Project Area covers 927 acres in the Dan Creek subwatershed. The Sauk and Sauk River Forks Watershed Assessment was completed in 1996 and provides information for analysis. The project includes timber harvest using ground-based and cable yarding systems. Areas proposed for timber harvest include two stand age classes, an area of seventy-year-old stand, (Units 1 through 9) of 214 acres and another area of forty- year-old stand (Units 10 through 13) of 145 acres. Specific and detailed stand data can be found in the Project Record. The Decline Thin Project is located on the Darrington Ranger District of the Mount Baker—Snoqualmie National Forest. The Forest is situated in the North Cascades of Washington State.

Abiotic Conditions

The 40-year-old stand spans elevations ranging from 1880 feet to 2680 feet and the 70- year-old stands range from 2680 feet to 3480 feet.

Aspect is primarily west to southwest, and slope is variable and broken, ranging from 10 percent to 60 percent near the top of the project area. The project area is dissected by several shallow draws running east to west into Dan Creek.

Old Cat trails or roads riddle these stands from the previous harvest in the 1930s, 1940s and 1960s. Usually on land too steep for present-day ground based yarding standards, the old trails were used for both downhill yarding with cats, and uphill yarding with skyline.

Climate

The climate of the surrounding area is Pacific Maritime influenced by marine air masses moving across the region from the southwest to the northeast. It receives an average annual precipitation of approximately 100 inches falling as snow and rain, with mild year-round temperatures, abundant winter rains, and dry summers.

Soil and Water

The upper portion of the Skagit basin above Sauk River and below the headwaters drains the High Cascades Mountains primarily comprised of Pre-Cretaceous and Pre-Tertiary metamorphic rock. Numerous tributaries drain glaciers. Considerable portions of the basin are wilderness. However,

three mainstem dams were constructed in this reach during the 1920s. Much of the stream network in this reach is not accessible to anadromous fish.

With the exception of Unit 13 and a small portion of Unit 11, all the harvest units are on one SRI soil map unit: 076M; a well-drained, moderately deep gravelly loam over schist bedrock. The project area contains many small benches that appear to be very old mass soil movements. At the base of these benches, shallow bedrock forces subsurface moisture to the surface. This results in numerous wet areas and seasonal springs. The soil is prone to damage by heavy equipment, especially if wet. Low ground pressure equipment is recommended, as well as a slope restriction for ground based equipment of 35 percent or less.

While the surface duff layer has accumulated to depths of ten to twelve centimeters in the 70-year-old stands, it remains about half that in the 40-year-old stands and in areas of higher impact by earlier logging, such as skidding in Unit 10. The surface organic layer may recover in a few more decades. Recovery of compacted soils, may take a century or more. No water quality issues are known to exist within the project area, although the majority of the project area is located in the rain-on-snow zone and is therefore susceptible to erosion (Hydrology Report, Decline Thin Project).

Noxious Weeds

Noxious weed sites were documented and will be considered as prime candidates for "skips" to minimize lighting to the weeds

Fuels

There is a concern for hazardous fuels along open and travelable roads. Fuels will be reduced along open roads as recommended.

Field examination, review of stand exams, and silvicultural analysis of stocking levels and tree size were used to determine the vegetation characteristics of stands in the project area.

Vegetation Community Attributes

The Decline Thin Project area falls in an area split by the Pacific Silver Fir ecozone and the western hemlock ecozone.

Plant Associations are primarily Western Hemlock/ Swordfern/Salal in the 70-year-old stands and range from Western Hemlock/Swordfern/Salal to Silver fir/Alaska Huckleberry in the 40-year-old stand. The Older stand is in the Moist POMU Plant Association Group (PAG) and the younger stand falls into both the Moist POMU and the Dry VAAL Plant Association Group.

The LSR Assessment for the Mount Baker-Snoqualmie National Forest draws a correlation between PAG and the length of time expected for a stand to develop into old-growth. For the two PAGs noted above 175 to 250 years would be the expected time frame (FS, 2001).

Age

Stand ages are currently 70 years and 40 years. 2112 would be the earliest expectation for old-growth features in the 70-year-old stand and 2217 would be for the 40-year-old stand.

Spatial Arrangement

Generally, these stands are continuous canopy cover across the slope from top to bottom. However, the younger stand at the top of the slope is less contiguous and has some openings where the understory has some coverage in the form of shrubs, forbs, and cryptogams. This is a very small

amount of the stand (perhaps 6 acres), but worth noting to refer to the possibility of creating openings and what may result in the understory.

At the landscape level this project area falls within the Dan Creek subwatershed which has had a recent history of commercial thinning and pre-commercial thinning in the past 10 years and even-aged regeneration harvest in the past 80 years.

Stand Structure

All forest stands included in this project are currently in the stem exclusion structural stage (Oliver 1996). They have developed into an even-aged pattern in the past 45 to 70 years. Dominant and co-dominant trees are apparent and have expanded into growing space occupied by less competitive trees. Intermediate trees are still present but under high competition from dominant and co-dominant trees, with some suppressed trees dying due to lack of light in their overtopped state. Small diameter litter and residue from the previous logging operations dominate the forest floor, as little understory vegetation survives in this low light environment

70 Year-old Stand

These stands are similar in composition, size, and structure. The age of the dominant and co-dominant trees ranges from 66 to 76 years. Diameter growth of the best growing trees for the last ten years averages 1.1 inches, with the trend in diameter growth declining compared to the previous years. Units 8 and 9 include several larger trees compared to the stand average. These range from 22 to 33 inches dbh and occur in patches near the bottom of the stand (west edge of project area).

Stand density averages 700 trees per acre (including trees in all diameter classes) across these stands, but varies greatly with the occurrence of regeneration. Trees greater than 7 inches dbh average 276 per acre. Basal area averages 360 square feet per acre. Stand density index (SDI) is at 666, which is 95 percent of maximum SDI for this combination of species. Quadratic mean diameter (qmd) in the stand is 14.7 inches and canopy cover is 95 percent.

The average species composition of trees 7 inches dbh and larger is 55 percent western hemlock, 12 percent western redcedar, 19 percent Pacific silver fir, and 7 percent Douglas-fir. Laminated root rot, red-brown butt rot, and Armillaria root disease are present, but uncommon, as is hemlock dwarf mistletoe.

