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Draft Environmental Impact Statement

Gap Landscape Restoration Project

Paulina Ranger District, Ochoco National Forest
Crook County, Oregon

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Gap Landscape Restoration Project
Draft
Environmental Impact Statement
Crook County, Oregon

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Abstract: This Draft Environmental Impact Statement (DEIS) describes the effects of implementing vegetation management strategies, fuel reduction and watershed restoration activities in the Gap Landscape Restoration project (Gap project). The project area is located on the Paulina Ranger District of the Ochoco National Forest approximately 35 miles east of the City of Prineville, Oregon. This EIS assesses the effects of four different alternatives: Alternative 1, No Action; Alternative 2, Proposed Action, Alternative 3 and Alternative 4. All three action alternatives would treat fuels and vegetation through the use of harvest, noncommercial thinning, juniper removal, hardwood restoration, riparian restoration and prescribed burning. The Responsible Official has identified Alternative 2, the Proposed Action, as the preferred alternative.

Reviewers should provide the Forest Service with their comments during the review period of the draft environmental impact statement. This will enable the Forest Service to analyze and respond to the comments at one time and to use information acquired in the preparation of the final environmental impact statement, thus avoiding undue delay in the decision-making process. Reviewers have an obligation to structure their participation in the National Environmental Policy Act process so that it is meaningful and alerts the agency to the reviewers' position and contentions. Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519, 553 (1978). Environmental objections that could have been raised at the draft stage may be waived if not raised until after completion of the final environmental impact statement. City of Angoon v. Hodel (9th Circuit, l986) and Wisconsin Heritages, Inc. v. Harris, 490 F. Supp. 1334, 1338 (E.D. Wis. 1980). Comments on the draft environmental impact statement should be specific and should address the adequacy of the statement and the merits of the alternatives discussed (40 CFR 1503.3).

Send Comments to: **Gary Asbridge, District Ranger**
3160 NE 3rd Street
Prineville, OR 97754

Date Comments Must Be Received: **45 days following the publication of the Notice of Availability in the Federal Register**

Summary

The Forest Service has prepared this Environmental Impact Statement (EIS) in compliance with the National Environmental Policy Act and other relevant Federal and State laws and regulations. This EIS analyzes a proposal to use commercial timber harvest, noncommercial thinning, prescribed fire, instream-work, and hardwood enhancement in the Gap project area for vegetation management, treatment of fuels and watershed restoration. This EIS analyzes three additional alternatives (including the No Action Alternative); the significant issues associated with the proposal; and the direct, indirect, and cumulative effects of implementing any of the alternatives.

The Gap project area is located on the Paulina Ranger District of the Ochoco National Forest, about 35 miles east of Prineville, Oregon. The 38,145-acre project area is located within two watersheds: the Upper North Fork Crooked River and the Horse Heaven Creek-Crooked River.

Why is the action being proposed?

Based upon direction from the Ochoco National Forest Land and Resource Plan (Forest Plan) (USDA Forest Service, 1989) and opportunities identified by the Gap Interdisciplinary Team (IDT) during the evaluation of the existing condition, the Paulina Ranger District has determined that within the Gap project area:

What action is proposed?

There is a need to strategically reduce forest vegetation density and fuel loading towards a historic range of variability to provide a range of forest conditions and habitats that would support historic disturbance processes, native wildlife, and plant species.

There is a need to increase or maintain large tree structure and to maintain the abundance of early-seral fire tolerant species compositions, i.e. ponderosa pine, western larch and Douglas-fir.

There is need to improve riparian conditions and associated upland vegetation within Riparian Habitat Conservation Areas (RHCAs) and maintain and enhance hardwood communities.

There is a need to contribute to the local and regional economies through restoration activities including providing timber and other wood products now and in the future.

Table 1. Activities proposed in Alternative 2

Activity	Quantity (approximate)
Commercial thinning (would include noncommercial thinning and fuels treatments)	14,037 ac.
Noncommercial thinning (outside of harvest units; would include fuels treatments) Noncommercial thinning only (plantations) Noncommercial thinning only up to 21” dbh	1,389 ac 458 ac. 180 ac. Total: 2,027 ac.
Underburning only	5,587 ac
Riparian restoration	13.7 miles/1,345 ac.
Aspen Restoration	213 ac.
Culvert Replacement	6 locations
Road closure	20.6 miles
Road decommission	3.3 miles

Table 2. Actions connected to the activities proposed in Alternative 2.

Connected Action	Quantity
New Temporary road construction	1.0 miles
Temporary roads on existing disturbance	38.9 miles
Expansion of Winter Material Source	up to .9 acres
Buck and Pole Fence	.9 miles
Temporary Barbed Wire Fence	4 miles
Water Developments	3

What would it mean not to meet the need?

Forest Vegetation

Stands in the project area would continue growing in a manner determined by existing vegetation and site condition. The amount of Late and Old Structure (LOS) would increase; however, the rate at which stands develop large tree characteristics would be hampered by over-stocked conditions. On drier sites, such as the ponderosa pine and Douglas-fir plant association groups, stand stagnation may preclude the attainment of additional large trees. Existing large trees would continue to be susceptible to mortality from competition with understory trees and the accompanying increase in risk to loss due to insect, disease, and wildfire. Acres dominated by ponderosa pine and western larch (early-seral species) would steadily decrease.

Aspen stands, and other hardwood communities would continue to decline in vigor and abundance. Juniper dominance and conifer cover would increase with a resulting decrease in grass and shrub cover. The proportion of juniper on ponderosa pine, Douglas-fir and grand fir sites would continue to increase.

No treatments to maintain or increase riparian plant communities would occur. Specifically, some aspen stands would continue to decline as conifer encroachment continues.

Fuels

Stands that are currently in a low-severity fire condition as a result of being thinned and burned in the 1980s and 1990s would not be maintained, and would transition into mixed and high-severity fire conditions over time. The amount of forested acres within the mixed and high-severity fire conditions are expected to increase as fuel accumulates faster than it decomposes and the number of trees per acre in the understory increases. Limited vegetation management, aggressive wildfire suppression, and insect and disease mortality would continue the trend of fuel loadings accumulating in the form of dead and down trees, small diameter trees growing into the overstory, and dense crown conditions. These changes would increase the risk of crown fire across the landscape, and associated severe effects to fish and wildlife habitat, soil productivity, LOS habitat, and air quality. Fire in these stands could be intense, stand replacing events, which could result in the loss of LOS, wildlife habitat cover, and consumption of large woody material and structure in riparian areas.

Riparian Restoration

Riparian areas identified as non-functional and functional at risk would remain in a degraded condition. Without active restoration, streams would continue to be disconnected with their floodplains and water storage capacity would remain limited. Improving water storage capacity is especially critical in the face of drought and climate change. Continued stream channel down-cutting and the lack of floodplain connectivity would continue to negatively affect native riparian vegetation.

The attainment of Riparian Management Objectives (RMOs) and recovery of habitat for R6-listed sensitive aquatic species, such as redband trout and Columbia spotted frog, and other riparian dependent species may not occur for many decades. Culverts and headcuts would persist and continue to compromise the recovery and persistence of sensitive aquatic species. Streams within the two watersheds would continue to be deficient in large woody debris, pools, and exceed standards for bank stability and width/depth ratios and continue to lack adequate riparian vegetation composition and structure. Impacted riparian areas would remain out of compliance with Ochoco Land and Resource Management Plan as amended by the Inland Native Fish Strategy (INFISH, 1995) and Clean Water Act (CWA).

Are there other alternatives that would meet the need?

Two other alternative were identified that would meet the need for the project. Alternative 3 was developed to respond to Key Issues #1, #2 and #3, as discussed in Chapter 1, while also meeting the stated purpose and need. Alternative 4 was developed to respond to Key Issue #4, as discussed in Chapter 1 of the EIS, while also meeting the stated purpose and need (see Issues on page 14)

Table 3. Activities proposed in Alternative 3.

Activity	Quantity (approximate)
Commercial thinning (would include noncommercial thinning and fuels treatments)	10,903 ac.
Noncommercial thinning (would include fuels treatments) Noncommercial thinning only Noncommercial thinning only up to 21” dbh	3,591 ac. 458 ac. 180 ac. Total: 4,237 ac.
Underburning only	6,396 ac.
Riparian restoration	13.7 miles/1,345 ac.
Aspen restoration	200 ac.
Culvert replacement	6 locations
Road closure	20.6 miles
Road decommission	3.3 miles

Table 4. Actions connected to the activities proposed in Alternative 3.

Connected Action	Quantity
New Temporary road construction	.9 miles
Temporary road on existing disturbance	33.1 miles
Expansion of Winter Material Source	up to .9 acres
Buck and Pole fence	.9 miles
Temporary Barbed Wire Fence	4 miles
Water Developments	3

Table 5. Activities proposed in the Alternative 4.

Activity	Quantity (approximate)
a) Commercial thinning (would include noncommercial thinning and fuels treatments) b) Commercial thinning trees ≥ 21" dbh	a) 11,850 ac. b) 2,187 ac. Total: 14,037
Noncommercial thinning (would include fuels treatments) Noncommercial thinning only Noncommercial thinning only up to 21"	1,389 ac. 458 ac. 180 ac. Total: 2,027 ac.
Underburning only	5,587 ac
Riparian restoration	13.7 miles/1,345 ac.
Aspen enhancement	224 ac.
Culvert replacement	6 locations
Road closure	20.6 miles
Road decommission	3.3 miles

Table 6.Actions connected to the activities proposed in Alternative 4

Connected Action	Quantity
New Temporary road construction	1.0 miles
Temporary road on existing disturbance	38.9 miles
Expansion of Winter Material Source	up to .9 acre
Buck and pole fence	.9 miles
Temporary Barbed Wire Fence	4 miles
Water Developments	3

What are the effects of the alternatives?

Forest Vegetation

Historic Range of Variability, Late and Old Structure and Stand Vigor

Under all action alternatives, stands would move toward HRV but at different rates. Under all alternatives, the amount of LOS would increase over time. Activities in each of the action alternatives would remove understory trees to reduce stand density, to maintain existing large trees, and to enhance the development of additional large trees. Harvest and noncommercial thinning would encourage the development of large structure at an accelerated rate. Activities would generally move stands from multi-strata conditions to or towards single-stratum conditions. The abundance of early-seral species would be maintained and enhanced in the long-term; however, late-seral species would continue to be present in stands where they exist prior to treatment. In addition, reducing stocking density would increase tree vigor and reduce insect and disease hazard.

The proposed activities (commercial harvest and noncommercial thinning) included in each of the action alternatives are designed to reduce tree density and improve growth and vigor of the residual trees and reduce susceptibility to insects and disease. These activities would more quickly restore historic seral/structural stage conditions and improve growing conditions for larger trees than either no action or prescribed fire alone.

Hardwood Communities

Harvest and noncommercial thinning in and around aspen stands, and other hardwood sites, would improve hardwood vigor and allow aspen stands to expand. Immediately after treatment, the aspen sites would have reduced cover until the aspen and other broadleaf shrubs can respond. Response time and amount would vary by current aspen condition, post treatment fencing and intensity of treatment, but generally would be apparent within three years.

Upland Grass and Shrub Communities

Proposed treatments in the uplands, including the cutting of juniper, would open the canopy and allow increased grass and shrub development. Better overall forage conditions would encourage more dispersed grazing and browsing with potentially less pressure in riparian areas. Furthermore, the removal of slash and thinning of thickets would allow more access for livestock into the uplands and potentially lower grazing pressure in riparian areas.

Prescribed fire treatments would reduce stocking of seedling and sapling junipers and other conifers. As a result of decreased stand density, shrub and grass cover would increase from recruitment of new plants and growth of existing plants.

It is anticipated that the proposed treatments in this project would also rejuvenate mountain mahogany. Survival of mountain mahogany seedlings would increase in treated stands in response to reduced conifer cover and exposed mineral soil. Other types of shrubs would increase from more vigorous sprouting and from recruitment of new seedlings.

Riparian Conditions

The effects of riparian restoration would be the same for all action alternatives. Under all alternatives, riparian areas and their corresponding functions and values would improve at a rate much faster than the no action alterative. Active restoration would connect streams with their floodplains, improving water storage capacity and improving native riparian vegetation. Restoration would also improve habitat (including RMOs) for sensitive aquatic species and other riparian dependent plants and animals. Riparian areas would contribute to increased landscape resiliency and buffer the effects of climate change and drought. Active restoration would also move impacted areas towards achieving compliance with Forest Plan standard and guides and the Clean Water Act more rapidly.

Fuels

All three action alternatives would modify fuels in the project area to move stands in Condition Class 3 toward Condition Class 1; basically, they would move stands from a condition of high fuel hazard to a condition of lower fuel hazard.

What factors would be used in making the decision between alternatives?

The Responsible Official for this proposal is the Forest Supervisor of the Ochoco National Forest. The Responsible Official will decide whether to:

- Select the proposed action;
- Select an action alternative that has been considered in detail;
- Modify an action alternative;
- Select the no action alternative;
- Identify what project design features and monitoring will apply.

The Responsible Official will decide whether to conduct commercial harvest, noncommercial thinning, aspen restoration, fuels reduction and riparian restoration activities in the Gap project area. The decision will be determined by how well each alternative provides the best mix of prospective results in regard to the purpose and need, the significant issues, and public comments. Factors that the Responsible Official will consider include effects of the alternatives on forested vegetation, on fuels, on aquatic species and water quality, and on wildlife species and habitats. The Responsible Official will also consider the ability of each alternative to contribute to local and regional economies.

What monitoring is necessary?

Implementation monitoring is necessary to ensure the selected alternative and project design features are implemented as designed and achieve the desired results. Monitoring that is necessary includes:

- Post-project surveys and monitoring of noxious weed infestations, including mineral sources, would be conducted to evaluate the effects of the project on noxious weeds and to continue eradication treatments. Post-project surveys would identify new noxious weed infestations while they are small.
- Occupancy and reproduction in mapped raptor territories would be monitored during and after project implementation.
- Snag levels would be surveyed in selected areas during project preparation and after implementation.
- Temperature monitoring would be accomplished in identified stream reaches using temperature recorders.
- Post-project road closure/road decommissioning would be evaluated for effectiveness and compliance with Best Management Practices (BMPs).

Which alternative is preferred?

Alternative 2 has been selected by the Responsible Official as the preferred alternative.

Alternative 2, the Proposed Action, increases large trees, overtime, through the use of fuels and vegetation treatments; reduces the risk of stand loss due to overly dense stand conditions; increases the resistance of forest stands to insects and diseases; changes the distribution of fire regimes and provides wood products to meet the needs of local and regional economies. Proposed riparian restoration activities would connect streams with their floodplains, improve water storing capacity, and improve native riparian vegetation.

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Chapter 1. Purpose of and Need for Action

Document Structure

The Forest Service has prepared this Environmental Impact Statement in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This Environmental Impact Statement discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. The document is organized into four chapters:

- *Chapter 1. Purpose and Need for Action:* The chapter includes information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.
- *Chapter 2. Alternatives, including the Proposed Action:* This chapter provides a more detailed description of the agency's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. This discussion also includes project design features. Finally, this section provides a summary table of the environmental consequences associated with each alternative.
- *Chapter 3. Affected Environment and Environmental Consequences*: This chapter describes the environmental effects of implementing the proposed action and other alternatives. This analysis is organized by [insert topic (i.e., resource area, significant issues, environmental component)].
- *Chapter 4. Consultation and Coordination:* This chapter provides a list of preparers and agencies consulted during the development of the environmental impact statement.
- *Appendices:* The appendices provide more detailed information to support the analyses presented in the environmental impact statement.
- *Index:* The index provides page numbers by document topic.

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at the Paulina Ranger District, Prineville, Oregon.

Background

The Gap Landscape Restoration project area (Gap project area) is located approximately 35 miles east of the city of Prineville (see Map 1). The project area covers 38,145 acres and is located within two watersheds: the Upper North Fork Crooked River and Horse Heaven-Crooked River.

The general purpose of entering this project area is to improve the resiliency of the landscape and to promote vegetative conditions that are similar to what occurred historically. The Gap project is proposing management activities that would promote and sustain Late and Old Structure (LOS); increase resistance of forested vegetation to insects, disease and high intensity wildfire; enhance aspen stands, improve riparian conditions and associated upland vegetation within Riparian Habitat Conservation Areas (RHCAs), and contribute to the health of local and regional economies.

The project area is home to a variety of fish, wildlife, and plant species; including northern goshawk, pileated woodpecker, redband trout, Columbia spotted-frog, deer, elk, and Peck's Mariposa lily. The area is also popular for recreation; the project area contains one developed recreation site and approximately 52 dispersed camping areas. Other recreational uses include wildlife viewing, hunting, sightseeing, hiking, biking, horseback riding, and snowmobiling.

Purpose and Need for Action

The existing condition of the Gap project area was evaluated in 2013-2015, with assistance from the Ochoco Forest Restoration Collaborative (OFRC), and is documented in the Gap project record. The evaluation determined that conditions in the planning area have departed from the historic condition in several ways:

- Tree species compositions are outside the historic range of variability.
- A reduction in Late and Old Structured forest (LOS); especially single-strata LOS.
- A reduction in open-canopy stands accompanied by an increase in stand densities and multi-storied stands.
- An increased risk of large-scale loss of forest to wildfire.
- An increased risk of insect infestation and/or disease that can impact forested stands.
- A decline in riparian/aquatic conditions and hardwood communities.

Based upon direction from the Ochoco Forest Plan and the evaluation of the existing condition, the Paulina Ranger District has determined that within the Gap project area:

1. There is a need to strategically reduce forest vegetation density and fuel loading towards a historic range of variability to provide a range of forest conditions and habitats that would support historic disturbance processes, native wildlife, and plant species.

2. There is a need to increase or maintain large tree structure and to maintain the abundance of early-seral fire tolerant species compositions, i.e. ponderosa pine, western larch and Douglas-fir.

3. There is need to improve riparian conditions and associated upland vegetation within Riparian Habitat Conservation Areas (RHCAs) and maintain and enhance hardwood communities.

4. There is a need to contribute to the local and regional economies through restoration activities including providing timber and other wood products now and in the future.

Forest Plan Direction and Other Guidance

The Ochoco National Forest Land and Resource Management Plan (Forest Plan) was approved in 1989, and has since been amended by several decisions. The Forest Plan, as amended, provides guidance for management activities on the Ochoco National Forest. The Forest Plan establishes goals, objectives, and desired future conditions, identifies management areas within the Forest, and provides standards and guidelines for each management area as well as Forest-wide standards and guidelines. This proposal is tiered to the Final Environmental Impact Statement (FEIS) for the Forest Plan, as amended.

Forest Plan Management Areas

The Ochoco National Forest management areas in the project area include (see Map 2):

Old Growth (MA-F6) 1,012 acres - Habitat will be provided for wildlife species dependent upon old-growth stands with pileated woodpecker as the management indicator species. The desired conditions for these areas are stands of mixed conifer and ponderosa pine with multi-layered canopy with shaded conditions and a large number of snags. Under standards and guidelines for the practice of Habitat Management, vegetative management will not be allowed, until further research is available on the needs of the dependent species (Forest Plan, p. 4-251). The Forest Plan (p. 4-58) also identifies that additional acres of pileated woodpecker "feeding areas" averaging 300 acres in size be located in areas adjacent to allocated old-growth stands.

Lookout Mountain Recreation Area (MA-F11) 3,430 acres-This management area encompasses Lookout Mountain, a landmark on the Ochoco National Forest that is well known for its scenery, big game habitat, and recreational opportunities. The emphasis is to maintain a natural setting and provide wildlife habitat and recreational opportunities while maintaining healthy forests.

Developed Recreation (MA-F13) 20 acres-The management emphasis is to provide safe, healthful, and aesthetic facilities for people to utilize while they are pursuing a variety of recreational experiences within a relatively natural outdoor setting. The one site in the Gap project area is Biggs Spring Campground (Forest Plan, p. 4-71).

Winter Range (MA-F20) 616 acres-The management emphasis is to provide winter cover and forage to big game species such as elk and deer (Forest Plan, p. 4-82).

General Forest (MA-F22) 18,003 acres - The emphasis for this area is to produce timber and forage while meeting the Forest-wide standards and guidelines for all resources. In ponderosa pine stands, management will emphasize production of high-value (quality) timber (Forest Plan, p. 4-86).

General Forest Winter Range (MA-F23) 13,827 acres - The emphasis for this area is to manage for timber production with management activities designed and implemented to recognize big game habitat needs (Forest Plan, p. 4-84).

North Fork Crooked River Recreation Corridor (MA-F24) 1,144 acres - This management area contains a portion of the North Fork Crooked River that has been designated as a Recreation River. The emphasis is to maintain the appearance of a natural landscape in the foreground view from Forest Road 42 to enhance recreational and scenic values.

Visual Management Corridors (MA-F26; Retention) 93 acres - The emphasis is to maintain the natural appearing character of the Forest along major travel routes, where management activities are usually not evident or are visually subordinate to the surrounding landscape. The outer boundary of this area will generally not exceed 600 feet on each side of the road. Vegetation will be manipulated but will reflect a natural forest setting where stands of trees exist in multiple age classes (Forest Plan, p. 4-95).

North Fork Crooked River Wild and Scenic River Management Plan

The Gap project area contains a portion of the North Fork Wild and Scenic River (NFCR W&S River) Segment 1 (recreation corridor, MA-F23, scenic corridor, MA-F24). Some relevant direction and information from the NFCR W&S River Management Plan are described below:

- (Segment 1) Federal land is characterized by predominantly natural-appearing environments with moderate evidence of the sights and sounds of man. Such evidence usually harmonizes with the natural environment (NFCR 10).
- (Segment 1) Resource modification and utilization practices are evident, but harmonize with the natural environment (NFCR 10).

Within the limits of ecological potential, riparian areas will be managed for a shady, brushy condition with a canopy of alder, willow, aspen or other deciduous vegetation. Streamside vegetation and habitat will be managed to maintain and improve water quality. Where coniferous trees are a natural component of the ecosystem, a variety of size classes will exist to perpetuate the supply of shade and woody debris over time. Sites unable to support a canopy of deciduous or evergreen species will be characterized by vigorous stands of forbs, grasses, and grass-like riparian species (NFCR 11).

- Restoration of riparian areas in all river segments with unsatisfactory conditions would occur using techniques such as beaver reintroduction, intensive livestock management, placement of instream structures, planting vegetation, dispersing livestock away from the riparian zone, or other site specific techniques determined necessary. All site specific projects will meet long term river management goals (NFCR 11).

Standards and guidelines (NFCR 15 and 16)

- Maintain 85% of unimpeded (uninhibited) recovery rate within riparian zones as measured through monitoring strategies such as site specific exclosures or other techniques.
- 100% of the potential streamside shade will be attained. Potential will be tied to seral stages recognizing that 100% shade over an entire stream is not sustainable over the long term.
- Provide suitable amounts of instream structures such as large woody material and rocks, based on specific characteristics of riparian areas and stream morphology.
- Meet State Department of Environmental Quality stream turbidity standards.
- Stream channel cutbanks will not exceed the occurrence found in a natural stream as determined through long term monitoring. Until natural stream morphology is established do not exceed an average of 20% cutbanks on any give stream drainage.
- Where possible, water sources will be developed outside the river corridor to disperse livestock.
- Existing water temperatures at or above 58° F will not be increased. Temperatures at or below 56° F may not be raised above 2° F. Where stream temperatures exceed 58° F, management activities will include objectives for reducing temperatures to levels that will improve fish habitat capability.

The Wild and Scenic Rivers Act (WSR) Section 7(a) evaluation for the North Fork Crooked River, Segment 1, is summarized in Chapter 3 (see Appendix H).

Eastside Screens

The Revised Continuation of Interim Management Direction Establishing Riparian, Ecosystem, and Wildlife Standards for Timber Sales amended the Ochoco National Forest Land and Resource Management Plan in 1995. The direction only applies to the design and preparation of timber sales on eastside Forests and is often referred to as “Regional Forester’s Forest Plan Amendment #2” or as the “Eastside Screens.” The Eastside Screens contain guidelines for management of timber sales in late and old structured stands relative to the historical range of variability (ecosystem screen), wildlife corridors, snags, coarse woody debris, and goshawk management.

All other noncommercial vegetative management treatments are exempt from the Eastside Screens. On June 11, 2003 the Regional Forester issued supplemental guidance for implementing the Eastside Screens.

The Regional Forester encouraged the consideration of Land and Resource Management Plan (LRMP) amendments in cases where the proposed treatments would move landscape conditions towards historic range variability and providing LOS for the habitat needs of associated wildlife species. On September 10th, 2015, the Regional Forester issued additional guidance on the development of LRMP amendments.

Inland Native Fish Strategy

The Inland Native Fish Strategy (INFISH) was intended to be interim direction to protect habitat and populations of resident native fish and to provide for options for management. The INFISH delineated Riparian Habitat Conservation Areas (RHCAs) where riparian-dependent resources receive primary emphasis. These RHCAs include traditional riparian corridors, wetlands, intermittent streams, and other areas that help maintain the integrity of aquatic ecosystems. These areas will be managed to maintain or restore water quality, stream channel integrity, channel processes, sediment regimes, instream flows, diversity and productivity of plant communities in riparian zones, and riparian and aquatic habitats to foster unique genetic fish stocks that evolved within the specific region. RHCAs run through and overlay other allocations (see Map 3, for RHCAs and distribution of redband trout).

Gap Roads Analysis

In January 2014, an interdisciplinary team completed a roads analysis for the Gap project area. The team reviewed existing roads in the Gap project area then compared the current road system with what is desirable or acceptable, and described options for modifying the road system that would advance achievement of desirable or acceptable conditions. The team developed a set of recommendations that included designating 20.6 miles of Operational Maintenance Level (M/L) 2 Open Roads as M/L 1 Closed Roads. In addition, the team recommended decommissioning 3.3 miles of Operational M/L 1 Closed Roads. The recommendations were based on the degree of impact that motor vehicle use would have on soils, aquatic and riparian systems, and wildlife populations.

Proposed Action

The action proposed by the Forest Service to meet the purpose and need is to implement commercial thinning on 14,037 acres, noncommercial thinning (outside commercial units) on 2,027 acres, underburning on 5,587 acres, hardwood restoration on 213 acres, 13.7 miles of stream restoration, and culvert replacement at six locations. The total area on which activities would be implemented would be approximately 21,731 acres. Alternative 2 also proposes closing 20.6 miles of roads, and decommissioning 3.3 miles of roads, as recommended through the Gap Roads Analysis process. Actions connected to the proposed action would include building one mile of temporary road, use of 38.9 miles of temporary roads on existing disturbance, 4.9 miles of fence, three water developments and the expansion of Winter Material Source by up .9 acres. Temporary roads would be closed and hydrologically stabilized following treatment (see Maps 4, 5 and 6 for location of proposed activities).

Decision Framework

The Responsible Official for this proposal is the Forest Supervisor of the Ochoco National Forest. The Responsible Official will decide whether to:

- Select the proposed action;
- Select an action alternative that has been considered in detail;
- Modify and an action alternative;
- Select the no action alternative;

- Identify what project design features and monitoring will apply.

The Responsible Official will decide whether to conduct commercial harvest, noncommercial thinning, aspen treatments, fuels reduction, and riparian restoration activities in the Gap project area. The decision will be determined by how well each alternative provides the best mix of prospective results with regard to the purpose and need, the significant issues, and public comments. Factors that the Responsible Official will consider include effects of the alternatives on forested vegetation, on fuels, on aquatic species and water quality, and on wildlife species and habitats. The Responsible Official will also consider the ability of each alternative to contribute to local and regional economies.

Public and Intergovernmental Involvement

The Gap project was announced in the Ochoco National Forest's Schedule of Proposed Action on February 25, 2014 as the Gap Fuels and Vegetation Management Project; it has been subsequently renamed the Gap Landscape Restoration Project. Letters announcing the proposed action and inviting comment were mailed to Paulina Ranger District's mailing list on February 25, 2014. The Notice of Intent (NOI) was published in the Federal Register on March 4, 2014. The NOI asked for public comment on the proposal from March 4, 2014 through April 2, 2014.

Letters announcing the proposed action and inviting comment were also mailed to the Burns Paiute Tribe, the Klamath Tribes, and the Confederated Tribes of the Warms Springs Reservation of Oregon, as part of government-to-government consultation. The Paulina Ranger District received seven comments from individuals, organizations and agencies. In addition, the Gap project Proposed Action was presented to the Ochoco Forest Restoration Collaborative. Using the comments from the public and other agencies that were submitted during the scoping period, the interdisciplinary team identified several significant issues regarding the potential effects of the proposed action. To address these concerns, the Forest Service created Alternatives 3 and 4.

Issues

The Forest Service separated the issues into two groups: significant and non-significant issues. Significant issues were defined as those directly or indirectly caused by implementing the proposed action. Non-significant issues were identified as those: 1) outside the scope of the proposed action; 2) already decided by law, regulation, Forest Plan, or other higher level decision; 3) irrelevant to the decision to be made; or 4) conjectural and not supported by scientific or factual evidence. The Council on Environmental Quality (CEQ) NEPA regulations explain this delineation in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)…" A list of non-significant issues and reasons regarding their categorization as non-significant may be found at the Paulina Ranger District office, Prineville, Oregon, in the project record.

The Forest Service identified the following significant issues that were raised by commenters during scoping:

1. Commercial activities within RHCAs may reduce stream shade, large wood and cause an increase in sediment delivery to streams.

2. Treating moist-grand fir does not meet the purpose and need of the project because the conditions described apply only to dry pine sites, not moist grand-fir sites.

3. Commercial activities in goshawk Primary Fledging Areas (PFAs) would adversely affect their nesting success.

4. The proposed action does not adequately protect old growth trees, improve forest health, and decrease the risk of stand replacement fires.

Chapter 2. Alternatives, including the Proposed Action

Introduction

This chapter describes and compares the alternatives considered for the Gap Landscape Restoration Project (Gap project). It includes a description of and map references for each alternative considered. This section also presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public. Some of the information used to compare the alternatives is based upon the design of the alternative and some of the information is based upon the environmental, social and economic effects of implementing each alternative.

Alternatives Considered in Detail

The Forest Service developed four alternatives, including the No Action and Proposed Action alternatives, in response to issues raised by the public.

Alternative 1 -No Action

Under the No Action alternative, current management plans would continue to guide management of the project area. No vegetation management, fuels reduction, hardwood enhancement and riparian restoration activities would be implemented to accomplish project goals.

Alternative 2 - Proposed Action

Table 7 summarizes the activities that are included in the proposed action for the Gap project area. Please refer to Maps 4, 5, and 6 for locations of activities. Table 8 summarizes the connected actions, which are actions necessary for the implementation of Alternative 2.

Table 7. Activities proposed in Alternative 2.

Activity	Quantity (approximate)
Commercial thinning (would include noncommercial thinning and fuels treatments)	14,037 ac.
Noncommercial thinning (outside of harvest units; would include fuels treatments) Noncommercial thinning only (plantations) Noncommercial thinning only up to 21” dbh	1,389 ac. 458 ac. 180 ac. Total: 2,027 ac.
Underburning only	5,587 ac
Riparian restoration	13.7 miles/1,345 ac.
Aspen Restoration	213 ac.
Culvert Replacement	6 locations
Road closure	20.6 miles
Road decommission	3.3 miles

Table 8. Actions connected to the activities proposed in Alternative 2

Connected Action	Quantity
New Temporary road construction	1 mile
Temporary roads on existing disturbance	38.9 miles
Expansion of Winter Material Source	up to .9 acres
Buck and Pole Fence	.9 mile
Temporary Barbed Wire Fence	4 miles
Water Developments	3

Explanation of Proposed Activities and Connected Actions:

Commercial Thinning: This prescription would be used in overstocked stands with a surplus of merchantable sized trees between 7 and 20.9 inch DBH. Current stand conditions often include multiple canopies, a component of large (21+" DBH) trees, dense stocking and may include all seral stages. The stands would be thinned, on average, to recommended stocking levels while retaining variable densities across the unit. Merchantable trees up to 20.9 inch DBH removed in a commercial thinning would be sold and removed from the stand. Following the commercial thinning, most stands would be non-commercially thinned and the thinning slash would be treated, in most cases by prescribed fire. All of these treatments work together to attain the desired stand condition that are more resilient to fire and insects/disease and where future prescribed burning can safely be used as a forest management tool that mimics the role that fire historically had in these forests. No trees 21" dbh and larger would be cut in this prescription, except where needed for public safety and/or road or landing construction.

Noncommercial Thinning: The objective of this treatment is to reduce the amount of small non-merchantable trees (generally less than 9 inches DBH). The number of small trees to be left varies by stand conditions, depending on the overall stocking objectives and the amount of existing overstory. Where the objective in the stand is to have single-storied LOS stand and many large diameter trees exist, then few small understory trees would be retained (40 or less per acre). Where few overstory trees exist, such as in young plantations, then the noncommercial thinning could retain 135 or more small trees per acre. Species selection usually retains ponderosa pine, western larch, and sometimes Douglas-fir, or removes species infected with or susceptible to insects/disease. Noncommercial thinning can occur either following a commercial entry or as the only treatment. Trees cut during this activity are usually left on site and the slash treated by a variety of fuels treatments. Within plantations, fuels would be lopped and left on site to decay.

Juniper Cutting within Noncommercial Thinning Units: This treatment is primarily proposed within the juniper woodland/steppe and ponderosa pine Plant Association Groups (PAGs) to reduce juniper density. Younger junipers up to 20.9 inch DBH would be cut using hand tools and the slash would be lopped and scattered or left intact. Old juniper would be retained, regardless of size (Miller et al. 2005). Concentrations of slash would be burned. The objectives of this treatment are to reduce juniper density and increase the amount of area that is dominated by grass and shrub vegetation.

Noncommercial Thinning up to 21" dbh: This prescription is designed to collect whole trees, by pushing them over with ground-based equipment, to be used as material in stream restoration units. A variety of trees sized and diameters would be utilized, the majority of trees selected would be between 12"-18" dbh; none would be over 21" in dbh. No commercial harvest activities would occur in any units. Follow up fuels treatments may occur based on site specific conditions.

Fuels Treatments: This activity includes a variety of treatments designed to reduce natural fuels and fuels created by other activities while retaining desired vegetation. These treatments occur under prescribed conditions and include broadcast underburning, piling and burning, and spot burning of fuels accumulations (jackpots).

Hardwood Treatments: These treatments are designed to enhance hardwood species such as aspen, willow, alder, and cottonwood. This includes planting of hardwoods where they are absent or sparse, reducing conifer competition by cutting down and/or girdling conifers that have encroached into hardwood communities and are both shading out hardwoods and occupying their growing space. Conifers up to 15 inch DBH may be felled or girdled so long as they do not qualify as old trees. Thinning would take place for an approximate distance of 75 feet from hardwoods to allow for sufficient sunlight, water, nutrient and growing space to be available.

Slash generated from this noncommercial activity would be left intact to provide protection to the hardwoods, lopped and scattered, or handpiled. Cut trees may also be felled or placed into stream channels for stream restoration purposes.

Handpiles within 50 feet of a stream would not be burned; handpiles outside of the 50 foot zone may be burned. To prevent browsing on hardwood seedlings and saplings, fencing or individual cages may be installed. In some stands livestock fencing may be installed, in others big game fencing may be required. The type of fence needed would be determined on a site specific basis. Fences could be wire, plastic or wooden.

When aspen clones are encountered in stands that are planned for commercial harvest or noncommercial thinning, the silvicultural prescription would be modified within and adjacent to the clone similarly to the above description.

Road Closure and Road Decommissioning: These actions are designed to improve riparian conditions by both decreasing road densities and hydrologically stabilizing identified road surfaces through decompaction, water barring and relief ditches. Decompaction reduces direct delivery of sediment into surface water bodies by reducing or eliminating surface flow on the road surface, thereby decreasing or eliminating the volume of erosive strength of that surface flow. Also, decompaction of the roadbed increases both roughness and infiltration rate on the road surface, both of which dramatically reduce flow rate, volume, and sediment transport capacity.

Road system density in a subwatershed directly relates to the amount of impervious surface area that effectively serves as surrogate stream channels, speeding up the passage of water through the subwatershed and thereby having an effect to aquatic systems. This can directly influence stream flow routing and affect the peak, timing, and duration of higher discharge events that can occur as a result of rain-snow or high-intensity rainfall events. These sorts of increased discharge rates contributed to by the artificial stream network the road system represents serve to increase the risk of channel-changing events, particularly in aquatic/riparian systems that are not in properly functioning condition.

The Gap project proposes 23.9 miles of road closure and decommissioning as recommended by the Gap Roads Analysis. Closure and decommissioning activities are proposed for roads that exist in varying conditions. Approximately 46% of these roads have limited entry as a result of terrain, lack of maintenance, or a destination that is reached by roads maintained in a better condition. As a result, these roads are essentially currently closed and receiving little if any use. Approximately 8% of the roads have been identified as having significant resource damage due to location, terrain, and design. As a result these roads have been identified as having a high priority for closure. The Gap Interdisciplinary Team identified the remaining 46% of roads proposed for closure or decommissioning as a result of field surveys and verification. It was determined that the closure or decommissioning of these remaining roads would benefit multiple resources and be in better alignment with funding and management objectives (for more information, please see the Gap Roads Analysis located in the Gap project record).

Temporary Roads: Temporary roads are sometimes needed to facilitate the economical harvest of trees. Temporary roads would be constructed on flat ground (slope less than 20%); excavation and construction of embankments would be negligible; they would be constructed in such a way as to minimize disturbance and impacts to adjacent resources (see section titled “Transportation” in Chapter 3 of this document). Following completion of Gap project activities, all temporary roads would be barricaded to prevent motorized access, rehabilitated and decompacted (depending on soil type) to return them to vegetative productivity.

Winter Material Source

Expansion: The Winter Material Source is located on Road 4215-011 in T14 S, R 21E, Section 31NE ¼ of the NW ¼, within the General Forest Management Area. Existing mineral reserves at the site will not meet needs associated with the Gap project. The purpose for expanding the material source is to provide pit-run rock for implementation of projects under the Gap decision, which may include road maintenance and reconstruction, and road closure. The site would be expanded from its current size of about 2.7 acres to no greater than 3.6 acres. Expansion of the Winter Material Source would require removal of timber on up to .9 acres.

Harvest in the Winter Material Source Expansion: Unit 307 would include the removal of all vegetative material, including conifer trees greater than 21 inches dbh in size, on 0.9 acres. The removal of this vegetation is required for the expansion of the Winter material source. Material sources are designated as Administrative Sites in the Forest Plan, allowing for the removal of trees larger than 21 inches dbh, without a Forest Plan amendment.

Stream restoration activities

In-stream Work: Stream restoration activities would occur within seven units in the Gap project area totaling 13.7 miles and encompassing 1,345 acres of riparian, meadow, upland and prairie habitats. These areas include the majority of all major streams and aquatic ecosystems within the project area that are not properly functioning including William's and Gray Prairies and Horse Heaven Meadow. The primary goal of the restoration is to restore hydrologic function of aquatic ecosystems and restore water tables. Through the Gap project area, aquatic ecosystems are currently significantly departed from historic conditions and are not properly functioning. Stream channel incision is currently negatively influencing riparian habitats, including hardwood vegetation and sensitive plants and fish and wildlife habitat. Additional goals include the advancement of Riparian Management Objectives (RMOs) and recovery of habitat for R6-listed sensitive aquatic species such as redband trout and Columbia spotted frog and other riparian dependent species.

The types and scope of treatments vary by and within streams or project areas (unit). Restoration activities may include a combination of channel reconstruction, placement of stream structures (primarily trees, but also include some rock and bedload material) including small-to medium sized debris jams and periodic 'fill' or 'plugs'. Channel reconstruction and limited 'plugs' and fill would occur in sections of the stream, or immediately adjacent to the stream, that are considerably incised and have lost contact with the floodplain. Stream structure placement would occur in areas where stream function and habitat conditions can be improved without significant channel manipulations. Stream structure placement would be intermittent and discontinuous along the linear length of the project. Stream structure placement would be the primary restoration activity in the forested upper portions of most streams including: Horse Heaven, Lost, Lytle, Short and Lookout Creeks.

In the predominately meadow and prairie systems, aquatic restoration would be accomplished through the addition of large woody material, excavated surfaces, filling gullies and incised channels, abandonment of ditch networks, re-connecting the stream with historic flow paths and the valley floor, planting with native riparian vegetation and fencing. The general project design would be to "re-plumb" the flow paths through the meadow and provide all of the elements needed to set the meadow on a trajectory toward recovery. Design features would allow the meadow to evolve and become more dynamic over the coming years with the development of riparian vegetation and in response to an elevated groundwater table and mobilized sediments. Multi-year, a variety of equipment would be used to accomplish the restoration, including, but not limited to: track mounted excavators, loaders, dump trucks, skidders and log trucks (tree collection). The duration of implementation would vary by project, the larger scale projects may be multi phased and implemented in 2-4 week segments; smaller project areas may be completed in 2-4 weeks.

Riparian Protection (Fences): Both Buck and pole and temporary standard wire fence is proposed within riparian specific units; standard fence is defined as 4 strand 'wildlife friendly' with a smooth bottom wire. The objective of the fencing is to protect and accelerate stream restoration actions directly via exclusion of livestock and in some cases indirectly by improving livestock management e.g. riparian pasture.

Spring Development: In lieu of additional fencing, three spring locations are proposed in two locations to reduce impacts to riparian areas and accelerate recovery of aquatic restoration activities.

Culvert Replacement or Removal: Six culverts are proposed to be replaced within the stream restoration units to restore or improve passage for fish and other aquatic organisms, improve riparian habitat and ecological function, e.g., reduction in floodplain fill. Replacement of culverts may be necessary to accommodate changes in location of or elevations of culverts post restoration activities. In all cases, culverts would be designed to accommodate 100 year flood event and prevent or reduce impacts to road network for storm damage**.**

Fill Source: The old dam has been identified as a fill source in William's Prairie. This material would be excavated and used as fill in ditches, gullies and incised channels. Other fill sources would include Winter Pit and deep fill areas on roads to be decommissioned in the Gap project.

Table 9. Summary of restoration activities by project area.

Stream/Rest-oration unit	Stream Miles	Acres	Access Routes	Trees w/in project area	Tree source units (NCT)	Fill needed (Cu-yds.)	Fence	Spring develop-ment	Riparian Planting	Culvert(s)
N.F. Crooked River (Williams Prairie)	2.3**	564	1.6	1,170	n/a	5,000 ident-ified	1.3	n/a	56.4	4225-050
Gray Creek (Gray Prairie)	2.6	292	1.1	1,120	6, 106 (PCT), 336**partial	***	1.1	n/a	29.2	4215 & 4215-250
Horse Heaven (meadow)	3.8	227.3	0.8	1,296	n/a	***	1.3	2	22.7	4235 (upper) & 4235 (lower)
Lytle	1.7	97.4	<0.6*	660	n/a	n/a	8.9 acres Buck & Pole	n/a	9.7	n/a
Lost	2.3	86	<0.5*	912	176.3 (PCT)	***	0	n/a	8.6	n/a
Lookout	0.8	68	<0.5*	320	n/a	n/a	0	n/a	6.8	n/a
Short	0.1	10.3	<0.2*	212	n/a	n/a	0.2	n/a	1	4215-230
Total	**13.7**	**1,345**	**3.8**	**5690**	n/a	n/a	**12.9**	**2**	**134.4 acres**	**6**

*****Multiple short access routes, not yet specifically identified
**Adjacent to riparian restoration unit
*** Amount and location TBD

Vegetation Management Strategy within RHCAs

Under INFISH, timber harvest (including fuel wood cutting) is prohibited within Riparian Habitat Conservation Areas (RHCAs) except to acquire desired vegetation characteristics where needed to attain Riparian Management Objectives (RMOs) (INFISH, A-7). The treatments described in tables 15 and 17 (see Chapter 2, Project Design Features) were designed to protect RHCAs while carefully managing to attain RMOs. These treatments were developed on a unit-by-unit basis after analysis determined specific RHCAs in which management strategies could be applied to attain RMOs; site-specific analysis was also used to ensure that water temperature, bank stability, and large woody material recruitment zones would be met (see analysis in Chapter 3). An assessment of consistency with INFISH Riparian Goals was conducted (see Appendix E).

Forest Plan Amendments

There are no Forest Plan Amendments in Alternative 2.

Alternative 3

Alternative 3 was developed to respond to Issues #1, #2 and #3 (see page 14).

Issue #1 indicated a concern on the part of the commenter that the Proposed Action both reduces stream shade, reduces down wood and contributes sediment to streams; the commenter recommends that there be no commercial activities within the RHCAs and only hand-thinning would be allowed. In response to Issue #1, Alternative 3 proposes to avoid commercial harvest in RHCAs while allowing for noncommercial treatments, underburning, and riparian restoration efforts.

Issue #2 indicated a concern that treating moist grand-fir sites does not meet the purpose and need of the project because the conditions described in the purpose and need only apply to dry pine sites, not moist grand-fir sites. In response to Issue #2, Alternative 3 proposes to avoid commercial harvest in moist grand-fir Plant Association Groups (PAGs).

Issue #3 indicated a concern that commercial activities in goshawk Primary Fledging Areas (PFAs) would adversely affect their nesting success. In response to Issue #3, Alternative 3 proposes to prohibit commercial harvest in PFAs while allowing for noncommercial treatments and underburning.

Table 10 summarizes the activities that are included in Alternative 3. Please refer to Maps 7, 8 and 9 for locations of activities. Table 11 summarizes the connected actions required for the implementation of Alternative 3.

Table 10. Activities proposed in Alternative 3.

Activity	Quantity (approximate)
Commercial thinning (would include noncommercial thinning and fuels treatments)	10,903 ac.
Noncommercial thinning (outside of harvest units; would include fuels treatments) Noncommercial thinning only (plantations) Noncommercial thinning only up to 21” dbh	3,591 ac. 458 ac. 180 ac. Total: 4,237 ac.
Underburning only	6,396 ac.
Riparian restoration	13.7 miles/1,345 ac.
Aspen restoration	200 ac.
Culvert replacement	6 locations
Road closure	20.6 miles
Road decommission	3.3 miles

Table 11. Actions connected to the activities proposed in Alternative 3.

Connected Action	Quantity
New Temporary road construction	.9 miles
Temporary road on existing disturbance	33.1 miles
Expansion of Winter Material Source	up to .9 acres
Buck and Pole fence	.9 miles
Temporary Barbed Wire Fence	4 miles
Water Developments	3

Explanation of Proposed Activities and Connected Actions:

These would be the same as described for Alternatives 2.

Vegetation Management Strategy within RHCAs

The RHCA strategy would not include the commercial harvesting of trees within the RHCA, but would include noncommercial thinning, hardwood enhancement, riparian restoration, and underburning.

Forest Plan Amendments

There are no Forest Plan Amendments in Alternative 3.

Alternative 4

Alternative 4 was developed to respond to Issue #4 (see page 14).

Issue #4 indicated a concern on the part of two commenters that the Proposed Action does not go far enough in meeting the purpose and need of the project, and indicated a desire for the Responsible Official to consider additional activities to increase restoration in the Gap project area. Due to economic reasons, the project ID team did not look at any ground that could not be accessed by a tractor logging system, but did identify restoration opportunities with the development of a Forest Plan Amendment that increases the harvest diameter limit above 21' dbh; this would allow for an increase in restoration objectives identified in the purpose and need, while enhancing the economic viability of the project.

Table 12 summarizes the activities that are included in the Alternative 4 for the Gap project area. Please refer to Maps 10, 11 and 12 for locations of activities. Table 13 summarizes the connected actions that would be necessary for implementation of Alternative 4.

Table 12. Activities proposed in Alternative 4

Activity	Quantity (approximate)
a) Commercial thinning (would include noncommercial thinning and fuels treatments) b) Commercial thinning trees $\geq$ 21" dbh	a) 11,850 ac. b) 2,187 ac. Total: 14,037
Noncommercial thinning (outside of harvest units; would include fuels treatments) Noncommercial thinning only (plantations) Noncommercial thinning only up to 21" dbh	1,389 ac. 458 ac. 180 ac. Total: 2027 ac.
Underburning	5,587 ac
Riparian restoration	13.7 miles/1,345 ac.
Aspen enhancement	224 ac
Culvert replacement	6 locations
Road closure	20.6 miles
Road decommission	3.3 miles

Implementation of the proposed action would require the following connected actions.

Table 13. Actions connected to the activities proposed in Alternative 4.

Connected Action	Quantity
New Temporary road	.9 miles
Temporary road on existing disturbance	38.9 miles
Expansion of Winter Material Source	up to .9 acres
Buck and pole fence	.9 miles
Temp Barbed Wire fence	4 miles
Water Developments	3

Explanation of Proposed Activities and Connected Actions:

The explanations of the activities common to the other action alternatives are explained under Alternative 2. Additional activities are explained below.

***Commercial thinning trees with 21≥ dbh*:** This prescription is similar to commercial thinning except that harvest would include the removal of some trees 21" dbh or larger. This treatment is proposed to help restore historic species compositions as well as increase the resiliency of existing old trees. It would be applied on dry mixed conifer sites where there are old ponderosa pine that are under competitive stress from large grand fir and/or Douglas-fir which, although large, do not meet the definition of old trees. Grand fir and Douglas-fir which qualify as old trees would not be removed. It is estimated that within the units where this prescription is applied there would be an average of 1 to 2 large trees/acre removed. Removal of large young trees from within approximately one canopy drip line, not to exceed 20 feet of the old tree is consistent with the guidelines provided in *Restoration of Dry Forests in Eastern Oregon* (Franklin et al., 2013). The prescription would also follow the decision marking guide for removal and retention of grand-fir and Douglas-fir that was developed by the Ochoco Forest Restoration Collaborative for the Wolf Fuels and Vegetation Management project (Gap project record).

Vegetation Management Strategy within RHCAs

Vegetation strategies would be the same as described for Alternative 2.

Forest Plan Amendments

Implementation of Alternative 4 would require the following Forest Plan amendment:

1. Allow a timber sale to cut and remove trees greater than 21" in diameter in limited, site-specific locations (see page 84 for the Effects of the Forest Plan Amendment)

Project Design Features Common to All Alternatives

The Forest Service developed the following project design features (PDFs) to be used as part of all of the action alternatives. These design elements were developed to reduce the environmental effects of the proposed activities or to comply with the standards and guidelines in the Forest Plan. Many of the design elements for Water Quality/Aquatic Habitats are intended to meet the requirements for protection of water quality in the State of Oregon through planning, application, and monitoring of Best Management Practices (BMPs-Appendix C).

Water Quality and Aquatic Habitats (Riparian Habitat Conservation Areas)

Table 14 identifies RHCA boundaries that were applied during unit design for the Gap project. The following Project Design Features (PDF) were developed to minimize adverse environmental effects of the proposed activities to streams, wetlands, and RHCAs and would be used in all of the action alternatives. These PDFs comply with the standards and guides outlined in the Ochoco National Forest Plan, INFISH, as well as requirements for protection of water quality in the State of Oregon in accordance with the Clean Water Act.

Table 14. RHCA boundaries by stream class, as defined in INFISH.

Stream Class	Description	Width Each Side (feet)
1 and 2	Fish-bearing streams	300
3	Perennial (and select intermittent), non-fish bearing streams Ponds, lakes, reservoirs, and wetlands greater than 1 acre Unstable areas near waterbodies	150
4	Intermittent streams Wetlands less than 1 acre Landslides and landslide-prone areas	50
INFISH uses the term *stream category*. These categories have been converted to *stream class*, which is a more commonly used term. These are only RHCA boundaries and do not indicate vegetation treatments within them.		

Commercial Thinning

The following table describes unit specific treatments within RHCAs for Alternatives 2 and 4. If Class 4 streams are encountered that are not accounted for in tables 15 and 17, the design features in tables 16 and 18 would be used. The stream data used to support these recommendations is located in the Gap project record on the Paulina Ranger District.

Table 15. Unit-specific RHCA Treatments for Stream Classes 1, 2, and 3 in Alternative 2 and 3.

Vegetation Treatment	Unit	RHCA Treatment Streams (Class 1, 2, 3 and 4) and Wetlands
Prescribed Burn	All prescribed burn units	No specific treatment recommendations beyond the Project Design Features
Commercial Harvest	11	Class 2: (northern portion of the unit); Use class 4 RHCA Design Criteria. Class 2: (eastern portion of the unit); Recommend commercial harvest.
	13	Class 2: Use class 4 RHCA Design Criteria; fell trees prior to harvest until large wood RMO is met. Buffer seeps and springs below the 4200-300 road by 50'.
	14	Class 2: Use class 4 RHCA Design Criteria; fell trees prior to harvest until large wood RMO is met. Buffer seeps and springs below the 4200-300 road by 50'.
	25	Class 2: Commercial harvest to unit boundary. Class 4: Use class 4 RHCA Design Criteria.
	26.2	Class 2: Commercial harvest to unit boundary; fell trees until large wood RMO is met. Class 3: Commercial harvest to unit boundary; fell trees until large wood RMO is met. Class 4: Actually a class 3. No commercial harvest within 75'; fell trees until large wood RMO is met.
	27	Class 2: Commercial harvest to unit boundary.
	28*	Class 2: Commercial harvest to unit boundary. Class 3: Commercial harvest to unit boundary.
	31.2	Class 2: Fell trees until large wood RMO is met. No PCT.
	41.1	Class 2: Commercial harvest to unit boundary. Class 4: Use class 4 RHCA Design Criteria.
	48.1	Class 3: Commercial harvest to unit boundary.
	49	Class 1: Commercial harvest to FS road 4215. Class 3: Commercial harvest to FS road 4215.
	58	Class 2: Commercial harvest to unit boundary.

Vegetation Treatment	Unit	RHCA Treatment Streams (Class 1, 2, 3 and 4) and Wetlands
	71	Class 3: Portion of a class 3 and class 4 exist. No commercial harvest within 25' of stream; from 25'-50' 1 track, no skids or turns within 50". Fall 20 trees/mile to meet RMOs.
	114.2	Class 1: Commercial harvest to unit boundary. Approximately 75 trees from the NE corner to be used for stream restoration. Class 2: Commercial harvest to unit boundary. Class 3: Commercial harvest to unit boundary.
	115.2	Class 1: Commercial harvest to unit boundary. Class 3: No commercial harvest below the 4215-300.
	129	Class 3: Commercial harvest to edge of wet meadow. RX3 prior to RX2. PCT to streams edge for aspen enhancement.
	132	Class 3: Commercial harvest to edge of meadow. 20' no equipment buffer. PCT to streams edge for aspen enhancement.
	133	Class 3: Commercial harvest to edge of meadow. 20' no equipment buffer. PCT to streams edge for aspen enhancement.
	153*	Class 2: Commercial harvest to unit boundary; fell trees until large wood RMO is met.
	156.1	Class 3: Commercial harvest to unit boundary. Class 4: Use class 4 RHCA Design Criteria.
	157.1	Class 2: Commercial harvest to unit boundary. Class 3: Commercial harvest to unit boundary.
	158	Class 2: Commercial harvest to unit boundary. Class 3s: Commercial harvest to unit boundary.
	159*	Class 2: No commercial harvest within 50' of stream. Class 3s: No commercial harvest within 50' of stream or meadow. Fall large wood to benefit 4220-301 closure. Class 4: Actually a class 2. No commercial harvest within 50' of stream.
	162	Class 2: Commercial harvest to unit boundary. Class 3: Commercial harvest to unit boundary. Buffer fen complex by 100'.
	176.1	Class 2s: Commercial harvest to riparian buffer, or temp road, or slope break.
	176.2	Class 2: (PCT unit); fell trees until large wood RMO is met.
	179.2	Class 2: Non-commercial thin up to 15" to meet large wood RMO.
	202	Class 2: Connectivity corridor; commercial harvest to unit boundary. Class 4: Use class 4 RHCA Design Criteria.
	203	Class 2: Unit was redelineated due to connectivity corridor; commercial harvest to unit boundary. Class 4s: Use class 4 RHCA Design Criteria.
	209.1	Class 2: Commercial harvest to unit boundary. Fell trees until large wood RMO is met (at edge of meadow).
	210.1*	Class 2: NE finger of the unit: no commercial harvest within 75' from the toe of the slope. Class 2: East edge of unit: harvest to unit boundary Class 2: Southern portion of unit: commercial harvest north of 4235-102 rd. Class 2: Western and northwestern edge: commercial harvest to unit boundary.
	210.2	Class 2: No commercial harvest within 75' of stream or below the slope break (stay above toe slope). Fell trees until large wood RMO is met.
	212.1	Class 2: Commercial harvest to 4235-104 road. Fell trees until large wood RMO is met.
	213*	Class 2: No commercial harvest within 100' of stream. Fell trees until large wood RMO is met. Class 4s: Use class 4 RHCA Design Criteria.
	214	Class 2s: No equipment within 25' of stream. Fell trees until large wood RMO is met. Class 4s: No equipment within 25' of stream. Fell trees until large wood RMO is met.
	215	Class 4s: Use class 4 RHCA Design Criteria.
	216.1	Class 4: Use class 4 RHCA Design Criteria.

Vegetation Treatment	Unit	RHCA Treatment Streams (Class 1, 2, 3 and 4) and Wetlands
	216.2	Class 2: Harvest to 4235-105 rd. Class 4s: No equipment within 25' of stream. Fell trees until large wood RMO is met.
	219.1	Class 2s: (PCT unit); fell trees up to 15" dbh within the RHCA until large wood RMO is met.
	221.2	Class 2s: Commercial harvest to unit boundary, if unit boundary is below the 4235-012 rd. then fell trees until large wood RMO is met.
	225*	Class 2: No commercial harvest within 100' of stream. Fell trees until large wood RMO is met. Class 3: Commercial harvest to unit boundary. Fell trees until large wood RMO is met. Class 4: No commercial harvest within 100' of stream. Fell trees until large wood RMO is met.
	231	Class 2: Commercial harvest to unit boundary.
	232.1	Class 3: Commercial harvest to unit boundary for aspen restoration.
	234	Class 2: Commercial harvest to unit boundary.
	235*	Class 2: No commercial harvest west of the creek and east of the 4235-150 rd. No commercial harvest within 50' unless limited by slope. If slope is a limiting factor that commercial harvest would not occur closer than the decommissioned road that parallels the east side of the creek. Buffer spring by 150' for both commercial and non-commercial treatment.
	235.1	Class 2: Commercial harvest to unit boundary.
	235.2*	Class 2: No commercial harvest within 100' of stream.
	236*	Class 2: No commercial harvest within 75' of stream. PCT to stringer meadow edge. Class 4: Believe to be a class 3 originating from a spring. Buffer spring 150' and apply a standard class 3 buffer.
	237.1	Class 2: Commercial harvest to the 4235-150 rd.
	237.2	Class 2: Commercial harvest to unit boundary. Class 4: Use class 4 RHCA Design Criteria.
	358	Class 3: NCT unit for aspen restoration.
* 303(d) listed stream		

Table 16. Class 4 RHCA Design Features

Distance From Channel/Feature (Feet)	RHCA Treatment
0 – 5	No Treatment
Slope %	**RHCA Treatment**
0-10	No commercial harvest within 25’ of stream; fell trees until large wood RMO is met
11-35	No commercial harvest within 50’ of stream
Exceptions may be possible after review by Fishery Biologist and/or Hydrologist.	

See also Appendix C, Water Quality BMPs, Veg-1 Vegetation Management Planning, Veg-2 Erosion Prevention and Control, Veg-3 Aquatic Management Zones, Veg-4 Ground-Based Skidding and Yarding Operations.

- No trees ≥ 21” dbh would be harvested within RHCAs.
- Trees felled to meet large wood RMOs would be felled into or towards stream channels to increase large woody material and to reduce livestock access. Felling trees may involve either cutting trees or pushing trees, dependent on ground conditions. If trees are felled by pushing, the same equipment, or its equivalent, used during commercial harvest would be utilized. Hazardous trees that are felled within RHCAs would be left on site or used for in-stream large wood structures.
- Ground based equipment within RHCAs is prohibited on slopes greater than 35%.

- Ground-based harvest equipment would not be allowed within "no commercial harvest" buffers except on system and temporary roads (existing and new).
- Ground based equipment being used for non-harvest restoration activities such as large wood placement, stream restoration, road decommissioning, etc. would be allowed within the "no commercial harvest" buffers upon approval/recommendation by the District Fish Biologist and/or Hydrologist.
- Avoid machine harvesting, skidding and minimize crossings of Class 5 stream channels within commercial units. Avoid skidding down Class 5 channels when possible.

Noncommercial Thinning

For noncommercial treatments, follow unit-specific design features in table 17. For the remainder of the RHCA units, follow the treatments outlined in table 18.

Table 17. Unit specific noncommercial thinning treatments for all alternatives.

Noncommercial Thinning	16.4	Class 2: PCT to unit boundary
	103.2*	Class 2: PCT to unit boundary (*303d listed stream)
	106	Trees from portion of the unit within the RHCA would be utilized for stream restoration
	176.3	Trees from portion of the unit within the RHCA would be utilized for stream restoration
	336	Class 3: No buffer on Class 3 stream. Leave slash in place. Do not pull trees out by the roots within dripline plus 10' of leave trees. Leave tree mark.

Table 18. Noncommercial thinning RHCA design features

Distance From Channel (Feet)	Treatment
0 – 5 (All Stream Classes)	No Treatment
6 – 12 (Class 1, II, III)	Hand cutting (drop and leave or girdling) of conifers up to 15" to remove competition from existing hardwoods or to provide growing space for hardwood plantings.
13 – 28 (Class 1, II, III)	Noncommercial thinning of conifers up to 6" dbh using hand tools
29 – 50 (Class 1, II, III)	Noncommercial thinning of conifers up to 9" dbh using hand tools
*Exceptions may be possible after review by Fisheries Biologist and/or Hydrologist.	

- Trees cut during noncommercial thinning would be felled toward designated stream channels, where practicable, to increase woody structure and roughness and to reduce livestock access.
- Do not pull trees out by the roots within dripline plus 10' of leave trees when utilized for stream restoration. This includes trees within NCT and stream restoration units.

Stream Crossings

See Appendix C, Water Quality BMPs, Road-7 Stream Crossings

- Locate stream crossings where the channel is narrow, straight, and uniform, and has stable soils and relatively flat terrain to the extent practicable. Select a site where erosion potential is low. Orient the stream crossing perpendicular to the channel to the extent practicable. Keep approaches to stream crossings to as gentle a slope as attainable.
- Temporary and reconstructed roads with stream crossings would have adequate relief drainage installed prior to runoff reaching the stream channel. Filter strips below drainage structures would be of sufficient size to catch sediment before runoff enters streams. If adequate filter strips are not available, slash, rock aprons, or other filtering structures would be installed. A stable structure would be constructed across all streams when crossed by new temporary roads.

- Reconstructed stream crossings should be constructed to accommodate a 100-year flood if the crossing structure is anticipated to remain in place during the winter or spring. As needed, temporary and reconstructed road stream crossings would be coordinated with the fisheries biologist or hydrologist.
- To protect morphology of dry stream channels and banks, temporary road crossings would be constructed by laying logs in the channel and covering with a layer of geotextile cloth (to prevent migration of soil/mud to the channel bed) prior to placement of soil to create a drivable travel surface. These "log culvert" crossing structures would be removed at the end of hauling activities.
- At dry stream crossing locations (either summer or winter haul) where low bank height (less than 1 foot) and broad channel width would make a "log culvert" structure an impracticable choice, rock fords would be constructed to protect the bank and channel from damage by hauling equipment. All temporary road crossings would be removed unless they are determined to be hydrologically beneficial.
- Where practicable, large woody debris would be placed in the stream channel during the removal of stream crossing.
- Where practicable, native riparian-associated vegetation would be planted or seeded at new and reconstructed stream crossings.
- For dry streams whose bed and banks are well armored by large cobble, boulders and/or bedrock, and whose bank angle and bank height are low enough to provide a smooth transition through the channel, skidding may proceed without a constructed crossing.
- Stream crossings would be installed when channel is dry, either naturally or by diverting and dewatering the site. Exceptions may be made for winter harvest activity.

Skid Trails, Landings, and Roads

See also Appendix C, Water Quality BMPs, Road-1 Travel Management Planning and Analysis, Road-2 Road Location and Design, Road-3 Road Construction and Reconstruction, Road-4 Road Operations and Maintenance, Road-5 Temporary Roads, and Road-6 Road Storage and Decommissioning.

- Where practicable, avoid new skid trails, landings, and temporary roads within RHCAs (including wetlands and springs) and up ephemeral draws (class 5). When using existing skid trails, landings, and temporary roads within RHCAs of Class 3 and 4 waterbodies and within 200 feet of Class 1 and 2 streams, minimize disturbance and subsequent impacts. Exceptions may be possible after review by the fisheries biologist or hydrologist.
- Maintenance level 1 closed roads (see Chapter 3, Transportation) used for project implementation shall be hydrologically stabilized and physically closed to vehicular traffic upon project completion.
- Temporary road construction would be constructed as agreed upon by Forest Service and constructor, in accordance with Section 7 guidelines of the Oregon State Occupational Safety and Health Standards. All temporary roads, within 200 feet of a stream, would not receive large vehicular use in support of post-harvest activities. Exception may be made to support post-harvest activities on a short-term basis through the use of smaller vehicles such as ATVs, UTVs, and small farm tractors.

- At the completion of harvest and post-harvest activities requiring their use, temporary roads utilized by this project would be blocked to eliminate motor vehicle access, hydrologically stabilized, and scarified or otherwise de-compacted (as soil conditions allow) to facilitate their return to proper hydrologic function and vegetative productivity .

Stream Restoration

Project Design Features for Riparian Restoration Activities Adopted from USACE (ACOE RGP-4) and Oregon DSL (GP 42104). In addition to the General Aquatic Conservation Measures outlined in the *http://fswebgstc.gsc.wo.fs.fed.us/services/data_management/Oregon/docs/ACOE_RGP-4_June2015.pdf*, the following includes a summary of the relevant PDF by category in the aforementioned documents. For a full list of applicable PDF reference Appendix D of this document.

See also Appendix C, AqEco-1 Aquatic Ecosystem Improvement and Restoration Planning, AqEco-2 Operations in Aquatic Ecosystems, AqEco-2 Ponds and Wetlands, AqEco-4 Stream channels and shorelines.

- No trees would be pushed over within a drip-line-length, plus-ten feet in order to protect the root systems of standing large trees.
- Define operational zone for Large Wood mitigation (pushing over or tipping of trees) outside of commercial thinning operations with consultation of soil, water, or fish specialist.

Large Wood and Boulder Projects

- Place Large Wood (LW) and boulders in areas where they would naturally occur and in a manner that closely mimic natural accumulations for that particular stream type. For example, boulder placement may not be appropriate in low-gradient meadow streams.
- Structure types shall simulate disturbance events—debris flows, rock slides, wind-throw, tree breakage, etc.—to the greatest degree possible.
- No limits are to be placed on the size or shape of structures as long as such structures are within the range of natural variability of a given location and do not block fish passage.
- Projects can include grade control and bank stabilization structures, while size and configuration of such structures would be commensurate with scale of project site and hydraulic forces.
- The partial burial of LW and boulders is permitted and may constitute the dominant means of placement. This applies to all stream systems but more so for larger stream systems where use of adjacent riparian trees or channel features is not feasible or does not provide the full stability desired.
- LW includes whole conifer and hardwood trees, logs, and rootwads. LW size (diameter and length) should account for bankfull width and stream discharge rates. When available, trees with rootwads should be a minimum of 1.5 times bankfull channel width, while logs without rootwads should be a minimum of 2.0 times bankfull width.
- Structures may partially or completely span stream channels or be positioned along stream banks.
- Stabilizing or key pieces of LW must be intact, hard, with little decay, and if possible have root wads (untrimmed) to provide functional refugia habitat for fish. Consider orienting key pieces such that the hydraulic forces upon the large wood increases stability.
- Anchoring Large Wood – Anchoring alternatives may be used in preferential order:
    - use of adequate sized wood sufficient for stability;

- orient and place wood in such a way that movement is limited;
- ballast (gravel and/or rock) to increase the mass of the structure to resist movement;
- use of large boulders as anchor points for the LW.

Tree Removal for Large Wood Projects

- Live conifers and other trees can be felled or pulled/pushed over in riparian and upland areas for in-channel large wood placement only when conifers and trees are fully stocked. Tree felling shall not create excessive stream bank erosion or increase the likelihood of channel avulsion during high flows.
- Danger trees and trees killed through fire, insects, disease, blow-down and other means can be felled and used for in-channel placement regardless of live-tree stocking levels.
- Trees may be removed by ground-based equipment.
- Trees may be felled or pushed/pulled directly into a stream and/or floodplain.
- Trees may be stock piled for future instream restoration projects.
- The project manager for aquatic restoration would coordinate with the district wildlife biologist in tree-removal planning efforts.

Access Road and Trail Erosion Control and Decommissioning

- For road decommissioning and hydrologic closure projects within riparian areas, recontour the affected area to mimic natural floodplain contours and gradient to the extent possible.
- When obliterating or removing segments immediately adjacent to a stream, consider using sediment control barriers between the project and stream.
- Dispose of slide and waste material in stable sites out of the flood-prone area. Native material may be used to restore natural or near-natural contours.
- Drainage features used for stormproofing and treatment projects should be spaced as to hydrologically disconnect road surface runoff from stream channels. If grading and resurfacing is required, use gravel, bark, or other permeable materials for resurfacing.
- Minimize disturbance of existing vegetation in ditches and at stream crossings.
- Conduct activities during dry-field conditions (generally May 15 to October 15) when the soil is more resistant to compaction and soil moisture is low.
- When removing a culvert from a first or second order, non-fish bearing stream, project specialists shall determine if culvert removal should include stream isolation and rerouting in project design. Culvert removal on fish bearing streams shall adhere to the measures described in the Fish Passage Restoration activity category.
- For culvert removal projects, restore natural drainage patterns and channel morphology. Evaluate channel incision risk and construct in-channel grade control structures when necessary.

Fish Passage Restoration including Headcut Stabilization

Crossing Design

- All projects shall meet Oregon Department of Fish and Wildlife fish passage design criteria as defined in OAR 635-412-0035.

- Crossings shall be designed using an interdisciplinary design team consisting of an experienced Engineer, Fisheries Biologist, and Hydrologist/Geomorphologist.
- Crossing structures with widths that exceed 20 feet or with costs that exceed $100,000 shall be reviewed by the USDA Forest Service Aquatic Organism Passage Design Assistance Team or a BLM equivalent.
- At least one member of the design team shall be trained in a week-long Aquatic Organism Passage course based on the USDA Forest Service's guide, Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings (USFS 2008) http://stream.fs.fed.us/fishxing/aop_pdfs.html.
- Bankfull width shall be based on the upper end of the distribution of bankfull width measurements as measured in the reference reach to account for channel variability and dynamics.

Stabilize Headcuts

- Armor headcut with sufficiently sized and amounts of material to prevent continued up-stream migration of the headcut. Materials can include both rock and organic materials which are native to the area. Material shall not contain gabion baskets, sheet pile, concrete, articulated concrete block, and cable anchors.
- Focus stabilization efforts in the plunge pool, the headcut, as well as a short distance of stream above the headcut.
- Minimize lateral migration of channel around headcut ("flanking") by placing rocks and organic material at a lower elevation in the center of the channel cross section to direct flows to the middle of channel.
- In streams with current or historic fish presence, provide fish passage over stabilized headcut through constructed riffles for pool/riffle streams or a series of log or rock weir structures for step/pool channels as described below. Short-term headcut stabilization (including emergency stabilization projects) may occur without associated fish passage measures. However, fish passage must be incorporated into the final headcut stabilization action and be completed during the first subsequent in-water work period.
- In streams without current or historic fish presence, it is recommended to construct a series of downstream log or rock weirs as described below to expedite channel aggradation.

Riparian Vegetation Planting

- Experienced silviculturists, botanists, ecologists, or associated technicians shall be involved in designing vegetation treatments.
- Species to be planted would be of the same species that naturally occur in the project area. Acquire native seed and/or plant sources as close to the watershed as possible.
- Tree and shrub species, willow cuttings, as well as sedge and rush mats to be used as transplant material shall come from outside the bankfull width, typically in terraces (abandoned flood plains), or where such plants are abundant.
- Sedge and rush mats would be sized to prevent their movement during high flow events.
- Concentrate plantings above the bankfull elevation.
- Removal of native and non-native vegetation that would compete with plantings is permitted.
- Enclosure fencing to prevent utilization of plantings by deer, elk, and livestock advised.

Other Activities

See also Appendix C, Water Quality BMPs, Min-1 Minerals Planning, Min-3 Minerals Production, Min-5 Mineral Materials Resource Sites, Min-6 Mine Waste Storage and Disposal and Reserve Pits, Min-8 Minerals Site Reclamation, Wat Uses-1 Water Uses Planning, Wat Uses-3 Administrative Water Developments.

- In channel work on Class I-III streams would be accomplished during low flow conditions in accordance with "Oregon Guidelines for Timing of in-Water Work to protect Fish and Wildlife Resources, June 2008." For the project area, the timing for in-water work is July 1 to October 31. The appropriate permit and/or authorizations would be obtained from the Division of State Lands and the Army Corp of Engineers.
- In channel work on Class IV streams would occur when the channel is dry. This would include the installation and removal of crossing structures (culverts, fords, log crossings, etc.) as well as the actual fording of dry channels during timber operations. As needed, the fisheries biologist or hydrologist would coordinate specifications and locations.
- New industrial camps would not be located in RHCAs.
- Develop or use existing fuel and chemical management plans (e.g., Spill Prevention Control and Countermeasures [SPCC], spill response plan, and emergency response plan) when developing the management prescription for refueling and servicing sites.
- Screen water pump intakes with appropriate size mesh screen to prevent entrapping fish. Draft hoses used to withdraw water from ponds or streams shall be screened with appropriate size mesh to prevent entrapping fish.
    - Woven Wire Screen or Perforated Plate: 3/32 in. (2.38mm)
    - Profile Bar Screen: 0.0689 in. (1.75mm).

If conditions are such that winter activities extend through March, avoid activities (including haul) in the Columbia Spotted Frog channel migration zone from March 1 to May 31st. Post-harvest activities such as noncommercial thinning and prescribed fire within RHCA Class I-III would also not be allowed unless waived by the fisheries biologist. It is improbable that conditions for winter activities would be the same conditions suitable for frog migration. Reference the Aquatics report for further specificity.

Prescribed Fire Activities (General)

- Prescribed burning activities shall be coordinated with the Department of Environmental Quality through the State of Oregon smoke management program.
- Burn plans (unit-specific prescriptions) shall be developed as an on-the-ground, interdisciplinary process.
- Range improvements such as exclosures, wood fence posts, exposed water lines, and other improvements would be protected during implementation.
- Where practicable, along firelines on slopes from 0 to 30 percent, waterbars would be placed approximately every 60 feet. On slopes over 30 percent, waterbars would be placed approximately every 25 feet.
- Private landowners within the project area would be notified approximately 5 days in advance of any burning activities adjacent to their lands.

Prescribed Fire Activities in RHCAs

The intent is that where these criteria are applied, retention of in-stream down wood would be retained at 100%; percent shade and sediment delivery to streams would not be measurably changed. The intent of INFISH and Forest Plan standards would be met.

- Burn plans (unit-specific prescriptions) would be developed through an interdisciplinary process.
- Generally in RHCAs, there would be no intentional ignition within 100’ of Class I, II, and III stream channels and within 50’ of Class IV stream channels. Fire would be allowed burn into the RHCAs and burn in a mosaic pattern. This criterion may be modified on a site-specific basis if:
    - There is a road or other existing fuel break within no ignition zone of the stream channel that would provide a logical boundary to the burn unit; in this case, ignition may take place up to the fuel break, but not between the fuel break and the stream channel.
    - Site-specific conditions exist such that intentional ignition within no ignition zone of the stream channel would be desirable.
        - EXAMPLE: Excessive amounts of conifer seedlings within 100’ of a stream channel are detrimental to the development of riparian hardwoods and fire is determined to be the tool of choice to remove them.
        - EXAMPLE: Heavy fuel accumulations within no ignition zone of the stream channel exist and fire is determined to be the tool of choice to reduce them.
- Where necessary, fireline (a fuel break to mineral soil, 12-24 inches wide) would be constructed within RHCAs with the following guidelines:
    - Fireline in RHCAs would not be constructed within 25’ of streambanks.
    - Fireline in RHCAs would be dug by hand. Exceptions, such as fire-line plow, may be possible after review by fisheries biologist or hydrologist.
    - The end of the line would fishhook away from the stream channel and stop on the contour.
    - Fireline would be rehabilitated following completion of activities; waterbars would be constructed on hand line, and sod would be replaced where possible.
- Sensitive areas within RHCAs would be identified and site-specific plans to protect each area during burn operations would be developed; site-specific plans would become part of each burn plan, and would be completed prior to approval of the burn plan.
    - EXAMPLE: A particular reach may contain down wood that is acting to prevent the progress of a headcut; barrier to livestock trailing; site-specific plan would be developed to ensure retention of that piece of wood.
- Where slash generated from thinning is handpiled, avoid burning handpiles within 50 feet of all waterbodies. Exceptions may be possible after review by fisheries biologist or hydrologist.

Cultural Resources

- Coordination with the project archaeologist would take place for implementation of activities that overlap with known sensitive cultural resource sites. Coordination would occur with the relevant specialists to ensure the protection of cultural sites and features to accomplish heritage objectives. Activities include road construction, maintenance and road closures, commercial harvest, noncommercial thinning, and stream restoration and prescribed fire.
- If human remains or heritage resources (historic or prehistoric) are discovered during implementation, all activities within the immediate vicinity of the discovery area would cease until the area is assessed by a professional archaeologist. Site specific mitigation would be determined and consultation with the Oregon State Historic Preservation Office, Oregon State Police and local Tribal Governments, as appropriate, would occur prior to resuming ground disturbing activities.
- If undocumented historic stock driveway signs, General Land Office bearing trees, or physical remains of other historic features are discovered within treatment units, activities would cease in their immediate vicinity and their location would be made known to the project archaeologist for recording. After recording, project activities would continue.
- Archeological sites would be protected from ground disturbing activities by establishing a 100 foot buffer around sites to avoid damage. During prescribed fire activities, firelines would be established around, or fuels pulled away from, sites to avoid damage.
- Any project proposal included in the Gap project EIS after submission of the Heritage Resources report to the State Historic Preservation Office (SHPO), or any area in the Gap project EIS project boundary not adequately assessed by the heritage program for a proposed undertaking, would be subject to Section 106 review and/or survey prior to implementation of that proposed project.
- Establishment of staging areas for motorized vehicles and equipment of any kind would not be permitted within buffered areas of known ground-based cultural resource sites.

Paleontology

- If paleontological resources (specifically vertebrate fossils) are discovered during implementation, all activities within the immediate vicinity of the discovery area would cease until the area is assessed by a professional paleontologist. Site specific mitigation would be determined and consultation with the Forest geologist, as appropriate, would occur prior to resuming ground disturbing activities.

Sensitive Plants and Scablands

- For vegetation management treatments, no slash piling or ground-based equipment would be used within 50 feet of mapped sensitive plant populations. Exceptions would be reviewed by the district botanist. Exceptions may include:
  - Pulling cable (winch lining) from an existing road;
  - Using existing disturbances as landings;
  - Hardwood treatments.
- Commercial harvest units that overlap with sensitive plant habitat would be coordinated with the district botanist.

- Mechanized noncommercial thinning and non-commercial harvest activities that overlap with sensitive plant habitat would be coordinated with the district botanist. Sensitive plants would be considered in project implementation, for example, management activity may be timed to occur after the growing season when plants are dormant (September-March).
- Where units with proposed hand piling overlap with sensitive plant habitat, pile placement would be coordinated with the district botanist before treatment.
- To reduce impacts to unique scabland soils and vegetation and associated sensitive plant habitat, ground disturbing activities, including slash piling, would be avoided. Exceptions may occur on existing roads, landings, or other areas that have been reviewed by the district botanist.
- Vehicles, including off-highway or all-terrain vehicles, would not be operated within areas identified as sensitive plant habitat, except on existing roads.
- Temporary roads across scablands would be limited to existing disturbances unless there is no other feasible alternative. Any new disturbance of scabland habitats would be reviewed by the district botanist prior to implementation.
- Fuel treatments within or adjacent to sensitive plant habitat would occur during the fall. Prescribed fire within sensitive plant habitat would be avoided during the spring prescribed burning window to allow plants to grow.
- Riparian restoration projects would be implemented in coordination with the district botanist. Revegetation plans using locally-sourced native species would be developed for riparian restoration projects.
- Riparian restoration projects occurring in mapped sensitive plant habitat would be surveyed for sensitive plants prior to implementation. No ground-based equipment would be used within 50 feet of known sensitive plant populations.
- If any new species or populations of sensitive plants are found during project implementation, these species would be considered as described in the policy guidelines found in FSM 2670, regardless of the date of sale or other contract.

Invasive Plants

- Pre-implementation surveys would be conducted to ensure updated information on invasive plant infestations within project areas. Treatment of infestations would occur prior to activities where practical would follow the Deschutes and Ochoco National Forests, Crooked River National Grassland Invasive Plant Treatments EIS (Invasive Plant Treatments EIS).
- Contract and sale administrators would work with the district invasive plant coordinator to identify and avoid invasive plant infestations during all project activities. Known invasive plant infestations would be shown on timber sale or stewardship contract maps and marked on the ground. Known infestations that have not been treated prior to management activities would be avoided during implementation. New invasive plant infestations discovered during implementation would be reported to the district invasive plant coordinator.
- To reduce the potential for transport or spread of invasive plants by road construction, logging equipment, equipment used for riparian restoration work, fire vehicles, and other all equipment shall be required to be washed before entering Forest Service lands.

- To reduce the potential for weed spread through mineral material (i.e. gravel and rock) used on roads and landings, Ochoco NF material sources proposed for use in the project would be inspected to ensure materials are weed-free. Additionally, the sale or stewardship contract would include provisions requiring any material from other sources is weed-free.
- Re-vegetate temporary roads, primary skid trails, and log landing areas in as part of the final sale contract work. Use locally-sourced native species recommended by the district botanist. All seed would be certified as "All States Noxious Weed Free" by an approved testing laboratory, such as the Oregon State University Seed Lab.
- If straw bales are used for sediment traps or seeding mulch, they would be certified weed-free or be acquired from certified fields that produce weed-free seed for the grain or grass seed industry.
- Road construction or reconstruction through invasive plant infestations would be avoided, unless provisions are made through the district weed coordinator. An example would be placement of clean fill over the weed site prior to use by vehicles.
- Water for prescribed fire control, watering roads, or other activities would be obtained from weed free sites or by methods that reduce the risk of spreading invasive plant parts or seeds from infested areas near water sources. Fire engines and water tenders would avoid driving over invasive plants on the banks of water sources, or other measures taken, such as covering with clean mineral material, to reduce risk.
- Post-project surveys and monitoring of invasive plant infestations, including mineral sources, would be conducted to identify new invasive plant infestations while they are small and more easily controlled.
- Burn plans and prescribed fire activities would be implemented with the involvement of the district invasive plant coordinator. Prescribed fire burn plans and maps would include known invasive plant infestations and would highlight relevant invasive plant prevention practices.

Soils and Geology

Refer to Appendix B, Soil Condition Analysis for specific units with mitigations.

- See also Appendix C, Water Quality BMPs Min-1 Minerals Planning, Min-3 Minerals Production, Min-5 Mineral Materials Resource Sites, Min-6 Mine Waste Storage and Disposal and Reserve Pits, Min-8 Minerals Site Reclamation
- Ground-based equipment would not be operated on slopes greater than 35 % in commercial units to minimize detrimental impacts. Prioritize areas of slope greater than 35% as leave areas within units.
- Skid trails would be approved by timber sale administrator prior to logging. Locate skid trails on existing disturbance where available. Avoid locating skid trails in the flow-line of ephemeral drainages where practicable. Minimize crossings of ephemeral drainages and establish crossings perpendicular to the flow-line of the drainage-way. Suspend the leading end of logs during skidding to limit soil displacement.
- In harvest units where detrimental soil conditions occur on less than 20 percent of the area, plan activities so that detrimental soil conditions do not exceed 20 percent. This includes designating skid trails, landings, and roads. Minimize off trail traffic of feller bunchers over the same piece of ground. Limit machinery used for post-sale grapple piling to skid trails, landings and roads.

- In units where detrimental soil conditions exceed 20 percent of the area,
  - if tillable, allow no more than 5 percent increase over existing conditions. Limit post-sale piling machinery to skid trails, landings and roads. Till primary skid trails and landings following harvest and post-sale operations so that there is no net increase in the percentage of detrimental soil conditions.
  - if tillage is not feasible, allow no increase in detrimental soil conditions. Operate harvest and post-sale machinery on existing disturbed areas or under winter harvest conditions. Consider alternate harvesting methods including hand felling or harvester/forwarder systems.
- Ground conditions shall meet at least one of the following criteria if machine operations occur during the winter season:
  - 1) Six inches of frozen ground,
  - 2) Four inches of frozen ground with one foot of snow,
  - 3) Two feet (>24 inches) or more of snow, or
  - 4) Soil moisture conditions acceptable for minimizing rutting or puddling of soils
- Waterbars on skid trails would be installed at regular intervals (varies by slope class), preferably with a crawler type tractor with an angled blade. On slopes from 0 to 30 percent, waterbars would be placed at a minimum of every 60 feet. On slopes over 30 percent, waterbars would be placed at a minimum of every 25 feet. Where waterbars are not feasible, place or back blade slash and other woody debris onto the skid trail surface.
- Avoid operating machinery on excessively wet soil conditions capable of incurring detrimental puddling or rutting greater than six inches in depth.
- Infiltration buffering is required along the scab/forest interface to mitigate alteration of sensitive hydrologic conditions. Maintain a buffer of 50-66 feet in which the number of crossings, landings and road impacts would be kept to a minimum.
- Consult with the Forest geologist upon any evidence of recent landslide slope movement.

Wildlife

Leave Areas

- In general, commercial and noncommercial treatments would leave approximately 10% and 15%, respectively, of the treatment area in un-thinned patches, except where desired conditions and prescriptions are in direct conflict (i.e. hardwood restoration and juniper thinning units). Consultation on these exceptions would be conducted prior to implementation with the District wildlife biologist.

Goshawk

- A 30 acre nest stand and a 400 acre post-fledging area (PFA) have been established around each known nest site. No management activities, including underburning activities, would occur inside the 30 acre nest stand. Burning activities within the PFA would be designed to protect overstory trees, large down wood and large snags. For example, burning would occur during the lower end (cooler/wetter) of the prescription window.
- Total treatment activities, including burning would be limited to 50% of the PFA.

- A seasonal restriction (March 1 to August 31) would exist on all activities; including commercial harvest, non-commercial thinning, underburning, and stream restoration within 0.5 mile of an active nest. A seasonal restriction (March 1 to August 31) would also apply to hauling, new road construction, and road reconstruction within 0.25 mile of active nests. Haul restrictions would not apply to arterial or collector roads.
- Seasonal restrictions may be waived, with approval of District Ranger, in a particular year if reproductive success surveys reveal that goshawks are non-nesting or that no young are present (consult District wildlife biologist). Waivers are valid only until January 1 of the following year.
- If a previously unknown active nest or aggressive goshawk is discovered during implementation, efforts would be made to avoid any further disturbance. Site-specific measures would be determined by District wildlife biologist.