The forest floor is depauperate of plants in much of the area and has a substantial covering of litter and residual downed wood from the previous logging operations (logs up to 30 inches diameter). In pockets or small open areas where understory plants are established several species are present including swordfern, oak fern, deer fern, red huckleberry, salmonberry, devil's club, vine maple, thimbleberry, salal, foamflower, twinflower, and several mosses and lichens. There are also small amounts of red alder, black cottonwood, pacific yew, Sitka spruce, and vine maple.

Current and past tree competition for growing space within the stands has resulted in overtopping and competition-related mortality. These standing snags are generally smaller trees, most of which are twelve inches diameter or less. Some remnant large snags (greater than 20 inches dbh) are present but uncommon.

The projected numbers of snags per acre in the overstory are 22 Douglas-fir, 20 Pacific silver fir, 22 western hemlock, and 6 western redcedar.

40 Year-old Stand

The dominant trees in these stands are approximately 40 to 45 years old, regenerated from clear cut harvesting. Most of the area was not pre-commercially thinned following the harvest resulting in a

high stem density of 840 trees per acre (including trees less than 7 inches dbh), and a basal area of 297 square feet per acre.

Trees greater than 7 inches dbh average 370 per acre. Stand density index (SDI) is at 588, which is 85 percent of maximum SDI for this combination of species. Fifty-five percent maximum SDI is where density related mortality begins (Drew and Flewelling 1979). Diameter growth within the past ten years is 1.12 inches, showing a declining trend from previous years. Dead trees are projected to be 23 per acre: 11 western hemlock, 6 Douglas-fir, and 6 Pacific silver fir.

The average species composition of trees 7 inches dbh and larger is 57 percent western hemlock, 20 percent Douglas-fir, 20 percent pacific silver fir and 1 percent western redcedar.

There is also a component of red alder, vine maple, and black cottonwood in this stand. Understory vegetation varies greatly, but occurs mainly in gaps. The majority of the densely stocked areas have no plants in the understory. In small openings, the following plants were noted: devil's club, salmonberry, salal, huckleberry, twinflower, Oregon grape, sword fern, oak fern, lady fern, queen's cup beadlily, and foamflower.

There is litter and downed wood present throughout these stands, though less total accumulation and smaller in diameter than found in the older 70-year-old stand.

Quadratic mean diameter (qmd) in the stand is 10.4 inches and canopy cover is 95 percent.

Mean annual increment is decreasing in the 70-year-old stand and is projected to continue in that trend. The 40-year-old stand is increasing until 2007, when it starts to decrease according to the Forest Vegetation Simulator modeling.

Both stands would benefit from a thinning to increase growth and capture mortality–related volume.

Forest Plan Management Direction

Matrix

The Matrix contains prime forestlands. The Forest Plan, as amended (USDA Forest Service 1990), has a Forest-wide goal to maintain prime forest-lands in timber production. The Matrix stands have good health and vigor but are beginning to show declining tree vigor and increased mortality due to competition from overstocking, making them susceptible to insects and pathogens.

Approximately 603 acres (65 % of the project area) fall within the Matrix land allocation. The desired outcome of Matrix lands is to provide a steady supply of timber sales that can be sustained over the long-term without degrading the health of the forest (ROD pp. 3 and 4).

Late Successional Reserves (LSR)

The Northwest Forest Plan (USDA Forest Service Record of Decision (ROD) 1994) recognizes one of the objectives of LSR as enhancement of late successional and old-growth forest ecosystems. West of the Cascades, it limits thinning to stands less than 80-years-old. The Mt. Baker-Snoqualmie Forest-wide Late Successional Reserves Assessment (LSRA) (USDA Forest Service 2001) identifies as a key objective the evaluation of the potential for silvicultural treatment to benefit the development of late successional and old-growth forest characteristics in stands less than 80 years of age. A gradual increase in abundance and diversity of understory vegetation may not occur for 100 to 200 years without intervention (D.R. Thysell and A.B. Carey, 2000).

Management activities designed to accelerate development of new spotted owl habitat are desired. Retention of legacy trees in areas of timber harvest enhance habitat quality as will changes in forest

structure which allow for understory development and increase suitable habitat. LSR Stands considered for treatment by this project are less than 80-years-old (USDA Forest Service 1994). Treatments in stands within LSR in this project would further these objectives.

Riparian Reserves

According to the Northwest Forest Plan, application of silvicultural practices is appropriate to control stocking, manage stands, and acquire desired vegetation characteristics needed to attain ACS objectives (USFS 1990). Treatment of stands in Riparian Reserves in the Decline Thin Project area were assessed as potentially benefiting from treatments which would increase species composition and structural diversity well-distributed populations of native plant, invertebrate, and vertebrate riparian species.

Table 20. Forest Plan Allocations within Project Area

Land Allocation	Acres
Riparian Reserve	Accounted for in other land allocations.
Matrix	603
Late Successional Reserve	324
Total acres in project area	**927**

Stand objectives

Desired future conditions include the following measurable features.

Tiering to the Forest Plan, and the watershed assessment,

4. **1. Provide commercial wood fiber products consistent with the 1990 Forest Plan, as amended.**
5. **2. Retain health and vigor and enhance growth that would foster long-term site productivity and horizontal and vertical diversity in currently overstocked stands.**
6. **To apply silvicultural practices within Riparian Reserves to reduce stocking, reestablish and manage stands, and to acquire desired vegetation characteristics needed to attain riparian objectives (Forest Service, Bureau of land Management, 1994, ROD page C-32).**
7. **The project area includes Riparian Reserves with high stocking level. The project proposal provides an opportunity to control stocking and promote desired vegetation characteristics.**
8. **To apply silvicultural practices for Late Successional Reserves to maintain a functional, interacting, late-successional and old-growth forest ecosystem.**

Maintain adequate amounts of downed woody debris on site using Forest Plan standards and guides.

The 70-year-old stand which is allocated to a timber harvest emphasis land management strategy is declining in growth and would benefit from a density reduction to within the management zone of between 35 and 55 percent Stand Density Index. This is the desired density for stand resiliency to forest pests and to take advantage of growing space in between thinnings or regeneration harvest.