Bald Eagle, Golden Eagle and Osprey

  - Bald Eagle – A seasonal restriction (January 1 to August 31) would exist for all activities within 0.25 mile (non-line-of-sight), 0.5 mile (line-of-sight), or 1 mile (for blasting) of known bald eagle nests.
  - Golden Eagle – A seasonal restriction (March 1 to August 15) would exist for all activities within 0.5 mile of known nests.
  - Osprey – A seasonal restriction (March 1 to August 1) would exist for all activities within 0.25 mile of known osprey nests.

- Restrictions on haul would not apply to arterial and collector roads but site specific measures would be developed to reduce disturbance; for example restrict compression braking or avoid parking near nest site (consult District wildlife biologist).
- Restrictions may be waived, with approval of District Ranger, in a particular year if reproductive success surveys reveal that the species in question are non-nesting or that no young are present (consult District wildlife biologist). Waivers are valid only until January 1 of the following year.
- If a previously unknown active eagle or osprey nest is discovered during implementation, efforts would be made to avoid any further disturbance. Site-specific measures would be determined by District wildlife biologist.

All Other Raptors

- No management activities (including underburning) would occur within 330 feet of nest site (primary zone). Between 330 and 660 feet around a nest site (secondary zone), modified habitat treatments are permitted. Modified treatments are intermediate treatments between that required in the primary zone, and that normally prescribed outside the whole protection zone. Operations would be restricted for both primary and secondary zones between March 1 and August 1. Exceptions would be evaluated on a case by case basis by District wildlife biologist.
- Seasonal restrictions may be waived, with approval of District Ranger, in a particular year if reproductive success surveys reveal that the species in question is non-nesting or that no young are present (consult District wildlife biologist). Waivers are valid only until January 1 of the following year.

Primary Cavity Excavators

- Active nest trees (including snags) located during layout or project implementation would be designated with a wildlife tree marker and protected. If the nest tree is determined to be a safety hazard, coordination with District wildlife biologist would occur to determine if the hazard can be mitigated. Safety hazards would be identified by a qualified person, as defined by, and using the procedures provided in the interagency Field Guide for Danger Tree Identification and Response (Toupin et. al. 2005).
- If the hazard cannot be mitigated, felling of the tree would preferably not occur during nesting season (April 1 to August 15), but rather after the young have fledged, unless immediate removal is necessary due to the nature of the hazard (i.e. proximity to open road, campground, etc.).

Deer and Elk

- A seasonal restriction (December 1 to May 1) would exist for all activities within designated big game winter range (Management Area 20 and 21).
- A seasonal restriction (May 15 to June 30) would exist for all activities within known elk calving areas.
- A seasonal restriction (September 1 to October 15) would exist for all activities within 0.25 mile of known elk wallows.
- Seasonal restrictions for deer and elk may be waived, with approval of District Ranger, in a particular year depending upon multiple biological and environmental factors (consult District wildlife biologist).
- Where wire fencing is used, fencing guidelines from Wyoming Game and Fish Department Habitat Extension Bulletin No. 53 (Karhu 2004) or A Landowner's Guide to Wildlife Friendly Fences (Paige 2012) would be utilized to minimize impacts to big game.
- Utilize water development guidelines from Water for Wildlife; a Handbook for Ranchers and Range Managers (Taylor and Tuttle 2007). This methodology would ensure that native species utilizing water developments as drinking sources, such as bats and birds, would not incur injury.

Silver-Bordered Fritillary

- Within known or suspected fritillary habitat, use of ground based equipment would be coordinated with the District wildlife biologist prior to implementation.

Snags/Down Logs

- Snags that pose a safety hazard which cannot be mitigated would generally be felled and left onsite; however where appropriate, these snags may be utilized as large woody debris in adjacent stream restoration units, or depending on location and size be considered on a case by basis for commercial removal determined by interdisciplinary team members. Safety hazards would be identified by a qualified person, as defined by, and using the procedures provided in the interagency Field Guide for Danger Tree Identification and Response (Toupin et. al. 2005).
- Harvest activities would not remove existing down logs. Burn crews would be briefed to avoid direct ignition of large snags and down wood. Down logs are defined as logs that are 12 inches in diameter or greater at the small end and greater than 6 feet in length.

- Burning within goshawk post-fledging areas, pileated feeding habitat, and connective corridors would be designed to minimize loss of mid and overstory cover, snags, and large down wood by avoiding the hot end of the prescription. The District wildlife biologist would be notified when prescribed burning is scheduled in these habitat areas so that implementation and effectiveness monitoring can be coordinated.

Range

- All activities would be designed to not damage or negatively affect range improvements; i.e. fences, spring developments, cattle guards, stock ponds, etc. If damage or negative affects cannot be avoided, the operation undertaking the activities must repair or replace the damaged improvement.
- When a fence needs to be cut, it must be attended when livestock are within the action area. If livestock are not in an area, the fences would be repaired prior to livestock entering the area. Prior to any fence cutting all locations must be reported to the range specialist to determine if or when livestock would be in or near the project area, and to determine if fences are mended adequately.
- No gates would be left open if actions are taking place where livestock grazing is occurring.
- Any exclosure would need to have at least one gate installed to allow for removal of any inadvertent livestock entry. Also, if an exclosure would restrict the use of water resources, alternate water sources would be needed to be provided prior to construction. Any exclosure should be designed in coordination with the responsible range specialist. Maintenance responsibility of any exclosure must be determined prior to construction. Also, a removal plan for any temporary exclosure should be outlined prior to construction.

Recreation

- Restrict commercial timber haul on the following holidays: Memorial Day, 4th of July, Labor Day, and also during the weekends of deer rifle hunting season. Restriction applies on the Holiday date and/or contained within the weekend from Friday noon through Monday noon.
- Forest Plan designated dispersed recreation sites located on existing landings may be reused for log decks, piling slash, or storing road rock. The site would be rehabilitated after use.
- Activities adjacent to dispersed recreation sites identified in Forest Plan would be designed to retain visual screening within 50 feet. If a Forest Plan dispersed recreation site is utilized as a landing. The site would be rehabilitated after use.
- Hand piling of noncommercial generated slash would be required within 50 feet of Forest Plan dispersed campsites.

Visual/Scenic Resources

- When marking trees to be left, mark side of tree facing away from road within 75 feet of visual corridor.
- Boundary tags, flagging, and markers would be removed from visual foreground areas in treatment units after completion of activities.
- In Foreground areas or within 75 feet of the travel corridor, stumps would not exceed 8 inches in height.
- Where practical, in Foreground retention areas, design and locate new skid trails and landings outside of visual foreground areas.

- Existing landings and skid trails within visual foreground areas may be reused. When reusing existing landing within foreground areas, reduce potential landing size by using logging methods such as but not limited to; hot loading or requiring slash to be hauled into the unit on haul-back.
- Within visual foreground landing slash would be burned within two years.
- Landings in visual foreground areas would be reseeded or replanted.

Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received in response to the Proposed Action provided suggestions for alternative methods for achieving the purpose and need. Some of these alternatives may have been outside the scope of the proposed action, duplicative of the alternatives considered in detail, or determined to be components that would cause unnecessary environmental harm. Four alternatives were considered, but were dismissed from detailed consideration for reasons summarized below.

1. Based on public comments, a “no commercial harvest” alternative was considered for the Gap project. Such an alternative has been considered during several previous environmental analyses, which analyzed similar stand conditions to those in the Gap project area, on the Ochoco National Forest (see Wolf Vegetation Management project EIS and the Jackson Vegetation Management project EIS for examples). Previous analyses have determined that the “no commercial harvest” alternative would do little to increase the amount of LOS stands within the project area and would not accelerate the restoration of seral structures toward HRV because the level of treatment would not maintain a sufficient amount of open, single-stratum stands. Treated stands would return to dense, stagnated conditions sooner. As a result of no commercial thinning, this alternative would limit the ability to restore aspen and other broadleaf trees and shrubs. This alternative would not produce forest wood products and the jobs associated with commercial harvest. Small tree thinning by itself would not move the project area towards the desired condition in a meaningful manner and would not meet the purpose and need of the project.

2. Based on public comments, a “no temporary road construction” alternative was considered for the Gap project. A Gap project IDT analysis determined that, because of reduced access to only the existing road system, this alternative, as compared to the proposed action, would reduce the commercial thinning acreage by approximately 8,150 acres or 58%. As a result, this alternative would not appreciably increase the abundance of late and old structure (LOS) stands within the project area, nor move seral structures towards HRV because the level of treatment would not maintain a sufficient amount of single-stratum stands; especially early, fire tolerant seral species such as ponderosa pine and western larch. Under this alternative, untreated stands would continue to be vulnerable to mortality from competition with understory trees and the accompanying increase in risk to loss owing to insect, disease and stand replacing wildfire. This alternative would decrease the restoration of some aspen stands and other hardwood communities. This alternative would considerably reduce merchantable forest wood products and the jobs associated with commercial thinning. In summary, this alternative would not demonstrably move the project area towards the future desired condition and would not meet the purpose and need.

3. Based on public comments, an alternative with decreased diameter limits on commercial thinning was considered (commenters proposed a range of diameter limits of 15 inches). Removal of trees with an upper diameter limit of up to 15 inches would not demonstrably change the outcomes determined for smaller diameter treatments.

Development of LOS and maintenance and enhancement of existing large trees and LOS requires the reduction of density in treated stands to the recommended stocking level for a given site. In some locations, stocking level recommendations may be met by removing smaller-diameter commercial-sized material, while in other areas site objectives may require removing some larger trees. In stands with dwarf mistletoe, small upper diameter limits inhibit reduction of disease problems. Species composition objectives would not be met in some stands if lower diameter limits are required. This would impede the maintenance and restoration of early seral species such as ponderosa pine. Applying a 15 inch upper diameter limits cannot be relied upon to move the project area towards the desired condition, and therefore would not meet the Purpose and Need of the project.

Comparison of Alternatives

Table 19 provides a summary of the effects of implementing each alternative. Information in the table is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives.

Table 19. Comparison of alternatives.

Comparison Point	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Commercial Thinning from below (acres)	0	14,037	10,911	14,037
Commercial Harvest Trees ≥ 21" dbh (acres)	0	0	0	2,187
Total Acres of Commercial Thinning (acres)	0	14,037	10,903	14,037
Volume (mmbf)	0	63.1	49.0	64.6
Noncommercial Thinning (acres outside of harvest units)	0	2,027	4,237	2,027
Hardwood Enhancement (acres)	0	213	200	224
Underburning only	0	5,587	6,396	5,587
RHCA Treatments	0	Commercial: 1,041 PCT thinning: 1,249 Underburn only: 1,725	Commercial: 0 PCT thinning: 1,190 Underburn only: 1,727	Commercial: 1,041 PCT thinning: 1,249 Underburn only: 1,725
Temporary Road Construction (mi)	0	1.0	1.0	1.0
Temp road on Existing disturbance (miles)	0	38.9	33.1	38.9
Stream Restoration (miles)	0	13.7	13.7	13.7
Culvert Replacement	0	6 locations	6 locations	6 locations
Road Closure (miles)	0	20.6	20.6	20.6
Road Decommissioning (miles)	0	3.3	3.3	3.3
Fencing (miles)	0	4.9	4.9	4.9
Water Developments	0	3	3	3

Comparison Point	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Acres of Dense Structural Stages (Acres) projections at Year 0, 20, 30, and 50 (HRV: 3,272-8,765 ac)	0: 22,952 20: 25,277 30: 25,966 50: 26,858	0: 9,761 20: 14,709 30: 16,459 50: 18,132	0: 10,701 20: 15,608 30: 17,308 50: 19,862	0: 9,562 20: 14,506 30: 16,260 50: 18,948
Total Late and Old Structure (LOS) (Acres) projections at Year 0, 20, 30 and 50 (HRV: 10,318 – 20,676)	0: 9,753 20: 12,052 30: 12,915 50: 14,209	0: 9,753 20: 12,678 30: 13,781 50: 15,446	0: 9,753 20: 12,628 30: 13,706 50: 15,327	0: 9,753 20: 12,688 30:13,797 50: 15,475
Single-Strata LOS (Acres) projections at Year 0, 20, 30 and 50 (HRV: 8,693-16,516)	0: 562 20: 827 30: 901 50: 979	0: 4,798 20: 5,082 30: 5,096 50: 4,963	0: 4,088 20: 4,392 30: 4,422 50: 4,331	0: 4,907 20: 5,207 30: 5,226 50: 5,099
Multi-Strata LOS (Acres) projections at Year 0, 20, 30 and 50 (HRV: 1,625-4,160)	0: 9,191 20: 11,226 30: 12,014 50: 13,231	0: 4,955 20: 7,596 30: 8,685 50: 10,483	0: 5,665 20: 8,236 30: 9,284 50: 10,996	0: 4,846 20: 7,481 30: 8,571 50: 10,376
High Risk to Insects and Disease (Acres) – projections at year 0, 20, 30 and 50 (HRV: 1,821-4,856)	0: 22,346 20: 24,628 30: 25,335 50: 26,289	0: 9,389 20: 14,259 30: 15,988 50: 18,613	0: 10,267 20:15,129 30: 16,816 50: 19,342	0: 9,170 20: 14,070 30: 15,806 50: 18,445
Change in Fuels Condition (acres)	CC1: 14,628 CC2: 2,638 CC3: 13,760	CC1: 22,701 CC2: 1,970 CC3: 6,349	CC1: 22,599 CC2: 1,917 CC3: 6,507	CC1: 23,038 CC2: 2,069 CC3: 5,924
Activities in Connective Corridors	No activities would occur in connective corridors.	Activities would include 284 acres of commercial thinning, 47 acres of noncommercial thinning, and 89 acres of underburning.	Activities would include 207 acres of commercial thinning, 104 acres of noncommercial thinning, and 109 acres of underburning.	Activities would include 284 acres of commercial thinning, 47 acres of noncommercial thinning, and 89 acres of underburning.
Goshawk reproductive habitat	Existing condition includes 17,906 acres of reproductive habitat.	Post Treatment: 8,764 acres of reproductive habitat; within HRV	Post Treatment: 9,579 acres of reproductive habitat; within HRV	Post Treatment: 8,584 acres of reproductive habitat; within HRV
Pileated Woodpecker Reproductive Habitat	Existing condition includes 11,092 acres of reproductive habitat.	Post Treatment: 5,990 acres of primary nesting habitat; above HRV	Post Treatment: 6,690 acres of primary nesting habitat; above HRV	Post Treatment: 5,959 acres of primary nesting habitat; above HRV
White-headed Woodpecker Reproductive Habitat	Existing Condition includes 7,522 acres of reproductive habitat.	Post Treatment: 20,626 acres of reproductive habitat	Post Treatment: 19,688 acres of reproductive habitat	Post Treatment: 20,857 acres of reproductive habitat
Elk (Habitat Effectiveness Index)(Forest Plan Standards: General Forest: 7 Winter Range: 7 GF Winter Range: 7	General Forest: 47 Winter Range: 29 GF Winter Range: 60	General Forest: 55 Winter Range: 39 GF Winter Range:40	General Forest: 55 Winter Range: 41 GF Winter Range: 53	General Forest: 55 Winter Range: 39 GF Winter Range: 40

Comparison Point	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Open Road Density (Forest Plan Standards: GF: 3 mi/mi^2; Winter Range: 1 mi/mi^2 winter, 3 mi/mi^2 summer; GF Winter Range: 1 mi/mi^2 winter, 3 mi/mi^2 summer	General Forest: 2.34 Winter Range: 1.52 GF Winter Range: 1.22	General Forest: 1.88 Winter Range: 1.52 GF Winter Range: 1.24	General Forest: 1.88 Winter Range: 1.52 GF Winter Range: 1.24	General Forest: 1.88 Winter Range: 1.52 GF Winter Range: 1.24

Chapter 3. Affected Environment and Environmental Consequences

This Chapter includes the physical, biological, social, and economic environments of the project area and the effects of implementing each alternative on that environment. It also presents the scientific and analytical basis for the comparison of alternatives presented in the alternatives chapter.

Forested Vegetation

The draft Silviculture report discloses the analysis of forest vegetation changes expected as a result of implementation of alternative vegetation management activities proposed in the Gap Landscape Restoration project area (Gap project).

Vegetation patterns and occurrence within the project area are different now than what existed historically. Changes to the health, structure, composition, distribution, and function of forest stands have altered the natural processes such as fire that historically maintained the ecosystem. These changes have affected watershed resiliency, wildlife habitat diversity and amount, and fuel loadings and potential fire behavior.

Currently, more area is occupied by dense stands of smaller trees than was present historically. Stands dominated by large trees are fewer than were present historically. Species composition of many forest stands has shifted from ponderosa pine to Douglas-fir and grand fir. Risk associated with insects and diseases are above the levels that were historically present.

Plant Association Groups

The upland forest areas within the Gap project area have been characterized using the plant association concept. Plant associations are a method of land classification which is based on the probable, or projected, plant community which will occupy a site given enough time and an absence of disturbance influences. The plant associations for the entire Ochoco National Forest have been mapped using the classifications described in “Plant Associations of the Blue and Ochoco Mountains” (Johnson and Clausnitzer 1992). The mapping was based on 1:12000 aerial photography and intensive fieldwork.

The Ochoco National Forest has defined eight plant association groups (PAGs) for upland forest and woodland/steppe sites. These groups contain plant associations of similar biophysical environments, productivity, and disturbance regimes. Eight PAGs of upland forest and woodland/steppe occur within the Gap project area, as well as areas described as non-forest which includes meadows, shrublands, and rock.

There are no absolute elevation zones that limit where a plant association may be found in the project area; however, subalpine fir is generally located on higher elevations, while juniper sites tend to be on the lower elevations within the area. Plant associations are highly related to the soil type as it’s been sculptured by water and air across the landscape. The following is a brief description of the PAGs and more common plant associations found in the Gap project area.

Moist grand fir PAG sites support the most diverse flora and in general are the most productive sites on the Ochoco National Forest. Approximately 990 acres of this PAG is present in the Gap project area. Most of this is found in the moist sites adjacent to streams or on north slopes, often in isolated patches within Dry grand fir stands. In this PAG grand fir and Douglas-fir are common. Ponderosa pine, western larch and lodgepole pine are common early seral species following disturbance and can be maintained with frequent low intensity disturbance.

Dry grand fir is the most common PAG in the project area encompassing about 50 percent of the total forest acres. These sites occur on moderately deep soils, with or without volcanic ash deposits. The grand fir/pinegrass plant association is the most common association in this PAG. Historically, low intensity fires maintained much of this PAG with ponderosa pine, western larch and to a lesser degree Douglas fir in an open park-like condition. On most sites grand fir was a minor component historically. In the absence of fire more shade tolerant species, grand fir and Douglas-fir, have increased in abundance.

The Douglas-fir PAG occurs on soils with depths less than those in the dry grand fir groups often on southerly facing slopes. Douglas-fir/pinegrass (ash soils) and Douglas-fir/elk sedge (residual soils) are the two most prevalent plant associations for this PAG in the Gap project area. Historically, ponderosa pine was the major species in the PAG, and was commonly maintained in an open park-like condition by frequent low intensity fire.

Ponderosa pine/pinegrass (ash soils) and ponderosa pine/elk sedge (residual soils) are the two most common plant associations for this PAG in the Gap project area. Ponderosa pine is the major species and was commonly maintained in open park-like stands by frequent ground fires. The exclusion of fire has allowed western juniper to become more abundant on these sites.

Xeric ponderosa pine PAG sites are found on shallow soils and commonly border scablands or juniper PAGs. Usually ponderosa pine and western juniper are the only tree species present. In the Gap project area these sites tend to be on south slopes or interspersed with mesic pine. Like the Douglas-fir and Mesic Pine PAGs, ponderosa pine was historically the major species and was maintained in an open park-like condition by frequent fire.

Western juniper steppe and western juniper woodland PAGs make up less than 2 percent of the project area. Juniper is the most common tree species on these sites and it occurs on very shallow soils, often adjacent to shrub scablands and xeric ponderosa pine PAG. Historically, tree densities were kept quite low by frequent fires and much of these areas were dominated by grasses, forbs, and shrubs.

Table 20. Plant Association Group & Non-Forested Lands for the Gap Project Area

Plant Association Group	Total Acres	Percent of the Watershed
Subalpine fir	233	<1
Moist Grand fir	990	2.6
Dry Grand fir	15,421	40.4
Douglas-fir	2,839	7.4
Mesic Ponderosa Pine	6,900	18.1
Xeric Ponderosa Pine	4,412	11.6
Western Juniper Woodland	462	1.2
Western Juniper Steppe	131	<1
Non-Forested Lands	6,756	17.7

Existing Forest Vegetation

The Ochoco National Forest's Viable Ecosystem Management Guide (VEMG) (Simpson et al 1994) describes a seral/structural matrix for characterizing forest vegetation within each of the plant association groups. This matrix is a departure from the classic linear succession models, which typically describe succession as a progression through different stages, i.e. early, mid, late, climax. The Ochoco NF matrix has three seral stages based on species composition (early, mid, late), and each of these is subdivided into five size/structural conditions (grass/forb/shrub, seedling/sapling, pole, small trees, large trees).

Thus, the matrix can accommodate up to fifteen cells, each represents a different seral (E, M, L) and size/structural (1-5) condition. The grass/forb/shrub condition is only reflected in the early seral condition. Matrix cells can be further subdivided to reflect relative differences in tree density.

Subscripts "a" and "b" are used to denote high and low density respectively. For example, L4a describes a late-seral species composition, small-sized trees, at a high-density level. An example matrix is shown below

Table 21. Viable Ecosystem seral/structural matrix.

Structure Class	Species Composition		
	Early	Mid	Late
Grass, forb, shrub (trees may be present but not dominant)	E1		
Seedling, sapling (less than 4.9 inches DBH)	E2	M2	L2
Pole (between 5 and 8.9 inches DBH), high density	E3a	M3a	L3a
Pole, low density	E3b	M3b	L3b
Small (between 9 and 20.9 inches DBH), high density	E4a	M4a	L4a
Small, low density	E4b	M4b	L4b
Medium/large (21 inches DBH and larger), high density	E5a	M5a	L5a
Medium/large, low density	E5b	M5b	L5b

The VEMG describes the array of conditions, which may exist within each matrix cell, as well as descriptions of predominant natural processes such as insects/disease and fire. The seral/structural matrix is applied to each PAG for consideration of existing and historic condition.

Vegetation polygons for the entire Gap project area were delineated using eCognition object-based image analysis software. These polygons were then populated with forest structure and density information obtained from 2011 LiDAR imagery (Hudak et al 2009). Species composition was obtained from Gradient Nearest Neighbor (GNN; Ohmann and Gregory 2002). These data sets, along with field reconnaissance completed in 2012 and 2013, were used to determine existing vegetative conditions within the analysis area.

Past Silvicultural Activities

There have been numerous timber sales within the project area, which include a variety of harvest prescriptions. Records from the Paulina Ranger District indicate the following amount of past harvest treatments on Forest Service lands since 1980:

1. Regeneration Harvest Total – 501 acres
   - Clearcut/Clearcut with Reserve Trees – 421 acres
   - Shelterwood/Seedtree– 80 acres
2. Overstory Removal/Final Removal – 10,845 acres.
3. Partial Removal (commercial thinning, selection/improvement cutting) – 1,480 acres

Table 22. Past Timber Harvest 1980 – 2015 by Sale Name

Timber Sale Name	Acres	Harvest Type	Years
North Fox	160	Overstory Removal	1980
Triple	2,204	Overstory Removal, Partial Removal	1981
Sand Springs	2,119	Overstory Removal	1983
Nelson	1,347	Overstory Removal, Clearcut	1983
Horse Prairie	729	Clearcut and partial removal	1983-1984
Goldie Spring	645	Shelterwood, Clearcut, Partial Removal	1985 - 1987
Lost	683	Overstory removal	1987
Dudley	493	Overstory Removal, Partial Removal	1987 - 1989
Evaluation Plantation	45	Clearcut	1987
Lytle	1,272	Overstory Removal, Clearcut	1990
Roundup	733	Overstory Removal	1991-1992
Lutsey	929	Selection Cut, Overstory Removal	1991-1993
Fawn	594	Overstory Removal, Seed tree	1992-1993
Rough	429	Overstory Removal	1993
Arvid	390	Overstory Removal, Selection Cut	1994
Gray	54	Selection Cut	1999

Additional harvest prior to 1980 is known to have occurred in the area but it is not recorded in the District database. In general, prior to 1980 the harvest was primarily focused on harvesting individual trees, often removing large diameter, high value trees which were deemed at risk to insect mortality. The Keen's Tree Classification system was often used for this risk rating and ground based logging was used.

Timber sale harvest units have some spatial overlap. An example of this would be Lutsey timber sale unit 7, which was selectively harvested in 1991, and is proposed for commercial thinning again in one of the Gap timber sale units.

Noncommercial thinning of smaller trees has been occurring in the area since before 1993. Thinning has often occurred following harvest (improvement cutting, commercial thinning, or overstory removal cutting) as a post-sale activity, to reduce tree density to desired levels. To date, approximately 4,900 acres of noncommercial thinning have occurred. Over three quarters of it, 3,785 acres, has been in harvest units. Slash generated by noncommercial thinning has typically been lopped into smaller pieces and then underburned.

Table 23. Past Noncommercial Thinning by Year

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2003	2005	2006
Acres	505	835	580	87	100	486	473	232	606	123	382	478

The effects of past harvest, noncommercial thinning, fire, and mortality has been incorporated into this analysis. Changes occurring since the LiDAR imagery was obtained are so small in scale or effect that they would not meaningfully change this analysis.

Existing versus Historic Vegetative Conditions

It is widely documented and supported in the scientific literature that 100-plus years of management, including the exclusion of frequent, low and mixed-severity fire, intensive grazing, and widespread harvest of large fire-tolerant trees have increased the density of small trees, elevated fuel loads, increased the risk of crown fire, accelerated mortality of large, old trees, and homogenized fire-prone/fire-adapted forests compared to historic conditions. As a result, the fire-adapted forests of the inland Pacific Northwest are at high risk of uncharacteristically large, severe fires (Hessburg and Agee 2003, Hessburg, Agee & Franklin 2005, Spies et al. 2006). Across the entire interior Columbia Basin, the change in fire-severity classes (e.g. low, mixed, and high) between 1800 and today is dramatic: a decrease by more than half in the area of low-severity fire conditions and a doubling in the area of high-severity fire conditions (Hann et al. 1997, Quigley et al. 1996, Hessburg et al. 2005).

Our knowledge of historically resilient forest conditions in Central Oregon is further informed by local forest history and demographic research. In Hagmann et al. (2013) and Merschel, Spies & Heyerdahl (2014) researchers used historical survey data and forest reconstruction plot data (respectively) to reconstruct historic forest conditions in the East Cascades (Hagmann et al. 2013) and East Cascades and Ochoco (Merschel, Spies & Heyerdahl 2014). Both studies utilized intensively sampled datasets and found large discrepancies between historic forest composition and structure data (both survey and reconstructed) and the conclusions and landscape extrapolations made by other studies (Baker 2012) across some of the same forested regions in Central Oregon. Collectively this work supports and is supported by the majority of other forest reconstruction work across the inland West, documenting the widespread eruption of young shade tolerant species (principally white fir/grand fir and Douglas-fir) following euro-American settlement, grazing, the exclusion of fire, and the harvest of large fire-tolerant species. Hagmann concludes, “The historical inventory of Reservation lands provides strong evidence that forests on mixed-conifer sites were predominantly low-density, pine-dominated, and have undergone massive changes in composition and density (Hagmann et al. 2013).”

Within the Gap project area, seven of the PAGs have been analyzed and compared to their ranges of historic abundance, or HRV. The subalpine fir PAG has not been analyzed as it represents a small amount of the total watershed acreage and no treatments are planned in this PAG. The departures from HRV within the project area are consistent with the discussion of broader scale departures discussed above.

Important departures from the historic condition are listed below:

1. The exclusion of fire as a disturbance agent, along with past harvest practices, has resulted in changes in species composition. Fire intolerant understories have been allowed to develop and fire tolerant overstory trees have been removed. In many stands today there is relatively more western juniper, Douglas-fir, and grand fir and less ponderosa pine and western larch than what occurred historically.
2. Overall, stands dominated by large trees (size class 5) are deficient on the landscape. Stands of large trees with an open “park-like” nature were abundant historically, being maintained by frequent low intensity fires in most of the PAGs. Today, open “park-like” stands of large trees are relatively scarce and below their historic levels of abundance. Multi-story dense stands dominated by large trees are present at more than twice the historic levels of abundance. Fire exclusion (which allowed understory development) and past harvest (which removed large trees) have been the major causes of change. Many stands, which were once dominated by large trees, have been replaced by stands in which pole and/or small sized trees (size classes 3 and 4) are the dominant structure.

3. Increases in stand densities have created more multi-storied stands than occurred historically. Fire exclusion has allowed the development of shade tolerant understories while at the same time selective harvest and overstory removal have decreased the abundance of fire tolerant large tree overstories.

The current trends within the area indicate that, without active management, many of these departures from the desired conditions would continue to increase. The vegetation across the landscape has been altered to the point that many natural disturbance agents can no longer function within their historic roles. Today, there is an elevated risk of experiencing disturbances such as stand replacement wildfire and insect and disease. Successional trends, in the absence of disturbance, would tend to favor a continued increase in late-seral and/or fire-intolerant species. Many of the vegetative components are so far out of balance that it may take 100 years or more to return all of them to their former ranges of abundance. The fundamental capability of the system is still largely intact, however, and with careful management can support most historic vegetative conditions.

The following tables display the existing condition of each PAG and the historic range for each seral/structural stage:

Table 24. Moist Grand Fir

Seral/Structural Stage	Existing Percent of PAG	HRV Low Percent	HRV High Percent	Relation to HRV
E1	0	5	12	Below
E2a	0	0	0	Within
E2b	2.3	5	12	Below
E3a	0	1	3	Below
E3b	0	4	12	Below
E4a	0	0.4	2	Below
E4b	0	1.6	8	Below
E5a	0	0.4	1	Below
E5b	1.5	1.6	4	Below
M2a	0	0	1	Within
M2b	0	3	10	Below
M3a	0	0	2	Within
M3b	5.0	5	20	Within
M4a	16.6	12	32	Within
M4b	1.8	3	8	Below
M5a	55.2	8	16	Above
M5b	1.4	2	4	Below
L2a	0	0	0	Within
L2b	0	0	2	Within
L3a	0	0	2	Within
L3b	0	1	5	Below
L4a	0	4	8	Below
L4b	0	0	0	Within
L5a	16.2	4	8	Above
L5b	0	0	0	Within

Table 25. Dry Grand Fir PAG

Seral/Structural Stage	Existing Percent of PAG	HRV Low Percent	HRV High Percent	Relation to HRV
E1	0.1	2	7	Below
E2a	0	0	0	Within
E2b	0.6	3	8	Below
E3a	0.2	1	3	Below
E3b	0.5	4	12	Below
E4a	3.6	2.4	4	Within
E4b	7.2	9.6	16	Below
E5a	1.2	2.4	4	Below
E5b	0.2	9.6	16	Below
M2a	0	0	1	Within
M2b	0.6	3	9	Below
M3a	0	0	2	Within
M3b	1.1	3	10	Below
M4a	29.3	3	5.6	Above
M4b	14.7	12	22.4	Within
M5a	35.5	2	5	Above
M5b	2.6	8	20	Below
L2a	0	0	2	Within
L2b	0	0	0	Within
L3a	0	0	2	Within
L3b	0	0	0	Within
L4a	0.1	1.6	4	Below
L4b	1.0	0.4	1	Within
L5a	1.3	3.2	6.4	Below
L5b	0.1	0.8	1.6	Below

Table 26. Douglas-fir PAG

Seral/Structural Stage	Existing Percent of PAG	HRV Low Percent	HRV High Percent	Relation to HRV
E1	0	5	20	Below
E2a	0	0	0	Within
E2b	0	0	10	Within
E3a	0	0	2	Within
E3b	0	0	8	Within
E4a	2.2	4	8	Below
E4b	16.0	16	32	Within
E5a	3.5	7	10	Below
E5b	0	28	40	Below
M2a	0	0	0	Within
M2b	0	0	10	Within
M3a	0	0	0	Within
M4a	40.3	1	4	Above
M4b	15.0	4	16	Within
M5a	20.6	1	3	Above
M5b	0.5	4	12	Below
L2a	0	0	1	Within
L2b	0	0	4	Within
L3a	0	0	4	Within
L3b	0	0	1	Within
L4a	0	3.2	6.4	Below
L4b	0	0.8	1.6	Below
L5a	2.0	3.2	6.4	Below
L5b	0	0.8	1.6	Below

Table 27. Mesic Ponderosa Pine PAG

Seral/Structural Stage	Existing Percent of PAG	HRV Low Percent	HRV High Percent	Relation to HRV
E1	0	5	25	Below
E2a	0	0	0	Within
E2b	0	0	5	Within
E3a	0	0	1	Within
E3b	0	0	4	Within
E4a	0	0	2	Within
E4b	0	0	8	Within
E5a	0	0	2	Within
E5b	0	0	8	Within
M2a	0	0	0	Within
M2b	0	0	5	Within
M3b	0	0	4	Within
M4a	21.7	0	2	Above
M4b	15.6	0	8	Within
M5a	5.8	0	3	Within
M5b	0.1	0	12	Within
L2a	0	0	0	Within
L2b	0	0	10	Within
L3a	0	1	3	Below
L3b	0	4	12	Below
L4a	27.1	0	4	Above
L4b	16.4	20	36	Within
L5a	13.0	0	4	Above
L5b	0.4	50	66	Below

Table 28. Xeric Ponderosa Pine PAG

Seral/Structural Stage	Existing Percent of PAG	HRV Low Percent	HRV High Percent	Relation to HRV
E1	0	5	25	Below
E2a	0	0	0	Within
E2b	0	0	5	Within
E3a	0	0	0.5	Within
E3b	0	0	4.5	Within
E4a	0	0	1	Within
E4b	0	5	9	Within
E5a	0	0	1	Within
E5b	0	5	9	Within
M2b	0	0	5	Within
M3a	0	0	0.5	Within
M3b	3.1	0	4.5	Within
M4a	41.0	0	2	Above
M4b	5.6	5	18	Within
M5a	2.9	0	1.5	Within
M5b	0	5	13.5	Within
L2a	0	0	0	Within
L2b	0.5	5	10	Within
L3a	0	0	2	Below
L3b	0.3	5	18	Below
L4a	37.4	0	3.5	Above
L4b	1.1	15	32.5	Within
L5a	7.3	0	4	Above
L5b	0.8	15	36	Below

Table 29. Western Juniper Steppe PAG

Seral/Structural Stage	Existing Percent of PAG	HRV Low Percent	HRV High Percent	Relation to HRV
E1	0	50	70	Below
M2b	0	5	10	Below
M3a	18.6	0	0	Above
M3b	0	5	10	Below
L3a	52.4			
L3b	29.0			
L4a	0	0	0	Above
L4b	0	15	30	Below

Table 30 Western Juniper Woodland PAG.

Seral/Structural Stage	Existing Percent of PAG	HRV Low Percent	HRV High Percent	Relation to HRV
E1	0	50	70	Below
M3a	51.2			
M3b	5.2			
L2a	0	0	0	Above
L2b	0	5	10	Below
L3a	37.0	0	0	Above
L3b	6.6	5	10	Below
L4a	0	0	0	Above
L4b	0	15	30	Above
L5	0	0	0	Above

Effects Common to all Action Alternatives

Successional and structural changes due to the proposed treatments and projections through time were estimated using the Viable Ecosystems model. This model accounts for multi-directional change (multiple pathway succession) through time, but does not include future disturbances after the proposed treatments have been implemented. The juniper PAGs were not included in these projections, however, the intent of all activities on juniper sites is to move towards the grass/forb/shrub stage E1.

There are two primary processes that affect the movement of one seral structural stage to another. Species composition changes due to succession tend to favor shade tolerant species and move stages from early seral to late seral. Growth moves stages from smaller structure to larger structural stages. Although some insects and disease disturbances are species specific and can move early seral to mid or late seral, natural disturbance processes (including fire, insects and diseases, and flooding) tend to move stages backward from mid or late seral to early seral. The magnitude of movement depends on the intensity of the disturbance. Some disturbances, such as low intensity fire, may not affect the dominant stand character, but serve to maintain the existing stage.

Differing growth rates were applied to the two density categories ("a" and "b" densities) within the grand fir, Douglas-fir, and ponderosa pine PAGs. These growth rates directly correspond to rates of change in structure in the Viable Ecosystem seral/structural stages. Less dense "b" stages received an average 20% growth rate bonus over stands which have high "a" densities. This estimate corresponds with density and spacing studies (Oliver 1979, Barrett 1982, Cochran and Barrett 1993, Cochran and Barrett 1999b) where growth rate increases from thinning varied between 15 to 25% depending on stand density and little gains were realized when canopy closure was not reduced below 50 to 60%.

The projected future abundance of each stage is based on stand development assumptions for the various seral structural stages. The 20, 30, and 50-year time intervals were chosen to demonstrate vegetation development over time. The projections that follow later in this report do not include future disturbance events such as widespread insect and disease occurrences, fire, or management activities other than continued fire suppression.

Proposed treatments (both commercial and noncommercial) are designed to reduce tree density and improve growth and vigor of the residual trees and reduce susceptibility to insects and disease. Thinning would be conducted to move towards historic seral/structural stage conditions. Restoration of the mosaic of these conditions would improve resiliency and lessen susceptibility to future fire and other disturbances (Fulé et al. 1997, Taylor and Skinner 2003, Stephens et al. 2008, Moritz et al. 2011, Perry et al. 2011).

Thinning also decreases the probability of crown fires, reducing the potential area burned by unwanted fires, and decreases potential fire severity (Peterson et al. 2005). Thinning followed by fuels treatment has been shown to be effective at mitigating wildfire severity in dry western forests (Prichard 2010).

Numerous studies have shown increased growth and vigor of remaining trees following density management treatments (Oliver 1979, Barrett 1981, Barrett 1982, Barrett 1989, Larson et al. 1983, Cochran and Barrett 1999a, and Cochran and Barrett 1999b). Growth response to thinning has been shown to occur in all size classes of trees, including large old ponderosa pine (McDowell et al. 2003, Latham and Tappeiner 2002, Fajardo et al. 2007, Kolb et al. 2007).), although their response is not guaranteed and can take four to twenty years to manifest (Skov et al. 2005, Roccaforte et al. 2010). Other studies have shown reduced susceptibility to many insect and diseases that are density related (Roth and Barrett 1985, Filip and Schmidt 1990). Further studies show moderated fire hazard and lower crown fire potential as a result of thinning and fuel treatment (Omi and Martinson 2002, Pollet and Omi 2002).

Expansion of the Winter material source is proposed in all action alternatives. This activity would have the effect of removing approximately 1 acre from the dry grand fir PAG and converting it to non-forest land. This would not have a meaningful effect on the overall PAG as the area is so small it represents less than 1/100 of 1 percent of the PAG area.

Table 31. Summary of Proposed Silvicultural Treatments in Gap Project Area (acres)

Proposed Treatment	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Commercial thinning	0	14,037	10,903	11,850
Commercial thinning with 21"+ trees	0	0	0	2,187
Non-commercial thinning outside of commercial units	0	2,027	4,237	2,027
Non-commercial aspen treatments	0	79	88	79
Underburn	0	5,587	6,396	5,587

Table 32. Acres of Silvicultural Treatment by PAG – Alternative 2*

Plant Association Group	Commercial Harvest	Commercial Harvest with 21"+ Trees	Non-Commercial Thinning	Non-commercial Hardwood Treatment	Underburn only
Moist Grand Fir	172	0	55	32	110
Dry Grand Fir	6,865	0	818	10	1,819
Douglas-fir	1,384	0	283	4	632
Mesic Ponderosa Pine	3,582	0	327	6	1,806
Dry Ponderosa Pine	1,836	0	246	1	1,047
Juniper Woodland	31	0	204	0	72
Juniper Steppe	0	0	0	0	0
Aspen	45				
Non forest	121	0	93	26	100
Total	14,037	0	2,026	79	5,587

* Totals do not match table 7 due to rounding.

Table 33. Acres of Silvicultural Treatment by PAG – Alternative 3*

Plant Association Group	Commercial Harvest	Commercial Harvest with 21"+ Trees	Non-Commercial Thinning	Non-commercial Hardwood Treatment	Underburn only
Moist Grand Fir	0	0	179	32	133
Dry Grand Fir	5,326	0	1,842	10	2,302
Douglas-fir	1,111	0	551	9	633
Mesic Ponderosa Pine	2,975	0	633	6	2,104
Dry Ponderosa Pine	1,386	0	693	1	1,049
Juniper Woodland	18	0	214	0	76
Juniper Steppe	0	0	0	0	0
Aspen	2				
Non forest	86	0	125	27	100
Total	10,903	0	4,237	85	6,396

* Totals do not match table 10 due to rounding.

Table 34. Acres of Silvicultural Treatment by PAG – Alternative 4*

Plant Association Group	Commercial Harvest	Commercial Harvest with 21"+ Trees	Non-Commercial Thinning	Non-commercial Hardwood Treatment	Underburn only
Moist Grand Fir	131	53	55	32	110
Dry Grand Fir	5,048	1,817	818	10	1,819
Douglas-fir	1,229	155	283	4	632
Mesic Ponderosa Pine	3,490	92	327	6	1,806
Dry Ponderosa Pine	1,792	44	246	1	1,047
Juniper Woodland	31	0	204	0	72
Juniper Steppe	0	0	0	0	0
Aspen	21	12	0	0	0
Non-forest	107	14	93	26	100
Total	11,850	2,187	2,026	79	5,587

* Totals do not match table 12 due to rounding.

The acres displayed in tables table 32, table 33, and tables 34 were determined by overlaying the proposed units with the Ochoco National Forest PAG GIS layer. Alternatives 2 and 4 include about 184 acres of harvest would in the moist grand fir PAG. Within these harvest units, a portion of the acreage is found in patches 0.5 to 5 acres in size.

Within three units (23, 44 and 47), the acreage mapped as moist grand fir is mapped in stringers along moist draws and along RHCA's within larger areas of mapped dry grand fir, Douglas fir and moist pine. Unit 59 has a mapped area of moist grand fir on an east facing slope. This represents less than 15% of the unit and would be considered as a potential leave island.

Departure from Historic Conditions - Direct and Indirect Effects

Alternative 1, No Action

No treatments would occur. Vegetation would continue to develop within the project area in a manner determined by existing stocking and species composition. Many of the future stages, which develop through natural growth and succession, would tend towards mid or late-seral species composition and multi-strata characteristics. The rate at which many stands would develop large tree character would be hampered by overstocked conditions. The density of most stands would continue to increase and individual tree growth rates are expected to decline. On drier sites, such as ponderosa pine PAGs, stand stagnation would become more common. Existing trees would continue to be weakened by competition in overly dense stands.

In the absence of stand treatments, the presence of Douglas-fir in the understory of Douglas-fir PAG stands would increase as would grand fir in dry grand fir PAG stands. Western juniper seedlings would continue to become established in dry and mesic ponderosa pine PAG stands and grow into saplings and pole sized trees that would compete with the ponderosa pine. The establishment of these seedlings and saplings in the understory aids in the development of ladder fuels. Increasing and sustained high stand densities would result in high shade levels and reduce the amount of understory vegetation that is important for soil protection and forage.

Density related tree mortality is expected to increase and would result in increased amounts of dead and down wood in these same stands. Increased ground and ladder fuels and high crown closure would maintain a higher risk of intense fire behavior. High intensity wildfires have the greatest potential to create rapid, large scale change to stand structure and density. In the event of such a fire, more early seral stand structures dominated by shrubs, herbaceous plans and tree seedlings/saplings would be created.

Dense structural stages are above their historic abundance and would continue to increase, reaching the highest levels of all alternatives. Acres dominated by grand and Douglas-fir would steadily increase, while acres dominated by ponderosa pine and western larch would remain below HRV through the 50 year projection period. Tables 34 and 35 and Figures 1 and 2 displays the effects of the alternatives on species composition and dense conditions.

Alternative 2

Treatment would generally move stands in a multi-strata condition to or towards a single-strata condition. Many stands would continue to be in an uneven-aged condition. Reducing stand density would reduce competitive stress on the remaining trees (Powell 1999). This would result in more large trees being maintained over time, as well as to encourage the development of additional large trees (Cochran et al. 1994). The abundance of early-seral species would be maintained and enhanced in the long-term; however, late seral species would continue to be present in stands where they exist prior to treatment. Grand fir and Douglas-fir would be retained both in the overstory (all trees $\geq$21" dbh) as well as in the understory but at lesser amounts.

Treatments are also proposed in single-strata conditions but where stocking density is currently considered to be too high. Treatment would target the smaller diameter and less vigorous trees for removal, while maintaining the generally single strata characteristics. This would encourage the development of large structure at an accelerated rate. In addition, reducing stocking density would increase tree vigor and reduce insect and disease hazard.

The amount of dense structural stages would be reduced by over 13,191 acres and moved closer to the historic range. After 20 years and beyond, the amount of dense conditions increases as succession and growth continue in the absence of additional disturbance, however it stays below the levels in Alternative 1. The amount of area dominated by ponderosa pine and western larch would be increased, but not to the extent of Alternative 4. Acres dominated by ponderosa pine and western larch would be maintained within the historic range for 50 years.

Alternative 3

Treatment would generally move stands in a multi-strata condition to or towards a single-strata condition. Many stands would continue to be in an uneven-aged condition. Reducing stand density would reduce competitive stress on the remaining trees (Powell 1999). This would result in more large trees being maintained over time, as well as to encourage the development of additional large trees (Cochran et al. 1994). The abundance of early-seral species would be maintained and enhanced in the long-term; however, late seral species would continue to be present in stands where they exist prior to treatment. Grand fir and Douglas-fir would be retained in the overstory (all old trees) as well as in the understory but at lesser amounts.

Treatments are also proposed in single-strata conditions where stocking density is currently considered to be too high. Treatments would target the smaller diameter and less vigorous trees for removal, while maintaining the generally single strata characteristics. This would encourage the development of additional large structure at an accelerated rate. In addition, reducing stocking density would increase tree vigor and reduce insect and disease hazard.

The amount of dense structural stages would be reduced by almost 12,250 acres. This alternative moves closer to the historic range but less than Alternatives 2 and 4. The amount of dense conditions remains above the historic range as succession and growth continue in the absence of additional disturbance. Over the 50 year period stand density remains the highest of all alternatives. Over time this alternative retains the least number of acres with ponderosa pine and larch dominance of all the action alternatives.

Alternative 4

Treatment would generally move stands in a multi-strata condition to or towards a single-strata condition. Many stands would continue to be in an uneven-aged condition. Reducing stand density would reduce competitive stress on the remaining trees (Powell 1999). This would result in more large trees being maintained over time, as well as to encourage the development of additional large trees (Cochran et al. 1994). The abundance of early-seral species would be maintained and enhanced in the long-term; however, late seral species would continue to be present in stands where they exist prior to treatment. Grand fir and Douglas-fir would be retained in the overstory as well as in the understory but at lesser amounts than in either Alternative 2 or 3.

Treatments are also proposed in single-strata conditions where stocking density is currently considered to be too high. Treatments would target the smaller diameter and less vigorous trees for removal, while maintaining the generally single strata characteristics. This would encourage the development of additional large structure at an accelerated rate. In addition, reducing stocking density would increase tree vigor and reduce insect and disease hazard.

The amount of dense structural stages would be reduced by about 13,390 acres. This alternative moves the closest to the historic range but remains above HRV. The amount of area dominated by ponderosa pine and western larch would increase by 7,705 acres immediately after treatment and would remain the highest of all the alternatives over the next 50 years.

Table 35. Acres of Dense Structural Stages

	0 years	20 years	30 years	50 years	Historic Low	Historic High
Alt 1	22,952	25,277	25,966	26,858	3,272	8,765
Alt 2	9,761	14,709	16,459	18,132		
Alt 3	10,701	15,608	17,308	19,862		
Alt 4	9,562	14,506	16,260	18,948		

Figure 1. Dense Structural Stages

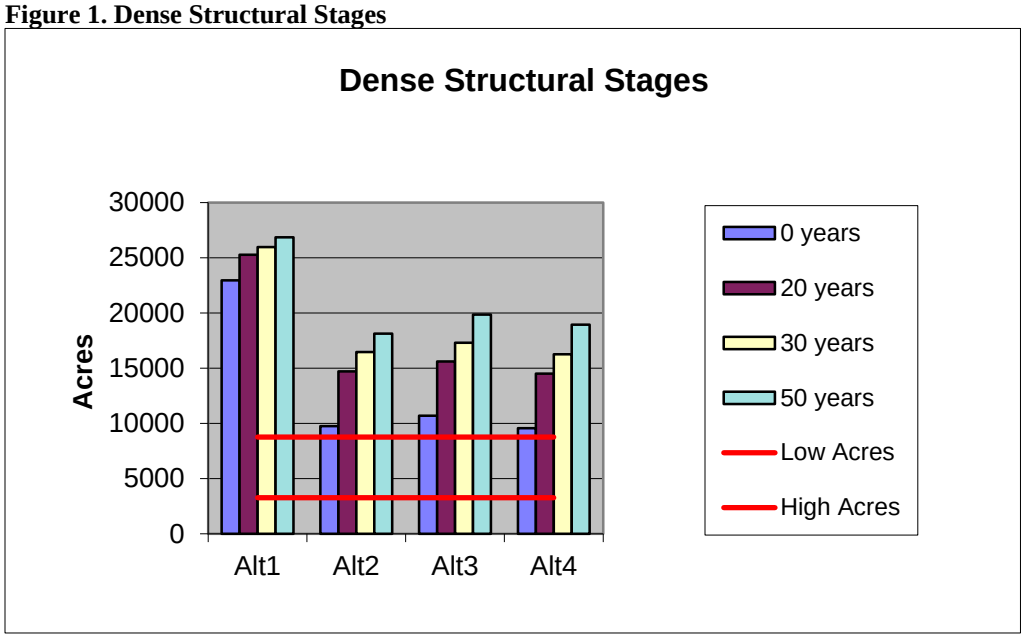
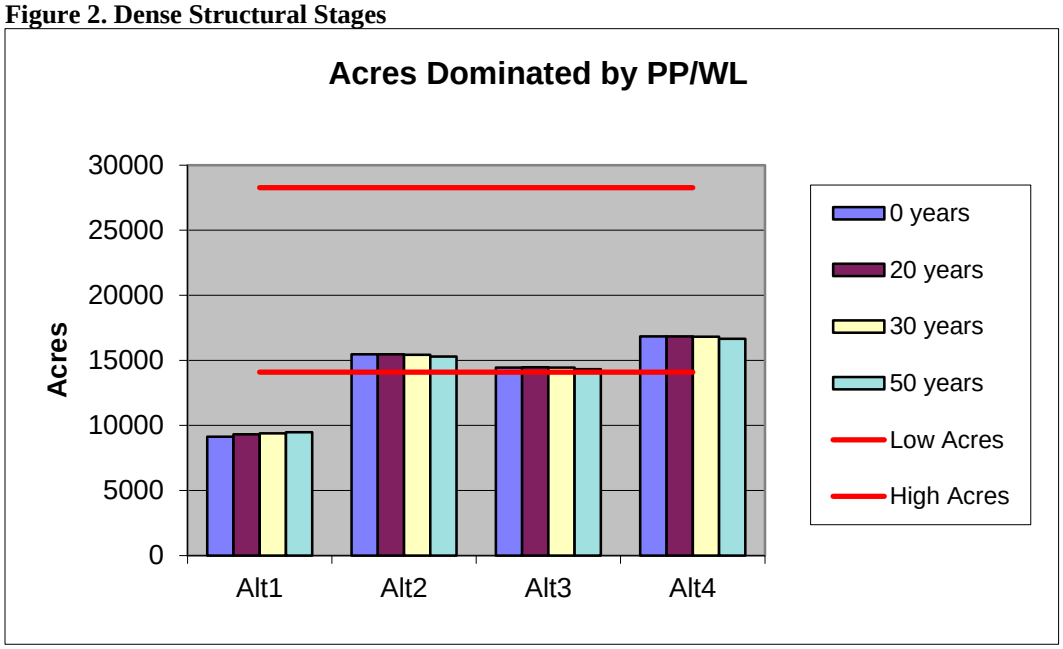


Table 36. Acres Dominated by Ponderosa Pine and Western Larch

	0 years	20 years	30 years	50 years	Historic Low	Historic High
Alt 1	9,130	9,322	9,393	9,481	14,089	28,266
Alt 2	15,467	15,468	15,433	15,287		
Alt 3	14,447	14,462	14,438	14,322		
Alt 4	16,835	16,846	16,811	16,661		

Figure 2. Dense Structural Stages



Cumulative Effects – Departure from Historic Conditions

The cumulative effects boundary includes Forest Service lands within the Gap project area, private lands located within and bordering the project area, and adjacent BLM lands. The cumulative effects of past management (see tables 22 and 23) are reflected in the discussion of existing condition, and the above effects analysis with respect to various proposed activities. There are no timber sales planned or currently active in the Gap project area or adjoining lands (see table 167). Present and foreseeable actions include proposed noncommercial thinning and prescribed burning in the Fox Canyon AMP (2013). The Fox Canyon AMP proposed noncommercial thinning within 12 aspen stands that occur within the Gap project area. Of those, seven are within aspen stands also proposed for treatment within Gap, and five are adjacent to proposed aspen treatments. The noncommercial thinning within these aspen units would have results similar to those described for the Gap project but the magnitude of these acres is so small it would not meaningfully change the effects on dense structural changes as described above. The Fox Canyon AMP also proposed two prescribed fire units within the Gap project area. Both of these units are grass burns on primarily non-forest land, designed to improve forage. These would have little or no effect to upland vegetation within the project area.

Insects and Disease

Past management practices, including fire suppression and selection harvest, have favored the development of stands which are now considered to be out of balance when compared to their historic conditions. Historically (100-plus years ago), many stands in the project area would have commonly had more ponderosa pine and western larch and less grand fir, Douglas-fir and western juniper. There would have been more open and single storied stands rather than the multi-storied stands of today. These stand conditions were maintained by frequent low-intensity fires, which prevented them from becoming overcrowded. Natural disturbance agents have always been present in the planning area, however, the degree to which they now affect the area can be considered to be a reflection of the decline in the ecosystem's health and resiliency.

According to "America's Forest Health Update 2009" published in June 2009 by the Forest Service, "much of the Interior West was significantly drier during the period from 1996 to 2005, compared to the 110-year average". "Periods of below normal precipitation, often coupled with above normal temperatures, can lead to increased tree stress, reduced tree resistance to insects and pathogens, accelerated insect life cycles, and insect abundance, resulting in high levels of tree mortality and increased wildfires". These observations along with the current stand conditions point towards an un-sustainable situation for many overstocked forest stands in the Gap project.

Bark Beetles: Aerial insect and disease surveys for years 2003 through 2014 show numerous mortality centers due to bark beetle feeding. Field reconnaissance has verified ongoing bark beetle activity and susceptible stand conditions within the project area. A primary concern is the loss of large diameter mature ponderosa pine and, to a lesser extent, Douglas-fir.

Mountain pine beetle (*Dendroctonus ponderosae*) and western pine beetle (*Dendroctonus brevicomis*) occur in the project area. Ponderosa pine is a susceptible host to both beetles in overstocked stands, and mature lodgepole pine stands attract mountain pine beetles. Bark beetle mortality is symptomatic of over-stocked stand conditions that create competition stress and reduce tree vigor (Schmidt et al.1994, Graham and Knight 1965). Thinning (density reduction) has been shown to be effective in reducing bark beetle susceptibility in stands (Fettig et al. 2007, Shaw et al. 2009). Drought conditions and root disease can also contribute to a tree's susceptibility to a successful bark beetle attack that result in the tree dying.

Mortality caused by the western pine beetle tends to occur in scattered locations where large, overstory ponderosa pines are crowded by dense conditions. Pockets of large pine mortality can also be found following prescribed burning where dense stand conditions have weakened the overstory trees and additional stress from the burning has put the individual trees at risk.

Also occurring in the project area are Douglas-fir beetle (*Dendroctonus pseudotsugae*) and the fir engraver (*Scolytus ventralis*). Both of these insects are regarded as secondary pests because they attack trees that are weakened and stressed. Factors such as drought, defoliation, overstocking and disease can result in outbreaks of these insects that can cause increased mortality within a stand. Managing stands within recommended stocking levels, removing low vigor/high susceptibility trees, and favoring non host species such as pine and larch are recommended management strategies for reducing susceptibility to these insects (Fettig et al. 2007, Shaw et al. 2009).

Foliage Insects: A group of insects called defoliators are also present in the area. The western spruce budworm is the most notable. From approximately the mid-1980s to the early 1990s the western spruce budworm was at an outbreak level in the planning area, along with the rest of the Ochoco, which caused large amounts of trees damage and/or mortality in nearly all stands in which grand fir and Douglas-fir were major components. Attributes, which contribute to high susceptibility to defoliating insects, are: 1) increased amount of late seral host species, 2) increased stand densities, and 3) the development of multi-storied stand structure (Carlson and Wulf 1989). The trend without vegetative treatments would be for these characteristics to increase until insect population dynamics and climatic conditions combine to generate another outbreak of epidemic proportions.

The Douglas-fir tussock moth is another defoliating insect present in the project area. Douglas-fir and grand fir are the preferred hosts for this species. Stands dominated by these species that have multiple canopy layers are at the highest risk to defoliation during an epidemic outbreak. Management activities that reduce the canopy layers to two or fewer layers and promote the stand composition of non-host species (ponderosa pine, western larch, lodgepole pine) can reduce the effects from the Douglas-fir tussock moth during an epidemic outbreak (Shaw et al. 2009).

Balsam woolly adelgid**:** Balsam wooly adelgid (*Adeges piceae*), previously called balsam wooly aphid, is an introduced pest and first appeared in Oregon in the 1920s. Its hosts are true firs and in the planning area it is most damaging to higher elevation subalpine fir stands on Lookout Mountain and Mt. Pisgah.

The insect sucks sap from the host tree and injects toxic saliva, which results in decreased water and nutrient transport. Infestations result in decreased tree vigor, reduced growth, and increased susceptibility to other insects and pathogens (Goheen and Willhite 2006). Effective management usually entails removing the host tree species and replanting with other non-host species such as pine and larch (Shaw et al. 2009).

Within this project area there is no proposal to treat stands currently impacted by this insect due to their location and management allocations. Favoring non-host species in other stands would, however, reduce their susceptibility to future damage.

Dwarf mistletoe: Ponderosa pine dwarf mistletoe (*Arceuthobium campylopodum*) decreases tree vigor, reduces growth, and increases susceptibility to other pathogens (Hawksworth and Shaw 1987). Infections in upper canopy trees spread readily to trees in the lower canopies. Douglas-fir dwarf mistletoe (*Arceuthobium douglasii*) and larch dwarf mistletoe (*Arceuthobium laricis*) cause growth loss, reduce wood quality, and result in top kill and eventually mortality. Larch dwarf mistletoe is common in larch throughout the project area and is the most damaging disease-caused parasite for the species (Burns 1990). Observations by District foresters confirm that severe dwarf mistletoe infections are the main contributor to larch mortality. When present in Douglas-fir, the Douglas-fir dwarf mistletoe can also be severe and lead to top kill and tree mortality. Ponderosa pine dwarf mistletoe is also present in the planning area. It is not widespread, but in selected stands the infection level is severe.

Dwarf mistletoes accelerate the movement to mid and late seral species compositions by reducing the vigor of infected early seral species and increasing the competitive advantage of later seral species. Dwarf mistletoes cause branch “brooms” creating nest and hiding sites for many animals. Some animals forage on dwarf mistletoe plants.

Dwarf mistletoes are probably more common at present than historically due to the reduction of normal fire events. Dwarf mistletoe spreads from infected trees to adjacent trees that are close enough to catch mistletoe seeds as they are released from the plant. Historically more stands in the project area were open with fewer understory trees. Frequent low ground fire would have scorched lower branches thus killing infected branches and preventing mistletoe spread. As stands have become more dense and multi-strata, dwarf mistletoes have been able to spread more readily. As height growth slows due to infected branches, dwarf mistletoe moves more quickly into the higher tree crown. Branches with mistletoe brooms may contribute to ladder fuels that allow wildfire to reach tree crowns, increasing the risk of crown fire initiation (Hessburg, 1994).

Dwarf mistletoe management can be directed at either prevention or reduction. The most effective treatment for dwarf mistletoe control is to remove infected overstory trees. However, large scale removal of large trees is not part of the proposed treatments in this project. Harvest or non-commercial thinning do, however, reduce stocking and can effectively reduce some growth loss, improve vigor and reduce re-infection (Roth and Barrett 1985). Favoring of non-host tree species can also reduce mistletoe infestation as can increasing tree spacing which removes susceptible species from the seed dispersal area of an infected overstory tree (Shaw et al. 2009).

Indian Paint Fungus: This stem decay (*Echinodontium tinctorium*) is common in late seral stands in the grand fir PAGs in the project area. Trees infected with this disease develop heart rot and are prone to breakage as they have less strong heartwood to support them. Grand fir is commonly infected with Indian paint fungus, and a minor wounding of the tree can activate the dormant fungus (Mallams et al. 2010). In stands were grand fir is abundant today, this disease is most likely present. Across the interior west this decay pathogen has become prevalent as past timber harvest and fire suppression have resulted in stands that are composed of more grand fir and less ponderosa pine and western larch (Filip et al. 2009).

To reduce tree wounding and subsequent decay from Indian paint fungus while thinning stands, implementation practices such as leave tree marking, designating skid trails and avoiding spring or early summer activities near host trees are recommended (Filip et al. 2009).

Root disease: Annosus root disease has been identified in the project area. The presence of this disease is often associated with past timber harvest of large diameter trees. Future spread from timber harvest can be prevented through the use of borax (registered product name Sporax) applied to freshly cut stumps. Most trees to be removed in this proposed timber sale are of small diameter (<18 inches) and do not function as a host to the disease. Borax treatment is also not required if grand fir is not to be the favored species for long term management. As a precautionary measure, in select stands, grand fir stumps that are 18 inches in diameter and larger may be treated (Shaw et al. 2009). Favoring tree species that are resistant to the specific root disease is another management strategy to manage root disease (Shaw et al. 2009).

Armillaria root disease and laminated root rot are two other root diseases of concern for the project area although disease centers have not been located. They are most evident in stands of high density and stands with a major component of late seral species. Vigorously growing trees can be infected but can often confine the fungi and limit the extent of the infection (Hadfield et al. 1986, Shaw et al. 2009). Favoring tree species that are resistant to the specific root disease, such as ponderosa pine and western larch, is an important management strategy (Shaw et al. 2009).

The grand fir PAGs are where most of the root disease activity can be found, especially in areas where stands conditions combine to reduce stand vigor. These diseases can kill trees directly, and often work in conjunction with insects to create pockets or patches of mortality (Hagle and Shaw 1991). Historically, these disease centers were usually small and contributed to stand diversity. With the changes over time in species composition, the incidence of and susceptibility to root disease infection is increasing (Schmitt 2001). The tendency, without disturbance or management, is for infection centers to be repopulated with host tree species and for infections to perpetuate and intensify.

Direct and Indirect Effects – Insects and Disease

The susceptibility of the landscape to disturbance agents has been evaluated by examining the abundance of those vegetative stages that have a high risk factor associated with them. Table 37 indicates the stages that are considered to be at high risk to insects and disease.

Table 37. High risk stages by PAG.

PAG	High Risk Stages
Moist GF	E4a, E5a, M5a, L3, L4a, L5a
Dry GF	E3a, E4a, E5a, M4a, M5a, L3, L4, L5
Doug-fir	E3a, E4a, E5a, M4a, M5a, L3, L4a, L5a
Mesic PP	M4a, M5a, L4a, L5a
Xeric PP	M3, M4a, M5a, L4a, L5a

Alternative 1, No Action

Currently, there are about 22,346 acres within the project area that are in stages rated as high risk. This is about two and a half times higher than the historic range. Under this alternative, no actions are proposed which would reduce susceptibility. Vegetative development would continue dependent on the conditions and successional trends which currently exist. Many of the stages, which become more abundant in the future, have high risk factors associated with them (high density, abundance of late-seral species, etc.) In 20 years the amount of high risk area is projected to increase to about 24,628 acres and would continue to increase through the projection period.

Table 38 and Figure 3 display the amount of high risk area associated with each alternative.

Alternative 2

The actions proposed in this alternative reduce the high-risk stages by almost 13,000 acres and brings it within 880 acres of the historic range. The proposed treatments would reduce stand densities, increase the relative abundance of early-seral species, and increase resistance to disturbance agents. This alternative reduces the acres of high risk condition the second most of all of the action alternatives. This trend continues through the 50 year projection period

Alternative 3

The actions proposed in this alternative reduce the high-risk stages by approximately 12,000 acres and brings it within about 1,800 acres of the historic range. The proposed treatments would reduce stand densities, increase the relative abundance of early-seral species, and increase resistance to disturbance agents. This alternative reduces the acres of high risk condition the second most of all of the action alternatives. This trend continues through the 50 year projection period

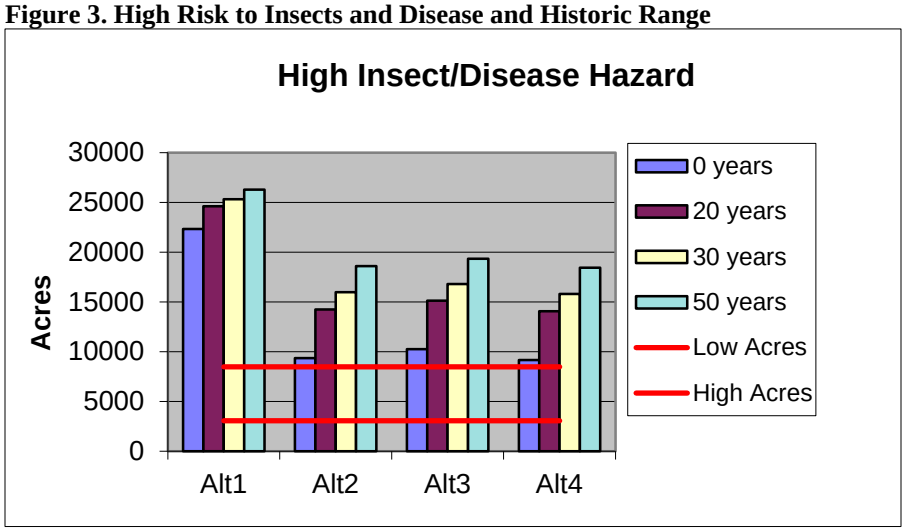
Alternative 4

The actions proposed in this alternative reduce the high-risk stages by almost 13,800 acres and brings it to within about 684 acres of the historic range. The proposed treatments would reduce stand densities, increase the relative abundance of early-seral species, and increase resistance to disturbance agents. This alternative reduces the acres of high risk condition the most of the all the action alternatives, both immediately and through the 50 year projection period. In addition, the removal of grand fir and Douglas fir trees greater than 21 inches dbh would reduce the levels of Indian Paint fungus and dwarf mistletoe the most effectively of all the action alternatives.

Table 38. Acres in a Condition of High-Risk to Insects and Disease.

	0 years	20 years	30 years	50 years	Historic Low	Historic High
Alt 1	22,346	24,628	25,335	26,289	3,063	8,486
Alt 2	9,369	14,259	15,988	18,613		
Alt 3	10,267	15,129	16,816	19,342		
Alt 4	9,170	14,070	15,806	18,445		

Figure 3. High Risk to Insects and Disease and Historic Range



Cumulative Effects (see table 167)

The cumulative effects boundary includes Forest Service lands within the Gap project area, private lands located within and bordering the project area, and adjacent BLM lands. The cumulative effects of past management (see tables 22 and 23) are reflected in the discussion of the existing condition and the above effects analysis with respect to various proposed activities. Present and foreseeable actions include proposed noncommercial thinning and prescribed burning in the Fox Canyon AMP (2013). This Fox Canyon project proposed noncommercial thinning within 12 aspen stands that occur within the Gap project area. Of those, seven are within aspen stands also proposed for treatment within Gap, and five are adjacent to proposed aspen treatments. The noncommercial thinning within these aspen units would have results similar to those described for the Gap project but the magnitude of these acres is so small it would not meaningfully change insect and disease risk. The Fox Canyon project also proposed two prescribed fire units within the Gap project area. Both of these units are grass burns, on primarily non-forest land, designed to improve forage. These would have little or no effect to upland vegetation within the project area. There are no known activities proposed on BLM or private lands which would affect high risk stages in the Gap project area.

Late and Old Structure

Late and Old Structure (LOS) is an important vegetative condition specifically identified in the Regional Forester's Forest Plan Amendment #2 (June 1995). The amendment defines LOS as those vegetative structures in which large trees are a common feature. It goes on to identify two different structural conditions, multi-strata and single-strata. The amendment provides guidance to analyze LOS and, depending on its abundance in relation to historic condition, sets different scenarios for interim management.

LiDAR imagery was used as the landscape analysis tool to estimate the existing amount of LOS. The amount of each LOS type by PAG has been compared to its corresponding HRV. This comparison determines which of the scenarios outlined in the amendment are applicable to the Gap project.

Existing LOS Condition

There are currently an estimated 9,753 acres of LOS within the moist grand fir, dry grand fir, Douglas-fir, and ponderosa pine PAGs. The majority **(**9,191 acres**)** of the LOS is in a multi-strata condition. Historically, the overall total amount of LOS would have ranged between about 10,358 and 20,678 acres, with the bulk of it in a single strata condition due to frequent low-intensity fires which were the dominant disturbance regime in the area. Examination of each PAG reveals that all PAGs are above the historic range for the multi-strata condition. All PAGs are below the historic range for the single strata condition. Across all PAGs, the total amount of multi-strata LOS is above the combined historic ranges, while single stratum LOS is below.

Table 39. Existing LOS and Historic Ranges by PAG

PAG	LOS Type	Existing Acres	Historic Low Acres	Historic High Acres	HRV Status
MGF	multi	746	130	261	Above
	single	31	38	84	Below
	Total	777	167	345	Above
DGF	multi	5,809	1,161	2,353	Above
	single	446	2,811	5,745	Below
	Total	6,255	3,973	8,098	Within
DF	multi	774	333	577	Above
	single	14	976	1,595	Below
	Total	788	1,309	2,172	Below
M Pine	multi	1,389	0	667	Above
	single	33	3,704	6,370	Below
	Total	1,422	3,704	7,037	Below
X Pine	multi	473	0	302	Above
	single	38	1,163	2,720	Below
	Total	511	1,163	3,023	Below
Total	multi	9,191	1,658	4,235	Above
	single	562	8,699	16,533	Below
	Total	9,753	10,358	20,768	Below

Table 40. Summary of Existing LOS Status by PAG

Plant Assoc. Group	Multi-strata LOS	Single-strata LOS	RF Amend. #2
Moist Grand Fir	Above Historic	Below Historic	Scenario A
Dry Grand Fir	Above Historic	Below Historic	Scenario A
Douglas-fir	Above Historic	Below Historic	Scenario A
Mesic ponderosa pine	Above Historic	Below Historic	Scenario A
Xeric ponderosa pine	Above Historic	Below Historic	Scenario A

Under Scenario A of the RF Amendment #2, the Interim Wildlife Standard directs that no harvest activities would occur within LOS stages that are below HRV and that all live trees 21 inches DBH or larger would be maintained. Silvicultural treatments outside LOS stands should maintain or enhance late and old structure components. Open, park-like stand conditions would be maintained where it occurred historically.

Most previous timber sales within this project area included the harvest of large trees. However, many previously harvested stands still have a component of large trees that can be maintained and augmented over time. Some areas nearly meet the large tree criteria for LOS and present opportunities for expanding the size of existing LOS stands and developing new LOS.

Due to the current multi-strata, dense conditions within most LOS stands, large trees within them are at risk of mortality from insects and disease. As discussed previously, there is evidence that density reduction treatments have shown increased diameter growth rates and improved vigor of large residual trees thus helping to maintain them over time. Alternatives 2, 3, and 4 propose harvest and non-harvest treatments within LOS stands to help maintain the existing large tree structure, enhance the development of additional large trees, lessen the risk of loss due to insects, disease, or fire, and to move towards historic species compositions and structures. Alternative 4 would also require an additional Forest Plan Amendment to harvest live trees 21 inches DBH or larger on about 2,187 acres.

Direct and Indirect Effects – LOS Stands

Part of the purpose and need in this project area is development and maintenance of late and old structure. Alternatives 2, 3, and 4 include harvest and non-harvest treatments within LOS. Alternative 1 does not propose any treatment in LOS. The following tables show the amount of LOS treated by alternative and harvest in LOS by plant association group

Table 41. Acres of Treatment within LOS by Alternative

	Alternative 1 No Action	Alternative 2	Alternative 3	Alternative 4
Acres LOS treated	0	5,429	5,379	5,429
Commercial thinning with non-commercial thinning and fuel treatment	0	4,375	3,360	2,786
Commercial thinning that includes trees 21”+ DBH with non-commercial thinning and fuel treatment	0	0	0	1,590
Non-commercial thinning	0	410	1,062	410
Prescribed burning only	0	643	1,016	643

* Noncommercial thinning also includes non-harvest thinning for hardwood enhancement and juniper cutting.

Table 42. Acres of Harvest within LOS Stands by Alternative and PAG

Alternative	Moist Grand Fir	Dry Grand Fir	Douglas-fir	Mesic Pine	Xeric Pine	Aspen	Total
1	0	0	0	0	0	0	0
2	88	2,546	532	815	316	45	4,342
3	0	1,974	452	593	230	2	3,279
4	88	2,546	532	815	316	45	4,342

Predictions have been made for each alternative, which display future amounts of LOS occurring within the planning area at 20, 30, and 50 years as a result of the proposed alternatives. These projections include changes from natural growth and succession, as well as endemic levels of disturbance (insects and disease). These projections do not include widespread events such as stand replacement wildfire, western spruce budworm, or bark beetle epidemics. They also do not include assumptions about future management except for continued fire suppression.

Table 43. Existing and Post-treatment Total LOS by PAG (acres).

	LOS Type	Existing	Alt 2	Alt 3	Alt 4	Historic Low Acres	Historic High Acres
MGF	multi	746	587	629	587	130	261
	single	31	190	148	190	38	84
DGF	multi	5,809	3,482	3,918	3,451	1,162	2,353
	single	446	2,773	2,337	2,804	2,811	5,745
DF	multi	774	335	380	335	333	577
	single	14	463	408	463	976	1,595
M Pine	multi	1,389	331	509	331	0	666
	single	33	1,091	913	1,092	3,704	6,371
X Pine	multi	473	229	229	151	0	303
	single	38	282	282	360	1,164	2,721
Total	multi	9,191	4,955	5,665	4,846	1,625	4,160
	single	562	4,798	4,088	4,907	8,693	16,516
	Total	9,753	9,753	9,753	9,753	10,318	20,676

Table 44. Projected Acres of Total LOS by Alternative.

		Year 20	Year 30	Year 50
Alternative 1	multi	11,226	12,014	13,231
	single	827	901	979
	Total	12,052	12,915	14,209
Alternative 2	multi	7,596	8,685	10,483
	single	5,082	5,096	4,963
	Total	12,678	13,781	15,446
Alternative 3	multi	8,236	9,284	10,996
	single	4,392	4,422	4,331
	Total	12,628	13,706	15,327
Alternative 4	multi	7,481	8,571	10,376
	single	5,207	5,226	5,099
	Total	12,688	13,797	15,475

Figure 4. Projected Acres of Multi-strata LOS by Alternative

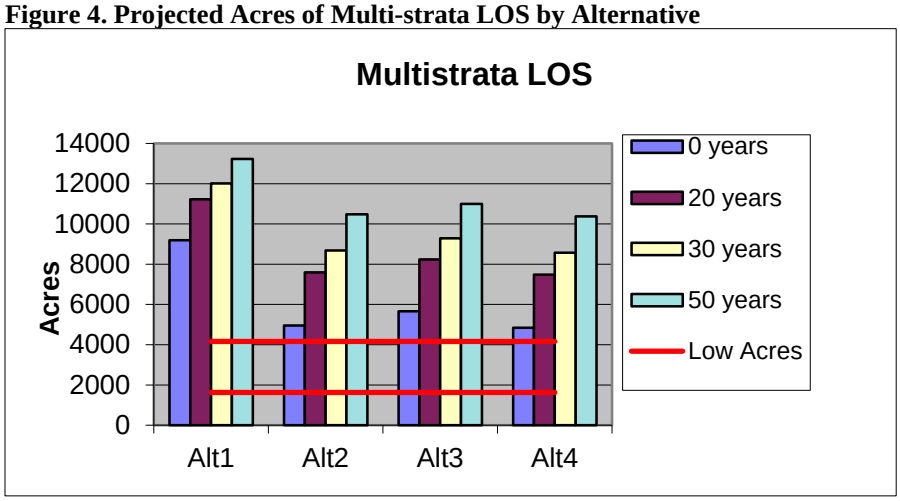


Figure 5. Projected Acres of Single Strata LOS by Alternative

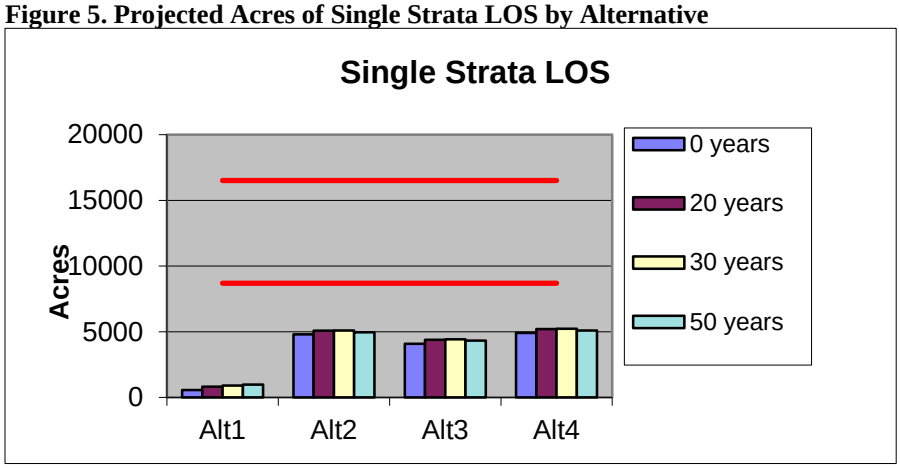
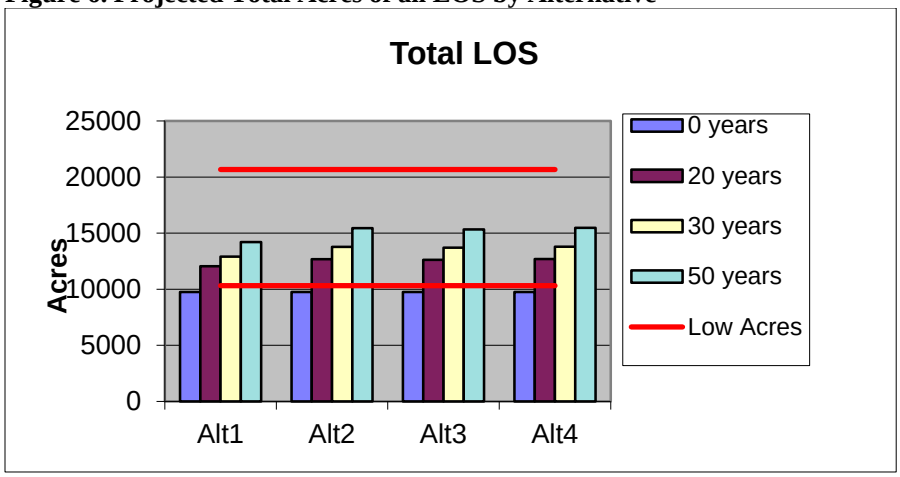


Figure 6. Projected Total Acres of all LOS by Alternative



Alternative 1

No proposed activities would occur. LOS development within the Gap project area would be in a manner determined by existing stocking and species composition. Much of the future LOS that develops through natural growth and succession would tend towards shade tolerant/ fire intolerant species compositions and dense multi-strata characteristics. These conditions are currently above HRV for all of the PAGs. The rate at which stands would develop large tree character would be hampered by over stocked conditions. On drier sites, such as the ponderosa pine and Douglas-fir PAGs, stand stagnation may preclude the attainment of additional large trees. Large trees within existing LOS stands, especially old ponderosa pine, would continue to be susceptible to mortality from competition with understory trees and the accompanying increase in risk to loss due to insects, disease, and wildfire.

Alternative 2

Treatments would remove understory trees to reduce stand density, maintain existing large trees, and enhance the development of additional large trees. No live trees 21 inches dbh or larger, except those trees considered hazardous to the logging/hauling operation, would be cut. Primarily fire-intolerant, late-seral species would be targeted for removal although these species would not be eliminated.

Reduction in stand density would reduce competitive stress. This would result in more large trees being maintained over time as opposed to Alternative 1, as well as encourage the development of additional large trees. Treatment would also reduce the risk of large tree mortality due to disturbance agents. Single-strata conditions are more likely to be sustained over time than multi-strata conditions since the trees are more vigorous and less susceptible to insects, disease, and wildfire. The abundance of early seral/fire-tolerant species would be maintained and enhanced in the long term.

Implementation of this alternative results in the following:

1. About 4,200 acres of multi-strata LOS would move to single strata LOS. The total amount of multi-strata LOS would remain above HRV.
2. Moist grand fir multi-strata would remain above HRV after treatment, while single-strata would move to above HRV.
3. Dry grand fir multi-strata LOS would remain above HRV, while single-strata would move to within about 40 acres of HRV. Within 20 years this stage would increase within HRV.
4. Douglas-fir multi-strata LOS would be reduce to be within HRV and single-strata LOS would move towards HRV by almost 450 acres.
5. Multi-strata LOS in both pine PAGs would be reduced to within HRV. Single-strata HRV would be increased but would remain below HRV.
6. Over the 50 year projection period the total amount of LOS would increase by about 1,240 acres over the amount predicted for Alternative 1. The amount of single strata LOS, however, would be increased by almost 4,000 acres.

Alternative 3

Treatments would remove understory trees to reduce stand density, maintain existing large trees, and enhance the development of additional large trees. No live trees 21 inches dbh or larger, except those trees considered hazardous to the logging/hauling operation, would be cut. Primarily fire-intolerant, late-seral species would be targeted for removal although these species would not be eliminated.

Reduction in stand density would reduce competitive stress. This would result in more large trees being maintained over time as opposed to Alternative 1, as well as encourage the development of additional large trees. Single-strata conditions are more likely to be sustained over time than multi-strata conditions since the trees are more vigorous and less susceptible to insects, disease, and wildfire. The abundance of early seral/fire-tolerant species would be maintained and enhanced in the long term.

Alternative 3 proposes no commercial treatment within RHCA's or late seral stands on moist grand fir sites. Treatment would reduce the risk of large tree mortality due to disturbance agents; however, the reduction would be less than with either Alternative 2 or 4. Movements of stands from a multi-storied condition to a single-storied condition would occur, but to a lesser extent than with either Alternative 2 or 4.

Implementation of this alternative results in the following:

1. The commercial harvest in existing multi-strata LOS would move 3,500 acres within these stands to single strata LOS, however, only the moist grand fir PAG would reach HRV in single-strata.
2. Dry grand fir multi-strata LOS would remain above HRV while single-strata would remain below HRV. At year 50, total LOS in this PAG would be above HRV.
3. Douglas-fir multi-strata LOS would move to be within HRV after treatment.
4. Multi-strata LOS in both the mesic pine and xeric pines PAG's would move from above HRV to within HRV.
5. Over the 50 year projection period the total amount of LOS would increase by about 1,120 acres over the amount predicted for Alternative 1.

Alternative 4

Treatments would remove understory trees to reduce stand density, to maintain existing large trees, and to enhance the development of additional large trees. Primarily fire-intolerant, late-seral species would be targeted for removal although these species would not be eliminated.

Reduction in stand density would reduce competitive stress. Selected individual large/old ponderosa pine would receive additional release from competition by the removal of large, young (<150 years), grand fir and Douglas-fir that are competing with them. This would result in more large pine being maintained over time, as well as encourage the development of additional large trees. It would also better help maintain historic species compositions than any of the other alternatives. Treatment would also reduce the risk of large tree mortality due to disturbance agents. Single-strata conditions are more likely to be sustained over time than multi-strata conditions since the trees are more vigorous and less susceptible to insects, disease, and wildfire. The abundance of early-seral/fire tolerant species would be maintained and enhanced in the long term.

Implementation of this alternative results in the following:

1. The commercial harvest in existing multi-strata LOS would move 4,350 acres in these stands to single strata LOS. The total amount of multi-strata LOS would remain above HRV.
2. Moist grand fir multi-strata would remain above HRV after treatment, while single-strata would move to above HRV.
3. Dry grand fir multi-strata LOS would remain above HRV while single-strata would be slightly below HRV. At year 20, single-strata LOS would be within HRV and would remain so through year 50.
4. Douglas-fir multi-strata LOS would move from above HRV to within HRV and single-strata LOS would move towards HRV about 450 acres.

5. In both moist pine and dry pine PAGs, multi-strata LOS would move to within HRV and single-strata would remain below HRV.
6. Over the 50 year projection period the total amount of LOS would increase by about 1,250 acres over the amount predicted for Alternative 1. The amount of single-strata LOS would increase by about 4,120 acres, which is the greatest increase of the action alternatives.

Cumulative Effects (see table 167)

The cumulative effects boundary includes Forest Service lands within the Gap project area, private lands located within and bordering the project area, and adjacent BLM lands. The cumulative effects of past management (see tables 22 and 23) are reflected in the discussion of the existing condition, and the above effects analysis with respect to various proposed activities. There are no vegetation management projects currently active, or planned, on Forest Service land in the Gap project area which would have an effect on LOS. There are approximately 90 acres of BLM land within the project area. It is estimated that between 25 and 50 of these acres could be classified as multi-strata LOS. There are no current proposals to commercially treat within these stands in the next 25 years; however, it is feasible that these acres could be treated with noncommercial thinning and/or an underburn. Either of these treatments would likely move these stands from a multi-storied condition towards a single-storied condition and help to maintain the single-strata condition over time. Approximately 600 acres of private ownership is included within the project area. The vast majority of private ownership is non-forest sage lands or agricultural. The forested portion of the private land holdings occurs on the fringes of non-forest sage lands and does not classified as LOS.

Connective Corridor Treatments

The Interim Wildlife Standard contained within the Regional Forester's Forest Plan Amendment #2 (1995) provides guidance to maintain connectivity between LOS stands and between all Forest Plan designated old growth habitats. Connective corridors have been mapped for the project area and various treatments, including timber harvest, have been proposed within them. Approximately 675 acres within the project area are mapped as connective corridors.

Table 45. Proposed Activities within Connective Habitat by Alternative (acres)

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Commercial Harvest with non-commercial thinning and/or fuels treatment	0	284	207	284
Non-commercial thinning and fuels treatment (no harvest)*	0	47	104	47
Underburning only	0	89	109	89

* Noncommercial thinning also includes non-harvest thinning for hardwood enhancement.

The Interim Wildlife Standard provides stand criteria relating to structure and density which should be met within connective corridors when proposing harvest activities. The Interim Wildlife Standard does not apply to activities such as non-commercial thinning and fuels reduction which are not timber sales. The described condition is: "Stands in which medium diameter and larger trees are common, and canopy closures are within the top one-third of site potential". Medium and large trees are not defined, but for the purposes of this analysis it is assumed that an average tree diameter of 16 inches at breast height would meet this criterion. To meet the density criteria it would be necessary to retain enough trees to maintain between 66 percent and 100 percent of full stocking. Full stocking is the density level at which inter-tree competition is occurring and resulting in mortality (in other words the stand is self-thinning). Stand densities above full stocking are not sustainable due to competition related mortality and resultant susceptibility to attack by insects and disease (Powell 1999).

The Wildlife Standard allows for timber harvest within connectivity corridors so long as these two criteria (tree size and canopy density) can be met, as well as criteria relating to corridor width. It also directs that some amount of understory (if any exists) be left in patches or scattered to assist in supporting stand density and canopy cover.

The upper limit of the management zone is set at 75 percent of full stocking, while the lower limit of the management zone is set at 50 percent of full stocking. Retaining trees at these densities would result in a corresponding canopy closure ranging from 50 to 75 percent of site potential. Retaining additional understory trees during non-commercial thinning would add to the amount of canopy closure retained. These understory trees may be retained in clumps or scattered as mentioned previously. The table below displays representative canopy closures which would be retained in various plant association groups for a stand of primarily ponderosa pine with an average stand diameter of 16 inches (Powell 1999). The plant associations selected as examples are those common within the project area.

Table 46. Example Canopy Closures at Various Densities.

Plant Association Group (Plant Association)	Full Stocking Canopy Closure (%)	Upper Limit Management Zone Canopy Closure (%)	Lower Limit Management Zone Canopy Closure (%)
Xeric Ponderosa Pine (Ponderosa pine/Idaho fescue)	52	39	26
Mesic Ponderosa Pine (Ponderosa pine/pinegrass)	68	51	34
Douglas-fir (Douglas-fir/pinegrass)	68	51	34
Dry Grand fir (Grand fir/pinegrass)	73	55	37

Thinning to densities within the management zone would reduce canopy cover to between 50 and 75 percent of site potential. This does not include additional canopy contributed by any understory that would be retained during non-commercial thinning. Thinning to the lower level of the management zone within connective corridors would result in a canopy closure that is lower than the top one-third of site potential and would require a Forest Plan Amendment. Thinning to the midpoint of the management zone and leaving additional understory, as proposed in this project, would retain canopy closure in the top third of site potential and not require a Forest Plan amendment. In Alternatives 2, 3, and 4 about 75% of the harvest that is proposed within connective corridors occurs within the dry grand fir and mesic pine plant association groups.

Alternative 1

No proposed activities would occur. Stand development within the connective corridors would be in a manner determined by existing stocking and species composition. Current stocking levels are above the upper limit of the management zone. Corridors would continue to increase in density until a disturbance agent such as insects or wildfire causes tree mortality. Once this mortality occurs it is likely that density would be reduced below the top third of site potential since insects and wildfire in densely stocked stands tend to remove entire patches of live trees as opposed to selectively thinning them. The rate at which stands would develop large tree character would be hampered by over stocked conditions. On drier sites, such as the ponderosa pine and Douglas-fir PAGs, stand stagnation may preclude the attainment of additional large trees. Existing large trees would continue to be susceptible to mortality from competition with understory trees and the accompanying increase in risk to loss due to insects, disease, and wildfire.

Alternatives 2, 3, and 4

The commercial harvest proposed within Alternatives 2, 3, and 4 would selectively thin stands to reduce density thereby increasing tree growth and reducing susceptibility to insects, disease, and fire. Thinning would reduce densities to be within the management zone as determined by site productivity and tree size (Powell 1999). The management zone is that range of stand density between full utilization of the site resources (on the lower end) and the onset of competition induced mortality (at the upper end). Alternatives 2 and 4 include the same portions of harvest units within connective corridors encompassing approximately 280 acres. Alternative 3 proposes harvest within approximately 206 acres of connective corridors. Prescriptions in the connective corridors would be modified to retain density in the upper half of the management zone (63 percent or more of site potential). This level of density, in addition to retained understory, would maintain canopy closure in the top one third of site potential and meet the Interim Wildlife Standard. Thinning would also maintain or enhance the large tree component.

Alternatives 2, 3, and 4 propose other treatments in addition to the harvest units discussed above (see table 45). While the Interim Wildlife standards do not apply to these treatments they would have an effect of reducing canopy cover by thinning or killing smaller trees. Changes in stand density are expected to retain canopy cover in the top half of site potential since stocking would be maintained within the management zone (minimum of 50% of full stocking) and only smaller understory trees would be affected. The effect of these treatments is to: 1) cause a reduction in tree density and encourage the growth of the remaining trees, 2) reduce competitive stress on the remaining trees, especially the larger trees, and reduce the risk of insect mortality, and 3) reduce the risk of wildfire causing the loss of tree structure. Noncommercial thinning prescriptions within these units would be modified to retain clumps of understory as described previously. Non-harvest treatments would meet the intent of the Interim Wildlife standards.

The connective corridors pass through three young conifer plantations within the project area. All three of these have been proposed for noncommercial thinning to promote tree growth and begin the development of variable structure and density. The prescriptions within these plantations (units 308, 325 and 332) would be modified to incorporate skips (leave patches) and gaps (small openings).

Cumulative Effects to Connective Corridors (see table 167)

The cumulative effects boundary includes Forest Service lands within the Gap project area, private lands located within and bordering the project area, and adjacent BLM lands. There are no vegetation management projects, currently active or planned, on Forest Service land in the Gap project area which would have an effect on connective corridors. Past harvest and other treatments that have occurred within connectivity corridors were considered when the corridors were delineated. No connective corridors were delineated through private or BLM lands.

Hardwood Treatments

Quaking aspen can be found abundantly scattered within the planning area. They are located along streams, at springs, rock outcrops, within meadows and some are located in upland forest stands. Aspen clumps range in size from a few scattered suckers within or adjacent to a larger conifer stand to almost pure aspen stands, five acres and larger in size. Historically many of these stands were larger as evidenced by dead aspen corpses and unsuccessful suckers. Aspen stands are struggling in the area for many reasons, with one main reason being the encroachment of conifers into the aspen stands. Aspen needs full sunlight to thrive (Burns and Honkala 1990). As the presence of conifers has increased the aspen have become shaded. Conifer competition along with other factors: livestock grazing, big game browsing, lowered water tables through stream down-cutting, fire suppression, and aspen diseases, has contributed to a rapid decline of the species (Bartos, et al. 1998, Bates et al. 2010, Shepperd et al. 2001). Conifers compete for not only sunlight, but also for limited site factors, nutrients and water. In most aspen stands, the majority of the conifers present are young trees less than 21 inch DBH.

Other hardwood species which are common in the project area include mountain alder, bitter cherry, and various species of willow. These commonly occur in riparian areas and areas near springs and seeps. These plants do well in full sunlight and most produce rhizomatous root systems which help provide streambank stability. Similar to aspen, the vigor of these species declines under heavy shade from overtopping conifers and they can also suffer from the detrimental effects of browsing and lowered water tables.

Table 47. Proposed Hardwood Treatments

Unit	Ac. of aspen treatment *Alt 3	Treatment	Additional Protection Measures
4	2.21	Commercial thinning unit with aspen, pct, underburn	Fence aspen stand
9	0.59	Underburn	Fence
12.1	4.88	Commercial thinning unit, pct, underburn	Fence 2 – 3 ¼ acres to protect aspen sprouts
13	3.63	Commercial thinning unit, pct, underburn	
14	1.65	Commercial thinning unit, pct, grapple pile	
16.1	3.45	Commercial thinning unit, pct, grapple pile	
16.4	0.06	Noncommercial cutting of conifers, hand pile	
17.1	2.97	Commercial thinning unit, pct, underburn	
26.2	2.14 *1.3		
28	10.18	Commercial thinning unit, pct, underburn	
49	2.75	Commercial thinning unit, pct, underburn	
54	0.03		
55.2	0.19		
55.3	0.32		
57	0.69	Commercial thinning unit, pct, underburn	
106	0.61	Noncommercial cutting of conifers, underburn	
110	0.82	Commercial thinning unit, pct, underburn	Individual cages
112	0.25	Commercial thinning unit, pct, underburn	¼ acre fence around aspen stand
115	7.67	Noncommercial cutting of conifers, underburn	
117	3.25	Noncommercial cutting of conifers, underburn	Thin conifers within 150 feet of the aspen stand and fence.
122	0.13	Underburn	Fence aspen to protect suckers (< 1 acre)
122.1	4.11	Commercial thinning unit, pct, grapple pile	Fence aspen to protect suckers (< 1 acre)
123.2	3.77	Noncommercial cutting of conifers, underburn	Fence aspen to protect suckers (< 1 acre)
123.2	15	Commercial thinning unit, pct, grapple pile	
133	5.31 *0.29	Commercial thinning unit, pct,	Maintenance on existing fence. Potential for (< 1

Unit	Ac. of aspen treatment *Alt 3	Treatment	Additional Protection Measures
		grapple pile	acre) exclosure.
133.1	0 *4.17		
133.2	0 *0.86		
139.1	1.45	Noncommercial cutting of conifers, underburn	Fence stand. Thin all conifers w/in 75 feet of suckering aspen.
146	13.55	Commercial thinning unit, pct, underburn	Fence ½ acre stand below Rd. 4230-117. Cage suckers. Fall trees into stream.
156.2	0.33	Commercial thinning unit, pct, grapple pile	
157.1	2.17 *0	Commercial thinning unit, pct, underburn	Fence two - 1 acre stands.
158	35.29	Commercial thinning unit, pct, grapple pile	Fence three - 1 acre stands.
158.1	1.62		
159	14.0	Commercial thinning unit, pct, grapple pile	Cage aspen suckers.
161.1	0.7	Underburn	Cage aspen suckers.
166.2	0.81	Underburn	
184	2.2	Commercial thinning unit, pct, underburn	
186	0.09		
195.1	0.86	Commercial thinning unit, pct, underburn	Cut all conifers < 21” dbh within 75 feet of aspen.
203	1.8	Commercial thinning unit, pct, underburn	Cage aspen suckers.
204	1.01	Commercial thinning unit, pct, underburn	Cage aspen suckers.
232.1	0.35	Commercial thinning unit, pct, underburn	
233	0.01		
239	1.23	Commercial thinning unit, pct, underburn	
239.1	10	Noncommercial cutting of conifers, underburn	
311	0.31	Underburn	Cage aspen suckers.
313	1.26	Commercial thinning unit, pct, underburn	
337	2.65	Underburn	
338	1.66	Noncommercial cutting of conifers, underburn	
339	0.71	Hardwood treatments	
341	1.12	Noncommercial cutting	
342	3.29		Cage aspen suckers.343, 344
343	0.8	Noncommercial cutting	
344	1.0		
345	3.41	Noncommercial cutting	Repair old exclosure build 2 ½ acre exclosure, cage sprouts.
346	2.26	Noncommercial cutting	Cage aspen suckers.
347	7.82	Noncommercial cutting	

Unit	Ac. of aspen treatment *Alt 3	Treatment	Additional Protection Measures
348	9.51		
349	0.73		
350	3.01	Noncommercial cutting	Cage aspen suckers.
351	0.83	Noncommercial cutting	Cage aspen suckers.
352	3.57		
353	7.42	Noncommercial cutting	Potential for a 1 acre exclosure or cage aspen suckers.
354	1.0	Noncommercial cutting	Cage aspen suckers.
355	5.12		
356	0.21		
358	1.81	Noncommercial cutting	
359	11.97	Noncommercial cutting	Cut all fir and juniper up to 12 inches dbh, cage aspen suckers.
360	0.5	Noncommercial cutting	
361	1.08	Noncommercial cutting	
362	0.9		
363	0.98		
366	1.21	Noncommercial cutting	Cage aspen suckers.
367	1.07		Fence < 1acre
368	1.85	Noncommercial cutting	Fence < 1acre
369	0.17	Noncommercial cutting	Thin below Rd. 4220-257 Fence < ¼ acre.
391	0.89	Noncommercial cutting	

Many aspen treatments are small, < 1acre to 5 acre treatments within larger commercial thinning units.

Direct and Indirect Effects

Alternatives 2, 3, and 4 include non-harvest treatments (non-commercial thinning and fencing/caging for protection) to promote aspen and other hardwood species. If aspen are encountered in other commercial harvest units the prescriptions would be modified to make enhancement of the aspen a treatment objective.

Alternative 1

No treatments would occur. Aspen stands that are currently struggling to regenerate due to conifer competition, big game and livestock grazing, and stream down cutting would continue to decline with a high risk of aspen mortality and conversion of the site to be fully occupied by conifers. Stream-side sites where hardwoods are lacking would not be planted under this alternative and regeneration of hardwood species would be dependent on natural processes only. This alternative does the least to benefit hardwood vegetation of all the alternatives.

Alternatives 2, 3 and 4

Commercial harvest and noncommercial thinning would reduce conifer competition, providing more growing space, sunlight, water and nutrients for aspen and other hardwoods. Protection from big game browsing and livestock grazing would aid regeneration to grow above browse height and persist on these sites. These treatments should lead to the restoration of aspen stands, aiding to maintain the genetic diversity of the different stands across the watershed.

Cumulative Effects (see table 167)

The cumulative effects boundary includes Forest Service lands within the Gap project area, private lands located within and bordering the project area, and adjacent BLM lands. The Paulina Ranger District has performed various hardwood enhancement projects within the project area over the past 20 years. The Fox Canyon AMP includes a portion of the Gap project area within its analysis. Under this proposal an additional 5 aspens sites are planned for noncommercial thinning. All of these aspen sites are scheduled for protection from grazing and browsing using fences, cages or untreated thinning slash. The effects of aspen treatments in the Fox Canyon project, combined with the effects of the Gap project, would cumulatively benefit aspen.

Silvicultural Treatments within RHCAs

Direct and Indirect Effects on RHCA Vegetation

Riparian Habitat Conservation Areas (RHCAs) were established with the adoption of the Native Inland Fish Strategy (1995). INFISH identified goals for watershed, riparian, and stream channel conditions. RHCAs lack natural vegetative complexity, species compositions, and resiliency. Vegetative conditions exist which are not as resistant to disturbance as they were historically and there is an elevated risk of unwanted loss from stand replacement wildfire and/or insects and disease. Hardwoods have decreased in abundance or are completely lacking from areas where they occurred historically.

The majority of this project area, including RHCAs outside of the perennially wetted riparian areas, historically experienced frequent low intensity wildfire as a dominant disturbance process. This disturbance regime maintained areas in a more open, less dense condition that was often dominated by large trees of fire tolerant species. Today large trees are less abundant, stands are denser, within stand spatial diversity has declined, fire intolerant species have become established and fuel loads have increased. In many areas hardwoods have declined due to competition from conifers, big game and livestock grazing, and stream down-cutting. Currently, about 64 percent of the area within RHCAs is in a condition considered to be at high risk to insects and disease.

Various silvicultural activities are proposed within RHCAs to maintain and restore the historic distribution, diversity, and complexity of vegetation within RHCAs to protect their function and resiliency. Specific objectives of these treatments are to:

1. Retain and increase the abundance of large trees by reducing competition and increasing tree vigor.
2. Restore fire tolerant species compositions.
3. Reduce risk to high severity wildfire.
4. Increase the abundance and vigor of hardwoods.
5. Restore meadow habitats that have become stocked with encroaching conifer species.

To meet these objectives, site specific prescriptions have been developed on a unit by unit basis based on slope, aspect, stream condition, soil conditions, and existing vegetation. These include no treatment buffers of various widths adjacent to steam channels, identification of trees to be felled to meet large wood requirements, equipment restrictions, and modifications to silvicultural prescriptions. These site specific prescriptions were developed to ensure attainment of the Riparian Management Objectives (RMOs) identified in INFISH as well as provide for no increase in the potential for sediment delivery.

Alternative 1

Under this alternative no activities would occur that would improve resiliency. The amount of area that is at high risk to unwanted disturbance would remain unchanged and increase over time as fire intolerant understories continue to develop and large fire tolerant trees are lost due to within stand competition. Tree mortality would potentially contribute to large down wood but over time inputs of large trees would decline as the development of large replacement trees would be retarded by dense stand conditions. Existing shade would be maintained at current levels; however shade generated by hardwood species is expected to decline as these species are replaced by conifers. In the event of high intensity wildfire or insect epidemic, high amounts of existing shade would be lost. High intensity wildfire could also contribute to loss of existing down wood. Loss of ground cover and roughness due to high severity wildfire could also cause high inputs of sediment to stream systems.

Alternative 2

This alternative includes both commercial and noncommercial activities designed to improve vegetative resiliency and lessen the likelihood of high severity events occurring. Overall, approximately 1,275 acres of silvicultural activities would occur with RHCAs. The maintenance of existing large trees would occur and treatments would promote the development of additional large trees. Mortality of large trees would not be eliminated, but would be reduced below the level associated with Alternative 1. This would result in a reduction of potential large wood recruitment within RHCAs in the short term but would increase the likelihood of a long term supply of large trees. To offset this potential short fall, unit prescriptions include requirements to fall trees to meet the INFISH down wood goal. In addition, unit prescriptions include no treatment zones and modified or no commercial harvest zones adjacent to stream channels so that future recruitment trees are available near stream channels. Potential tree heights in the project area range from about 150 feet in the more productive upper reaches of Lookout Creek to approximately 75 to 100 feet in some of the ponderosa pine sites in the southern portion of the project area. Within the driest pine and juniper zones potential tree height are limited to 75 feet or less. No harvest zones prescribed in RHCAs typically range from 50 to 100 feet in width.

Reducing stand densities, managing for more historic and fire tolerant species compositions, and reducing fuel loads would lessen the risk of a high intensity event such as a stand replacement wildfire or insect epidemic occurring. Unit specific prescriptions were developed so that no loss of shade would occur to streams that flow during summer months. Lessening the likelihood of a stand replacement event would help ensure that shade in the long term would be maintained or increased. Shade currently provided by hardwood species would be maintained and increased in the future as areas where they are absent or lacking becomes populated through restoration projects. Maintaining and increasing hardwoods can also help improve bank stability as many of these species have rhizomatous root systems.

Table 48. Acres of Silvicultural Treatment by RHCA Class – Alternative 2.

	Stream Class			
	1	**2**	**3**	**4**
Commercial harvest and noncommercial thinning	61	461	376	205
Noncommercial thinning outside of harvest units*	31	76	103	25

* Noncommercial thinning also includes juniper cutting and hardwood treatments.

Alternative 3

This alternative avoids commercial harvest within RHCAs. Approximately 985 acres of silvicultural activities would occur within RHCAs. The amount of noncommercial thinning is increased over Alternatives 2 and 4, but overall there would be about 300 fewer acres of silvicultural activities occurring within RHCAs. Areas treated noncommercially under this alternative would have some density and species composition objectives met, but not as well as if they were commercially thinned as in the other two action alternatives.

Table 49. Acres of Silvicultural Treatment by RHCA Class – Alternative 3.

	Stream Class			
	1	**2**	**3**	**4**
Commercial harvest and noncommercial thinning	0	0	0	0
Noncommercial thinning outside of harvest units*	90	475	369	52

* Noncommercial thinning also includes juniper cutting and hardwood treatments.

Alternative 4

This alternative treats approximately the same number of acres, both commercially and noncommercially, in RHCA's, as Alternative 2. Harvest of young trees 21" DBH and larger would only occur where the removal of those trees would contribute to the retention of aspen and/or old growth ponderosa pine. It is estimated that, on average, 1 to 2 trees per acre, of this size would be removed across the twenty five units. Removal of these trees is anticipated to have minimal additional effects to RHCAs. Retention of aspen and fire tolerant old growth ponderosa pine would be consistent with the goal of restoring resiliency to the landscape.

Table 50. Acres of Silvicultural treatment by RHCA Class – Alternative 4.

	Stream Class			
	1	2	3	4
Commercial harvest with noncommercial thinning	61	391	284	192
Commercial harvest with 21+" trees and noncommercial thinning	0	51	98	12
Noncommercial thinning outside of harvest units*	29	97	60	27

* Noncommercial thinning also includes juniper cutting and hardwood treatments.

Cumulative Effects (see table 167)

The cumulative effects boundary includes Forest Service lands within the Gap project area, private lands located within and bordering the project area, and adjacent BLM lands. Approximately 3.25 miles of hardwood planting in RHCAs is proposed in the Fox Canyon AMP. Planting of hardwoods where they are currently absent should result in an increase of shade over time, as hardwood abundance increases. Many hardwood species have rhizomatous root systems which can contribute to bank stability.

There are no other silvicultural projects proposed at this time which are expected to have a meaningful effect on vegetation within RHCAs. Underburning outside of commercial and noncommercial thinning projects is also proposed within this project. This activity is primarily focused on the reduction of existing ground fuels and includes design features which are intended to meet INFISH RMOs. It is anticipated that there would a minor amount of understory conifer mortality resulting from underburning. Reducing unwanted density of understory trees would complement the silvicultural activities and improve landscape resiliency but is not expected to be of a magnitude that would meaningfully change this analysis. There are no known activities proposed on BLM or private lands which would affect upland vegetation in RHCA's.

Analysis of Forest Plan Amendments

Cutting Trees Greater than 21 Inches in Diameter

In Alternative 4, the project proposes a site-specific amendment to the *Interim Eastside Screens Appendix B 6(2.a*) "Maintain all remnant late and old seral and/or structural live trees greater to or equal to 21 inches in diameter that currently exist within stands proposed for harvest activities." The proposed amendment would allow a timber sale to cut and remove trees greater than or equal to 21 inches in diameter in limited, specific locations.

Reasons for Amending

The amendment is being proposed in Alternative 4 on 2,187 acres in order to move towards historic species compositions as well as increase the resiliency of existing old trees. It would be applied on dry mixed conifer sites where old ponderosa pine are under competitive stress from large grand fir and/or Douglas-fir which, although large, do not qualify as old trees. It would also be applied to remove grand-fir and/or Douglas-fir competition from aspen clones. Grand fir and Douglas-fir which qualify as old trees would not be removed. It is estimated that within the units where this prescription is applied there would be an average of 1 to 2 large trees/acre removed.

Removal of large young trees (<150 years old) from the vicinity of old trees for approximately one canopy drip line of the old tree is consistent with the guidelines provided in *Restoration of Dry Forests in Eastern Oregon* (Franklin et al., 2013).

The proposal reflects the *"Criteria to Guide Decision-making on the Removal/Retention of Grand fir and Douglas-fir*" provided by the Ochoco Forest Restoration Collaborative.

Effects to Alternative 4

Selected individual large/old ponderosa pine would receive additional release from competition by the removal of large, young (<150 years), grand fir and Douglas-fir that are competing with them. This would result in more large pine being maintained over time, as well as encourage the development of additional large trees. It would also better help maintain historic species compositions than any of the other alternatives. Treatment would also reduce the risk of large tree mortality due to disturbance agents. Single-strata conditions are more likely to be sustained over time than multi-strata conditions since the trees are more vigorous and less susceptible to insects, disease, and wildfire. The abundance of early-seral/fire tolerant species would be maintained and enhanced in the long term.

Within aspen clones, removal of overtopping grand-fir and Douglas-fir would increase the sunlight and growing space available to aspens. Aspen are a shade intolerant species and removing this competition would help to maintain this species where it currently exists as well as allow for successful increase in sprouting and clone expansion.

Removal of Douglas-fir and grand fir trees >21"dbh would reduce future snag recruitment to a greater degree than Alternatives 2 and 3, both of which do not propose the Forest plan amendment.

Cumulative Effects

The cumulative effects boundary includes Forest Service lands within the Gap project, Wolf, and Black Mountain projects areas, private lands located within and bordering the project area, and adjacent BLM lands. Harvest of young Douglas-fir and grand fir trees >21" dbh to reduce competition around large/old ponderosa pine and aspen is being conducted in the Lower Beaver Creek watershed of the Paulina Ranger District, about 20 miles to the east of the Gap project area. Harvest of these trees was proposed and analyzed as part of the Wolf Fuels and Vegetation Management Project (2014). This project is harvesting an average of about 1.2 large young trees/acre on 384 acres of mixed conifer stands. The first of the sales from this project (Cana timber sale) has been sold, but harvest operations have not begun as of fall 2015.

No other vegetation management projects on the Ochoco National Forest have implemented the harvest of live trees >21" dbh in the past 15 or more years. In 2013, the McKay Fuels and Vegetation Management project included an alternative, not selected, that would have removed young Douglas-fir and grand-fir trees > 21" dbh. The Black Mountain project (adjacent to the Gap project area to the northeast) has developed a proposed action which does not include the harvest of live trees >21" dbh. However, it is foreseeable, based on scoping comments, that this project would propose an alternative which would include the removal of live trees >21" dbh under conditions similar to the Gap and Wolf projects. Within the Black Mountain project area there about 480 acres of mixed conifer stands proposed for harvest which could include the removal of trees >21"dbh if such an alternative were developed. Cumulatively, there would be beneficial effects across the three project areas as more large/old ponderosa pine would receive additional release from competition by the removal of large, young (<150 years), grand fir and Douglas-fir that are competing with them. There is insufficient existing condition data to determine if the conditions described, for which the Forest Plan Amendment were devised, are unique to these four project areas.

Forest Wood Products and Jobs

This section discloses the draft socio-economic effects on the economy; it includes the draft socioeconomic specialist report in its entirety.

Affected Environment

For the purposes of describing socio-economic effects on the economy, this analysis focuses on the economy of central and southeastern Oregon. The effects to the local economies are based on the estimated number of jobs created. The bulk of the area and communities potentially influenced by actions on the Ochoco National Forest lie within Deschutes, Crook, and Jefferson, the southernmost part of Wheeler, eastern most part of Grant, and the northern most sections of Harney and Lake counties. This is referred to as the Zone of Influence. The major population centers within the Zone of Influence and their population figures based on the 2000 census and 2010 estimates are displayed in table 51. Populations and change for the region and by each individual county are displayed in table 51.

Table 51. Population data in the seven Zone of Influence counties for the Gap project.

County	Population		Change	Percent Change
	2000 Census Data	2010 Census Data		
Crook	19,182	20,987	1,805	8.6
Deschutes	115,367	157,733	42,266	26.8
Grant	7,935	7,445	-490	-6.1
Harney	7,609	7,422	-187	-2.5
Jefferson	19,009	21,720	2,711	12.5
Lake	7,422	7,895	473	6.0
Wheeler	1,547	1,441	-106	-6.8
Total	**178,071**	**224,643**	**46,572**	**20.7**
Information obtained from reports generated in November 2015, from the census.gov website				

Future population projections are expected to mimic that of the past decade. Deschutes, Crook, and Jefferson Counties are expected to continue with growth, whereas the more rural counties, Wheeler, Grant, Harney, and Lake are projected to grow quite slowly, if at all.

Table 52 summarizes the changes in the civilian labor force in Central Oregon.

Table 52. Changes in civilian labor force in Central Oregon.

County	Civilian Labor Force		Change	Percent Change
	2000 Census Data	2010		
Crook	8,764	9,252	488	5.5
Deschutes	58,836	72,837	14,001	23.8
Grant	3,792	3,135	-657	-17.3
Harney	3,765	3,313	-452	-12.0
Jefferson	8,918	8,571	-347	-3.9
Lake	3,371	3,373	2	0
Wheeler	662	614	-48	-7.2
Total	88,108	103,105	14,997	17.0
Information obtained from reports generated in November, 2015, from the "Economic Profile System-Human Dimensions Toolkit."				

The following information comes from a report generated by the "Economic Profile System-Human Dimensions Toolkit" in November, 2015. In Crook County, the three largest sectors were education, health care and social assistance, (1,494), manufacturing (1,400), and retail trade (1,355). In Deschutes County the three largest sectors were education, health care, and social assistance (13,364), retail trade (9,219) and construction (8,539).

In Grant County the three largest sectors were education, health care and social assistance (695), agriculture, forestry, fishing, hunting, and mining (469), and retail trade (294).

In Harney County, education, health care and social assistance was tied with agriculture, forestry, fishing, hunting and mining for largest sector (618), followed by arts, entertainment, recreation, accommodation, and food (430) and retail trade (363). In Jefferson County the three largest sectors were education, health care and social assistance (1,629), manufacturing (1,552), and retail trade (989). In Lake County the three largest sectors were agriculture, forestry, fishing, hunting and mining (710), education, health care and social assistance (520), and retail trade (376). In Wheeler County the three largest sectors were arts, entertainment, recreation, accommodation, and food (163), agriculture, forestry, fishing, hunting and mining (110), and education, health care and social assistance (107). Overall, the number of jobs in most sectors has declined in recent years; in Deschutes County, however, jobs increased in all sectors.

As of September, 2015, the unemployment rate in Oregon as a whole was 6.2 percent; while unemployment rates in the individual counties were:

- Crook, 7.9 percent;
- Deschutes, 5.8 percent;
- Grant, 7.1 percent;
- Harney, 12.5 percent;
- Jefferson, 6.9 percent;
- Lake, 6.9 percent; and
- Wheeler, 5.3 percent.

Environmental Effects

Alternative 1

There would not be any activities implemented; therefore, no jobs would be created. As a result there would be no direct benefits to the local or regional economies. The No Action Alternative would have negative impacts to local and regional economies because forest product jobs would not be maintained. The ability to substitute this material from another source is questionable given the current availability of timber, especially from Federal lands. As noted in the affected environment section, Crook County no longer has any primary manufacturing capacity and more than half of the direct jobs supported by the harvesting, transporting, and processing of timber are associated with primary manufacturing. However since the activities would take place in Crook County, it is likely that many of the logging jobs that would be supported under Alternatives 2, 3, and 4 would in fact be associated with Crook County's logging industry. It is also unlikely that many of these local logging jobs would be supported by another harvest activity on the Ochoco National Forest or within the Zone of Influence. This would result in some downward pressures on all facets of Crook County's economy.

The economic activity associated with road work, and vegetation and fuel treatments, would not occur under this alternative. Except for the prescribed fire treatments (these are usually accomplished with local Forest resources), many of the jobs associated with these activities, are accomplished through the use of contracting and many of the resources needed, including workers, are from outside the Zone.

Alternatives 2, 3 and 4

Timber harvest (lumber and wood products) would affect employment and income in three ways: (1) direct effects attributable to employment associated with the harvesting, transportation, and manufacturing; (2) indirect effects attributable to industries that supply materials, equipment, and services to these activities; and (3) induced effects attributable to personal spending by the owners, employees, families, and related industries.

Employment and personal income impacts were made from estimates derived from Gebert et al. (2002). The jobs associated with prescribed fire and noncommercial thinning are based on local observations and do not include indirect and induced jobs.

Table 53 shows the estimated annual job and income by alternative. No attempt has been made to value what has been termed ecosystem service values. This type of analysis, if done at all, is more appropriate at the Forest Plan level, not at the project level (Bartuska, 2000, and a United States Court of Appeals, 9th circuit Memorandum, 2006).

Timber harvest jobs and income shown in table 53 are based on State-wide relationships and are not necessarily the expected impact in any one county. Because of this, the estimated jobs and income figures are likely to be higher than what one would expect in a less developed rural economy. For example, the indirect and induced jobs described above would be less in a rural economy such as Crook's as money "leaks" out of the local economy to Redmond, Bend, and the Willamette Valley. The jobs and income associated with the road work are directly tied to Crook County's economy.

However, they are based on all road work within the County. Because the road work on the Forest is generally less intensive, the number of jobs portrayed in table 53 is likely overstated.

Over half of the timber jobs displayed in table 53 are associated with primary manufacturing (sawmills), and since there is no certainty on where this manufacturing would occur, as materials may not be processed within the Zone of Influence; it is therefore not possible to predict where many of these jobs would exist.

Table 53. Projected annual employment and income.

	Alternative 2	Alternative 3	Alternative 4
Jobs (Direct), commercial harvest	959	745	981
Jobs (Indirect), commercial harvest	94	73	97
Total Jobs commercial harvest	1,053	818	1,078
Personal Income (Direct) derived from timber harvest in the $1000s	$20,007	$15,542	$20,482
Jobs, noncommercial thinning	40	38	40

Alternatives 2, 3 and 4 propose commercial harvest activities and would contribute to the local, regional, and State economies. The estimated jobs would occur over several (3 to 7) years as timber is harvested and processed. Given the major restructuring of the wood product industries over the past 10 to 15 years, it is likely that these would not be new jobs but jobs needed to maintain current levels of employment in the forest products industry. As noted in the affected environment section, Crook County no longer has any primary manufacturing capacity. Over half of the direct jobs supported by the harvesting, transporting, and processing of timber are associated with the primary manufacturing. Although many of the logging activities may be associated with Crook County, the most likely location for processing is in either Grant or southern Deschutes County.

In addition to the employment and income figures from harvesting and manufacturing of wood products, the vegetation, fuel treatments, and road work, would also generate jobs and income over the next 3 to 10 years.

It is reasonable to expect a good proportion of the noncommercial thinning work would go to minority-based small businesses, as they have in the past. The vast majority of these businesses and their employees are based along the I-5 corridor, so most of the disposable income from these activities would not flow into local communities. There would be some local economic activity generated from these activities. The primary services needed by the workers would be food and shelter. Local businesses that can supply food (grocery stores and restaurants) and other services would capture most of the money being spent by the workers in the area. Some businesses may need to increase their employment, either by temporarily adding employees, or giving present employees more hours.

This would likely result in increased local household incomes during implementation of project activities. Since these businesses have supported similar workforces in the past, capitol expansion would probably not be required.

What was not estimated for this DEIS is the amount of restoration-related jobs that would be created by each action alternative. However, the Ochoco National Forest routinely accomplishes restoration work using service contracts. Because all action alternatives include additional riparian restoration work, it is assumed that these alternatives would result in the creation of several additional jobs for the duration of the restoration work.

Within the social context presented above, the action alternatives have the potential to bring in workers from the outside to perform logging and related activities. While the outside workforce is more likely to be racially diverse than the local resident population, the residents have worked effectively with and supported anticipated fluctuations in the workforce expected with the implementation of any of the action alternatives.

Cumulative Effects

Overall, the economic influence from implementation of any of the alternatives is likely to be small within the economic context of the zone as a whole. Trends in employment indicate increased employment, primarily in construction, services, and trade. This would help ameliorate any adverse economic impacts under Alternatives 1. Alternatives 2, 3 and 4, which provide commercial wood products in addition to economic activities associated with the other management activities, along with these same overall economic trends, would help strengthen local, particularly Crook's, and regional economies. In the context of larger economies, regional or State-wide scales, the amount lost under Alternative 1, or the amount provided in Alternatives 2, 3 and 4, would not be measurable.

Fuels and Fire

Background

Fires have burned through the Pacific Northwest forests for thousands of years. (Agee, 1990) Prior to 1900, an estimated 6 million acres burned annually in the northwestern United States. Four million of those acres burned in dry grasslands and sagebrush. The remaining two million acres burned in the forest – more than half of that being low severity fire in forests dominated by ponderosa pine. (Barrett, Arno, & Menakis, 1997)

Fire exclusion over the past 100 – 120 years has reduced the acres burned by naturally-occurring fires and has resulted in the buildup of surface fuels, the development of ladder fuels, and an increase in fire intolerant species such as grand fir. Stands have become denser and the potential for high severity fires has increased.

Fire Regime and Condition Class

One method of quantifying departure from historic conditions uses the concepts of Fire Regime and Condition Class.

Fire Regime

Five natural fire regime groups are classified based on the average number of years between fires (fire frequency or mean fire interval [MFI]) combined with characteristic fire severity reflecting percent replacement of dominant overstory vegetation. (Schmidt, Menakis, Hardy, Hann, & Bunnell, 2002) (Barrett, et al., Interagency Fire Regime Condition Class Guidebook, Version 3.0, 2010).

Table 54. Fire Regime Groups Used in FRCC Methodology.

Group	Frequency	Severity
I	0-35 years	Low/Mixed
II	0-35 years	Replacement
III	35-200 years	Mixed/Low
IV	35-200 years	Replacement
V	200+ years	Replacement/Any

In FRCC methodology, fire severity is the effect of fire in terms of upper layer canopy replacement and is described by three levels; Low – up to 25% replacement, Mixed – 25%-75% replacement and Replacement – 75%-100% replacement. (Barrett, et al., Interagency Fire Regime Condition Class Guidebook, Version 3.0, 2010)

Replacement may or may not cause a lethal effect on the plants. For example, replacement fire in grassland simply removes the leaves, which usually re-sprouts from the basal crown, whereas replacement fire in most conifers causes total tree mortality. Other fire severity indicators include fuel consumption, ash color, soil composition and soil temperatures.

Table 55. Fire Severity Classification (Robichaud, Beyers, & Neary, 2000).

	Surface Fire	Mixed Severity Fire	Crown Fire
Litter	Scorched, charred, consumed	Consumed	Consumed
Duff	Intact, surface charred	Deep charred	Consumed
Woody debris – small, < 3 in. diam	Partly consumed - charred	Consumed	Consumed
Woody Debris – large, > 3 in. diam	Charred	Deep charred, consumed	Consumed
Ash color	Black	Light gray	Reddish orange
Mineral soil	Unchanged	Unchanged	Altered structure, hydrophobic
Soil temp at 0.4 in	< 120 F	210-390 F	> 490 F

Condition Class

Condition class describes changes in stand conditions and fire effects (e.g. potential for uncharacteristic high severity fire) which are caused in part by fire exclusion. The change in a stand compared to its reference condition is referred to as the stand's degree of departure. Departure is based on a *central tendency* (or mean) metric that represents a composite estimate of the reference condition vegetation and fire regime characteristics. The three condition classes are generally equivalent to low, moderate and high departure from historic conditions at a stand level. Using FRCC methodology in tandem with examined vegetation data to describe stand conditions and resulting potential fire effects makes condition class a good representation of fire hazard. (National Interagency Fuels, Fire, & Vegetation Tech Transfer, 2010) Changes in condition class result from changes in successional stage, and stand density. When fire is excluded from a forested environment, surface fuels accumulate, ladder fuels (small trees) accumulate, and crown base heights (the distance from the ground to the crowns of the trees) decreases, making the stand more susceptible to high intensity/high severity fire. Some of the general characteristics used to describe the 3 condition classes are found in table 56. The three fire regime condition classes have been defined (Barrett, et al., Interagency Fire Regime Condition Class Guidebook, Version 3.0, 2010) as follows:

1) <33 percent (low) departure from reference conditions,

2) 33-66 percent (moderate) departure,

3) >66 percent (high) departure

Table 56. Characteristics of Condition Classes.

	FRCC 1	FRCC 2	FRCC 3
Description	**0-33% departure from reference conditions.** Within the natural (historical) range of variability of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.	**34-66% departure from reference conditions.** Moderate departure from the natural (historical) regime of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.	**67-100% departure from reference conditions.** High departure from the natural (historical) regime of vegetation characteristics; fuel composition; fire frequency, severity and pattern; and other associated disturbances.
Potential Risks	Fire behavior, effects, and other associated disturbances are similar to those that occurred prior to fire exclusion (suppression) and other types of management that do not mimic the natural fire regime and associated vegetation and fuel characteristics. Composition and structure of vegetation and fuels are similar to the natural (historical) regime. Risk of loss of key ecosystem components (e.g. native species, large trees, and soil) is low.	Fire behavior, effects, and other associated disturbances are moderately departed (more or less severe). Composition and structure of vegetation and fuel are moderately altered. Uncharacteristic conditions range from low to moderate. Risk of loss of key ecosystem components is moderate.	Fire behavior, effects, and other associated disturbances are highly departed (more or less severe). Composition and structure of vegetation and fuel are highly altered. Uncharacteristic conditions range from moderate to high. Risk of loss of key ecosystem components is high.

Affected Environment

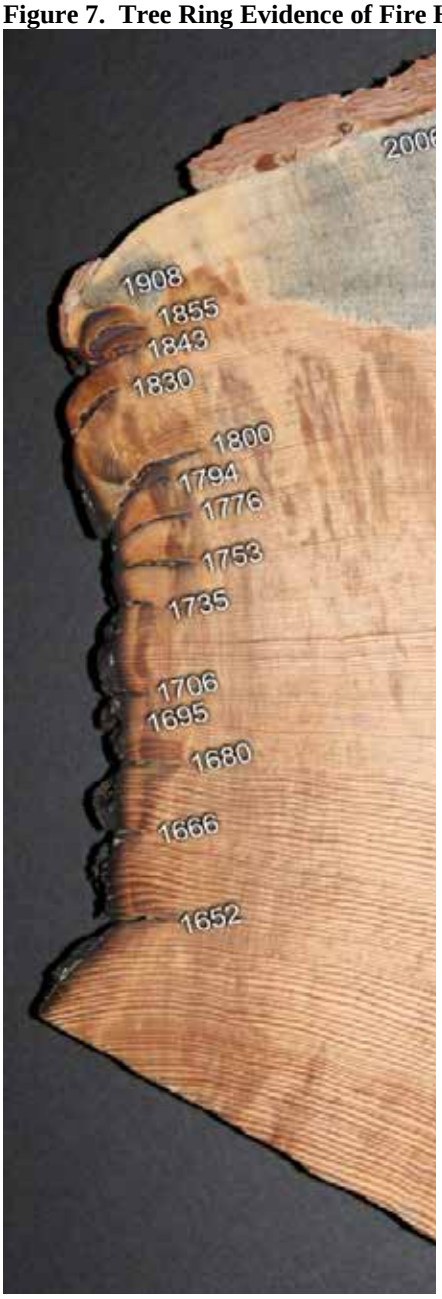
Determining Fire Regime for the Gap Project Area

Current predominance of shade-tolerant species in a mixed-conifer forest does not necessarily indicate that the historical disturbance regime had long fire-return intervals and/or large patches of high-severity fire (Merschel, Spies, & Heyerdahl, 2014) as moist mixed conifer patches embedded within large dry forest patches or adjacent to grass or shrub patches may experience a higher fire frequency than they would if they were embedded in moist forest. (Stine, et al., 2014)

A fire history analysis was recently conducted in three areas on 93 plots across the Ochoco National Forest. (Heyerdahl, Falk, & Loehman, 2012) The analysis was conducted in areas that have seen little disturbance from logging or large fires in the last 60 years. Fire history was reconstructed from two types of tree-ring evidence: (1) fire scars, which are formed during a surface fire that does not kill the scarred tree, and (2) dates of tree establishment, which postdate forest stands killed during a mixed or high severity fire.

At each plot, a chain saw was used to remove partial cross sections from up to 10 fire-scarred trees. Crossdating allowed for accurately dating wood from trees that were dead when sampled (stumps, logs, or snags). Small partial cross sections were also removed from live fire-scarred trees if dead ones are not present or had poorly preserved scars. All samples were dated (i.e., crossdated) using existing master ring-width chronologies that are already publicly available for the region. (NCDC, updated 2013)

Figure 7. Tree Ring Evidence of Fire History.



Fire-scarred partial cross section collected from a ponderosa pine (Pinus ponderosa) snag in 2010 near McKay Creek, Ochoco National Forest, Oregon. UTM (NAD 83, zone 10): 686694E 4928182E

Exact calendar years determined with crossdating by Emily Heyerdahl, Rocky Mtn Research Station

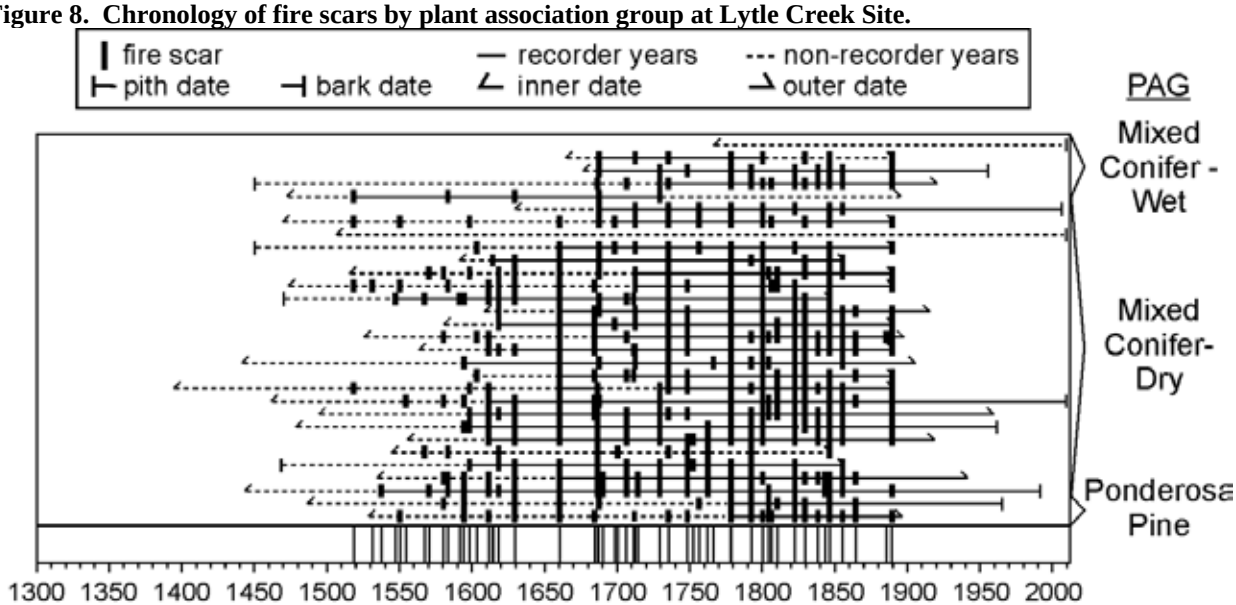
The average fire return interval, 14 fires between 1652 and 1908, is 18 years

The longest interval, 53 years between 1855 and 1908, coincides with the introduction of livestock grazing on the Ochocos in the 1880s.

The absence of fire after 1908 also coincides with the beginning of organized fire suppression by the U.S. Forest Service.

At the Lytle Creek site, which lies between 5,054 and 5,798 feet in elevation within the Gap project, data was taken from a 1,925 acre area. 1,115 fire scars were identified, dating from 1519 to 1890, showing an average fire return interval of 11 years on ponderosa pine sites, 18 years on dry mixed conifer sites, and 23 years in wet mixed conifer sites.

Figure 8. Chronology of fire scars by plant association group at Lytle Creek Site.



For the purpose of analysis, the entire Gap project area will be considered historically as Fire Regime I, experiencing frequent, mostly low, occasionally mixed severity fire. Though the higher elevations and moisture profiles of Lookout Mountain may have limited fire occurrence with more mixed severity (232 acres mapped in sub-alpine fir PAG), there are no activities proposed within the scope of this project in the Lookout Mountain Recreation Area. At the lower elevations along the south boundary, there are 596 acres mapped in juniper woodland and juniper steppe PAGs as the forest transitions into the grass and sage of the Paulina Valley. These areas would also experience frequent fire in grass and brush with little change to existing overstory as established western juniper would occur only in rocky or barren areas and scattered clumps of ponderosa pine would go largely unaffected on microsites of higher quality.

Recent Fire History in Gap

Based on Heyerdahl's average fire return intervals for the project's forested acres and mapped plant association groups, the annual average for acres burned would be 1,082 acres of ponderosa pine, 1,014 acres of dry mixed conifer, and 53 acres of wet mixed conifer.

From 1986 through 2014, 86 wildfires started in the Gap project area, all but 12 were lightning caused and natural ignitions occurred in 23 of 28 years. All ignitions within the area burned for a total of 28 acres, an average of 1 acre per year. Over 70% of these fires were less than 0.1 acre in size, and over 90% were less than 0.5 acres. The largest fire was 6 acres in 2004. In addition, in 2014 the 9,848 acre Fox Fire started in the adjacent watershed to the east and burned 69 acres in the Gap project area.

Forest Service records also show 2,059 total acres of prescribed fire, all in the last 10 years. There are anecdotal accounts of past prescribed fires, but no records exist in the current database.

Based on historic mean fire return intervals for the same 28 year timeframe, over 60,000 total acres would have burned, much of the area having burned twice.

FRCC Affected Environment

Determining the existing Condition Class for the Gap project area was based on FRCC methodology (Barrett, et al., Interagency Fire Regime Condition Class Guidebook, Version 3.0, 2010) using aircraft based Light Detection and Ranging (LiDAR) data, and GNN imputation (Ohmann & Gregory, 2002) to determine seral/structural stage, then using a crosswalk developed by fire managers on the Ochoco NF (Owens) to assign a Condition Class. Using this information, 17% of the forested project area is classified as low departure CC1, while 35% is moderate departure CC2 and 48% is high departure CC3.

Fire and Fuels Objectives Related to Project Needs

It is not the objective of this project to prevent wildfires from occuring; this is neither possible nor desirable. Rather, thinning and prescribed fire in dense, overstocked stands would open the forest canopy, and reduce ladder fuels and surface fuels, creating conditions that would allow for frequent, low severity fire. Prescribed fire also promotes fire-tolerant species composition.

Fuels Treatment Types

The following fuels treatment types are proposed in the Gap project area:

1. **Natural Fuels Underburning** would reduce naturally occurring debris on the forest floor and seedlings and saplings, maintaining low intensity fire conditions in stands that have been previously treated or in stands that are closely representative of their Historic Range of Variability (HRV).
2. **Activity Fuels Underburning** would reduce the forest debris (slash) from commercial and non-commercial thinning.
3. **Grapple Piling** of activity fuels with equipment is proposed in harvest units where post thinning fuel load would be too heavy to burn without damaging the residual stand. Would occur on less than 35% slopes with equipment utilizing existing skid trails. Piled fuels would be burned outside of typical fire season.
4. **Hand Piling** would occur in non-harvested units, where equipment use is not desirable, or along property boundaries to reduce the risk of fire spread onto private property. Piles would be burned outside of typical fire season.
5. **Juniper Jackpot Burning** would dispose of concentrations of juniper slash from non-commercial thinning under cool conditions when soils and adjacent fuels are wet or frozen to reduce the risk of spread onto private property.

Prescriptions and Changes in Fire Hazard

Changes in fire hazard result from reductions in surface fuels, ladder fuels and stand density. The action alternatives would reduce the potential for uncharacteristic high severity fire by 1) reducing surface fuels, which would shorten the flame lengths of surface fires, 2) by increasing crown base heights, the distance from the ground to the base of the canopy, requiring longer flame lengths to initiate tree torching, and 3) by decreasing crown density, making it harder for fire to travel from tree to tree.

High Hazard/CC3 to Low Hazard/CC1

Prescription: Commercial Thinning – Noncommercial Thinning – Underburn

Effects: Reduces crown density by opening the canopy – increases crown base height by reducing ladder fuels – reduces surface fuels.

High Hazard/CC3 to Moderate Hazard/CC2

Prescription: Noncommercial Thinning – Underburn

Effects: Increases crown base height by reducing ladder fuels – reduces surface fuels

Moderate Hazard/CC2 to Low Hazard/CC1

Prescription: Commercial Thinning – Noncommercial Thinning – Underburn

Effects: Reduces crown density by opening the canopy – increases crown base height by reducing ladder fuels – reduces surface fuels

Moderate Hazard/CC2 to Low Hazard/CC1

Prescription: Noncommercial Thinning – Underburn

Effects: Increases crown base height by reducing ladder fuels – reduces surface fuels

Low Hazard/CC1 Maintenance

Prescription: Underburn

Effects: Increases crown base height by reducing ladder fuels (seedlings and saplings), and reduces surface fuels

Timeline

Based on the timelines of previous projects on the Ochoco National Forest, natural fuels underburning in the Gap project area would occur over the next 10 - 15 years, depending on climate, fuels accumulation and understory growth. Activity fuels burning would also occur over the next 10 - 15 years, depending on when commercial and noncommercial thinning occurs.

Alternatives Comparison

Objective: Reduce forest vegetation density and fuel loading towards a historic range of variability to provide a range of forest conditions and habitats that would support historic disturbance processes, native wildlife, and plant species.

Unit of measure: Change in Condition Class by percentage of project area.

Many of the characteristics of forested stands that estimate condition class are also inputs that help determine potential fire hazard for those areas. Within this context, a comparison of alternatives was completed using changes in Condition Class as a measure for the changes in fire hazard. The three action alternatives would reduce the potential for uncharacteristic high severity wildfire (high and moderate hazard/Condition Classes 2 & 3) by opening the forest canopy, and reducing surface and ladder fuels. They would also maintain conditions that support frequent, low severity wildfire (low hazard/Condition Class 1) by reducing surface and ladder fuels.

For each action alternative, new seral/structural stages were assigned to stands based on proposed treatment, then the same crosswalk was applied that was used to determine existing condition.

Table 57 represents the changes in Fire Regime Condition Class for forested stands after treatment.

Table 57. Comparison of Alternatives for Fire Hazard/Condition Class.

Alternative 1					
Hazard/Condition Class	**Existing**	**10 year projection**		**20 Year Projection**	
	%	**%**	***Change***	**%**	***Change***
L/CC1	17%	**13%**	*-4%*	**11%**	*-6%*
M/CC2	35%	**34%**	*-1%*	**34%**	*-1%*
H/CC3	48%	**53%**	*5%*	**55%**	*7%*
Alternative 2					
Hazard/Condition Class	**Existing**	**Post Treatment (10 years post decision)**		**20 Year Projection (10 years post treatment)**	
	%	**%**	***Change***	**%**	***Change***
L/CC1	17%	**54%**	*37%*	**46%**	*29%*
M/CC2	35%	**25%**	*-10%*	**27%**	*-8%*
H/CC3	48%	**21%**	*-27%*	**27%**	*-21%*
Alternative 3					
Hazard/Condition Class	**Existing**	**Post Treatment (10 years post decision)**		**20 Year Projection (10 years post treatment)**	
	%	**%**	***Change***	**%**	***Change***
L/CC1	17%	**50%**	*33%*	**37%**	*20%*
M/CC2	35%	**26%**	*-9%*	**30%**	*-5%*
H/CC3	48%	**24%**	*-24%*	**33%**	*-15%*
Alternative 4					
Hazard/Condition Class	**Existing**	**Post Treatment (10 years post decision)**		**20 Year Projection (10 years post treatment)**	
	%	**%**	***Change***	**%**	***Change***
L/CC1	17%	**58%**	*41%*	**50%**	*33%*
M/CC2	35%	**21%**	*-14%*	**23%**	*-12%*
H/CC3	48%	**21%**	*-27%*	**27%**	*-21%*

Alternative 4 would move the largest percentage of the project area currently in Condition Classes 2 and 3 into Condition Class 1.

Effects Analysis

No Action Alternative

According to the project area analysis, more of the watershed is covered by dense stands of small trees than were present historically. Prior fuels treatments including stands that were thinned and/or burned in the 1980s, 90s, and early 2000s have most likely suffered decreased effectiveness as fuel loadings can be expected to trend toward pre-treatment conditions in 7 – 20 years after treatment (Graham, McCaffrey, & Jain, 2004).

Under the No Action alternative, low hazard/Condition Class 1 stands would not be maintained in that condition, and would transition into moderate hazard/Condition Class 2 within the next 10 - 20 years as surface fuels accumulate, ladder fuels fill in the understory and raise the fueled, and the forest canopy closes. Wildfires would tend to be more severe.

Without treatment, the amount of high hazard/Condition Class 3 forest stands would increase. Limited vegetation management, wildfire suppression, and insect and disease mortality would continue the trend of fuel accumulating in the form of dead and down trees, small diameter trees growing into the overstory, and dense crown conditions. These conditions would increase the potential for a surface fire to transition to a crown fire, which could result in the loss of late and old structure, wildlife cover and large woody debris in riparian areas.

The Hash Rock Fire provides an example of the changes in fire effects caused by the exclusion of fire as a natural process. In August of 2000, the Hash Rock fire burned almost the entire 18,000 acre Mill Creek Wilderness. Prior to the Hash Rock fire, the proportion of the Wilderness where vegetation and fuels conditions would have supported a low severity fire had been altered from a historic range of 45-100 % to 21% The vegetative conditions that would have supported a high severity fire had increased from a historic range of 6-14 % to 45% of the Wilderness.

Fire severity mapping of the Hash Rock Fire was completed in October 2000. The fire severity mapping was compiled from aerial and ground reconnaissance and post-fire photography. This mapping identified 43% of the Wilderness as having experienced high severity, stand replacement fire. By 2002, 70% of the forested stands in the Wilderness were dead, including a high percentage of old growth ponderosa pine. [1]

According to a synthesis of more than 1,000 scientific studies as part of the National Climate Assessment, the fastest and most significant effects on forest ecosystems will be caused by altered disturbance regimes. A warmer climate will increase the area burned by wildfire and the area affected by bark beetles and other insects. These two factors, individually, in combination, and as components of broader stress complexes, may lead to permanently altered species composition, distribution of forest age and structure, and spatial patterns across large landscapes.

An increase in wildfire throughout the United States, which will likely include at least a doubling of area burned by the mid-21st century, will challenge government agencies and social institutions. Expanded efforts to reduce hazardous fuels can reduce the severity of wildfire on a local basis, but if the current investment in reducing stand densities and fuels does not increase significantly, it will be impossible to mitigate the effects of increasing crown fires. (Vose, Peterson, & Patel-Weynard, 2012)

Effects Common to Action Alternatives

Under the action alternatives Condition Class 1 stands would be maintained and high and moderate hazard areas would be converted to low hazard conditions resulting in decreased risk to late & old structure trees, riparian habitat, and the private land adjacent to the forest.

Changes in condition class would result from reductions in surface fuels, ladder fuels and stand density. The activities would reduce the potential for high severity fire by 1) reducing surface fuels, which would shorten the flame lengths of surface fires, 2) by increasing crown base heights, the distance from the ground to the base of the canopy, requiring longer flame lengths to initiate tree torching, and 3) by decreasing crown density, making it harder for fire to travel from tree to tree.

Fine Fuel Increase

Thinning would increase the amount of sunlight and moisture that reaches the forest floor, which would increase the quantity and vigor of native grasses, forbs and shrubs (fine fuels). The average temperature and windspead would increase, and average relative humidity would decrease. This would lower fine fuel moisture, the amount of moisture in dried grass and timber litter (pine needles and small sticks).

[1] Fontaine and Seymour, forest survey 2002, Ochoco NF

Open stands have higher surface wind speeds than closed stands, therefore the average windspeed in thinned stands would increase. A fully-sheltered, dense stand has a wind reduction factor of 0.1; a fully-sheltered, open stand has a wind reduction factor of 0.2, and a partially-sheltered open stand has a wind reduction of 0.3. With a wind speed of 15 mph at 20 feet above the canopy, the wind speed in the dense stand is 1.5 mph, the wind speed in the fully-sheltered, open stand is 3 mph, and the wind speed in the partially-sheltered open stand is 4.5 mph. (NWCG Training Working Team, 1992)

Lower fine fuel moisture and higher wind would facilitate the spread of surface fire. More frequent surface fires in treated stands would maintain historically low levels of surface fuels and ladder fuels, which would decrease the risk of crown fire.

Thinning Slash Hazard

Thinning can cause a short-term increase in fire hazard if the fuel load is heavy and continuous, the slash has dried out, and a fire occurs during hot and dry conditions. The heat generated by the increased fuel load has the potential to cause undesired effects to the surrounding stand, soils and other resources.

Recent commercial thinning operations on the Ochoco National Forest have utilized whole tree yarding techniques, which means the entire tree is brought to a landing where it is limbed and topped, and the limbs and tops are piled. Whole tree yarding does not significantly increase fire hazard because the increase in surface fuels is minimal.

However, the noncommercial thinning of trees less than 9” dbh could result in a short-term increase in surface fuels. The hazard from untreated slash is reduced by either lopping (cutting) the slash to reduce the height of the fuel bed to under 24 inches (the lower the fuel bed, the lower the flame length), or by piling the slash. In units that have been lopped, the slash gets further compacted by winter snows and after 2 or 3 years is compacted to less than 12 inches and can be burned with a low intensity underburn. Leaving slash in place during this time allows for the redistribution of nutrients from the slash back into the soil. (Graham, Harvey, Jain, & Tonn, 1999)

Treatment Effects on Fire Hazard

Hazard is defined as a source of danger. (Merriam-Webster, 2013) Forest fuels are considered hazardous when they could result in damage to a value. Some of the values identified in this document that could be damaged by wildfires that are carried by forest fuels are: Late & Old Structure trees (LOS), wildlife habitat, soils and fisheries habitat, and air quality. Reducing the hazard – the amount of fuel in a stand – lowers the risk, or probability, of high severity fire in that stand (see Purpose and Need).

An example of treatment effects on fire hazard is displayed in the table below. The outputs were calculated using Forest Veg Simulator (FVS) model which uses stand exam data as inputs for the current condition. The stand chosen currently has a high hazard fuel condition; closed canopy, heavy surface fuels, and heavy ladder fuels. A low hazard is the condition in the unit after harvest, which would open the canopy; after thinning, which would reduce ladder fuels, and; after underburning, which would reduce surface fuels. Table 58 compares fire effects with treatment (action alternatives) and without treatment (alternative 1), from a wildfire under the extreme conditions when large fires typically occur. (USFS, 2005)

Table 58. Fire Effects from a Wildfire Post Treatment by Alternative.

	Alternative 1 – Stands without Treatment (High Hazard)	Alternatives 2,3 & 4 After treatment (Low Hazard)
Flame Length	16 feet	3 feet
Scorch height on trees	108 feet	7 feet
Percentage of trees with consumed crowns	46%	0%
Change in Basal Area	From 120 square feet to 3	From 69 square feet to 50
Smoke Production, tons per acre of pm 2.5	0.16 tons per acre	0.08 tons per acre

Fire Behavior Effects

Measuring the Current Condition and Alternatives

Potential fire behavior for the Gap project area was analyzed utilizing current fuels data acquired from LANDFIRE (LF2010 data) (Zahn, 2015) and FlamMap, version 5 (Finney, Seli, Brittain, & McHugh, 2006). Modeling was used to predict various fire behavior characteristics for Alternative 1 (no action) to assess the current condition as well as Alternatives 2, 3, and 4 to assess the changes anticipated as a result of proposed activities. Fire behavior attributes assessed include flame length and potential crown fire activity. This analysis provides an assessment of potential fire behavior across the entire project area as opposed to Condition Class which models degree of departure and was determined at the stand level for this project. This analysis considers fuel moisture and arrangement and utilizes topographic and weather influences to model fire behavior.

Three fire behavior levels define the likelihood of effective fire suppression actions while also considering the ecological effects of the fire itself and the associated suppression actions that the fire would require. **Low** fire behavior areas could be effectively suppressed using hand crews and direct fireline construction with minimal negative impacts. **Moderate** and **High** fire behavior areas would require increasingly heavier equipment such as dozers, and/or aerial methods to effectively suppress a wildfire. Moderate and high fire behavior areas have an increased likelihood of negative resource effects from wildfire: overstory tree mortality, soils impacts, smoke production, etc. For this analysis the fire behavior level is determined using a matrix combining flame length and crown fire activity as displayed in table 59. For crown fire activity, **Surface** is the absence of crown fire, **Passive** is tree torching linked to surface fire behavior, and **Active** is tree-to-tree crown fire independent of surface fire. Since FlamMap calculates fire behavior characteristics cell by cell, the crown fire activity of any cell is independent of any adjacent cells. This means active crown fire cannot "spread" cell to cell and spotting is not modeled in FlamMap.

For this analysis 97th percentile conditions (National Fire Danger Rating System) as recorded by the Brer Rabbit Remote Automated Weather System (RAWS 352208) were used for weather and fuel moisture inputs to FlamMap as shown in table 60.

Table 59. Fire Behavior Levels.

Flame Length (feet)	Crown Fire Activity		
	Surface	**Passive**	**Active**
0 - 2	Low	Low	Moderate
3 - 4	Low	Moderate	Moderate
5 - 6	Moderate	High	High
7+	High	High	High

Table 60. 97th Percentile Weather Conditions.

Weather Parameter	97th Percentile Value
Temperature	85° F
Relative Humidity	11%
Wind Direction	SW
Wind Speed	12 MPH
Energy Release Component (ERC)	23
1 Hour Fuel Moisture	2%
10 Hour Fuel Moisture	3%
100 Hour Fuel Moisture	5%
1000 Hour Fuel Moisture	6%
Live Herbaceous Fuel Moisture	< 30%
Live Woody Fuel Moisture	60%

Figures 9 through 12 display potential fire behavior in forested areas within the Gap project area before and after treatment with colors corresponding to Low, Medium, and High as shown in table 61. Effects of action alternatives were analyzed by altering LANDFIRE data for Fuel Model, Crown Base Height, Crown Bulk Density, and Canopy Cover to model commercial harvest, non-commercial thinning, and underburning treatments.

The results of the action alternatives would be similar, and would decrease potential for High and Moderate fire behavior levels and increase potential for Lower fire behavior across 26-27% of the forested project area. Project area totals are shown in table 61.

The largest remaining areas with greater potential for high fire behavior and severity would be the Lookout Mountain Recreation Area, Old Growth Management Areas, and stands identified for wildlife habitat or other resource concerns. These areas would become more isolated making them both easier to protect from unwanted fire entering them, and easier to confine high severity fires that started in them to smaller areas.

Figure 9. Alternative 1

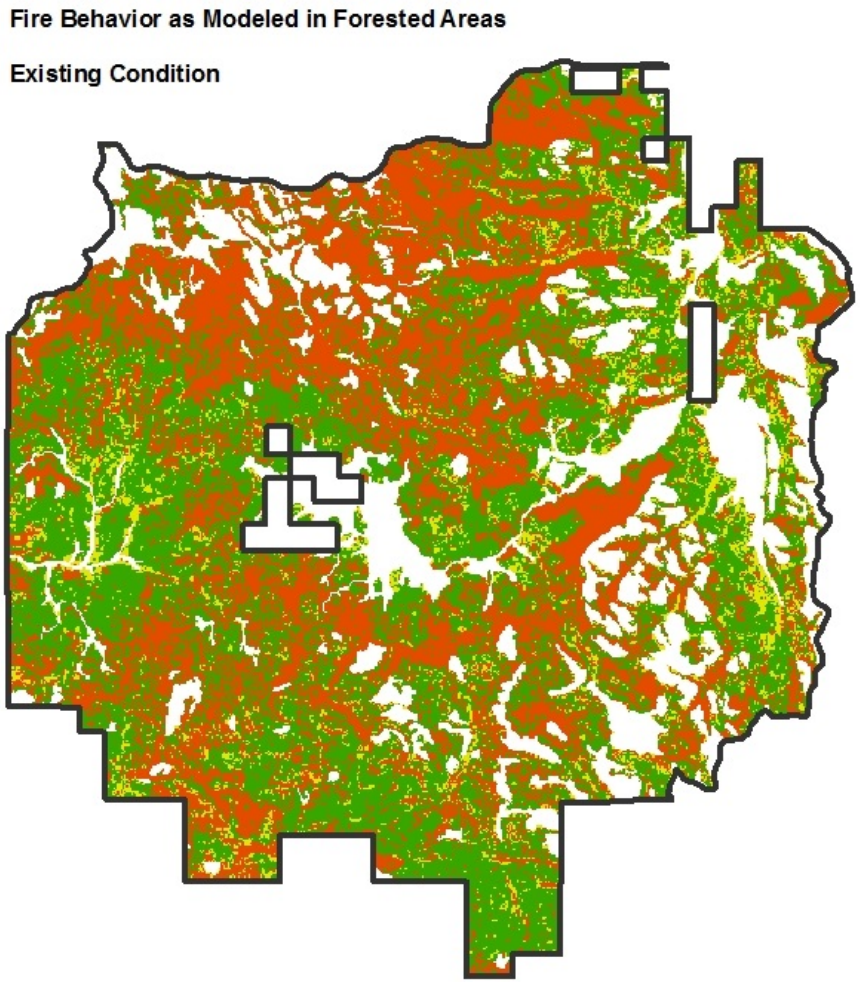


Figure 10. Alternative 2

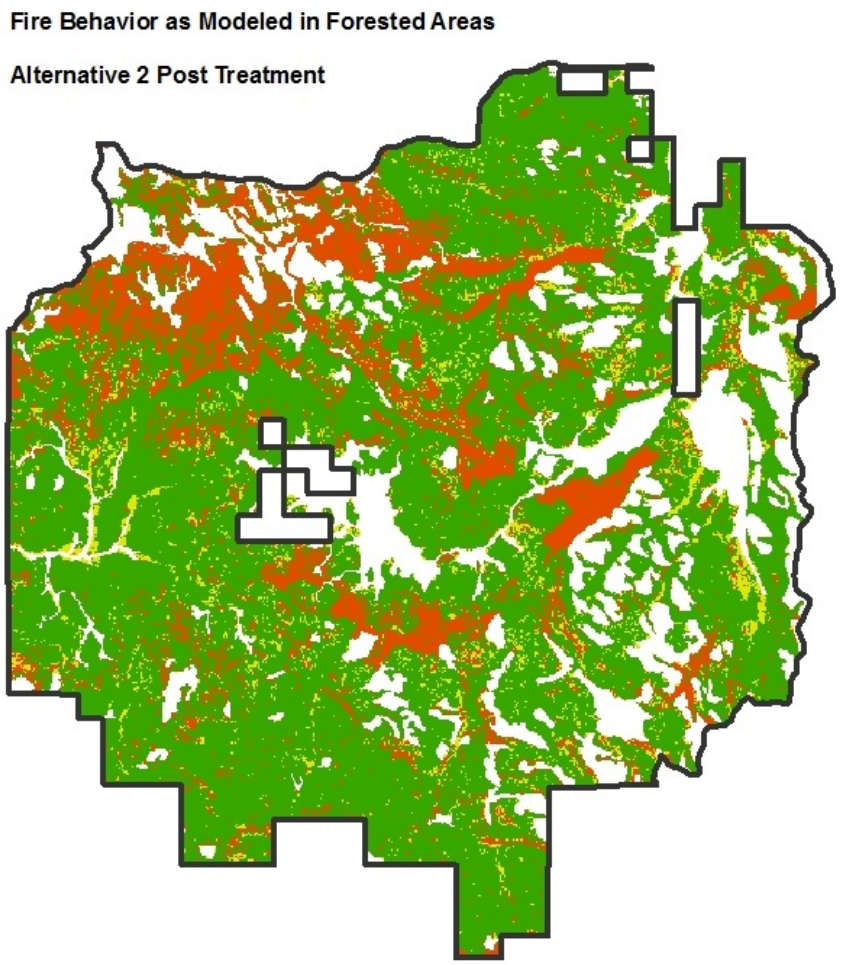


Figure 11. Alternative 3

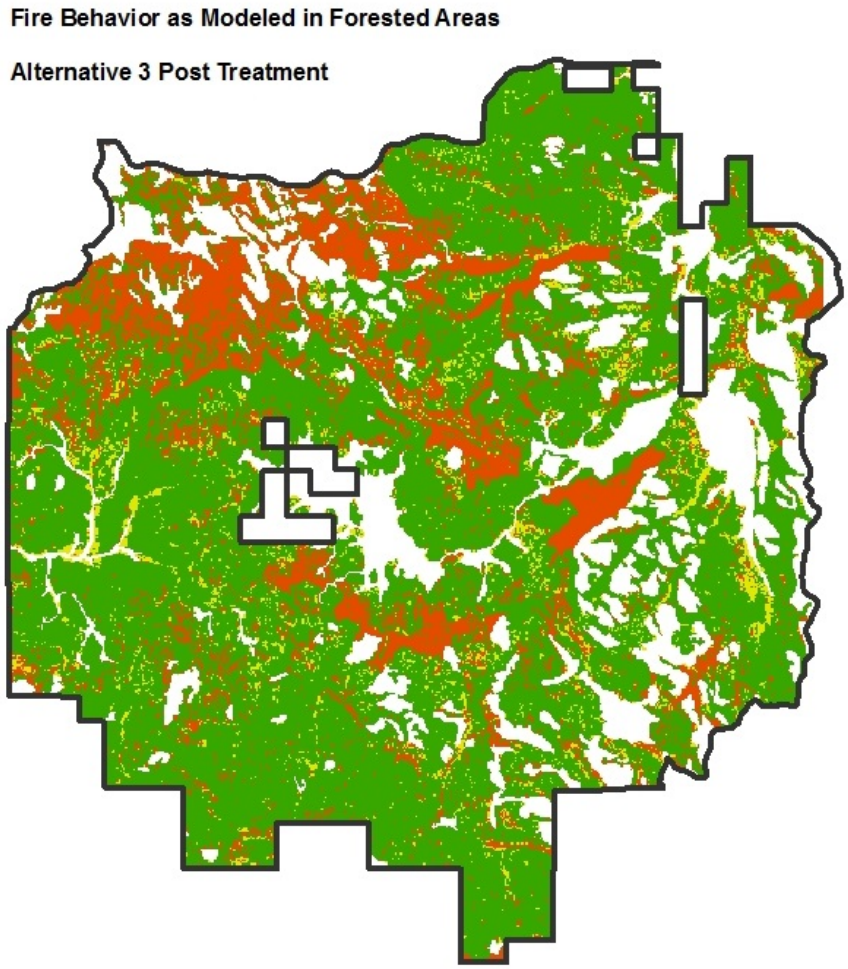


Figure 12. Alternative 4

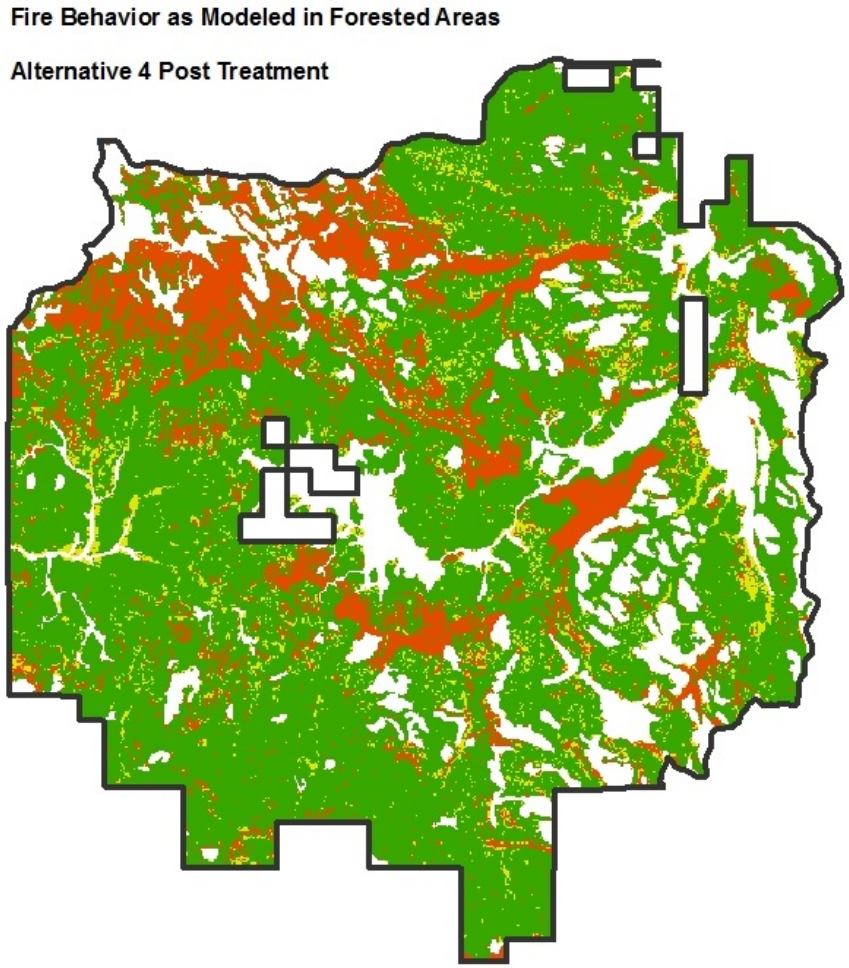


Table 61. Changes in Fire Behavior within Treatment Units.

Alternative 2 Units						
Fire Behavior Level	**Existing (Alt 1)**		**Post Treatment**		**Difference**	
	Acres	**%**	**Acres**	**%**	**Acres**	**%**
L	14,628	47%	22,701	73%	8,073	26%
M	2,638	9%	1,970	7%	-676	-2%
H	13,760	44%	6,349	20%	-7,425	-24%
Alternative 3 Units						
Fire Behavior Level	**Existing (Alt 1)**		**Post Treatment**		**Difference**	
	Acres	**%**	**Acres**	**%**	**Acres**	**%**
L	14,628	47%	22,599	73%	7,965	26%
M	2,638	9%	1,917	6%	-729	-3%
H	13,760	44%	6,507	21%	-7,267	-23%
Alternative 4 Units						
Fire Behavior Level	**Existing (Alt 1)**		**Post Treatment**		**Difference**	
	Acres	**%**	**Acres**	**%**	**Acres**	**%**
L	14,628	47%	23,038	74%	8,404	27%
M	2,638	9%	2,069	7%	-569	-2%
H	13,760	44%	5,924	19%	-7836	-25%

*Project area total size shown in this table varies slightly due to conversion of the a LANDFIRE 30m^2 raster data to acres and rounding.

Effects to Large Old Pine after Prescribed Fire

While all action alternatives would reduce the risk of losing large old pine to wildfire, some mortality of large pine can be expected after prescribed burning. Trees are more at risk in stands that have missed several fire entries (condition classes 2 and 3). Mortality from prescribed fire is less than 5%. (Scholz, Fuels Specialist. Personal Communications - Observations of Prescribed Fire Projects on the Ochoco National Forest, 1986-2015) By contrast, 48% of the 18,000 acre Hash Rock fire in the Mill Creek Wilderness in 2000 had 100% mortality from a high severity fire.

Factors that could contribute to mortality in large pine include:

- depth of duff collar around the base of the tree
- diameter of tree
- age of tree
- health of tree
- age of surrounding stand
- health of surrounding stand
- presence of a catface
- live fuel moisture
- effects of long-term drought
- moisture profile of duff collar
- duration of heat pulse
- type of heat - radiant or conductive (a function of moisture profile)
- soil type

As ponderosa pine trees grow, they shed bark chips. Fire exclusion has allowed large piles of chips to accumulate around their base. These duff collars are often more than a foot deep, and are sometimes 2-3 feet deep. There has been mortality associated with the complete consumption of these collars when they burn. Frequent low severity fires would have prevented these collars from accumulating. Using fire around these trees when there is moisture in the collars could reduce the collars with less risk to the trees than wildfire.

In August of 2010 monitoring was initiated on a 105-acre prescribed fire unit in advance of a summer-condition burn. The objective was to track survival of large trees. Trees greater than 19”dbh were tagged and measured at each of seven plots throughout the unit. A total of 48 trees were measured. The average dbh was 24” and average height was 70 feet. Two trees were snags and two appeared unhealthy; all the rest were healthy before the fire. (Unhealthy here is defined as less than vigorous, but likely to survive the next ten years.)

The burn was conducted on September 7, 2010 with temperatures between 60-65 degrees F and relative humidity ranging from 35 to 43 percent with partly cloudy skies. There was 90% consumption of fine fuels and flame lengths were generally less than one foot high. Re-measurement was done one year following the burn.

At one year post-burn, all living trees had survived, both snags were still standing, and four trees appeared unhealthy. One of the unhealthy trees and three of the healthy trees had developed catfaces. Average char height was 3 feet and average percent canopy scorch was zero.

In 2015 one of the unhealthy trees had died and fallen, the other three appeared healthy. The tree that died was a 25”-dbh Douglas fir that looked had looked healthy in 2010. The fact that it fell so quickly suggests death was partly related to underlying pathology, not directly due to the fire.

Effects in Riparian Habitat Conservation Areas (RHCAs)

Fire would be used in RHCAs to promote the growth of riparian vegetation by reducing conifer encroachment, and to reduce the risk of high severity fire by reducing small diameter surface fuels (less than 3 inches in diameter) and ladder fuels (trees less than 1 inch dbh).

“The narrow stringers of forest bordering streams that flow through the ponderosa pine zone owe their lush diversity of trees, shrubs, and herbaceous plants to the mixed fire regime. These strips of moist riparian habitat evidently burned at intervals comparable to the adjacent dry upland forests in some areas and somewhat longer intervals in other areas. Fires thinned the conifers, leaving a mixed open growth of large ponderosa pine, western larch, and Douglas fir. Broadleaved trees and shrubs prospered in the openings. Most of these species sprout after fire and grow rapidly.” (Arno & Allison-Bunnell, 2002)

Prescribed fire usually burns the litter layer and upper part of the duff layer over 10-50% of the surface area within RHCAs, with less than 5% mineral soil exposure, and hydrophobic soil formation occurring on less than 1% of the area, usually where old punky logs are completely consumed. (Scholz, Fuels Specialist. Personal Communications - Observations of Prescribed Fire Projects on the Ochoco National Forest, 1986-2015)

Post-fire Monitoring of Large Woody Debris in Dick Creek

In October 2008, a 388-acre underburn was conducted in Bull units 17 and 45, in T12S, R18E, Sec 3, 4, 9, and 10. Within those units is two miles of Dick Creek, a 2.5-mile-long intermittent tributary to Trout Creek. By the standards set forth in the Inland Native Fish Strategy (INFISH) EA (USDA FS, 1995), Dick Creek is a Category 4 Riparian Habitat Conservation Area, which includes "the intermittent stream channel and the area to the top of the inner gorge … and the area to the outer edges of the riparian vegetation." Here the inner gorge would be the floodplain, which is up to 20 feet across where there is no stream incision, and as narrow as 2 feet where the channel is incised.

On August 14, 2009, a survey was conducted of Dick Creek from where it enters the burned area at Forest Road 2730, past where it leaves the burn at the 300 road, to where it crosses the 2725 road just above its junction with Trout Creek; the last quarter mile is below the burned area and will be considered a control reach. Logs that meet the INFISH criteria for Large Woody Debris (LWD = 12" x 35') were tallied and assigned them to one of four categories based on their interaction with fire.

Root wads and logs in smaller size classes that are considered Large Organic Debris by the American Fisheries Society (American Fisheries Society, 1985) were also tallied. INFISH does not specify a range of stream discharges for which its LWD criteria are designed, but given an estimated bank-full flow of 10 cfs for this stream (Gordon, McMahon, & Finlayson, 1992), Large Organic Debris would function the same as LWD for purposes of channel stabilization and shading. In mid-August, in stream segments where there was flowing water, the discharge was at most 0.1 cfs; much of the streambed was dry. Riparian vegetation consisted of sedges lining the channel for most of its length and scattered alders along the control reach. Conifers and junipers grow in and adjacent to the channel.

Table 62. Tally of LWD and LOD along Dick Creek within the Burned Units.

Log Size	Unburned	Burned	Burned, now too small	Fallen due to fire
≥ 12" x ≥ 35'	26	6	3	5
6-12" x ≥ 35'	17	5	1	9
≥ 12" x ≥ 25'	9	6		
6-12" x ≥ 25'	8	3		1
≥ 12" x ≥ 15'	11	4		
6-12" x ≥ 15'	16	4	1	3
≥ 18" x 5-15' (rootwads)	10	5		
4-6" x ≥ 35'	13	3		4

Table 63 compares the LWD count for the stream segment within the burned area to the control reach, and standardizes both counts to pieces of LWD per mile.

Table 63. Tally of LWD in Burned (B) and Unburned Control (C) Reaches of Dick Creek.

Log Size	Unburned (per mile)		Burned (per mile)		Burned, now too small (per mile) B/C		Fallen due to fire (per mile) B/C	
	B	C	B	C	B	C	B	C
≥ 12” x ≥ 35’	13	8	6		1.5		2.5	
6-12” x ≥ 35’	8.5		2.5		0.5		4.5	
≥ 12” x ≥ 25’	4.5	4	3					
6-12” x ≥ 25’	4	4	1.5				0.5	
≥ 12” x ≥ 15’	5.5		2					
6-12” x ≥ 15’	8	8	2	8	0.5		1.5	
≥ 18” x 5-15’ (rootwads)	5	4	2.5					
4-6” x ≥ 35’	6.5	8	1.5				2	

The presence of burned wood in the control reach indicates an earlier natural or prescribed fire in the sub-watershed just north of the reach. Similarly, some of the burned pieces within the Bull units had been burned in a prior event, not during the 2008 burn.

The majority of LWD that was in the channel before the burn has decayed to the point of losing structural soundness, meaning turbulent flood flows could break it apart. Also, most of these deteriorated pieces have sawed ends, indicating they originated in a logging operation, not with natural tree mortality. While three large logs (≥ 12” x ≥ 35’) were consumed in the prescribed burn, five new logs were added to Dick Creek, suggesting that maintenance burns are a mechanism for restoring LWD.

High severity fires in RHCAs where fire has been excluded have occurred on the Ochoco, including in the East Fork of Mill Creek in the Mill Creek Wilderness in 2000. This can detrimentally affect fish habitat: “Some vulnerable fish populations are restricted to small, isolated segments of streams. If a wildfire and subsequent erosion damages their remaining habitat, some of these populations may have nowhere to go and will not be able to recover. This problem is compounded by fuel buildup in forests formerly in understory or mixed fire regimes. If these forests burn in severe wildfires, damage to stream habitat is likely (Agee, 1998).” (Arno & Allison-Bunnell, 2002) High severity fires followed by heavy runoff flows can harm streams and their aquatic food chains. (Minshall & Brock, 1991)

High severity fires can also detrimentally affect other species in RHCAs: “Broadleaved species (in RHCAs) provide critical nesting habitat for many songbirds. (Wheeler, Redman, & Tewksbury, 1997) However, with continuing protection from lightning fires and restrictions on prescribed burning, many riparian forests are now dominated by conifer thickets.” (Arno & Allison-Bunnell, 2002)

Figure 13. High Severity Fire in RHCA.

Photo: water03.jpg Description: Hash Rock Fire, Ochoco National Forest.
East Fork Mill Creek Watershed
Headwater 1st order class 4 drainage feeding into East Fork Mill Creek.
High intensity burn.

Date: 09/2000

Figures 14 and 15 are of a Class 3 stream inside the perimeter of the Hash Rock Fire in the Mill Creek Wilderness (August 2000). During this mostly high severity fire, a mixed severity fire front backed down through the RCHA, causing effects similar to that of a prescribed fire; small diameter conifers were removed, surface fuels reduced, and most large downed logs retained. The duff collar surrounding the old growth pine was reduced, increasing its chance of survival during the next fire event.

Figure 14. Mixed Severity Fire in RHCA.