To attain this level, the basal area, trees per acre and size of average trees is considered. Maximum Stand Density Index was averaged for Douglas-fir and western hemlock to determine an acceptable stocking level. 693 SDI was considered maximum and 35 percent of maximum equals 243 SDI.

The 40-year-old stand also would benefit in terms of forest health and resistance to disturbance from a thinning to a recommended 35 to 55 percent maximum SDI for its size, and basal area.

In addition, the 40-year-old stand would benefit from a variable density thinning which creates some openings to establish understory plants and vary the distribution of those plants across the stand. Diverse structure and species composition is a desired future condition for the 40 year-old stand in Late Successional Reserve land allocation.

Both stands include Riparian reserves, which could benefit from a thinning treatment. The current high canopy closure present across most of the stand, is excluding tree and plant recruitment in the understory. Long term downed wood supply to the streams is in jeopardy without treatment, and the species composition is homogeneous and does not provide good habitat for terrestrial species using the Riparian Reserves at this time, nor is it projected to in the future.

Figure 31. Basal Area and Trees per Acre by Diameter Class for 70-year-old stand.

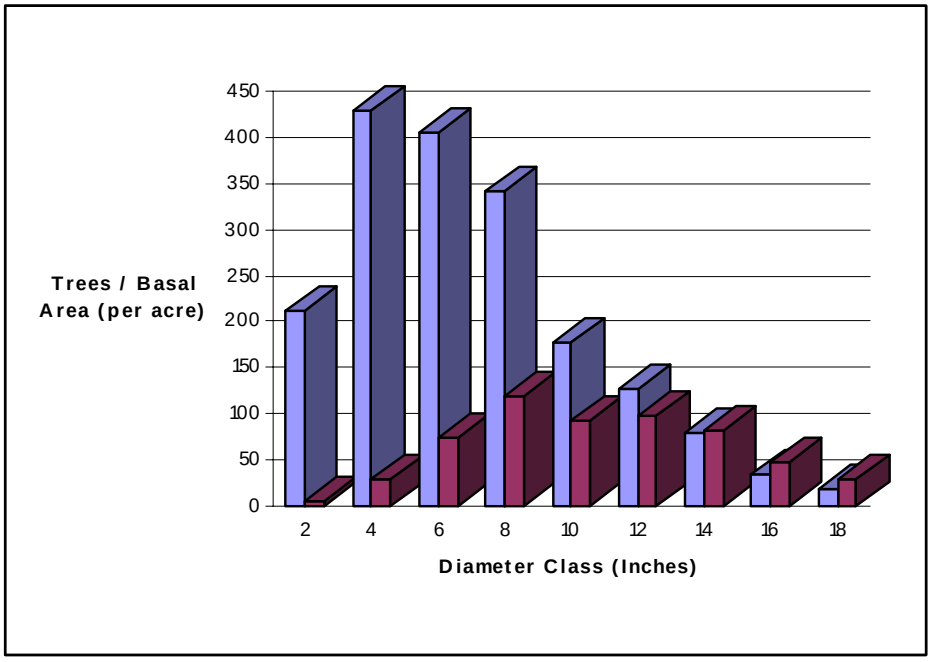


Figure 32. Basal Area and Trees per Acre by Diameter Class for the 40-year-Old Stand

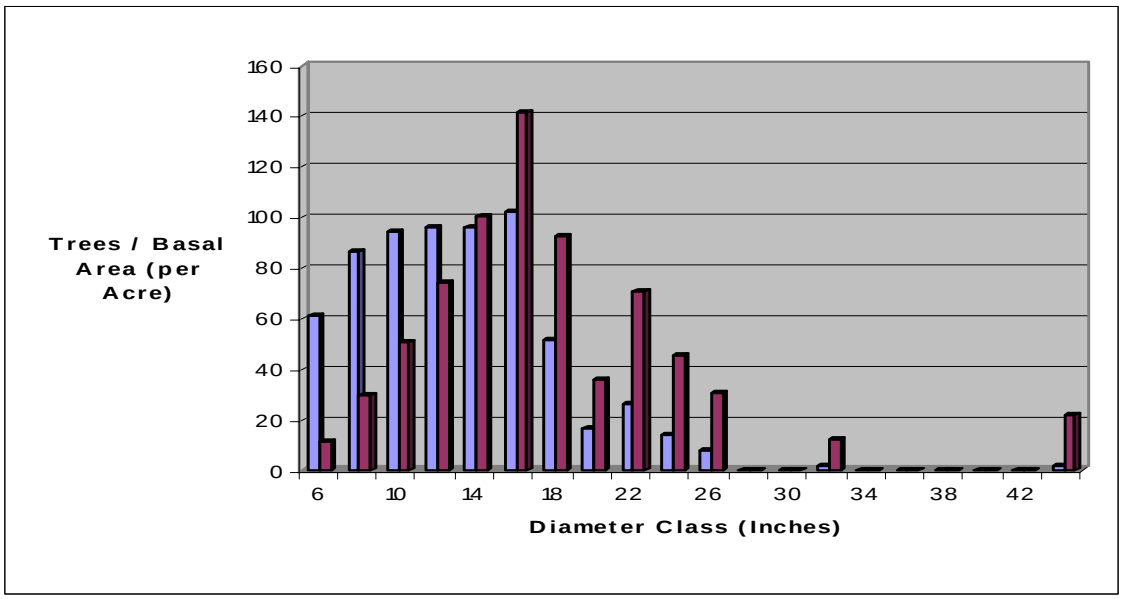


Table 21. Decline 70 Year-Old Stand Information 2001

All Species	0–5.9”	6–9.9”	10–13.9”	14–17.9”	18–21.9”	22–25.9”	26–44”
Trees/Acre	883.1	180.6	190.8	199	67.7	41.1	12.4
Basal Area (Sq ft/ac)	8.9	80.7	125.5	241.8	128.6	116.6	64.8
Volume (Cubic Feet)	0	1,122.6	5,276.5	11,058.2	6,361.8	5,544.9	3,063.5
Volume (Bd Feet)	0	6,154	27,297.7	55,161.8	33,628.2	3,0451.7	18,636.3
Average Ht (Feet)	14	55	82	96	116	107	121

Table 22. Decline 40 year-Old Stand Information 2002

All Species	0–5.9”	6–9.9”	10–13.9”	14–17.9”	18–21.9”	22–25.9”	26–44”
Trees/Acre	640	748.5	302.8	114.3	17.1	0	0
Basal Area (Sq ft/ac)	31.4	192.4	188.1	127	28	0	0
Volume (Cubic Feet)	0	4,074	6,859	4,808	1,117	0	0
Volume (Bd Feet)	0	3,525	14,621	12,667	6,154	0	0
Average Ht (Feet)	14	48.8	67.6	77.6	83	0	0

Limitations

The stands are currently of a homogeneous structure, and regeneration is limited by light availability. The recruitment of patches of conifer regeneration is desirable, yet is expected to be primarily western hemlock with little diversity in the understory unless

cultured. Natural regeneration is expected as western hemlock due to the residual shaded environment.