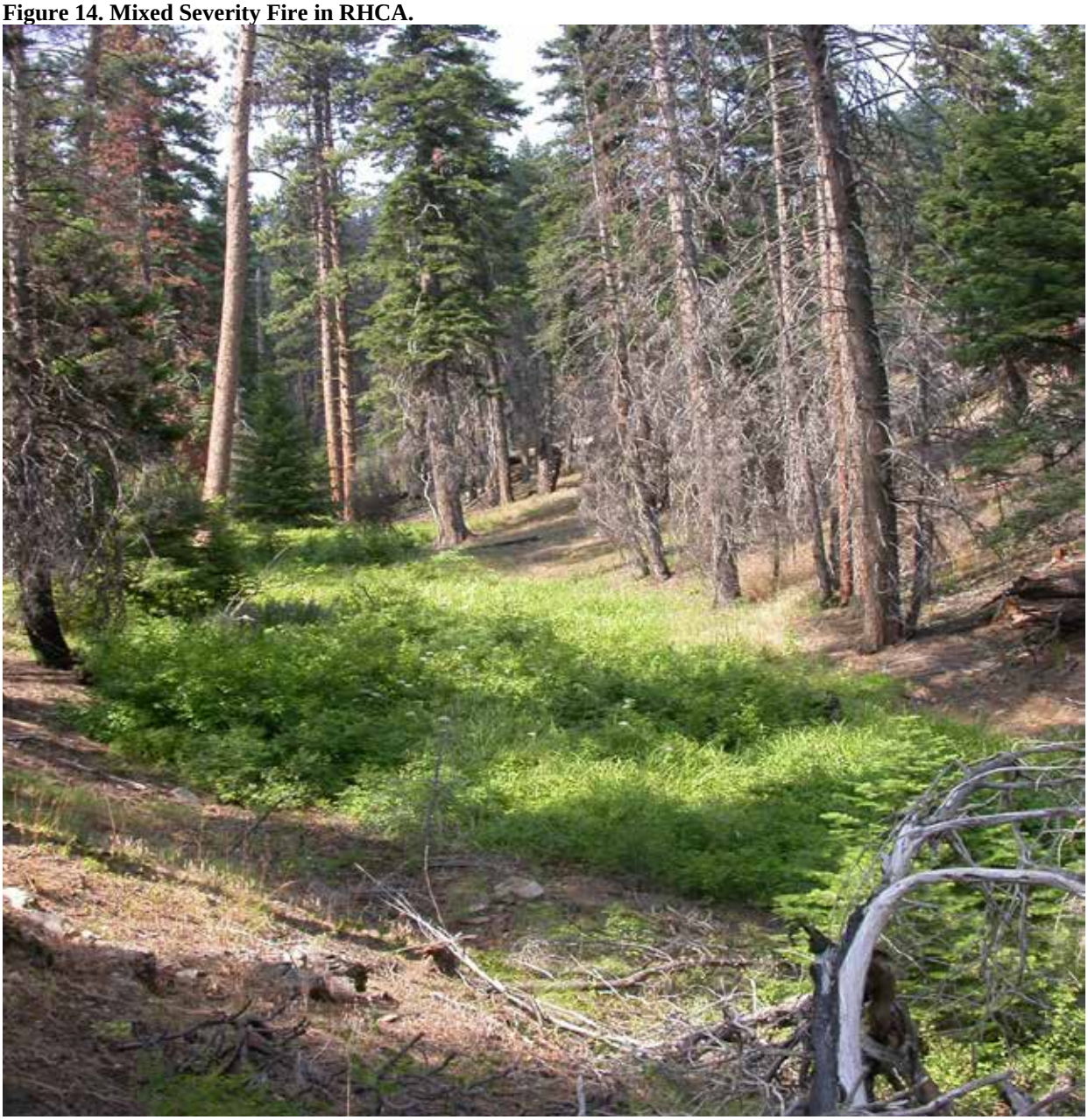


Figure 15. Mixed Severity Fire in RHCA.

The vegetation and fuels treatments proposed in the action alternatives reduce both the potential intensity and severity of a wildfire. Other indicators of effects of wildfire on riparian and water related factors include change in crown cover (shade), change in fuel loading, and other vegetation changes.

Effects of Stream Restoration on Fuel Loading in RHCAs

Each action alternative proposes 13.1 miles of stream restoration. Actions associated with this include removing trees from the areas surrounding the stream (1,345 acres identified) and placing them in the channel to increase amounts of LWD.

In the short term this would potentially increase fire hazard to RHCAs as fuels would be concentrated and wildfire effects would likely be more severe around hardwoods and other riparian vegetation on the banks of the stream were it to burn in the driest parts of the year.

Based on the timing of activities there could also be potential conflict with prescribed fire objectives in or adjacent to RHCAs due to dramatically increased fuel loading.

In the long term, the potential effects of stream restoration would be increased retention of stream sediment filling in the channel and rising water tables lending more moisture to riparian vegetation. Much of the LWD would become buried in sedimentation, and more available moisture would keep grasses and forbs greener later in to the summer leading to lower fire severity in RHCAs.

Cumulative Effects

The cumulative effects boundary includes Forest Service lands within the Gap project area, private lands located within and bordering the project area, and adjacent BLM lands. Past harvest, thinning, and prescribed fire treatments within the boundary of the Gap project area have been considered in the development of the existing condition and are not analyzed as cumulative effects to restoration activities proposed in this document. Additional prescribed fire treatments planned in the Gray Prairie Fuels Project CE (2010) have been incorporated in the proposed treatments of all action alternatives and the effects are not analyzed as cumulative.

Present and reasonably foreseeable future actions related to fire and fuels in the Gap project area include livestock grazing planned in both the Fox Canyon AMP EIS (2013) and Big Summit Cluster AMP EIS (2009), prescribed fire planned in Fox Canyon AMP, and prescribed fire proposed in the Juniper Hills Preserve, Nature Conservancy.

Livestock grazing in the project area could reduce fire spread in open stands with light fuels by reducing grass, which helps carry fire through a stand. The amount of reduction would depend on how intensely an area is grazed, how productive the grass is in any given year, and how extreme fire conditions are on any given day. Livestock grazing does not have a measurable effect on fire behavior in closed canopy, multi-storied stands with heavy surface fuel loading.

Fox Canyon AMP proposed 525 acres of prescribed fire in Williams Prairie and 226 acres of prescribed fire in Gray Prairie. The majority of this acreage is non-forested, and therefore was not included in the analysis of condition class or fire effects for this project. In addition, fuels reduction associated with burning these prairies is short lived as the grass would be expected to recover quickly in the next 1-2 growing seasons.

Prescribed fire and fuels treatment in the Juniper Hills preserve would be cumulatively beneficial to the treatment proposed in the Gap project.

Cost Analysis

Reducing the fuel load in a stand changes the fuel model in that stand, so the cost effectiveness of fuels reduction can be measured by the difference in suppression costs before and after the activity.

The following costs are for a 10-100 acre fire, which has the highest suppression cost per acre.[2]

- H = suppression cost-per-acre for NFDRS fuel model H (short needle conifers, closed canopy, Condition Class 3)
- C = suppression cost-per-acre for NFDRS fuel model C, **the desired condition**, open pine w/ grass, Condition Class 1)

Table 64. Suppression Costs per Acre by Fuel Model.

NFDRS Fuel Model	Fire Behavior Fuel Model	2007 Suppression Cost-per-acre
C – Open Pine	9	$3906
H – Short Needle, normal dead	8	$6086

[2] Fire suppression costs from the National Fire Management Analysis System (NFMAS), Bell 2001, NFDRS see Deeming et al 1978

The cost-per-acre of noncommercial thinning and underburning is $250. Should a fire occur on a treated acre: the potential suppression cost **savings per acre** that is gained from thinning and burning to change from fuel model H / Condition Class 3 to a fuel model C / Condition Class 1 = (6086 - 3906) – 250 = **$1930**

Transportation

This section summarizes the draft Transportation report; the entire report can be found in the Gap project file on the Paulina Ranger District, Prineville, Oregon.

Road Management Objectives

The existing management objectives for roads within the analysis area generally call for roads to be managed for administrative and land management purposes, with varying degrees of consideration given to public access. The majority of the road system is managed primarily for administrative access and is only secondarily managed to facilitate public usage, although many routes see a great deal of public usage during hunting season. Beyond that, arterial and collector routes (the two and four digit roads) are generally managed to allow for a mix of commercial and public traffic.

The seven-digit roads in the transportation system are generally managed, when open, to be primarily used by high clearance vehicles. While passenger car operation is possible on some of these routes, no special consideration or effort is devoted to allowing their use. During periods of log haul, these seven-digit roads are intended to be single-user facilities, given that their narrow travel ways and lack of frequent, inevasible turnouts preclude opportunities to safely provide for mixed commercial/public traffic.

Desired Transportation System Conditions (Management Direction)

The desired condition is to provide a road system that is safe, affordable, has minimal ecological impacts, and meets immediate and projected long-term public and resource management needs. The current direction for management of the road system is found in the Ochoco National Forest Land and Resource Management Plan (LRMP). According to the LRMP, the goal of the Forest's transportation system is "to plan, design, operate, and maintain a safe and economical transportation system providing efficient access for the movement of people and materials involved in the use and protection of National Forest Lands." (LRMP)

Existing Condition

Location and Distribution

Within the Gap project area there are approximately 192 miles of roads, virtually all of which are under Forest Service jurisdiction. The existing road system is relatively evenly distributed throughout the project area.

The majority of roads within the project area are located on moderate terrain, with ground slopes rarely exceeding 30%. Scattered roads can be found in midslope positions on slopes at or beyond 30% and a few isolated segments, such as a short segment of Road 4235, reside on slopes up to or exceeding 50%.

Age and Development History of the Transportation System

The majority of roads within the project area have been in existence for better than 40 years, with some additions having been constructed in the recent past. While a few of the primary roads within and adjacent to the project area have existed as travel routes to and through the forest since early in the 20th Century, most of the secondary and tertiary road system has been constructed to provide access for vegetative management purposes.

Road Use Patterns

The roads within the project area generally have a pattern of use common to low-standard roads in the Ochoco National Forest. The use is moderate in the spring after snow melt with various recreational users and wood cutters clearing trees that felled on roads over winter. With the exception of roads that access areas of recreational interest - where off-highway vehicle (OHV) use can be extensive – or of the arterial Road 42 and historic through-routes such as Roads 4215, 4225, and 4235 - most roads see low to moderate public use and administrative traffic through the course of the spring and increasing recreational traffic through the summer. Peak use occurs in the late summer and fall with the commencement of deer and elk hunting seasons. Timber sale activity can contribute substantially to daily traffic values, but the pattern of such activity is usually isolated to one particular area at any given time.

Grazing allotments are located within the project area that also create a small usage component provided by permittee vehicles and isolated short term higher usage during spring and fall for movement of livestock on and off of the forest.

The anticipated future use patterns would most likely reflect current trends, with the majority of summer usage being comprised of recreational traffic with occasional isolated increases resulting from timber sale and grazing allotment activity, followed by large increases in late summer/fall traffic due to hunting activity.

Primary Destinations of Road System Users

The majority of the roads within the project area do not serve any particular destinations. Rather, they provide access to areas of interest for various users. For land managers, these roads serve as access to areas where vegetative management activities are ongoing or planned. For hunters, they provide access to popular hunting areas.

Existing Maintenance Levels and Road Surface Types

Maintenance Levels define the degree of maintenance required for a specific road and the level of service which that road provides, consistent with road management objectives and maintenance criteria (FSH 7709.59, Transportation System Maintenance Handbook). The five maintenance levels are defined as:

Maintenance Level 1: Assigned to intermittent service roads during the time they are closed to vehicular traffic. The closure period must exceed 1 year. Basic custodial maintenance is performed to keep damage to adjacent resource to an acceptable level and to perpetuate the road to facilitate future management activities. Emphasis is normally given to maintaining drainage facilities and runoff patterns. Planned road deterioration may occur at this level. Appropriate traffic management strategies are "prohibit" and "eliminate". Roads receiving level 1 maintenance may be of any type, class or construction standard, and may be managed at any other maintenance level during the time they are open for traffic. However, while being maintained at level 1, they are closed to vehicular traffic, but may be available and suitable for nonmotorized uses.

Maintenance Level 2: Assigned to 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. Log haul may occur at this level. Appropriate traffic management strategies are either (1) discourage or prohibit passenger cars or (2) accept or discourage high clearance vehicles.

Maintenance Level 3: Assigned to roads open and maintained for travel by a prudent driver in a standard passenger car. User comfort and convenience are not considered priorities. Roads in this maintenance level are typically low speed, single lane with turnouts and spot surfacing. Some roads may be fully surfaced with either native or processed material. Appropriate traffic management strategies are either "encourage" or "accept" passenger cars. "Discourage" or "prohibit" strategies may be employed for certain classes of vehicles or users; unless otherwise specifically authorized, non-street-legal OHV use is prohibited.

Maintenance Level 4: Assigned to 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 roads may be single lane. Some roads may be paved and/or dust abated. The most appropriate traffic management strategy is "encourage" passenger cars. However, the "prohibit" strategy may apply to specific classes of vehicles or users at certain times; unless otherwise specifically authorized, non-street-legal OHV use is prohibited.

Maintenance Level 5: Assigned to roads that provide a high degree of user comfort and convenience. Normally, roads are double-lane, paved facilities. Some may be aggregate surfaced and dust abated. The appropriate traffic management strategy is "encourage", except that, unless otherwise specifically authorized, non-street-legal OHV use is prohibited.

The distribution of roads by Maintenance Level within the project area is displayed in table 65.

The majority of roads within the project area, approximately 52%, are native surface roads. Those roads, which are almost exclusively under Forest Service jurisdiction, are variously managed as either being open for high clearance vehicle traffic (Maintenance Level 2) or as being physically closed or designated as closed so that traffic is eliminated or prohibited and the roads are in a basic custodial status (Maintenance Level 1). The native surface roads in Maintenance Level 2 status are not maintained on a recurring basis but are instead periodically reviewed to determine whether maintenance needs to protect adjacent resource values are present. A very small number of the native surface roads in the project area are on private land and generally closed to public access.

An additional 47% of the roads are categorized as being surfaced with either crushed aggregate or improved native material such as grid-rolled aggregate or cinders. These roads aren’t specifically maintained for passenger car use but are generally capable of being traversed by such vehicles under most circumstances.

The remaining 1% of road mileage, consisting of Roads 42 along the north boundary of the project area, is an asphalt-paved facility.

Table 65. Miles of road by maintenance level

Operational Maintenance Level	Miles
M/L 1 Closed Physically or by Prohibition	78.07
M/L 2 (High Clearance Vehicles Allowed)	113.74
M/L 5 (Passenger Car Encouraged; High Speed)	0.70

Table 66. Miles of Road by Surface Type

Surface Type	Miles
Asphalt	0.70
Crushed Aggregate	30.55
Improved Native Material	60.04
Native Material	101.21

Road Densities

Open road densities within the project area can be expressed as either objective or operational owing to the difference between previously made access management decisions and the degree to which those decisions have been implemented. In essence, the objective open road density is the desired density that would be achieved if all roads were in their desired opened or closed status; the operational road density is a reflection of the current opened or closed status of roads within a given sixth field subwatershed. The project area covers portions of five separate subwatersheds. The following table displays the overall operational road densities within those subwatersheds and includes roads under all ownership.

Table 67. Road Density - Subwatershed Basis (Mile/Square Mile)

Subwatershed	Area Sq. Mi.	Total Road Density	Total Open Road Density	FS Road Density	FS Open Road Density
Gray Creek	15.64	3.18	2.72	3.18	2.72
Headwaters North Fork Summit River	21.40	2.98	2.10	2.98	2.10
Lost Creek	9.50	3.83	0.99	3.83	0.99
Lower Horse Heaven Creek	1.24	3.84	2.32	3.84	2.32
Upper Horse Heaven Creek	11.82	3.20	1.24	3.20	1.24

Environmental Effects

Alternative 1

Under Alternative 1 the existing road system would experience no changes to its current status and condition. Roads that are currently in custodial status (Maintenance Level 1) would remain closed and open roads would continue to provide access for recreational, commercial, and administrative functions in the same manner that they currently do. Open roads would receive no maintenance beyond that which is normally scheduled, which is generally devoted to the higher standard roads within the project area.

Effects Common to Action Alternatives

As a function of use during harvest activities, road maintenance activities would be conducted on roads designated for use. As a direct effect, some roads that do not receive recurring maintenance, primarily low standard roads in the Maintenance Level (M/L) 2 category, would see some improvements in both safe drivability and in their ability to handle surface runoff and the resultant sediment. Native surface M/L 2 roads, as a result of use and infrequent blade maintenance, tend to develop shallow ruts in their wheel tracks, which can concentrate shallow flow and lead to increased sediment rates (Foltz, 1991). Post-haul maintenance that would occur on these roads would restore flat road surfaces (without ruts) that would be capable of producing less sediment than their rutted counterparts; post-haul waterbarring would also remove surface runoff from the erosive road surfaces.

The type of work that would be expected to be performed as maintenance in timber sale contracts includes:

6. Brushing for improved sight distances
7. Removal of hazard trees
8. Blading and shaping of traveled way
9. Restoring existing surface drainage features, such as drain dips or outlet ditches
10. Cleaning culverts and ditches
11. Installing water bars after periods of haul
12. Dust abatement, primarily using water as the dust palliative, would be performed as necessary to maintain safe driving conditions.

Maintenance Level 1 roads used for implementation activities would be hydrologically stabilized and physically closed to eliminate vehicular traffic upon the completion of project activities for which these roads would be needed.

Reconstruction

In the contractual setting, commercial haulers of forest products are required to perform or pay for the performance of their commensurate share of road maintenance resulting from the individual operator's use. These routine maintenance items can include road blading and dust abatement, minor roadside brushing, and maintenance of drainage structures. This work is governed by road maintenance specifications and work exceeding the requirements or intent of those specifications can be included in contracts as reconstruction items, even though such work does not improve a given road beyond its intended level of service and is still considered by definition to be maintenance. The preliminary recommendations displayed in table 68 represent work that would be considered to be beyond the definition of maintenance that would be performed on roads within the Gap project area intended to be used as haul routes. This work would provide for protection of road travel surfaces, provide for sediment mitigation to protect adjacent resource, and provide travel way surfaces that can be maintained. The action alternatives would implement reconstruction activity of varying intensity on approximately 31 miles of roads.

The majority of this work is considered moderate level road reconstruction, including such items as placing additional crushed aggregate on major haul roads that have exposed soft soils, installation of surface and in-road drainage features in areas that show erosional problems or have stream crossings, roadside brushing beyond that intended to be performed with maintenance specifications, and placing spot rock in heavily rutted sections or soft spots in local roads to provide for roadbed stabilization. Costs displayed in table 68 are for evaluation purposes and are not intended to represent the estimated costs of a completed design for the proposed activities.

Table 68. Road reconstruction recommendations.

ID	Estimated Distance (Miles)	Description	Cost Estimate
2300055	0.20	Place material to fill road bed ruts	$2,000
4200300	0.20	Repair culvert M.P. 2.4 and road surface rutting M.P. 4.5	$3,500
4200324	0.50	Place material to fill road bed ruts	$2,500
4200330	1.25	Reconstruct Drain Dips	$1,500
4215021	0.10	Reconstruct Road Embankment	$15,000
4215053	0.51	Spot Rock Road Surface	$5,000
4215180	0.10	Subgrade Treatment for wet segment	$5,000
4215230	0.10	Construct ditch/drainage structure	$1,000
4215253	0.86	Prehaul clearing	$1,000
4215261	0.10	Construct drainage structure	$2,500
4215300	0.10	Subgrade Treatment and ditch for wet segment	$3,000
4215400	0.10	Drainage Repair	
4215405	0.30	Prehaul clearing and blading	$4,000
4215422	0.37	Prehaul clearing and blading	$3,000
4220000	0.20	Repair embankment at culvert M.P. 0.6 and roadside spring M.P. 1.4	$7,500
4220050	0.10	Subgrade treatment	$5,000
4220150	0.10	Subgrade treatment	$2,500
4220151	0.10	Subgrade treatment	$2,500
4220152	0.10	Construct drain dip	$3,000
4220259	0.12	Prehaul clearing and blading	$1,500
4220300	0.10	Repair roadside spring M.P. 0.5	$7,500
4225050	0.10	Repair Cattleguard approaches.	$2,500
4225060	0.48	Reconstruct Drain Dip and repair road surface	$6,000
4225070	0.08	Reconstruct drain dip, repair cattleguard approaches, place material to fill ruts	$6,000
4225072	0.10	Reconstruct drain dip and repair road surface ruts	$4,000
4225100	0.30	Reconstruct drainage structures and repair road surface ruts	$10,000

ID	Estimated Distance (Miles)	Description	Cost Estimate
4225110	0.25	Road and drainage structure reconstruction	$15,000
4225111	0.91	Drain dip reconstruction and prehaul clearing	$3,500
4225141	0.72	Reconstruct drain dips and repair culvert crossing	$7,500
4225141	0.39	Construct drivable ford	$5,000
4230000	0.10	Replace cattleguard base	$7,500
4230050	0.10	Construct ditch/drainage structure and prehaul clearing	$5,000
4230100	2.05	Surface aggregate placement	$75,000
4230110	1.94	Replace cattleguard base	$7,500
4230118	0.10	Reconstruct Road (spring/saturated roadbed)	$6,000
4230123	1.07	Spot rock road surface wet areas	$8,000
4230150	0.20	Construct ford	$5,000
4230200	0.48	Surface aggregate placement	$45,000
4230500	0.10	Construct drain dip	$2,500
4235000	2.75	Replace cattleguard base	$7,500
4235012	0.10	Install culvert	$5,000
4235015	0.10	Prehaul clearing	$1,500
4235050	0.10	Prehaul clearing and construct drain dip	$4,500
4235100	0.52	Construct drain dip and prehaul clearing	$4,000
4235101	0.34	Construct 2 drainage structures and repair road shoulder. Repair cattleguard approaches	$8,000
4235104	0.39	Prehaul clearing; install culvert	$5,000
4235106	2.00	Prehaul clearing	$3,000
4235109	0.30	Prehaul clearing	$2,000
4235110	1.85	Blade/shape road surface	$1,000
4235152	0.96	Reconstruct road	$15,000
4235153	0.18	Reconstruct spring crossing	$7,500
4235157	0.50	Reconstruct and place spot rock	$15,000
4235159	0.24	Reconstruct road	$25,000
4235160	0.23	Reconstruct road	$25,000
4235178	0.49	Reconstruct road	$25,000
4235179	0.73	Reconstruct road	$25,000
4235200	0.23	Subgrade treatment M.P. 0.5 - 0.73	$15,000
4235218	0.10	Replace log culvert	$7,500
4235222	0.20	Replace two log culverts	$11,000

ID	Estimated Distance (Miles)	Description	Cost Estimate
4235224	0.99	Prehaul clearing	$4,000
4235252	0.20	Realign roadbed	$15,000
4235258	0.10	Construct ford	$2,500

Temporary roads

Temporary road construction is sometimes required to facilitate the economical harvest of trees from a particular harvest unit. Within the Gap project area, implementation of one of the three action alternatives would result in the construction of temporary roads to aid in completing Silviculture treatments, and would result in the temporary commitment of acreage to use as road beds. Mileage and acres per Alternative are shown in table 69 below.

Table 69. Temporary Road Estimate, By Alternative

Alternative	Estimated Mileage On Previously Disturbed Ground	Estimated Mileage On Undisturbed Ground	Estimated Acres
Alternative 2	38.87	1.02	56.7
Alternative 3	33.12	0.88	49.5
Alternative 4	38.87	1.02	56.7

Temporary roads would be constructed primarily on flat ground (slopes less than 10%) and excavation and construction of embankments would be negligible; in all possible situations, existing areas of past ground disturbance such as old temporary or other roadbeds and skid trails would be used to minimize the additive effect of additional new disturbance. These temporary roads would be built to low construction standards, with constraints of grade, curve radius, compaction, surfacing, and width being tailored to the minimum capabilities of the intended user vehicles. By doing so, they would be constructed in a manner that would minimize disturbance and impacts to adjacent resources.

Temporary roads, by their nature, are not intended for mixed vehicle use, nor are they intended to remain as identifiable facilities after the administrative need for their use has ended. At the completion of harvest activities all temporary roads would be barricaded to eliminate motor vehicle access, would have their surfaces decompacted by various means depending on soil type, and would be treated with erosion control measures such as waterbarring and/or slash placement as part of post-harvest soil remediation activities to facilitate their return to vegetative productivity and minimize sediment production from surface runoff.

Effects of temporary roads stem directly from compaction and include loss of infiltrative capacity, increased erosion potential, and dramatically reduced vegetative productivity. Compaction results in increased bulk density and reduced porosity, primarily through the loss of macropores, leading to reduced aeration and drainage, as well as disruption to microbial populations that causes reduced productivity and increased erosion potential (Elliot et al., 1999).

Bulk density has been show in several studies to reduce tree growth not only within the compacted area itself, but also for trees adjacent to the compacted area because of root zone compaction (Froehlich, 1979; Heilman, 1981; Helms and Hipkin, 1986; Conlin and van den Driessche, 1996) as a result of increased root impedance and disrupted microbial processes. Natural recovery from compaction can be variable, with the more dramatic reduction in bulk density coming near the surface of the soil profile, but in general the rate of natural, unassisted recovery is slow (Froehlich et al., 1985). These effects would be reduced by decompaction methods such as subsoiling so that they generally apply only over the short term – five years or less.

Because of the moderate ground slopes and moderate to high infiltration rates of the soils adjacent to these temporary road beds, sedimentation effects would be localized to upland areas immediately adjacent to the roads.

Table 70. Post-Implementation Road Density - Subwatershed Basis (Mile/Square Mile)

Subwatershed	Area Sq. Mi.	Total Road Density	Total Open Road Density	FS Road Density	FS Open Road Density
Gray Creek	15.64	3.05	3.05	3.05	2.12
Headwaters North Fork Summit River	21.40	2.91	1.51	2.91	1.51
Lost Creek	9.50	3.79	1.01	3.79	1.01
Lower Horse Heaven Creek	1.24	3.84	2.41	3.84	2.41
Upper Horse Heaven Creek	11.82	3.15	1.19	3.15	1.19

Alternatives 2

Commercial haul activities and other vegetative treatments proposed in this Alternative would result in the use within the project area of approximately 175 miles of system roads under U.S.D.A.-Forest Service jurisdiction. This Alternative proposes to use approximately 40 miles of temporary roads, with 39 miles of that amount being temporary roads on existing disturbed ground. During the course of treatment activities, 67 miles of roads currently in custodial status as M/L 1 roads would be used for hauling activity. While this would result in some short-term increase in open-road densities, the exact magnitude of the increase would be impossible to predict because not all roads would be open at any given time. All Maintenance Level 1 roads used would be closed when such use was completed. The majority of maintenance work would be performed on the 174 miles of M/L 1 and 2 roads used for commercial activities, in particular blading and brushing, along with erosion control work.

Table 71. Haul Road Miles (Forest Service Jurisdiction) by Maintenance Level – Alternative 2

Operational Maintenance Level	Length
1 – Basic Custodial Care (Closed)	66.65
2 – High Clearance Vehicles	107.41
4 – Moderate Degree of User Comfort	0.70

Table 72. Haul Road Miles (Forest Service Jurisdiction) by Surface Type – Alternative 2

Surface Type	Length
Asphalt/Bituminous Surface Treatments	0.70
Crushed Aggregate	30.52
Improved Native Material (Cinders)	58.27
Native Material	85.27

Alternative 3

Since Alternative 3 proposes to treat a lesser number of areas than does Alternatives 2 and 4, vegetative management activities and commercial haul proposed in this Alternative would result in the use of a lesser number of miles of system roads and temporary roads than would be used in implementation of the other action alternatives. Under this alternative, approximately 163 miles of system roads would be used for hauling within the project area. Approximately 34 miles of temporary roads would be employed for harvest activities, with roughly 33 miles of that total being located on previously disturbed ground. During the course of treatment activities, 63 miles of roads currently in custodial status as M/L 1 roads would be used for hauling activity and would result in some short-term increase in open-road densities. Because not all roads would be open at any one time during implementation, the exact magnitude of the increase would be impossible to. All Maintenance Level 1 roads used would be closed when implementation activities were completed. The majority of maintenance work would be performed on the 162 miles of M/L 1 and 2 roads used for commercial activities, in particular blading, brushing, and post-haul erosion control work.

Table 73. Haul road miles (Forest Service jurisdiction) by maintenance level – Alternative 3.

Operational Maintenance Level	Length
1 – Basic Custodial Care (Closed)	62.88
2 – High Clearance Vehicles	99.46
5 – High Degree of User Comfort	7.27

Table 74. Haul road miles (Forest Service Jurisdiction) by surface type – Alternative 3.

Surface Type	Length
Asphalt/Bituminous Surface Treatments	0.70
Crushed Aggregate	27.73
Improved Native Material (Cinders)	55.17
Native Material	79.45

Alternative 4

Under this alternative, which would use the same set of roads within the project area as would Alternative 2, 175 miles of system roads would be used for commercial haul activities and other vegetative treatment proposals. The amount of temporary road used in Alternative 4 would be approximately 40 miles, with nearly 39 miles of that amount being temporary roads on existing disturbed ground. Treatment activities would result in the use of 67 miles of M/L 1 roads, resulting in a short-term increase in open road density, but – as with Alternative 2 – not all of those roads would be opened at the same time and all would be closed at the end of treatment activities. Under this Alternative, approximately 174 miles of M/L 1 and M/L 2 roads would receive the majority of maintenance effort, in particular the native surface roads.

Table 75. Haul Road Miles (Forest Service Jurisdiction) by Maintenance Level – Alternative 4

Operational Maintenance Level	Length
1 – Basic Custodial Care (Closed)	66.65
2 – High Clearance Vehicles	107.41
5 – High Degree of User Comfort	0.70

Table 76. Haul Road Miles (Forest Service Jurisdiction) by Surface Type – Alternative 4

Surface Type	Length
Asphalt/Bituminous Surface Treatments	0.70
Crushed Aggregate	30.52
Improved Native Material (Cinders)	58.27
Native Material	85.27

Table 77. Comparison of Route Mileage for Existing Condition and Alternatives

Route Status	Existing Condition Miles	Post Implementation (Miles)
Gray Creek Subwatershed		
Total Miles of Road	**50**	**48**
a) Miles designated as open	43	33
b) Miles designated as closed	7	14
Total Miles of Roads in RHCAs	**11**	**11**
a) Miles designated as open	10	9
b) Miles designated as closed	1	2
Headwaters North Fk. Summit River		
Total Miles of Road	**64**	**62**
c) Miles designated as open	45	32
d) Miles designated as closed	19	29
Total Miles of Roads in RHCAs	**11**	**11**
c) Miles designated as open	8	6
d) Miles designated as closed	3	5
Lost Creek		
Total Miles of Road	**36**	**36**
e) Miles designated as open	9	10
f) Miles designated as closed	27	26
Total Miles of Roads in RHCAs	**5**	**5**
e) Miles designated as open	2	2
f) Miles designated as closed	3	3
Lower Horse Heaven Creek		
Total Miles of Road	**5**	**5**
g) Miles designated as open	3	3
h) Miles designated as closed	2	2
Total Miles of Roads in RHCAs	**0.4**	**0.4**
g) Miles designated as open	.01	0.1
h) Miles designated as closed	0.3	0.3
Upper Horse Heaven Creek		
Total Miles of Road	**38**	**37**
a) Miles designated as open	15	14
b) Miles designated as closed	23	23
Total Miles of Roads in RHCAs	**10**	**10**
i) Miles designated as open	4	4
j) Miles designated as closed	6	6

Cumulative Effects (see table 167)

Transportation System/Travel Management

The geographic boundary for consideration of cumulative effects on the transportation system can be considered to be larger than the defined boundary of the Gap project area. The defined boundary for cumulative effects analysis of the Transportation System can be roughly described as being bounded by the southern and western Forest Boundary, along with Forest Service Roads 30 and 42 to the north and roads 4200400, 4260, and 4260350 to the east.

The combination of route designations through implementation of the Deschutes and Ochoco Travel Management Plan (2011), the year-long Green Dot road system for the South Boundary Cooperative Travel Management Area in the southwest portion of the Gap project area, and proposed road closure and decommissioning activities in the action alternatives would result in a reduction in road miles open to motorized vehicles. During certain time periods, in particular various hunting seasons, this would result in an increase in traffic by both highway-legal vehicles and off-highway vehicles (OHV's) on the remaining tertiary portions of the road system that would remain designated open and available for use. This would result in a potential need for increased maintenance on those roads. With implementation of the Travel Management Plan and any particular action alternative, those remaining open roads would be the sole means of vehicular access to the further reaches of the National Forest Land within and adjacent to the project area.

Temporary Roads

Some of the primary effects of note accruing from the construction, use, and remediation/decommissioning of temporary roads are related to surface and groundwater hydrology and sediment production; because of this, the effects boundaries for analysis of the cumulative effects of temporary roads are the subwatershed boundaries that define the hydrologic system and the project area. The relatively moderate topography within the two subwatersheds that make up the project area has led to a tradition of employing ground-based yarding systems to remove logs to landings. Temporary roads have customarily been constructed to provide access to those landings that were within the interior of units or otherwise not immediately adjacent to existing portions of the transportation system. Older temporary roads that had not revegetated were added to the transportation system in the late 1970's in response to a directive that all existing wheel tracks be inventoried. With the advent of the requirement in 1976's National Forest Management Act that temporary roads be revegetated within 10 years, more attention has been paid to improving circumstances for revegetation on compacted temporary road surfaces, and within the last decade they have been aggressively treated by decompaction with tractor-mounted winged subsoiling tools.

Under Alternative 1, there would be no treatments within the project area and no temporary roads would be built. Previously constructed temporary roads that were not treated by subsoiling and have not naturally recovered would continue to provide some effect to vegetative productivity, surface/groundwater hydrology, and sediment production; although the moderate ground slopes and the nature of the surrounding soil types would localize these effects. Such effects would be slowly diminishing as these compacted roadbeds slowly de-compact.

Under Alternatives 2, 3, and 4 there would be, over time, a baseline of untreated temporary roads having been constructed within the project area as individual units were harvested by various timber sales with a certain degree of erosion potential and reduced vegetative productivity. As temporary roads receive post haul de-compaction treatments, erosion potential would decline. The productive capability would increase over time subsequent to de-compacting as subsidence returned the soil profile to a more natural ratio of macroporosity and microporosity.

Geology and Soils

This section summarizes the draft Geology and Soils specialists' reports; the entire reports are located in the Gap project file in Prineville, Oregon.

Introduction

The long-term sustainability of forest ecosystems depends on the productivity and hydrologic functioning of soils. Ground-disturbing management activities directly affect soil properties, which may adversely change the natural capability of soils and their potential responses to use and management. A detrimental soil condition often occurs where heavy equipment or logs displace surface organic layers or reduce soil porosity through compaction. Detrimental disturbances reduce the soils ability to supply nutrients, moisture, and air that support soil microorganisms and the growth of vegetation. The biological productivity of soils relates to the amount of surface organic matter and coarse woody debris retained or removed from affected sites.

Forest soils are considered to be a non-renewable resource, as measured by human life spans, and maintenance or enhancement of soil productivity is an integral part of National Forest management. Therefore, an evaluation of the potential effects on soil productivity is essential for integrated management of forest resources.

Target Landscape Condition

The primary goal for managing the soil resource is to maintain or enhance soil conditions at acceptable levels without impairment of the productivity of the land. The extent of detrimental soil disturbances is minimized through the application of project design criteria, management requirements and mitigation measures designed to minimize, avoid or eliminate potentially significant effects, or rectifying effects in site-specific areas by restoring the affected environment. The land effectively takes in and distributes water, and erosion rates are controlled to near-natural levels. The biological productivity of soils is ensured by management prescriptions that retain adequate supplies of surface organic matter and coarse woody debris without compromising fuel management objectives.

Management Direction

Ochoco Forest Plan

The Ochoco Land and Resource Management Plan (Ochoco LRMP) identifies the following applicable standards and guidelines for soil resource to be applied for all proposed activities occurring on the Ochoco National Forest (Ochoco LRMP p. 4-196, 197):

Soil Compaction and Displacement:

"*In order to maintain site productivity, all project activities will be planned to reduce soil compaction and displacement to the lowest reasonable level.*"

- *Strive to reduce compaction and displacement to get as close to 90 percent of the total activity area (including permanent, rocked, and non-surface roads) remaining in a non-compacted/non-displaced condition, as realistically possible, one year after any land management activity.*

- *The minimum will be 80 percent of the total activity area.*[3] *Existing areas exceeding these standards will be scheduled for rehabilitation as soon as possible.*
- *The threshold level of detrimental compaction is defined as any bulk density increase of 15% or more for residual soils and 20% or more for ash soils, or any macro pore space reduction of 40% or below 15%. These values are critical changes over the natural state in the top 12 inches.*

On August 24, 1998, the Regional Forester issued a Region 6 supplement to the 2520 Forest Service Manual (R-6 Supplement No. 2500.98.1). This supplement clarifies direction for planning and implementing activities in areas where soil standards are exceeded from prior activities:

2520.3 – Policy. Design and implement management practices which maintain or improve soil and water quality. Emphasize protection over restoration.

When initiating new activities:

1. *Design new activities that do not exceed detrimental soil conditions on more than 20 percent of an activity area. (This includes the permanent transportation system.)*
2. *In areas where less than 20 percent detrimental soil conditions exist from prior activities, the cumulative detrimental effect of the current activity following project implementation and restoration must not exceed 20 percent.*
3. *In areas where more than 20 percent detrimental soil conditions exist from prior activities, the cumulative detrimental effects from project implementation and restoration must at a minimum, not exceed the conditions prior to the planned activity and should move toward a net improvement in soil quality.*

2521.03.3 - Application of Soil Quality Standards.

a. *Planning. Use soil quality standards to guide the selection and design of management practices and prescriptions on a watershed scale. Evaluate existing soil conditions on all ownerships within the watershed and consider cumulative effects with the addition of proposed actions on ecosystem sustainability and hydrologic function. On a planned activity area, evaluate existing soil conditions and design activities to meet soil quality standards. Document adjustments to management practices, soil conservation practices or restoration techniques necessary to meet threshold values for the affected soil properties and watershed conditions.*

Surface Soil Erosion:

The Ochoco LRMP directs that land management activities will be planned to achieve effective ground cover[4] as defined by the following table (ONF-FEIS 4-196):

[3] An activity area is the total area for which a ground disturbing activity is planned, for example, a unit for a timber sale, slash disposal project, or grazing allotment. The area would also include transportation systems within and directly adjacent to the project.

[4] Effective ground cover is defined as the basal area of perennial vegetation, plus litter and coarse fragments (greater than 2mm sizes), including tree crowns and shrubs that are in direct contact with the ground. Exceptions may occur where specific projects meet erosion control objectives without meeting the ground cover objectives stated above.

Table 78. Soil Resource Inventory Erosion Hazard Class

Erosion Hazard Class	Minimum % effective ground cover , First Year	Minimum % effective ground cover, second year
Low	20-30	30-40
Moderate	30-40	40-50
Severe	50-60	60-75
Very Severe	60-75	75-90

The Soil Resource Inventory landtypes are classified by slope class, surface texture and rock content to generate a slope erosion hazard map for the Forest. Slope Erosion hazard classes were queried for the proposed treatment units and used to assess erosion risks. This guideline is met on the Forest by implementing best management practices (BMPs) such as scarification and seeding of skid trails and landings after treatment entry. Waterbarring and tilling compacted skid trails and replacing organics and soil moved into berms along them reduces erosion and provides soil conditions capable of supporting seeded and naturally regenerated herbaceous vegetation .

Soil Mass Wasting:

The Ochoco LRMP directs that alternative project proposals will be evaluated and documented through the environmental analysis when a project could result in an increased potential for mass wasting that could cause significant soil loss or sedimentation, hazards to property, loss of fish habitat, or damage to other resource values (ONF-FEIS 4-196).

Dormant landslide terrain has been identified across the Forest through aerial photo interpretation and field mapping during the compilation of the Soil Resource Inventory of the Ochoco National Forest and additional LiDAR and field interpretation by Carrie Gordon, ONF Geologist. Dormant landslide terrain susceptible to localized sloughing is present in the Gap project area. This guideline is met on the Forest by avoiding springs and seeps during road and skid trail construction and minimizing machine traffic and removal of trees on toe slopes or steeper sideslopes of landslide prone terrain.

Scablands:

The Ochoco LRMP directs that the analysis of proposed activities recognize the sensitivity and potential of certain areas and/or situations to be adversely affected by management activities and plan accordingly to minimize those effects. Fragile areas include scablands (shallow soil areas), elk wallows, and other isolated soil areas which exhibit sensitivities that require special care (ONF-FEIS 4-197, 198). Scablands are recognized as among the most fragile ecosystems on the Ochoco National Forest. Damage to the soil and vegetation as a result of management activities is nearly impossible to mitigate.

Other standards and guidelines for scablands are specific to certain types of activities, such as timber harvesting, livestock grazing, and road building, and are listed under those applicable sections.

ONF FEIS Timber 4-209:

- Scablands will not ordinarily be used for landings and skid trails. An exception to this would be in the case of skyline logging where a particular location would necessitate using a scab. Should this occur, the affected area will be erosion-proofed through use of rock or other appropriate methods.

ONF-FEIS-Transportation 4-227:

- Road construction on scablands will be limited to long-term collector, arterial and local roads. Temporary or short-term roads or trails will not be constructed across scablands unless there is no other feasible alternative. Should a specific activity necessitate the construction of temporary access, the area affected will be completely erosion proofed through us of crushed rock and other appropriate methods.

Affected Environment

Hydrologic Units

The Gap project area includes portions of the Horse Heaven (14,439 acres) and Upper North Fork Crooked River (23,706 acres) 10th field watersheds. Activities are proposed within the Upper Horse Heaven, Lost, Gray and Headwaters North Fork Crooked River 12th field subwatersheds. The landscape in these watersheds receives an average annual rainfall ranging from 18 to 30 inches per year and functions as a recharge collection area for regional and local aquifers. Perennial surface flows are supported in Horse Heaven, Lost and Gray Creeks, as well as the North Fork of the Crooked River.

Ecoregion Units

The project area is located in the southwestern portion of the Blue Mountains physiographic province and lies within the Blue Mountain Ecoregion 11. A landscape of high plateaus and deeply dissected ridges across the entire area has been created by forces associated with tectonics and the uplift of the Blue Mountain anticline. Large areas of hummocky terrain, seeps, ponds and springs within the Upper Horse Heaven and Lost Creek subwatersheds have been created by landslides associated with mass wasting.

Geologic Units

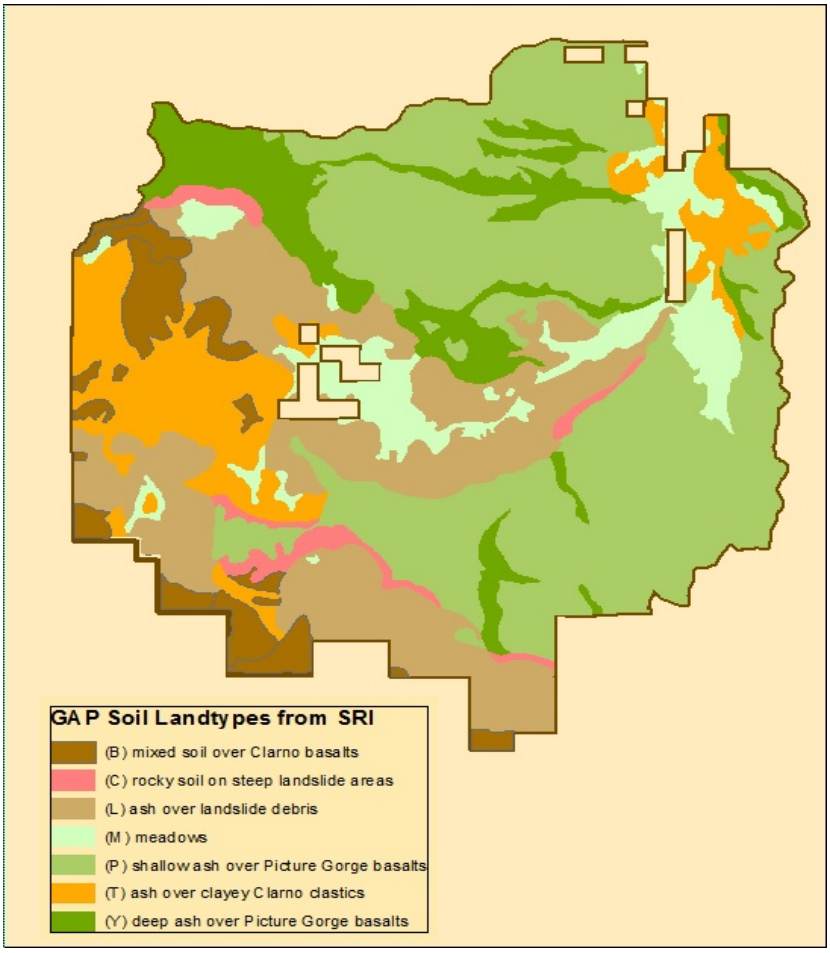
Underlying geology consists primarily of units associated with the John Day Formation (Tsfj - tuffaceous sediments) and the Picture Gorge Formation (Tcp - basalt flows). Areas of younger units consisting of Quaternary-aged alluvial fan glomerates (Qf) or land slide deposits (Qls) and a small exposure of the older Clarno Formation (Tca - clastics and andesitic flows) are also present. The Picture Gorge basalts are the most resistant to mechanical and chemical weathering, the John Day and Clarno Formations are considered intermediates and the Quaternary deposits are the least resistant to these processes. See the Geology report for more detailed discussion of these units.

Soil Units

Soils within the project area have formed from the parent material of the various geologic units and an ash cap deposited by past eruptions of Mount Mazama (7,600 years) and Newberry (1,300 years). These surface ash deposits have subsequently been re-worked by the forces of water and wind that have generally deposited deeper accumulations on northern and eastern aspects.

Landtype categories mapped by the Soil Resource Inventory (SRI) for the Ochoco National Forest describe ash cap soils associated with a variety of geologic parent materials. These include Clarno basalts weathered to montmorillonitic clays (B), steep sloped landslide areas (C), moderately sloped landslide debris areas (L), meadows (M), shallow profiles over Picture Gorge basalts (P), moderately deep profiles over Clarno pyroclastic sediments weathered to clays (T), and moderately deep to deep profiles over Picture Gorge basalts (Y).

Figure 16. Ochoco Soil Resource Inventory Landtype Categories in the Gap project area.



A number of soil landtypes are mapped within each of these categories that describe differences in the depth of surface ash present, the composition and depth of subsurface material, and the aspect, slope position and elevation on which these soils developed. In general, the landtypes within each of the categories can be separated into types with either an ash surface or a clay surface as the primary characteristic that affects the susceptibility and resiliency of the soil resource to detrimental disturbances from management activities. Variability across the landscape is also a function of the moisture regimes and vegetative communities that each landtype supports, both of which influence the amount of biomass and decomposition on site.

Ash surface soils: The original deposition of surface ash from Mt Mazama has been re-worked by water and wind to favor greater depths on the leeward and generally moister northern and eastern sides of topographic landforms. The productivity of these soils is directly related to the depth of the surface ash as a rooting and moisture holding medium. Soils comprised of surface ash greater than 7 inches in depth are the most susceptible to compaction and displacement from mechanical machine traffic associated with ground based logging systems. Soils with surface ash are also susceptible to erosion following disturbance from cattle hooves, especially along streams with ashy banks. SRI landtypes with deep ash soils include types B7, B8, C2, L2, L8, P2, P8 and Y2.

Clay surface soils: Shallower depths of surface ash are present on the windward and generally drier southern and western sides of topographic landforms. Soils in these areas are primarily comprised of the residuum weathered from their underlying parent materials and commonly have clay loam surface A horizons that grade to heavier clays. Surface cracks are common in these soils and many are classified as Vertic intergrades of Argixerolls or Haploxererts (USDA, NRCS, 2010, Keys to Soil Taxonomy).These soils are less susceptible to lasting detrimental compaction from ground based logging activities due to the shrink and swell nature of the smectitic clays in the profile. They are susceptible, however, to detrimental puddling (destruction of soil pedon structure) via logging activities and hoof action during wet conditions. These soils generate higher amounts of overland flows and associated sheet and rill erosion, especially on southern exposures, due to lower infiltration and permeability rates, and are susceptible to post holing, plugging and trail erosion. SRI landtypes with shallow ash caps and clay at or near the surface include B4, B5, C3, L3, L7, P3, P5, P54, T2, T2B, T3, T3B, T5, T7, T7M, TB8, Y1 and Y3.

Vegetation Communities

Forested vegetation supported by the soils in the project area include subalpine fir, moist grand fir, dry grand fir, Douglas fir, mesic pine, dry pine, juniper steppe and juniper woodland communities. Forest types generally correlate with the mapped soil landtypes and moisture gradients across the project area, both of which are directly influenced by topographic elevation and aspect. Moist grand fir plant associations are present on deeper ash soils over Picture Gorge basalts (SRI landtypes P2 and Y2) in the Lookout and Jungle Creek drainages. Dry grand fir associations are found on a number of different SRI landtypes that are generally shallow or moderately deep and have lower annual precipitation amounts. Douglas fir associations are also found on a number of different SRI landtypes and reflect a closer relationship with total precipitation on site. Dry and mesic pine types are mapped across a number of SRI landtypes and appear to be primarily stratified by elevation breaks on the landscape.

Physical Environment

The planning area is located on the western corner of the Blue Mountains physiographic province, which also includes the Wallowa, Elkhorn and Strawberry Mountains. The shaping of the landform in the subwatersheds is a reflection of the past geologic history of the area. The tectonic movement, combined with the uplift of the Blue Mountain anticline and mass wasting processes have created the dissected ridges and steep draws. Mass wasting, sheet and rill are some of the physical processes currently in action.

During the last 60 million years before present (Ma), the central Oregon area has been the scene of major episodes of volcanic activity interspersed by periods of sedimentation (Walker, 1990). According to Walker, the area was under compression for the majority of the Mesozoic to early Cenozoic eras (250 to 50 Ma), slowly raising the land elevation, building mountains. A northeast trending structural uplift began forming the base of the Ochoco, Elkhorn and Wallowa mountains. This compressional trend continued, forming the Blue Mountain anticline (uplift) around 35 million years ago. Extensional tectonism with local compression occurred from mid-Miocene (15 Ma) to the present, deforming and fracturing the brittle young tuffs and basalts.

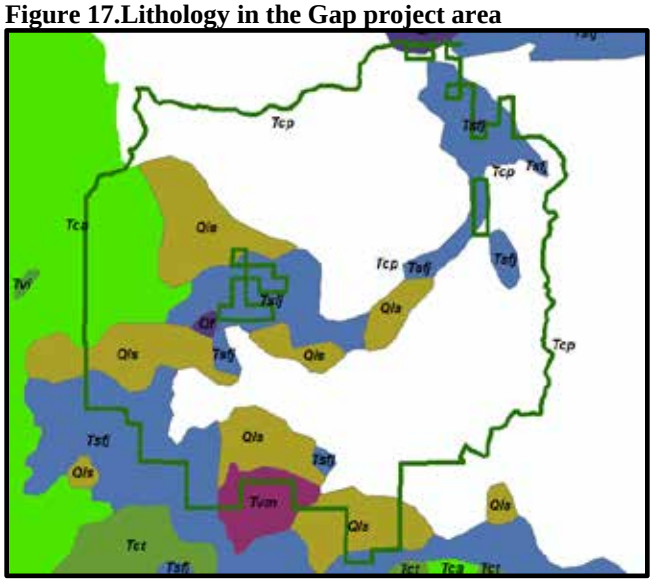
Lithology

The Gap project area is underlain by 6 distinct geologic formations (see figure 17 and table 79).

Table 79. Lithology (acres) in the Gap project area

Lithology	Acres	Percent
Quaternary Landslide Debris (Qls)	6447	17%
Quaternary Fanglomerate (Qf)	151	1%
Tertiary Picture Gorge Basalt (Tcp) - Acres	22,222	58%
Tertiary John Day FM (Tsfj)	6111	16%
Tertiary John Day FM (Tvm)	484	1%
Tertiary Clarno FM (Tca)	2730	7%
Total Acres	**38,144**	

Figure 17.Lithology in the Gap project area



The oldest is the Clarno Formation (FM) (Tca) (Eocene to lower Oligocene, 41-34 Ma) composed of lava flows, mudflows, and small amounts of tuffaceous rocks (Swanson, 1969 and Walker & MacLeod, 1991). The Clarno Formation (Tca) is mapped on the northwest corner of the watershed and covers 7 percent of the project area (table 79). The formation is rated as intermediate for susceptibility to mechanical and chemical weathering processes. The most of the landslides are underlain by the Clarno FM, occur on the upper slopes, on slopes greater than 40 percent, are rotational slides and are associated with ridge tops. Springs and seeps are associated with these hummocky areas.

An erosional surface exists between the deposition of the John Day Formation and the underlying Clarno Formation, representing the continuing uplift. A saprolite (thoroughly decomposed rock) has been mapped in places along the boundary between the formations.

Between the deposition of the Clarno and the John Day Formations, the style of volcanism changed from local to regional in nature (Walker, 1990; Swanson, 1969 and Swinney, 1968). The John Day Formation (Tsfj, Tvm) (middle Oligocene to lower Miocene -- 32-25 Ma) is compositionally heterogeneous, erupting from local vents. The two John Day age units underlie approximately 17 percent of the watershed (see table 79). The John Day Formation generally consists of air fall and ash-flow tuff (Twt), tuffaceous sedimentary rocks, lava flows and domes (Swanson, 1969 and Swinney, 1968) and is poorly stratified. The flows and intrusive bodies (Tsfj, Tvm) are rated intermediate for susceptibility to mechanical and chemical weathering processes. Most of the landslides that occur on the John Day Formation are on the upper slopes, on slopes greater than 40 percent, are rotational slides and are associated with ridge tops.

The Picture Gorge Basalt (Tcp) (see table 79) (Walker and MacLeod, 1991) (Brown and Thayer, 1966 and Swanson, 1969) was deposited between 15 to 16.4 Ma (Million Years). The unit underlies the eastern half of the planning area (58%). The formation consists of olivine-bearing basalt flows with thin ashy sedimentary beds between the lower flows. The thin sedimentary beds between the flows often allow subsurface groundwater flow to express on the surface as springs and seeps. They often are reflected by 'stringers' of timber and shrubs running parallel to the contours, scribing the contact between the lava flows.

The fanglomerate (Qf) (Holocene and Pleistocene -- 2 Ma to Present) (Walker, Peterson and Greene, 1967) (see table 79, figure 17), is mapped on the south edge of Big Summit Prairie. It is composed of poorly sorted and poorly stratified alluvial fan debris, slope wash, colluvium and talus (Walker and MacLeod, 1991). The fanglomerate is mostly silt and fragments of basalt, basaltic andesite and andesite. In places, it also includes small areas of pediment gravels and colluvium. The unconsolidated material is highly susceptible to mechanical and chemical weathering. It underlies 1 percent (151 acres) of the project area.

The youngest geologic unit in the Gap project area is the landslide and debris flow deposits (Qls) (Pleistocene and Holocene -- 2 Ma to Present) composed of chaotic masses of angular blocks, chiefly mixtures of basalt and tuffaceous sedimentary rocks (Swanson, 1969). The unit includes debris flows and large talus piles.

Landslide debris (Qls) underlies 17 percent of the watershed (table 79). The majority of the debris is mapped on the west side of the watershed. The unconsolidated material is highly susceptible to mechanical and chemical weathering. The difference between published mapped landslide debris acres and the dormant landslide terrain discussed later in this report is due to how geologic maps are compiled, additional air photo interpretation and analysis of LiDAR images to identify landforms.

Capping the erosion surfaces of the Ochoco Mountains is the Mt. Mazama ash fall. The ash fall occurred roughly 7,700 years ago. The axis of the ash fall lies from Crater Lake (Mt. Mazama) to Lewiston, Idaho (Walker and MacLeod, 1991). The Ochoco Mountains received 1 1/2 feet of fine volcanic ash. Through time and weathering processes the ash has moved to the draws on the leeward slopes. The ash-laden soils have a tendency toward developing debris flows and torrents on slopes greater than 30 percent where the shallow saturated soils slide on the underlying lithologies. The ash is weathering to clay. The soil, which has formed on all the formations, combined with the ash, provides the majority of the natural stream sediment due to processes like sheet and rill erosion. The ash, primarily from Mt. Mazama, has collected in the draws, increasing the fertility of the drainages, allowing development of the tree/shrub component of the vegetation in an otherwise thin soil bedrock dominated terrain.

Groundwater, Landslides and Faults

The related tectonic fault traces, visible on the aerial photographs, have influenced the development of drainage patterns. The mass wasting process includes the formation of talus slopes, deep seated landslides, slope creep, rock topple, debris flows and earthflows. The slip surfaces for deep seated dormant landslides tend to be located within the underlying bedrock. The slip surfaces within debris flows and earthflows tend to be within the soil zone or very shallow bedrock. The wet areas adjacent to dormant landslides and tectonic faults identify interrupted drainage flow of the groundwater.

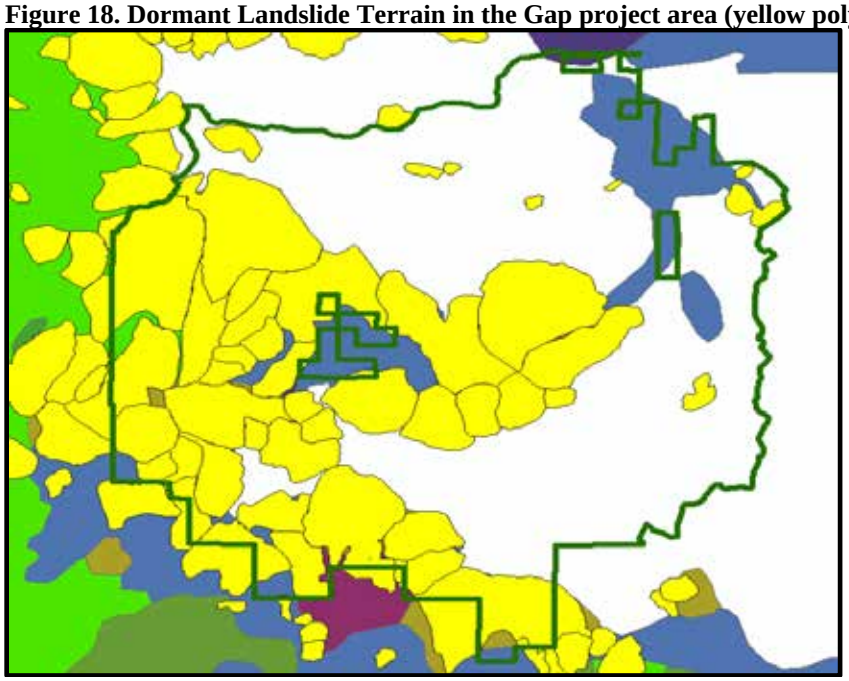
Based on an air photo and LiDAR image interpretation, the Gap project area has dormant landslide terrain composed of scarps and debris lobes, spread throughout the watersheds (figure 18). The dormant landslide terrain range in size from 2 to 2,000 acres, cover approximately 16,996 acres (45% of the planning area), are located on 117 mapped landslide forms, occur on slopes greater than 40 percent and are generally associated with ridge tops. The dormant landslide terrain is underlain by all 6 formations. The dormant landslide terrain underlies the majority of the western half of the planning area. It is the source for the numerous springs and seeps.

There are many Riparian Habitat Conservation Areas (RHCAs) within the area including the main stems and tributaries of Gray Creek, Lost Creek and Little Horse Heaven Creek. Portions of the dormant landslide toes form the banks of these creeks. These segments are susceptible to erosion and have the potential to destabilize the upper slopes within the landslide terrain.

The majority of the project area (65%) is at a low to moderate risk for reactivation by management activities such as road construction or harvest, or by the continued weather pattern of higher precipitation.

The development of the scenic cliffs and prominent escarpment on the north rim of the Ochoco Mountains has been due to the rise of the Blue Mountain Anticline. The related tectonic fault traces, visible on the aerial photographs, have influenced the development of drainage patterns. The mass wasting process includes the formation of talus slopes, deep seated dormant landslides, slope creep and rock topple. The wet areas adjacent to dormant landslides and tectonic faults identify interrupted drainage flow, which brings the groundwater to the surface. These sub-watersheds are in the groundwater recharge zone for the local aquifers.

Figure 18. Dormant Landslide Terrain in the Gap project area (yellow polygons)



Existing Condition

The existing condition of the soil resource is influenced by the type and extent of natural or man-made disturbances that have occurred on site. Natural disturbances capable of detrimentally affecting the condition of the soil resource in the project area include wildfires, wind events and landslides. Man-made activities within the project area that can affect the soil resource include mechanical timber harvesting and associated transportation systems, Off Highway Vehicles, grazing management, wildfire suppression activities and recreational uses.

Natural disturbances have occurred within the project area but have had minimal amounts of detrimental soil disturbance on the resource. Wildfire historically played a large role in the project area but has only burned 97 out of a predicted 60,000 acres in the last 28 years due to fire suppression (Kleckler, 2015). . In 2014, the 9,848 acre Fox Fire started in the adjacent watershed to the east and burned 69 acres in the Gap project area with variably severity and minimal effects to the productivity of the soil resource. Although short term loss of vegetation and isolated areas of long duration burning under high temperatures did occur, the condition of the resource as a result of wildfires has not been detrimentally affected. Wind events capable of uprooting trees and disturbing soil profiles do not appear to have occurred to any significant degree across the landscape. Landslides in the project area occurred long enough ago that the soil resource has developed on top of these surfaces and not disturbed them in any recent events. As a result, natural disturbances were not included in any estimates of existing detrimental soil disturbance within the project area.

Timber harvest using mechanical ground based systems are the primary activities that have incurred detrimental disturbance to the soil resource within the project area. Clearcuts, selection cuts, seed tree cuts, overstory removal cuts and sanitation cuts are the primary prescriptions under which stands were entered and harvested in the past. Many areas have been entered multiple times and established skid trails and landings created during these entries remain in place. The location of logging system infrastructure was primarily influenced by the locations of commercial trees, slope and surface rock, creating variably dendritic patterns of skid trails leading to landings and roads throughout area. Impacts to the soil resource include the compaction and displacement of surface soil where multiple machine trips occurred, primarily on slid trails and landings.

The spatial distribution of 208 proposed commercial harvest units (HTH) and the predominant landtypes that encompasses them has been considered. Each of these units has had multiple entries in the past that created skid trails and landings available for re-use during this proposed entry. These units were assessed for their existing detrimental disturbance in the field or using aerial photography to estimate the extent of skid trails and landings within their boundaries. The observed coverage and detrimental disturbance of the logging system infrastructure within unit areas ranges from 15 to 25% as a result of these activities. The estimated existing detrimental disturbance within proposed Gap units is compiled in Appendix B for this analysis.

Effects

Direct, indirect and cumulative effects analyzed for the soil resource includes those that can detrimentally impact the physical, chemical and biological properties that influence the function and productivity of the resource. This analysis primarily describes the extent and manner in which the proposed management activities could affect the disturbance types described in the Region 6 supplement to the 2520 Forest Service Manual (R-6 Supplement No. 2500.98.1) and whether these disturbances would be within allowable levels to maintain soil productivity over a minimum of 80% of an individual activity area[5].

[5] Activity Area is described as the total area of ground impacting activity, and is a feasible unit for sampling and evaluating. Some examples are: a sale contract unit, pasture, allotment, meadow, riparian reach, burned area (FSM 2521.05)

The following disturbance types are discussed in this analysis:

- **Compaction**: Detrimental compaction is defined as a 15% increase in bulk density or soil strength for residual soils and a 20% increase for ashy soils. Three to four passes with crawler tractors or rubber-tired skidders commonly produce this effect.
- **Displacement**: Detrimental displacement is defined as the removal of more than 50% of the A horizon from and area greater than 100 square feet, which is at least 5 feet in width.
- **Burn Damage**: Detrimental burn damage occurs when the mineral soil surface has been significantly changed in color, oxidized to a reddish color, and the next one-half inch blackened from organic matter charring by heat conducted through the top layer.
- **Puddling:** Detrimental puddling occurs when the depth of ruts or imprints is six inches or more. Soil deformation and loss of structure is observable and bulk density is usually increased.
- **Erosion:** Detrimental erosion occurs when there is visual evidence of surface loss in areas greater than 100 square feet, rills or gullies and/or water quality degradation from sediment or nutrient enrichment[6].

Alternative 1

None of the proposed actions described under alternatives 2, 3 and 4 would be implemented under this alternative. Existing levels of soil disturbance would not be affected and would remain the same as those described in the existing condition section of this report and the unit tables in Appendix B. The risk of high intensity wildfire is greatest under this alternative and would result in the largest extent of exposed mineral soil and potential detrimental burn damage to the soil resource if a wildfire were to occur. However, even this type of event has resulted in less than 5% detrimental burn damage within recent fires across the Forest.

Alternatives 2, 3 and 4

Direct, indirect and cumulative effects to the soil resource are all analyzed at the activity area or unit scale. The types of actions proposed are common between the three action alternatives, with only the extent of the commercial harvest units and temporary roads varying slightly between alternatives. As a result, the effects of the proposed actions displayed in Chapter 2 of the DEIS are analyzed as common between the three action alternatives.

The extent of commercial thinning is the same for Alternatives 2 and 4 (14,038 acres) and slightly less for Alternative 3 (10,922). Approximately 2,187 acres in Alternative 4 would have a slight increase in the number of trees removed per acre compared to the same areas under Alternative 2 as a result of removing some trees over 21” in diameter.

Commercial Harvest (HTH)

The primary impacts to the soil resource from proposed activities would be incurred by ground-based machinery used to harvest, yard and haul material in units proposed for commercial thinning (HTH) operations. Proposed harvest under commercial thinning prescriptions would remove an estimated range of 4.5 to 6 thousand board feet (mmbf) per acre or approximately 50 to 60 trees with an average diameter at breast height (dbh) of 12” per acre. Total acres of commercial harvest vary slightly by alternative and some acres proposed in alternatives 2 and 3 would have a slightly higher number of trees removed under alternative 4.

[6] The volcanic ash soils of the Blue Mountains have several properties which can make erosion hazard assessment difficult. In an uncompacted state, these soils have infiltration rates often exceeding 10 inches per hour. Permeability of applied water through the ash layers is also rapid. However, because of their lack of structural development (weak granular to singular grain), they are easily susceptible to erosion in situations where water is channeled on the soil surface such as skidroads, waterbar outlets, and near road drainage structures. (Ash Soil Guidelines for OR/WA 1985).

Compaction: The harvest, yarding and processing of thinned material by ground based machinery requires the use of a skid trail and landing system covering approximately 15% of the unit area. The majority of units proposed for commercial (HTH) harvest have an existing logging system in place that would be re-used during this entry although additional skid trails and in some cases temporary roads would be created in some units to access and remove timber. Soils trafficked by machinery for landings and skid trails would be detrimentally compacted following their use for harvesting operations.

Additional compaction is also likely within the units as a result of off trail traffic by machine harvesters used to cut and accumulate trees. Areas where harvesters traveled over the same piece of ground more than three to five times off of skid trails are likely to be detrimentally compacted. As a result, all units entered are likely to have an increase in the amount of area compacted by multiple machine trips as a result of this entry. Planning Best Management Practices (BMPs) are included to re-use existing skid trails and landings and minimize the extent of additional compaction and the amount of area detrimentally compacted in proposed HTH units from harvest, yarding and hauling activities is estimated to increase less than 5%.

Although compaction can have a negative effect on soil productivity, the extent of detrimental compaction within the proposed activity units following harvest and yarding activities would meet Forest Plan and Region 6 guidelines for maintaining soil productivity as a result of planning and implementation BMPs included as Design Criteria. Units with existing levels of detrimental disturbance below the 20% standard could accommodate a slight increase in these levels while units exceeding the 20% standard are required to have no net increase in detrimental disturbance. Units located on soils with moderately deep or deeper ash surfaces could have the extent of detrimental compaction reduced following harvest and fuels treatments through tillage activities on primary skid trails and landings. Acreage above the 20% level is targeted for tillage treatment if tillage operations are feasible.

The major effect of detrimental compaction is a reduction in of soil pore space in the profile which can limit air, water and nutrient availability to roots. Compaction can also increase mechanical resistance to tree root growth and reduce mycorrhizal symbiosis. Compacted areas also have a reduced infiltration rate than can increase the amount and energy of surface runoff during rain events, causing erosion, the transport of sediment and higher peak flows. Design criteria to waterbar, spread organics and/or till skid trails where possible would reduce the ability of these areas to collect and focus runoff during these events.

Tillage: It is widely recognized that ground based harvest systems need a dedicated framework of roads, landings and main skid trails that generally covers less than 20 percent of the area. Portions of this system can be tilled, where soil conditions allow, and returned to a productive condition if the combined amount of detrimental disturbance within a unit following proposed activities exceeds 20% of the unit area or where detrimental disturbance already exceeds 20% prior to this entry.

Tillage of landings and the first 300 feet of main skid trails leading from the landings by the purchaser on an average timber sale can reduce the amount of detrimental compaction by 3 to 4 percent within an individual harvest unit.

Research indicates that some mechanical method to ameliorate compacted soil conditions is desirable and feasible for maintaining productivity, especially on coarse and medium textured soils such as the ash capped soils on the ONF (Geist, J. M. and. Froehlich, H. A; 1994). Evidence indicates that de-compaction through tillage appears to be sufficient to restore productivity (Sanborn, P; Kranabetter, M; and Bulmer; 1999). Tillage effectiveness varies widely with soil depth, texture, rock content, water content and type of tillage implement used. Local monitoring of tillage operations by Jim David, ONF Soil Scientist, has shown the effectiveness of tillage for reducing compaction using a forest cultivator or tractor mounted subsoiler is about 70 percent for a single pass.

Tillage suitability is reliant on the depths of the ash surfaces and varies across the project area. Where depths are sufficient, the use of a forest cultivator or tractor mounted with a subsoiler is an established activity on the Forest to break up compacted surfaces of skid trails and landings. Tillage de-compacts the soil, re-establishes pore space in the profile and improves soil aeration, infiltration and moisture holding capacity. Mechanical resistance to root growth is also reduced. Long term (5 years or more) effects of tillage are largely beneficial due to the improved infiltration, percolation, aeration and reduced soil strength. Short term effects (up to 5 years) may include increases in localized erosion potential before effective vegetative ground cover is established. This short term hazard would be reduced by the use of water bars and slash placement.

Displacement: The maneuvering of tracked machinery used to harvest or pile material can displace surface organics and mineral soil, especially on areas of slope exceeding 20%. Soils with deeper ash surfaces are the most susceptible to this process and displacement of the A horizon can have a negative effect on soil productivity and increased erosion if the extent is great enough. Displacement of the surface ash can expose finer textured soil layers, alter hydrographic function and reduce growth. Displaced soils are often channelized and loosened so than they are more susceptible to erosion. However, displacement over an area larger than 100 square feet and greater than five feet in width is not a common occurrence off of compacted skid trails and landings and is unlikely to increase the total amount of detrimental disturbance on site.

Puddling: Puddling results from the breakdown of soil structure under wet conditions. Heavy machinery used for logging operations and fuels treatments can puddle soils and cause channelization and loss of permeability. Soils with shallow or no ash cap are the most susceptible to this process, especially landtype category B and T soils. Project Design Criteria (PDC) are included in the analysis document to limit machine operations during wet periods when rutting over six inches can occur in order to reduce the amount of puddling from these activities. As a result, the amount of puddling expected to occur from the proposed activities is minimal.

Soil Erosion: Soils within proposed treatment units are susceptible to erosion from wind and water when vegetative canopy and cover is decreased on site. A slope erosion hazard map was generated for the Forest based on the surface texture and rock content of the SRI landtypes and the slope class on the landscape. Erosion hazard classes 0-20% High; 20-35% High and 20-35% Moderate are the most susceptible to erosion and are present within some units proposed for commercial harvest treatments. Although slopes exceeding 35% exist within some units drawn in GIS for analysis, PDCs do not allow any machine traffic on these slopes during implementation and these areas would likely be excluded during layout.

Proposed mechanical treatments would expose and/or compact mineral soil on skid trails and landings comprising up to 15% of the unit area. An additional 5% of the unit area would have some disturbance of surface vegetation and mineral soil from the off trail travel of machine harvesters used to cut and bunch material.

Although the risk of erosion on these areas would increase during the short term, vegetative canopy and surface cover would be maintained across the majority of the treated areas following all proposed activities. These conditions would provide raindrop interception and surface roughness at levels capable reducing overland flow accumulations and energies during low and moderate intensity storms.

The amount of disturbance from commercial harvest activities would also be spatially and temporally distributed across the landscape with the total acres proposed for harvest spread out over two years. In addition, PDCs and BMPs for the treated areas include the rehabilitation of skid trails and landings with tillage treatments; waterbars, berm smoothing and organic cover to reduce the amount of soil exposed or compacted on site. As a result, the extent of erosion would be minimized to acceptable levels during all but the highest intensity storms that also produce overland flows and erosion on the existing untreated landscape due to the natural infiltration thresholds of the soils present.

Table 80. Percent of subwatersheds proposed for commercial harvest under Alternatives 2/4

12th Field Subwatershed	Percent of subwatershed proposed for Commercial Harvest
Gray Creek	34%
Headwaters NFK Crooked	28%
Lost Creek	14%
Lower Horse Heaven	3%
Upper Horse Heaven	16%

Soil Mass Wasting: Portions of the project area consist of dormant landslide terrain where past mass wasting created hummocky terrain and exposed seeps and springs. Landtype categories C and L are mapped within a number of proposed units and represent soils developed on landslide debris from these events. Although the risk of additional mass wasting on a large scale is low, localized movement is possible in areas near existing seeps and springs. PDCs that minimize the risk of proposed treatments from causing slumping include avoiding seeps and springs, avoiding treatment on the toeslopes of landslide debris features and avoiding machine traffic on slopes over 30% in these areas.

Fuels Treatments:

Fuels treatments proposed in commercial harvest units include the grapple piling of activity fuels, burning of piles and the underburning of units after harvest operations. In general, these treatments would have minimal and localized effects to the soil resource as a result of PDCs and BMPs included in the document.

Grapple piling and burning of machine piles: Machine excavators used to grapple pile activity fuels would operate from existing skid trails and landings on slopes less than 35%. Although minimal overlap of this traffic could occur off of these areas it is unlikely that any additional compaction or displacement of the soil resource would occur with these restrictions. Grapple piles can cover approximately 4% of units with heavy activity fuels, much of which would overlap existing disturbance on skid trails. Burning these piles may incur detrimental burn damage to the soil resource depending on the duration and consumption that occurs. Piles located on skid trails and landings overlap soil that is already detrimentally compacted and would not add to the total detrimental disturbance within the unit.

Underburning (UB) activity fuels: Underburns in commercial harvest units would be ignited during spring or fall burn windows with variable soil moistures. Burn plans following guidelines to minimize the amount of duff consumption would limit the intensity and durations of these burns and have minimal effects to the soil resource. These types of burns closely emulate natural processes as to nutrient volatilization and nutrient dispersal and would have positive effects on the productivity of the soil resource.

Non-commercial thinning and Underburn

Non-commercial thinning would occur inside and outside of commercial units using hand crews. This activity would have no effects to the soil resource. Hand piling of thinned non-commercial material may occur in non-commercial only units. These piles would be burned prior to underburning and would incur minimal burn damage to the soil resource due to their limited size and lower density compared to grapple piles.

Underburns would occur in some non-commercial units and would be ignited during spring or fall burn windows under variable soil moistures. Burn plans following guidelines to minimize the amount of duff consumption would limit the intensity and durations of these burns and have minimal effects to the soil resource.

Juniper Cutting

Juniper density would be reduced by hand cutting young junipers within juniper woodland/steppe communities. Slash would be lopped and scattered and some concentrations would be jackpot burned. Effects to the soil resource are expected to be negligible from these activities.

Noncommercial thinning only

The hand-felling of non-commercial sized trees would have no direct effect to the soil resource. Trees left on the ground would contribute fine needles and branches to the soil surface as cover and nutrient input over time. Boles on the ground would provide moisture retention and microbial habitat.

Prescribed Burning Only

Units proposed for prescribed burning only have existing levels of standing and down fuels within acceptable levels to introduce a broadcast underburn or spot burning of accumulations. Underburns would be ignited during spring or fall burn windows under variable soil moistures. Burn plans following guidelines to minimize the amount of duff consumption would limit the intensity and durations of these burns and have minimal effects to the soil resource.

Stream Restoration

Proposed stream restoration activities include the removal of trees from adjacent upland locations and placement onto the floodplains and into the channels of multiple streams within the Gap project area. Tree would be knocked over using excavators to keep root wads intact or felled by hand where safety or machine access is an issue. Trees pushed over with root wads intact would expose the soil profile and displace topsoil in a manner that mimics natural mechanisms during a wind throw event. These disturbances would not meet criteria for detrimental disturbance of the soil resource. Excavator traffic to push over and bunch trees during this process would variably compact the soil during each pass, although traffic over the same piece of ground would be minimized and compaction levels are unlikely to meet threshold levels considered to be detrimental. Displacement of surface organics and mineral soil would also occur on a scale below threshold levels considered to be detrimental.

Trees used for instream structures and plugs located in open meadow areas like Williams and Gray Prairies would be yarded from the source sites using a rubber tired skidder on designated access routes. Approximately 3.5 miles of access routes have been identified for the seven areas proposed for restoration. Access routes would be detrimentally compacted as a result of multiple machine trips following the yarding of hundreds of trees and access traffic of excavators used to place trees and build structures in the channels. This would compact approximately 4.25 acres of the soil resource within a total of 1,345 acres of stream restoration units, which is less than 1% of the area and within allowable LRMP soil disturbance levels for maintaining soil productivity. In addition, PDCs include the restoration of these access routes using tillage implement to break up the surface compaction and/or the placement of organic material on the surface. Soil surfaces within meadow or floodplain locations are moderately resilient to compaction disturbances and should be returned to a condition capable of supporting vegetation and recover quickly following restoration activities.

Aspen Restoration

A total of 54 aspen restoration sites covering 213 acres are proposed for the thinning of conifer competition within and around the identified aspen stand. Conifers within non-commercial stands may be hand-felled and left on the ground, lopped and scattered or handpiled, actions that would have no impacts to the soil resource. Handpiles located greater than 50 feet from streams may be burned with minimal and localized impacts to the soil.

Conifers treated within stands located in commercial harvest units would be cut and yarded by harvest machinery where ground moisture and operating conditions allow. These actions would contribute to compaction levels off of skid trails within the commercial units previously described under Commercial Harvest.

Hardwood Treatments

A total of 30 hardwood treatment sites covering 83 acres are proposed for thinning of conifer competition within and around the hardwood stands. Conifers within non-commercial stands may be hand-felled and left on the ground, lopped and scattered or handpiled with no impacts to the soil resource. Cut trees may also be felled or placed into stream channels for restoration purposes. Handpiles greater than 50 feet from streams may be burned with minimal and localized impacts to the soil.

Riparian Planting

Riparian restoration would also include the planting and/or seeding of native plants in disturbed areas and along stream channels and floodplains being restored. This would include planting rooted and potted plants, sticks and/or bundles by manual techniques using a shovel or auger. A small portion of larger trees/shrubs in 5-10 gallon pots would be planted with heavy equipment at the time of structure placement. These activities would have minimal direct effects on the soil resource in the short term and benefit the soil resource in the near and long term by providing cover and a source of organic input to the surface on an annual basis.

Riparian Protection Fencing

The construction of wooden, plastic or wire fencing may occur around some sites to prevent browsing of planted and seeded vegetation from big game or livestock. Up to 8.9 miles of buck and pole fencing and 4 miles of wire fencing have been identified for installation using hand crews. Construction would have only localized impacts on the soil resource where fence posts were installed into the ground. In addition, it is anticipated that there would be livestock trailing along newly constructed fence lines.

Culvert Replacement

The replacement of four existing undersized culverts to accommodate 100 year flood events would have localized effects to the soil resource. Removal of existing structures and the installation of new culverts would disturb the shoulder of the road beds and portions of the streambank and terrace to accommodate a larger culvert span. Impacts would be short term and disturbed areas would be stabilized with vegetation and apron rock as part of the installation.

Road Closures

Approximately 20.7 miles of existing system roads would be administratively closed under alternative 2. Roads proposed for closure would have their road surfaces hydrologically stabilized through the installation of water bars and relief ditches. Road surfaces would not be de-compacted. These actions would have minimal effects on the soil resource in terms of restoring productivity but should reduce the erosive energies of overland flows during storm events and minimize detachment and transport of sediment from these surfaces.

Road Decommissioning

Approximately 3.6 miles of open or closed system roads would be decommissioned under all action alternatives. At a minimum, the surfaces of these roads would be de-compacted and/or covered with material within the RHCA or sediment delivery zone to create roughness, improve infiltration and reduce overland flow[7] energies during storm events. These actions would improve the condition of the soil resource by decreasing the extent of compacted surfaces and creating a soil profile capable of supporting planted or naturally regenerated vegetation. The soil resource would be expected to become productive ground in treated areas over the next five years as soil properties improved and herbaceous vegetation returns.

Road surfaces outside of the RHCA are unlikely to be treated in the same manner and would become vegetated more slowly over time due to continued compaction of the surface soil horizons. Water bars would be installed and culverts removed along the extent of the decommissioned roads as funding allows, potentially reducing the length and energy of unobstructed overland flows generated on these surfaces.

Temporary Roads

Approximately 0.9 miles of temporary road would be created on currently undisturbed ground and 39.4 miles of temporary road would be created on existing disturbed surfaces previously used for hauling, yarding or transportation under Alternatives 2 and 4. Approximately 33.2 miles of temporary road would be created on existing disturbances under Alternative 3. The majority of the temporary road surfaces would be within proposed commercial harvest units and contribute temporarily to soil disturbance levels as a result of multiple trips by log trucks to haul material out of the units. However, all temporary road surfaces would be rehabilitated by blading back embankments and de-compacting their surfaces where soil depth allows following their use. Although disturbed to some degree, these surfaces would be returned to a condition capable of supporting vegetative growth following these treatments and are unlikely to exceed detrimental disturbance thresholds for compaction or displacement.

Winter Material Source Expansion:

Approximately 0.9 acres of soil resource would be removed from production as a result of the proposed expansion of the Winter Material Source site under all three actin alternatives. This area is within a General Forest Management Area and would become dedicated as a material source and no longer considered productive ground. Top soil from the area is recommended for stockpiling and use for rehabilitation purposes where needed.

Cumulative Effects (see table 167)

Alternative 1

Alternative 1 would have no cumulative effects to the soil resource since none of the proposed actions would be implemented and there would be no ground disturbing activities.

[7] Overland flow occurs when the rate or capacity of the soil to infiltrate water has been exceeded by the amount of precipitation or rate of snowmelt. Independent variables that influence infiltration rate include soil texture, rock fragments on the surface, vegetative canopy and surface cover, intensity and duration of precipitation, steepness of slope and whether or not the soil is frozen.

Alternatives 2, 3 and 4

For the purposes of this analysis, the Gap cumulative effects boundary is Forest Service land located within Gap project area. Detrimental disturbance to the soil resource is measured at the activity unit scale for this analysis. Cumulative effects to the soil resource are the sum total of direct and indirect effects from proposed and reasonably foreseeable activities within each activity unit. Present and foreseeable future projects that overlap the Gap project area includes the Fox Canyon and Big Summit Allotment Management Plans (AMPs) and the Deschutes Ochoco Travel Management Plan (see table 167).

Multiple activities would occur within many of the activity areas as part of the proposed vegetation management and stream restoration activities. However, analysis of the proposed actions in activity units shows that the sum totals of detrimental disturbance for all harvest and fuels treatment activities would not impair long-term productivity on site. Project Design Criteria (PDCs) such as the re-use of skid trails for grapple piling machinery, the minimal extent of pile burn treatments, the low impact nature of underburning and the application of restoration treatments within units that temporarily exceeded acceptable LRMP standards for detrimental disturbance ensure that each activity unit would be consistent with the Ochoco LRMP Standards and Guidelines and Region 6 Standards for the soil resource following implementation.

Additional impacts to the soil resource from ongoing and reasonably foreseeable projects are not likely to measurably increase detrimental disturbance levels within any of the proposed activity areas. Grazing will continue to occur under the Fox Canyon and Big Summit AMPs with some localized compaction to the soil resource from trampling. However, a reduced length of the grazing season implemented in those AMPs would shorten the length of time that animals spend in any of the proposed activity areas and lessen their direct impacts compared to past management. The proposed restoration of riparian areas included in those projects would also minimize effects to the soil resource by planting vegetation and adding down wood to reduce access to sensitive riparian soil areas.

The Travel Management Plan also benefits the soil resource by designating open travel routes for motorized vehicles on existing roads and trails while closing cross country travel to motorized travel. Impacts to the soil resource from off route travel would be expected to decrease over time as these regulations are implemented. New proposed routes proposed under the Ochoco Summit OHV project are outside the Gap project area. As a result, the incremental increase of detrimental soil disturbance within any of the proposed activity areas from activities proposed under the Gap action alternatives and ongoing or reasonably foreseeable projects would be consistent with the Ochoco LRMP Standards and Guidelines and Region 6 Standards for the soil resource following implementation. There would be no cumulative effects to the soil resource from the application of short-term management practices proposed in the Gap project.

Mass wasting

The majority of the west side of the planning area is underlain by dormant landslide terrain. When there is a change in the ground water flow through the unstable terrain, the potential is increased for slope movement. Rapid shallow debris flows and deeper rotational slides can result, altering the vegetation potential and possibly releasing sediment into the stream systems, depending on proximity to the riparian areas. Effects of the alternatives on the landslide terrain will be measured by:

* Acres of dormant landslide terrain and mapped landslide debris (Qls)
* Miles of road within dormant landslide terrain and mapped landslide debris (Qls)

Alternative 1

Alternative 1 would allow the dormant landslide terrain to continue the natural process of erosion under the current precipitation pattern. No change in direct, indirect or cumulative effects.

For All alternatives

The proposed treatments of noncommercial thinning, controlled riparian underburn and underburn would have no direct effects on increasing slope instability. Indirectly, the treatments would encourage increased growth of the vegetation, which would increase the evapotranspiration, thereby increasing the stability of the dormant landslide terrain.

Alternatives 2, 3 and 4

Direct Effects: For all the units in the action alternatives, primary concern from a mass wasting standpoint is for those units on dormant landslide terrain. Mapped landslide debris underlies 162 commercial units. Landslide terrain tends to develop unusual subsurface drainage patterns. The intensity and style of management activity on landslide terrain, in the vicinity of seeps and springs, could potentially change the drainage pattern, possibly increasing the risk for instability.

The proposed harvest commercial thinning (HTH) does not generally alter groundwater movement measurably, except in the vicinity of seeps and springs. The treatments should not reduce the amount of water taken up by the trees through evapo-transpiration substantially. More aggressive prescriptions have been known to reduce the amount of evapo-transpiration which leaves more groundwater in the slope, which has the potential to increase instability.

The acres of dormant landslide terrain are denser in the western half of the planning area. The affected area varies slightly based on the proposed managed acres for each alternative (see table 81).

Tractor logging systems tend to compact the soil, changing groundwater flow patterns, potentially altering slope stability. Alternative 3 proposes management of fewer acres in dormant landslide terrain with the tractor method than Alternatives 2 or 4.

Table 81. Dormant Landslide terrain within proposed logging systems for each alternative (acres)

Logging System	Alternative 2 (Proposed Action)	Alternative 3	Alternative 4
Tractor	6,962	5,436	6,801
Total Treated Acres within Dormant Landslide Terrain	6,962	5,436	6,801
Total Treated Commercial Acres	14,037	10,291	14,037
Percent of Treated Acres in Dormant Landslide Terrain	50%	53%	48%

Indirect Effects: Those units located on the upper slopes of dormant landslide scarps have a slightly increased potential for reactivating the landslide debris on the lower slopes when combined with a higher precipitation or a rain on snow event like the forest experienced in 1997, due to the potential increase flow of groundwater to the lower slopes.

Through the design elements and mitigation, the units identified would have seeps and springs buffered and any evidence of recent motion evaluated by the geologist. The tractor method used to harvest those units does have a tendency to compact the ground. The units, generally located on the upper slopes, may have a slightly increased risk for indirectly destabilizing the lower slopes if there should be a continued weather pattern of higher precipitation.

Alternative 2

Of 243 Rx1 (HTH) Harvest Units (14,037 acres), 162 units (6,962 acres) are in dormant landslide terrain (50 %) for the Proposed Action (Alt. 2). Of the 162 units, 96 units (4,400 acres) have areas on greater than 25% slopes, which raises a potential concern for slope instability if there is a rain-on-snow event, fresh tension cracks appear (evidence of slope movement) or seeps/springs aren't buffered.