The possibility of achieving and maintaining 70 percent canopy cover for hydrologic concerns limits the ability to make openings of the sizes possibly desired for structural heterogeneity.

40-year-old stand is small and may not have economical value as a commercial harvest. If not, non-commercial treatment will be necessary and may not provide desired results in terms of fuel loadings and the cost of disposing of fuels.

Slope steepness (often greater than 35%) and soils concerns require low ground pressure equipment and one-end suspension during yarding. The yarding system is limited to ground based or skyline. A small amount of helicopter yarding would be infeasible.

The broken nature of the slopes may be troublesome for reliable deflection across the entire project area. Some temporary roads will be necessary to facilitate logging systems. Intermediate supports may be used in cases where deflection is not attainable with a conventional skyline setting.

There is a concern that there may be problems for equipment such as harvesters and forwarders working in these stands under these high levels of clustered downed logs. Hand falling and tractor skidding may be preferred over cut-to-length operations.

Assumptions in Modeling

For volume calculations: FVS files do not include damage assessments from the stand exams, with the exception of dwarf mistletoe. Assume a 10 percent merchantable BF defect and merchantable CF defect for all species.

For StrClass keyword: Set a minimum 30 foot height gap between layers. Seedling/Sapling/Pole diameter break = 5.0 ". dbh break between pole and large, older trees = 12." Minimum trees per acre needed to be classified as "Stand Initiation" = 100.

Minimum cover percent to qualify a potential stratum as an actual stratum =5%.

For Density: SDI max = 693 for Douglas-fir and western hemlock combined and averaged. Upper Management Zone = 382 SDI. Lower Management Zone=242 SDI.

Stand Exam data was collected 2001 and 2002, and to address current condition, the stands were projected forward to 2007 with the Forest Vegetation Simulator before information was summarized.

Appendix D Stand Exam Information

Stands 1–9 Modeled with No Treatment

```
FOREST VEGETATION SIMULATOR VERSION 6.21—WESTSIDE CASCADES PROGNOSIS RV:10.26.06 08-28-2007 09:46:24
** NOTE: DUE TO HARVEST, COMPRESSION, OR REGENERATION ESTABLISHMENT, NEW SAMPLE TREES WERE SELECTED.
FOREST VEGETATION SIMULATOR VERSION 6.21—WESTSIDE CASCADES PROGNOSIS RV:10.26.06 08-28-2007 09:46:25
STAND POLICIES: All, forest type=CH, 'DECLINE'
STAND ID: 060502060001 MGMT ID: NONE Stand 060502060001 at FSVEG
SUMMARY STATISTICS (PER ACRE OR STAND BASED ON TOTAL STAND AREA)
```

START OF SIMULATION PERIOD							REMOVALS AFTER TREATMENT							GROWTH THIS PERIOD							
						MAI							MAI								
NO OF YEAR	AGE	TOP TREES	TOTAL BA	MERCH SDI	MERCH CCF	HT	QMD	NO OF CU FT	TOTAL CU FT	MERCH BD FT	TOP TREES	RES CU FT	PERIOD CU FT	ACCRE BD FT	MORT BA	MERCH SDI	MERCH CCF	HT	QMD	YEARS	PER YEAR CU FT	FOR TYP	SS ZT
2001	65	770	364	686	360	115	9.3	16955	16208	85635	0	0	0	0	364	686	360	115	9.3	6	361	246	249.4	301	11
2007	71	704	359	666	350	123	9.7	17646	16925	90643	0	0	0	0	359	666	350	123	9.7	10	327	260	238.4	301	11
2017	81	601	346	628	330	134	10.3	18317	17545	81837	0	0	0	0	346	628	330	134	10.3	10	280	237	216.6	301	11
2027	91	524	338	600	316	143	10.9	18752	17991	84740	0	0	0	0	338	600	316	143	10.9	10	252	218	197.7	301	11
2037	101	455	332	575	304	151	11.6	19100	18340	87062	0	0	0	0	332	575	304	151	11.6	10	247	211	181.6	301	11
2047	111	396	328	554	295	157	12.3	19455	18687	88995	0	0	0	0	328	554	295	157	12.3	10	234	202	168.4	301	11
2057	121	347	324	535	287	161	13.1	19774	19032	91677	0	0	0	0	324	535	287	161	13.1	10	222	195	157.3	301	11
2067	131	302	321	516	279	165	14.0	20045	19332	94087	0	0	0	0	321	516	279	165	14.0	10	218	190	147.6	301	12
2077	141	383	318	537	273	168	12.3	20319	19618	96352	0	0	0	0	318	537	273	168	12.3	10	214	193	139.1	301	12
2087	151	339	315	520	267	171	13.0	20536	19828	98177	0	0	0	0	315	520	267	171	13.0	10	204	182	131.3	301	12
2097	161	300	312	503	261	174	13.8	20751	20029100170		0	0	0	0	312	503	261	174	13.8	0	0	0	124.4	301	12

Stands 10–13 Modeled with No Treatment

```
FOREST VEGETATION SIMULATOR VERSION 6.21—WESTSIDE CASCADES PROGNOSIS RV:10.26.06 08-28-2007 10:13:40
STAND POLICIES: All, forest type=CH, 'DECLINE'
STAND ID: 060502060002 MGMT ID: NONE Stand 060502060002 at FSVEG
SUMMARY STATISTICS (PER ACRE OR STAND BASED ON TOTAL STAND AREA)
```

START OF SIMULATION PERIOD							REMOVALS AFTER TREATMENT							GROWTH THIS PERIOD							
						MAI							MAI								
NO OF YEAR	AGE	TOP TREES	TOTAL BA	MERCH SDI	MERCH CCF	HT	QMD	NO OF CU FT	TOTAL CU FT	MERCH BD FT	TOP TREES	RES CU FT	PERIOD CU FT	ACCRE BD FT	MORT BA	MERCH SDI	MERCH CCF	HT	QMD	YEARS	PER YEAR CU FT	FOR TYP	SS ZT
2002	40	911	283	581	322	81	7.6	9761	8429	43486	0	0	0	0	283	581	322	81	7.6	5	414	148	210.7	301	11
2007	45	842	294	588	322	89	8.0	11089	9711	45106	0	0	0	0	294	588	322	89	8.0	10	397	180	215.8	301	11
2017	55	703	304	583	315	105	8.9	13262	11874	56120	0	0	0	0	304	583	315	105	8.9	10	356	210	215.9	301	11
2027	65	591	310	573	306	119	9.8	14725	13519	64180	0	0	0	0	310	573	306	119	9.8	10	331	220	208.0	301	11
2037	75	501	313	559	297	129	10.7	15827	14735	69522	0	0	0	0	313	559	297	129	10.7	10	312	232	196.5	301	11
2047	85	425	316	544	288	137	11.7	16626	15628	73599	0	0	0	0	316	544	288	137	11.7	10	290	226	183.9	301	11
2057	95	362	316	528	279	142	12.7	17258	16404	77065	0	0	0	0	316	528	279	142	12.7	10	275	222	172.7	301	11
2067	105	311	316	512	271	146	13.7	17790	17079	80523	0	0	0	0	316	512	271	146	13.7	10	273	224	162.7	301	11
2077	115	266	315	495	263	150	14.7	18280	17655	83779	0	0	0	0	315	495	263	150	14.7	10	256	216	153.5	301	11
2087	125	229	312	478	255	154	15.8	18685	18084	86224	0	0	0	0	312	478	255	154	15.8	10	245	212	144.7	301	12
2097	135	198	309	461	247	157	16.9	19019	18422	88427	0	0	0	0	309	461	247	157	16.9	0	0	0	136.5	301	12

Appendix E—Climate Change Implications

The Intergovernmental Panel on Climate Change (2007) predicts fewer cold days and nights, warmer and more hot days and nights, more heat waves, increasing area affected by drought, and an increase in precipitation that falls as rain.

On a regional basis, the Climate Impacts Group (2007) predicts a similar scenario for the Pacific Northwest. Their models predict a future warming of approximately 0.5°F per decade with temperatures increasing in all seasons, but particularly in June-August. A larger percentage of winter precipitation would fall as rain rather than snow, with an earlier spring snowmelt, lower summer stream flows, droughts becoming more common, and a greater risk of wildfires.

Plant communities are expected to undergo shifts in composition where different species will not all move in the same direction at the same rate. Loss of biological diversity is likely as species with poor dispersal abilities are unable to respond quickly enough to the shift in climate.

The effects of climate change on forest pests depend on whether summer are dryer or wetter, a subject of some debate (Joint Institute for the Study of the Atmosphere and Ocean (JISAO), undated). If summers are the same or dryer, the resulting physiological stress is expected to lead to an increase in the susceptibility of insect attack.

Some strategies that have emerged recently as potential ways to mitigate for the effects of climate change are to maintain a wide range of biological diversity, including a full array of species, and to maintain stands at a moderate density rather than have them in an over-stocked condition where vulnerability to stress is higher (JISAO, undated; DeBell 2007).

Appendix F—Monitoring Forms

Mount Baker-Snoqualmie National Forest Monitoring Summary Form

DISTRICT: Darrington Ranger District

PROJECT NAME: Decline Thin

MONITORING OBJECTIVE: Assess effectiveness of intended stocking level reduction

MONITORING TYPE: Effectiveness

PRIORITY: High

PARAMETER: Growth rates of residual stand (radial growth rate in inches per decade)

METHODOLOGY: Systematically locate 1 plot per ten acres across all units treated; measure radial growth rate per decade on each tree over 7 inches dbh within $1/40^{th}$ acre plot. GPS the plot location.

FREQUENCY/DURATION: Once, five years after treatment

DATA STORAGE: SO Vegetation Files

REPORT: Once, after five years

PROJECTED COSTS: 2 GS-7. $12.50/ plot including overhead x 40 plots = $500.00, total. Assumes combined monitoring with **Species Diversity** item, using the same plot locations.

Mount Baker-Snoqualmie National Forest Monitoring Summary Form

DISTRICT: Darrington Ranger District

PROJECT NAME: Decline Thin

MONITORING OBJECTIVE: Assess effectiveness of treatment on increasing species diversity across treated stands

MONITORING TYPE: Effectiveness

PRIORITY: High

PARAMETER: Vegetation Species Diversity

METHODOLOGY: Systematically locate 1 plot per ten acres across all units treated, (including LSR and Riparian Reserve and Matrix land allocations), and estimate percent cover of all species present on 1/40th acre plot. GPS plot location

FREQUENCY/DURATION: Once, five years after treatment

DATA STORAGE: SO Vegetation Files

REPORT: Once, after five years

PROJECTED COSTS: 2 GS 7. $12.50/ plot including overhead x 40 plots = $500.00, total. Assumes combined monitoring with Radial Growth item, using the same plot locations.

Appendix G—Glossary of Commonly Used Terms and Acronyms

Glossary

Activity center: The core of an owl's territory and the focal point of protection measures. Most frequently located in or near the highest concentration of remaining suitable habitat.

Aggradation: Deposition in one place of material eroded from another. Aggradation raises the elevation of streambeds, flood plains, and the bottom of other water bodies.

Alluvial fan: A low, outspread mass of loose materials and/or rock material, commonly with gentle slopes, shaped like an open fan or a segment of a cone, deposited by a stream at the place where it issues from a narrow mountain valley upon a plain or broad valley, or where a tributary stream is at its junction with the main stream. It is steepest near the mouth of the valley where its apex points upstream. Moreover, it slopes gently and convexly outward with decreasing gradient.