Alternative 3

Of 207 Rx1 (HTH) Harvest Units (10,291 acres), 132 units (5,436 acres) are in dormant landslide terrain (53 %) for the Alternative 3. Of the 132 units, 85 units (3,916 acres) have areas on greater than 25% slopes, which raises a potential concern for slope instability if there is a rain-on-snow event, fresh tension cracks appear (evidence of slope movement) or seeps/springs aren't buffered.

Alternative 4

Of 243 Rx1 (HTH) Harvest Units (14,037 acres), 157 units (6,801 acres) are in dormant landslide terrain (48 %) for the Alternative 4. Of the 157 units, 95 units (4,318 acres) have areas greater than 25% slopes, which raises a potential concern for slope instability if there is a rain-on-snow event, fresh tension cracks appear (evidence of slope movement) or seeps/springs aren't buffered.

The units identified in table 82 for each alternative are more sensitive than the other units in dormant landslide terrain based on steeper slopes and presence of landslide indicators. The units on steeper slopes (greater than 25%), in common with all action alternatives are listed in the table.

Table 82. Units by Alternative with Dormant Landslide Terrain (containing slopes >25%)

Unit	Alternative 2	Alternative 3	Alternative 4
	Dormant Landslide Terrain acres	Dormant Landslide Terrain acres	Dormant Landslide Terrain acres
1.1	59.81	59.81	59.81
4	63.82	63.82	63.82
49	39.19		39.19
54	51.83	51.83	51.83
57	37.46	37.46	37.46
102	98.67	98.67	98.67
104	23.57	23.57	23.57
105	37.96	37.96	37.96
121	51.17		51.17
123.1	18.97		18.97
123.2	15		15
124	46.71	46.71	46.71
127.1	11.05	11.05	11.05

Unit	Alternative 2	Alternative 3	Alternative 4
	Dormant Landslide Terrain acres	Dormant Landslide Terrain acres	Dormant Landslide Terrain acres
127.2	42.67		42.67
129	36.41	36.41	36.41
132	50.14	50.14	50.14
138.1	100.69	100.69	100.69
140.1	18.09	18.09	18.09
147	23.65	23.65	23.65
153	50.97	50.97	50.97
155	61.43	61.43	61.43
156.1	57.79	57.79	57.79
156.2	15	15	15
158	64.15	64.15	64.15
162	104.88	104.88	104.88
166.1	40.12	40.12	40.12
167	23.46	23.46	23.46
168	72.86	72.86	72.86
169	50.19	50.19	50.19
170	20.71	20.71	20.71
171	12.59	12.59	12.59
172	57.21	57.21	57.21
173.1	108.89	108.89	108.89
174.1	103.7	103.7	103.7
176.1	70.92	70.92	70.92
179.1	42.79	42.79	42.79
179.2	82	82	
180.1	47.71	47.71	47.71
181.1	22.42	22.42	22.42
182.1	17.95	17.95	17.95
182.2	17.95	17.95	17.95
183.1	30.34	30.34	30.34
184	46.98	46.98	46.98
185	51.82	51.82	51.82
186	12.81	12.81	12.81
188	58.89	58.89	58.89
189.2	16.4	16.4	16.4
191	18.51	18.51	18.51
192.2	12.56	12.56	12.56
193	104.7	104.7	104.7

Unit	Alternative 2	Alternative 3	Alternative 4
	Dormant Landslide Terrain acres	Dormant Landslide Terrain acres	Dormant Landslide Terrain acres
194.1	72.17	72.17	72.17
195.1	43.75	43.75	43.75
196	58.81	58.81	58.81
197	60.74	60.74	60.74
198	61.83	61.83	61.83
199	40.67	40.67	40.67
201.1	71.27	71.27	71.27
206	20.41	20.41	20.41
207.1	28.27	28.27	28.27
209.1	148.15		148.15
212.1	9.99		9.99
212.2	19.06	19.06	19.06
213	71.31		71.31
215	77.83	77.83	77.83
216.1	3.49	3.49	3.49
216.2	131.6	131.6	131.6
217	52.29	52.29	52.29
222	62.19	62.19	62.19
223.1	55.57	55.57	55.57
223.3	32.03	32.03	32.03
227.1	75.91	75.91	75.91
227.2	5.44	5.44	5.44
228.1	18.37	18.37	18.37
228.2	4.71	4.71	4.71
228.3	1.04	1.04	1.04
228.4	5.31	5.31	5.31
229	21.88	21.88	21.88
230	35.89	35.89	35.89
231	13.91	13.91	13.91
233	76.84	76.84	76.84
234	74.38	74.38	74.38
235.2	30.48		30.48
236	70.75	70.75	70.75
237.1	56.97		56.97
237.2	67.6	67.6	67.6
239	2.47	2.47	2.47
241.1	6.17	6.17	6.17

Unit	Alternative 2	Alternative 3	Alternative 4
	Dormant Landslide Terrain acres	**Dormant Landslide Terrain acres**	**Dormant Landslide Terrain acres**
243	32.03	32.03	32.03
244	52.17	52.17	52.17
245	68.41	68.41	68.41
246	15.24	15.24	15.24
247	63.31	63.31	63.31
250	56.21	56.21	56.21
254.2	31.55	31.55	31.55
255.1	36.92	36.92	36.92
256	26.85	26.85	26.85
Total Acres of Dormant Landslide Terrain (Concern)	**4,399.80**	**3,914**	**4,317.80**

Alternatives 2 and 4 propose roughly the same amount of tractor harvest method acres with the least acres in Alternative 3. The slight difference lies in the slope of the units, the prescription, method of harvest and total acres to be harvested. There are 16,996 acres of dormant landslide terrain within the planning unit boundary. Alternative 2 proposes to commercially treat 41 percent (6,962 acres), Alternative 3 proposes treatment of 32 percent (5,436 acres) and Alternative 4 proposes treatment of 40 percent (6,801 acres). Alternatives 2 and 4 propose treating slightly more acres of dormant landslide terrain, the actual acres at risk is less in Alternative 3. Alternative 3 has fewer acres of dormant landslide terrain on steeper slopes within the units (table 82).

For all the units in all the subwatersheds

With the design elements and the mitigation, the riparian corridors would be protected with vegetation left on the stream banks; the landslide debris should remain stable, reducing the risk for increasing sediment production. The riparian vegetation would maintain the stability of the landslide debris toeslopes. Protection of springs and seeps by providing a buffer is important. The additional compaction of ground surrounding wet areas could alter the subsurface water flow, increasing the risk for reactivation of landslide debris, depending on the steepness of the slope.

These alternatives are in compliance with the Regional Forester's Eastside Interim Management Direction, Forest Plan Amendment No. 2, Alternative 2, as adopted (USDA Forest Service, 1995a) for the interim riparian standard. Springs and landslide-prone area less than 1 acre would be protected by a slope distance of 50 feet (INFISH, 1995). Unstable terrain and springs greater than 1 acre would be protected by a buffer of 150 feet (INFISH, 1995).

Transportation System

There is a low to moderate for risk for reactivation of landslide terrain through road related activity for the proposed temporary road construction (table 83) and for the restoration for the action. Alternative 3 has fewer miles of temporary road length on dormant landslide terrain; however, it has a higher percentage of the length on dormant landslide terrain.

Table 83. Proposed Temporary Road miles on Dormant Landslide terrain for each alternative

Road Type	Alt. 2 (PA) – Road Length on Dormant Landslide Terrain(Total) (Miles)	Alt. 3 – Road Length on Dormant Landslide Terrain (Miles)	Alt. 4 – Road Length on Dormant Landslide Terrain (Miles)
Existing Temporary Roads	18.94 (38.87)	16.99 (33.12)	18.94 (38.87)
New Temporary Roads	0..23 (1.02)	0.23 (0.88)	0.23 (1.02)
Total Miles	**19.17 (39.9) = 48%**	**17.22 (34.01) = 51%**	**19.17 (39.9) = 48%**

Road Reconstruction Miles

All alternatives propose 75.18 miles of road reconstruction. Of the 75.18 miles, roughly 50% are located on dormant landslide terrain.

Culvert removal/replacements

There are 6 culvert removal/replacements proposed for the project area. Four out of the 5 are on dormant landslide terrain. The four culverts on dormant landslide terrain are on:

Rd 4215-230 – near Short Creek, Quaternary Landslide Debris

Rd 4235 – near Buck Creek, Clarno Formation

Rd 4215-230 – near Gray Creek, Quaternary Landslide Debris

Rd 4235 – Little Horse Heaven Creek, Quaternary Landslide Debris

The two culverts not on dormant landslide terrain are:

Rd 4225-050 – North Fork Crooked River, Picture Gorge Basalt

Rd 4215, Gray Creek, John Day Formation

All of the culvert removal/replacements would help maintain the stability of the stream banks, which in turn, stabilized the toeslopes of the dormant landslide terrain.

Wildlife

This section summarizes the draft Wildlife specialists' report; information has been included almost verbatim, but some appendices were not included. Included is the Biological Evaluation (BE) for proposed, endangered, threatened, and sensitive wildlife species within the Gap project area. The entire report and appendices are located in the Gap project file, Prineville, Oregon. See Map 13 for key wildlife areas.

Regulatory Framework

The Paulina Ranger District, Ochoco National Forest, is proposing the Gap Landscape Restoration Project (Gap project). Biological Evaluations (BE) provide a process to review all Forest Service planned, funded, executed or permitted programs and activities for possible effects on threatened, endangered, proposed or sensitive species (FSM 2672.4). BE's are intended to help ensure that Forest Service actions do not contribute to a loss of viability on any native or desired non-native plant or animal species, or contribute to trends toward Federal listing of any species. They provide a process and standard by which to ensure that threatened, endangered, proposed, and sensitive species receive full consideration in the decision-making process (FSM 2672.41).

The effects analysis in the BE is required to address any direct, indirect, and cumulative effects of an action on threatened or endangered species or their critical habitat (50 CFR 402.02) and on sensitive species or their habitat (FSM 2672.42).

The BE also complies with Section 7 of the Endangered Species Act (ESA), which requires all Federal Agencies, in consultation with the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS), to insure that their actions are not likely to jeopardize the continued existence of threatened, endangered or proposed species or adversely modify their habitat. Management policy and direction for threatened, endangered, proposed, and sensitive species is also contained in Forest Service Manual 2670 and under Forest Plan standards and guidelines for threatened or endangered species.

Current management direction on desired conditions for threatened, endangered, proposed and sensitive species on the Ochoco National Forest can be found in the following documents:

- Forest Service Manual and Handbooks (FSM/H 2670/2609)
- National Forest Management Act (NFMA)
- Endangered Species Act (ESA)
- Migratory Bird Treaty Act (MBTA)
- National Environmental Policy Act (NEPA)
- Ochoco National Forest Land and Resource Management Plan as amended
- Recovery Plans (species specific)
- Regional Forester policy and management direction

The principle policy document relevant to wildlife management on the Forest is the Ochoco National Forest Land and Resource Management Plan (USDA Forest Service 1989*b*).

In 1995, the Regional Forester's Forest Plan Amendment #2, hereafter referred to as Amendment #2, adopted Interim Management Direction Establishing Riparian, Ecosystem, and Wildlife Standards for Timber Sales. Amendment #2 requires that all timber sales incorporate associated standards for old growth, old growth connectivity, snags, large down logs, and northern goshawks. The Regional Forester has periodically distributed letters clarifying direction in Amendment #2 (Regional Forester, October 2, 1997; October 23, 1997; June 11, 2003, September 10, 2015).

Additional management direction is provided for the conservation of migratory landbirds. This direction is consolidated in the Forest Service Landbird Strategic Plan (USDA Forest Service 2000) and further developed through the Partners in Flight Program. The Oregon-Washington Partners in Flight Conservation Strategy for Landbirds in the Northern Rocky Mountains of Eastern Oregon and Washington (Altman 2000) identifies priority bird species and habitats for the Blue Mountains in Oregon.

The Regional Forester's Special Status Species List was recently updated in July, 2015, resulting in a change of sensitive status for some plants documented or suspected on the Ochoco National Forest. Since the project was initiated prior to this update, the 2011 list which was in effect at the time of project initiation is used in this document. The provision for use of the prior list can be found in the letter dated July 21, 2015 from the Regional Forester to Forest Supervisors providing the updated list.

Conflict Determination (Effects)

Determination effects for all terrestrial threatened, endangered, proposed, and sensitive species listed on the Ochoco National Forest are assessed below. Aquatic and botanical species are addressed in separate biological evaluations.

Alternative 1, the no action alternative, is used as a benchmark to compare and describe the differences and effects between taking no action and implementing action alternatives. The no action alternative is designed to represent the existing condition.

Effects on species will be determined by assessing how the alternatives affect the structure and function of vegetation relative to current, projected, and historical distributions. Effects on habitats are discussed, with the assumption that if appropriate habitat is available for a species, then that species occupies or could occupy the habitat.

Cumulative effects have been analyzed in respect to past, ongoing and foreseeable future activities that overlap the project area in time and space listed in table 167 of the Gap project.

Direct, indirect, and cumulative effects of alternatives are identified and discussed.

The duration of effects on the wildlife resource is described according to the following terms and definitions:

- Short-term – 0 to 5 years
- Mid-term – 5 to 25 years
- Long-term – 25+ years

Rather than addressing all wildlife species, the Forest Plan focuses on two categories of wildlife: 1.) threatened, endangered, proposed and sensitive species which are addressed in the Biological Evaluation, and 2.) management indicator species (MIS) which are addressed in the Wildlife Resource report. In addition, interest has been raised for landbirds including neotropical migratory birds which are also addressed in the Wildlife Resource report. Categories are summarized below:

Species presence/absence determinations were based on habitat presence, wildlife surveys, recorded wildlife sightings, observations made during reconnaissance, non-Forest Service databases, and status/trend and source habitat trends documented for the Interior Columbia Basin. Informal wildlife surveys were conducted for some species.

Threatened, Endangered, Proposed, and Sensitive Species

Existing Condition of the Affected Environment

The U.S. Department of Interior Fish and Wildlife Service (USFWS) provides a list of threatenened, endangered, proposed, and sensitive species that have the potential to occur in Crook County for consideration in analysis (USDI Fish and Wildlife Service 2015). Currently the gray wolf is the only terrestrial threatened, endangered, proposed, or sensitive species that may occur within Crook County identified on the USFWS list. However, the greater sage grouse is listed as a candidate species that may occur. In addition, no designated or proposed critical habitat for terrestrial threatened or endangered species exists in the affected subwatersheds.

The Ochoco National Forest is also within the listing range for the Canada lynx (*Lynx canadensis*), but Canada lynx habitat was remapped in 2001. Due to insufficient quantities of primary habitat, Key Linkage Areas (KLA) and Lynx Analysis Units (LAU) are not currently mapped on the Ochoco National Forest. In addition, the Deschutes and Ochoco National Forests requested informal consultation (March 30, 2001) on continued implementation of their respective Forest Plans with LAUs mapped in accordance with the original Lynx Conservation Assessment Strategy (Ruediger et al. 2000). The USFWS gave concurrence that the mapping was consistent with the current mapping direction. Based upon the lack of habitat to support lynx residency and reproduction, and the view that lynx are not a resident, reproductively active animal in Oregon, it has been concluded that implementing Forest Plans using the current mapping would result in “may affect, but not likely to adversely affect” (NLAA) conflict determinations (May 24, 2001 and June 22, 2001).

An updated and revised Lynx Conservation Assessment Strategy was recently developed (Interagency Lynx Biology Team 2013). The updated LCAS did not identify any potential habitat on the Ochoco National Forest. The Regional Foresters Special Status Species list dated December 9th, 2011 does not have the Canada Lynx as either suspected or documented on the Ochoco National Forest.

Sensitive species that are not listed as documented or suspected on the Regional Foresters Sensitive Species list for the Ochoco National Forest are not analyzed for potential effects.

There are 16 terrestrial species on the 2011 Regional Forester's Special Status Species (RFSSS) list (USDA Forest Service 2011) that are known or suspected to occur on the Ochoco National Forest. However, only 9 species have potential habitat in the proposed project area. Species listed as Strategic are not addressed in this analysis.

The Columbia Spotted Frog is addressed in the Aquatics BE and therefore will not be discussed further in this section. Table 84 describes threatened, endangered, and sensitive species considered in the analysis of the Gap project. The Townsend's big-eared bat, American peregrine falcon, horned grebe, greater-sage grouse, tri-colored blackbird, and upland sandpiper do not have habitat within the project area and are not documented or suspected to occur in the general vicinity of project activities.

Table 84. Threatened, Endangered, Proposed and Sensitive Species for the Ochoco National Forest and Crooked River National Grassland: Status and Occurrence.

Common Name	Scientific Name	Status	Occurrence
gray wolf (outside Northern Rocky Mountains)	*Canis lupus*	E	HD/N
wolverine	*Gulo gulo*	S/C	HD/N
pygmy rabbit	*Brachylagus idahoensis*	S	HD/N
Townsends big-eared bat	*Corynorhinus townsendii*	S	HN/N
bald eagle	*Haliaeetus leucocephalus*	S, DL	HD/D
American peregrine falcon	*Falco peregrinus anatum*	S, DL	HN/N
white-headed woodpecker	*Picoides albolarvatus*	S	HD/D
Lewis's woodpecker	*Melanerpes lewis*	S	HD/S
greater sage-grouse	*Centrocercus urophasianus*	S, C	HN/N
bufflehead	*Bucephala albeola*	S	HN/D
tricolored blackbird	*Agelaius tricolor*	S	HN/N
upland sandpiper	*Bartramia longicauda*	S	HN/N
silver-bordered fritillary	*Boloria selene*	S	HD/D
Johnson's hairstreak	*Callophrys johnsoni*	S	HD/N
Crater Lake Tightcoil		S	HN/N
Columbia spotted frog	*Rana luteiventris*	See Aquatics BE	

Status

E	Federally Endangered
DL	Federally Delisted
T	Federally Threatened
S	Sensitive species from 2015 Regional Forester's list
C	Candidate species under Endangered Species Act

Occurrence

HD	**Habitat Documented** or suspected within the project area or near enough to be impacted by project activities
HN	**Habitat Not** within the project area or affected by its activities
D	Species **Documented** in general vicinity of project activities
S	Species **Suspected** in general vicinity of project activities
N	*Species **Not documented** and not suspected in general vicinity of project activities*

Gray Wolf (*Canis lupus*)

Status: Federal – Endangered, State – Endangered, Region 6, Ochoco NF – None

In 2008, the U.S. Fish and Wildlife Service (USFWS) published a final rule that established a distinct population segment (DPS) of the gray wolf in the northern Rocky Mountains (which includes a portion of Eastern Oregon, east of the centerline of Highway 395 and Highway 78 north of Burns Junction, and that portion of Oregon east of the centerline of Highway 95 south of Burns Junction). Any wolves found west of this line in Oregon belong to the conterminous USA population (USDI Fish and Wildlife Service 2008*b*). On May 5, 2011, the USFWS published a final rule – as directed by legislative language in the Fiscal Year 2011 appropriations bill – reinstating the Service's 2009 decision to delist biologically recovered gray wolf populations in the Northern Rocky Mountains (USDI Fish and Wildlife Service 2011). Gray wolves in Oregon are State-listed as endangered, regardless of location.

Life History and Habitat

Gray wolves are highly adaptable and use a variety of habitats, primarily associated with wilderness and remote areas (Mech and Boitani 2010). Areas occupied by wolves are more dependant on availability of prey than physcial cover requirements (Fuller 1989, Snyder 1991). Gray wolves are oppotunistic carnivores whose primary prey are large ungulates, including Rocky Mountain elk, and mule deer (Mech and Boitani 2010; ODFW 2005; Verts and Carraway 1998). In unexploited populations, survival of young and population growth are dependent upon availability of food during the rearing season (Jordan et al. 1967, Verts & Carraway 1998). Currently, the major limiting factor to gray wolf populations throughout it's range is human caused mortality and disturbance (Mech and Boitani 2010).

Distribution

Oregon:

In July of 2008, a biologist confirmed the presence of Oregon's first reproducing pack of wolves on the Umatilla National Forest (USDI Fish and Wildlife Service 2008*c*). Currently, Oregon Department of Fish and Wildlife (ODFW) confirms nine wolf packs in Oregon with individuals dispersed throughout the state (Dennehy 2015).

Ochoco National Forest:

In 2011, a collared wolf from the Wallowa County Imnaha pack was confirmed travelling through the Ochoco National Forest. The wolf, known as OR-7, currently resides near the Oregon/California border.

Existing Condition

There are approximately 376,000 acres of available habitat for the gray wolf on the District. Within the project area, 38,145 acres of suitable habitat exists as well as abundant prey in the form of deer and elk. High road densities and human presence may limit wolf presence within the Gap project area.

Direct, Indirect and Cumulative Effects

Alternatives 1, 2, 3, & 4

According to the USFWS, "occupied wolf range" is defined as follows: areas of confirmed presence of resident breeding packs of wolves or an area consistently used by ≥ 1 resident wolf or wolves over a period of at least one month. As a result, until an active pack is identified within the Ochoco National Forest, there is no effect of the No Action alternative nor would there be direct, indirect, or cumulative effects to wolves through proposed actions in Alternatives 2, 3, or 4.

Determination

The determination for wolves is **No Effect (NE)** because no populations currently occupy the Ochoco National Forest.

Wolverine (*Gulo gulo*)

Status: Federal – None, State – Threatened, Region 6 – Sensitive

Life History and Habitat

Wolverines are strongly associated with remote mountainous wilderness habitats (Beauvais and Johnson 2004). Open areas are avoided (Hornocker and Hash 1981) and the most critical habitat component is the absence of human activity or development (Hash 1987). Wolverines prefer cold, snowy conditions that persist late into the warm season (Copeland et al. 2010), which in Oregon is restricted to high elevation alpine and mature coniferous forests. The presence of boulder fields (Magoun and Copeland 1998), avalanche chutes, and/or large piles of down logs are also important habitat features for denning and/or rendezvous sites (Inman et al. 2007). The wolverine's diet consists mainly of elk and deer carrion, however they will consume other foods opportunistically (Hornocker and Hash 1981; Hash 1987). Wolverines are extremely mobile travelling great distances within large home ranges (Hornocker and Hash 1981). The major limiting factors to wolverine populations are lack of reliable spring snow cover (Copeland et al. 2010), and human disturbance factors (May et al. 2006).

Distribution

Oregon:

The U.S. Fish and Wildlife Service identified and characterized the current range of wolverines throughout the contiguous United States and concluded that habitat for this species exists only in the Wallowa Mountains of eastern Oregon and possibly the Cascades Mountains (USDI Fish and Wildlife Service 2013; Copeland et al. 2010). There is potential for wolverines from the Rocky Mountain population to enter Oregon from Idaho, Wyoming, or Montana (Magoun et al. 2011).

Ochoco National Forest:

Since 1965, wolverine presence has not been confirmed on the forest, although museum specimens have been collected from Linn, Deschutes, and Wheeler Counties (Verts & Carraway 1998). Unconfirmed wolverine sightings or potential wolverine sign have been recorded on the forest between 1969 and 1996. Suitable habitat consists of areas with persistent snow cover, low human impacts and disturbance, and high deer and elk concentrations. Areas on the Forest that may serve as marginal habitat for this species include; Bridge Creek, Mill Creek, and Black Canyon Wilderness Areas, and potentially portions of the Lookout Mountain Recreation Area.

Existing Condition

The project area lies within the historic range for wolverines. Historic records indicate that over the past 50 years there have been only 10 unconfirmed sightings within a 5 mile radius of the project area.

However, the most recent unconfirmed observation of a wolverine in the area was in 1996. The Lookout Mountain IRA occurs within the project area which has the potential to serve as marginal habitat for dispersing wolverines, however consistent snow has not been present in this area over the last few years reducing its ability to serve as suitable denning habitat. Wolverine presence in the project area would likely be a result of animals dispersing from suitable habitat areas to other suitable habitats, or in search of mates.

Direct, Indirect and Cumulative Effects

Alternative 1

The no action alternative does not directly alter cover or forage for prey species associated with wolverines. However, there may be a higher risk of future large scale disturbance associated with this alternative.

Under this alternative forage for many herbivorous species would continue to decline because of the continued development of closed forest canopies resulting in less available food resources for wolverine. At some point in the future, forage areas would likely develop due to insect or disease outbreaks or high intensity wildfire. Thus, availability of prey would vary over time depending on extent and intensity of future disturbance events. Ongoing uses in the project area would continue to occur.

Alternatives 2, 3, & 4

The Gap project area may be used seasonally by wolverines when human access is impeded by snow or more likely used as dispersal habitat for animals traveling between suitable denning habitat areas. The greatest impacts from proposed project activities on wolverines would be habitat fragmentation and increased human presence associated with implementation. However, wolverines have been documented using both recently logged areas (Krebs et al. 2007) and burned areas (Copeland 1996). In addition, recent research suggests that wolverines can persist in areas of dispersed recreational activities, even when use of that area is very high (Heinemeyer 2012; USDI Fish and Wildlife Service 2013). Although all action alternatives propose to reduce open road densities, it is unlikely that wolverines avoid the type of low-use roads that are generally present within their habitat (USDI Fish and Wildlife Service 2013) and thus would not benefit substantially from these actions. The scale at which most land management activities occur is relatively small compared to the average size of a wolverine home range.

The distribution of elk and deer throughout the project area may be impacted by project activities; however, treatments are not expected to decrease big game populations (see MIS section analysis on Rocky Mountain elk and mule deer). Thus, foraging opportunities for wolverines within the project area would not change. In addition, no activities are planned within the Lookout Mountain Recreation Area, thus limiting the potential for any large-scale disturbance to this species or its potential habitat.

Cumulative Effects

The cumulative effects boundary includes the five subwatersheds (see figure 37) that fall within the Gap project boundary. All of the activities listed in table 167 were considered for their cumulative effects to wolverine or their habitat.

Management activities and uses that have occurred in the past have not likely influenced the availability and quality of habitat for wolverine within the Gap project area because wolverines are not thought to be dependent on specific vegetation or habitat features that might be manipulated by land management activities, nor is there evidence to suggest that land management activities are a threat to the conservation of the species (USDI Fish and Wildlife Service 2013). In addition, the project area does not contain any identified suitable denning habitat (Copeland et al. 2010).

Ongoing and reasonably foreseeable uses, including the Lookout Mountain Multi-use Trail project, would continue to occur within the project area now and into the foreseeable future, however these disturbances have not been shown to have a detrimental effect to the viability of the species (Copeland 1996; Krebs et al. 2007; Heinemeyer 2012; USDI Fish and Wildlife Service 2013). The net combined effects of implementing the alternatives in this project with the past, present and reasonably foreseeable actions in the area are the same as described under the direct and indirect effects section above.

Determination

Implementation of the action alternatives 2, 3, and 4 **may impact individuals or habitat, but would not likely contribute to a trend toward federal listing or loss of viability to the population or species (MIIH)** for the following reasons:

- This project does not impact identified suitable habitat for this species.
- This species has not been confirmed in the project area.
- This project would increase human presence associated with project activities, however these activities have a low probability of disturbing wolverines travelling between source habitats.
- Land management activities associated with this project have the potential to displace or impact individuals at a local scale, but research has shown these effects are negligible at the population scale. Thus activities would not contribute to a loss in viability of the species.

Pygmy Rabbit *(Brachylagus idahoensis)*

Status: Federal – None, State – Sensitive, Region 6 – Sensitive

Life History and Habitat

Habitat for this species consists of tall dense stands of big sagebrush (Artemisia tridentata) in deep loose soils. Pygmy rabbits live in burrows they construct themselves or in those modified from burrows dug by other mammals. Burrows are typically found in deep loamy soils with minimum depth of 20” in alluvial fans, swales in rolling hills, large flat valleys, or creek bottoms (Weiss & Verts 1984).

The single largest loss in cover types for pygmy rabbit within the Columbia Basin has been linked to the decline of big sagebrush habitat resulting from conversion of exotic forbs and annual grasses for agriculture, as well as mismanaged grazing practices and associated soil erosion (Hann et al. 1997; Wisdom et al. 2000).

Distribution

Oregon and the Ochoco National Forest:

Weiss and Verts (1984) found only 51 occupied sites in Oregon, out of 211 potentially suitable sites, which included 1 site in Crook County. There are no records of pygmy rabbits on the Ochoco National Forest.

Existing condition

Management activities and uses that have occurred in the past have influenced the availability and quality of sagebrush habitat for the pygmy rabbit. Roads associated with past timber sales have fragmented sagebrush-steppe habitat and some removal of sagebrush from prescribed burning has occurred.

Suitable habitat for the pygmy rabbit may occur within the project area; however, potential for this species is limited by the overall lack of large expanses of dense sagebrush with deep loamy soils and the high percentage of the project area that is forested. In addition to a lack of suitable habitat, there are no documented occurrences of this species.

Direct, Indirect and Cumulative Effects

Alternative 1

The no action alternative does not directly alter sagebrush habitat. In the short term shrubs, grasses, and forbs would remain in their current state. However, in the long term juniper may continue to out-compete other sagebrush-steppe flora, reducing the suitability of habitat and potential for occupancy for this species.

Alternatives, 2, 3, & 4

For all action alternatives the primary treatments proposed within potential pygmy rabbit habitat are riparian restoration and prescribed burning. Direct and indirect effects of these activities include reductions of sage-brush habitat. While riparian restoration would predominately occur within the stream channels, access routes for heavy equipment have been identified for implementation purposes. These access routes traverse across open sagebrush-steppe habitat which may serve as potential habitat for this species. In addition, prescribed burning would occur in sagebrush-steppe habitat across the project area. Though these activities would result in reduced sage-brush habitat, the suitability of these areas for burrowing and occupancy by the pygmy rabbit is low because soils in these sites are typically shallow and lack the depth necessary for pygmy rabbit habitat.

Though activities may impact individuals or habitat at a local scale, project design features have been identified to help minimize these impacts and prevent large-scale habitat loss as projects planned in these habitats would be coordinated with the District wildlife biologist prior to and during implementation.

There is no proposed change to current grazing levels under any alternative, thus the suitability of habitat within the project area would likely remain relatively low for this species. Although, all action alternatives propose to reduce open road densities, none of those changes occur within potential suitable habitat and thus would not improve habitat fragmentation for this species. Other activities proposed under the action alternatives would not impact individuals or habitat as they are not likely to occur within potential habitats.

Cumulative Effects

The cumulative effects boundary includes the five subwatersheds that fall within the Gap project boundary (see figure 37). All of the activities listed in table 167 were considered for their cumulative effects to pygmy rabbit or their habitat.

Most of the projects yet to be implemented occur outside of potential pygmy rabbit habitat and would likely have negligible effects to this species; prescribed burning and stream restoration activities from the Fox Canyon AMP (2013) overlap with potential habitat. However, because of project design criteria from this and other projects, and the low likelihood that potential habitat is occupied, the net combined effects of implementing the alternatives in the Gap project with the past, present and reasonably foreseeable actions in the area would be negligible.

Determination

The determination for pygmy rabbit for all action alternatives is **"may impact individuals or habitat, but would not likely contribute to a trend toward federal listing or loss of viability to the population or species (MIIH)**." This determination is based on the low likelihood that potential habitat within the project area is occupied and proposed treatments have design features identified to reduce overall impacts to habitat.

Townsend's Big-Eared Bat (*Corynorhinus townsendii*)

Status: Federal – Species of Concern, State – Sensitive, Region 6 – Sensitive

Life History and Habitat

The Townsend's big-eared bat occurs in a wide variety of habitat types ranging from sea level to 11,000 feet. Habitat associations include: coniferous forests, mixed meso-phytic forests, deserts, native prairies, riparian communities, active agricultural areas, and coastal habitat types (Piaggio 2005). Distribution is strongly correlated with the availability of caves and cave-like roosting habitat, including abandoned mines (Perkins 1987). The Townsend's big-eared bat is a moth specialist, foraging within wooded areas, along edge habitats and near streams. The primary threat to the Townsend's big-eared bat is related to disturbance and/or destruction of roost sites. Timber harvest and loss of riparian habitat further threatens the persistence of this bat (Piaggio 2005).

Distribution

Oregon:

In Oregon, the Townsend's big-eared bat has been collected throughout most of the state except in parts of the Blue Mountain Province and in the western part of the Basin and Range Province (Verts & Carraway 1998).

Ochoco National Forest:

Townsend's big-eared bats were observed in 1998 and again in 2004 roosting at a mine site located on the Ochoco National Forest that is approximately 2.5 air miles from the Gap project area.

Existing Condition

There are no caves or mines that would provide suitable sites for maternity or hibernation colonies within the project area. There are no recorded locations for Townsend's big-eared bat within the project area.

Direct, Indirect and Cumulative Effects

Alternatives 1, 2, 3, & 4

Suitable habitat for the Townsend's big-eared bat does not occur within the project area. Lack of caves or mines limits this species presence within the project area. Because of the lack of habitat and the unlikely occurrence of the species in the project area no direct, indirect, or cumulative effects are expected.

Determination

A **No Impact (NI)** determination is reached for all alternatives. There are no documented occurrences of this species in the project area. Because of lack of habitat and species presence, there would not be any direct, indirect, or cumulative effects to this species.

Bald Eagle *(Haliaeetus leucocephalus)*

Status: Federal – Delisted, State – None, Region 6 – Sensitive Species and Ochoco National Forest Management Indicator Species

Life History and Habitat

The bald eagle is heavily associated with aquatic habitats and a majority of their diet is fish, however they will also consume carrion, waterfowl, and small mammals. Nests are typically located in large trees or snags in close proximity to water (Csuti et al. 2001). Habitat loss and human activities that adversely affect the suitability of breeding, wintering, and foraging areas continue to be the most significant long term threat to bald eagles (USDI Fish and Wildlife Service 1986).

Distribution

Oregon:

Bald eagles are widely distributed across Oregon, and are a fairly common breeder (Issacs and Anthony 2003). In Oregon, bald eagles are most common around large inland lakes, marshes, coastal areas, and along the Columbia River (Csuti et al. 2001).

Ochoco National Forest:

Bald eagles have been documented on the Forest, Crooked River National Grassland, and adjacent private lands. There are ten known eagle territories across the Forest and Grassland, with an additional 5 territories on adjacent private lands. Most observations of bald eagles are seasonal, occuring in the late fall, winter, and early spring. The Forest has identified 4 Eagle Roost Management Areas (F-12), and 5 additional Bald Eagle Management Areas (BEMA).

Existing Condition

Management activities and uses that have occurred in the past have influenced the availability and quality of habitat for bald eagles. The removal of large trees and snags, through timber harvest and other management activities, has altered the availability of potential nest or roost sites. Fire suppression activity over the last 100 years has led to the development of dense stand conditions that currently exist.

Road construction and developed recreation have altered the extensiveness and level of human activity throughout the project area, increasing the potential for disturbance. Prescribed burning, and hazard tree reduction within the project area has removed some snags potentially affecting the abundance of roosting and nesting sites. There has also been increased forage production for big game in thinned or burned areas, contributing to food resources for bald eagles in the form of carrion.

There are no current or historical records of bald eagles nesting within the project area. In addition, there are no designated Bald Eagle Management Areas or Eagle Roost Management Areas. However, there are numerous observations of bald eagles within and adjacent to the project area. Potential nesting and roosting habitat for the bald eagle is present within the project area in the form of large trees that could serve as perch trees, roost sites, or potential future nest sites; however, the absence of large bodies of water limits the potential for the area to serve as important bald eagle habitat.

Direct, Indirect and Cumulative Effects

Alternative 1

There would be no activities outside of the ongoing program of work that would affect bald eagles or their habitat within the project area. There is potential for an increased risk of loss of habitat due to future wildfire intensity or extent due to retention of existing fuel loads and continuation of fuel development and accumulation over time. However, predicting the impact of future events on bald eagle nesting, roosting, or foraging areas in a quantitative manner is difficult because of uncertainties regarding the location and conditions under which such future events might occur. Over time live trees currently supporting a nest or with potential as future nest sites may be weakened by stress competition, and succumb to insect infestation. Once the live overstory trees die they become less attractive as nest sites for bald eagles. The development of additional potential nest or roost trees would be slower under the no action alternative because of the current high stocking levels that exist.

Conclusion

Over the mid- to long-term the lack of action to increase the health and vigor of large diameter ponderosa pine may result in the loss of these trees important for bald eagle nesting. This loss of suitable nesting trees would reduce or potentially eliminate the use of the area for nesting by bald eagles over the foreseeable future.

Alternatives 2, 3, & 4

All action alternatives propose treatments that would retain and develop future old trees of all species. Retention of existing large trees, accelerating growth, and moving younger stands towards older forest structure would indirectly benefit bald eagles in the long-term by providing larger, older tree structure and additional potential roost trees. In the short-term, disturbance to bald eagles as a result of project implementation could occur as well as the potential loss of large snags if designated as hazard trees within units, along haul routes, or as a result of fuel wood cutting along reopened roads, however, there are no known nest or roost sites within the project area, so the likelihood of disturbance is low. In addition, the landscape is near or above reference conditions for densities of large snags (>20" dbh) within the project area. A distribution analysis for snags has been done for the Gap project and is summarized in the Management Indicator Species section under primary cavity excavators.

Alternative 4 may remove grand fir trees less than 150 years old but greater than 21" dbh in stands where grand fir affects the survivability of older pine and Douglas-fir trees or where grand fir affects the ecological sustainability of the stand directly effecting the abundance of suitable nest and roost structure. Comparatively, alternatives 2 and 3 retain all trees over 21" dbh, regardless of tree species. This may retain some young, yet large grand fir on site. Most fir trees do not have the branch structure needed for nests; however they may be used as perches or roosts. Commercial and noncommercial thinning would not remove large, old ponderosa pine with branch structure suitable for bald eagle nest or roost trees.

Prescribed fire activity proposed in all action alternatives could result in the loss of large green trees or snags; design elements that include ignition patterns avoiding snags, and clearing brush and fuel accumulations from select snags would minimize losses. Overall reduction in fire risk as a result of thinning and fuels reduction would benefit retention of large old ponderosa pine, and snags, indirectly benefiting bald eagle nest and roost habitat in the long-term.

The proposed reduction in open road densities would likely result in retaining more snags as a result of limiting access for public firewood cutting in these areas. Snag retention may increase roost sites or perch trees although, there would likely be no benefit to nesting bald eagles as 98% of eagle nests are built in live trees (Isaacs and Anthony 2003).

Riparian restoration activities proposed in all action alternatives could benefit aquatic species. These activities occur on class 1 and 2 streams which would benefit fish population numbers, and thus increase the potential suitability of the project area by increasing the prey base present for bald eagles.

The Forest Plan established standards for protecting active bald eagle nests and roost areas. In addition, project design features for this species have been identified which would minimize any disturbance impacts to this species during critical time periods. Currently, there are no known bald eagle nest sites or winter roosts within the Gap project area. However, if an occupied bald eagle nest is discovered during project activities, standards and guidelines described in the Forest Plan and further identified in the project design features would be implemented to protect active eagle nests from human disturbance until such time that nesting, feeding, and fledging are completed in addition to providing protections of nest sites and nesting habitat (USDA Forest Service 1989*a*).

Cumulative Effects

The cumulative effects boundary includes the five subwatersheds that fall within the Gap project boundary (see figure 37). All of the activities listed in table 167 were considered for their cumulative effects to bald eagle or their habitat.

Effects from other commercial and noncommercial treatments previously implemented within the project area were included in the existing condition. No additional thinning outside of a small amount of aspen enhancement would overlap in time and space with proposed project activities.

The aspen enhancement activities to be implemented from the Fox Canyon and Big Summit AMPs intend to reduce encroaching conifers and promote the development of large hardwood species. These treatments have the potential to add negatively to the cumulative effects in the short-term due to disturbance during implementation as these treatments could be implemented simultaneously with others across the project area.

Prescribed burning from the Fox Canyon and Big Summit AMPs has yet to be implemented within the project area. However, because not all acres would be burned simultaneously, or in a contiguous block, refugia would exist across the project area where bald eagles would be expected to persist. In addition, mid- to long-term effects of these treatments have the potential to improve the overall condition of the habitat, by reducing the competition and improving the health and vigor of large diameter trees suitable for nesting. Therefore, it is unlikely that effects from the action alternatives in the Gap project when combined with these ongoing activities would contribute negatively to the overall cumulative effects.

Public firewood cutting is expected to continue along open roads. However, due to the restrictions placed on cross-country travel from the Deschutes Ochoco Travel Management EIS and South Boundary Travel Management Area, the impacts from these directives, combined with the additional proposed reduction in open road density from the Gap project would have a beneficial cumulative effect on snag retention. This benefit would come by reducing access for firewood cutting, therefore increasing potential nest, roost and perch sites for the bald eagle.

Additional riparian restoration activities yet to be implemented from Fox Canyon and Big Summit AMPs could also benefit aquatic species. These activities when combined with activities proposed in the Gap project would have a positive cumulative effect by improving habitat conditions for the bald eagle prey base and thus increasing potential suitability of the project area for this species.

Determination

The determination for bald eagle is all action alternatives "**may impact individuals or habitat, but would not likely contribute to a trend toward federal listing or loss of viability to the population or species (MIIH)**." In the long term, treatments would help retain and promote growth and longevity of large trees and improve aquatic prey availability, and would have a **Beneficial Impact (BI)** on Bald Eagles.

American peregrine falcon *(Falco peregrinus anatum)*

Status: Federal – Delisted, State – Sensitive, Region 6 – Sensitive

Life History and Habitat

Peregrine falcons nest on cliffs greater than 75 feet in height, and are typically found no farther than 1 mile away from some form of water (Henny and Pagel 2003). Nest sites typically overlook open habitat where waterbirds are plentiful, as peregrines are not well suited for interior forests (Csuti et al. 2001).

The diet and prey species of peregrine falcons varies considerably between locations (Csuti et al. 2001). Across its range this species consumes birds, small mammals and insects. In Oregon, the major prey items at most sites are rock doves, starlings, and gulls (Henny and Pagel 2003).

Distribution

Oregon:

Within Oregon, American peregrine falcons are a regular breeder and an uncommon migrant (Henny and Pagel 2003). Nesting occurs in xeric areas of eastern Oregon, marine habitats of western Oregon, montane habitats that extend to over 6,000 feet in elevation, small riparian corridors statewide, and more recently in urban habitats of the lower Willamette and Columbia rivers (Henny and Pagel 2003).

Ochoco National Forest:

There are no known peregrine falcon eyries on the Ochoco National Forest. Observations of this species have occurred on the Forest and adjacent private land, however they are likely associated with seasonal migration.

Existing Condition

There is no suitable cliff habitat for nesting within the Gap project area. Suitable foraging habitat for this species may exist within the project area, although peregrines typically do not select denser forested habitats or rolling topography that characterizes the area.

Direct, Indirect and Cumulative Effects

Alternatives 1, 2, 3, & 4

Due to the lack of suitable cliff habitats within the project area, it is unlikely that peregrine falcons would be reproducing within this area. There have been no sightings of peregrine falcons within the project area. The nearest historical sighting was approximately 15 air miles from the Gap project area. Suitable foraging habitat exists and peregrine falcons may utilize the project area for foraging, especially during migration, though the habitat is not ideal for the species needs.

Dispersing falcons that may pass through the project area are expected to be able to avoid any human disturbance associated with alternatives 2, 3, and 4. Action alternatives 2, 3, and 4 could improve foraging habitat for this species by creating more open forest conditions which has the potential to make prey more accessible.

Past activities, ongoing projects and reasonably foreseeable future activities are not expected to combine with effects from this project to result in cumulative effects. If a peregrine falcon nest site was located, protection measures described in the Forest Plan standards and guidelines would be implemented to protect active bird of prey nests from human disturbance until nesting, feeding, and fledging are completed and provide protections of nest sites and nesting habitat for the species involved (USDA Forest Service 1989*b*).

Determination

A **No Impact (NI)** determination is reached for all alternatives. Suitable reproductive habitat for this species does not exist in the project area. There are no documented occurrences of this species in the project area. Any use of the area by this species would be considered incidental, and project effects would be negligible. Therefore, no direct, indirect or cumulative effects to this species are anticipated.

White-headed Woodpecker (*Picoides albolarvatus*)

Status: Federal – Species of Concern, State – Sensitive, Region 6 – Sensitive

Life History and Habitat

White-headed woodpeckers are associated with open canopy stands of large mature and over mature ponderosa pine, and less frequently associated with mixed ponderosa and Douglas-fir stands (Burleigh 1972; Ligon 1973; Cannings 1995; Buchanan et al. 2003). The white-headed woodpecker differs from many of the other primary cavity excavators in its near exclusive selection of mature single stratum ponderosa pine dominated habitats. In Oregon this species relies almost exclusively upon the seeds from large ponderosa pine cones for foraging and eats insects gleaned off ponderosa pine trees (Bull et al. 1986; Dixon 1995). White-headed woodpeckers prefer large snags for nesting; however, other substrates are used including stumps, leaning logs, and dead tops of live trees (Dixon 1995).

White-headed woodpeckers lack strong excavating ability and rarely forage on completely dead trees (Mellen-McLean et al. 2013). Because of its more limited need and use of snags for foraging (Bull 1980, Ligon 1973, Raphael and White 1984) the species snag requirements are less than those required by other primary cavity excavators such as the pileated, downy, and hairy woodpeckers.

Distribution

Oregon:

White headed woodpeckers are found in the Blue, Ochoco, and Wallowa Mountains as well as the east slope of the Cascades. Loss of mature ponderosa pine habitat has resulted in a severe decline of this species in the Blue Mountains of Oregon (Csuti et al. 2001)

Ochoco National Forest:

As with the rest of Oregon, habitat abundance and distribution for white-headed woodpeckers has been reduced or eliminated in the warm dry and hot dry forest types. Past harvest activities have concentrated on removing the large overstory ponderosa pine, western larch and Douglas-fir trees and snags, setting many stands back to younger structural stages. Fire suppression has increased stocking of understory firs, shifting stand structure from old forest single structure to old forest multi-structure.

As part of a region-wide monitoring effort, formal surveys for the white-headed woodpecker were conducted in 2010, 2011, and 2012 within the project area. Only 2012 yielded any observations, however, the total area covered was very minimal in relation to the total suitable habitat present.

Since that time, numerous observations of both adults and juveniles have occurred, which further confirm the species use of suitable habitat within and adjacent to the Gap project area.

Existing Condition

Past activities that impacted white-headed woodpecker habitat include salvage and green timber harvest through the removal of large trees and snags that would have provided nesting habitat. Management practices, including clearcutting, overstory removal, salvage, and shelterwood harvest of ponderosa pine have converted many stands previously dominated by open, large diameter pine to stands now characterized as young even-aged plantations.

The extensive road network in the project area (largely a result of past harvest) has impacted snag densities by decreasing habitat from road construction and increasing accessibility of the area to firewood cutting. The Ochoco National Forest personal use firewood cutting guidelines prohibit the cutting of standing snags, however, violations of these rules occur and standing snags are often felled. Satellite imagery from 2004 was used to characterize vegetation, which was subsequently used to estimate white-headed woodpecker reproductive habitat within the watershed. The satellite imagery only provides a broad scale look at the live-tree component and does not provide information on stand specific snag or down log levels. A distribution analysis for snags has been done for the Gap project and is summarized in the Management Indicator Species section under primary cavity excavators.

Predictive modeling using the Viable Ecosystem Management Guide (Simpson et al. 1994) developed on the Ochoco National Forest indicates that the HRV for white-headed woodpecker nesting habitat would have been between 13,586 and 26,381 acres in the project area (see table 85). Currently, there are approximately 7,522 acres of white-headed woodpecker reproductive habitat, which is below the HRV. In addition, a majority of the reproductive habitat may be dominated by mid-sized trees as the large tree component has been removed during past timber harvest within much of the ponderosa pine PAGs. Dense understories, consisting primarily of young trees, are likely limiting suitable white-headed woodpecker habitat within the project area. It is expected that with more frequent fire return intervals that occurred historically, open large diameter ponderosa pine stands would have been much more evident than what exists today.

Mellen-McLean et al. (2013) recommended the following restoration treatments within dry forests for the purposes of improving habitat conditions for the white-headed woodpecker:

- Retaining and producing large, old ponderosa pine used for foraging;
- Retaining and producing large snags used for nesting;
- Reducing shrub cover and excess down wood to reduce numbers of small mammals that prey on nests;
- Reducing canopy density to provide interspersion of open and closed pine stands;
- Maintaining within stand heterogeneity

Direct, Indirect, and Cumulative Effects

Alternative 1

This alternative would not treat forest stands. Habitat for white-headed woodpecker would remain below the HRV under this alternative in the short-term. The existing acres of fir-dominated understories and the trend toward fir dominated habitats would continue unabated, leading to a continued decline in open pine dominated stands, favorable habitat for this species. Mortality of large ponderosa pine due to stand densities being above sustainable levels would likely result in loss of foraging habitat for white-headed woodpeckers as the overstory pine trees succumb to stress from competition in overstocked stands. Open road density would remain the same, thus fuel wood cutting (snag removal) is not likely to change.

Over time stand conditions are expected to decline on sites that cannot sustain high densities of conifers. As trees on such sites succumb to insect invasion they would stop producing seeds, sap and invertebrates associated with foliage. These are listed as important food resources for this species (Marshall 2003). If the mortality becomes extensive and live canopy closure is lost in large areas of severe insect infestations or fire intensity, then affected areas would become less suitable for this species. If the mortality remains moderate and patchy, then the affected areas may become more suitable for this species which prefers relatively open forest conditions. Risk of habitat loss due to insect, disease, and wildfire would not be addressed.

Conclusion

This alternative would have no direct effects on the white-headed woodpecker. Indirectly, it could ultimately lead to an elevated level of risk of habitat loss in some areas. Lack of treatment in ponderosa pine habitats to reduce stand density and create single stratum habitats would maintain the current projection of reduced habitat suitability for the white-headed woodpecker.

Alternatives 2 and 3

These action alternatives would reduce the understory fir component on acres dominated by ponderosa pine and western larch and increase the abundance of more open stand structure with ponderosa pine contributing a relatively larger percentage of the species composition. This would help restore white-headed woodpecker habitat on most of the commercial harvest acreage. Both alternative 2 and alternative 3 would improve white-headed woodpecker habitat within the project area (see table 85). Under alternative 2 and alternative 3, commercial treatments would occur on 5,418 acres and 4,363 acres respectively, within ponderosa pine PAGs; which serve as nesting and foraging habitat for white-headed woodpecker (see table 86). The remainder of the commercial thinning would occur within Douglas-fir and dry grand fir plant associations that are dominated by early seral species, primarily ponderosa pine and western larch. Due to the variation in species composition and size within the Douglas-fir and dry grand fir plant associations, the quality of habitat for white headed woodpeckers would be variable within these acres. A portion of these acres are expected to retain higher concentrations of fir species in the understory, which may reduce the suitability.

Where noncommercial thinning occurs in multi-storied stands with a component of large, live ponderosa pine and suitable snags for nesting, this treatment would restore white-headed woodpecker habitat. Noncommercial thinning in young stands promotes the development of large pine in the future, and thus habitat for white-headed woodpecker. Prescribed underburning would occur on acres outside of thinning units in ponderosa pine PAGs (see table 86). The implementation of these alternatives would restore white-headed woodpecker habitat and increase the total reproductive habitat to 20,626 acres for alternative 2, and 19,688 acres for alternative 3, which as a result would be within the HRV post-treatment for both alternatives. These alternatives would continue the process on the District, and Forest, of implementing the Viable Ecosystems Management Guide, a guide that describes historical stand conditions and seral processes, by reducing the understory fir component on acres dominated by ponderosa pine and western larch, and thus benefitting the white-headed woodpecker.

Table 85. White-Headed woodpecker reproductive habitat (in acres) with relation to the Historic Range of Variability (HRV).

Alternative	HRV - Min	HRV - Max	Acres (Post Treatment)	Relation to HRV
Alternative 1	13,586	26,381	7,522	below
Alternative 2	13,586	26,381	20,626	within
Alternative 3	13,586	26,381	19,688	within
Alternative 4	13,586	26,381	20,857	within

Table 86. Treatments in potential white-headed woodpecker habitat (Ponderosa Pine PAGs) within the Gap Landscape Restoration project.

Treatment	Commercial Thinning	Noncommercial Thinning	Prescribed Burning Only
Alternative 1	0	0	0
Alternative 2	5,418	5,970	2,853
Alternative 3	4,363	5,670	3,153
Alternative 4	5,418	6,135	2,853

Implementation of alternative 2 and alternative 3 would result in 13,104 and 12,166 acres more reproductive habitat for white-headed woodpeckers compared to the no action alternative as shown in table 85. Post-treatment stand conditions are expected to provide conditions in which white-headed woodpeckers would be expected to nest for up to 15 years on mesic sites (grand fir and Douglas-fir PAGS), or up to 30 years on more xeric sites (ponderosa pine PAGs). These lengths of time correspond to the regeneration of the mid- and understory layers, and are also dependent on the intervals and intensities of maintenance burning that occur post-treatment.

Reduction of open road densities proposed in all action alternatives would reduce the loss of snags and down wood within the project area by restricting public access for roadside firewood cutting. Currently, the project area has an adequate amount of large diameter snags present for this species. A distribution analysis for both snags and down wood was completed for the Gap project and can be found in the MIS section under primary cavity excavators.

All action alternatives propose riparian restoration and aspen enhancement. Treatments within aspen stands would open up forest structure and may improve habitat for white-headed woodpeckers, however neither of these treatments would have substantial benefits to this species.

Determination

Alternative 2 and 3 would improve habitat for this species by enhancing the development of large trees and snags in stands where they are currently limited, and by creating more open forest conditions that are preferred by the white-headed woodpecker. Prescribed fire has the potential to modify the abundance of large snags and their condition class in treated areas. This could lead to a reduction in nesting structure for this species.

Conversely, prescribed fire would indirectly benefit the white-headed woodpecker by reducing shrub and down wood cover, habitat of ground squirrels that predate on this species (Frenzel 2004; Kozma and Kroll 2012). Protective measures incorporated in the project design should reduce the loss of large snags, though it is likely some would still be consumed during prescribed burning. In addition, the proposed reduction in open road density may offset this loss of snag and down wood habitat by limiting access for woodcutting.

Alternative 4

Alternative 4 would have similar effects to those described for alternatives 2 and 3 (see table 85), but with the addition of harvesting trees ≥ 21" dbh on 2,187 acres. Trees ≥ 21" dbh proposed for harvest would be done to meet the purpose and need of the project. Species targeted for removal are grand fir and Douglas-fir within ponderosa pine PAGs. This alternative would increase reproductive habitat from the existing condition (7,522 acres) by 13,335 acres, thus reaching a level within the HRV (see table 85).

Cumulative Effects

The cumulative effects boundary includes the five subwatersheds that fall within the Gap project boundary (see figure 37). All of the activities listed in table 167 were considered for their cumulative effects to the white-headed woodpecker or its habitat. The cumulative effects explained below are common to all action alternatives.

Currently there are no other projects proposed in the Gap project area that include commercial harvest.

Public firewood cutting is expected to continue along open roads. The continued implementation of the Deschutes Ochoco Travel Management Plan and the South Boundary Travel Management Area will continue to limit cross-country motorized access within the project area. These restrictions combined with the proposed road closure and decommissioning activities in the Gap project would have a positive effect on the species as they retain snags by reducing access for firewood cutting. Cattle may have caused shifts in plant species composition and abundance through selection of more palatable forage species, however, grazing does not alter snag densities or the number of mature pine present in the project area so there are no anticipated effects as a result of implementation of any action alternatives. Therefore, there would not be any cumulative effects on white-headed woodpecker as a result of the adaptive management activities associated with Fox Canyon or Big Summit Cluster AMPs.

Invasive weed treatments in the project area outlined by the Deschutes and Ochoco Invasive Plant Treatment FEIS, although beneficial to the persistence of native desirable vegetation will have negligible effects on the white-headed woodpecker. Riparian restoration and aspen enhancement may improve habitat for this species in the long-term, however this benefit would be almost negligible. Therefore, the implementation of any of the proposed action alternatives when combined with the additional pending implementation of riparian restoration and aspen enhancement within the project area from the Fox Canyon and Big Summit Cluster AMP projects would not contribute negatively toward any cumulative effect for this species. The implementation of Alternatives 2, 3, & 4 would provide positive effects to nesting and foraging habitat; which may diminish some past negative cumulative impacts to these habitats within the project area. These alternatives were developed to improve the forest and riparian vegetative conditions faster than Alternative 1.

Determination

All action alternatives result in a net increase in habitat for this species at the landscape scale, based on structural stages. The determination of effect of these alternatives on white-headed woodpecker is "**may impact individuals or habitat, but not likely contribute to a trend toward federal listing or loss of viability to the population or species (MIIH)**" because of the potential to disturb or displace individuals during implementation in the short-term. In the mid- to long-term, treatments would help retain and promote growth and longevity of large trees and would have a **Beneficial Impact (BI)** on this species.

Lewis's Woodpecker (*Melanerpes lewis*)

Status: Federal – Sensitive, State – Sensitive, Region 6 – Sensitive

Life History and Habitat

Unlike most other woodpecker species in Oregon, the Lewis's woodpecker inhabits primarily open forests and woodlands since its primary foraging strategy is fly catching (Galen 2003). Nesting habitat consists of two distinct types in eastern Oregon: riparian areas with large cottonwoods, and fire maintained or burned old-growth ponderosa pine forests (NatureServe 2014). This species seldom excavates its own nest cavity; instead it uses cavities created by other woodpeckers (Bock 1970; NatureServe 2014). In burned areas, ponderosa pine snags greater than 16" dbh are chosen for nesting. Similar diameter cottonwood snags in riparian areas are selected (Galen 1989).

Distribution

Oregon and Ochoco National Forest:

Currently, the Lewis's woodpecker is common year round only in the white oak-ponderosa pine belt east of Mt. Hood. However, it breeds in eastern Oregon river and stream valleys such as the John Day, Grande Ronde, Lower Deschutes, Wallowa, Imnaha, Burnt, Klamath, Squaw, Murderers, and Pike Creek (Galen 2003).

There has been an approximate 70-75% decline in source habitat for this woodpecker compared to historic estimates in the Blue Mountains (Wisdom et al. 2000). This decline is possibly due to loss of habitat including nest and food storage trees, and from increased competition for nest trees by introduced European starlings. In addition, Altman (2000) identifies numerous conservation issues specific to Lewis's woodpecker including: fire suppression, salvage logging, the alteration of single stratum old forest to younger structural stages, high grading individual old ponderosa pine trees before decay and snag formation, fuelwood cutting, increased roads accessing fuelwood, limited insect productivity due to grazing and brush control, insect control, and pesticides.

There have been limited sightings of this species on the Ochoco National Forest, although nesting is known to occur along streams in the Blue Mountains (Galen 2003).

Existing Condition

Past activities that impacted Lewis's woodpecker habitat include salvage and green timber harvest through the removal of large trees and snags that would have provided nesting habitat. Management practices, including clearcutting, overstory removal, salvage, and shelterwood harvest of ponderosa pine have converted many stands previously dominated by open, large diameter pine to stands now characterized as young even-aged plantations.

The extensive road network in the project area (largely a result of past harvest) has impacted snag densities by decreasing habitat from road construction and increasing accessibility of the area to firewood cutting. The Ochoco National Forest personal use firewood cutting guidelines prohibit the cutting of standing snags, however, violations of these rules occur and standing snags are often felled.

The exclusion of fire has increased stand densities, which has reduced Lewis's woodpecker habitat by creating heavily stocked stands with higher canopy cover than what existed historically. An increased canopy cover limits shrub production, decreasing foraging habitat for Lewis's woodpecker.

Current livestock grazing in the uplands and along streams has also affected nesting and foraging habitat for Lewis's woodpecker. Cattle may have caused shifts in plant species composition and abundance through selection of more palatable forage species. Cattle reduce ground cover through trampling or consuming vegetation, decreasing insect availability. Past grazing in stream corridors has also reduced riparian shrub habitat. The conditions of some riparian areas and aspen habitats has been improved by new management practices and restoration activities in more recent years, but some areas are still not fully restored to conditions that are most suitable for Lewis's woodpecker.

The Paulina Ranger District has had numerous stand replacing fires that provide suitable foraging habitat for the Lewis's woodpecker. In 2014, the Fox wildfire burned a small portion of the project area (<5 acres) at moderate intensity in ponderosa pine habitat. Additional moderate and high severity burned acreage for the Fox wildfire exists adjacent to the project area, which has potential to provide habitat for the Lewis's woodpecker. Within riparian zones found in the project area, small stands of cottonwoods exist in scattered clumps; however, in numerous locations, the declining water table is limiting the regeneration of such hardwoods.

Reproductive habitat for Lewis's woodpecker is composed of 7,522 acres within the project area which is below the HRV (see table 87). The reproductive habitat estimate is a broad scale look at the live tree component and does not provide information on stand specific snag or down wood log levels. A distribution analysis for snags has been done for the Gap project and is summarized in the Management Indicator Species section under primary cavity excavators.

According to district records and GIS data layers there is one historic record of the Lewis's woodpecker located within 5 air miles of the project area on private land.

Direct, Indirect and Cumulative Effects

Alternative 1

Habitat for Lewis's woodpecker would not be treated and current trends in habitat condition would continue. Habitat would remain below the HRV, and Lewis's woodpecker habitat would be expected to decline with the ingrowth of understory trees the subsequent reduction of open habitats. The risk of habitat loss due to insect, disease and wildfire would not be addressed. Increasing stand densities and density-related mortality of large diameter ponderosa pine would create an increased risk of high intensity wildfire that would benefit the Lewis's woodpecker should a wildfire occur. Refer to the Silviculture report and the Fire and Fuels report for detailed discussion of risk of loss due to these disturbance agents.

Conclusion

This alternative would have no direct effects on the Lewis's woodpecker, but indirectly could lead to an elevated level of risk of high intensity wildfire which, should a wildfire occur, increase habitat for the Lewis's woodpecker.

Alternatives 2, 3 & 4

The action alternatives directly improve habitat for this species by promoting riparian hardwood vegetation, enhancing the development of large trees and snags in stands where they are currently limited, and by creating more area with open forest canopy. Prescribed fire has the potential to modify the size, abundance and condition class of snags in treated areas, which could yield both positive and negative results to habitat for this species. Snags can be both lost and created during implementation of burning. Project design features are incorporated into underburning prescriptions to minimize the effects to existing snags and large diameter down wood, as well as limiting mortality to large green trees.

Patches of mortality may consist of one or two trees, or, depending on fuels, topography, and weather, may occasionally result in small burn patches. Because the trees with the highest potential to be killed would be smaller than 10" dbh, benefits to this species would be primarily to foraging habitat. The extent of project activities and expected outcomes should provide for a net increase of reproductive habitat acres for each action alternative, with all of them falling within the HRV post-treatment (see table 87).

Table 87. Lewis's woodpecker reproductive habitat (in acres) with relation to the Historic Range of Variability (HRV).

Alternative	HRV - Min	HRV - Max	Acres (Post Treatment)	Relation to HRV
Alternative 1	13,586	26,381	7,522	below
Alternative 2	13,586	26,381	20,626	within
Alternative 3	13,586	26,381	19,688	within
Alternative 4	13,586	26,381	20,857	within

Cumulative Effects

The cumulative effects boundary includes the five subwatersheds that fall within the Gap project boundary (see figure 37). All of the activities listed in table 167 were considered for their cumulative effects to the Lewis's woodpecker or its habitat.

Currently, there are no other projects proposed within the Gap project area that include commercial harvest.

Public firewood cutting is expected to continue along open roads. The continued implementation of the Deschutes and Ochoco Travel Management plan and the South Boundary Travel Management Area will continue to limit cross-country motorized access within the project area. These restrictions combined with the proposed road closure and decommissioning activities in the Gap project would have a positive effect on the species as they retain snags by reducing access for firewood cutting.

Adaptive management activities outlined in the Fox Canyon and Big Summit AMP projects should cumulatively enhance and expand habitat and connectivity of riparian habitats through riparian restoration and aspen enhancement and protection. Expanding and enhancing riparian habitats and hardwood species, particularly cottonwood, would benefit the Lewis's woodpecker.

Invasive weed treatments in the project area outlined by the Deschutes and Ochoco Invasive Plant Treatment FEIS, although beneficial to the persistence of native desirable vegetation will have very little effect on the Lewis's woodpecker.

The implementation of Alternatives 2, 3, & 4 would provide positive effects to foraging habitat; which may diminish some past negative cumulative impacts to foraging habitat within the cumulative effects boundary. These alternatives were developed to improve the forest/riparian vegetative conditions faster than alternative 1. Nesting habitats would also be improved by the removal of conifer from aspen stands.

Determination

The determination of effect of the action alternatives on the Lewis' woodpecker is "**may impact individuals or habitat, but not likely to result in a trend toward federal listing or loss of viability of the species or populations (MIIH)**" because of the potential to disturb or displace individuals during implementation in the short-term**.** In the long term, treatments would help retain and promote growth and longevity of large trees and open stand conditions that would have a **Beneficial Impact (BI)** on Lewis's woodpecker.

Greater Sage Grouse *(Centrocercus urophasianus)*

Status: Federal – None, State – Sensitive, Region 6 – Sensitive

Life History and Habitat

Sage grouse are a sagebrush obligate species, relying on the plant for food and cover throughout the year (Barnett 2003). Greater sage grouse are found in foothills, plains, and mountain slopes where sagebrush is present and the habitat contains a mixture of sagebrush, meadows, and aspen in close proximity. Winter habitat containing palatable sagebrush is the most limited seasonal habitat in some areas (NatureServe 2014). This species aggregates on breeding sites (leks) in the spring which consist of open areas with sparse cover which could conceal a predator (Barnett 2003). After breeding, the females nest in stands of tall sagebrush with spreading (umbrella shaped) crowns and abundant bunchgrass cover. After hatching the females lead their chicks to riparian areas or other sites where succulent forbs and invertebrate food resources are abundant (Barnett 2003). Juniper expansion, loss of sagebrush at lower elevations, and anthropogenic disturbances such as structures and recreation are the greatest threats to sage-grouse and their habitats on the Forest, private, and Bureau of Land Management lands that are in the vicinity of the Gap project area (Hagen 2011).

Distribution

Oregon:

Sage grouse were once widespread in sagebrush-dominated areas east of the cascades (Aldrich 1963). Currently they are most common in the southeastern desert regions (Barnett 2003; Crawford & Lutz 1985).

Ochoco National Forest:

On the Ochoco National Forest there are 19,550 acres of sage grouse habitat, of which 16,933 acres is identified as core habitat and 2,617 acres is identified as low density habitat. Core areas represent a proactive attempt to identify a set of conservation targets to maintain a viable and connected set of populations before the opportunity to do so is lost (Doherty et al. 2011; Hagen et al. 2011). The core area approach provides guidance to land use planners, land managers, and the public (Hagen et al. 2011). Low density areas provide for breeding, summer, and migratory habitats for the greater sage grouse but have low productivity (Hagen et al. 2011).

Existing Condition

No core area, or low density habitat has been identified within the project area. Potential for this species within the project area is limited by the lack of large expanses of dense sagebrush and the high percentage of the project area that is forested. In addition to a lack of suitable habitat, there are no documented occurrences of this species in the project area. The nearest lek occurs off Forest is approximately 6.5 air miles away and seven leks are within 10 air miles of the project boundary.

Direct, Indirect and Cumulative Effects

Alternatives 1, 2, 3, & 4

Determination

A **No Impact (NI)** determination is reached for all alternatives. Suitable habitat does not exist in the project area. There are no documented occurrences of this species in the project area. There would be no direct, indirect or cumulative effects to this species.

Bufflehead *(Bucephala albeola)*

Status: Federal – None, State – None, Region 6 – Sensitive

Life History and Habitat

The bufflehead nests near high mountain lakes surrounded by open woodlands (Gilligan et al. 1994). Buffleheads are the smallest diving ducks allowing them to nest in small cavities excavated by northern flickers (Griffee 1961). In migration and winter, buffleheads can be seen on sheltered freshwater lakes, freshwater ponds, sewage ponds, slow-moving rivers, estuaries, bays and backwaters (Gilligan et al. 1994). Buffleheads eat crustaceans and aquatic insects during the nesting season and seeds of pondweeds and bulrushes (Csuti et al. 2001). The bufflehead is a game species in Oregon.

Distribution

Oregon:

Nesting primarily occurs in the central and southern Cascade Mountains. The bufflehead is widely distributed throughout the state frequenting open waters on major rivers and lakes. However, Csuti et al. (2001) states that only several hundred breeding pairs are present within Oregon.

Ochoco National Forest:

On the Ochoco National Forest buffleheads are not commonly seen. However, the occasional bufflehead is spotted during migration on small ponds and reservoirs. There are no current or historic records of this species nesting within the project area or on the Forest.

Existing Condition

There have been no sightings of bufflehead within the project area; however, recent sightings of this species have occurred adjacent to the project area. There are no lakes, stock ponds, nor reservoirs of sufficient size to provide suitable nesting, brooding, or foraging habitat for a pair of buffleheads and their young.

Direct, Indirect and Cumulative Effects

Alternatives 1, 2, 3, & 4

Determination

A **No Impact (NI)** determination is reached for all alternatives. Suitable breeding habitat for this species is not present in the project area. Any use of the area that may occur would be considered incidental, and project effects would be negligible. Therefore, no direct, indirect, or cumulative effects to this species or its habitats are anticipated.

Tricolored Blackbird (*Agelaius tricolor*)

***Status*:** Federal – None, State – None, Region 6 – Sensitive

Life History and Habitat

The Tricolored blackbird is a highly gregarious colonial breeder largely endemic to California (Spencer 2003). Tricolored blackbirds nest in large lowland marshes with an abundance of tall emergent vegetation, or in thickets of willows or other shrubs (Csuti et al. 2001). Tricolored blackbirds are vulnerable to nesting failures that affect entire colonies (Beedy and Hamilton 1999; Spencer 2003).

Distribution

Oregon:

Breeding colonies are scattered and intermittent in Oregon (Spencer 2003). The Oregon population was estimated to have declined by 22 percent in the 1980s, but this population represents only one percent of the total tricolored blackbird population (Beedy and Hamilton 1999).

Ochoco National Forest:

While the tricolored blackbird has been documented to occur between Prineville and Madras (Spencer 2003) and is occasionally observed near Powell Butte by local birders and posted on the Central Oregon Birders On Line (COBOL) internet site, there are no known breeding locations of this species on the Forest. Habitat for tricolored blackbird has likely always been limited in this project area by the absence of extensive marsh habitat with an abundance of cattails or bulrush.

Existing Condition

The project area does not contain any marshes with expansive thickets of cattail, bulrush, willow, nettles or blackberries that could potentially provide adequate nesting habitat for this colonial nesting species. This species has not been observed in the project area.

Direct, Indirect and Cumulative Effects

Alternatives 1, 2, 3, & 4

Determination

A **No Impact (NI)** determination is reached for all alternatives. Suitable habitat does not exist in the project area. There are no documented occurrences of this species in the project area or on the District. Therefore, no direct, indirect or cumulative effects to this species or its habitats are anticipated.

Upland Sandpiper *(Bartramia longicauda)*

***Status*:** Federal – None, State – Sensitive, Region 6 – Sensitive

Life History and Habitat

The upland sandpiper breeds in partly flooded meadows, grasslands and prairies, usually with a fringe of trees, and often in the middle of higher elevation sagebrush communities (Csuti et al. 2001). Meadows comprised of grasses, sedges, and herbaceous plants that are not heavily grazed are preferred (Stern 2003). Stern (2003) identified possible reasons for the western population decline which may include: encroachment of pine into meadows, use of herbicides to control or eliminate forbs in nesting meadows, overgrazing in meadows especially during incubation and brood rearing, and downcutting of streams which impact water table and meadow systems.

Distribution

Oregon:

According to Stern (2003), Oregon's upland sandpiper population, probably the largest west of the Rocky Mountains is close to extirpation, and that remnant breeding populations are limited to Bear and Logan Valleys in Grant County. However, some field guides show isolated or rare occurrences in south central Oregon and northern California (Kaufman 2000; Sibley 2000). Breeding by this species at Big Summit prairie was reported in 1919 and a single bird was observed in that area in 1987. Big Summit prairie borders the project area to the northeast.

Though populations east of the Rocky Mountains are stable or increasing, populations west of the Rockies are declining and its continued existence in the Northwest is precarious (Stern 2003).

Ochoco National Forest:

The Ochoco National Forest contains potentially suitable breeding habitat for upland sandpipers within Big Summit prairie. The edges of the prairie are under Forest Service ownership and may be suitable for nesting sandpipers. The majority of this prairie is privately owned and is grazed each year by livestock which likely reduces the quality for nesting. Additional open prairies exist within the project area, but are not likely serving as suitable breeding habitat as the largest one is approximately 500 acres, and does not fall within the typical range (1,000 – 30,000 acres) for this species (Stern 2003).

Existing Condition

There are no known sightings of sandpipers on the Paulina Ranger District or within the Gap project area. However, historically breeding populations of sandpipers occurred in Big Summit prairie northeast of the project area.

Direct, Indirect and Cumulative Effects

Alternatives 1, 2, 3, & 4

Determination

A **No Impact (NI)** determination is reached for all alternatives. Suitable habitat does not exist in the project area. There are no documented occurrences of this species in the project area or on the District. Because of lack of habitat and species presence, there would not be any direct, indirect, or cumulative effects to this species.

Silver-bordered Fritillary (*Boloria selene*)

Status: Federal – None, State – None, Region 6 – Sensitive

Life History and Habitat

Habitat for silver-bordered fritillaries consists of open, boggy, wet meadows that contain marsh and bog violets, which serve as the host species for caterpillars. Adults feed on plants including black-eyed Susan' and goldenrod. Loss of open meadows or bogs due to encroaching woody-stemmed plants, de-watering of marsh habitat, and livestock grazing practices have degraded habitat for this species (Miller and Hammond 2007).

Distribution

Oregon and the Ochoco National Forest:

Only two primary colonies are found in Oregon. One colony is found near Big Summit prairie in the Ochoco Mountains and one in the Strawberry Mountains of the Malheur National Forest (Miller and Hammond 2007).

Existing Condition

Historically, moist meadow and riparian habitats were more abundant than what currently exist today. A variety of activities have influenced the existing conditions, including historic and current livestock grazing, timber harvesting, road construction, and the loss of beaver. Many stream channels within the project area have down cut, resulting in a lowering of the water table and a loss of riparian vegetation, including cottonwood, aspen, dogwood, birch and willow species. The down cutting has also caused a reduction in moist meadow habitats within the project area.

On the Ochoco National Forest 307 acres of potential habitat have been identified, of which 85 acres occur within the project area. Potential habitat is in close association with meadow systems. There is no current inventory of marsh and fen type habitats that may be associated with these meadow systems. Historic records indicate the presence of this species within the project area, and surveys conducted in 2015 within suitable habitat confirm the presence of silver-bordered fritillary in William's prairie, Gray prairie, and Antler prairie within the project area. The identified suitable habitat within the project area for this species is currently functioning in a manner consistent with the needs of this species.

Direct, Indirect and Cumulative Effects

Alternative 1

Under the no action alternative no management activities would occur. In the short to mid-term, the various habitats that currently exist for this species within the project area would be maintained in their current condition. Over time conditions would be expected to decline with the continued lowering of the water table and the eventual loss of moisture from open meadow areas. The loss of moisture would reduce the distribution and abundance of host plant species, and in turn potentially eliminate habitat for this species within the project area.

Conclusion

This alternative would have no direct effects on silver-bordered fritillary, but could indirectly lead to an overall decrease in habitat quality over the long-term because of an overall reduction in host plant populations from loss of moisture into meadows.

Alternatives 2, 3, & 4

All action alternatives propose commercial and noncommercial harvest treatments and aspen enhancement; however, these treatments do not overlap with identified habitat for this species, so no effects from these treatments are expected.

Riparian restoration activities would occur in known habitat for this species. Machinery used for in-stream work would directly impact habitat for this species in the short-term by potentially crushing host plants and/or individuals during implementation. However, project design criteria developed to minimize the impacts to the species and its habitat would attempt to avoid areas of high concentrations of host plants and place restrictions on the number of passes the machinery performed through the habitat. Depending on the proximity of host plant species to the stream banks, the suitability of habitat for this species may be compromised in small isolated areas due to structures and debris extending into the meadow. In the long-term, effects from implementation of the stream restoration would prevent further lowering of the water table, thus allowing moisture levels in associated meadow habitat to be, at a minimum retained, but likely improved, ensuring habitat for this species is maintained within the project area.

Open roads have the potential to introduce invasive weeds to meadow habitat, degrading native plant communities. Road closures after project implementation, and project design criteria to reduce the spread of invasive weed species would offset effects. Habitat for this species is largely protected from vehicle use, however machinery used in implementation would be traversing suitable habitat. Project design criteria would be in place to prevent the spread of invasive weed species during project implementation, and thus effects would be negligible.

Prescribed burning proposed in all action alternatives would occur outside of suitable habitat for this species, thus there are not expected to be any effects from these activities.

Cumulative Effects

The cumulative effects boundary includes the five subwatersheds that fall within the Gap project boundary (see figure 37). All of the activities listed in table 167 were considered for their cumulative effects to the silver-bordered fritillary or its habitat.

Unregulated livestock grazing in the early 1900s may have affected grass, forb, and sedge composition within meadow habitat in the Gap project area. Introduction of non-native grasses and invasive weed species may have also contributed to the deteriorated conditions. Over time, and with changes in grazing management, habitat has improved. Cattle grazing is ongoing within the project area. Range improvements, including riparian restoration, habitat protection, water developments, and fence reconstruction would occur within existing allotments under the Fox Canyon and Big Summit AMPs. These activities are expected to improve the current condition of the riparian and adjacent meadow habitats within the Gap project area where it overlaps, and has the potential to increase the available suitable habitat for this species.

Treatments of invasive weed populations will continue to occur within the project area under the direction of the Deschutes and Ochoco Invasive Plant Treatment FEIS. In addition, areas not yet infested would be protected from future introduction and spread under this plan, thus effects to this species from invasive weeds are not anticipated.

The continued implementation of the Deschutes and Ochoco Travel Management Plan and the South Boundary Travel Management Area will continue to limit cross-country motorized access within the project area. These restrictions have a positive effect on the species as they minimize the loss of individuals or habitat through direct crushing of host plants or larvae/pupae.

Prescribed burning would occur within William's prairie and Gray prairie and riparian restoration would occur within Antler prairie associated with the Fox Canyon AMP which overlaps spatially with a portion of stream restoration activities proposed in the Gap project. Implementing these stream restoration activities would have the potential to contribute negatively to the cumulative effects for this species, as the impacts from one restoration activity may not be fully diminished before the implementation of the other. However, project design features identified in both the Fox Canyon AMP and the Gap project would help to minimize impacts from these activities individually and thus reduce the overall cumulative effects.

Determination

The determination of effect of the action alternatives on the silver-bordered fritillary is "**may impact individuals or habitat, but not likely to result in a trend toward federal listing or loss of viability of the species or populations (MIIH)**" due to disturbance or displacement of individuals during implementation and the potential to reduce the overall amount of habitat in the short-term**.** In the mid- to long-term, treatments would help retain and promote moisture in adjacent meadows and would have a **Beneficial Impact (BI)** on silver-bordered fritillary.

Johnson's Hairstreak *(Callophrys johnsoni)*

Status: Federal – None, State – None, Region 6 – Sensitive

Life History and Habitat

Johnson's hairstreak habitat is almost entirely restricted to coniferous forest areas which provide its host species, dwarf mistletoe (*Arceuthobium spp.*) (Spiegel 2014). Caterpillars feed exclusively on aerial shoots of dwarf mistletoe plants (LaBonte et al. 2001) that grow on various conifers including; ponderosa pine, lodgepole pine, western larch, and Douglas-fir, though in Oregon, documented feeding has only occurred on ponderosa pine (Spiegel 2014). Adults feed on nectar from various flowering plants (Miller and Hammond 2007).

Hessburg et al. (1999) documented the slow decline of dwarf mistletoe-infected ponderosa pine through the loss of pine overstory and the encroachment of shade-tolerant species. According to Hessburg's analysis maintenance of healthy populations of Johnson's hairstreak requires the maintenance of ponderosa pine and possibly western larch (Hessburg et al. 1999; Spiegel 2014).

Distribution

Oregon:

This species is found in conifer forests throughout the Pacific Northwest west of the Cascade Mountains and in the Sierra Nevada Mountains in California. However, there is a disjunct population of Johnson's hairstreak in the Hells Canyon region of northeast Oregon and adjacent Idaho (Miller and Hammond 2007). Scattered sightings in Oregon occur in the Coast Range, Siskiyou Mountains, Blue Mountains, and Wallowa Mountains (Spiegel 2014).

Ochoco National Forest:

In 2010, the Interagency Special Status/Sensitive Species Program (ISSSSP) conducted field surveys in Oregon and Washington to document presence of Johnson's hairstreak butterfly where species presence is currently unknown but likely based on habitat modeling (Davis and Weaver 2011). Survey efforts focused on high probability of occurrence areas, none of which occur on the Ochoco National Forest. The Johnson's hairstreak is not known to occur on the Ochoco National Forest.

Existing Condition

No documented occurrences of Johnson's hairstreak have been recorded within the project area; however, suitable habitat does exist. Dwarf mistletoe supporting caterpillar larvae would occur on ponderosa pine forested stands within the project area. The ponderosa pine plant associations (as well as Douglas-fir, and drier grand fir plant associations where ponderosa pine is often common) were used to determine potential habitat for this species. Approximately 30,311 acres of potential habitat are present within the project area. Of this potential habitat, ponderosa pine, dry grand fir, and Douglas- fir plant associations comprise 40%, 50%, and 10%, respectively. To date there have not been surveys for Johnson's hairstreak on the Ochoco National Forest and it is unknown whether or not they occupy any of the potential habitats within the project area.

Direct, Indirect and Cumulative Effects

Alternative 1

Under the no action alternative, no management activities would occur. In the short to mid-term, the various habitats that currently exist within the project area would be maintained in their current condition, and provide for the species density and distribution that currently exists.

Over the long term, increased stand densities and related stress would result in a greater incidence of insects and disease in the project area. Dwarf mistletoe, one of the diseases that increases with increasing stand densities, would increase where present within the project area. In the event of a wildfire, however, uncharacteristically intense burns could effectively sanitize stands of dwarf mistletoe. When all trees are killed, reestablishment of dwarf mistletoe in stands could take decades, as seeds are reintroduced by birds and the mistletoe slowly spreads (Spiegel, 2014).

Conclusion

There is not expected to be a measureable change in available habitat for this species under this alternative due to the offset between the slowly developing and limited potential benefits of increased habitat due to overstocking and disease over the long-term in conjunction with the increase in potential for large-scale wildfire within the project area. In addition, the Johnson's hairstreak is not known to occur on the forest, and there are no identified high probability areas of occurrence (Davis and Weaver 2011).

Alternatives 2, 3, & 4

Suitable breeding habitat for this species may occur within 30,311 acres in the project area. Action alternatives propose to treat up to 20,678 acres present in the project area. These treatments include commercial harvest, noncommercial thinning, and prescribed fire to reduce stand densities. Table 88 lists the activities occurring within potential habitat for this species. Maintaining or reestablishing ponderosa pine in areas where it historically dominated would benefit Johnson's hairstreak in the long-term. In ponderosa pine, as well as drier Douglas-fir and grand fir plant associations, commercial and noncommercial thinning would result in more open stands favoring ponderosa pine. Harvest of some mistletoe infected trees potentially providing habitat for Johnson's hairstreak would occur under all action alternatives. This would result in a direct reduction of potential habitat, and may impact Johnson's hairstreak individuals, but would not impact the ability of the species to survive in the Blue Mountains (Spiegel 2014). In all action alternatives, large diameter ponderosa pine trees as well as fir species, exhibiting old growth characteristics, would be retained across the project area, although in Alternative 4, trees greater than 21" dbh could be harvested. Leave areas within units, and areas outside of treatment would also retain ponderosa pine trees that could potentially host dwarf mistletoe.

Prescribed burning may impact larvae of this species in the short-term due to heat and smoke from underburning operations, depending on the intensity of the burn, and weather conditions. Not all acres would be burned simultaneously, nor in a contiguous block, so refugia would exist across the project area where butterflies and caterpillar larvae would be expected to persist. While short-term impacts could occur, prescribed burning that reduces fuels, and future fire intensity, would maintain ponderosa pine on the landscape and benefit potential Johnson's hairstreak habitat in the long-term.

Table 88. Proposed treatments, by alternative, in potential Johnson's hairstreak habitat.

Alternative	Treatments		
	Commercial Thinning	Noncommercial Thinning	Prescribed Burning
Alternative 1	0	0	0
Alternative 2	13,638	15,079	19,938
Alternative 3	10,739	14,243	19,840
Alternative 4	13,642	15,368	20,222

Cumulative Effects

The cumulative effects boundary includes the five subwatersheds that fall within the Gap project boundary (see figure 37). All of the activities listed in table 167 were considered for their cumulative effects to the Johnson's hairstreak or its habitat. Past, present, and reasonably foreseeable future activities are not expected to combine with effects from this project to result in any cumulative effects. Effects to this species from past commercial and noncommercial treatments that are still present within the Gap project area are captured within the existing condition and thus would not contribute towards cumulative effects for the Johnson's hairstreak or its habitat. Projects yet to be implemented include aspen enhancement with a goal of removing encroaching conifers. However, the impacts to this species from those activities would be negligible due to the scale of these treatments. Additional acres of prescribed fire have yet to be implemented within the project area but effects from these activities would be similar to those described in the direct and indirect effects from the Gap project, and thus not contribute negatively to the cumulative effects for this species. There are no projects presently or in the reasonably foreseeable future occurring within the Gap project area that would impact this species or its habitat.

Determination

The determination of effect of the action alternatives on the Johnson's hairstreak is "**may impact individuals or habitat, but not likely to result in a trend toward federal listing or loss of viability of the species or populations (MIIH)**." In the short-term proposed activities may impact individuals or habitat through the harvest of mistletoe infected trees, but these impacts would be negligible at the project scale. Over the long-term treatments would maintain increased levels of ponderosa pine, and therefore more potential habitat for this species. However, the Johnson's hairstreak is not known to occur on the forest. In addition, habitat modeling by Davis and Weaver (2011) indicated that there are no high probability areas of occurrence on the Ochoco National Forest and therefore any effects to this species or its potential habitat explained above would be negligible.

Management Indicator Species (Terrestrial)

The National Forest Management Act (NFMA) directs the Forest Service to provide habitat to maintain viable populations of existing native and desired non-native vertebrate species. For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area. The planning area is the Forest and Grassland. In order to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others in the planning area. Maintaining viable populations was addressed in the Final Environmental Impact Statement for the Ochoco National Forest Land and Resource Management Plan by defining management requirements for those species that were considered limiting or sensitive to management activities (USDA Forest Service 1989*a*).Management Indicator Species (MIS) were selected for emphasis in planning, and are assessed during Forest Plan implementation in order to determine the effects of management activities on their populations and the populations of other species with similar habitat needs. For project-level planning and environmental analysis the use of habitat abundance and quality, and the distribution of habitat have been used to estimate project effects on MIS. It has been determined by court decision that where population monitoring data are not available, due to lack of funding or feasibility of monitoring populations, the amount and quality of habitat can be used as a proxy for determining viability effects of projects on MIS (Lands Council v. McNair, 2010).