Alluvial: Originate through the transport and deposition from running water.

Anadromous fish: Fish that are hatched and rear in freshwater, move to the ocean to grow and mature, and return to freshwater to reproduce. Salmon and steelhead are examples.

Base Rate: The minimum acceptable bid rate per hundred cubic feet of timber.

Benefit:cost ratio: A measure of economic efficiency computed by dividing total discounted primary benefits by total discounted economic costs.

Bole: Trunk of the tree

Bryophyte: collectively mosses, liverworts, and hornworts.

Carrying capacity: The maximum number of organisms that can be supported in a given area of habitat at a given time.

Cataloging unit: The Forest Service has added two additional levels of finer resolution. The structures for these levels are called the Watershed and Subwatershed. The Fifth Field Watershed is the fifth of these resolutions, or the "Watershed."

Closed road: A road that remains part of the transportation system, but motorized use has been eliminated, prohibited, or restricted during all or certain times of the year.

Concern species: Species whose populations are of concern to biologists on the Mt. Baker-Snoqualmie National Forest. An informal designation.

Critical habitat: (Endangered Species Act) defined as an area occupied by a species listed as threatened or endangered within which are found physical or geographical features essential to the conservation of the species, or an area not currently occupied by the species, which is itself essential to the conservation of the species. As defined in the ESA "conservation" means any and all methods and procedures, and the use of those, needed to bring a species to recovery—the point at which the protections of the ESA are no longer needed.

Cumulative effect: The effect on the environment that results from the incremental effect of the action, when added to the effects of other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes the other actions and

regardless of land ownership on which the other actions occur. An individual action when considered alone may not have a significant effect, but when its effects are considered in sum with the effects of other past, present, and reasonably foreseeable future actions, the effects may be significant. They can occur when small, incremental amounts of habitat are lost over time through a variety of management activities across a landscape.

Debris avalanche: A rapid moving mass of rock fragments, soil, and mud of various sizes not reaching a stream channel.

Debris fans: A gently sloping fan shaped mass of detritus formed as a result of upslope or upstream erosional events.

Debris flow: A rapid moving mass of rock fragments, soil, and mud with more than half the particles being larger than sand size.

Debris flows: (Lahar) a flowing mixture of water-saturated rock debris that forms on the slopes of a volcano, and moves downslope under the force of gravity, sometimes referred to as a mudflow.

Decommissioned road: On the MBSNF, a road that no longer is serving a current or planned future access need and has been removed from the transportation system maps and database. The ground occupied by the road corridor is managed according to the land allocation in which it is located.

Deficit timber Sale: Deficit sales are timber sales where the average indicated advertised rate is less than the average base rate.

Degradation: Erosional removal of materials from one place to another. Degradation lowers the elevation of streambeds and floodplains.

Depressed stock: A stock of fish whose production is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely.

Discharge: Volume of water flowing past reference point per unit time (usually expressed as cubic meter/second).

Early seral (Regional Ecological Assessment Program [REAP]): An ecological age class designation. Early successional condition with open canopy generally with less than 60 percent overstory tree cover and less than 2 inches mean diameter breast height. Vegetation is typically some combination of graminoids, forbs, and shrubs, and can have tree seedlings or saplings.

Early seral (Terrestrial Vertebrate Habitat Condition Mode [TVHCM]): A structural or size-class designation referring to sparsely vegetated, non-forest stands with 60–90 percent bare ground, including grass-forb, shrub, open sap-pole, and sparse vegetation. These stands may be included in early, mid, or late seral as defined in the REAP.

Economic efficiency analysis: This analysis uses the cost and revenue estimates included in the financial efficiency analysis, and adds other economic costs and benefits that are not part of Forest Service monetary transactions.

Ecosystem management: A land management system that strives to maintain the natural processes and balances as well as provide for human use

Ecotone: Edge habitat. For the purpose of this analysis, the area within 400 feet of the edge between mid/late seral forested stands and early seral of non-forested stands.

Endangered species: A native species found by the Secretary of the Interior to be threatened with extinction.

Escapement: Those fish that have survived all fisheries and will make up a spawning population.

Ethnographer: One who studies or is proficient in ethnography, which is the branch of anthropology that considers man geographically and descriptively, treating of the subdivision of races, the causes of migration etc.

Expected bid rate: The expected bid rate per hundred cubic feet of timber. The expected bid rate is estimated through the Forest Service timber sale appraisal system.

Extirpated: Eliminated from a local area.

Fifth field watershed: A hierarchical catalog system designed by the U.S. Geological Survey and the Water Resource Council comprised of Region, Subregion, Accounting Unit, and

Financial efficiency analysis: This analysis provides a comparison of anticipated costs and revenues that are part of Forest Service monetary transactions.

Fine (light) fuels: Fast-drying fuels, generally with a comparatively high surface area-to-volume ratio, which are less than 1/4-inch in diameter and have a time lag of one hour or less. These fuels readily ignite and are rapidly consumed by fire when dry.

Fire handline: Site preparation associated with managed wildland fire and prescribed fire (hand line, snagging, mop-up)

Fire intensity level (FIL): Fire Intensity Level are an expression of fireline intensity, based on typical and/or calculated flame length of a fire behavior condition. FILs are used in the analysis to reflect the differences in difficulty of suppression and fire effects on natural and cultural resources.

Flame length: The distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface); an indicator of fire intensity.

Floodplain: Level lowland bordering a stream onto which the stream spreads at flood stage.

Fragmentation: The degree to which the landscape is broken into distinct patch types.

Fuel Bed: An array of fuels usually constructed with specific loading, depth and particle size to meet experimental requirements; also, commonly used to describe the fuel composition in natural settings.

Fuel Model: Simulated fuel complex (or combination of vegetation types) for which all fuel descriptors required for the solution of a mathematical rate of spread model have been specified.

Fuel: Combustible material. Includes, vegetation, such as grass, leaves, ground litter, plants, shrubs and trees that feed a fire. (See Surface Fuels.)

Girdle: The process of completely removing a strip of bark and cambium around a tree's outer circumference, causing its death.

Guild: A group of species aggregated together based on similarities in habitat requirements and anticipated response to changes in landscape conditions.

Habitat conservation area (HCA): Part of a network of habitat proposed by the Interagency Scientific committee to protect spotted owls. A contiguous block of habitat to be managed and conserved for breeding spotted owl pairs, connectivity, and distribution of owls. Has been replaced by late successional reserves as the working management unit for protecting spotted owl habitat.

Healthy stock: A stock of fish experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock.

Hibernacula: Sites where hibernation occurs.

Human influence zone: Areas of human activity (recreation sites, roads, trails, buildings, mines, hydropower operations, etc.) buffered by one-fourth mile around trails and one-half mile around roads and other sites.

Initial attack: The actions taken by the first resources to arrive at a wildfire to protect lives and property, and prevent further extension of the fire.

Inner gorge: Consists of steep (50 percent or greater), continuous slopes immediately above a channel.

K-V funds: Knutson-Vandenberg Act. Federal law that allows the U.S. Forest Service to collect money from a timber sale for resource enhancement, protection, and improvement work in the timber sale vicinity.

Landslide: Any sudden movement of earth and rocks down a steep slope.

Large woody debris: Pieces of wood larger than 10 feet long and 6 inches in diameter located within a stream channel.

Late seral (REAP): An age class designation. Late successional condition with a single or multiple canopy structure, including mature, large sawtimber, and old-growth stands.

Late seral (TVHCM): A structural of size-class designation referring to mature or old-growth stands. These stands roughly correspond to the late seral forested stands as defined in the REAP.

Late-successional forest: Late-successional forests are those forest seral stages that include mature and old-growth age classes. (ROD USDA-USDI, Standards and Guidelines 1994, B-1)

Lava flows: Stream of molten rock that erupts relatively nonexplosively from a volcano and moves slowly downslope.

Lichen: a fungus and its photosynthetic partner growing together in a mutually controlled, symbiotic relationship.

Live fuels: Living plants, such as trees, grasses, and shrubs, in which the seasonal moisture content cycle is controlled largely by internal physiological mechanisms, rather than by external weather influences.

Maximum modification: Visual Quality Objective where management activities are dominant, but appear natural when seen as background.

Mid-seral (REAP): An age class designation. Mid successional condition. Defined in FEMAT as that period in the life of a forest between crown closure and first merchantability.

Mid-seral (TVHCM): A structural or size-class designation referring to closed sap-pole, open mature, closed immature and residual stands. These stands roughly correspond to the mid seral forested stands as defined in the REAP.

Native resident fish: An indigenous stock of fish that has not been substantially impacted by genetic interactions with non-native stocks or by other factors, and is still present in all or part of its original range.

Neotropical migrants: Birds that migrate from North America to regions south of the Tropic of Cancer (latitude 23 1/2 degrees north) to winter.

Non-native fish: A fish stock that has become established outside of its original range.

Noxious weeds: Invasive non-native plant species, some of which are toxic to livestock and/or wildlife as designated by the State Noxious Weed Board under the Washington State Noxious Weed Law RCW 17.10.

Omnivore: Animal that feeds on both plants and animals.

pH: A measure of the hydrogen ion concentration in a solution.

Plant association (PA): The basic unit of vegetation including all its successional stages; a potential natural plant community of definite floristic composition and uniform appearance.

Plant association group (PAG): Groups of plant associations with similar floristic characteristics.

Present net value (PNV): The difference between the discounted financial revenues and the discounted financial costs.

Prime timberland: Land that has soil capable of growing wood at the rate of 85 cubic feet or more/acre/year (at culmination of mean annual increment) in natural stands and is not in urban or built-up land uses or water.

Pyroclastic flows: A hot (570–1470 degrees F), dry, fast-moving, and high-density mixture of ash, pumice, rock fragments, and gas formed during explosive eruptions or from the collapse of a lava dome.

Pyroclastic surges: Turbulent, low-density cloud of hot rock debris and gases that moves over the ground surface at high speed. Similar to a pyroclastic flow but of much lower density (higher gas to rock ratio).

Rate of spread (ROS): The relative activity of a fire in extending its horizontal dimensions. It is expressed as a rate of increase of the total perimeter of the fire, as rate of forward spread of the fire front, or as rate of increase in area, depending on the intended use of the information. Usually it is expressed in chains or acres per hour for a specific period in the fire's history.

Release tree: A tree targeted for long term growth by removing most to all of the trees in the immediate surrounding area.

Rendezvous sites: Temporary resting sites used for several days at a time by a wolf pack during summer months while pups are developing.

Riparian zone: Those terrestrial areas where the vegetation complex and microclimate conditions are products of the combined presence and influence of perennial and/or intermittent water, associated high water tables, and soils that exhibit some wetness characteristics. Normally used to refer to the zone within which plants grow rooted in the water table of these rivers, streams, lakes, ponds, reservoirs, springs, marshes, seeps, bogs, and wet meadows.

River mile: Length of the river course extended from salt-water confluence to headwaters.

Road maintenance levels: one of five levels assigned based on the maintenance required to provide the desired type of access.

Road maintenance level 1 (ML1): Intermittent service roads managed as closed to vehicular traffic, and kept in storage until the next project access need; the closure period must exceed one year.

Road maintenance level 2 (ML2): Roads open for use by high clearance vehicles. Passenger car traffic is not a consideration. Traffic is normally minor, usually consisting of one or a combination of administrative, permitted, dispersed recreation or other specialized uses.

Road maintenance level 3 (ML3): Roads open and maintained for travel by a prudent driver in a standard passenger car. Roads are typically low speed, single lane with turnouts and spot surfacing.

Road maintenance level 4 (ML4): Roads that provide a moderate degree of user comfort and convenience at moderate travel speeds. Most roads are double lane and aggregate surfaced; however, some may be single lane. Paved surfaces or dust abatement may be used.

Road maintenance level 5 (ML5): Roads that provide a high degree of user comfort and convenience. These roads are normally double lane and paved, although some may be aggregate surfaced and dust abated.

Road decommissioning treatment: Treatment (including obliteration) applied to some roads no longer needed, which if treatment is not performed, present an unacceptable hazard to habitats and watershed condition. It removes those elements of a road and reroute or impede hillslope drainage and present slope stability hazards.