In order to use habitat as a proxy the project analysis must at a minimum include: 1) a clear relationship between the species and its habitat based on habitat relationship models that utilize the best available science; 2) the amount of habitat available at the Forest scale; 3) species presence in the project area; 4) the amount of habitat being impacted at the project level in terms of both quality and quantity; and 5) a determination of the project impact on viability at the Forest scale.

Table 89 lists the terrestrial species selected as MIS in the Forest Plan. Of these 6 species, or groups of species, all have habitat present in the project area, and effects of the project on these MIS will be assessed. More detailed discussion of the bald eagle can be found in the Threatened, Endangered, and Sensitive Species (TES) section of this document.

Table 89. Management Indicator Species identified in the Ochoco National Forest Land and Resource Management Plan (USDA Forest Service 1989b).

MIS Species	Representing	Habitat Requirements	Habitat Present in Project Area	Species Present in Project Area
primary cavity excavators	snag habitat	snag habitat	Yes	Yes
pileated woodpecker	old growth habitat	closed canopy, late-seral subalpine, montane and lower montane forests	Yes	Yes
common (northern) flicker	old growth juniper	forest habitat generalist	Yes	Yes
golden eagle & prairie falcon	cliff, talus, or cave habitats	nesting habitat includes ledges along rims and cliffs	golden eagle – Yes prairie falcon – Yes	Yes No
bald eagle	State or Federal Threatened or Endangered Species	associated with large bodies of water and nests in forested areas near water	Yes	Yes
Rocky Mountain elk & mule deer	species that are commonly hunted	habitat generalist – mixture of successional stages in both forest and grasslands	Yes	Yes

Viability of MIS is being assessed using the historical range of variability (HRV) concept; comparing current amounts and distribution of habitat to historical conditions (Wisdom et al. 2000; Suring et al. 2011). Scientists assume that species are more likely to persist into the future under the conditions that remain most similar to the conditions that they persisted in during the past (Landres et al. 1999; Samson et al. 2003). By managing habitat within HRV it is assumed that adequate habitat would be provided because species survived those levels of habitat in the past to be present today. Thus, if we manage current habitats within HRV, we are likely to do satisfactory job of maintaining population viability for those species that remain. The greater departure of current habitat conditions from HRV, the more likely it is that population viability would be compromised.

Primary Cavity Excavators (PCEs)

Primary cavity excavators were selected to serve as an indicator for species that are dependent upon standing and down wood for nesting, roosting, and foraging. By providing adequate dead wood habitat for these birds, it is assumed that adequate habitat would be provided for other species that rely on dead wood for all or part of their life histories.

Because these MIS were selected to represent dead and defective wood habitat, this analysis and discussion focuses primarily on that habitat component. Additional information on cavity-excavating birds' habitat associations, distribution and life history requirements is summarized in Mellen-McLean (2012*a*).

In general, populations of cavity nesting birds have declined across the Blue Mountains compared to historical conditions, primarily due to reductions in the numbers of large snags (Wisdom et al. 2000). However, of the cavity excavating MIS, Breeding Bird Surveys in Oregon have only detected a statistically significant decrease in populations of the northern flicker between 1966 and 2010 (Sauer et al. 2011).

Current Forest Plan direction, as amended by the Eastside Screens (Amendment #2), is to maintain snags at 100% of biological potential for all primary cavity excavator species that occur on the Forest. Rose et al. (2001) report that results of monitoring indicates that the biological potential models are a flawed technique. New information about the ecology, dynamics, and management of decayed wood has been published since then, and the state of the knowledge continues to change. However, until the Forest Plan is amended to reflect the new science, 100% biological potential is the minimum number of snags that need to be maintained through the life of the stand rotation.

Integration of the latest science is incorporated into this analysis using DecAID Advisor (version 2.2) (Mellen-McLean et al. 2012) which is an internet-based summary, synthesis, and integration (a "meta-analysis") of the best available science: published scientific literature, research data, wildlife databases, forest inventory databases, and expert judgment and experience. In addition to data showing wildlife use of dead wood, DecAID also contains data showing amounts and sizes of dead wood across the landscape based on vegetation inventory data. Data from unharvested plots are assessed separately and these data can be used as a reference condition to approximate HRV of dead wood. There is debate among professionals on the impact fire exclusion has on stands relative to HRV of dead wood. One caveat to using these data is, "On the eastside in particular, current levels of dead wood may be elevated above historical conditions due to fire suppression and increased mortality, and may be depleted below historical levels in local areas burned by intense fire or subjected to repeated salvage and firewood cutting" (Mellen-McLean et al. 2012). Even with this caveat, the data are used in this analysis because: they are still some of the best data available to assess HRV of dead wood, even in eastside dry forests; they are the only available data showing distribution and variation in snag and down wood amounts across the landscape; the data from unharvested stands are in the range of other published data on HRV of dead wood even in the drier vegetation types. For a full discussion see HRV Dead Wood Comparison (Mellen-McLean 2011).

A distribution analysis was used to determine how close current conditions for snag and down wood on the landscape match reference conditions. Existing conditions were derived by using Gradient Nearest Neighbor (GNN) data developed by the Landscape Ecology, Modeling, Mapping and Analysis Team (LEMMA). GNN produces pixel-based maps with associated snag and down wood data. This data is based on 2012 imagery and is updated on a project-by-project basis in order to capture any change in condition on the landscape due to insect outbreak or wildfire. This information provides the direct data necessary to construct histograms displaying current conditions. GNN uses the same data that were used to develop the distribution histograms for DecAID. For more information see Ohmann and Gregory (2002).

The analysis area used for the distribution analysis was the project area and encompassed the Horse Heaven Creek-Crooked River and Upper North Fork Crooked River HUC 10 level watersheds. The analysis area met the minimum size requirements of 12,800 acres per wildlife habitat type recommended by the authors of DecAID (Mellen-McLean et al. 2012). Within the analysis area only the Ponderosa Pine/Douglas-fir and Eastside Mixed Conifer wildlife habitat types were present in large enough acreages for analysis. The Montane Mixed Conifer and Lodgepole Pine wildlife habitat types both occur in the project area but it and the surrounding watersheds contain so few acres, analysis would not be valid at such a large scale.

The distribution analysis results are then compared to the needs of primary cavity excavators using tolerance levels and intervals (range between two tolerance levels) from DecAID. A tolerance interval is similar to the more commonly used confidence interval but with a key difference: tolerance intervals are estimates of the percent of all individuals in the population that are within some specified range of values. In comparison, confidence intervals are estimates of sample means from the population of interest. For more information see Marcot et al. (2010).

An example of use of a tolerance level is as follows. If the 50% tolerance level for snag density at pileated woodpecker nest sites in a specific wildlife habitat type is 7.8 snags/acre, the interpretation would be that 50% of nest sites used by pileated woodpeckers in that habitat have < 7.8 snags/acre and 50% of nest sites used by pileated woodpeckers have > 7.8 snags/acre.

Existing Condition

Past timber harvest, thinning, road construction, fire suppression, wildfires, prescribed fire, and grazing have combined to create the existing condition within the Gap project area. Existing distribution of snags and down wood within the project area reflects the effects of past management activities as well as large-scale disturbance events. Past timber harvest targeted and removed many of the largest diameter trees reducing LOS stands. Large green replacement trees removed during this time reduced future snag potential and subsequent large snag densities throughout the project area. The extensive road network in the analysis area (largely a result of past harvest) has impacted snag densities by decreasing habitat from road construction and increasing accessibility of the area to firewood cutting.

The Ponderosa Pine/Douglas-fir (PPDF) and Eastside Mixed Conifer (EMC) wildlife habitat types occur in the analysis area. Results of the DecAID snag distribution analysis are displayed in figures 19 and 20. Tolerance levels for primary cavity excavators are displayed in tables 91 and 92. In addition, a distribution analysis was done for down wood within both wildlife habitat types and is displayed in figure 21, with tolerance levels for species where appropriate.

Current Forest Plan direction, as amended by the Eastside Screens (Amendment #2), is to maintain snags at 100% of biological potential for all primary cavity excavator species that occur on the Forest and in addition, this should be determined using the best available science. Thomas (1979) reported that densities of snags within the Blue Mountains needed to be at or above 2.25 snags per acre in both the ponderosa pine and mixed conifer communities to meet the 100% biological potential of primary cavity excavators. In addition, management direction for down logs within these habitat types was established at 3-6 pieces per acre in the ponderosa pine community and 15-20 pieces per acre in the mixed conifer community with a diameter of at least 12”. For comparison purposes these numbers were converted to percent cover per acre and are as follows; 0.55% - 1.10% in ponderosa pine and 2.75% - 3.86% in mixed conifer.

Due to the differences between the Forest Plan standards and the DecAID diameter classes (i.e. 12” in Forest Plan, and >5” and >20” in DecAID) direct comparison of the analysis and Forest Plan standards and guides is difficult. When determining which analysis to use, down wood >5” dbh would likely overestimate the amount of cover, as it would include down wood less than 12” dbh, and down wood >20” dbh would likely underestimate the amount of cover as it would exclude down wood greater than 12” but less than 20”. However, without down wood survey data for the project area these analysis methods represent the best available science.

Ponderosa Pine/Douglas-fir Wildlife Habitat Type

In the Ponderosa Pine/Douglas-fir Wildlife Habitat Type (PPDF WHT), the analysis area is near or above reference conditions for densities of large snags (>20” dbh) and for snags >10” dbh (figure 19). There is less area lacking snags (0 snags/acre) than would be expected under reference conditions, and more area in the lower snag density classes.

Distribution of snag densities across the Ochoco National Forest in the PPDF WHT is similar to this analysis area. Most primary cavity excavators using this WHT should currently have an adequate amount of snag habitat on the landscape. The exception is those species using high densities of small snags in recent post-fire habitats (e.g., black-backed woodpecker). Large snag habitat for pileated woodpecker and Williamson’s sapsucker is rare in this WHT both currently and historically. Snag densities on a large percentage of the project area in this habitat type (approximately 67%) currently are above 2.25 snags per acre, and therefore are meeting or exceeding the Forest Plan standards and guides.

The other 33% of the project area within the PPDF WHT is below the 2.25 snags per acre, however when you consider that 25% percent of the project area has snag densities that exceed 6 snags per acre, and the fact that the Forest Plan standards and guidelines do not need to be met on every acre within the project area, it can be concluded that across the project area the snag habitat requirements for primary cavity excavators are being met.

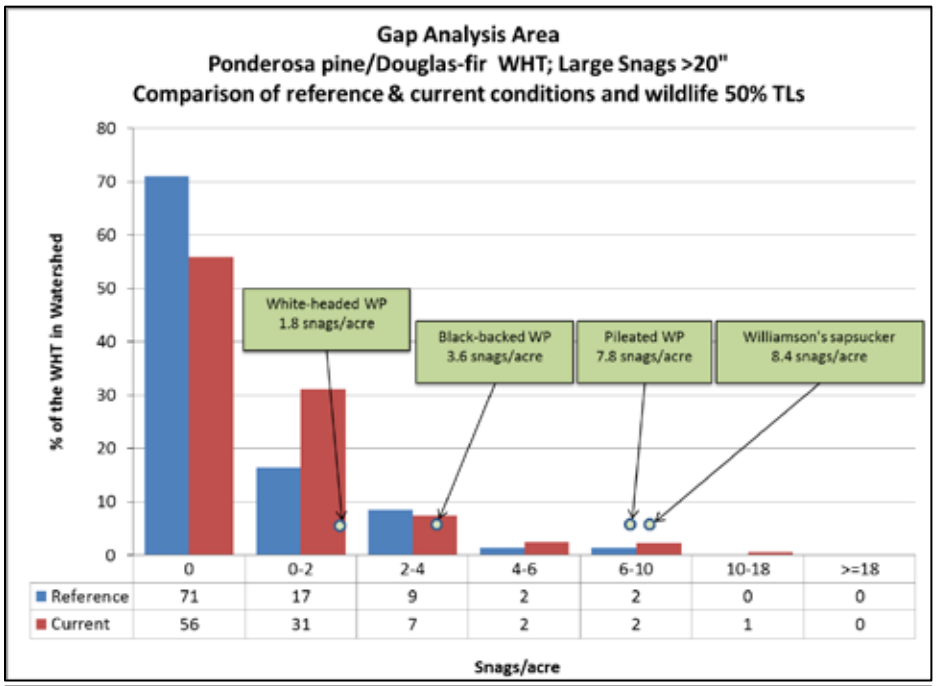
Percent cover of down wood within the analysis area is near or above reference conditions in nearly all of the percent cover classes for down wood >5" and >20" in diameter (see Figures 21 and 22). A smaller percentage of the analysis area is lacking down wood (0 percent cover) than would be expected under reference conditions. Reference conditions show a lack of area in cover classes greater than 4% for snags in general across the project area and greater than 2% for large snags (>20" diameter). Overall current conditions of down wood within this analysis area are similar to what would have been present historically. Approximately 75% of the project area exceeds the Forest Plan standards for down wood in ponderosa pine habitat when considering all down wood >5" dbh, and approximately 30% when considering only down wood >20" dbh. Because direction is based on 12" diameter down wood, the actual percentage of the project area meeting or exceeding the down wood standards likely falls somewhere in between. Historical reference conditions within this habitat type for down wood cover percentages would have been lower than current conditions as approximately 60% and 27% of the project area would have exceeded current management standards for all down wood >5" and down wood >20" dbh respectively.

Eastside Mixed Conifer Wildlife Habitat Type

In the Eastside Mixed Conifer Wildlife Habitat Type (EMC WHT), the analysis area is below reference conditions for densities of large snags (>20" dbh) and for snags >10" dbh in many of the snag density classes (figure 20. There is less area lacking snags (0 snags/acre) than would be expected under reference conditions, and more area in the lower snag density classes. The percentage of the project area with snags >10" dbh is above reference conditions in the 6-12 snags per acre density class. Similarly, the percentage of the project area with large snags (>20" dbh) is above reference conditions in the 4-6 snags per acre density class. Distribution of snag densities across the Ochoco National Forest in the EMC WHT is similar to this analysis area. Based on research by Bull et al. (2007) and Ohmann and Waddell (2002) pileated woodpeckers and Williamson's sapsuckers may be limited to more productive sites in this WHT where snag densities are expected to be higher. Snag densities on a large percentage of the project area in this habitat type (approximately 80%) are currently above 2.25 snags per acre, and therefore are meeting or exceeding the Forest Plan standards and guides. The other 20% of the project area within the EMC WHT is below the 2.25 snags per acre, however when you consider that 42% percent of the project area has snag densities that exceed 6 snags per acre, and the fact that the Forest Plan standards and guidelines do not need to be met on every acre within the project area, it can be concluded that across the project area the snag habitat requirements for primary cavity excavators are being met.

Percent cover of down wood within the analysis area is near or above reference conditions in three of the six cover classes. There is less area lacking down wood (0 percent cover) than would be expected under reference conditions. In addition, the 2-4%, and 6-8% cover classes are below reference condition. Current conditions of down wood are adequate within this analysis area for some species of primary cavity excavators such as the pileated woodpecker (30, 50, and 80% tolerance levels), and to a degree the black-backed woodpecker (30% tolerance level). Approximately 41% of the project area exceeds the Forest Plan standards for down wood in mixed conifer habitat when considering all down wood >5" dbh, and approximately 11% when considering only down wood >20" dbh. Because direction is based on 12" diameter down wood, the actual percentage of the project area meeting or exceeding the down wood standards likely falls somewhere in between. Historical reference conditions within this habitat type for down wood cover percentages are similar to current conditions as 44% and 11% of the project area would have exceeded current management standards for all down wood >5" and down wood >20" dbh respectively.

Figure 19. Comparison of reference condition to current condition for snag density classes in the PPDF WHT portion of the Gap Landscape Restoration project analysis area. Figure A displays snags > 20" dbh; figure B displays snags > 10" dbh. 50% tolerance levels for wildlife species are displayed on both figures. Reference condition derived from DecAID unharvested vegetation plots (see analysis file); wildlife tolerance levels from Tables PPDF_S/L.sp-22 and PPDF_PF.sp-22 (Mellen-McLean et al. 2012). Current conditions derived from 2012 GNN data.



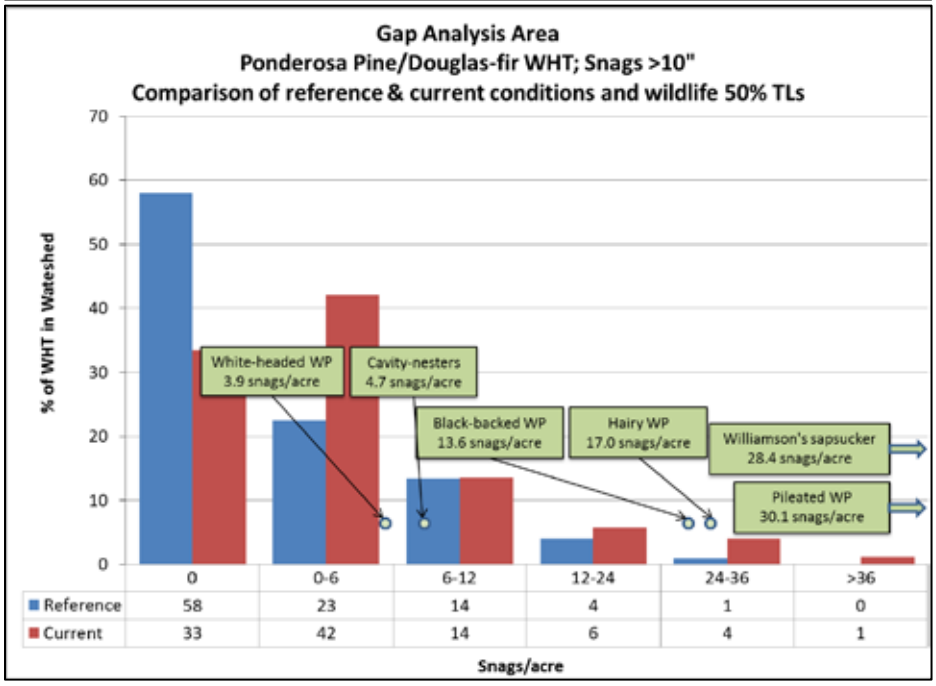
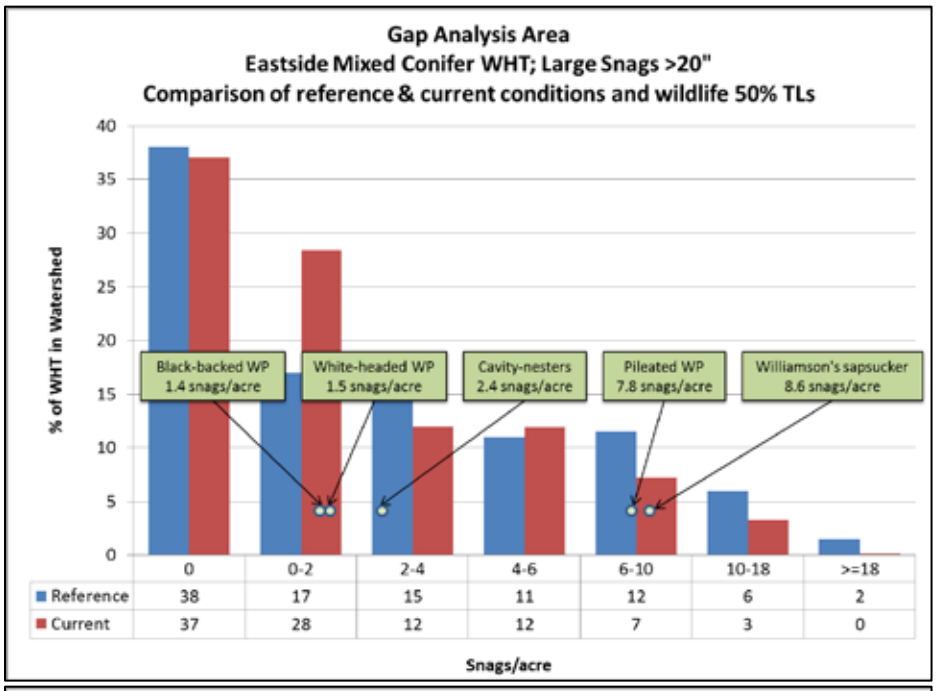


Table 90. Tolerance levels for primary cavity excavators occurring in the PPDF Wildlife Habitat Type (From DecAID Tables PPDF_S/L.sp-22 and PPDF_PF.sp-22)

Species	Snag density/acre for 30%, 50%, 80% tolerance levels			
	Green Forests		Recent Post-fire	
	>10” dbh	>20” dbh	>10” dbh	>20” dbh
Black-backed woodpecker	2.5, 13.6, 29.2	0.0, 1.4, 5.7	37.4, 52.8, 76.5	
Hairy woodpecker	0.0, 17.0, 44.4		39.2, 63.3, 100.0	
Northern flicker			25.0, 44.9, 83.1	2.2, 17.4, 39.6
Lewis’s woodpecker			24.7, 42.7, 70.6	0.0, 6.2, 16.1
Pileated woodpecker	14.9, 30.1, 49.3	3.5, 7.8, 18.4		
Pygmy nuthatch	1.1, 5.6, 12.1	0.0, 1.6, 4.0		
White-headed woodpecker	0.0, 3.9, 11.9	0.5, 1.8, 3.8	22.2, 40.9, 68.3	
Williamson’s sapsucker	14.0, 28.4, 49.7	3.0, 8.4, 16.3		

Figure 20. Comparison of reference condition to current condition for snag density classes in the Eastside Mixed Conifer Wildlife Habitat Type (EMC WHT) portion of the analysis area. Figure A displays snags > 20" dbh; figure B displays snags > 10" dbh. 50% tolerance levels for wildlife species are displayed on both figures. Reference condition derived from DecAID unharvested vegetation plots (see analysis file); wildlife tolerance levels for green stands and post-fire habitat from Tables EMC_S/L.sp-22 and EMC_PF.sp-22 (Mellen-McLean et al. 2012). Current conditions derived from 2012 GNN data.



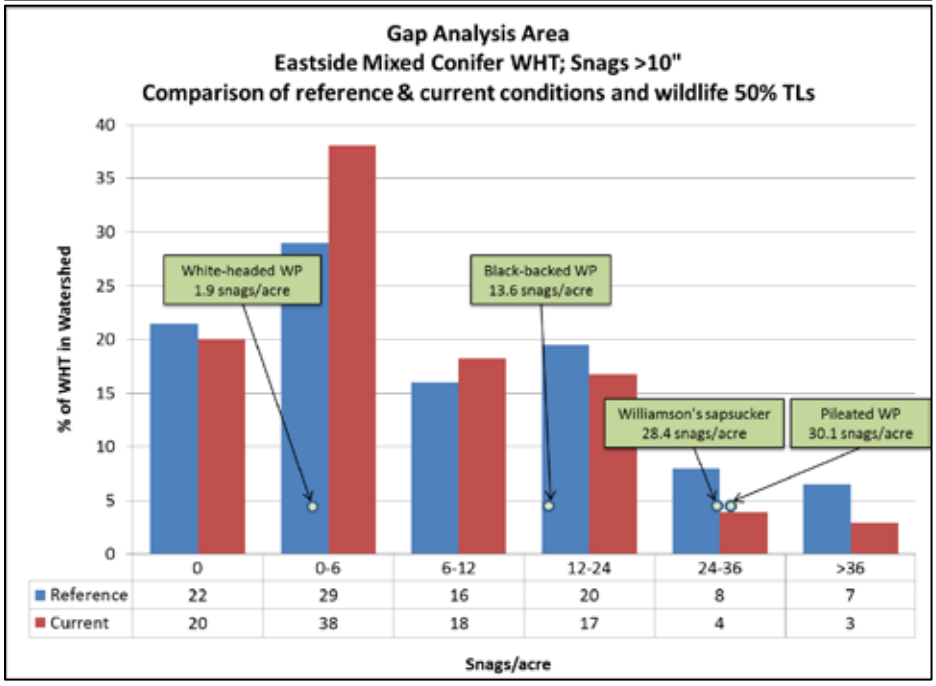
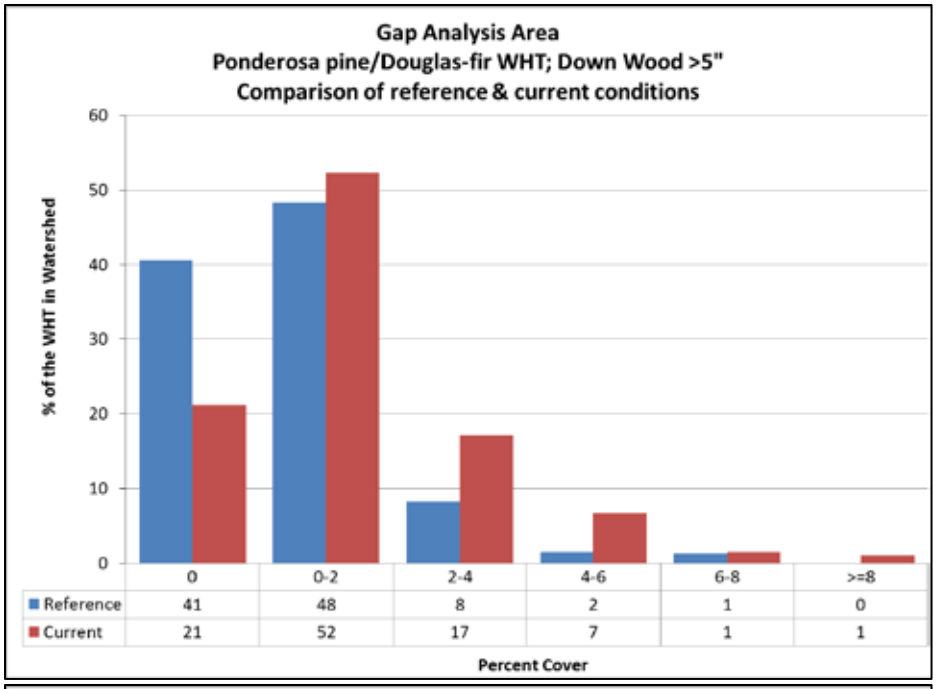


Table 91. Tolerance levels for primary cavity excavators occurring in the Eastside Mixed Conifer Wildlife Habitat Type (EMC WHT; from DecAID Tables EMC_S/L.sp-22 and EMC_PF.sp-22)

Species	Snag density/acre for 30%, 50%, 80% tolerance levels			
	Green Forests		Recent Post-fire	
	>10” dbh	>20” dbh	>10” dbh	>20” dbh
Black-backed woodpecker	2.5, 13.6, 29.2	0.0, 1.4, 5.7	56.1, 81.1, 117.6	
Hairy woodpecker			39.2, 63.3, 100.0	
Northern flicker			25.0, 48.0, 83.1	2.2, 17.4, 39.6
Lewis’s woodpecker			24.8, 43.0, 71.0	0.0, 6.2, 16.1
Pileated woodpecker	14.9, 30.1, 49.3	3.5, 7.8, 18.4		
Pygmy nuthatch	1.1, 5.6, 12.1	0.0, 1.6, 4.0		
White-headed woodpecker	0.3, 1.9, 4.3	0.0, 1.5, 3.8	28.8, 49.8, 81.6	
Williamson’s sapsucker	14.0, 28.4, 49.7	3.3, 8.6, 16.6		

Figure 21. Comparisons of reference condition to current condition for the down wood percent cover classes in the Ponderosa Pine/Douglas-fir (PP/DF) and the Eastside Mixed Conifer (EMC) Wildlife Habitat Types (WHT) portion of the analysis area. Figure A displays down wood > 5" dbh in the PP/DF WHT; figure B displays down wood > 5" dbh in the EMC WHT. Tolerance levels for wildlife species are displayed where appropriate. Reference condition derived from DecAID unharvested vegetation plots (see analysis file); wildlife tolerance levels from Table MMC_S.sp-22 (Mellen-McLean et al. 2012). Current condition derived from 2012 GNN data.



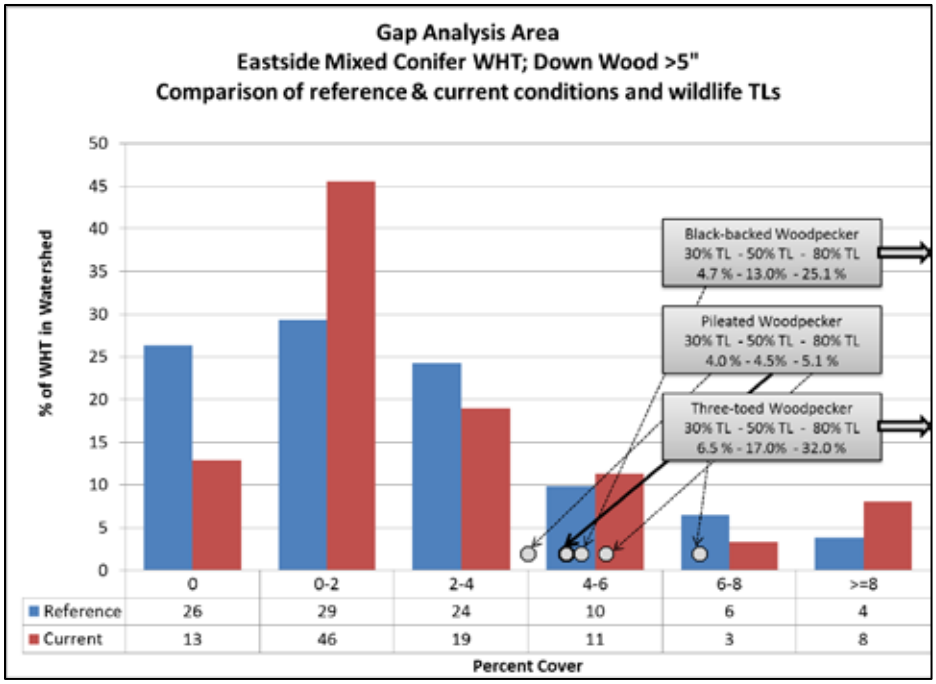
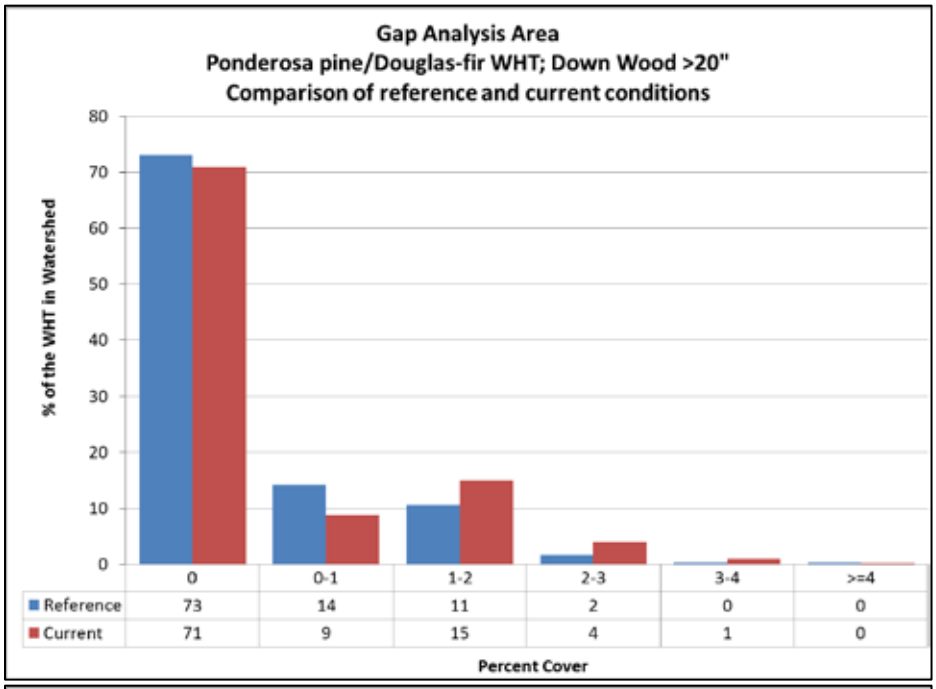
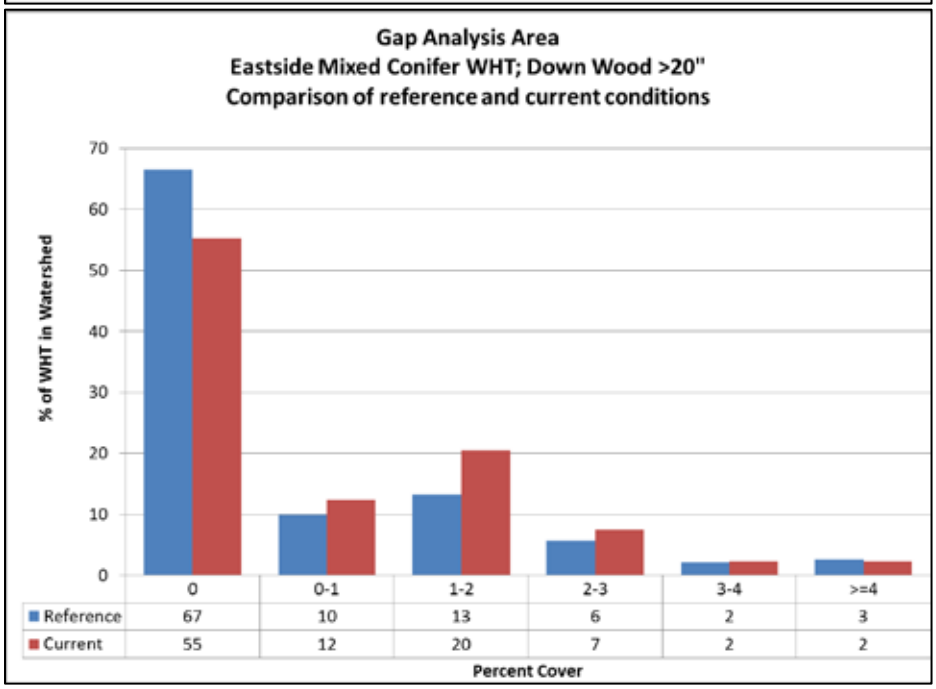


Figure 22. Comparisons of reference condition to current condition for the down wood percent cover classes in the Ponderosa Pine/Douglas-fir (PP/DF) and the Eastside Mixed Conifer (EMC) Wildlife Habitat Types (WHT) portion of the analysis area. Figure A displays down wood > 20" dbh in the PP/DF WHT; figure B displays down wood > 20" dbh in the EMC WHT. Reference condition derived from DecAID unharvested vegetation plots (see analysis file). Current condition derived from 2012 GNN data.





Direct, Indirect, and Cumulative Effects

Alternative 1

Under the no action alternative, no management activities are proposed. In the short term, snag levels would change slowly over time. Distribution and abundance of snags would continue to change naturally due to endemic levels of insects, disease, stress mortality, and decay. Due to the increased number of dense stands in the planning area, wildfire risk is also increased which, should a wildfire occur, lead to higher densities of snags than with active management. Alternative 1 has the greatest potential for the development of high density snag patches.

Disturbances due to wildfire or insects could have beneficial or detrimental effects for standing and down dead wood habitat, depending on the plant community affected, and the severity or extent of such events. Smaller scale disturbances similar to historic fire events or insect outbreaks would benefit most primary cavity nesters dependent on snags and down wood. Large scale events outside of the historic range of variability would benefit some species in the short to mid-term, but the overall gap in snag recruitment or large down wood over extensive areas could be detrimental in the long term, since replacement trees that ultimately provide future snags could take decades to develop.

Conclusion

Alternative 1 would not affect standing and down dead wood habitat and therefore would not contribute to a negative trend in viability on the Ochoco National Forest for primary cavity excavators.

Alternatives 2, 3, & 4

While it is likely that the proposed action treatments would result in some loss of snags, at the project scale, the loss of large snags from commercial or non-commercial thinning operations would be expected to be minimal. Snag loss may be greater in units where commercial thinning using ground based equipment occurs. Hand crews conducting non-commercial thinning could more easily avoid snags by identifying the area around them for no treatment (leave area) within the unit. Snags could be lost if designated as hazard trees, both within units, or along roads designated as haul routes. However, project design features would help to minimize the loss of standing snags during project implementation. Retention of untreated patches of trees within units (buffers around unique habitats, leave areas, etc.) as well as denser forest areas within the project boundary would continue to provide natural snag recruitment.

Proposed alternatives move stands towards LOS. Retaining large mature ponderosa pine where they exist, reducing basal areas in over-stocked stands, accelerating growth and moving young forest towards old forest structure would provide large green trees on the landscape. In the long-term, these larger trees may be available for future snag recruitment. However, in the short to mid-term it is reasonable to assume that snag recruitment in thinned areas may decline as competition factors are reduced.

Prescribed burning would be expected to have the greatest impact on snags and down wood as underburning operations may reduce their ability to serve as functional foraging or nesting habitat components for primary cavity excavators. However, snags can be both lost and created during implementation of burning. Project design features are incorporated into underburning prescriptions to minimize the effects to existing snags and large diameter down wood, as well as limiting mortality to large green trees which may serve as replacements. Patches of mortality may consist of one or two trees, or, depending on fuels, topography, and weather, may occasionally result in small burn patches. Because the trees with the highest potential to be killed would be smaller than 10” dbh, benefits would be primarily to foraging habitat.

Where fire created snag recruitment exceeds loss, local woodpecker habitat would benefit. The small diameter down wood percent cover has the potential to be reduced after prescribed fire activities though project design features including no direct ignition of down logs would help minimize potential effects during project implementation.

All action alternatives propose to reduce open road densities. The effective closing or decommissioning of roads would secure snag habitat from the risks of firewood cutting and hazard tree removal. However, during project implementation roads not normally open could receive higher than normal traffic making some areas that were off limits to firewood cutting open.

All action alternatives propose aspen enhancement and riparian restoration. Effects from these treatments would be negligible because of the small amount of habitat affected and associated project design features.

Cumulative Effects

The cumulative effects boundary includes the five subwatersheds that fall within the Gap project boundary (see figure 37). All of the actions in table 167 have been considered for their cumulative effects on primary cavity excavators and their habitat.

Treatments yet to be implemented within the Fox Canyon or Big Summit AMPs would not impact snag or down wood habitat. Prescribed burning is proposed in the Fox Canyon AMP; however, these acres are not likely to contain suitable foraging or nesting habitat for primary cavity excavators as they occur in open meadows and prairie habitat, nor would any snags or down wood be lost due to implementation other than the occasional hazard tree which would be negligible.

In addition to the reduction in open road densities proposed in the Gap project, the ongoing cross-country travel restrictions associated with the Deschutes and Ochoco Travel Management Plan and the South Boundary Travel Management Area would continue to help reduce access for firewood cutting and help retain snag and down wood components across the project area.

Effects from the Gap project when combined with effects from these projects are not expected to result in any additional, negative, cumulative effects, because the projects yet to be implemented will have negligible effects on snags and/or down wood habitats. No short- or long-term population decreases in primary cavity excavators would occur; therefore additive cumulative effects are not anticipated.

Conclusion

Because this project impacts little to no standing dead and/or down wood across the Forest, the overall direct, indirect and cumulative effects would result in a small negative trend of habitat over the short term. The loss of habitat would be insignificant at the scale of the Forest. The Gap Landscape Restoration project is consistent with the Forest Plan, and thus the continued viability of primary cavity excavators is expected on the Ochoco National Forest.

Pileated Woodpecker *(Dryocopus pileatus)*

The pileated woodpecker is a MIS for old growth habitats. Below is a summary of pileated woodpecker ecology important for assessing impact of the project on the species. For additional details see Mellen-McLean (2012*b*) in the analysis file. Also see the body of work by Evelyn Bull in the Blue Mountains (Bull 1987, Bull and Holthausen 1993, Bull et al. 2005, Bull et al. 2007) and Nielsen-Pincus and Garton (2007).

Pileated woodpeckers are associated with late-seral stages of the subalpine, montane, and lower montane forests, specifically, the old-forest single- and multi-strata stages of mixed conifer forests (Wisdom et al. 2000). Stands of pure ponderosa pine typically lack the abundance of snags and down wood necessary for foraging habitat for pileated woodpeckers (Bull et al. 2007).

In the Blue Mountains, densities of nesting pairs of pileated woodpeckers were positively associated with the amount of late structural stage forest and negatively associated with the amount of area dominated by ponderosa pine and the amount of area with regeneration harvests since 1970 (Bull et al. 2007).

Snags, down logs, and large hollow trees are important habitat components for pileated woodpeckers. Large ponderosa pine and western larch snags are used for nesting and roosting (Bull 1987). Bull and Holthausen (1993) found that density of large snags (>20" dbh) was the best predictor of density of pileated woodpeckers in the Blue Mountains. The pileated woodpecker also uses large, decadent trees and hollow grand fir for roosting (Bull et al. 1993). Large snags and down logs are important foraging substrate for pileated woodpeckers in the Blue Mountains (Bull 1987).

Existing Condition

Habitat for pileated woodpeckers is increasing across the Blue Mountains due to an increase in dense, multi-canopy stands from fire suppression (Wisdom et al. 2000). However, densities of large-diameter snags (>20" dbh) have declined from historical to current levels (Wisdom et al. 2000; Korol et al. 2002). In addition, within drier ponderosa pine sites, structural conditions used by pileated woodpeckers have increased due to fire suppression. However, this habitat type does not produce large-diameter snags (>20" dbh) in densities used by pileated woodpeckers (figure 19).

Densities of large-diameter snags (>20" dbh) in both the Eastside Mixed Conifer and Ponderosa Pine / Douglas-Fir Wildlife Habitat Types are near or above reference conditions in the snag density classes that provide habitat for pileated woodpeckers (Figures 19 and 20). A distribution analysis was done for snags and down wood and is summarized in the primary cavity excavators section of this document.

The Forest Plan allocated areas for old-growth management (MA-F6) to provide habitat for wildlife species dependent on old growth averaging 300 acres in size. The Forest Plan also stipulated that additional "supplemental feeding habitats" now referred to as Pileated Feeding Habitats (PFH), averaging 300 acres in size, would be located adjacent to these old-growth management areas to meet the needs of the associated wildlife species (USDA Forest Service 1989*b*).

There are three old-growth management areas (OGMA) within the project area; OG-D1-01 (408 acres), OG-D1-02 (384 acres), and OG-D1-04 (287 acres). A portion of OG-D1-01 (approx. 68 acres) falls outside of the project area.

Consistent with Forest Plan direction, feeding areas for this species, or PFHs were identified adjacent to the OGMAs. A 300 acre feeding area was designated for OG-D1-01 with 144 acres falling outside of the project area. A 311 acre feeding area for OG-D1-02 and a 301 acre feeding area for OG-D1-04 were also designated. The OGMAs and PFHs residing within the project area are currently functioning in their intended roles as suitable pileated reproductive and foraging habitat. In 2014 and 2015, surveys for pileated woodpeckers were conducted in all three OGMAs within the project area. In all three OGMAs, pileated woodpeckers were observed foraging, and additionally, the presence of juveniles confirmed successful reproduction.

There are currently 63,478 acres of suitable pileated reproductive habitat on the Ochoco National Forest, 11,062 acres of which occurs within the Gap project area.

Direct, Indirect, and Cumulative Effects

Alternative 1

Under the no action alternative, no management activities are proposed; animals would not be displaced, harassed, or injured by the project. Habitat would remain as described in the existing condition section. Due to an increase in dense, multi-canopy stands resulting from fire suppression; habitat for pileated woodpeckers is increasing across the Blue Mountains (Wisdom et al. 2000). However, densities of large-diameter snags (>21 inches dbh) have declined from historical to current levels (Wisdom et al. 2000; Korol et al. 2002). These trends would continue into the future under the no action alternative.

With the no action alternative there is an elevated risk of insect activity as well as higher severity wildfire as dense forest conditions would remain within the project area. Mortality to large pine from insect activity could result in snags for pileated woodpecker nesting habitat. However, depending on extent and severity, insect activity or wildfire effects would possibly set back the structural stage development, resulting in areas of young trees and longer time spans to develop old forest structures. Smaller fires of lower intensity could create snag habitat for pileated woodpeckers. In contrast, larger more intense fire events would reduce suitable pileated woodpecker habitat.

In the Ponderosa Pine/Douglas-fir Wildlife Habitat Type (PPDF WHT) the landscape is near or above historic conditions for snag densities of both large (>20”) and small (>10”) diameter snags. However, large diameter snag habitat for pileated woodpeckers is rare in this WHT both currently and within historic reference conditions.

In the Eastside Mixed Conifer Wildlife Habitat Type (EMC WHT) the percentage of the landscape with more than 4 large diameter (> 20” dbh) snags per acre is currently similar to historic conditions, only varying a percentage or two between each snag density class (figure 20). These snag density classes provide habitat above the 30% tolerance level for pileated woodpecker. Large diameter snag habitat for pileated woodpecker may be limiting in this WHT and therefore woodpeckers may be limited to more productive sites where snag densities are expected to be higher (Bull et al. 2007; Ohmann and Waddell 2002).

Conclusion

The no action alternative would not affect pileated woodpecker habitat and therefore would not contribute to a negative trend in viability on the Ochoco National Forest for this species.

Alternatives 2 & 3

Alternatives 2 and 3 would reduce the quantity and quality of existing reproductive and feeding habitat for the pileated woodpecker (see table 92). However, pileated woodpecker habitat within the project area would remain above HRV post-treatment as determined by the Viable Ecosystems model (see table 93). The existing 11,092 acres of suitable reproductive habitat currently found within the project area would be reduced to, at minimum, 4,759 acres which exceed the maximum acres (3,984) of habitat historically present on the landscape.

The reduction of habitat would predominately come as a result of commercial and noncommercial thinning. In addition, prescribed burning may have varying effects on habitat suitability by reducing down wood that provides a foraging substrate (Bull et al. 2005). Commercial treatment would reduce the suitability of these stands for nesting and foraging immediately after treatment due to reduced stand densities and complexity, however, all large diameter trees (> 21” dbh) essential for nesting and foraging would be retained under alternatives 2 and 3. With time, canopy closure is expected to recover to some extent, as the retained trees expand their crowns in diameter and depth in response to the release from competition that results from thinning. Noncommercial thinning would help promote the development of larger trees in the stand by reducing competition factors and could facilitate the development of higher quality foraging and nesting habitat in the long term. Noncommercial thinning that occurs in grand fir and Douglas-fir PAGs is not expected to affect foraging or nesting habitat in the short term because trees less than 9” dbh are not commonly used for foraging or nesting. In the long term foraging habitat in these PAGs may be slightly reduced because thinning would select against grand fir which is a desirable forage species.

Prescribed burning may reduce habitat suitability by reducing down wood and canopy closure, and by altering the timing of mortality in grand fir and Douglas-fir. Fire is likely to result in an abundance of small diameter (<10” dbh) fire-killed fir trees soon after the treatment, providing a flush of foraging substrate, but later within-stand mortality would be expected to decline and thus foraging opportunities would decline as well from the lack of continued recruitment of snags.

The level of impact to suitability for pileated woodpeckers with this treatment is dependent on fuel loading and burn conditions initially, as well as the frequency of maintenance burning. It is assumed that across the majority of units treated only with prescribed burning, forested stands are expected to retain sufficient snag and live tree replacement densities needed for this species.

Table 92. Proposed treatments within pileated woodpecker habitat designations including Pileated Woodpecker Feeding Habitat (PFH), and reproductive habitat, by alternative. Reproductive acres are determined using Viable Ecosystems Management Guide (VEMG; Simpson et al. 1994).

Habitat Designation	Total Acres	Alternative	Treatment Type			Suitable Habitat Post Treatment
			Commercial Acres	Noncommercial Acres	Prescribed Fire Acres	
Pileated Reproductive Habitat	11,092	Alt. 1	0	0	0	11,092
		Alt. 2	4,950	5,323	6,229	4,823
		Alt 3.	3,742	4,851	6,130	4,922
		Alt 4.	4,950 (1,500[2])	5,387	6,289	4,759
Pileated Feeding Habitat	767 (146[1])	Alt. 1	0	0	0	767
		Alt. 2	0	0	0	272
		Alt. 3	0	0	0	272
		Alt. 4	0	0	0	236
OG-D1-01	408 (68[1])	Alt. 1	0	0	0	408
		Alt. 2	0	0	0	408
		Alt 3.	0	0	0	408
		Alt 4.	0	0	0	408
OG-D1-02	384	Alt. 1	0	0	0	384
		Alt. 2	0	0	0	384
		Alt 3.	0	0	0	384
		Alt 4.	0	0	0	384
OG-D1-04	287	Alt. 1	0	0	0	287
		Alt. 2	0	0	0	287
		Alt 3.	0	0	0	287
		Alt 4.	0	9	0	278

[1]Additional acres that fall outside of the project area that would not be treated under any alternative.
[2]Acres proposed for the harvest of ≥ 21" dbh trees.

Table 93. Pileated woodpecker reproductive habitat derived from the Viable Ecosystems Management Guide (VEMG; Simpson et al. 1994).

Alternative	HRV – Min Acres	HRV – Max Acres	Acres (Post Treatment)[1]	Relation to HRV
Alternative 1	1,843	3,984	11,092	above
Alternative 2	1,843	3,984	5,990	above
Alternative 3	1,843	3,984	6,690	above
Alternative 4	1,843	3,984	5,959	above

[1]These acre totals do not take into account effects to suitability of habitat from treatments other than commercial harvest.

Snag habitat is currently adequate for pileated woodpeckers when compared to historic reference conditions in the Gap project area. This project would maintain adequate habitat in the short-term as snags would not be felled, outside of those deemed hazardous to operations, under any alternative. A distribution analysis for snags and down wood was done and is summarized in the MIS section of this document under primary cavity excavators.

Treatments within pileated habitat are similar between alternatives 2 and 3; however fewer overall treatment acres within suitable habitat are proposed in alternative 3 and thus this alternative retains the most habitat post treatment of all action alternatives.

Alternative 4

Alternative 4 would have similar effects to those identified in alternatives 2 and 3. However, units proposed for commercial harvest may remove fir trees greater than 21" dbh across 1,500 acres of pileated reproductive habitat (see table 92). Removal of these trees greater than 21" dbh, although not necessarily old, would reduce future snag recruitment to a greater degree than alternative 2 as well as select against the tree species that is most likely to become suitable nesting and foraging habitat. In addition, Alternative 4 would reduce current reproductive habitat, however, upon completion of proposed activities reproductive habitat would remain above the maximum HRV value for this species (see table 93).

Cumulative Effects

The cumulative effects boundary includes the five subwatersheds that fall within the Gap project boundary (see figure 37). All of the actions in table 167 have been considered for their cumulative effects on pileated woodpeckers and their habitat.

Much of the past fuels reduction and timber sale projects occurred within pileated woodpecker habitat. Proposed thinning and fuels treatments are additive to other similar projects in the cumulative effects area.

Fuels treatments yet to be implemented from the Fox Canyon AMP project do not occur within pileated woodpecker habitat. However, these treatments may influence the distribution of this species as certain areas may be avoided during implementation due to effects from smoke. In addition, these treatments, and those proposed in the Gap project would not be burned simultaneously, nor in a contiguous block, so refugia would exist across the project area where this species would be expected to persist.

Together with other landscape objectives that limit or discourage large fires and insect outbreaks, the project would help protect existing old growth habitat from these disturbances. However, these same treatments would contribute to a negative trend in dead and defective wood habitat across the Forest. These treatments, added to the needs for hazard tree falling along roads and trails either from new projects or ongoing/existing projects, would alter or remove potential pileated woodpecker nesting, roosting and foraging snags.

The extensive road network in the analysis area (largely a result of past harvest) has impacted snag densities by decreasing habitat from road construction and increasing accessibility of the area to firewood cutting. Public firewood cutting is expected to continue along open roads. The continued implementation of the Deschutes and Ochoco Travel Management Plan and the South Boundary Travel Management Area will continue to limit cross-country motorized access within the project area. These restrictions combined with the proposed road closure and decommissioning activities proposed in the Gap project would have a positive effect on the species as they retain snags, by reducing access for firewood cutting, thus maintaining dead and down wood habitat.

While additive cumulative effects may be anticipated, the amount of available habitat for the pileated woodpecker following treatments would still exceed HRV.

Forest Plan Consistency

The Forest Plan indicates that the allocated OGMAs are intended to provide reproductive habitat for pileated woodpeckers, and additionally PFHs for supplemental feeding areas. Wildlife and Fish standards and guidelines for MA-F6 indicate that vegetative management would not be allowed, until further research is available on the needs of the dependent species.

In accordance with the Forest Plan, no alternative in the Gap project proposes treatments within an OGMA or supplemental feeding habitat (PFH).

In addition, all OGMAs and PFHs within the project area are sufficient in size and meet standards established in the Forest Plan.

Conclusion

Under all action alternatives pileated woodpecker habitat would remain above the HRV within the project area. This project implements Forest Plan standards by ensuring Old Growth Management Areas and respective pileated woodpecker feeding habitats are sufficient in size and because this project impacts less than 10% of suitable habitat across the Forest, the overall direct, indirect and cumulative effects would result in a small negative trend of habitat. The loss of habitat would be insignificant at the scale of the Forest, and thus continued viability of the pileated woodpecker is expected on the Ochoco National Forest.

Northern Flicker *(Colaptes auratus)*

The northern flicker was selected to represent species that utilize old growth juniper habitat (USDA Forest Service 1989*a*). The flicker is probably the only primary cavity excavator that is capable of creating cavities in juniper (Thomas 1979).

Life History and Habitat

This species uses a wide variety of plant communities and successional stages. It prefers open habitats, and is commonly found foraging on the ground in open woodlands, meadows, fields and regeneration harvest areas (DeGraaf et al. 1991; Csuti et al. 2001). Thomas (1979) reported this species using all forest successional stages for foraging, and young (40-79 years) to old-growth (160+ years) for reproduction. Limited reproductive use of earlier stages is due to the absence of snags that this species requires for nesting. Nesting occurs in open areas in snags with some decay.

Existing Condition

Northern flickers are observed in almost all forest types. Habitat for this species is well distributed throughout the Gap project area. However, because this species is a MIS for old growth juniper habitat, only those activities occurring in juniper habitat will be analyzed to assess the effects of this project to this species.

There are 462 acres of juniper woodland and 131 acres of juniper steppe PAGs scattered across the project area. Of the 593 acres of total juniper habitat, Viable analysis indicates that there are no LOS stands identified. According to Viable and HRV, LOS stands associated with the juniper PAGs would not have been present within the project area.

Because juniper grows in most of the PAGS on the forest and that juniper has been expanding in both distribution and abundance, the acres listed above are an under representation of the amount of juniper that occurs within the project area. Historically juniper would have occurred on less acreage throughout the project area than what currently exists due to periodic wildfire that removed young juniper. Most of the expansion has been into the ponderosa pine habitats and at the interface between non-forest PAGs with other forested PAGs. In addition to the acres previously listed, juniper trees are also found scattered within non-forested lands that occur across the project area. A majority of these juniper trees associated with the non- forested lands are old growth juniper. Historically, wildfire was infrequent in the non-forested vegetation type due to low fuel levels. Potential nesting habitat for the northern flicker occurs throughout the Ochoco National Forest in minor amounts in the following plant associations; juniper steppe, juniper woodlands, lodgepole pine, ponderosa pine, Douglas-fir, and grand fir where the stands average tree size is 15” dbh or greater. However, as this species is an MIS for old growth juniper habitats only those habitats will be included in analysis.

Approximately 5,534 acres of LOS juniper habitat within the juniper steppe and juniper woodland PAGs occur on the Ochoco National Forest, however this acreage underestimates the total old-growth habitat present as there are likely individual juniper trees exhibiting old-growth characteristics outside of this habitat that are difficult to quantify.

Direct, Indirect and Cumulative Effects

Alternative 1

Habitat for the northern flicker would not be treated and current trends in habitat condition would continue. Younger juniper would continue to occur at higher densities as a result of fire suppression. Juniper would continue to outcompete grasses, forbs, and shrubs. No late and old structure (LOS) juniper stands were present historically, are present currently, or would be expected to be present in the future within the project area in the juniper steppe or juniper woodland PAGs, therefore no change would occur in the distribution or abundance of LOS habitat as a result of this alternative.

Conclusion

Alternative 1 would not affect the northern flicker and therefore would not contribute to a negative trend in viability on the Ochoco National Forest.

Alternatives 2, 3, & 4

All action alternatives propose to remove post settlement juniper on 277 acres within the juniper woodland and juniper steppe PAGs. Younger junipers up to 20.9" dbh would be cut using hand tools and the slash would be lopped and scattered or left intact. Old juniper would be retained, regardless of size providing potential nesting structure for the northern flicker. Concentrations of felled juniper slash would be burned. Burning is expected to occur in patches around felled juniper. A continuous fuel bed of slash is not anticipated due to the low density of fuel. The vegetative objective of this treatment is to reduce juniper density and increase the amount of area that is dominated by grass and shrub vegetation similar to what would have historically occurred. Other present, and foreseeable activities identified in the cumulative effects table do not remove old growth juniper. Proposed project activities would not contribute any additional negative effects toward the overall cumulative effects to the northern flicker.

Conclusion

Alternatives 2, 3, & 4 of the Gap project would not contribute to a negative trend in viability on the Ochoco National Forest for the northern flicker because all old growth junipers would be retained.

Golden Eagle (*Aquila chrysaetos*) & Prairie Falcon (*Falco mexicanus*)

The golden eagle and prairie falcon were chosen as terrestrial management indicator species (MIS) on the Ochoco National Forest for cliff, talus or cave habitat (USDA Forest Service 1989*b*).

Life History and Habitat – Golden Eagle

Golden eagles inhabit shrub-steppe, grassland, juniper, open ponderosa pine and mixed conifer/deciduous habitats. This species forages in a variety of habitat types and successional stages, preferring areas with an open shrub component that provides food and cover for prey. Suitable nesting and foraging habitat can be found in mountains, canyons, and rolling hills (Carey 2003). Of 506 occupied nests in 1982, 35% were in mature trees and 65% on ledges along rims and cliffs (Isaacs & Opp 1991). Nest trees are typically live ponderosa pine greater than 30 inches dbh with sturdy open branching (Carey 2003). Golden eagles have large breeding territories ranging from 10 to 40 square miles (Newton 1979; Collopy and Edwards 1989). Nest territories may contain several alternate nests in close proximity. Golden eagles forage on a variety of species including: jackrabbit, cottontail, ground squirrels, marmots, woodrats, other small mammals, fresh carrion, and a variety of bird species (Carey 2003).

Life History and Habitat – Prairie Falcon

Prairie falcons are most common in rimrock country, where they nest, but may travel great distances in search of prey (Janes 2003). A combination of rimrock or other outcrops and adjacent open country provides ideal breeding habitat. Cliffs need not be large. Denton (1976) found 59% of nests occur on cliffs less than 100 feet, some as low as 15 feet high (Janes 2003). The principal requirement is that the nest site be sheltered from above (Bent 1938; Webster 1976). This appears to reflect a need for shade and possibly protection from predators (Janes 2003). Grasslands are preferred habitat although they also occur in less-producitve areas dominated by sagebrush (Janes 2003). The prairie falcon is an oportunistic feeder that eats small mammals, a variety of small birds, lizards, and grasshoppers (Csuti et al. 2001).

Existing Condition – Golden Eagle and Prairie Falcon

On the Ochoco National Forest, including the Crooked River National Grassland, there are numerous historic records for golden eagle nest sites. The majority of the nests occur in the rimrock habitat present in Jefferson County. In 2012, a golden eagle nest was discovered within the project area, however survey efforts since that time have not detected presence of nesting eagles.

Prairie falcons have not been observed within the project area but may utilize the meadow and sagebrush habitat for foraging. No known nests occur in or adjacent to the project area.

Based on GIS and aerial photo analysis, nesting habitat in the form of rock features for both species are limited to only a few possible locations within and immediately adjacent to the project area. In addition, only one location could be identified spatially where possible rimrock structures existed adjacently to open habitat, areas described as ideal for prairie falcon nesting. Field verification of possible nesting suitability or surveys to detect evidence of recent reproductive activity are lacking for these areas. However, suitable foraging habitat for both the golden eagle and prairie falcon as well as nesting habitat for golden eagle, in the form of mature ponderosa pine trees, does occur in the project area.

Direct, Indirect and Cumulative Effects

Alternatives 1, 2, 3, & 4

The Forest Plan provides guidance for the protection of nests, the protection of habitat surrounding nests, and minimizing disturbance to nesting individuals that would be implemented in all alternatives if a nest was located.

There are no prairie falcon nests known to occur within the project area. Cliff faces and ledges suitable for golden eagles do not occur within the project area. One golden eagle nest located in a large diameter tree is known to occur within the project area. However, this nest has not been active since 2012, and no commercial harvest activities are planned in the nearby vicinity. Cliffs or rimrock within close proximity to open habitats are extremely rare within the project area, thus suitable nesting habitat for prairie falcons is not likely to exist. Thinning of overstocked stands and prescribed burning could improve foraging opportunities by making the habitat more open. Juniper thinning, riparian restoration and aspen stand enhancement could improve habitat for prey species associated with golden eagle and prairie falcons. However, the project area is likely to have a relatively minor influence on potential nesting and foraging habitat for golden eagles and prairie falcons due to a general lack of cliff and rimrock features within the project boundary. Proposed project activities would not contribute any additional negative effects toward the overall cumulative effects to either species.

Conclusion

Implementation of any alternative proposed in the Gap project would not contribute to a negative trend in the viability of either the prairie falcon or golden eagle on the Ochoco National Forest.

Bald Eagle *(Haliaeetus leucocephalus)*

The bald eagle was analyzed in the Threatened, Endangered, Proposed, and Sensitive Species section of this document. That analysis determined that project activities may **impact individuals or habitat, but would not likely contribute to a trend toward federal listing or loss of viability to the population or species (MIIH).** In the long term, treatments would help retain and promote growth and longevity of large trees and would have a **Beneficial Impact (BI)** on Bald Eagles.

Conclusion

Implementation of any action alternative proposed in the Gap project would not contribute to a negative trend in the viability of the bald eagle on the Ochoco National Forest.

Rocky Mountain Elk (*Cervus elaphus*) & Mule Deer (*Odocoileus hemionus*)

Rocky Mountain elk and mule deer are species that are commonly hunted and were chosen as terrestrial MIS for populations of big game and their habitat (USDA Forest Service 1989*b*). The desired condition is to provide forage, thermal cover, and security habitats (hiding cover) to maintain healthy populations of Rocky Mountain elk and mule deer that are consistent with population management objectives established by the Oregon Department of Fish and Wildlife (ODFW) (USDA Forest Service 1989*b*).

The objective of the Ochoco National Forest as stated in the Forest Plan is to manage elk and deer habitat to meet the population objectives of the ODFW to the extent practicable. Big game management on the Ochoco National Forest is a cooperative effort between the Forest Service and the ODFW where the Forest Service manages habitat while ODFW manages populations. The agencies cooperate by managing big game according to pre-established Management Objectives (MOs) for each big game management unit. The management objective is the number of elk and deer that ODFW manages for to prevent depletion of big game animals and to provide optimum recreational and aesthetic benefits for the public including quality hunting and wildlife viewing opportunities in the present and in the future. The project area falls within the Ochoco Big Game Management Unit (GMU). Table 94 displays MOs for elk and mule deer populations in the Ochoco GMU.

Table 94. Management Objectives for Rocky Mountain elk and mule deer in the Ochoco Big Game Management Unit.

Elk			
Year	**Population**	**Bulls per 100 cows**	**Calves per 100 cows**
Management Objectives	**4,500**	**20**	**N/A**
2015	4,050	13	25
2014	4,200	16	37
2013	4,000	12	19
2012	4,032	27	41
2011	3,900	14	42

Mule Deer			
Year	**Population**	**Bucks per 100 does**	**Fawns per 100 does**
Management Objectives	**20,500**	**15**	**N/A**
2015	15,000	16	60
2014	14,800	20	62
2013	15,000	20	65
2012	15,400	19	45
2011	15,400	18	64

Life History and Habitat

Elk **-** Elk occur throughout Oregon and are most abundant in the Blue and Wallowa mountains and in the northern coast range (Verts & Carraway 1998). Elk require a mosaic of early forage-producing stages and later, cover-forming stages in close proximity (Harper et al. 1987).

Mule Deer **–** Mule deer occur throughout Oregon east of the Cascade Range, and in summer, range into the Cascades (Verts and Carraway 1998). Mule deer occupy a wide range of habitat types from desert shrubs to woodlands to conifer forests (Einarsen 1956) but generally prefer more open, rugged areas (Verts and Carraway 1998).

Existing Condition

Thomas et al. (1988) developed the Habitat Effectiveness Index (HEI) model for estimating elk habitat effectiveness on the landscape. Overall habitat effectiveness (HEcsrf) incorporates four variables or indices: cover quality (HEc), size and spacing of cover (HEs), density of roads traveled by vehicles (HEr), and quality and quantity of forage (HEf). The Forest Plan establishes minimum habitat effectiveness standards for various Management Areas (see table 95). In addition, the Forest Plan identifies minimum standards for cover and open road density. Quantity and quality of cover, and open road density are the main factors influencing the habitat effectiveness index (HEI). The Forest Plan page 4-258 states that, “It is expected that individual projects will be above and below these values, but that the overall objective (HEI) for the management areas will be met”. The Forest Plan does not identify a model for deer habitat analysis.

Thomas et al. (1979) defined two types of cover for elk habitats; thermal and hiding. Thermal cover was “any stand of coniferous trees 40 feet or more tall, with an average canopy closure exceeding 70 percent.” Hiding cover was defined as “vegetation capable of hiding 90 percent of a standing adult elk from the view of a human at a distance equal to or less than 200 feet.” For calculating the existing condition and additionally the effects from proposed actions to thermal cover, all forested stands within the project area were categorized by their estimated individual canopy cover values pre- and post-treatment where satisfactory cover was greater than 70%, marginal cover was between 70% and 40%, and forage was defined as less than 40%. Canopy cover percentages for each stand were estimated using attributes from LiDAR (Light Detection and Ranging) data as described by Hudak et al. (2008).

The MO for the Ochoco WMU is 4,500 elk and 20,500 mule deer. Currently elk and mule deer populations are below the management objectives in the Ochoco GMU (see table 94) although it is unlikely that forage availability within the project area is limiting population size. The legal harvesting of animals, poaching, predation, and the quality of wintering habitat on adjacent private and Bureau of Land Management (BLM) land are likely the primary factors limiting population size. The Forest Plan objective is 2,600 elk and 18,300 mule deer across the Ochoco National Forest (USDA Forest Service 1989*b*). In the third decade (current decade) of plan implementation it was expected that there would be 2,900 elk and 18,300 mule deer across the forest.

Mule deer populations have been generally declining across the western United States. This decline is evident in the Ochoco WMU as well. In contrast, the elk population within the Ochoco WMU has steadily increased from less than 300 total elk in the 1970's to over 5,000 in the early 2000's. Since that time the population has fluctuated around 4,000 total elk (see table 94). The current population numbers of both elk and mule deer are below the management objectives for the Ochoco WMU; however they exceed the Forest Plan objectives.

The project area contains the following habitats pertaining to elk and mule deer management; Winter Range (F20), General Forest Winter Range (F21), and General Forest (F22). Winter range is primarily at lower elevations, less than 5,200 feet, where forested areas are interwoven with non-forested grasslands and shrublands. The project area contains: 616 acres of Winter Range, 13,827 acres of General Forest Winter Range, and 18,003 acres of General Forest. All of the project area is occupied by big game throughout the summer so all 38,145 acres of project area is considered habitat. However, analysis will only focus on those management areas identified in the Forest Plan that have elk and mule deer management standards associated with them. On the Ochoco National Forest there are 36,372 acres of Winter Range, 82,623 acres of General Forest Winter Range, and 356,888 acres of General Forest.

Calving and fawning can occur throughout the watershed although they primarily occur in proximity to riparian areas that provide high quality forage and cover. Aspen stands and other riparian hardwoods such as willow are likely to be attractive areas for calving and fawning. The project area contains approximately 2,736 acres of habitat specifically identified as elk calving habitat.

Elk and mule deer use the project area throughout most of the year. Seasonal movements are primarily influenced by snow depth. During winters with below average snowfall, both species can remain in the southern portion of the project area throughout the year. During winters with normal to above normal snow accumulations, the majority of animals move to lower elevations on the Forest, private lands, or BLM managed lands.

Upland shrub species that provide forage for big game such as mountain mahogany, ceanothus, upland willow and bitterbrush do not occur in large numbers within the project area. Mountain mahogany was likely represented by higher populations and wider distribution historically because there were more open ponderosa pine stands and shrub steppe habitat that occurred at lower elevations. Bitterbrush did not cover large areas historically and remains limited within the project area.

Open road densities were calculated using the district access travel management database. It is important to note that for the purpose of this analysis the assumption is that only open roads are being used. However, we are aware that ineffective road closures, limited enforcement, vegetation and relative flat topography contribute to non-authorized use. Table 95 displays open road densities by alternative. Because of the aforementioned reasons, the road densities do not give an accurate indication of the amount of vehicle use and the potential disturbance effects to big game habitat. Many of the three digit roads receive very light use until the beginning of archery season, at which time road use increases. Off-highway vehicle (OHV) use within the project area has also increased in the last 10 years, which is primarily associated with the beginning of archery season and related in general to other hunting activities. Many studies have documented that elk avoid areas near open roads (Ager et al. 2003; Lyon 1979; Rowland et al. 2000, 2005).

Rowland et al. (2005) utilized distance bands corresponding to habitat effectiveness (HE) values to further incorporate the effects of disturbance to elk from open road densities across the landscape with 0 being the lowest HE value and 1 the highest. Currently, the project area has a weighted HE value of 0.30 with regard to open road densities and their relationship on habitat effectiveness for elk (see table 96). These lower values may indicate, but do not definitively prove, that elk may be spending more time on private land in response to traffic on federal lands. However, this may also be a response to hunting pressure, forage quality and availability, an increase in disturbance from motor vehicle use, or a combination of these factors.

Table 95. Existing Cover, Road Density, HEI Value and Goals (HEI values are average values for the watershed) based on values within HEI Tables – PIN #11 (September 13, 1990).

Management Area	Cover % of MA	Open Road Density (miles/mile^2)	HEI Value
General Forest			
Forest Plan Standards[2]	20%	3	7
Alternative 1	52%	2.34	47
Alternative 2	43%	1.88	55
Alternative 3	45%	1.88	55
Alternative 4	43%	1.88	55
Winter Range			
Forest Plan Standards[2]	18%	3 (1)	7
Alternative 1	72%	1.52	29
Alternative 2	58%	1.52	39
Alternative 3	62%	1.52	41
Alternative 4	58%	1.52	39
General Forest Winter Range			
Forest Plan Standards[2]	20%	3 (1)	7
Alternative 1	54%	1.22	60
Alternative 2	29%	1.24	40
Alternative 3	35%	1.24	53
Alternative 4	29%	1.24	40

[1]*The goal for winter range road densities is 1 mile per square mile from Dec. 1 - May 1 and 3 miles per square mile for the remainder of the year.*
[2]*Forest Plan Standard and Pin #11 Objectives for the 3rd Decade*

Table 96. Comparison of Habitat Effectiveness (HE) values and their corresponding acreage for each alternative for Rocky Mountain elk with regard to distance from open roads within the Gap project. These values are taken from Rowland et al. (2005); where 0 represents the lowest HE value, with 1 representing the highest.

Habitat Effectiveness Values	Existing Condition / Alternative 1	Alternatives 2, 3, & 4	Net Change
	Acres	Acres	Acres
0.17	22,715	19,673	- 3,042
0.33	8,711	9,553	+842
0.5	3,653	4,757	+1,104
0.67	1,491	2,136	+645
0.83	557	790	+233
1	1,018	1,036	+18
HE Value Weighted Average	0.30	0.33	+0.03

Direct, Indirect and Cumulative Effects

Alternative 1

No commercial thinning or noncommercial thinning would occur. With no activities proposed, cover percentages, quantity and quality of forage, and open road densities, which are all used to evaluate habitat effectiveness of elk, would remain in their current condition (see table 95). Elk habitat would remain the same therefore there would be no impact to elk populations.

The current quantity of cover and forage within the analysis area would be unchanged. In the mid- to long-term (with continued fire suppression), development of multi-strata stands would create additional marginal cover and potentially satisfactory cover stands, increasing both thermal and hiding cover for ungulates. Conversely, with improved cover or potentially larger homogeneous stands of cover, there would be less forage available as tree canopies close and shade the ground, which could conceivably reduce HEI values.

Increased tree stocking may increase the chance of a high severity wildfire. A fire of moderate to intense magnitude and severity could convert multi-strata cover habitat to stand initiation forage habitat in the short- and mid-term, increasing available forage, however, increasing vulnerability of big game to hunting.

No prescribed fire would occur. With no activities proposed, cover percentages which are used to evaluate habitat effectiveness of elk, would remain in their current condition (see table 95). Possible benefits to forage quantity and quality would not occur.

Open road densities would be maintained at current levels as described in the Existing Condition section. Implementation of this alternative would construct no new roads, but at the same time, it would do nothing to modify existing open road densities or road management. Relationships between the spatial distribution and disturbance associated with open roads and hiding cover habitat would also not change, as existing road densities and levels of use are expected to remain the same in the short-, mid-, and long-term.

Aspen stands would remain in their current condition. Grazing and browsing of aspen stands would continue. Conifer encroachment into groves would remain and continue to increase. The overstories of each stand would remain even aged with many of the groves approaching the end of their life cycle. Aspen would continue to decline and stands would slowly disappear.

Conclusion

Alternative 1 would not affect habitat of the Rocky Mountain elk or mule deer and therefore would not contribute to a negative trend in viability on the Ochoco National Forest.

Alternatives 2, 3, & 4

All of the action alternatives would reduce cover (see table 95). This analysis is based on the assumption that all proposed harvest treatments would reduce the current cover present within each stand post treatment. It was generally assumed that canopy cover would be reduced by at least 10% post treatment. Additionally, it is assumed that noncommercial thinning and prescribed burning would not affect thermal cover in the short term because the trees that provide canopy cover that are greater than 40 feet tall would not be cut during noncommercial thinning or lost to prescribed burning operations.

The reduction of canopy cover and corresponding tree density would decrease security and increase the potential for human disturbance for both deer and elk. Disturbance is primarily related to activities associated with hunting seasons and to a lesser extent other recreational activities. Increased disturbance due to decreases in cover could increase the movements of elk and deer onto areas of the forest that provide greater security or adjacent private lands. Cover quality and quantity is expected to increase over time as the forest canopy recovers and the ingrowth of conifer seedlings occurs.

Commercial thinning, noncommercial thinning, and prescribed burning, while reducing thermal and hiding cover would improve forage conditions throughout the project area. Though a reduction in cover would occur in the short- to mid-term, Forest Plan standards regarding cover within each Management Area would be met for each alternative (see table 95).

Cover requirements may not always be compatible with the HRV. This conflict is readily apparent in the hot-dry and warm-dry biophysical environments dominated by ponderosa pine.

Historically, frequent low intensity fires favored large blocks of single story, mature stands with canopy closure too low to support large blocks of satisfactory and marginal cover. Under historical conditions, cover percentages would be inherently low, probably below Forest Plan standards. Today cover requirements are being met on many ponderosa pine sites because of the ingrowth of ponderosa pine and fir species; however, stands are overstocked and at high risk to bark beetle attack and uncharacteristically severe wildfires. Thinning treatments that effectively reduce beetle and fire risk also reduce the effectiveness of a stand to serve as adequate cover.

The noncommercial thinning of small trees would have the greatest impact on hiding cover in the short term. In the long term, noncommercial thinning is expected to increase growth of younger trees and increase the development of tree crowns that provide hiding cover, and over time thermal cover. Those areas where thinning would occur would be expected to transition back to marginal thermal cover in approximately 25-50 years depending on the residual stand density, species composition, site quality, etc., following treatment.

Prescribed fires are expected to burn relatively cool, move slowly, and burn in a mosaic of burned and unburned patches. Burning would primarily be conducted in dry forest vegetation types that were historically dominated by open, park-like stands of large diameter trees. Prescribed burning can reduce hiding cover when allowed to burn at moderate to high intensity in thickets of young understory, but rarely reduce the stocking of understory trees to a condition that is unsuitable for use by this species. Burning would improve forage conditions by reducing forest litter (needles and limbs), opening canopies, and allowing more sunlight to reach the forest floor. Most native grasses and forbs and many shrubs respond positively to increased sunlight and fire.

Open road densities vary by alternative within each Management Area (see table 95). Open road densities within General Forest would be reduced for each action alternative, increasing the effectiveness of the habitat for big game. Within General Forest Winter Range, a minimal increase in road density would occur under all action alternatives but this increase is negligible. There would be no change in Winter Range road densities. This lack of measurable change in road densities for both Winter Range and General Forest Winter Range Management Areas is due to the fact that these areas currently fall under the South Boundary cooperative Travel Management Area (TMA). This TMA was established in 1991, and designated year round closure travel restrictions for many of the roads already on the landscape. The current open road density will not likely be significantly reduced any further in the near future.

Within the first 10 years new road construction would increase open road densities. When timber sales are active, log haul activities would temporarily increase local traffic levels. Disturbances to big game would be expected to increase over the current condition. Disturbance to big game is a concern in both Winter Range and General Forest Winter Range and therefore, timber management activities would be restricted from December 1 to May 1 to minimize disturbance. Elk are likely to shift use areas as activities progress across the project area (Rapp 2006). As road closures are completed, disturbances to deer and elk from vehicular traffic and mortality from hunting would be expected to decrease from current levels. However, the decrease in disturbances to deer and elk would only occur if road closures are effective. Closures would in part mitigate losses in hiding cover that occur due to timber harvest and prescribed fire resulting in increased security.

In addition, the reduction in the open road densities increases the road specific weighted habitat effectiveness value for the entire project area, as well as increasing the size and distribution of more isolated habitat, which is preferred by elk and deer (see table 96).

The project area contains approximately 281 acres of mapped aspen habitat, though additional acreage is likely to exist. Quaking aspen can be found scattered throughout the planning area. They are primarily located along streams, at springs, rock outcrops, within meadows and scattered amongst upland forest stands. A majority of the aspen stands within the Gap project area are small in size, with a mean size of 4 acres.

These aspen stands are characterized as being heavily over-browsed and encroached upon by conifers, leading to declines in health and vigor. All action alternatives propose aspen treatments that can be important to calving and fawning as well as an important forage source. Treatments would enhance current hardwoods that exist, although the treatments occur on a small percentage of the entire project area. In the first 10 years many of these trees would be fenced, restricting access for elk and deer, but as new regeneration becomes established and protective fences deteriorate or are removed, available browse should increase and aspen groves would be larger, healthier, and more likely to remain a viable component of the landscape. Project design features would ensure the implementation of wildlife friendly fences, negating any harmful affects to big game.

Riparian restoration to stop channel down cutting and provide for stable water tables would occur along 13.7 miles of streams within the project area. This restoration would help ensure that complementary aspen and hardwood release as well as additional planting projects would be successful. It is anticipated that there would be an increase in the forage available as a result of stream restoration activities, as well as improved conditions for existing hardwoods, with the potential for expansion within these areas. Due to the treatments, riparian areas within the project area would become more desirable for calving and fawning.

With the exception of General Forest Winter Range, all action alternatives propose to improve the overall habitat effectiveness for each Management Area. Within General Forest Winter Range there are decreases of overall habitat effectiveness for each action alternative. The decrease in amount of cover available is contributing to the decreased habitat effectiveness. The results of the HEI analysis for each action alternative show that although a decrease in HEI value occurs within the General Forest Winter Range, this would not likely effect elk within the project area as HEI values post-treatment would still exceed Forest Plan standards in all three management areas. In addition, HEI values would improve in both General Forest and Winter Range management areas under all action alternatives.

Cumulative Effects

The cumulative effects boundary includes the five subwatersheds that fall within the Gap project boundary (see figure 37). All of the actions in table 167 have been considered for their cumulative effects on elk, mule deer, and their habitat. Past and present management activities that have affected elk habitat within the project area include: Harvest activities, road construction, fire suppression, and livestock grazing. Past harvest activities have led to the existing road densities, cover values, and HEI values referred to in the existing condition.

Road construction associated with past timber harvest, hunting along open roads, and off-road vehicle use has increased road-related disturbance to big game and impacted their populations. The Gap project proposes to reduce open road densities through all action alternatives. The Deschutes and Ochoco Travel Management EIS and the South Boundary Travel Management Area, further increase big game security as a result of continued implementation. The Travel Management EIS's decision precludes off-highway vehicles from traveling cross-country in the project area and coincides with the goals of the South Boundary Travel Management Area, whose boundary lies completely within the project area, and reduces open road densities year round.

The implementation of any action alternative from the Gap project would contribute positively to the overall cumulative effects from other ongoing projects regarding reduction of open road densities.

Livestock grazing is ongoing throughout the project area. Proposed activities within the Gap project include the construction of livestock exclosures as well as additional fencing for improved grazing management. No change to the frequency or total number of livestock being grazed would occur under any alternative. Project effects would contribute positively when combined with other actions yet to be implemented within the project area, such as activities within the Fox Canyon and Big Summit AMPs. These activities would improve grazing management and conditions of the habitat, thus providing more forage availability for both livestock and other ungulates such as deer and elk.

Aspen enhancement and riparian restoration is ongoing within the project area. The Fox Canyon and Big Summit AMPs include more than 21 acres of aspen enhancement as well as over 7 miles of stream restoration. Effects from the implementation of any action alternative from the Gap project combined with the effects from these treatments would result in a positive cumulative effect for these species.

Established populations of invasive plant species are present within the project area. Project design features mitigate any additional spread of noxious and invasive plants through the implementation of any action alternative within the Gap project however, a slight increase in the abundance and distribution of invasive plants may occur as a result, though this increase is likely negligible at the project-scale. In addition to project design features, the Deschutes and Ochoco Invasive Plants FEIS (USDA Forest Service 2007) allows for the treatment of invasive species, resulting in fewer invasive plants and thus reducing the likelihood of any decline in quantity and quality of big game forage.

The Lookout Mountain Multi-use Trail project would likely increase the amount of recreation that occurs within portions of the project area and could contribute negatively to the overall cumulative effects to this species when combined with disturbance factors associated with implementation from the Gap project. However, temporal overlap between projects would likely be minimal, thus anticipated effects would be short-term in duration.

Juniper removal, prescribed burning and additional habitat restoration to other unique habitats including aspen associated with the Juniper Hills Preserve project located immediately adjacent to the Gap project boundary on private land owned and managed by the Nature Conservancy would contribute positive effects for both elk and mule deer. When combined with effects from the Gap project these treatments would contribute positively to improving forage conditions in known winter range and transitional habitats as well as parturition habitat for these species.

Forest Plan Consistency

Populations of Rocky Mountain elk and mule deer across the State of Oregon, and across the Ochoco National Forest, have a demonstrated harvestable surplus. Oregon Department of Fish and Wildlife monitors these populations annually and sets harvest levels based on these surveys. Given the widespread distribution of these species and their habitat across the Forest, and the potential effects described above, this project would improve the forage conditions and decrease cover. Road densities, which have the largest potential for impacting habitat have been decreased over the last ten years and with the continued implementation of the Ochoco Travel Management plan will be further reduced. The Gap project would not reduce the habitat capability or carrying capacity due to the increase in HEI in General Forest and Winter Range management areas. Though the HEI value for General Forest Winter Range would be reduced, all HEI values as well as cover percentages would remain above Forest Plan standards for all management areas.

Conclusion

The overall direct, indirect and cumulative effects would result in a positive trend of habitat, though some negative impacts would occur. Both winter range and general forest would see a positive trend of habitat and an increase in HEI from reducing road densities and improving forage quantity and quality, while a decrease in both cover and HEI within general forest winter range as well as an increase in disturbance across the project area would cause a slight negative trend. The decrease of cover and reduced HEI, and the increase in disturbance during harvest and post-sale activities would be insignificant at the scale of the Forest. The Gap project is consistent with the Forest Plan, and thus continued viability of Rocky Mountain elk and mule deer is expected on the Ochoco National Forest.

Other Species or Habitat Identified in the Forest Plan

The Forest Plan provides standards and guidelines for an additional suite of species identified as Other Species. This section analyzes the affects to the Other Species identified in the Forest Plan (see table 97) but does not include species already analyzed as Threatened, Endangered, Proposed, Sensitive, or Management Indicator Species.

Table 97. Other Species Identified by the Forest Plan for the Ochoco National Forest (USDA Forest Service 1989b).

Other Wildlife Identified in the Forest Plan		
Species	**Management Direction**	**Habitat Present in the Project Area**
Antelope	Activities will be in accordance with ODFW population objectives.	Yes
Raptor Habitat	Protect nest sites and nesting habitat. Minimize disturbance during the nesting period.	Yes
Hawks and Owls	Protect nest sites and nesting habitat. Minimize disturbance during the nesting period	Yes
Northern Goshawk	In 1995 the Regional Forester's Eastside Forest Plan Amendment #2 amended the Forest Plan. This amendment included interim management guidelines for northern goshawk in regards to timber sales	Yes

Pronghorn Antelope (*Antilocapra americana*)

Life History and Habitat

Pronghorn antelope are established east of the Cascade Range in most of Oregon (Verts and Carraway 1998). They are usually associated with areas of open plains, but in Oregon their primary habitats are broad areas dominated by big sagebrush and intermittent lakes (Einarsen 1948; Good and Crawford 1978; Herrig 1974) and occasionally occur in areas with widely spaced junipers or ponderosa pines (Mace 1954; Polenz 1976). Within these habitats, water is the predominant factor influencing seasonal use of sites by pronghorns in Oregon (Good and Crawford 1978; Herrig 1974). They eat a variety of forbs, grasses and shrubs (Verts and Carraway 1998).

Existing Condition

Pronghorn occur within the project area, and are most commonly found within larger prairie habitats in close proximity to Big Summit prairie. The Forest Plan does not identify a model for pronghorn habitat analysis. However, it does specify that habitat for pronghorn is to be managed in accordance with ODFW Management Objectives. However, ODFW doesn't have management objectives similar to those for elk and mule deer, instead population trends are monitored and hunting seasons vary according to those trends. Available information from ODFW is presented in table 98.

Table 98. Management Objectives for pronghorn antelope in the Ochoco Big Game Wildlife Management Unit.

Pronghorn Antelope			
Year	**Population**	**Bucks per 100 does**	**Kids per 100 does**
Management Objectives	**N/A**	**N/A**	**N/A**
2015	N/A	23	29
2014	N/A	24	23
2013	N/A	27	31
2012	N/A	35	46
2011	N/A	47	49

Direct, Indirect and Cumulative Effects

Alternative 1

Antelope habitat would not be treated and current trends in habitat condition would continue. Conifer expansion would continue to occur and change the proportion of trees, shrubs, grasses, and forbs. This change would decrease not only the availability of forage but it would be less desirable because antelope prefer open areas with short vegetation to evade predators. This alternative would have no direct effects on antelope but could lead to reduced habitat suitability through juniper expansion into non-forested areas.

Alternatives 2, 3, & 4

The Gap project proposes a variety of actions including; commercial harvest, noncommercial thinning, riparian restoration, aspen stand improvement, underburning and reduction of open road densities. It is anticipated that the effect to antelope as a result of all action alternatives would be similar to those summarized for Rocky Mountain elk and mule deer. In addition, activities including prescribed burning and noncommercial thinning of juniper would likely benefit antelope as they would improve habitat conditions by reducing the amount of young juniper present and reinvigorating grass and forbs utilized as forage by this species. All action alternatives propose prescribed fire and noncommercial thinning of juniper to meet project objectives. Prescribed burning would incorporate project design features to minimize the invasion of noxious weeds and retain existing sage brush, bunch grasses, forbs, and shrubs.

Noncommercial thinning within juniper treatments would focus on post-settlement juniper. These treatments would reduce juniper densities within suitable habitat, benefitting bunch grasses, forbs, shrubs, and sage brush, thus increasing forage for antelope.

The effects of reducing road densities are similar to Rocky Mountain elk and mule deer as well and would increase security for antelope.

The chances of negative direct or indirect effects to the pronghorn antelope as a result of implementing any action alternative are minimal. Most activities would benefit habitat for this species, but there is a slight chance of disturbance and a possibility of increased noxious weeds within the project area as a result of implementation.

Cumulative effects for this species would be similar to those already discussed for the Rocky Mountain elk and mule deer.

Conclusion

Effects to pronghorn antelope would be similar to Rocky Mountain elk and mule deer, although pronghorn would likely benefit more as a result of juniper management.

Raptor Habitat

Raptors are birds of prey, of which numerous species occur or have been seen throughout the project area. The Forest Plan provides guidance for: the protection of nests, the protection of habitat surrounding nests, and minimizing disturbance to nesting or roosting individuals.

Effects to raptor nesting habitat would be mitigated as stated in the Forest Plan, therefore none of the alternatives would affect nesting habitat or disturb raptors. However, there are no land use provisions for protecting foraging habitat for raptors and this analysis would focus on effects to the prey base by alternative.

A variety of raptors are known to be within the area of influence of this project or have sightings within the project area including: American kestrel, Northern harrier hawk, red-tailed hawk, Cooper's hawk, sharp-shinned hawk, bald eagle, golden eagle, goshawk, osprey, and great horned owl.

Known nesting habitat within the project area includes: 7 goshawk territories, 2 Cooper's hawk nests, 1 golden eagle nest, and 1 historic osprey nest. The bald eagle (TES), golden eagle (MIS), and Northern goshawk (Other Species) have been discussed in other sections of this report.

Existing Condition

Avian and vertebrate population densities may change in response to a change in vegetation structure and composition (Chambers 2002). Although some wildlife species are highly mobile and can move to more favorable habitat, many species are often restricted to small areas (Hall & Morrison 1997).

A variety of forest management activities have affected the distribution and amount of habitat available for a variety of raptor species as well as negatively affected habitat for prey species. Past harvest activities were focused on clearcuts or the removal of large diameter trees which decreased habitat for those species dependent on large diameter, open stand conditions as well as large diameter multi-storied conditions. Many species of raptors nest in large trees; where these structures have been removed, potential nesting habitat has been eliminated. However, these open areas do provide foraging opportunities for many species that forage over open ground, such as Northern harriers, red-tailed hawks and kestrels, as well as flammulated, barn, great horned and pygmy owls (Marshall et al. 2003). Commercial thinning and selective harvest areas may provide nesting habitat for some species of hawks and some owls. Ferruginous hawks, kestrels, flammulated owls, great-horned owls and long-eared owls are known to prefer relatively open forests (Marshall et al. 2003). However, thinned stands would likely be too open for other owls and the forest dwelling accipiters, such as goshawks (Reynolds et al. 1982).

Harvest activities have also reduced the size and distribution of dead wood habitat throughout the project area, which has affected a large number of prey species dependent on this habitat. Past harvest activities have resulted in dense forested conditions, compared to historic conditions, dominated by trees in the size class 9" dbh to 21" dbh. Current habitat conditions would seem to favor species like the Coopers hawk that prefers fairly closed stand conditions 50 to 70 years old (Reynolds et al. 1982). Past harvest activities, grazing activities, and fire suppression activities have resulted in much denser forest conditions that have expanded into areas once dominated by shrubs. Higher conifer densities have also resulted in the decline of understory shrub and grass species. A variety of prey species may have been affected by this change in vegetation conditions. Cattle grazing and grazing by wild ungulates removed herbaceous and shrubby vegetation which affected vegetation availability for cover, forage and nesting habitat for a variety of bird and small mammal species.

Direct, Indirect and Cumulative Effects

Alternative 1

This alternative would not treat forest stands and thus the current trends in forest development would continue to occur. This alternative would maintain the existing acres of fir-dominated understories and the trend toward fir dominated habitats. This would tend to favor the forest dwelling accipiter's (Coopers hawk and sharp-shinned hawk) and the small forest dwelling owls (pygmy owls and saw-whet owls). These dense, fir-dominated understory conditions would result in a continued loss of herbaceous and shrubby vegetation in the understory. As a result, the ability of open forest avian predators to effectively hunt ground dwelling small mammals would continue to be limited. There would be a continued decline in habitat for species which prefer open ponderosa pine habitats such as the flammulated owl, as stand densities would increase within these habitats. Tree mortality due to stand densities being above sustainable levels would result in recruitment of snag and down log habitat over time. Potential for high intensity wildfires would be increased. Should a wildfire occur, this would likely trigger an increase in the woodpecker populations in the short term, which are also prey for some raptors such as Cooper's hawks and northern goshawks.

Conclusion

This alternative would maintain the suitability of all existing habitat for raptors in the short term and would not result in disturbance or displacement of raptors from existing occupied territories.

Alternatives 2, 3, & 4

These alternatives propose commercial and noncommercial thinning, as well as prescribed burning. Additionally, alternative 3 proposes the removal of trees >21" dbh on 2,187 acres identified for commercial thinning. Other activities that may impact raptor habitat include: riparian restoration, aspen restoration, road closure and decommissioning, and fence construction. Thinning could reduce canopy closure below 60% in treated stands. Retained trees would expand their crowns in diameter and depth in response to the release from competition that results from the thinning. Activities occurring within riparian habitats, including thinning and stream restoration, as well as aspen enhancement treatments would improve riparian shrubs and riparian hardwoods as more sunlight would reach the forest floor and improvements to the water table would increase the amount of water available to plants, thus improving vegetation diversity and habitat for a variety of raptor prey species. Thinning of mid-story trees would promote the development of large structure trees, large snags and down logs. Reducing competition from below is also likely to improve the longevity of existing large trees in the overstory. Thus, treatments may reduce suitability, in the short-term, for the forest dwelling accipiters and the small forest dwelling owls. However, over time, the treatments may maintain overstory canopy by improving health and vigor of retained trees in the stands. The development of herbaceous and shrubby vegetation in the understory that results from reducing conifer density, should also improve habitat for many species of shrub and ground nesting birds, and the ability of open forest avian predators to effectively hunt ground dwelling small mammals would also be improved. Large raptors that nest on large trees or snags in relatively open forests, such as red-tailed hawks and golden eagles would benefit in the long run from treatments that promote the development of large trees and snags.

Prescribed burning may impact individuals in the short-term due to heat and smoke from underburning operations, depending on the intensity of the burn, and weather conditions. Not all acres would be burned simultaneously, nor in a contiguous block, so refugia would exist across the project area where raptors would be expected to persist. While short-term impacts could occur, prescribed burning that reduces fuels, and future fire intensity, would maintain nesting and roosting habitat on the Forest for raptors.

The proposed reduction in open road densities would likely result in retaining more snags by limiting access for public firewood cutting in these areas. Snag retention may increase roost sites or perch trees for all raptor species, and would increase nesting trees for those species that utilize snags.

In addition, the reduction of open road densities would reduce fragmentation and may lower the potential for disturbance to nesting individuals from human activity.

Habitat for raptor prey species would be improved through a number of proposed activities. Prescribed burning may initially reduce the suitability of habitat for prey species of raptors in the short-term through the loss of ground cover of forbs or down wood. However, in the mid- to long-term prescribed fire would help to reinvigorate the growth of native forb and grass species and would improve conditions across the project area. The construction of exclosures would improve the understory habitat for prey species of raptors by excluding livestock and/or big game from overgrazing and browsing the forb, grass, and shrub component. Additionally, riparian restoration would improve the water table and promote the expansion of riparian hardwood species, further improving prey habitat and likely abundance within the project area.

Cumulative Effects

The cumulative effects boundary includes the five subwatersheds that fall within the Gap project boundary (see figure 37). All of the actions in table 167 have been considered for their cumulative effects on raptors and their habitat.

Grazing by livestock and big game would continue to occur on both privately owned and federally managed lands in and adjacent to the project area. Proposed activities within the Gap project include the construction of livestock exclosures as well as additional fencing for better grazing management. No change to the frequency or total number of livestock being grazed would occur under any alternative. Project effects would contribute positively when combined with other actions yet to be implemented within the project area, such as activities within the Fox Canyon and Big Summit AMPs which include aspen enhancement, riparian restoration, water developments, and exclosure fencing. These activities would improve the shrub and forb habitat conditions, thus providing improved conditions for raptor prey species.

In addition, prescribed burning from the Fox Canyon AMP has yet to be implemented within the project area. However, because not all acres would be burned simultaneously, nor in a contiguous block, refugia would exist across the project area where prey for raptors would be expected to persist. In addition, mid- to long-term effects of these treatments would improve the overall condition of the habitat. Therefore, it is unlikely that effects from the action alternatives in the Gap project when combined with these ongoing activities would contribute negatively to the overall cumulative effects.

Established populations of invasive plant species are present within the project area. Project design features mitigate any additional spread of noxious and invasive plants through the implementation of any action alternative within the Gap project however, a slight increase in the abundance and distribution of invasive plants may occur. In addition to project design features, the Deschutes and Ochoco Invasive Plants FEIS (USDA Forest Service 2007) allows for the treatment of invasive species, resulting in fewer invasive plants and thus reducing the likelihood of any decline in forb and shrub habitat for raptor prey species.

The extensive road network in the project area (largely a result of past harvest) has impacted snag densities by decreasing habitat from road construction and increasing accessibility of the area to firewood cutting. Public firewood cutting is expected to continue along open roads. The continued implementation of the Travel Management plan and the South Boundary Travel Management Area will continue to limit cross-country motorized access within the project area. These restrictions combined with the proposed road closure and decommissioning activities proposed in the Gap project would have a positive effect on raptors as they retain snags, by reducing access for firewood cutting, thus increasing potential perch and roost trees, as well as nesting habitat for some species.

Alternative 1 would not contribute to the cumulative effects within the project area. The implementation of alternative 2, 3, or 4 would contribute both positive and negative effects to raptors. However, when combined with effects from past, present, and reasonably foreseeable projects in table 167, the overall cumulative effects do not significantly reduce the overall suitability of habitat for raptors within the project area.

Forest Plan Consistency

In accordance with standards and guidelines for hawk and owl nests contained in the Forest Plan, a primary buffer of five chains (330') would be flagged around each nest site and a seasonal restriction (March 1 to August 1), within 10 chains (660') of active hawk or owl nests, would be implemented under all action alternatives. Within the primary nest buffers the management objective is to maintain the current habitat characteristics.

If risk of loss of overstory trees within these nest areas is imminent, then selective removal of competing understory conifers from the base of large trees and associated slash disposal may occur. However, commercial removal would not occur within primary nest buffers. The seasonal restrictions may be waived on a case-by-case basis, if appropriately timed monitoring indicates that the nest area is not reproductive during that nesting season. This assessment cannot be made until well into the nesting season. Waivers would only be valid for the year in which they are granted. For this reason, this project is expected to be consistent with the Forest Plan.

Conclusion

These alternatives would maintain the suitability of habitat for raptors that select for open forest environments within treated stands and for other species in untreated stands. These alternatives have potential to disturb nesting raptors in occupied territories. Project design features as identified in the Forest Plan are included in this project to minimize disturbance to nesting raptors.

Hawks and Owls

Hawks and owls are birds of prey; therefore, those species were analyzed in the Raptors section of this document. Standards and guidelines for hawk and owl nests are also included in the Raptors section of this document.

Northern Goshawk *(Accipiter gentilis)*

In 1995, the Regional Forester's Eastside Forest Plans Amendment 2 (from here on referred to as Amendment #2) amended the Forest Plan. This amendment included interim management guidelines for northern goshawk in regards to timber sales. The northern goshawk is a raptor and the Forest Plan provides guidance for: the protection of nests, the protection of habitat surrounding nests, and minimizing disturbance to nesting individuals.

Life History and Habitat

The northern goshawk, a 'true' hawk highly adapted for forested landscapes, is found throughout the intermountain west (Hanauska-Brown et al. 2003). In the Pacific Northwest, goshawks prefer to nest in mature, unlogged, or lightly managed, forested habitats. These areas include sites with closed canopies (greater than 60%), northerly exposures, gentle slopes, and close proximity to water (Reynolds et al. 1992). Canopy closure is an important factor in nest site selection and, in the desired percentages, provides security from avian predators as well as decreasing impacts from human disturbance. Nest trees are typically dominant trees in the canopy (10"- 58" dbh) and are usually found in Douglas-fir, ponderosa pine, and western larch (McGrath et al. 2003).Recent peer-reviewed research suggests that goshawks forage in a variety of forested and non-forested environments (Brewer et al. 2007).

Small openings and forest edges in mixed conifer and ponderosa pine forests, in particular, appear to be important for foraging. These foraging habitats support higher plant diversities and, in turn, support a higher number of desirable prey species such as rabbits, squirrels, and grouse. Because it decreases availability of appropriate nesting habitat, timber harvest methods that create large areas of reduced canopy cover (< 35-40%) are considered a primary threat to breeding goshawks (Bright-Smith & Mannan 1994; Beier & Drennan 1997). In addition, increased human presence could also displace the northern goshawk during nesting.

Existing Condition

Amendment #2 (USDA Forest Service 1995) established minimum standards for protection of the northern goshawk, stating that "until further information is known and management plans approved to ensure species viability, the following standards are to be met as a minimum." The minimum standards which are still in effect are:

- Protect every known active and historically used goshawk nest site from disturbance. "Historical" refers to known nesting activity occurring at the site in the last 5 years. Seasonal restrictions on activities near nest sites would be required for activities that may disturb or harass a pair while bonding and nesting.
- 30 acres of the most suitable nesting habitat surrounding all active and historical active nest tree(s) would be deferred from harvest.
- A 400-acre "post fledging area" would be established around every known active nest site. While harvest activities can occur within this area, retain late and old structure (LOS) stands and enhance younger stands toward LOS condition, as possible.

There are six known nesting territories, and one known area of occupancy (Horse Spring) within the Gap project area (see table 99). 400+ acre post-fledging areas (PFAs) have been mapped for all seven territories within the project area. Nest stands have been delineated for all territories except Horse Spring. For the purpose of this analysis all seven territories are considered occupied.

During preliminary field visits a pair of goshawks displaying territorial behavior was found within the area now identified as Horse Spring PFA. During multiple field visits a nest could not be located within the stand and thus a 30-acre nest stand was not delineated for this occupied territory when the PFA was created.

Table 99. Status of northern goshawk nest and post-fledgling areas within the Gap project area.

Territory	Last Year of Documented Activity	Size of Post Fledgling Area	Size of Nest Stand	Number of Documented Nest Cores
Horse Heaven Creek	2015	444 acres	49 acres	1
Kemp Springs	1995	437 acres	44 acres	1
Lookout Creek South	2013	434 acres	31 acres	1
Lytle Creek	2015	432 acres	39 acres	1
Booton Spring	2011	436 acres	41 acres	1
Long Prairie	2015	400 acres	32 acres	1
Horse Spring	2015	402 acres	n/a	n/a

Additional habitat outside of PFAs exists within the project area. Queries of forest habitat databases, using Viable identified 17,906 acres of suitable northern goshawk reproductive habitat within the project area. The 17,906 acre total includes those acres identified within the PFAs. Historically, between 6,668 acres and 11,484 acres of reproductive habitat would have been present within the project area (see table 100). The amount of suitable habitat is currently above the Historic Range of Variability.

Past timber sales have affected the quality and distribution of goshawk habitat within the project area. District records indicate multiple harvest activities have occurred since 1984. Regeneration harvest activities have occurred on 43 acres within the project area. Overstory removal has occurred on 138 acres. A majority of the 138 acres treated would have removed most or all of the overstory trees and the potential to provide suitable goshawk nesting habitat. Partial cutting has occurred on 267 acres within the project area. Portions of these acres could retain enough large or medium tree structure with high densities that would continue to provide suitable nesting habitat and likely provide suitable foraging habitat.

The majority of acres that received commercial thinning or selective harvest prescriptions would have reduced large and medium tree structure and stand density and the quality of nesting habitat would have been reduced. These stands would have the potential of providing suitable nesting habitat in the future as the stands develop larger structure and densities over time. Additional harvest occurred in the project area beginning as early as 1950 and likely included the majority of the project area. The older harvest likely focused on individual tree selection, removing the high value trees at risk to insect mortality.

Table 100. Northern goshawk reproductive habitat derived from the Viable Ecosystems Management Guide (VEMG; Simpson et al. 1994).

Alternative	HRV - Min	HRV - Max	Acres (Post Treatment)	HRV (Year 1)
Alternative 1	6,668	11,484	17,906	above
Alternative 2	6,668	11,484	8,764	within
Alternative 3	6,668	11,484	9,579	within
Alternative 4	6,668	11,484	8,584	within

Direct, Indirect and Cumulative Effects

Alternative 1

This alternative would not treat forest stands within currently mapped PFAs, nesting areas, or suitable nesting and foraging habitat outside of existing PFAs. The no action alternative would maintain the existing acres of suitable foraging and nesting habitat within mixed conifer and ponderosa pine stands in the short-term. Lack of treatment of the mid-story trees where a larger overstory exists would lead to the development of multiple canopy layers with increased canopy closure, a condition preferred by goshawks for nesting. Within the majority of habitat the development of stands dominated by large tree structure with high canopy closures would be slow because of the high stocking levels that currently exist.

Over time stand densities would continue to increase and the risk of mortality to the remaining overstory trees would be expected to increase. Observations within the project area indicate that mortality is occurring within the larger diameter trees that are scattered across the project area. High stocking levels are likely partially responsible for the observed mortality. There is also an increased threat of high severity wildfires occurring as stand densities increase, ladder fuels increase and ground fuels accumulate. Dense understories, which exist in many of the PFA's, as well as additional suitable nesting/foraging habitat outside of PFA's, may lead to increased susceptibility of stand replacing fire and insect and disease outbreaks, which can result in the deterioration or loss of nesting habitat (Graham et al. 1999; Wisdom et al. 2000). Under alternative 1 open understory conditions that are preferred by foraging goshawks are expected to decrease over time as trees continue to develop in the understory.

This alternative would maintain the suitability of all existing habitat for goshawks within the PFAs in the short-term. This alternative would result in short-term retention of the existing amount and distribution of goshawk habitat at the landscape scale; 17,906 acres of reproductive habitat within the project area. The suitability of the existing habitat would change over time, both positively and negatively. Some stands attain increased tree diameters over time, although, the diameter growth of retained trees would not be as rapid as that of retained trees in treated stands. No disturbance to goshawks within existing occupied territories from project activities would occur under this alternative.

Table 101. Habitat designations for Post Fledgling Areas and treatments within those areas.

Post Fledgling Areas			Treatment Types					
			Commercial		Noncommercial		Prescribed Fire	
	Total Acres	Reproductive Habitat Post Treatment	Total Acres	Within Reproductive Habitat	Total Acres	Within Reproductive Habitat	Total Acres	Within Reproductive Habitat
Horse Heaven Creek								
PFA Alt. 1	444	375	0	0	0	0	0	0
PFA Alt. 2	444	325	54	38	54	38	68	50
PFA Alt. 3	444	325	0	0	54	38	68	50
PFA Alt. 4	444	325	54	38	54	38	68	50
Kemp Springs								
PFA Alt. 1	437	354	0	0	0	0	0	0
PFA Alt. 2	437	248	112	101	123	106	112	101
PFA Alt. 3	437	248	0	0	37	30	112	101
PFA Alt. 4	437	248	112	101	123	106	112	101
Lookout Creek South								
PFA Alt. 1	434	391	0	0	0	0	0	0
PFA Alt. 2	434	258	151	130	154	133	151	130
PFA Alt. 3	434	271	0	0	63	43	138	116
PFA Alt. 4	434	258	151	130	154	133	151	130
Lytle Creek								
PFA Alt. 1	432	385	0	0	0	0	0	0
PFA Alt. 2	432	254	133	124	142	131	136	125
PFA Alt. 3	432	335	0	0	60	49	54	44
PFA Alt. 4	432	254	133	123	142	131	136	124
Booton Spring								
PFA Alt. 1	436	295	0	0	0	0	0	0
PFA Alt. 2	436	157	205	125	210	127	219	138
PFA Alt. 3	436	157	0	0	79	71	248	138
PFA Alt. 4	436	157	234	125	238	127	248	138
Long Prairie								
PFA Alt. 1	400	272	0	0	0	0	0	0
PFA Alt. 2	400	262	16	10	16	10	16	10
PFA Alt. 3	400	262	0	0	16	10	16	10
PFA Alt. 4	400	103	16	10	0	0	0	0
Horse Spring								
PFA Alt. 1	402	202	0	0	0	0	0	0
PFA Alt. 2	402	8	359	188	360	189	366	194
PFA Alt. 3	402	8	0	0	105	80	366	194
PFA Alt. 4	402	8	359	188	360	189	366	194

Direct, Indirect and Cumulative Effects

Alternatives 2, 3, & 4

There would be no proposed treatments within identified goshawk nest stands under action Alternatives 2, 3, and 4. However, there are a number of activities proposed within mapped PFAs. Refer to table101 for the treatments, habitat types, and acres affected. The effects are similar for all action alternatives because treatments are similar but vary by acreage for each alternative. Prescriptions would selectively thin the existing stands from below with ponderosa pine and western larch being the tree species favored for retention. No trees >21" dbh would be removed from PFAs although in alternative 4 trees >21" dbh are proposed for harvest on up to 80 acres within goshawk reproductive habitat.

Commercial thinning of trees would occur on up to 716 acres within goshawk reproductive habitat. It is expected that commercially treated areas would express a reduction in suitability of nesting habitat at least in the short-term due to a reduction in canopy closure. Some treated stands would be structurally less complex following treatment and though still suitable, may have reduced habitat quality immediately following treatment. Commercial thinning would be followed by noncommercial thinning, prescribed burning and or handpiling.

Noncommercial thinning would occur on up to 893 acres of reproductive habitat. Noncommercial thinning would be followed by prescribed burning and is expected to retain or improve foraging habitat of the northern goshawk. The thinning of small understory trees in stands with an existing overstory would reduce competition and improve the health of the overstory. Dense understories may obstruct flight corridors used by goshawks to hunt prey (Wisdom et al. 2000). In many cases habitat may be improved through opening up of overly dense understory conditions and creating a patchy distribution of dense clumps and small openings in a matrix of intermediate burn conditions (a fire mosaic). Underburning is proposed on up to 907 acres of reproductive habitat. Underburning would enhance goshawk foraging habitat by reducing seedling and saplings within the treatment areas which maintains open understory favored by goshawks. The effects to snag and down wood habitat which can affect goshawk prey species can be variable. In most areas variability remains with the amount and distribution of down wood following underburning activities. Canopy gaps created by prescribed burning activities can benefit some prey species by allowing more sunlight to reach the forest floor, thus improving the understory shrub, forb, and grass layer. The noncommercial thinning and prescribed burning proposed under alternatives 2, 3, and 4 are intended to decrease the risk of habitat loss through insect and disease outbreaks and stand replacing wildfires.

New temporary road construction would reduce habitat for goshawk prey species and have the potential to fragment existing mature stands within the Booton Spring PFA (0.14 miles). However, for all action alternatives 2, 3, and 4, open road densities would decrease as a result of project implementation. It is expected that the overall decrease in road densities including the closure of 3.05 miles of road in the Lookout Creek PFA, 3.11 miles of road in the Lytle Creek PFA, and 0.95 miles of road in the Long Prairie PFA would benefit goshawk by reducing fragmentation and potential for human disturbance.

Horse Spring PFA was delineated mid-way through project planning, and because of this, proposed treatments within this PFA under all action alternatives exceed the maximum level of habitat alteration allowed by the project design features for this species. Therefore, pending the finding of an active nest, actual implementation acres would be reduced to not exceed 50% of the PFA, and the 30-acre nest stand would be delineated. Proposed project activities that occur within the nest stand would then be dropped.

Cumulative Effects

The cumulative effects boundary includes the five subwatersheds that fall within the Gap project boundary (see figure 37). All of the actions in table 167 have been considered for their cumulative effects on goshawks and their habitat.

Grazing by livestock and big game would continue to occur on both privately owned and federally managed lands in and adjacent to the project area. Proposed activities within the Gap project include the construction of livestock exclosures as well as additional fencing for better grazing management. No change to the frequency or total number of livestock being grazed would occur under any alternative. Project effects would contribute positively when combined with other actions yet to be implemented within the project area, such as activities within the Fox Canyon and Big Summit AMPs which include aspen enhancement, riparian restoration, water developments, and exclosure fencing. These activities would improve the shrub and forb habitat conditions, thus providing improved conditions for northern goshawk prey species.

In addition, prescribed burning from the Fox Canyon and Big Summit AMPs has yet to be implemented within the project area. However, because not all acres would be burned simultaneously, or in a contiguous block, refugia would exist across the project area where goshawks and its prey would be expected to persist. In addition, mid- to long-term effects of these treatments would improve the overall condition of the habitat for northern goshawk prey species as the grasses, forbs, and shrubs are reinvigorated by implementation. Therefore, it is unlikely that effects from the action alternatives in the Gap project when combined with these ongoing activities would contribute negatively to the overall cumulative effects.

Established populations of invasive plant species are present within the project area. Project design features mitigate any additional spread of noxious and invasive plants through the implementation of any action alternative within the Gap project. In addition to these measures, the Deschutes and Ochoco Invasive Plants EIS (USDA Forest Service 2007) allows for the treatment of invasive species, resulting in fewer invasive plants and thus preventing any decline in forb and shrub habitat for northern goshawk prey species.

Alternative 1 would not contribute to the cumulative effects within the project area. The implementation of Alternatives 2, 3, and 4 would contribute negative effects to reproductive habitat while conversely contributing positive effects to foraging habitat, and when combined with effects from projects in table 167, do not contribute to a loss in viability of this species as the reproductive habitat post-treatment would remain within the historic range of variability for the northern goshawk in the project area.

Forest Plan Consistency

Post-fledging areas (PFA) have been mapped for all known occupied goshawk territories in the project area. The 30-acre goshawk nest core areas would have no treatments under any action alternative. Harvest activities within PFAs would not remove late and old structure (LOS) trees or snags. Treatments within PFAs would be implemented with seasonal restrictions. Seasonal restrictions would be employed for disturbance activities within ½ mile of known nest sites, from March 1 to September 30 of each year. These restrictions may be waived on a case-by-case basis, if appropriately timed monitoring indicates that the nest area is not reproductive during that nesting season. This assessment cannot be made until well into the nesting season. Waivers would only be valid for the year in which they are granted. All action alternatives considered in the Gap project are consistent with the Forest Plan, as amended by the Regional Forester's Plan Amendment 2.

Conclusion

Although treatments are proposed within reproductive habitat and PFA's, goshawk reproductive habitat would be within the HRV for the project area post-treatment. Treatments occurring within designated PFA's for the territory (Horse Spring) where a nest has not yet been located allow for a minimum of 8 acres of reproductive habitat (complex stand structure with high canopy cover) remaining after implementation of alternatives 2, 3, or 4.

Nest surveys would occur prior to project implementation in this PFA and project design features exist, so should nesting status be determined, it is likely that this PFA would remain suitable post implementation.

However, as currently proposed, Horse Spring PFA would not retain enough habitat post-treatment to maintain suitability for nesting goshawks within the short to mid-term. Regarding the project area overall, some treated stands would be structurally less complex following treatment and, though still suitable, they may have reduced habitat quality immediately following treatment. Over time, stand complexity is expected to improve and may in the long run result in habitat that is higher in quality than what may develop in some untreated stands.

Migratory and Resident Landbirds

Migratory birds breed in the U.S. and winter south of the border in central and South America. Continental and local declines in population trends for migratory and resident landbirds have developed into an international concern and led to the creation of the North American Bird Conservation Initiative (NABCI). Under this initiative, plans have been developed for the conservation of waterbirds, shorebirds, seabirds and landbirds. The landbird initiative known as Partners-In-Flight (PIF) has developed a series of bird conservation plans for every state.

The Oregon and Washington Chapter of PIF was formed in 1992 and has since developed a series of publications aimed at assisting private, state, tribal and federal agencies in managing for landbird populations. In 2000, the Oregon-Washington Partners in Flight published the Conservation Strategy for Landbirds in the Northern Rocky Mountains of Eastern Oregon and Washington (Altman 2000). This strategy is used to address the requirements contained in Executive Order 13,186 (2001) as well as those agreed upon by the USDA Forest Service and USDI Fish and Wildlife Service (USDA Forest Service 2008, 2014*a*) regarding responsibilities of federal agencies to protect migratory birds. Many of the birds identified in this plan are also addressed in the U.S. Fish & Wildlife Service's Birds of Conservation Concern (USDI Fish and Wildlife Service 2008*a*).

Birds of Conservation Concern

The Birds of Conservation Concern (BCC) species list (USDI 2008*a*) was reviewed to determine which species may occur in the project area. Those species and habitats that are within the project area are incorporated and effects disclosed in this analysis. In addition, Altman (2000) developed a strategy for achieving functioning ecosystems for landbirds through the use of habitat requirements of "focal species" highly associated with important attributes or conditions within each habitat type. The rationale for using focal species is to draw immediate attention to habitat attributes most in need of conservation or most important in a functioning ecosystem. By managing for a group of species representative of important components in a functioning ecosystem, many other species and elements of biodiversity also will be conserved. Table 102 displays the list of BCC species found within Bird Conservation Region (BCR) 10 which includes the Northern Rocky Mountains exclusively within the United States, and within which the Ochoco National Forest is located. This list identifies species, subspecies, and populations of migratory and resident birds not already designated as federally threatened or endangered that represent the highest conservation priorities and are in need of additional conservation actions. Table 103 displays habitat present in the project area that may be impacted by proposed project activities and the corresponding focal species from Altman (2000).

Table 102. Priority species for conservation action as identified by the U.S. Fish and Wildlife Service within Bird Conservation Region (BCR) 10 Northern Rockies U.S. portion only, that are known or likely to be present in the Gap project area.

BCC Species	General Habitat Requirements	Impacts to Habitat	
		Alternative 1	Alternatives 2, 3, and 4
bald eagle *(Haliaeetus leucocephalus)*	Associated with large bodies of water, forested areas near the ocean, along rivers, and at estuaries, lakes and reservoirs.	See Threatened, Endangered, Proposed, and Sensitive Species section for analysis	See Threatened, Endangered, Proposed, and Sensitive Species section for analysis
Swainson's hawk *(Buteo swainsoni)*	Found in open country with no need for numerous trees, prefer prairies and irrigated farmland with high prey densities.	Swainson's hawk is a raptor. Effects to raptors are addressed in the Raptor section of this document.	Swainson's hawk is a raptor. Effects to raptors are addressed in the Raptor section of this document.
ferruginous hawk *(Buteo regalis)*	Occupy habitats with low tree densities and topographic relief in sagebrush plains of the high desert and bunchgrass prairies in the Blue Mountains.	Ferruginous hawk is a raptor. Effects to raptors are addressed in the Raptor section of this document.	Ferruginous hawk is a raptor. Effects to raptors are addressed in the Raptor section of this document.
long-billed curlew *(Numenius americanus)*	Open grassland areas east of the Cascades. Found in small numbers in estuaries along the coast.	Continued decline of grassland and sagebrush steppe habitat due to encroaching conifers.	Prescribed fire may reduce shrub component in the short term, however thinning to remove juniper and other conifers and promote native grasses would improve nesting and foraging habitat.
flammulated owl *(Otus flammeolus)*	Associated with ponderosa pine forests and mixed conifer stands with a mean of 67% canopy closure, open understory with dense patches of saplings or shrubs.	Flammulated owl is a raptor. Effects to raptors are addressed in the Raptor section of this document.	Flammulated owl is a raptor. Effects to raptors are addressed in the Raptor section.
calliope hummingbird *(Stellula calliope)*	Predominantly a montane species found in open shrub sapling seral stages (8-15 years) at higher elevations and riparian areas.	Continued decline of riparian areas and shrubs as a result of conifer encroachment and loss of water table.	Prescribed fire may reduce shrub saplings however riparian areas would benefit as a result of stream restoration, aspen enhancement, and hardwood planting.
Lewis' woodpecker *(Melanerpes lewis)*	Ponderosa pine, cottonwood riparian or oak habitats with an open canopy, brushy understory, dead and down material, available perches and abundant insects.	See Threatened, Endangered, Proposed, and Sensitive Species section for analysis	See Threatened, Endangered, Proposed, and Sensitive Species section for analysis
Williamson's sapsucker *(Sphyrapicus thyroideus)*	East Cascades, mid to high elevation, mature open and mixed coniferous - deciduous forests. Snags are a critical component.	See Management Indicator Species – Primary Cavity Excavator section for analysis	See Management Indicator Species – Primary Cavity Excavator section for analysis
white-headed woodpecker *(Picoides albolarvatus)*	Mixed conifer forests (< 40 % canopy cover) dominated by old growth ponderosa pine and open habitats where standing snags and scattered tall trees remain	See Threatened, Endangered, Proposed, and Sensitive Species section for analysis	See Threatened, Endangered, Proposed, and Sensitive Species section for analysis
olive-sided flycatcher *(Contopus cooperi)*	Open conifer forests (< 40 % canopy cover) and edge habitats where standing snags and scattered tall trees remain after a disturbance.	Continued overstocking of stands and reduction of edge habitat.	Thinning and burning in a mosaic pattern would increase edges and openings (foraging habitat). Reducing open road densities would promote snag retention.

BCC Species	General Habitat Requirements	Impacts to Habitat	
		Alternative 1	Alternatives 2, 3, and 4
willow flycatcher *(Empidonax traillii)*	Associated with riparian shrub dominated habitats, especially brushy/willow thickets. In southeast Washington also found in xeric brushy uplands.	Continued decline of hardwood and shrubs as a result of conifer encroachment and loss of water table.	Aspen treatment and hardwood planting are designed to enhance hardwood species such as aspen, willow, alder, and cottonwood. Stream restoration activities would further enhance riparian habitat conditions.
loggerhead shrike *(Lanius ludovicianus)*	Inhabits grasslands, pastures with fence rows, agriculture fields, sagebrush with scattered juniper and open woodlands. Requires elevated perches throughout for hunting and nesting.	Continued decline of grassland and sagebrush steppe habitat due to encroaching conifers.	Prescribed fire may reduce shrub component in the short term, however thinning would improve steppe shrubland habitat and reduce stocking levels in woodland habitats.
sage thrasher *(Oreoscoptes montanus)*	A sagebrush obligate dependent on large patches and expanses of sagebrush steppe and bitterbrush with shrub heights in the 30 -60 cm height. Prefers bare ground over grassy understories.	Continued decline of grassland and sagebrush steppe habitat due to encroaching conifers.	Prescribed fire may reduce shrub component in the short term, however thinning to remove juniper and other conifers and promote bitterbrush and other shrubs would improve nesting and foraging habitat.
Brewer's sparrow *(Spizella breweri)*	Sagebrush obligate found in shrublands of contiguous big sagebrush, greasewood, rabbit brush, and shadescale habitats.	Continued decline of grassland and sagebrush steppe habitat due to encroaching conifers.	Prescribed fire may reduce shrub component in the short term, however thinning to remove juniper and other conifers and promote sagebrush would improve nesting and foraging habitat.
sage sparrow *(Amphispiza belli)*	Found in se. and c. OR associated with semi-open evenly spaced shrubs 1-2 m high in big sage up to 6,800 ft.	Continued decline of grassland and sagebrush steppe habitat due to encroaching conifers.	Prescribed fire may reduce shrub component in the short term, however thinning to remove juniper and promote shrubs would improve nesting and foraging habitat.
McCown's longspur *(Calcarius mccownii)*	Rare in OR & WA, A bird of the plains prefers dry sparse prairies	Continued decline of prairie habitat due to encroaching conifers.	Prescribed fire may reduce shrub component in the short term, however thinning to remove juniper and other conifers and promote native grasses would improve nesting and foraging habitat.
Cassin's finch *(Carpodacus cassinii)*	Open, mature coniferous forests of lodgepole and ponderosa pine, aspen, alpine fir, grand fir and juniper steppe woodlands	Continued overstocking of stands with increased competition leading to longer timelines in the development of mature forest structure.	Treatments that help promote the future growth of late and old structure such as commercial harvest, noncommercial thinning and prescribed burning would improve nesting and foraging habitat for this species.

Table 103. Focal species and their associated habitats as identified by the Conservation Strategy for Landbirds in the Northern Rocky Mountains of Eastern Oregon and Washington (Altman 2000), which are known or likely to be present in the Gap project area.

Focal Species	Habitat: Habitat Attributes	Impacts to Habitat	
		Alternative 1	Alternatives 2, 3, and 4
white-headed woodpecker *(Picoides albolarvatus)*	Dry Forest: old forest - large patches	See Threatened, Endangered, Proposed, and Sensitive Species section for analysis	See Threatened, Endangered, Proposed, and Sensitive Species section for analysis
flammulated owl *(Otus flammeolus)*	Dry Forest: grassy openings – dense thickets	Flammulated owl is a raptor. Effects to raptors are addressed in the Raptor section of this document.	Flammulated owl is a raptor. Effects to raptors are addressed in the Raptor section.
chipping sparrow *(Spizella passerina)*	Dry Forest: open understory – regeneration	Continued overstocking of stands leading to a lack of suitable habitat.	Thinning and burning would increase forest mid- and understory openings and reduce stocking levels of stands, improving habitat conditions for this species.
Lewis' woodpecker *(Melanerpes lewis)*	Dry Forest: burned old forest Riparian Woodland: large snags	See Threatened, Endangered, Proposed, and Sensitive Species section for analysis	See Threatened, Endangered, Proposed, and Sensitive Species section for analysis
Vaux's swift *(Chaetura vauxi)*	Mesic Mixed Conifer: large snags	Overstocking, competition factors within stands, insect and disease, and wildfire risks would continue unaltered and thus snag densities and distributions would not be changed in the short-term. Long-term these factors may contribute to increased snag levels, though large diameter (>21" dbh) snags may be lacking. See snag distribution analysis in primary cavity excavator section for more info.	Treatments that help promote the future growth of large diameter trees such as commercial harvest, noncommercial thinning, and prescribed burning would provide large diameter snags in the long-term, thus improving nesting and foraging habitat for this species in the future. However, in the mid-term it is likely that snag density and distribution would be impacted due to the decrease of within-stand competition factors. See snag distribution analysis in primary cavity excavator section for more info.
varied thrush *(Ixoreus naevius)*	Mesic Mixed Conifer: multi-layered, structurally diverse	Continued overstocking of stands providing suitably diverse, multi-layered habitat for this species.	Thinning and burning treatments designed to reduce stocking levels and move forests towards a more open even-aged condition that would have been present historically would result in a decrease of understory structure, decreasing habitat suitability for this species.
Townsend's warbler *(Dendroica townsendi)*	Mesic mixed Conifer: canopy foliage cover	Continued increase of Douglas-fir and grand fir understory providing more nesting and foraging habitat.	Thinning treatments designed to restore forests towards historic conditions and meet the purpose and need of the project would result in a decrease of understory fir species, decreasing foraging and nesting habitat for this species.
MacGillivray's warbler *(Oporornis tolmiei)*	Mesic Mixed Conifer: dense shrub layer	Continued increase of dense understory shrub layers providing foraging and nesting habitat.	Thinning treatments designed to restore forests towards historic conditions and meet the purpose and need of the project would result in a reduction of shrub

Focal Species	Habitat: Habitat Attributes	Impacts to Habitat	
		Alternative 1	Alternatives 2, 3, and 4
			habitats as a result of restoring relatively open understory forests. Conditions of willow and other shrub habitats adjacent to riparian areas may improve as a result of stream restoration and aspen treatments.
olive-sided flycatcher *(Contopus cooperi)*	Mesic Mixed Conifer: fire edges and openings	See Birds of Conservation Concern analysis in table 103	See Birds of Conservation Concern analysis in table 03
red-eyed vireo *(Vireo olivaceus)*	Riparian Woodland: canopy foliage cover	Continued decline of hardwoods as a result of conifer encroachment and loss of water table.	Aspen treatment and hardwood planting are designed to enhance hardwood species such as aspen, willow, alder, and cottonwood. Stream restoration activities would further enhance riparian habitat conditions. Alternative 3 has no commercial treatments proposed within RHCAs and thus would maintain the existing canopy foliage cover in the short- to mid-term more so than alternatives 2 and 4.
veery *(Catharus fuscescens)*	Riparian Woodland: understory shrub cover	Continued decline of hardwood and shrubs as a result of conifer encroachment and loss of water table.	Aspen treatment and hardwood planting are designed to enhance hardwood species such as aspen, willow, alder, and cottonwood. Stream restoration activities would further enhance riparian habitat conditions.
willow flycatcher *(Empidonax traillii)*	Riparian Shrub: dense shrub patches	See Birds of Conservation Concern analysis in table 103	See Birds of Conservation Concern analysis in table 103
hermit thrush *(Catharus guttatus)*	Subalpine Forest: patches	No treatments are proposed in subalpine forest habitat present within the project area; therefore no change in habitat would occur under any alternative.	No treatments are proposed in subalpine forest habitat present within the project area; therefore no change in habitat would occur under any alternative.
upland sandpiper *(Bartramia longicauda)*	Montane Meadows: mesic and dry conditions	See Threatened, Endangered, Proposed, and Sensitive Species section for analysis	See Threatened, Endangered, Proposed, and Sensitive Species section for analysis
vesper sparrow *(Pooecetes gramineus)*	Steppe Shrublands: patches	Continued decline of grassland and sagebrush steppe habitat due to encroaching conifers.	Prescribed fire may reduce shrub component in the short term, however thinning to remove juniper and promote shrubs would improve nesting and foraging habitat.
red-naped sapsucker *(Sphyrapicus nuchalis)*	Aspen: large trees/snags with regeneration	Conifer competition would continue to inhibit aspen suckering. Stands in need of protection would continue to be over browsed by ungulates.	Aspen treatment and hardwood planting are designed to enhance hardwood species such as aspen, willow, alder, and cottonwood. Stream restoration activities would provide stable water tables

Focal Species	Habitat: Habitat Attributes	Impacts to Habitat	
		Alternative 1	Alternatives 2, 3, and 4
			increasing potential of aspen regeneration.
gray-crowned rosy finch *(Leucosticte tephrocotis)*	Alpine: patches	No alpine habitat exists within the project area; therefore no change would occur from this alternative.	No alpine habitat exists within the project area; therefore no change would occur from any alternative.

Botany

This section describes expected effects of the proposed action and alternatives upon botanical resources as part of the Gap Landscape Restoration project (Gap project). Included is the draft Biological Evaluation (BE) for proposed, endangered, threatened, and sensitive plant species within the Gap project area. Also addressed are non-native invasive plants (noxious weeds).

Threatened, Endangered and Sensitive Plants

Biological Evaluation for Proposed, Endangered, Threatened, and Sensitive Plant Species (PETS)

The purpose of this biological evaluation (BE) is to determine the effects of the proposed action and alternatives on plant species : 1) listed or proposed for listing by the US Fish and Wildlife Service as Endangered or Threatened (USFWS 2015); and 2) designated by the Pacific Northwest Regional Forester as Sensitive[8] (USDA Forest Service 2011). This BE is consistent with the requirements of the Endangered Species Act of 1973 (ESA), Forest Service Manual 2630.3 (FSM), FSM 2670, Region 6 Supplement 2600-95-3, and the Ochoco National Forest Land and Resource Management Plan (USDA Forest Service 1989). The intent of these requirements is to ensure that management activities will not likely jeopardize the continued existence of ESA-listed species or adversely modify critical habitat. The objective for sensitive species is to ensure that actions do not contribute to a loss of viability or cause a significant trend toward listing under the ESA. The BE also provides a process and standard by which sensitive plant species receive full consideration in the decision making process.

This BE primarily discusses the more immediate, short-term (<10 years) effects of the proposed action and alternatives. Long-term (>10 years) effects are included where trends and other information are available and discussion is not speculative. For proposed riparian restoration, the proposed management activities would have short-term (3-5 years) negative impacts but long-term (10+ years) beneficial effects for sensitive plant habitat.

Pre-field Review

Each area to be affected by management actions is investigated for sensitive plant habitat and previously documented populations in the pre-field review. The following sources were consulted to determine whether potential habitat and known populations exist:

- USFWS list of Proposed, Endangered and Threatened Plant Species (USFWS 2015)

[8] The Regional Forester's Special Status Species List was recently updated in July, 2015, resulting in a change of sensitive status for some plants documented or suspected on the Ochoco National Forest. Since the project was initiated prior to this update, the 2011 list which was in effect at the time of project initiation is used in this document. The provision for use of the prior list can be found in the letter dated July 21, 2015 from the Regional Forester to Forest Supervisors providing the updated list.

- Regional Forester's (R-6) Sensitive Plant Species List (USDA Forest Service 2011)
- Oregon Natural Heritage Information Center
- Species fact sheets provided by the Interagency special status sensitive species program website (http://www.fs.fed.us/r6/sfpnw/issssp)
- USFS personnel and District botanical survey records, USGS topographical maps, current literature, and knowledge provided by individuals familiar with the area
- Forest Service database of record for sensitive plants, NRIS-TESP
- Analysis of geospatial imagery (1-m scale) and existing vegetation types (PAG layer)
- Vascular plant surveys conducted from 1990-2013 for previous projects such as the Rough, Lutsey, Kelly Gap, and Fox Canyon Cluster Allotments
- Botany reports for the Fox Canyon Cluster and Big Summit Allotments range analysis
- Nonvascular plant surveys by Rick Dewey conducted in 2005

Results of the Pre-field Review

There are no known occurrences of federally listed endangered or threatened plants within the Gap project area. The Ochoco National Forest has no habitat recognized as essential for listed or proposed plant species recovery under the ESA. There are 39 sensitive species on the 2011 Regional Forester's Sensitive Species List that are known to occur or have habitat on the Ochoco National Forest (table 104). Based on occurrence records and habitat information, each sensitive species listed in the table below was ranked with a probability of occurrence as high, moderate, or low.

Table 104. R6 Regional Forester's Sensitive Species List for the Ochoco National Forest. Species in bold are carried forward in the analysis.

Species	Habitat	Probability of Occurrence	Rationale
Achnatherum hendersonii **Henderson's needlegrass**	**Sagebrush scablands**	**HIGH**	**Documented in project area**
Achnatherum wallowaensis **Wallowa needlegrass**	**Sagebrush scablands**	**MODERATE**	**Habitat present**
Astragalus peckii Peck's milkvetch	Sage/juniper/lodgepole pumice/coarse soils	LOW	Outside documented range
Astragalus tegetarioides **bastard kentrophtya**	**Sage steppe/ponderosa pine forest**	**MODERATE**	**Habitat present**
Botrychium ascendens **Ascending moonwort**	**Wet meadows, springs, seeps**	**MODERATE**	**Habitat present**
Botrychium crenulatum **Crenulate moonwort**	**Wet meadows, springs, seeps**	**MODERATE**	**Habitat present**
Botrychium minganense **Mingan's moonwort**	**Wet meadows, springs, seeps**	**MODERATE**	**Habitat present**
Botrychium montanum **Mountain moonwort**	**Wet meadows, springs, seeps**	**MODERATE**	**Habitat present**
Botrychium paradoxum **twin-spike moonwort**	**Wet meadows, springs, seeps**	**MODERATE**	**Habitat present**
Calochortus longebarbatus **var.** ***peckii*** **Peck's mariposa lily**	**Vernally moist meadows, streambanks**	**HIGH**	**Documented in project area**
Camissonia pygmaea Dwarf suncup	Low elev plains/washes w/ coarse soil or gravel	LOW	No habitat
Carex diandra Lesser panicled sedge	Sphagnum bog, lakeshores	LOW	No habitat
Carex lasiocarpa **var.** ***americana*** **Slender sedge**	**Very wet sedge meadows, along lakes/streams**	**MODERATE**	**Habitat present**

Species	Habitat	Probability of Occurrence	Rationale
Carex retrorsa **Retrorse sedge**	**Swamps, marsh, meadows, along lakes, streams**	**MODERATE**	**Habitat present**
Cheilanthes feei **Fee's lip fern**	**Basalt cliffs but occasionally limestone**	**MODERATE**	**Habitat present**
Cyperus lupulinus ssp. *lupulinus* Great Plains flatsedge	Riparian edge but dry hackberry, wheatgrass	LOW	No habitat
Elatine brachysperma Short-seeded waterwort	Muddy shores, shallow pools	LOW	No habitat
Eleocharis bolanderi **Bolander's spikerush**	**Seasonally wet; low sage/sandberg in basalt**	**MODERATE**	**Habitat present**
Eriogonum cusickii **Cusick's buckwheat**	**Juniper/big sage and low sage scabland**	**MODERATE**	**Habitat present**
Heliotropium curassavicum Salt heliotrope	Moist to dry, saline soils	LOW	No habitat
Lipocarpha aristulata Aristulate liptocarpa	Low elev, silty below high water along banks	LOW	No habitat
Lomatium ochocense **Ochoco lomatium**	**Sagebrush scablands**	**MODERATE**	**Habitat present**
Mimulus evanescens Disappearing monkeyflower	Sage/juniper vernally moist streambanks	LOW	No habitat
Muhlenbergia minutissima **Annual dropseed**	**Weathered lava soils in riparian**	**MODERATE**	**Habitat present**
Penstemon peckii Peck's penstemon	Stream banks Disturbed areas	LOW	Outside documented range
Phemeranthus spinescens Spiny fameflower	Sagebrush scablands	LOW	No habitat
Potamogeton diversifolius **Water thread pondweed**	**Lakes, ponds, including created habitat**	**MODERATE**	**Habitat present**
Rorippa columbiae Columbia yellowcress	Wet meadows, moist plains, streams	LOW	No habitat
Rotala ramosior Lowland toothcup	Sand and silt below high water, Low elevation	LOW	No habitat
Salix wolfii **Wolf's willow**	**Riparian**	**MODERATE**	**Habitat present**
Thelypodium eucosmum Arrow leaf thelypody	Dry slopes in vernal drainages	LOW	Outside documented Range
Utricularia minor **Lesser bladderwort**	**Lowland and montane fens, sedge meadows**	**MODERATE**	**Habitat present**
Bryophytes and lichens			
Encalypta brevipes	In soil on ledges and cliffs	LOW	No habitat
Entosthodon fascicularis Banded cord moss	Seasonally wet seeps, along intermittent streams	LOW	No habitat
Helodium blandowii **Blandow's bogmoss**	**Montane fens**	**MODERATE**	**Habitat present**
Schistidium cinclidodonteum **Schistidium moss**	**Wet/dry rocks or soil along intermittent streams**	**MODERATE**	**Habitat present**
Tomentypnum nitens **Tomentypnum moss**	**Montane fens**	**HIGH**	**Documented in project area**
Tortula mucronifolia **Mucronleaf tortula moss**	**Riparian *Populus* montane *Abies***	**MODERATE**	**Habitat present**
Texosporium sancti-jacobi	Often old root clumps of Sandberg	LOW	No habitat

Species	Habitat	Probability of Occurrence	Rationale
Woven spore lichen	or scat		

Species were ranked with a high probability of occurrence if there was a documented population within the project area or if there is high quality habitat present and the species is known to occur within the project area. Species determined to have a moderate probability of occurrence are those for which habitat is present and the species may occur on the Ochoco National Forest, but there are no documented occurrences in the project area. Species determined to have a low probability are those for which habitat is not present within the project area or are not suspected to occur in the area because the project is outside of the potential distribution and geographic range of the species. Of the 39 species known or suspected to occur on the Ochoco National Forest, 23 occur or have suitable habitat within the Gap project area.

The other 16 sensitive species have a low probability of occurrence in the project area. There would no impact to these plant species or their habitat resulting from actions proposed in the Gap project area. Since these species would not be affected by the proposed project, they will not be discussed further in the analysis. Likewise, there are no known occurrences of federally listed endangered or threatened plant species within the Gap project area and no habitat is present for listed species (USDA Forest Service 2011, USFWS 2015). Therefore, for all alternatives, no effect to proposed, endangered, or threatened plant species is expected. These species will not be discussed further.

Field Surveys and Habitat Mapping

The purpose of field reconnaissance is to conduct sensitive and rare plant surveys within the affected area, produce accurate sensitive plant habitat maps, and determine the extent and condition of any TES species that are encountered. Areas identified in the pre-field analysis as having potential TES habitat were the primary focus of the surveys; these generally included riparian areas, meadows, wetlands, seeps, springs, fens, scablands, rock outcrops, and special forest habitats. Surveys were conducted according to standardized procedures with varying degrees of survey intensity: complete, general, intuitive controlled, or incidental, depending on the quality of the habitat.

Extensive surveys for vascular sensitive plants were conducted between 1990 and 1995 within the Gap project area. These surveys produced the majority of currently known sensitive plant occurrences. Additional surveys were completed in the summer of 2012 and the spring of 2013 by USFS botanist Krista Farris for the Fox Canyon Cluster Allotments range analysis. Surveys for sensitive nonvascular plants occurred in 2005 and in 2013 by USFS bryophyte expert Rick Dewey, focusing primarily on fen species and high potential habitat within the Lookout Mountain Management Area, Prairie Hill, Williams Prairie, and Jungle Creek.

During the summer of 2015, approximately 1,000 acres within the project area were surveyed for sensitive and invasive plants by a contractor. These surveys were contracted as part of the Blue Mountains Landscape Resiliency Project. No occurrences of sensitive plants were detected by the surveys.

Based on known occurrences and habitats for potential sensitive plants in the project area, a GIS dataset was created to map habitats in the project area suitable for sensitive plants. The map included all known sensitive plant occurrences, all meadow vegetation types, a small amount of scabland, and in some areas, forested meadow edges. The sensitive plant habitat map contains most of the high quality habitat for some sensitive plant species, but for others, the habitat map reflects only a small portion of the potential habitat in the project area. The completeness of habitat mapping is discussed below for each sensitive plant habitat.

Finally, ground truthing of the sensitive plant habitat map and previously mapped sensitive plant populations, focused on Peck's mariposa lily, was conducted by USFS botanist Jill Welborn over the summer of 2015.

Surveys documented the following sensitive plant species within the project area:

- Henderson's needlegrass (*Achnatherum hendersonii)*
- Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii)*
- Tomentypnum moss (*Tomentypnum nitens)*

Affected Environment

Plant Communities and Habitats

The Gap project area contains a variety of native plant communities, some of which are relatively uncommon to the Ochocos. One relevant source of data on vegetation in the project area is the Potential Natural Vegetation inventory (PNV), a digital spatial vegetation map based on the concept of potential vegetation. "Potential vegetation is defined as the community of plants that would become established if all successional sequences were completed, without interference by humans, under existing environmental conditions including edaphic, topographic, and climatic factors. Potential vegetation, the theoretical endpoint of plant succession in the absence of disturbance, is used to characterize biophysical settings and their associated potential natural communities." (Powell et al. 2007) Since PNV is based on the potential, not existing, vegetation, it can help describe the project area but does not translate directly into sensitive plant habitats.

There are 49 different PNV types represented in the project area. The grand fir/pinegrass type is most extensive, with 13,577 acres. Ponderosa pine/pinegrass and ponderosa pine/Idaho fescue types are also abundant, with 7,382 acres. Other dry forest types with graminoid understory are also very common in the project area. Uncommon forest types include subalpine fir/elk sedge and subalpine fir/spruce/grass types, with 233 acres. Among nonforested vegetation types, rigid sage/Sandberg's bluegrass is most common with 2,769 acres. Other scabland communities are also common, often scattered in small pockets within the forest matrix. Meadow types are also relatively abundant in the project area, with 1,493 acres of dry meadow and 717 acres of wet meadow. Aspen is also relatively abundant in the project area, at 129 acres. Other, smaller vegetation types lend diversity to the project area. Among these are willow and alder wetlands, false hellebore wetlands, talus fields, and juniper shrublands with mountain mahogany and/or bitterbrush.

The project area includes a portion of the Lookout Mountain Management Area, which is managed for semi-primitive recreation and wildlife habitat in a natural setting. This area contains several unique plant communities, including the subalpine fir forest types noted above. It also includes several fens that support obligate plant populations not often found elsewhere on the forest. The fens in this area represent some of the highest quality habitat on the Ochoco National Forest for fen plant species, including *Eriophorum gracile* (slender cottongrass), *Eleocharis quinqueflora* (fewflower spikerush), *Meesia triquetra* (meesia moss), and *Tomentypnum nitens* (tomentypnum moss).

The project area encompasses several large internal grasslands characteristic of the Ochocos. The project area is located just south of Big Summit Prairie, the largest and most well-known of these grasslands. Gray Prairie, Antler Prairie (mostly privately owned), Williams Prairie, Long Prairie, Lytle Prairie, and Horse Prairie are other such large meadows within the project area. These grasslands contribute important habitat for native plants, sensitive plants, and wildlife ranging from big game species to pollinators.

Sensitive Plant Habitats

Sensitive plant habitats in the Gap project area include riparian meadows and grasslands, hardwood dominated riparian communities, upland forest, and sparsely vegetated scablands. Potential sensitive plant habitat, including the extent of all known sensitive plant occurrences, has been identified for the project area and is depicted in figure 23. There is a total of 2,449 acres of mapped sensitive plant habitat within the project area. When the Lookout Mountain Management Area is excluded (where no management activities are proposed in any action alternative), there is a total of 2,187 acres of sensitive plant habitat.

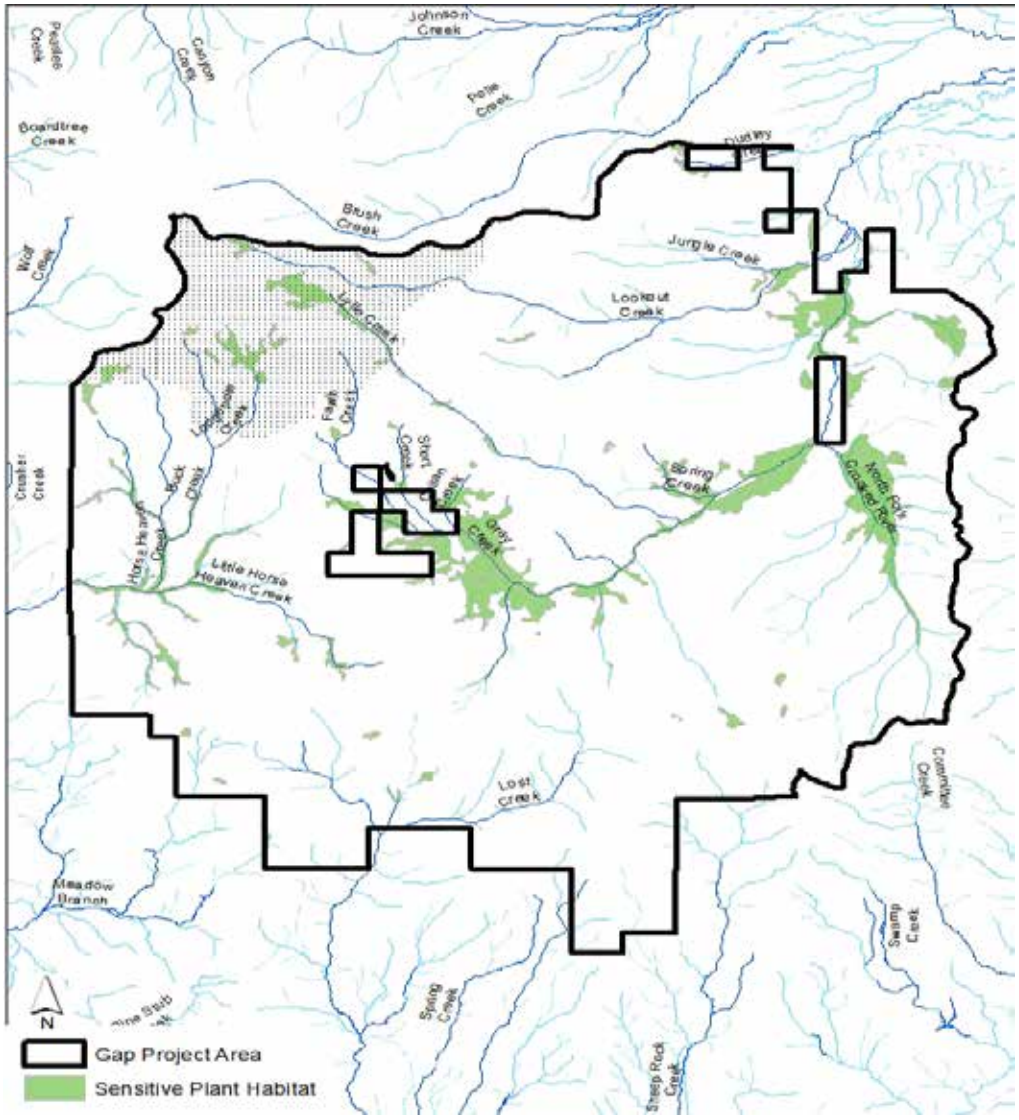


Figure 23. Sensitive plant habitat in the Gap project area. Major streams and Lookout Mountain Management Area (stippled area) are indicated.

Riparian Habitats

Existing Condition

Riparian habitats in the Gap project area are characterized by three main community types. The first is hardwood stream vegetation composed primarily of mountain alder (*Alnus incana*), quaking aspen (*Populus tremuloides*), and willow species (*Salix* spp.). These communities are often found along higher gradient or rocky streamcourses. Hardwood dominated riparian areas also typically support moist streamside and floodplain areas with sedges, rushes, and grasses. Lodgepole pine (*Pinus contorta* var. *latifolia*) and other conifers are frequently intermixed in hardwood riparian habitats. Hardwood dominated riparian habitats can be found in the Horse Heaven, Little Horse Heaven, and Buck Creek drainages. Some conifer and/or hardwood riparian communities have a significant shrub component with red osier dogwood (*Cornus stolonifera*) and a number of currant and/or gooseberry species (*Ribes* sp.); Lost Creek is an example of this riparian habitat.

The second major riparian community is wet to moist meadow dominated by graminoid species, such as sedges, grasses, and rushes, often with willow. These communities are found in expansive, low-gradient valleys, such as Gray and Williams Prairies. Moist meadow riparian habitats provide important ecological functions on the landscape, providing water storage critical to supporting sustained stream flow. Hydrologically, these grassland plant communities provide excellent stability to stream banks and soil surfaces. Their deep spreading root systems can resist flooding and slow water velocity, and shade stream channels keeping temperatures low.

Road construction, grazing, timber harvest, fire suppression, and other management activities have resulted in hydrologic changes. The quality and function of both hardwood and wet meadow riparian community types have diminished over time due to the above management activities. By the 1900s, many riparian plant communities were changed in plant structure and composition, often moving from willow and deep-rooted wet sedge communities to shallower rooted grasses and forbs more tolerant of drying. This shift was a response to stream bank damage, subsequent stream incision and lowered water tables (Elmore 1992). Stream downcutting, reduced bank stability, and lowered water tables have reduced the capacity of riparian habitats to support sensitive plant populations which require access to intact water tables and stream banks. The hydrology in Williams Prairie and Long Prairie has also been directly altered as a result of historic ditching.

The Watershed Condition Framework (WCF) for Upper North Fork Crooked River and Horse Heaven-Crooked River watersheds rank riparian/wetland vegetation as Poor and Fair, respectively. The WCF notes the poor rating is due to a large percent of native vegetation attributes along stream corridors, wetlands and water bodies are not in proper functioning condition. The WCF describes existing conditions in riparian areas: “Mesic dependent herbaceous vegetation is limited in extent with many lower terraces dominated by xeric species most commonly associated with uplands. Reproduction of mid and late seral species is very limited. For much of the area, the water table is disconnected from the riparian area and the vegetation reflects this loss of available soil water” (WCF for Upper North Fork Crooked River and Horse Heaven-Crooked River watersheds, in Quezada 2015).

Riparian habitats have also been negatively impacted by non-native plants and invasive weed populations (DiTomaso 2000). Oxeye daisy (*Leucanthemum vulgare*) is particularly abundant in the Horse Heaven and Little Horse Heaven drainages. Canada thistle (*Cirsium arvense*) is also of concern because it readily establishes in riparian zones, and has the ability to form large patches of rhizomatous growth. Treatment and control options for both species are limited due to the rhizomatous growth form and proximity to water. Other invasive plants are present in the project area outside of riparian areas. These plants are discussed further in the Invasive Plant Risk Assessment portion of this document.

The third riparian habitat type includes fens, springs, and other groundwater-related features that are dependent on groundwater for most of their moisture. These areas support plant communities that require sustained groundwater to exist. As such, they are considered to be groundwater-dependent ecosystems (GDEs). GDEs have been recognized to be of particular importance as both water resource and sensitive plant habitat (USDA Forest Service 2007). Although inventory efforts to date have not covered all potential sites, fens are relatively rare on the Ochoco National Forest, with 11 fens inventoried. There are 4 inventoried fens (totaling approximately 22 acres in size) and 27 springs mapped within the Gap project area. Three of the fens are located within the Lookout Mountain Management Area, where no project activities are proposed, and thus they are not discussed further in this analysis. The remaining fen is located in Williams Prairie. GDEs are sensitive to hydrologic alteration that can result from ditching, diversion, and livestock damage. Historic water diversions, current water diversion, livestock damage, and past ditching have altered the hydrology of many of the project area's GDEs.

Overall, riparian habitat and the adjacent upland transition zone within the project area constitute the most important and extensive sensitive plant habitat type within the project area. Riparian habitat is associated with 17 of the 23 sensitive plant species with potential habitat in the project area (table 105). Riparian habitat has declined in extent and suitability for many sensitive plant species due to the impacts described above.

Table 105. Sensitive plant species associated with riparian habitat

Scientific Name	Common Name	Riparian Habitat Type
Botrychium ascendens	Ascending moonwort	Meadow, hardwood/conifer, or GDE
Botrychium crenulatum	Crenulate moonwort	Meadow, hardwood/conifer, or GDE
Botrychium minganense	Mingan's moonwort	Meadow, hardwood/conifer, or GDE
Botrychium montanum	Mountain moonwort	Meadow, hardwood/conifer, or GDE
Botrychium paradoxum	Twin-spike moonwort	Meadow, hardwood/conifer, or GDE
Calochortus longebarbatus var. *peckii*	Peck's mariposa lily	Meadow
Carex lasiocarpa var. *americana*	Slender sedge	Meadow or hardwood
Carex retrorsa	Retrorse sedge	Meadow or hardwood
Eleocharis bolanderi	Bolander's spikerush	Meadow or hardwood
Muhlenbergia minutissima	Annual dropseed	Meadow or hardwood
Potamogeton diversifolius	Water thread pondweed	Aquatic
Salix wolfii	Wolf's willow	Meadow, hardwood, or GDE
Utricularia minor	Lesser bladderwort	GDE
Helodium blandowii	Blandow's bogmoss	GDE
Schistidium cinclidodonteum	Schistidium moss	Hardwood/conifer
Tomentypnum nitens	Tomentypnum moss	GDE
Tortula mucronifolia	Mucronleaf tortula moss	Hardwood

Moonworts *(Botrychium spp.)*

There are six species of *Botrychium*, also known as moonworts or grapeferns, on the Regional Forester's Sensitive Species List (USDA Forest Service 2011). Five of them have potential habitat in the Gap project area, and while they are documented elsewhere on the forest, there are no known populations of the five species within the project area. *Botrychium ascendens, B. crenulatum, B. paradoxum* are on the ORBIC List 1 (2010), meaning these species are considered to be threatened with extinction throughout their range. *Botrychium montanum* is on the ORBIC List 2, meaning this species is of conservation concern but is not currently listed, by the State of Oregon, as threatened or endangered. *Botrychium minganense* has been determined to be less at risk, and is currently on the ORBIC List 4, meaning this species is of conservation concern but is not currently listed, by the State of Oregon, as threatened or endangered.

Moonworts are found in a variety of habitats in Oregon, from old growth Western red cedar forests to xeric open meadows, seeps, and springs. On the Ochoco National Forest moonwort species occupy primarily moist meadow sedge/forb communities associated with seeps, drainages, and the edges of wet meadows, to lightly shaded forested riparian areas. The habitat requirements of moonwort species on the Ochoco National Forest are similar, with several species often growing together, therefore they will be considered as one group for this analysis.

The Interagency ISSSSP Conservation Assessment for moonworts notes an apparent association between occupied moonwort sites (with the exception of *B. montanum*) and older (10 to 30 years) disturbances, including abandoned roadbeds, ditches, pastures, and meadows. In the Ochoco Mountains, as noted above, moonworts seem to be restricted to areas of additional moisture. Moonworts are also mycorrhizal obligates, thus changes affecting mycorrhizal fungi may also affect moonwort populations (Ahlenslager and Potash 2007).

No recent surveys were conducted in the Gap project area focused on sensitive moonworts. Several populations have been detected by past plant surveys outside the project area. Despite the existence of extensive wet meadow habitat within the project area, no sensitive moonwort populations have been documented in the Gap project area. However, these plants are small in stature, may be dormant underground for several years, and therefore are easily overlooked. The sensitive plant habitat map produced for the project includes most high probability habitat for moonwort species.

Peck's Mariposa Lily *(Calochortus longebarbatus var. peckii)*

Calochortus longebarbatus var. *peckii*, Peck's mariposa lily, is an endemic species with a global distribution restricted to central Oregon. Peck's mariposa lily occurs mostly on the Ochoco National Forest (2,963 total mapped acres), with a few populations on the Malheur National Forest (290 acres) and Prineville BLM (150 acres). It is currently on the Oregon Biodiversity Information Center (ORBIC 2015) List 1, which is considered to be threatened with extinction throughout its range. Peck's mariposa lily is a sterile triploid, which reproduces exclusively through the asexual production of bulblets that form at the base of the plant and are presumably dispersed downstream (Dewey 2011). Peck's mariposa lily is found in habitats ranging from riparian strips along seasonal streams and meadows within open ponderosa and lodgepole pine forests to open meadows, but is restricted to seasonally moist areas. Very wet meadows and wetter portions of meadows tend not to support Peck's mariposa lily; however the drier margins of these meadows and meadows that are seasonally moist or moist overall tend to support the largest populations of the lily. Populations are concentrated within the Little Summit and Lower Deep Creek watersheds on the Ochoco National Forest.

The conservation strategy for Peck's mariposa lily (Dewey 2011) suggests this species may benefit from changes to riparian areas that result in increased amounts of seasonally moist habitat. It also suggests that in some areas of the Ochoco National Forest, habitat for this species has been eliminated or degraded due to human influences. Road construction, grazing, timber harvest and other management activities have resulted in hydrological changes; especially stream down cutting that has lowered water tables and in some areas, has resulted in loss of riparian habitat for Peck's mariposa lily. Fire exclusion has also been noted as a potential threat to habitat (Dewey 2011).

The Gap project area contains many known populations of Peck's mariposa lily and substantial habitat. Known populations are located along the North Fork Crooked River, Lookout Creek, Jungle Creek, Gray Creek, and Horse Heaven Creek. There are 22 element occurrence records (roughly corresponding to discrete populations) for Peck's mariposa lily in the rare plant database (NRIS-TESP) occupying 329 acres within the Gap project area. The habitat map produced for the project contains most of the potential habitat for this species.

All proposed riparian restoration project areas and proposed temporary roads on existing disturbance intersecting with mapped Peck's mariposa lily populations were visited during the summer of 2015, between July 22 and August 3, ordinarily considered a good time to observe flowering plants. Very few flowering plants were observed. Warm and dry conditions during 2014 and 2015 may have caused plants to forego above-ground expression or to flower early and thus not be easily detected. Population trends for Peck's mariposa lily are difficult to determine due to the great variance in flowering individuals from year to year (Dewey 2011). Considering the habitat degradation described above, it is reasonable to infer that the number of Peck's mariposa lilies in the project area has declined compared to historic numbers present prior to the onset of extensive habitat modification.

Sensitive Sedge Species *(Carex spp.)*

There are three sedge species listed as sensitive on the Regional Foresters list that are suspected of occurring on the Ochoco National Forest. No documented populations exist on the forest or within the Gap project area. Lesser-panicled sedge (*Carex diandra*), slender sedge (*C. lasiocarpa* var. *americana*) and retrorse sedge (*C. retrorsa*) are on ORBIC List 2. These sensitive sedge species occupy wet meadows, swamps, and bogs and are found over a wide geographic range in Oregon and across North America. Most of the high potential habitat for these species is included in the sensitive plant habitat map.

Other Riparian Species

Eleocharis bolanderi, or Bolander's spikerush, is on ORBIC List 2. It is a densely tufted, grass-like perennial that grows in seasonally moist meadows and channel edges in grass steppe-scablands, from foothills to moderate elevations in the mountains. This species has never been documented on the Ochoco National Forest, but potential habitat does exist within the Gap project area. *Eleocharis bolanderi* was known in Oregon only from historical records (1940s) until it was located in Lake and Wallowa counties in 2002-2004. It also occurs in other eastern Oregon counties as well as other western states.

Muhlenbergia minutissima, or annual dropseed, is on ORBIC List 2. This annual grass is associated with sandy gravelly drainages, rocky slopes, flats, road cuts and open sites at moderate to high elevations. It is not known to be present on the Ochoco National Forest. In Oregon, it has been documented at only one site in Malheur County. It has also been documented in other western states.

Potamogeton diversifolius, or water thread pondweed, is on ORBIC List 2. This aquatic perennial forb is found in shallow ponds, marshes, and reservoirs in sage grassland or pine woodlands. It is found in most states, but has not been documented on the Ochoco National Forest. Open water habitat, while included in the project area, is not expected to be impacted by proposed project activities.

Salix wolfii, or Wolf's willow, is on ORBIC List 2. It is primarily a high elevation species associated with sites that collect cold air. In Oregon, it has been documented in Wallowa and Harney Counties. It has been documented in Idaho, Nevada, and the Rocky Mountain states. It is not known to be present on the Ochoco National Forest.

Utricularia minor, or lesser bladderwort, is on ORBIC List 2. Its habitat is low nutrient lakes and peatbog pools in lowlands and montane zones up to at least 5,500 feet. In Oregon, it has been documented in several counties on both sides of the Cascades. It also occurs in most western states and across the northern half of the US to the east coast. It is not known to be present on the Ochoco National Forest.

Helodium blandowii, or Blandow's bogmoss, is on ORBIC List 2. This moss forms mats and small hummocks in medium to rich montane fens or along streamlets in fens. Elevations range from 5,000 to 6,000 feet. In Oregon, it has been documented in several counties, on both sides of the Cascade Mountains and in the Blue Mountains, including the Ochoco National Forest. No management guide is available, but the species fact sheet suggests managing habitats to maintain hydrology and other processes needed for fen species (Christy 2007a).

Schistidium cinclidodonteum, or schistidium moss, is on ORBIC List 2. It occurs in large loose mats on wet or dry rocks or on soil in rock crevices along intermittent streams. There are no documented occurrences on the Ochoco National Forest.

Tomentypnum nitens, or tomentypnum moss, is on ORBIC List 2. It forms loose or dense sods or intermixes with other bryophytes in medium to rich montane fens, where it favors slightly elevated microsites sites such as logs, stumps, or hummocks. Potential habitat occurs in, but is not limited to, areas with calcareous bedrock. Elevations range from 5,000 to 6,000 feet. It is widely distributed across the Northern Hemisphere. It has been documented in several counties in Oregon, including both sides of the Cascade Mountains and the Blue Mountains, including the Ochoco National Forest. There is one known occurrence of tomentypnum moss within the Gap project area. The occurrence was found along the headwaters of Lookout Creek, within the Lookout Mountain Recreation Area where no activities are proposed for the Gap project. The species fact sheet suggests managing habitats to maintain hydrology and other processes needed for fen species (Christy 2007b).

Tortula mucronifolia, or mucronleaf tortula moss, is on ORBIC List 2. It has been documented in Southwest Oregon and in two sites in eastern Oregon. It distributed widely across North America and also in New Zealand. There are no documented occurrences on the Ochoco National Forest.

Most of the high potential habitat for Bolander's spikerush, Wolf's willow, Utricularia minor, Blandow's bogmoss, and tomentypnum moss is included in the sensitive plant habitat map. Habitats for annual dropseed, water thread pondweed, schistidium moss, and mucronleaf tortula moss are likely not completely inventoried in the sensitive plant habitat map.

Upland Forest Habitats

The most common upland forest plant associations include grand fir (*Abies grandis*)/pinegrass (*Calamagrostis rubescens*), ponderosa pine (*Pinus ponderosa*)/Idaho fescue (*Festuca idahoensis*), and Douglas-fir (*Pseudotsuga menziesii)/*pinegrass (*Calamagrostis rubescens*). While often associated with riparian areas, small aspen stands are also scattered in moister upland sites.

Upland forest habitat has been influenced by human activities and associated impacts over the last one hundred and fifty years. These activities include logging, road building, livestock grazing, and fire suppression. Grazing, and particularly, fire suppression, have altered the species composition and tree density of upland forests, resulting in increased density of fire intolerant conifers such as grand fir and Douglas-fir and reduced density of understory vegetation (Arno 2000). Habitat for many plant species adapted to frequent, low severity surface fire has been degraded due to fire suppression and succession to higher density forest.

Upland forest has also been negatively impacted by roads and invasive plant infestations. Roads alter runoff patterns, can contribute to soil erosion, interrupt and fragment the continuity of native plant communities, and provide corridors for invasive plants as vehicles and animals use them to travel. In order to support past timber harvest activities, many roads were located in upland forest habitat. Many of these roads remain on the landscape as open system roads. Some roads in the southern portion of the Gap project area have been closed as part of the South Boundary Closure area, which helps to reduce the impact of roads in this area.

Upland forest constitutes the majority of the Gap project area. Much of the proposed vegetation management activity included in the project would occur in this habitat. Few sensitive plant species rely on upland forest as habitat. Upland forest habitat has not been included in the sensitive plant habitat GIS layer.

Bastard kentrophtya *(Astragalus tegetarioides)*

Astragalus tegetarioides, bastard kentrophtya, is the only sensitive plant associated with upland forest habitat. It is currently on ORBIC List 1. This species occurs in openings, swales, and canyon bottoms in ponderosa pine forests and open stands of low and big sagebrush (*Artemisia arbuscula* and *A. tridentata*). Bastard kentrophtya is usually found on volcanic soils in openings of shrublands and dry ponderosa pine forests. The most common associated plants are *Artemisia arbuscula*, *Poa sandbergii*, *Festuca occidentalis* and *Phlox hoodii*. Specific ecological requirements are not well known for this species, but one documented population on the Ochoco National Forest is located on an old skid road below ponderosa pine and occupies approximately 14.2 acres. It is the northernmost documented population in its range which is primarily in the John Day drainage and therefore is important for species viability. There are no known occurrences of Bastard kentrophtya within the Gap project area.

Scabland Habitat

Scablands are characterized by shallow, gravelly lithosols and sparse vegetation. Soil crusts consisting of lichens and mosses are often present, although the gravelly soils are frequently bare. Plants that do colonize these scablands include rigid sage (*Artemisia rigida)*, low sage (*A. arbuscula*), Sandberg's bluegrass (*Poa secunda* ssp. *secunda)*, and one-spike oatgrass (*Danthonia unispicata).* Scablands experience extremes of both temperature and moisture, with frost-heaving through the winter season, a wet, saturated condition in the spring, and very hot, dry conditions during the summer and early fall. Only plant species tolerant to the harsh environment are able to grow on scablands. In some cases, endemic plant species have adapted to scablands and their habitat is largely confined to scabland. Based on PNV data, there are approximately 4,042 acres of scabland habitat in the Gap project area. Only a small portion of this habitat (approximately 21 acres) has been included in the mapped sensitive plant habitat GIS layer, based on known occurrences of Henderson's needlegrass.

Scablands are an important sensitive plant habitat, providing habitat for 4 of the 22 sensitive species (table 106). Scablands are one of the few sensitive plant habitats recognized with specific direction in the Ochoco Forest Plan. Forest plan direction regarding scablands includes minimizing disturbance, as mitigation and revegetation are nearly impossible (USDA Forest Service 1989). Scabland habitat has been degraded primarily by road building, localized disturbances such as mineral sources, livestock grazing, loss of soil biocrust, and especially by exotic annual grasses such as Japanese brome (*Bromus japonicus)* and similar annual brome species, and North-Africa grass (*Ventenata dubia).* The latter species has formed large, nearly monocultural stands on some scablands on the Ochoco National Forest, while other scablands have scattered or patchy *Ventenata* populations.

It is believed that fire was not a fundamental process historically in scablands, as they have very little in the way of fuels capable of carrying wildfire. Historically, scablands may have functioned as natural fuel breaks, influencing the disturbance patch size and burn patterns on the landscape. There is growing concern that scablands with high density *Ventenata* populations could contribute to the spread of uncharacteristic wildfire. Both the high density of exotic annual grass and the higher burn severity could be very detrimental to sensitive scabland plant species. There are varying levels of *Ventenata* invasion on scablands within the project area, with some scabs having only very low levels of infestation.

Scabland habitat in the project area is grazed by livestock. While a recently updated Allotment Management Plan is in place for the Fox Canyon Cluster, where most of the scabland habitat in the project is located, habitat degradation resulting from livestock grazing has impacted sensitive plants and habitat. These impacts include grazing of sensitive needlegrass plants. More widespread negative effects have resulted from soil impacts resulting from grazing, including loss of soil biocrust, subsequent soil erosion, increased susceptibility to exotic annual grasses, and hoof action in wet soils.

Table 106. Sensitive plant species associated with scabland habitat

Scientific Name	Common Name
Achnatherum hendersonii	Henderson's needlegrass
Achnatherum wallowaensis	Wallowa needlegrass
Eriogonum cusickii	Cusick's buckwheat
Lomatium ochocense	Ochoco lomatium

Two needlegrass species, *Achnatherum hendersonii* and *Achnatherum wallowaensis*, were split from one former species *Oryzopsis hendersonii*. Both species are on ORBIC List 1. *Achnatherum hendersonii* and *Achnatherum wallowaensis* are regional endemic species that occur sporadically in central and northeastern Oregon. They are found on exclusively on scablands in central and north-central Oregon.

There are forty-seven *Achnatherum hendersonii* sites and nine *Achnatherum wallowaensis* sites documented on the Ochoco National Forest in the NRIS-TESP database. One Henderson's needlegrass element occurrence is present within the Gap project area, with one subpopulation fully contained in the project area and another subpopulation bisected by the eastern project area boundary.

Eriogonum cusickii, or Cusick's buckwheat is on ORBIC List 1. Its habitat is sage scablands (lithosol soils), sandy volcanic flats, and mixed grasslands. In Oregon, it has been documented in Harney and Lake Counties. There is uncertainty whether this taxon occurs in central Oregon; central Oregon collections may have been misidentified (R. Halvorson, pers. comm. 2008).

Lomatium ochocense, or Ochoco lomatium, is an endemic species discovered in 1994, and described in 2010 (Helliwell 2010). It is restricted to basaltic scablands on shallow lithosols. It is on ORBIC List 2. There is one known site on the Ochoco National Forest; several more sites are located to the south on BLM lands. There are no known occurrences within the Gap project area.

Only a small amount of scabland has been included in the project sensitive plant habitat map. The extent of scabland openings that contain the known Henderson's needlegrass sites has been included.

Other Habitat-Basalt Cliffs

Cheilanthes feei, Fee's lip fern, is on the ORBIC list 2. The fern is found on calcareous cliffs and ledges, often on limestone from 300-12,500 feet in elevation, but is also found in crevices in basalt cliffs. In Oregon, it has been documented in Wallowa County. It is suspected on the Ochoco National Forest, but no populations have been found.

Basalt cliffs and other suitable rock formations may be found throughout the project area. This potential sensitive habitat is not included in the sensitive plant habitat GIS layer for the project. Generally, basalt cliff and rock outcrop habitat has been well-protected from past management activity and are generally in good condition. Threats include severe wildfire that could scorch or burn sensitive plants and habitat, although fire behavior could be moderated by the cooling mass of the rock, or cliffs may be perched above flames.

Effects of the Alternatives

This section of the report describes the direct, indirect, and cumulative effects of the actions proposed for each alternative, by sensitive plant habitat type. The proposed activities and affected associated sensitive plant habitat are summarized by alternative in table 107. All quantities and acreages listed are approximate. For sensitive plant habitat overlap, acreage values produced in GIS calculations of less than .05 acre or .01 mile are considered within the margin of error for this data and are not included in the analysis.

Cumulative effects are those that are expected from the impact of the no-action, and action alternatives, when added to other past, present, and reasonably foreseeable actions. Analysis of cumulative effects is bounded in space by the project area boundary, excluding the Lookout Mountain Management area where no actions are proposed in any alternative. This area, and the sensitive plant habitats and populations contained within, is a landscape of sufficient size to consider the effects of proposed actions and past and foreseeable actions on sensitive plant populations and their habitat. Bounding the analysis to the project area, which consists of the Upper North Fork Crooked River and Horse Heaven-Crooked River watersheds, is particularly appropriate since many sensitive plant species may be rare due to dispersal limitations and maintaining viable populations at the watershed level helps contribute to viability across the range of the species. Analysis of cumulative effects is bounded in time by twenty years into the future, as assumptions regarding trends may not be valid beyond that. Twenty years is also the approximate effectiveness timeframe of forest management actions.

Some, but not all, past effects considered date back to the beginning of significant European settlement and modification of the area, approximately 150 years ago. The most persistent and important historic environmental modifications and their effects to sensitive plant habitat are discussed in the Affected Environment. More recent past forest and fuels management activities in the Gap project area include commercial harvest totaling 448 acres, noncommercial thinning of 1,907 acres, and underburning of 2,793 acres. These activities affected a total of 5,148 acres within the project area. There have been past riparian restoration activities along the North Fork of the Crooked River at Williams Prairie and Sera Springs, as well as other locations in the project area. Finally, ongoing activities include vehicular travel, public recreation, hunting, and firewood gathering, livestock grazing, invasive plant treatments, road maintenance, a proposed non-motorized bike trail system and other management activities. A summary of known past, present, and foreseeable actions considered in effects analysis can be found in table 171.

It is important to note that for all acres of proposed activity that overlap with mapped sensitive plant habitat, project design features would be in place to minimize potential impacts to sensitive plant populations and habitat. Units with specific sensitive plant concerns and applicable design features are listed in Chapter 2.