Road obliteration: Full physical site restoration that attempts to re-contour slopes with the intent to completely remove the road from the landscape.

ROD: Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl. Sometimes known as “The President’s Plan,” it is the guiding document for doing watershed analysis.

Recreation opportunity spectrum: Range of opportunities for recreationists by combining variations of qualities provided by nature (vegetation, landscape, topography, scenery), qualities associated with recreational use (levels, types of use), and conditions provided by management (developments, roads, regulations). Includes Primitive, Semi-primitive Non-motorized, Semi-primitive Motorized, Roaded Natural, Roaded Modified, Rural, Urban, etc.

Salmonid: Any member of the taxonomic family Salmonidae, which includes all species of salmon, trout, and char.

Security habitat: Habitat that is outside of human influence zones.

Sensitive species: A species that occurs on the Regional Forester's Sensitive Species list (Forest Service Manual 2670). Includes species that are candidates for listing under the Federal Endangered Species Act.

Sensitive: (from http://www.fs.fed.us/r6/sfpnw/issssp/agency-policy)–For Region 6 of the Forest Service, those plant and animal species identified by the Regional Forester for which population viability is a concern, as evidenced by significant current or predicted downward trends in population numbers or density and habitat capability that would reduce a species' existing distribution (FSM 2670.5).

Seral: Of or pertaining to the series of stages in the process of ecological succession.

Silt: A soil particle between 0.05 and 0.002mm in diameter.

Slash: Debris left after logging, pruning, thinning or brush cutting; includes logs, chips, bark, branches, stumps and broken understory trees or brush.

Spawn: (from http://dictionary.reference.com/browse/spawn)–to deposit eggs or sperm directly into the water, as fishes

Stock status: The current condition of a stock, which may be based on escapement, run size, survival, or fitness level.

Stock: (from WDF et al. 1992)—the fish spawning in a particular lake or stream(s) at a particular season, which fish to a substantial degree do not interbreed with any group spawning in a different place, or in the same place at a different season.

Suitable habitat: Habitat in which an animal or plant can meet all or some of its life history requirements.

Surface fuels: Loose surface litter on the soil surface, normally consisting of fallen leaves or needles, twigs, bark, cones, and small branches that have not yet decayed enough to lose their identity; also grasses, forbs, low and medium shrubs, tree seedlings, heavier branchwood, downed logs, and stumps interspersed with or partially replacing the litter.

Survey and Manage species (S and M): Species to be protected through survey and management standards and guidelines on federal lands as identified by the Standards and Guidelines for Management of Habitat for Late-successional and Old-growth Forest and Related Species Within the Range of the Spotted Owl (ROD, Appendix J2).

Tephra falls: Materials of all sizes and types that are erupted from a volcano and deposited from the air.

Thin and leave: A non-commercial form of thinning. Trees are cut or girdled and left on site, rather than removed for commercial products.

Threatened species: A native species likely to become endangered within the foreseeable future.

Turbidity: An expression of the optical properties of a sample, which causes light rays to be scattered and absorbed rather than transmitted through the sample. Measured in nephelometric turbidity units (NTUs).

Ungulate: Hooved mammal.

Vegetation series: A group of habitat types having the same dominant canopy tree species at climax, i.e., western hemlock, silver fir, or mountain hemlock.

Vegetation zone: Elevational bands within which a certain vegetation series predominates, e.g., the western hemlock zone occurs between 1,400 and 3,500 feet elevation in the watershed.

Wetland: Lands where saturation with water is the major factor in determining soil development and the types of plants that grow there.

Acronyms

WDG	Washington Department of Game
ACS	Aquatic Conservation Strategy
ATM	Access and travel management
BA	Biological Assessment
BE	Biological Evaluation
BO	Biological Opinion
BMP	Best Management Practice
CCF	One Hundred Cubic Feet
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
Cfs	cubic feet per second
CHU	Critical Habitat Unit
CWA	Clean Water Act
Dbh	Diameter at breast height
DNR	Department of Natural Resources
DSR	Damage Survey Report
DPS	Distinct Population Segment
EA	Environmental Assessment
EIS	Environmental Impact Statement
ERFO	Emergency Relief for Federally Owned Roads
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FEMA	Federal Emergency Management Agency
FEIS	Final Environmental Impact Statement
FHA	Federal Highways Administration
FONSI	Finding of No Significant Impact
FS	Forest Service
GIS	Geographical Information System
GSI	Genetic Stock Information
HPA	Hydraulic Project Approval
HUC	USGS Hydrologic Unit Code
IDT	Interdisciplinary Team
LSR	Late Successional Reserve
LWD	Large woody debris
MA	Management Area
MBF	Thousand Board Feet
MBS	Mount Baker-Snoqualmie National Forest
Mgpd	Million gallons per day
MIS	Management Indicator Species
ML	Maintenance Level
MP	Milepost
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act
NFS	National Forest System
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWFP	Northwest Forest Plan
NWIFC	Northwest Indian Fisheries Commission
OG	Old-growth
ORV	Off Road Vehicle
PAG	Plant association group
RM	River Mile
RNV	Range of natural variability
ROD	Record of Decision
ROS	Recreation Opportunity Spectrum
RV	Recreational Vehicle
RVD	Recreational Vehicle Day
RVDS	Recreation visitor days
S and M	Survey and Manage
SHPO	State Historic Preservation Office
TES	Threatened, endangered and sensitive species
TMDL	Total Maximum Daily Load
U.S.C.	United States Code
US	United States
USACE	United States Army Corp of Engineers
USDA FS	U.S. Forest Service
USDI	U.S. Department of the Interior
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WAC	Washington Administrative Code
WaRIS	Washington Rivers Information System
WDF	Washington Department of Fisheries (now WDFW)
WDFW	Washington State Dept. of Fish and Wildlife
WDOE	Washington Department of Ecology
WDOT	Washington State Department of Transportation
WDW	Washington Department of Wildlife
WRIA	Water Resource Inventory Area
WSA	Watershed Analysis
WSCC	Washington State Conservation Commission
WSR	Wild and Scenic River
WWTIT	Western Washington Treaty Indian Tribe