Table 107. Summary of activities by alternative and overlap with sensitive plant habitat

	Alt. 2	Alt. 2	Alt. 3	Alt. 3	Alt. 4	Alt. 4
Treatment Prescription	**Treatment (acres)**	**Sensitive Plant Overlap (acres)**	**Treatment (acres)**	**Sensitive Plant Overlap (acres)**	**Treatment (acres)**	**Sensitive Plant Overlap (acres)**
Commercial thinning (includes juniper, aspen tx)	14,037	61.3	10,903	34.6	14,037	62.2
Non-commercial thinning (tree sources for riparian restoration, aspen tx)	180	46.7	180	46.7	193	46.8
Noncommercial thinning	16,001	122.5	15,082	120.5	16,290	133.4
Hardwood treatment (aspen tx not included in commercial thinning)	80	25	87	31.9	91	31.5
Fuels Reduction						
Hand piling	228	4.0	489	7.1	517	15.8
Underburn	18,558	160.6	18,560	160.8	18,559	161.0
Grapple pile	2,406	7.9	2,041	4.7	2,406	7.9
Total vegetation/fuels treatments*	**21,734**	**204**	**21,630**	**204**	**22,034**	**216.4**
Riparian restoration						
Riparian restoration	13.7 mi/ 1,345 ac	7.8 mi/ 708 ac	13.7 mi/ 1,345 ac	7.8 mi/ 708 ac	13.7 mi/ 1,345 ac	7.8 mi/ 708 ac
Culvert repair/replacement	6 locations	4 locations	6 locations	4 locations	6 locations	4 locations
Transportation System	**Miles of road**	**Sensitive Plant Overlap (miles)**	**Miles of road**	**Sensitive Plant Overlap (miles)**	**Miles of road**	**Sensitive Plant Overlap (miles)**
Temporary roads on existing disturbance	38.9	0.9	33.1	0.9	39.4	0.9
New temporary roads	1	0	0.9	0	0.9	0
Road closure	20.6	0.8	20.6	0.8	20.6	0.8
Road decommission	3.3	0.1	3.3	0.1	3.3	0.1

*Since more than one treatment may be applied to the same area, the total acres treated exceeds the sum of individual treatment types.

Direct and Indirect Effects

Riparian Habitats

Alternative 1

This alternative would have no disturbance resulting from road construction, use of temporary roads, timber harvest, noncommercial thinning, underburning, riparian restoration, or other proposed activities that could affect sensitive plants and their habitat. Current processes, such as forest succession, affecting sensitive plant habitat would be maintained as is, at least in the short term (<10 years). Other recurring management activities, including livestock grazing, fire suppression, treatment of invasive plants using chemical, manual, or biological controls, and public recreational use would continue throughout the Gap project area.

Potential impacts to sensitive plants and their habitats resulting from proposed project activities would not occur. These impacts include crushing of unknown plants by heavy equipment, removal of shading tree canopy, soil compaction from heavy equipment, and removal of native vegetation and habitat alteration from the construction of roads, use of temporary roads, and landings.

Fire intolerant trees would continue to increase in density, potentially increasing the risk of high severity wildfire and reducing the amount of single-stratum, open understory forest and meadow habitat. Proposed riparian restoration activities would not occur, thus sensitive plant populations and habitat would not experience the potential changes to hydrology, moisture, and possible inundation that could occur as a result of such restoration. Floodplains and meadow habitats that are presently drier than they were historically due to stream incision and lowered water tables would likely remain so.

Likewise, no beneficial effects resulting from proposed landscape restoration activities would occur. Commercial harvest, thinning, fuels treatments, and underburning are expected to reduce tree density and reduce fuels. These treatments may moderate wildfire activity should one burn through the project area, and could reduce burn severity. Prescribed fire and low severity wildfire are likely to be beneficial to many sensitive plant species, particularly Peck's mariposa lily and moonworts, due to their association with open habitats, moderate levels of disturbance, and historic surface fire regime.

Beneficial effects from proposed riparian restoration activities would not be realized. Riparian restoration is expected to raise water tables, expand water storage and capture, decrease channel scouring and incision, increase sediment capture, and generally expand wet meadow and riparian vegetation. These changes would likely benefit sensitive riparian plant species over the long term.

Action Alternatives: Proposed Action and Alternatives 3 and 4

The differences between the action alternatives in their potential impacts to sensitive plants and their habitat are negligible, varying by only 12 acres for all vegetation treatments and one-tenth of a mile for new temporary roads. Therefore, impacts described in this section will cover all action alternatives, and assumes impacts among alternatives are essentially equivalent.

Vegetation and Fuels Treatments

Vegetation and fuels treatments include commercial thinning, noncommercial thinning, thinning of tree over 21" dbh (Alt. 4 only), juniper cutting, slash piling and burning, and underburning. Where vegetation and fuels treatment units overlap with sensitive plant habitat, project design features apply in order to minimize impacts to sensitive plants and their habitat. These design criteria include avoidance of known sensitive plant populations in heavy equipment operations. Since all known sensitive plant populations would be avoided, negative impacts to sensitive plants are limited to where unknown populations and potential habitat overlap with project activities and to modification of habitat resulting from vegetation management activities. This has the potential to occur on a maximum of 216 acres throughout the project area and on any unmapped sensitive plant habitat.

Soil disturbance from heavy machinery can injure or destroy individual sensitive plants. Soil compaction or erosion caused by logging activities can change hydrological patterns in riparian habitat thus resulting in occupied microsites becoming too wet or too dry or can bury plants in sediment deposits. Heavy slash resulting from both commercial and noncommercial thinning activities can bury plants, and burning this slash particularly as grapple piles can scorch soils, damaging plants, mycorrhizal fungi, and their habitat.

The harvest prescription for RHCA units has been designed to meet Riparian Management Objectives. The harvest would be light, with the majority of the trees removed between 7-14" diameter range. Large populations of Peck's mariposa lily have been observed under previously harvested, partially opened canopies. While complete opening of the canopy through clearcut or shelterwood harvests appears to have detrimental effects to this species, a partially open canopy appears to be beneficial (Dewey 2011). Commercial and noncommercial thinning in RHCAs which would reduce competition and shade from smaller trees is expected to help maintain quality sensitive plant habitat. Similarly, moonworts can be found under lodgepole pine and other conifers within wet meadows. There is typically partial shading in these habitats, which is thought to be beneficial to the species but when partially shaded sites succeed to closed canopy sites, moonwort populations may disappear (Ahlenslager and Potash 2007).

Prescribed underburning would occur on approximately 161 acres of sensitive plant habitat. Some of this habitat is too moist to carry fire well and therefore is naturally buffered from higher intensity fire. Direct ignition is not ordinarily done through meadow and scabland habitats, and the fire is allowed to back down and burn in a natural pattern. Prescribed fire operations are conducted when conditions are unlikely to result in severe burning. Johnson-Groh and Farrar (1996) conducted studies investigating the effects of fire on moonwort populations and concluded that normal fires that were not excessively hot or dry pose no serious threat to moonworts. However, they noted that exceptionally hot burns or ones that occurs when soil is desiccated can kill moonworts or the mycorrhizae that they depend on.

The seasonal timing of prescribed burning is also important for maintaining Peck's mariposa lily populations. Prescribed fire would take place in the fall after the plants are dormant, to avoid leaf damage. In a study of the effects of fire and grazing on Peck's mariposa lily on the Ochoco National Forest, Kagan (1996) observed that cool burns appeared to reduce competition to the lily, and did not affect the moisture gradient in the meadows. This burn was conducted in a high moisture year and the burn did not carry well through the majority of the study plots. Thus, there were no data on the effects of hot burns on the population. On the Winema National Forest, a wildfire burned a population of *Calochortus longebarbatus* var. *longebarbatus*, a close relative of Pecks mariposa lily. Flowering individuals greatly increased in the year following the fire (Dewey 2011).

The district botanist will review burn plans prior to implementation and would work proactively with Fuels Specialists to ensure sensitive plant populations and habitat are considered in fuels treatments and prescribed fire implementation. This process, combined with project design features, would minimize potential damage to sensitive plants and their habitat resulting from higher severity burning. Prescribed burning in sensitive plant habitat and in surrounding forest stands is expected to benefit sensitive plant habitat by reducing hazardous fuels, reducing competing vegetation, stimulating natural growth response, and simulating the natural fire regime.

Sensitive plant habitat for the remaining riparian sensitive plant species (slender sedge, retrorse sedge, Bolander's spikerush, annual dropseed, water thread pondweed, Wolf's willow, lesser bladderwort, Blandow's bogmoss, schistidium moss, tomentypnum moss, and mucronleaf tortula moss) would receive little to no negative impact from proposed vegetation management activities. These species, with the possible exception of annual dropseed, are confined to very wet, saturated conditions along stream banks, wetlands, GDEs, and other sensitive areas protected by multiple project design features, including the water quality best management practices (BMPs) from the National Core BMPs. These are included in the EIS for the Gap project. Short-term, (during and up to one year after implementation) localized sediment increases described above could negatively impact the streamside and wetland habitats for these species by disrupting peat forming processes, altering pool formation, or microhabitat features, or by burying unknown plants. Prescribed fire would not carry through these saturated habitats, nor would they be directly ignited, and would have minimal effects to unknown plants or habitat.

Temporary roads, closures, and decommission

For all action alternatives, there would be 0.9 mile of temporary road on existing disturbance, 0.8 mile of road closure, 0.1 mile of road decommission, and no new temporary road located within mapped sensitive plant habitat. There are locations where known sensitive plant populations overlap with road-related actions, and project design features addressing temporary roads would limit negative impacts to sensitive plant habitat. Negative impacts to sensitive plants may also occur where unknown populations and mapped and unmapped potential habitat overlap with road-related actions and modification of habitat resulting from such actions.

There are older, revegetated existing routes visible on aerial and LIDAR imagery throughout the project area. Temporary roads on existing disturbance would reuse these routes to implement vegetation management activities. Many of these routes currently support quality native vegetation well-matched to the surrounding community, except they generally lack large trees. Use of these existing disturbances by heavy machinery and logging trucks would crush existing vegetation, resulting in bare soil tracks. Small segments of blading and other needed improvements would also expose bare soil, but substantially fewer disturbances are expected from temporary road use compared with specified road construction. Where temporary roads are within or adjacent to sensitive plant populations or habitat, exposed soils could contribute to soil erosion, increases in sediment input to streams and wetlands, and potential for invasive weed infestation. Temporary roads are revegetated and further access prevented, thus limiting some of these negative impacts after successful revegetation.

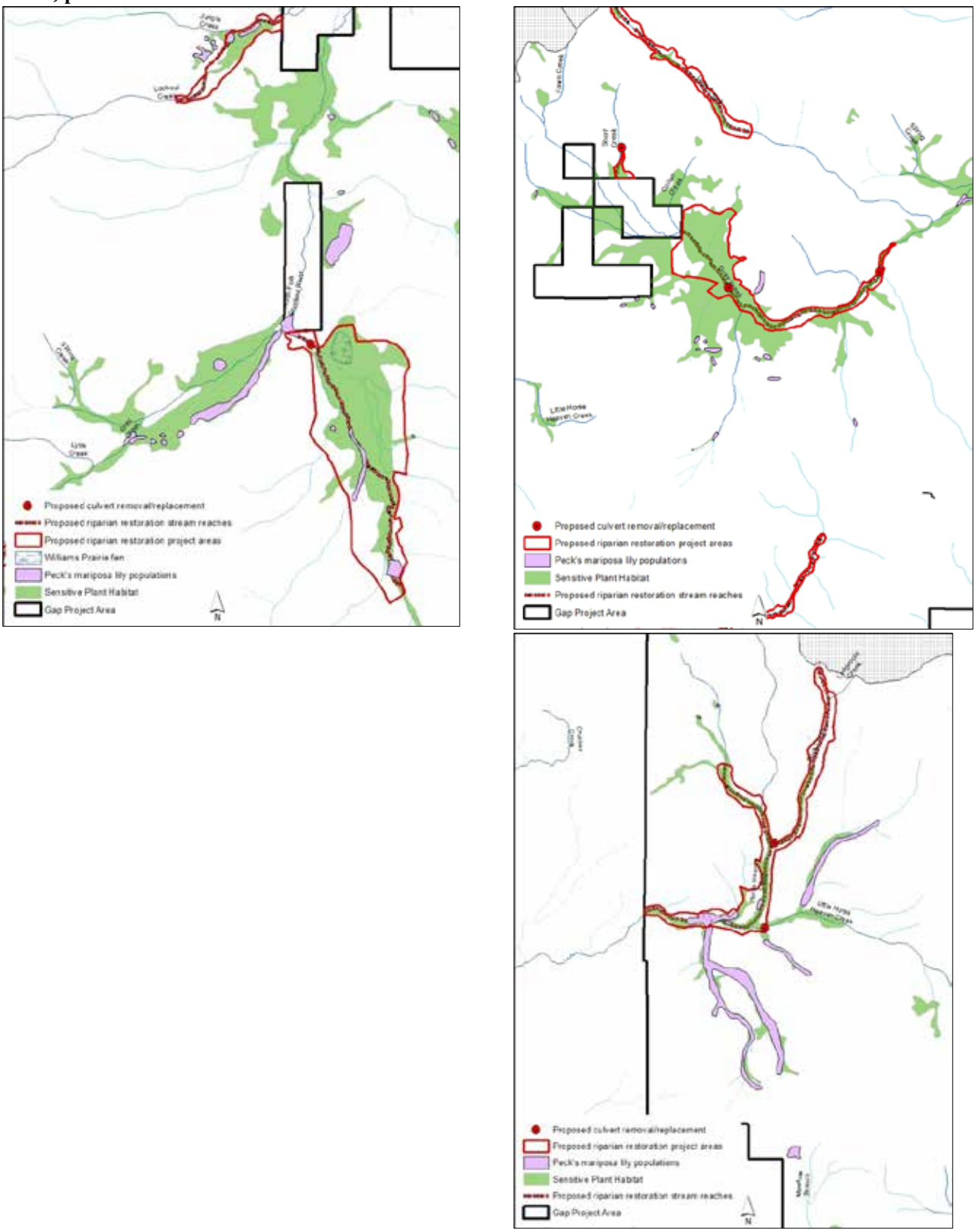
Disturbance associated with road closure and decommission could have short-term (3-5 year) negative effects to sensitive plant habitat by similarly creating localized bare soil, particularly from decompaction. While most routes are located in dry areas with less potential for moonwort, there is a possibility that unknown moonwort populations exist on routes to be used as temporary roads or on routes to be closed or decommissioned due to their apparent habitat preference for older disturbances. Unknown populations could be destroyed by these activities.

Road closures and decommissions would have a long-term (5+ years) positive effect on sensitive plant habitat by helping to reestablish hydrological function important to riparian habitats. Proposed road closures and decommissions would benefit sensitive plant habitat by reducing sedimentation, improving surface hydrology, infiltration rates and reducing further compaction as well as reducing the potential for spreading non-native invasive weeds along roads travelled by vehicles, which are well known vectors of invasive species.

Riparian restoration and culvert replacement

Riparian restoration proposed in all action alternatives would occur in meadows and riparian habitat within sensitive plant habitat. A total of 7.8 miles of stream and approximately 708 acres of mapped sensitive plant habitat could be affected by riparian restoration and culvert replacement. This includes known Peck’s mariposa lily populations along Lookout, Gray, and Horse Heaven Creeks and the North Fork Crooked River in Williams Prairie. Project design features would be in place to minimize impacts to sensitive plant populations. Figure 24 depicts riparian restoration reaches and project areas along with sensitive plant populations and habitat.

Figure 24. Proposed riparian restoration project areas, along with Peck's mariposa lily populations and habitat. Panel 1 shows Jungle Creek and North Fork Crooked River (Williams Prairie); panel 2 shows Gray Creek; panel 3 shows Horse Heaven Creek.



The riparian restoration project areas that overlap with sensitive plant habitat (708 acres) represent a large amount of habitat particularly important to Peck's mariposa lily, but also potentially suitable for the other sensitive riparian plant species. Of all proposed riparian restoration areas, only the Lost Creek riparian restoration project area does not include potential habitat for Peck's mariposa lily. 37 acres of mapped Peck's mariposa lily populations divided among five populations overlap with riparian restoration project areas. Two of the five populations would only be partially impacted, with some of the mapped population outside of the expected zone of influence of riparian restoration effects. The remaining three populations have extents of 93% or greater within areas anticipated to be impacted (table 108).

Table 108. Peck's mariposa lily populations within riparian restoration project areas.

EO Number	General location	Total population acres	Acres within riparian restoration project areas	Percent of population area potentially impacted
06070100019	Horse Heaven Creek	94.8	15.7	17%
06070100024	Gray Creek	0.4	0.4	100%
06070100108	Lookout Creek	10.2	4.9	48%
06070100041	North Fork Crooked River	9.5	9.3	98%
06070100100	North Fork Crooked River	7.3	6.8	93%

As noted in the discussion of affected environment, habitat degradation due to stream incision, lowering water table, and resultant drying and change to upland plant species has limited the potential for meadow and riparian habitats to support sensitive plants. These plants often require more moisture than is currently available for establishment and persistence of populations. Riparian restoration activities are specifically designed to reconnect streams to floodplains, slow and capture water, trap sediment, and raise water tables. This is accomplished primarily through strategic placement of large trees and other material to create plugs, or in the case of open meadow systems, filling of compromised stream channels, which is executed using large equipment. These activities would have negative impacts to sensitive plant populations and habitat over the first 3-5 years of the project, but would benefit sensitive plant habitat in the longer-term (5+ years) as new hydrologic regimes are established, expected moisture increases are realized, and riparian vegetation recovers from both historic drying and project activities.

While design features are in place that would minimize risk, it is possible that equipment could crush or destroy unknown sensitive plants. Equipment would operate within sensitive plant habitat for nearly all work associated with riparian restoration. Impacts resulting from these operations also include removal of native riparian vegetation within stream access areas, exposure of bare soil, temporary localized soil compaction and erosion, soil disturbance and displacement from vehicle tracks and tree root wad extraction from meadow edges and neighboring forest stands, and from rock extraction and placement. Removal and replacement of culverts using heavy equipment would also result in similar impacts. Bare soil exposure removes native vegetation in which sensitive plants grow and increases the potential for invasive plant infestation.

Hydrologic changes resulting from riparian restoration would have the highest potential to impact sensitive plant populations and habitat. Many sensitive plant species, particularly Peck's mariposa lily and moonworts, have highly specific, intermediate moisture requirements (Dewey 2011, Ahlenslager and Potash 2007).

While overall habitat has likely been lost due to riparian habitat degradation, it is possible that populations of these plants have contracted and followed available moisture patterns as meadows have dried. Current populations may be inundated or habitat may become too wet to support sensitive plants requiring intermediate amounts of moisture. Thus, some populations, including known populations of Peck's mariposa lily, could be eliminated due to hydrologic changes as a result of riparian restoration activities. It is unknown whether new populations could establish in newly available habitat. Sensitive plant species associated with GDEs (lesser bladderwort, Blandow's bogmoss, and tomentypnum moss) require relatively constant, saturated conditions associated with groundwater. Known potential habitat in riparian restoration areas is confined to the fen in Williams Prairie within the proposed riparian restoration project area for North Fork Crooked River. The fen and all associated groundwater features would be avoided. While the fen did not receive special consideration in restoration project design, no negative impacts to the fen or GDE dependent species are anticipated.

The remaining sensitive riparian plants (slender sedge, retrorse sedge, Bolander's spikerush, annual dropseed, water thread pondweed, Wolf's willow, schistidium moss, and mucronleaf tortula moss), with the possible exception of annual dropseed, require saturated habitat and inundation is less likely to be lethal to these species. They are adapted to dynamic, but very wet, environments.

Since some Peck's mariposa lily populations could be lost as a result of riparian restoration activities, it is important to consider how these populations might contribute to species viability. The majority of all known occurrences of this species are found on the Ochoco National Forest, with mapped populations totaling around 2,963 acres. As noted previously, the Lower Deep Creek and Little Summit watersheds support the highest lily concentrations. Of the populations in the Gap project area, the Horse Heaven and Lookout Creek populations likely contain the highest number of plants, with approximately 1,500 and 1,336 individuals originally reported in the mid-1990s, respectively. For both of these important populations, most of the population is located outside of riparian restoration project areas. For example, 960 of the 1,336 individuals reported along Lookout Creek were located in a drier meadow situated outside of proposed riparian restoration areas. While the current distribution of plants within mapped populations is unknown, occurrence records support the conclusion that these populations would persist even if the portion within the proposed riparian restoration area is lost to inundation or other changes in hydrology.

The original reports for the remaining populations show that they are relatively small, with 5 plants reported for the Gray Creek population, and approximately 200 plants reported from three different surveys along the North Fork Crooked River. While these empirical population estimates may only reflect a small number of potential plants present, they remain the best information on population size. Considering the limited potential for impact on the largest Peck's mariposa lily populations and the extent of existing populations and habitat within the Gap project area outside of riparian restoration project areas, negative impacts resulting from riparian restoration activities do not pose a threat to the viability of Peck's mariposa lily.

Other connected actions

Other connected actions proposed include .9 mile of buck and pole fence, 4 miles of barbed wire fence, and an expansion of the Winter material source of less than one acre. The fencing actions create minimal ground disturbance, fence placement would be coordinated with the district botanist, and would be designed to protect riparian restoration areas and aid revegetation. Known sensitive plant locations would be avoided. The limited ground disturbance and coordination measures ensure that proposed fencing would have minimal impacts on riparian sensitive plants and their habitat.

The area proposed for expansion of Winter material source is not located in habitat suitable for riparian sensitive plant species; therefore no impact to these species would result from this proposed activity.

Cumulative Effects-All Alternatives

The Gap project area, and the sensitive plant habitats and populations contained within, is a landscape of sufficient size to consider the effects of proposed actions and past and foreseeable actions on sensitive plant populations and their habitat. Bounding the analysis to the project area, which includes portions of the Upper North Fork Crooked River and Horse Heaven-Crooked River watersheds, is particularly appropriate since many sensitive plant species may be rare due to dispersal limitations and maintaining viable populations at the watershed level helps contribute to viability across the range of the species. The cumulative effects of past management are reflected in the discussion of Affected Environment, and the above effects analysis with respect to various proposed activities. Present and foreseeable actions impacting riparian areas in the Gap project area include livestock grazing, public uses such as recreation, dispersed camping, firewood gathering, and OHV use, invasive plant treatments, and road maintenance (see table 167 for a list of actions considered).

While many past management activities contributed to a departure from historic conditions and ecological processes, such as loss of frequent, low severity wildfire and periodic flooding in meadows connected to stream channels and higher water tables, current and foreseeable management actions are primarily designed to restore these processes to some extent. Most of the recent past timber harvest and thinning activities occurred outside of riparian habitat, but did help to reduce stand density in treated areas.

The Fox Canyon and Big Summit Allotment Management Plans include several restoration elements and project design features that reduce the impacts of cattle grazing on riparian sensitive plants and their habitat. Many of the Fox Canyon restoration elements have not yet been implemented, and riparian habitat degradation resulting from livestock overuse continues in many areas. As restoration elements such as protection of fens, reconstruction of exclosures, water developments that are designed to draw cattle away from sensitive areas, and riparian restoration activities are implemented, riparian habitat and sensitive plant habitat in the Fox Canyon, Gray Prairie, and Antler Allotments are expected to improve. Implementation of a riparian pasture along Jungle Creek in the Brush Creek Allotment would also be designed to improve riparian vegetation and provide more flexibility in responding to range conditions. In addition, riparian restoration activities proposed for the Gap project include temporary fencing that would protect riparian areas and sensitive plant habitat as they recover from restoration-related disturbance. These actions could also have localized, short-term detrimental impacts to sensitive plant habitat as ground disturbance is necessary to implement them. Over the long term, as riparian restoration actions planned in the AMPs are implemented along with those proposed in the Gap project, habitat connectivity, extent, and quality would improve cumulatively for sensitive plants.

Invasive plant treatments in Gap project riparian areas have been minimal within the last 3 years, but existing infestations of priority weed species would be treated as appropriate through chemical herbicide application and/or manual treatment in advance of project activities.

Some riparian areas have been negatively impacted by OHV use and by dispersed camping. These activities have likely resulted in localized reduction of sensitive plant habitat suitable for occupancy, particularly for Peck’s mariposa lily. This species’ habitat overlaps with areas likely to be used by recreationists, such as open forest stands adjacent to meadows. These activities also have the potential to spread invasive plant species into areas that are currently weed-free. These impacts would continue under all alternatives.

The proposed Lookout Mountain Multi-use Trail project would pass through riparian habitat on both existing disturbances and newly constructed trail. The proposed trail network could destroy unknown sensitive plant populations and habitat by removing natural vegetation, compacting soils, and potentially contributing to the introduction and spread of invasive plants. These negative impacts would be minimized by avoiding high quality habitat and known sensitive plant populations and implementation of invasive plant prevention measures.

For Alternative 1, the no-action alternative, the short-term negative impacts to riparian sensitive plants and habitat resulting from the proposed actions in the Gap project would not occur in combination with the above described past, present and foreseeable actions. Longer-term, beneficial effects to sensitive riparian habitats resulting from the proposed actions would also not occur. Under the action alternatives 2, 3, or 4, actions proposed in the Gap project area would add incrementally to the effects described above in riparian sensitive plant habitat. Since most effects described have short-term negative impacts associated with ground disturbance and removal of native vegetation and longer-term beneficial effects, cumulative effects would likely impact individual sensitive plants or discrete areas of habitat where activities take place but overall would result in improved habitat conditions for riparian sensitive plants.

Conclusion-Riparian Habitats

Under all action alternatives, proposed vegetation management activities, associated temporary roads, road closure and decommission, and culvert replacement could negatively impact unknown sensitive riparian plant populations and mapped and unmapped sensitive riparian plant habitat as described above. Proposed riparian restoration could negatively impact unknown sensitive plant populations, mapped sensitive plant habitat, and known populations of Peck's mariposa lily. Most of the effects are limited in scale and time to local effects that would decrease over 3-5 years. Over the longer term (5+ years), most sensitive plant habitat would benefit from these proposed activities, also in ways described above. The proposed activities 1) are implemented with project design features that minimize negative impacts and protect known populations; 2) would not impact populations of most sensitive species with potential habitat within the project area, since no populations have ever been documented; 3) primarily affect the periphery of sensitive plant habitat (thinning along a meadow edge); 4) are not expected to burn with high intensity; 5) would affect areas already disturbed (temporary road use, decommissioning); or 6) would only negatively impact a portion of known populations, leaving sufficient individuals and habitat to sustain species viability within the Gap project area. Therefore, for sensitive plant species associated with riparian habitats (including meadow, hardwood/conifer, and GDE habitats), anticipated effects would be that some individuals or habitat may be negatively impacted, but would not be likely to contribute to a trend towards federal listing or loss of viability.

Direct and Indirect Effects/Upland Habitats

Under the no-action Alternative 1, no proposed vegetation management or riparian restoration activities would take place. There would be no effects to any unknown populations of bastard kentrophtya and its habitat resulting from vegetation management actions, such as crushing of plants, soil disturbance and compaction, and increased potential for invasive plant infestation. No beneficial effects to bastard kentrophtya through habitat improvement would occur through fuels treatments, prescribed fire and stand density reduction through timber harvest, or noncommercial thinning. These actions have the potential to benefit bastard kentrophtya habitat, since this species is associated with open forest understory and possibly moderate past disturbance.

Action Alternatives: Proposed Action and Alternatives 3 and 4

All action alternatives are considered together, since the alternatives differ little in their potential impact to bastard kentrophtya and its habitat.

Vegetation and Fuels Treatments

Based on PNV data, proposed vegetation and fuels treatments overlap considerably with bastard kentrophtya habitat. Potential bastard kentrophtya habitat has not been included in the sensitive plant habitat GIS layer for the Gap project, the reference layer for application of sensitive plant-specific project design features. While there are no botany project design features covering bastard kentrophtya habitat, a number of other project design features and standard measures apply to timber harvest and thinning activities that would help to protect the habitat. These design measures include invasive plant survey and control in harvest units, general measures to minimize soil compaction and erosion, and limitation of temporary roads and other disturbances on scablands dominated by bastard kentrophtya associates such as low sage.

With such measures in place, potential negative impacts to bastard kentrophtya habitat would be minimized but still include crushing of unknown plants, disturbance and localized removal of native vegetation, and resultant potential for invasive plant infestation and/or soil erosion. These impacts could occur on up to 14,231 acres of upland forest with a primary prescription of commercial or noncommercial harvest.

Fuels treatments and underburning would also take place within potential bastard kentrophtya habitat. There is an assumption that bastard kentrophtya is an early successional, fire tolerant species like its congeners, although the effects of prescribed burning on the plants' biology are unknown. While multiple measures are in place to prevent high burn severity results in prescribed burning, it is possible that patches of higher severity burning could occur in the implementation of proposed underburning where fuel loading is higher, or large piles are burned. This could negatively impact upland forest habitat due to localized scorching or sterilization of soils and removal of native vegetation. This could lead to infestation by invasive plants or changes in microhabitat unsuitable for bastard kentrophtya. Long-term effects of burning are likely beneficial by reducing dense stands of brush and understory ponderosa pine, improving milkvetch habitat.

Temporary roads, closures, and decommission

Most proposed temporary roads on existing disturbance, new temporary road, and road closure and decommission actions would take place in upland forest habitat. Unknown bastard kentrophtya populations could be destroyed by any of the road-related actions. Potential habitat could be degraded due to removal of native vegetation, soil compaction and erosion along road routes, and the spread of invasive plants along road corridors.

Riparian restoration and culvert replacement

Impacts to upland forest habitat resulting from proposed riparian restoration and culvert replacement would be minimal. Areas used as tree or fill sources could be impacted by movement of heavy machinery and disturbance associated with removal of these materials. These activities would be confined to the identified riparian restoration project areas or within proposed road-related actions discussed above. To the extent any of these activities overlap with unknown bastard kentrophtya populations or habitat, negative impacts would be similar to those described above for thinning treatments and road-related actions.

Other connected actions

Other connected actions proposed include .9 mile of buck and pole fence, 4 miles of barbed wire fence, and an expansion of the Winter material source of less than one acre. The fencing actions create minimal ground disturbance, fence placement would be coordinated with the district botanist, and would be designed to protect riparian restoration areas and aid revegetation.

Known sensitive plant locations would be avoided. The limited ground disturbance and coordination measures ensure that proposed fencing would have minimal impacts on upland forest sensitive plants and their habitat. The area proposed for expansion of Winter material source is located in the upland forest habitat. The expansion would take place on less than one acre. Unknown bastard kentrophtya populations could be destroyed by expansion of the mineral source, and habitat would be permanently removed. The small size of area proposed and the lack of known sensitive plant populations in the vicinity limit the negative impact to upland forest sensitive plant species and habitat that would result from this proposed activity.

Cumulative Effects-All Alternatives

The cumulative effects boundary is the Gap project area. The cumulative effects of past management are reflected in the discussion of Affected Environment, and the above effects analysis with respect to various proposed activities. Present and foreseeable actions impacting upland forest habitat in the Gap project area include livestock grazing, public uses such as recreation, dispersed camping, firewood gathering, and OHV use, invasive plant treatments, and road maintenance (see table 167 for a list of actions considered).

While many past management activities contributed to a departure from historic conditions and ecological processes, such as loss of frequent, low severity wildfire and periodic flooding in meadows connected to stream channels and higher water tables, current and foreseeable management actions are primarily designed to restore these processes to some extent. Recent past timber harvest and thinning activities have helped to reduce stand density in treated areas, which would benefit bastard kentrophtya habitat by providing a more open forest structure.

Invasive plant treatments in Gap project upland forest areas have been minimal within the last 3 years, but existing infestations of priority weed species would be treated as appropriate through chemical herbicide application and/or manual treatment in advance of project activities.

Some upland forest habitat has been negatively impacted by unauthorized off-road OHV use and by dispersed camping. These activities have likely resulted in localized reduction of sensitive plant habitat suitable for occupancy by bastard kentrophtya. This species' habitat overlaps with areas likely to be used by recreationists, such as open forest stands. These activities also have the potential to spread invasive plant species into areas that are currently weed-free. These impacts would continue under all alternatives.

The Fox Canyon and Big Summit Allotment Management Plans (AMPs) could lead to an increase in livestock forage utilization in upland habitats, including upland forest habitat, as these projects are intended to improve riparian vegetation and livestock distribution throughout the pastures. This could result in a small increase in livestock impacts to bastard kentrophtya and its habitat, including direct grazing of plants, trampling of plants, soil compaction from livestock trailing or areas of concentrated use (such as salting locations), and other negative impacts resulting from livestock grazing. These impacts would be balanced by desired improvements in riparian vegetation.

The proposed Lookout Mountain Multi-use Trail project could negatively impact unknown bastard kentrophtya populations and could pass through potential habitat. Most of the proposed trail system would be located on existing disturbances, some of which could be old enough to have become suitable for this sensitive plant species. Some amount of new trail could remove natural vegetation, also negatively impacting upland forest habitat. For Alternative 1, the no-action alternative, the short-term negative impacts to bastard kentrophtya and its habitat resulting from the proposed actions in the Gap project would not occur in combination with the above described past, present and foreseeable actions. Longer-term, beneficial effects to bastard kentrophtya habitats resulting from the proposed actions would also not occur.

Under the action alternatives 2, 3, or 4, actions proposed in the Gap project area would add incrementally to the effects described above in upland forest habitat. Since most effects described have short-term negative impacts associated with ground disturbance and removal of native vegetation and longer-term beneficial effects, cumulative effects would likely impact individual sensitive plants or discrete areas of habitat where activities take place but overall would result in improved habitat conditions for bastard kentrophtya.

Conclusion-Upland Forest Habitats

Under all action alternatives, proposed vegetation management activities, associated temporary roads, road closure and decommission, and culvert replacement could negatively impact unknown sensitive bastard kentrophtya plant populations and potential sensitive plant habitat as described above. Proposed riparian restoration would have minimal impacts to the species and upland forest habitats. Most of the effects are limited in scale and time to local effects that would decrease over 3-5 years. Over the longer term (5+ years), most upland forest habitat would benefit from these proposed activities, also in ways described above.

The proposed activities 1) would not impact known populations of bastard kentrophtya within the project area, since no populations have ever been documented, and 2) are implemented with project design features that minimize negative impacts to habitat and would protect any newly discovered populations, anticipated effects would be that some individuals or habitat may be negatively impacted, but this would not likely contribute to a trend towards federal listing or loss of viability.

Direct and Indirect Effects

Scabland Habitat

Alternative 1-No Action

Under Alternative 1, no vegetation and fuels treatments or riparian restoration activities would take place. Generally, none of the proposed activities are directed at scabland habitat. Any disturbance to scabland habitat resulting from proposed activities would not occur, and thus would not impact scabland associated sensitive plant populations and their habitat. Since vegetation management is generally not proposed for these areas, and several project design features would limit negative effects, potential impacts mainly concern temporary roads on existing disturbance. There would be approximately 1 mile of temporary road on existing disturbance through scabland habitat under Alternatives 2 and 4, and approximately 0.62 mile of temporary road on existing disturbance under Alternative 3. Negative effects to sensitive plant habitat resulting from use of these disturbances include loss of revegetated surface and potential for infestation by invasive plants.

Potential beneficial effects to scabland habitat would not be realized under Alternative 1. These include reduction of unnatural fuel loading in surrounding forest stands that could contribute to uncharacteristically severe wildfire that could spread across scabland habitat. For some scablands already affected by invasive annual grasses, the occurrence of severe wildfire could exacerbate habitat degradation associated with annual grass invasion.

Proposed Action and Alternatives 3 and 4

All action alternatives are considered together, since the alternatives differ little in their potential impact to scabland-associated sensitive plant species and their habitat.

Vegetation and Fuels Treatments

Project design feature specific to scabland habitat and sensitive plant habitat are designed to minimize disturbance and to meet forest plan direction regarding scablands. As mentioned previously, vegetation and fuels treatments are generally not directed at scabland; therefore, few effects resulting from proposed vegetation management actions are anticipated. No commercial harvest treatments would take place on non-forested scablands in any alternative. Scablands could be minimally impacted by temporary increased runoff resulting from exposed or compacted soil on skid trails and roads located in adjacent harvest units.

Prescribed burning is not designed to burn across scablands. However, no control lines would be constructed to keep fire out of scablands. No direct lighting or ignition would occur within the scabs. It is unlikely that high quality sensitive plant habitat would carry a fire; by nature it is rocky and bare, with little fuel accumulation. *Achnatherum hendersonii* and *A. wallowaensis* probably evolved in an infrequent, light intensity fire regime; however prescribed fire effects on these and other scabland sensitive species are unknown.

Temporary roads, closures, and decommission

There would be approximately one mile of temporary road on existing disturbance through scabland habitat under Alternatives 2 and 4, and approximately 0.62 mile of temporary road on existing disturbance under Alternative 3. Not all scabland is included in the sensitive plant habitat layer, thus the temporary road lengths provided in Chapter 1 do not include all scabland habitat. However, the lengths mentioned above do account for scabland not included in the sensitive plant habitat layer. Some of these existing disturbances have revegetated with native plants well-matched to the surrounding community. Re-use of these disturbances as temporary roads would remove this vegetation, compact soils, and could contribute to soil erosion. It could also increase the potential for invasive plants to colonize re-used disturbances, including exotic annual grasses such as *Ventenata*, cheatgrass, medusahead, and other annual bromes. Finally, any unknown sensitive plants growing within the disturbance to be utilized would likely be destroyed.

Segments of three roads proposed for closure travel across scabland habitat. The segments total approximately 0.88 mile. No road decommissioning is proposed for routes that traverse scablands. There could be some localized disturbance of soils and vegetation from hydrologic stabilization performed as a part of road closure. Overall, the proposed closure would benefit scabland habitat by preventing vehicle use of the routes, thereby lowering risk of invasive plant introduction and spread.

Riparian restoration and culvert replacement

There would be no effects to scabland habitat or scabland sensitive plant populations resulting from proposed riparian restoration and culvert replacement actions, since these activities would not take place in or near scabland habitat.

Other connected actions

Other connected actions proposed include .9 mile of buck and pole fence, 4 miles of barbed wire fence, and an expansion of the Winter material source of less than one acre. Neither of these actions would take place on scablands, thus there would be no impact to scabland sensitive plants and their habitat as a result of these proposed activities.

Cumulative Effects-All Alternatives

The cumulative effects boundary is the Gap project area. The cumulative effects of past management are reflected in the discussion of Affected Environment, and the above effects analysis with respect to various proposed activities. Present and foreseeable actions impacting scabland habitat in the Gap project area include livestock grazing, public uses such as recreation, dispersed camping, firewood gathering, and OHV use, invasive plant treatments, and road maintenance (see table 167 for a list of actions considered).

Sensitive plant habitat degradation on scablands has primarily been the result of past road building, current and past livestock grazing, loss of soil biocrusts, and continued infestation of scablands with exotic annual grasses. The Fox Canyon AMP includes measures to reduce cattle impacts to scabland habitat, such as range readiness standards and evaluation of soil moisture conditions prior to turn-out. As other restoration elements such as protection of fens, reconstruction of exclosures, water developments that are designed to draw cattle away from sensitive areas, and riparian restoration activities are implemented, cattle distribution in the allotments is expected to improve, and overutilization in riparian areas and stringer areas would be reduced. This could also result in more cattle utilization on scabland plants, including Henderson's needlegrass. Spring grazing of sensitive needlegrasses could be detrimental to plants by removing needed biomass (Dewey 2013).

Some scabland habitat has been negatively impacted by unauthorized off-road OHV use and by dispersed camping. These activities have likely resulted in localized reduction of sensitive plant habitat. These activities also have the potential to spread invasive plant species into areas that are currently weed-free. Existing system roads traversing scablands have also removed sensitive plant habitat and contribute to the spread of exotic annual grasses. These impacts would continue under all alternatives. The proposed Lookout Mountain Multi-use Trail project is not anticipated to impact sensitive plant habitat in scablands, as the proposed trail system would be located on existing disturbances to the extent the trails traverse scabland habitat.

For Alternative 1, the no-action alternative, the short-term negative impacts to scabland sensitive plant habitat resulting from the proposed actions in the Gap project would not occur in combination with the above described past, present and foreseeable actions. The limited, longer-term, beneficial effects to scabland habitat resulting from the proposed actions would also not occur.

Under the action alternatives 2, 3, or 4, actions proposed in the Gap project area would add incrementally to the effects described above in scabland habitat. Most effects described have short-term negative impacts associated with ground disturbance and removal of native vegetation and the potential longer-term negative impacts associated with slow recovery of disturbance on scabland and increased vulnerability to infestation by invasive plant species. Compared to other sensitive plant habitat types, there are relatively fewer long-term beneficial effects to scabland habitat resulting from the combination of proposed vegetation and fuels treatments, riparian restoration, and improved livestock distribution, since these activities are not specifically designed to address habitat degradation in scabland habitat. Cumulative effects would likely impact individual sensitive plants or discrete areas of habitat where activities take place but overall not would result in a trend towards federal listing of sensitive scabland plant species.

Conclusion-Scablands

Under all action alternatives, proposed vegetation management activities, associated temporary roads, and road closure could negatively impact unknown sensitive plant populations and mapped and unmapped sensitive scabland plant habitat as described above. Most of the effects are limited in scale and time to local effects that would decrease over 3-5 years. Over the longer term (5+ years), most sensitive plant habitat would benefit from these proposed activities, also in ways described above, although benefits to scablands are more limited than other sensitive plant habitats.

The proposed activities 1) are implemented with project design features that minimize negative impacts and protect known populations; 2) would not impact populations of some sensitive species with potential habitat within the project area, since no populations have ever been documented (including Ochoco lomatium, Wallowa needlegrass, and Cusick's buckwheat); 3) primarily affect the periphery of sensitive plant habitat (thinning in forest stands adjacent to scabland habitat); 4) are not expected to burn or would not burn with high intensity; 5) would affect areas already disturbed (temporary road use, road closure). Therefore, for sensitive plant species associated with scabland habitat, anticipated effects would be that some individuals or habitat may be negatively impacted, but this would not likely contribute to a trend towards federal listing or loss of viability.

Direct and Indirect Effects

Basalt Cliff Habitats

Alternative 1-No Action

Under the no-action Alternative 1, no proposed vegetation management or riparian restoration activities would take place. There would be no effects to any unknown populations of Fee's lip fern and its habitat resulting from vegetation management actions, such as crushing of plants, soil disturbance and compaction, and increased potential for invasive plant infestation. No beneficial effects to Fee's lip fern through habitat improvement would occur through fuels treatments, prescribed fire and stand density reduction through timber harvest, or noncommercial thinning. These actions have the potential to benefit Fee's lip fern habitat, since the habitat could be better protected from severe wildfire.

Proposed Action and Alternatives 3 and 4

All action alternatives and proposed activities are considered together, since the alternatives differ little in their potential impact to Fee's lip fern and its habitat. The basalt cliffs and rock outcrops that constitute potential habitat for Fee's lip fern would remain untouched by proposed activities such as timber harvest, noncommercial thinning, riparian restoration, and associated temporary roads. The habitat is protected by virtue of inaccessibility; it is not operable ground. Potential Fee's lip fern habitat has not been included in the sensitive plant habitat GIS layer for the Gap project, the reference layer for application of sensitive plant-specific project design features.

Fuels treatments and underburning would take place within potential Fee's lip fern habitat. The effects of prescribed burning on the plants' biology are unknown. While multiple measures are in place to prevent high burn severity results in prescribed burning, it is possible that patches of higher severity burning could occur in the implementation of proposed underburning where fuel loading is higher, or large piles are burned. This could negatively impact basalt cliff and rock outcrop habitat due to localized scorching or sterilization of soils and removal of native vegetation. This could lead to infestation by invasive plants or changes in microhabitat unsuitable for Fee's lip fern. It is also possible that the rock crevices typically occupied by Fee's lip fern would not burn, which would reduce or eliminate negative impacts to unknown populations or habitat resulting from prescribed burning. Long-term effects of burning would be beneficial by reducing dense stands of brush and understory ponderosa pine, thereby reducing the chances of future severe wildfire.

Cumulative Effects-All Alternatives

The cumulative effects boundary is the Gap project area. The cumulative effects of past management are reflected in the discussion of Affected Environment, and the above effects analysis with respect to various proposed activities. Present and foreseeable actions impacting upland forest habitat in the Gap project area include livestock grazing, public uses such as recreation, dispersed camping, firewood gathering, and OHV use, invasive plant treatments, and road maintenance (see table 167 for a list of actions considered).

Basalt cliff and rock habitat is generally protected from management actions and has not experienced the extensive modification that other sensitive plant habitats have undergone. Unknown populations of Fee's lip fern are not likely to be affected by past or proposed project activities, except where past or proposed fire could negatively impact basalt cliff habitat by burning plants or increasing susceptibility to invasive plants.

Conclusion-Basalt Cliff Habitat

Under all action alternatives, proposed vegetation management activities, associated temporary roads, road closure and decommission, and culvert replacement fencing, and expansion of the Winter material source would pose minimal impacts to unknown Fee's lip fern populations or basalt cliff and rock outcrop plant habitat. Over the longer term (5+ years), basalt cliff habitat would benefit from reduction in fuels resulting from proposed activities.

The proposed activities 1) would not impact known populations of Fee's lip fern within the project area, since no populations have ever been documented, and 2) the habitat is protected by inaccessibility and no actions are proposed for basalt cliff and rock outcrop habitat, anticipated effects would be that some individuals or habitat may be negatively impacted, but this would not likely contribute to a trend towards federal listing or loss of viability.

Conclusion of Effects of Biological Evaluation for Sensitive Plants

Table 109 summarizes the expected direct, indirect, and cumulative effects to sensitive plant species for each of the proposed alternatives. These determinations are based on the assumption that all project design features and recommendations by the district botanist are followed, and that project implementation is coordinated with the district botanist as appropriate.

Table 109. Summary of effects to sensitive plant species by alternative

Species	Alternative 1 (No action)	Alternative 2	Alternative 3	Alternative 4
Achnatherum hendersonii Henderson's needlegrass	NI	MIIH	MIIH	MIIH
Achnatherum wallowaensis Wallowa needlegrass	NI	MIIH	MIIH	MIIH
Astragalus tegetarioides bastard kentrophtya	NI	MIIH	MIIH	MIIH
Botrychium ascendens Ascending moonwort	NI	MIIH	MIIH	MIIH
Botrychium crenulatum Crenulate moonwort	NI	MIIH	MIIH	MIIH
Botrychium minganense Mingan's moonwort	NI	MIIH	MIIH	MIIH
Botrychium montanum Mountain moonwort	NI	MIIH	MIIH	MIIH
Botrychium paradoxum Twin-spike moonwort	NI	MIIH	MIIH	MIIH
Calochortus longebarbatus var. *peckii* Peck's mariposa lily	NI	MIIH	MIIH	MIIH
Carex lasiocarpa var. *americana* Slender sedge	NI	MIIH	MIIH	MIIH
Carex retrorsa Retrorse sedge	NI	MIIH	MIIH	MIIH
Cheilanthes feei Fee's lip fern	NI	MIIH	MIIH	MIIH
Eleocharis bolanderi Bolander's spikerush	NI	MIIH	MIIH	MIIH

Species	Alternative 1 (No action)	Alternative 2	Alternative 3	Alternative 4
Eriogonum cusickii Cusick's buckwheat	NI	MIIH	MIIH	MIIH
Lomatium ochocense Ochoco lomatium	NI	MIIH	MIIH	MIIH
Muhlenbergia minutissima Annual dropseed	NI	MIIH	MIIH	MIIH
Potamogeton diversifolius Water thread pondweed	NI	MIIH	MIIH	MIIH
Salix wolfii Wolf's willow	NI	MIIH	MIIH	MIIH
Utricularia minor Lesser bladderwort	NI	MIIH	MIIH	MIIH
Bryophytes and lichens				
Helodium blandowii Blandow's bogmoss	NI	MIIH	MIIH	MIIH
Schistidium cinclidodonteum Schistidium moss	NI	MIIH	MIIH	MIIH
Tomentypnum nitens Tomentypnum moss	NI	MIIH	MIIH	MIIH
Tortula mucronifolia Mucronleaf tortula moss	NI	MIIH	MIIH	MIIH

NI No impact
MIIH May impact individuals or habitat, but would not likely contribute to a trend towards federal listing or a loss of viability to the population or species.
WIFV* Will impact individuals or habitat with a consequence that the action may contribute to a trend toward federal listing or cause a loss of viability to the population or species
BI Beneficial impact
N/A No Habitat or species present
*Trigger for a significant action as defined in NEPA

Invasive Plants Risk Assessment and Effects Analysis

Introduction

This portion of the report discusses and compares potential risks and effects of invasive plants for the Gap project proposed action and alternatives. Site specific weed concerns and high risk activities are discussed in the following effects analysis.

Due to their deleterious effects on the environment, Forest Service policy is to prevent and manage invasive species, including invasive plants (FSM 2900). Although this direction includes avoiding activities that increase the potential for spreading invasive plants, the Forest Service is also directed to sell timber, implement thinning and fuels treatments, issue grazing permits, and maintain a road system for administrative and public use. Since these activities can increase the risk of spreading invasive weeds, the Forest Service is directed to implement prevention measures to reduce the risk of introduction and spread of invasive plants (USDA Forest Service 2005).

For ground disturbing activities such as those proposed for the Gap project, Forest Service direction states that a determination of the risk of invasive species introduction or spread should be undertaken in project planning and analysis (FSM 2900). Project design features include prevention measures and recommendations that reduce the risk of introduction and spread of invasive plants.

Analysis Method

Surveys for invasive plants have been conducted in the Gap project area over the course of several years, in connection with prior projects such as the Invasive Plant Treatments EIS for the Deschutes and Ochoco National Forests and Crooked River National Grassland (USDA Forest Service 2012; referred to as 2012 EIS), Fox Canyon Cluster Allotment Management Plan (2013), Big Summit Cluster Allotment (2009), and some survey and revisits of known infestations in the summer of 2015. A number of mineral material sources located within the project area have been inspected and treated for invasive plants annually. Infestations and treatments are tracked in the NRIS-Invasives database, the Forest Service corporate geospatial database.

Weed species included in the inventory are generally those on the Ochoco National Forest A and B Invasive Plant Lists, although some C list weeds are selectively or occasionally also recorded. Other weed species on the C list or unlisted weeds that are so widespread that economic control is not feasible are typically not included in inventory or treatment programs. While not actively controlled, widespread weeds can cause substantial ecological impacts and many of these weeds have not occupied all potential sites. Therefore, prevention practices designed to limit the spread of these species as well as those of higher management concern can help limit the extent and impact of widespread weeds.

The risk assessment is calculated based on an estimate of the amount of ground disturbance and/or creation of mineral soil caused by the project activity and the proximity to invasive plant infestations. Factors including the species of invasive plant, size of infestation, life history characteristics, as well as the dispersal mechanism are also incorporated into the risk assessment. Effectiveness of treatment and control measures available for different weed species is also considered. The results from current and previous surveys, and the factors mentioned above form the rationale for analyzing effects.

Affected Environment

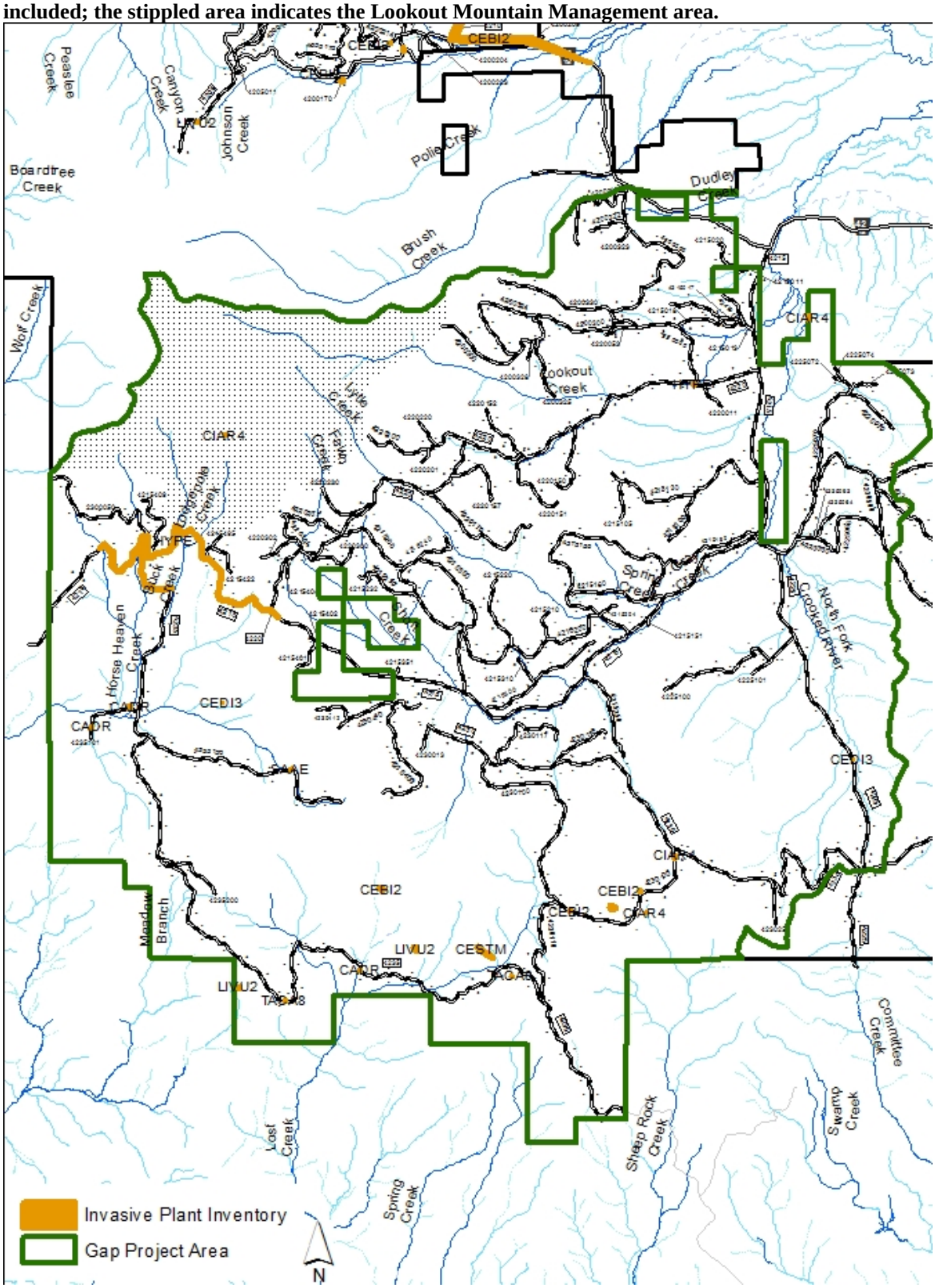
The Gap project area contains several known populations of invasive plants. Weed species of highest management concern are inventoried in the NRIS-Invasives database. The current inventory of known invasive plant occurrences is listed in Table 110 and depicted in figure 25.

Table 110. Non-native invasive weeds within the Gap project area

Species	Species code	Gross Area (acres)[9]	Infested area (acres)[10]
Butter and eggs (*Linaria vulgaris*)	LIVU2	1.0	1.0
Canada thistle (*Cirsium arvense*)	CIAR4	0.8	0.8
Common St. Johnswort (*Hypericum perforatum*)	HYPE	44.8	0.6
Diffuse knapweed (*Centaurea diffusa*)	CEDI3	0.1	0.1
Mediterranean sage (*Salvia aethiopis*)	SAAE	0.1	0.1
Medusahead (*Taeniatherum caput-medusae*)	TACA8	0.2	0.2
Spotted knapweed (*Centaurea stoebe* ssp. *micranthos*)	CESTM/CEBI2	2.5	2.5
Whitetop (*Cardaria draba*)	CADR	45.2	1.0
Grand Total		**94.7**	**6.3**

[9] Gross area is the general perimeter of the infestation. The gross area may contain areas that are not occupied by invasive plants.
[10] Infested (or net) area is area occupied by the canopy of the invasive plants. It may be equivalent to, or smaller than, gross area.

Figure 25. Mapped invasive plant populations within the Gap project area. Publically open roads are included; the stippled area indicates the Lookout Mountain Management area.



The level of currently inventoried weed infestation within the Gap project area is low, occupying approximately 0.25% of the project area, spread across 22 locations. The great majority of current infestations are associated with major roads and roads used in prior timber harvest activities. These weed sites range from a few individuals to many acres of scattered plants, and some sites that have very few or no plants have been kept in the current inventory so that they can be more easily monitored. Two occurrences account for 94% of the gross infested acres. One of these occurrences is common St. Johnswort and the other is whitetop. These infestations co-occur over the same spatial extent along the 4215 road west of Gray Prairie. As of the summer of 2015, there are very few plants remaining in these infestations. If these two occurrences are excluded, the gross infested acreage drops to 5.4.

Recent invasive plant treatments (primarily using manual methods) in the Gap project area have been implemented along small roadside infestations of knapweeds. The Jungle Creek, Kelly Gap, Lutsey, and Winter material sources are located within the project area and have been inspected annually for invasive plants and treated if needed. Inspections in 2015 indicated that all sources except Lutsey are weed-free. Annual monitoring visits would continue at all mineral sources in the project area. Lutsey has a known infestation of spotted knapweed. Approximately 20 plants were treated with chemical herbicide in 2015.

All of the weed species listed in table 110 have the potential to spread substantially within the project area. Habitats and vegetation types susceptible to these invasive species are present throughout the project area. Moister habitats with deeper, more developed soils on the west side of the project area are more likely habitat for Canada thistle, knapweeds, and whitetop. Scablands and dry forest concentrated on the east side of the forest are vulnerable to butter and eggs, Mediterranean sage, and medusahead. NFS lands adjacent to the forest boundary on the south and west sides of the project area are also more vulnerable to spread from infestations on other land ownerships. The rate of spread is dependent on weather conditions as well as on the amount of disturbance resulting from natural processes, ongoing management activities such as road maintenance and livestock grazing, and from proposed project actions. Some weed populations in the project area seem to have naturally declined and currently have low levels of presence in the project area, particularly common St. Johnswort and whitetop. Infestations of these plants were initially mapped in the mid to late 2000s. It is possible that recent dry conditions in the last three years have moderated the spread of these weed species, which tend to favor moist conditions and habitats. If this assumption is correct, a return to normal or above-normal precipitation could reactivate the spread of these populations, even in the absence of disturbance.

While not systematically inventoried or controlled, widespread weed species can cause substantial ecological impacts and many of these weeds have not occupied all potential sites in the project area. Invasive plant species in the project area on the C list or unlisted include Canada thistle (*Cirsium* arvense), oxeye daisy (*Leucanthemum vulgare*), bull thistle (*Cirsium* vulgare), cheatgrass (*Bromus tectorum*) and other exotic annual bromes, and *Ventenata* (*Ventenata dubia*).

Riparian sensitive plant habitat throughout the project area has been degraded by non-native plant populations. Oxeye daisy (*Leucanthemum vulgare*) is particularly abundant in the Horse Heaven, Buck Creek, and Little Horse Heaven drainages. Canada thistle (*Cirsium arvense*) is also of concern because it readily establishes in riparian zones, and has the ability to form large patches of rhizomatous growth. It is likely that Canada thistle is more extensive in the project area than is reflected by current inventory data. Treatment and control options for both species are limited due to the rhizomatous growth form and proximity to water. Riparian habitats in the project area also have extensive stands of non-native grasses, including timothy (*Phleum pratense*), Kentucky bluegrass (*Poa pratensis*), and smooth brome (*Bromus inermis*).

These grasses typically occur in open meadows which are habitat for Peck's mariposa lily and moonworts, but have generally occupied all available habitats. Non-native, rhizomatous grasses have likely increased their extent in drying riparian areas as a result of stream down cutting and resulting lowered water tables.

Sensitive scabland plant habitat in the project area has been degraded by exotic annual grasses, especially Japanese brome (*Bromus japonicus*), cheatgrass, and *Ventenata*. These grasses green up early in the spring and use moisture and nutrients that would otherwise be available to native vegetation. These exotic grasses have not occupied all potential habitats within the project area, and thus have the potential to spread to new areas of sensitive plant habitat.

Historic invasive plant vectors in the project area likely included livestock and past timber harvest and road building activities. As mentioned previously, most current infestations are associated with roads.

Regulatory Framework and Management Direction

The Final EIS for Pacific Northwest Region Invasive Plant Program, Preventing and Managing Invasive Plants (USDA Forest Service 2005) amended the Ochoco Forest Plan and prescribes prevention, inventory, early detection and rapid response to new populations, restoration of treatment sites, and cooperation with other agencies and landowners to prevent the spread of invasive plants and provide effective tools for control. The 2012 EIS authorized a variety of weed treatments and included a process for authorizing the treatment of newly detected infestations. In addition, there is a recent Forest Service National Strategic Framework for Invasive Species Management (USDA Forest Service 2013), which will further help prioritize and guide our invasive species management on public lands.

Under the 2012 EIS, the Forest invasive plant program implements a full suite of integrated pest management practices to control invasive plants on NFS lands, and works with partners to extend treatments across ownership boundaries. Treatment methods include manual, mechanical, and cultural treatments, application of chemical herbicides, and biological controls, depending on the size of the infestation, the species of weed, and the management area in which the infestation occurs.

Prevention measures

Project design features for preventing the introduction and spread of invasive plants are outlined in the project design features included in this DEIS. These design features have been developed for the project using the prevention measures described in Chapter 2 of the Regional Invasive Plant Program EIS (USDA Forest Service 2005).

To meet required prevention measures to reduce the potential for transport or spread of invasive plants by temporary road use or logging equipment, timber sale contracts or other instruments would include provisions which require: 1) certification that equipment be clean of all plant or soil material that may result in the establishment or spread of invasive plants; and 2) notification of location where equipment was most recently used. There is also a provision in timber sale contracts for purchase of native seed for landings and skid trails to reduce the likelihood of colonization by invasive plants. Invasive plant infestations are also included on the sale or contract area map furnished to operators so that these areas may be avoided.

Seeding with locally-sourced native grasses is standard practice where substantial ground disturbance occurs. Timber sale contracts or other instruments used in accomplishing project activities allow for funds to be collected for native seed. Native seed is applied on landings, temporary roads, skid trails, large burn piles, and other disturbed areas after activities conclude. Riparian restoration projects would include a revegetation plan as well; invasive plant prevention is an important consideration in such plans.

To reduce the potential for weed spread through mineral materials used on roads, all mineral sources to be used for the project would be inspected to ensure materials are weed-free. Additionally, the sale contract would include a provision requiring any material used is weed-free.

Risk Assessment and Direct, Indirect, and Cumulative Effects Analysis

The Gap project includes actions associated with a high risk of invasive plant introduction and spread under all alternatives. Such actions include the use of heavy equipment in riparian restoration and logging operations, road-related actions such as temporary road use and road closure and decommissioning, and burning of piles and activity fuels which create areas of scorched soil. The effects analysis assumes effective application of all invasive plant project design features.

The analysis area for cumulative effects includes the Gap project area boundary and the surrounding subwatersheds, including the headwaters of North Fork Crooked River, Gray Creek, Upper Horse Heaven, Lower Horse Heaven, and Lost Creek. This area includes NFS, Bureau of Land Management (BLM), and private lands, including The Nature Conservancy's 13,920 acre Juniper Hills Preserve just to the southwest of the Gap project boundary. The five subwatershed area is sufficient to assess risk and project effects with respect to invasive plants, as invasive plant populations can cross ownership boundaries and are often managed at a watershed scale.

Cumulative effects are those that are expected from the impact of the no-action, and action alternatives, when added to other past, present, and reasonably foreseeable actions. Analysis of cumulative effects is bounded in time by twenty years into the future, as assumptions regarding trends may not be valid beyond that. Twenty years is also the approximate effectiveness timeframe of forest management actions.

Some, but not all, past effects considered date back to the beginning of significant European settlement and modification of the area, approximately 150 years ago. The most persistent and important historic environmental modifications and their effects to invasive plants are discussed in the Affected Environment. More recent past forest and fuels management activities in the Gap project area include commercial harvest totaling 448 acres, noncommercial thinning of 1,907 acres, and underburning of 2,793 acres. These activities affected a total of 5,148 acres within the project area. There have been past riparian restoration activities along the North Fork of the Crooked River at Williams Prairie and Sera Springs, as well as other locations in the project area. Finally, ongoing activities include vehicular travel, public recreation, hunting, and firewood gathering, livestock grazing, invasive plant treatments, road maintenance and other management activities. A summary of known past, present, and foreseeable actions considered in effects analysis is included in table 167.

Alternative 1-No Action

Under Alternative 1, no project actions would take place. There would be no ground disturbance resulting from activities proposed in the action alternatives, thus the risk of invasive plant introduction and spread would not exist. Beneficial effects associated with reduced invasive plant risk on 20.6 miles of proposed road closure would not be realized.

Other ongoing management activity in the project area would continue. These actions have the potential to result in establishment and spread of invasive plants. Thus, risk would not be eliminated under any alternative, including the no-action alternative. Risk resulting from ongoing activity is considered in the cumulative effects analysis for the project.

Risk from invasive plant establishment and spread resulting from ongoing activities in the project area would be mitigated by treatments carried out under the 2012 EIS.

Action Alternatives: Proposed Action and Alternatives 3 and 4

The action alternatives differ little with respect to invasive plant risk, as all alternatives propose high risk actions. Expected effects resulting from invasive plant establishment and spread are very slightly less in Alternative 3 compared with Alternatives 2 (proposed action) and 4. Details are discussed in the analysis below.

Vegetation and Fuels Treatments

Ground-based commercial timber harvest, noncommercial thinning, hand piling, grapple piling, and underburning activities proposed in all action alternatives have the potential to introduce invasive plant populations and contribute to the spread of new and existing infestations. The risk of invasive plant introduction and spread is partly related to the amount of disturbed area. Table 111 shows the amount of disturbed area expected as a result of proposed vegetation management activities by alternative. Assumptions regarding the estimated amount of area disturbed are stated in the table; these estimates are based on quantification of similar actions in the past and on information contained in the soils analysis for the Gap project (Sussman 2015). Other proposed vegetation management actions, including noncommercial thinning and hardwood treatments are not expected to result in bare soil exposure since these activities do not use ground-based equipment. Since alternative 3 proposes less commercial timber harvest and grapple piling, the estimated amount of disturbed area is approximately 516 and 546 acres less than alternatives 2 and 4, respectively.

Table 111. Estimated soil disturbance by alternative

Proposed Activity	Disturbed area Alt. 2 (acres)	Disturbed area Alt. 3 (acres)	Disturbed area Alt. 4 (acres)
Commercial timber harvest (estimated 15% of total treated acres)	2,105.7	1,636.7	2,105.7
Noncommercial thinning (estimated 10% of total treated acres)	18.0	18.0	19.3
Hand piles (estimated 5% of total treated acres)	22.8	48.9	51.7
Underburning (estimated 5% soil exposure over 80% of treated acres)	742.3	742.4	742.4
Grapple piles (estimated 20% of total treated acres)	481.2	408.2	481.2
Total estimated disturbed area	**3,370.0**	**2,854.2**	**3,400.3**

While the above estimates can provide a sense of the magnitude of invasive plant risk associated with particular actions and a basis for comparing alternatives, estimated disturbance does not translate directly into the number of acres that could be potentially infested by invasive plants as a result of project activities. Burn piles are at higher risk of infestation due to the impact of the hot fire on soils (Sussman 2015). They are often slower to revegetate than skid trails in which soils are exposed but elements such as organic matter and soil organisms remain largely intact. Invasive plant risk is lessened where existing weed populations are absent, and is further mitigated by project design features. Only a few proposed treatment units are known to have or be near to mapped invasive plant populations. Project design features include avoidance of known invasive plant populations in timber sale operations. These populations are included on the sale or contact map provided to operators. These infestations would be pre-treated in advance of project activities, where appropriate and practicable. Disturbed areas such as landings and burn piles are also seeded after the conclusion of project activities.

Considered together, the lack of existing weed populations in the project area along with prevention measures and project design features considerably lower the risk of invasive plant introduction and spread as a result of proposed vegetation management activities.

The effects of invasive plant establishment and spread are similar for all action alternatives. Negative impacts resulting from the potential increase of invasive plant infestation as a result of project activities include degradation of diverse, native plant communities, decreases in water quality where riparian vegetation is impacted by invasive plants, increased soil erosion in infested sites, loss of wildlife habitat, especially for species dependent on a diversity of floral resources such as the western bumblebee and silver-bordered fritillary, and degradation of sensitive plant habitat. Some invasive plants, such as spotted knapweed, have allelopathic properties which decrease the suitability of infested areas for other plant species. There are also increased costs associated with treatment and control of more infested acres as a result of project activities.

Some proposed vegetation management units are adjacent to sensitive plant habitats such as riparian areas, meadows, and scabland. These areas are particularly vulnerable to negative impacts associated with invasive plant infestation, as well as weeds not included in inventory, such as oxeye daisy and *Ventenata*. Where project activities like timber harvest are adjacent to scablands, there is potential for the disturbance to introduce *Ventenata*. Once in the vicinity, this invasive annual grass can spread into sensitive scabland habitat in the absence of direct disturbance. *Ventenata* competes with sensitive plants for scarce water and nutrients, and denser populations could possibly carry fire across scabland habitat.

Temporary roads, closures, and decommission

In all action alternatives, proposed use of temporary roads on existing disturbances, road closure, and decommissioning has the potential to contribute to the risk of invasive plants. Similar to vegetation management actions, the estimated amount of area disturbed can inform assessment of the degree of risk involved (table 112). Alternative 3 would result in fewer disturbances than alternative 2 and 4, since the miles of proposed temporary roads are fewer in this alternative.

Table 112. Estimated disturbed area from proposed road-related actions

Proposed Activity	Disturbed area Alt. 2 (acres)	Disturbed area Alt. 3 (acres)	Disturbed area Alt. 4 (acres)
Temporary roads-new and on existing disturbance (estimated disturbance 1.82 acres per mile)	72.6	61.9	73.3
Road decommission (estimated disturbance 1.82 acres per mile)	6.0	6.0	6.0
Total estimated disturbed area	**78.6**	**67.9**	**79.4**

Negative effects resulting from increased invasive plant infestation due to road-related actions are similar to those described above for vegetation management activities. Some proposed road-related actions are near or within known invasive plant infestations. Alternatives 2 and 4 include four segments of temporary road on existing disturbance totaling 1.3 miles that intersect or are adjacent to mapped weed sites. Alternative 3 includes three temporary road segments totaling 1.2 miles that intersect or are adjacent to mapped weed sites. Although relevant project design features intended to reduce risk would be in place, the presence of weeds along these proposed temporary roads is associated with increased invasive plant risk and negative impacts from a potential increase in infested acres within the project area.

Road decommissioning may involve more disturbance than road closure, thus the same disturbance estimates used for temporary roads are applied to this proposed activity. Road decommissioning includes revegetation with native grass seed in order to prevent invasive plant infestation.

Proposed road closures could result in localized disturbance and some increased invasive plant risk. Materials used for road closures, such as large boulders, would be sourced from weed-free locations. Since road closures would eliminate vehicle travel on proposed routes, there would be reduced invasive plant risk overall as a result of this activity.

Under all alternatives, a portion of temporary road on existing disturbance passes through sensitive plant habitat such as riparian meadow and scabland. As discussed above in relation to proposed vegetation management treatments, these habitats are particularly vulnerable to negative impacts associated with invasive plants. Where temporary roads result in disturbance, oxeye daisy could increase in riparian meadows, and *Ventenata* could increase in scablands. These effects are not quantified in the above analysis of mapped invasive plants, since these species are not included in the inventory.

Riparian restoration and culvert replacement

Proposed riparian restoration and culvert removal or replacement is the same for all action alternatives. Disturbed area estimates for noncommercial thinning includes trees used in riparian restoration activities. Heavy equipment would operate within proposed riparian restoration project areas, resulting in localized soil exposure. Based on past projects, up to 10% soil exposure is expected, for an estimated disturbed area of 134.5 acres. The 6 proposed culvert removal or replacement locations could also result in soil exposure. All riparian restoration activities would include revegetation plans and relevant project design features and prevention practices to reduce invasive plant risk.

Proposed riparian restoration along Horse Heaven Creek includes or is adjacent to two mapped weed sites. The riparian restoration area along Lookout Creek includes one mapped weed site. These weed sites would be evaluated prior to riparian restoration activities and appropriate treatment applied. No proposed culvert locations are near mapped invasive plant populations.

Other connected actions

Other connected actions proposed include .9 mile of buck and pole fence, 4 miles of barbed wire fence, three water developments, and an expansion of the Winter material source of less than one acre. The fencing actions create minimal ground disturbance and thus are low risk for the introduction and spread of invasive plants. Water developments and fencing are proposed as part of riparian restoration activities that would be implemented in coordination with the district botanist. The potential for invasive plants would be considered in project implementation along with the application of appropriate prevention practices.

The area proposed for expansion of Winter material source was surveyed in 2014 for invasive plants and none were detected. The current area of Winter material source is inspected annually and is certified weed-free. This monitoring would continue including on any area expanded for use in the Gap project. These conditions along with the application of appropriate prevention measures would help to minimize risk associated with the disturbance created by the expansion. Due to the nature of ground disturbance and maintenance of exposed rock and soil associated with a material source, this action has a high risk for invasive plants.

Cumulative Effects-All Alternatives

The cumulative effects boundary includes the five subwatersheds that fall within the Gap project boundary (see figure 37). As itemized in table 167, numerous management activities are ongoing or are anticipated in the Gap project area. Many of these activities are associated with moderate or high risk of establishment or spread of invasive plants, including road maintenance, livestock grazing, and public use and recreation. However, many projects have reduced the risk of invasive plants through vehicle use restrictions or improved management, including the south boundary road closure, the Travel Management EIS, and changes intended to improve rangeland conditions in the Fox Canyon and Big Summit AMPs. The range of invasive plant treatments available under the 2012 EIS has been effective in reducing the extent of invasive plants in the Gap project area and across the Ochoco National Forest. The environmental effects of such treatments have been fully considered in the 2012 EIS, and project design features to minimize negative impacts resulting from invasive plant treatments are implemented on a site-specific basis for every treatment.

While three new invasive plant infestations have been mapped in the project area in the last two years, other previously mapped sites have declined to very few or no detectable individuals. While ongoing activities in the project area contribute to invasive plant risk, current rates of invasive plant establishment and spread are low. The extent of susceptible habitats, especially riparian areas and scablands, and potential for invasive plant infestation remains high. Wetter weather conditions conducive to invasive plants are likely to return to the area.

The Gap project would add incrementally in the amounts described above to the amount of disturbed ground that could become infested with invasive plants within the project area. Project design features and prevention practices, along with a pro-active treatment approach, would minimize invasive plant risk and effects resulting from Gap project activities. Unlike other historic and present activities in the project area such as livestock use and public use, implementation of the Gap project would be subject to a high level of project design and prevention measures that mitigate risk more than less regulated uses. The cumulative effects of these activities on invasive plants in the project area would likely remain localized and limited in time as new infestations in the project area are detected and treated promptly while the infestation size is still limited.

Unlisted and C list weeds of concern such as cheatgrass, *Ventenata*, oxeye daisy, and Canada thistle could continue to spread into and negatively impact susceptible habitats in the project area. Some amount of this potential spread could be attributed to ongoing and future management activities and uses in the project area, including the Gap project. Further spread of these weeds appears to also be unrelated to such activities, as populations of these plants can be found in remote areas not subject to many management activities. While many prevention measures and project design features would also help to minimize establishment and spread of these species, the current lack of active inventory and control limits the effectiveness of such measures. In all alternatives, further establishment and spread of these species can be expected.

There are few known invasive plant populations on NFS lands adjacent to the project area, thus these areas present little risk to the project area. While the project area is adjacent to private land that likely harbors invasive plant populations, the inventory, prevention, and treatment measures on NFS lands are such that potential risk from adjacent land is mitigated to a certain extent. Private ranch lands in the area may have populations of medusahead, yellow star thistle, scotch thistle, and other invasive plants. These lands are also typically grazed by livestock, which can spread invasive plants along fence lines and other areas of higher animal concentration.

Adjacent BLM lands are managed in accordance with BLM Resource Plans for the area. Known management activities include livestock grazing, public travel, fuels reduction, and recreation. BLM has an active invasive plant inventory and treatment program. While invasive plant treatments on BLM and NFS are largely conducted independently, there is the opportunity for future coordination of treatments. Representatives from both agencies also participate on the Crooked River Weed Management Area board. There are large populations of invasive plants, including medusahead, and adjacent BLM land. While these populations are treated according to BLM processes and priorities, the risk of spread onto NFS land is present. To the extent that project activities disturb vegetation and result in exposed soils near NFS boundaries, the risk of invasive plant spread from BLM and private land would increase.

The Juniper Hills Preserve is managed for habitat conservation. Known planned and ongoing activities in the preserve include juniper cutting, jackpot burning, broadcast prescribed fire, and invasive plant treatments. The current extent of invasive plant populations in the preserve is unknown. Broadcast burning, in particular, may increase exotic annual grass populations. Considering the purpose and mission of The Nature Conservancy and the Juniper Hills Preserve, it is reasonable to assume that invasive plants are considered in their vegetation management project design and implementation. To the extent that invasive plant populations exist on the preserve, these populations have the potential to spread onto NFS lands. If Gap project activities near the preserve result in exposed soils, this risk would increase.

The Lookout Mountain Multi-use Trail project includes a total of 75.2 miles of non-motorized trail in the Lookout Mountain Recreation Area and areas to the north and east. While only the eastern portion of the proposed trail system overlaps with the Gap project area, the entire proposed trail system is within the five subwatershed area considered for cumulative effects. If implemented, the trail system could contribute to an increase in disturbed soils, and movement of invasive plant seeds and parts could be spread by trail users. While prevention measures would be in place that would limit the risk of invasive plant introduction and spread, the proposed trail system would likely increase the risk of invasive plants at trailheads and along the trail system.

Finally, climate change adds uncertainty to invasive plant risk and the effects of management on invasive plant establishment and spread in the project area. This uncertainty is addressed in the 2012 EIS, and is incorporated by reference in this risk assessment. Under warmer and drier conditions expected for the Pacific Northwest, invasive plants may occupy new habitats, new invasive plant species could become established, and treatments could become less effective. As mentioned previously, some invasive plant populations in the project area may have declined as a result of current drought. The invasive plant survey and monitoring project design features implemented with the project would assist in detecting these changes early, allowing for timely management response.

Range

This section contains a summary of the draft Range Resource report; the entire report is in the Gap project file located in Prineville, OR.

Introduction

This report discusses the affected environment and environmental consequences of the proposed alternatives on upland and riparian vegetation for the Gap Watershed Restoration project area (Gap project area) with respect to livestock grazing. Eight grazing allotments are within the Gap project area, although the Lookout allotment and the Upper Pasture of the Brush Creek allotment are administratively closed. Table 113 shows the relative allotment acres and percent of the Gap project area.

Table 113. Allotment Acres in the Gap project area

Allotment	Acres within Project Area	Percent of Project Area
Antler	662	2%
Brush Creek	4,766	12%
Fox Canyon	4,547	12%
Gray Prairie	11,117	29%
Lookout	365	1%
Lost Horse	6,767	18%
North Fork	2,711	7%
Pringle	7,082	19%
Area not within a grazing allotment	129	>1%

The discussion of range resources and potential effects uses existing information include the Ochoco National Forest Land and Resource Management Plan (USFS, 1991), Fox Canyon Cluster Allotment Management Plans Environmental Impact Statement (USFS, 2013), Big Summit Cluster Allotment Management Plans Environmental Impact Statement (USFS, 2009), project-specific resource reports, agency and scientific studies, as well as site-specific professional experience and judgment. It contains a discussion of short and long-term, direct, indirect, and cumulative effects associated with the implementation of each of the four alternatives as they relate to livestock grazing and vegetative conditions.

Existing Condition

Livestock Management

Past Livestock Management

Records indicate that intense, unregulated sheep and cattle grazing occurred within the Gap project area from the mid-1800s to 1907. During this time, heavy livestock use impacts to soil and vegetative resources were severe contributing to increased amounts of bare soil, loss of topsoil, soil compaction, stream bank degradation and channel erosion, and these impacts continue to affect the ecosystems of the Ochoco National Forest. The inception of the Forest Service in the project area in 1907 began the regulation of grazing use, with changes occurring slowly as fences were built, livestock numbers were limited, and seasons of grazing use were shortened.

Management of the grazing infrastructure in the 1940s quickly increased the amount of fence and number of water developments that were constructed by permittees and CCC crews. Across the Paulina Ranger District from the late 1950s through the early 1960s, upland range conditions were monitored through Condition and Trend studies which were then used to develop allotment management plans.

These plans often further reduced the livestock numbers, shortened or changed season of use, and identified projects to improve livestock distribution. In the early 1960s many of the allotments within the project area were converted from sheep to cattle. From 1907 to 1960 the amount of grazing use, measured in AUMs (animal unit months), was reduced from approximately 689,000 AUMs to 81,600 AUMs (Hall, 1967). This reduction was associated with Forest Service management, monitoring, and a change in grazing suitability when converting from sheep to cattle.

In all the subject allotments sheep were grazed until the late 1960s or early 1970s except for Antler allotment, where cattle have been grazed since the 1930s-cattle grazing has been occurring on all subject allotments for at least the past four decades. Grazing seasons for livestock have generally been from mid-May through September or early October. From the 1970s until today livestock numbers have fluctuated in each allotment but were similar to what is currently permitted.

Current Livestock Management

Currently, eight grazing allotments are within the project area, one of which is administratively closed (Lookout). The seven active grazing allotments include; portions of Brush Creek (the Upper pasture of the Brush Creek allotment was administratively closed), Fox Canyon, and North Fork allotments and the majority or all of the Antler, Gray Prairie, Lost Horse, and Pringle allotments (see table 114 for acreages, by watershed, for each allotment). Livestock control and distribution is primarily dependent on forage quality, location and availability, fences (and other obstacles to livestock travel), herding practices, water developments, salting, and pasture rotation.

Available forage for domestic livestock use is expressed in terms of Animal Units (AUs) or Animal Unit Months (AUMs). An animal unit is a 1,000 pound mature cow, or its equivalent based on an average daily forage consumption of 26 pounds of dry matter per day, while an AUM is the amount of forage required by an animal unit for one month (USDA, 1991). A cow/calf pair is currently equivalent to 1.32 animal units. Table 115 describes the permitted use within the grazing allotments.

Table 114. Allotment and Pasture Acres within the Project Area by Watershed.

	Upper North Fork Crooked River		**Horse Heaven Creek - Crooked River**		
Allotment and Pasture	Gray Creek	Headwaters North Fork Crooked River	Lost Creek	Lower Horse Heaven Creek	Upper Horse Heaven Creek
Antler					
One		172			
Two A		61			
Two B		30			
Three	1	73			
Four	52				
Five	60				
Six	82				
Seven		130			
Brush Creek					
Lower		1,855			
Middle		846			
Upper	165	1,894			6
Fox Canyon					
Long Prairie		981			
Williams Prairie	223	2,653			
Williams Prairie Holding		29			
Williams Prairie Riparian	13	648			

Gray Prairie					
East B	784	1,882			
Gray Prairie	3,342		20		88
Holding	143				
Holding B	195				
North	3,971	540			70
Spring Creek	82				
Lookout	23	79			263
Lost Horse					
East			2,756		
Sand Springs	453		678		41
West			2,107	707	25
North Fork					
Five Corners		118			
Horse Prairie	402	1,702	488		
Pringle					
Chev Spring	11				1,731
East A					865
Holding A					335
Horse Heaven					1,798
Prairie Hill	9		32	82	2,218
Area not within an allotment	120			11	
Total Area by watersheds	***10,131***	***13,693***	***6,081***	***800***	***7,440***

Table 115. Allotment Permitted Use within the Grazing Allotments in the Project Area

Allotment	Permitted Numbers (Cow/Calf Pair)	Season of Use	AUMs
Antler	114	06/16 – 09/30	537
Brush Creek	110	07/01 – 09/30	445
Fox Canyon	400	05/01 – 06/19	880
Gray Prairie	300	06/20 – 09/30	1,360
Lookout	*Allotment Closed*		
Lost Horse	100	06/16 – 09/30	471
North Fork	150	06/15 – 09/30	713
Pringle	212	06/21 – 09/30	951

Grazing Management Standards

Grazing standards were implemented under the Big Summit Cluster Allotment Management Plans EIS, which includes the Brush Creek, Lost Horse, North Fork, and Pringle allotments (USDA, 2009) and the Fox Canyon Cluster Allotment Management Plans EIS, which includes the Antler, Fox Canyon, and Gray Prairie allotments (USDA, 2013). The Lookout allotment has no grazing standards as it is not actively grazed. Grazing standards are measured at Designated Monitoring Areas (DMA) within each pasture during yearly implementation monitoring. These grazing standards are found below in table 116.

Table 116. Grazing use standards.

Plant Community or Key Area	Key Species	Standard
Terrace / Dry Meadow	*Grasses*	*4-inch stubble height*
Terrace / Dry Meadow	*Kentucky Bluegrass*	*3-inch stubble height*
Greenline / Wet Meadow	*Grasses*	*4-inch stubble height*
Greenline / Wet Meadow	*Sedges/Rushes*	*6-inch stubble height*
DMA Streambank Greenlines		*≤ 20% alteration*
DMA Streambank Greenlines where woody species are present		*Change from herbaceous vegetation to woody vegetation use**
**Livestock change preference from herbaceous vegetation to woody vegetation will result in no more than "light to moderate" woody browse (<30% based on the Multiple Indicator Monitoring protocol).*		

Vegetation

Upland Vegetation

The two most abundant plant association groups (PAG) within the Gap project area is the dry grand fir and mesic pine PAGs (approximately 40% and 18% of the project area respectfully). The majority of the dry grand fir PAG is comprised of the grand fir (*Abies grandis*)/pinegrass (*Calamagrostis rubescens*) plant association, while the mesic pine PAG is comprised of the Ponderosa pine (*Pinus ponderosa*)/pinegrass association. Pinegrass is a preferred forage species for wildlife and livestock and is generally utilized later in the season as other grass species mature. Elk sedge (*Carex geyeri*), the usual subordinate and also a desirable forage species, is utilized earlier in the growing season by ungulates and in grand fir/elk sedge PAG can be a decreaser under heavy grazing pressure (Hall, 1989). As the disturbance regime in these PAGs has been altered through fire suppression and other human caused activities, the canopy cover in much of the watershed has or is becoming closed enough to suppress grass and shrub growth (Hall, 1980 & 1987). Ongoing and future vegetation management activities within these PAGs, such as harvest, thinning, and prescribed fire could be used to promote understory species growth and diversity and benefit wildlife and livestock (Hall, 1976).

The “scab stringer” landscape (approximately 11% of the project area – Juniper Steppe and Non-forested PAGs) is topography driven, the “scab” portion, generally occurring on the ridge tops, prevalent in the southwestern portion of the project area, presents a management challenge because it produces a droughty tolerant shrub and grass plant association group. The scab shrub/grass association produces very little forage and is extremely slow to show changes in vegetation trend due to the very shallow, rocky soils it occupies that dry very early into the growing season. Livestock prefer to utilize the grass species of the drier scabs earlier in the season while the forage is green. Once the forage has matured, the use on the scabs is very limited as they are generally drier, hotter sites that are furthest from available water.

A notable threat to more productive drier plant associations is encroachment by western juniper because these sites are productive enough to support juniper, yet under current management do not have frequent enough fire or mechanical disturbance to limit juniper expansion and establishment. Juniper encroachment is currently occurring across the lower portion of the project area and is occurring at higher elevations and in PAGs that receive more annual precipitation.

Riparian Meadow and Hardwood Communities Vegetation

Meadow systems are found scattered through the project area, major meadows consist of Antler, Gray, Lytle and Williams Prairies – which make up approximately 6% of the project area. A number of other small meadows and springs/streams alike have been fenced in order to enhance the vegetation by excluding livestock and, in a few cases wildlife. Historical use (grazing, road construction and timber harvest) of these systems contributed to entrenchment, lower water tables, and conifer encroachment. Many of the areas with riparian vegetation have shifted from more mesic riparian hardwood / sedge communities to drier community types dominated by upland grasses and forbs.

The extent of riparian hardwood communities has been greatly reduced over the last 200 years. The physical conditions that promote regeneration and vitality of hardwood species are currently lacking in many of the riparian areas. This is due to a number of factors including; extirpation of beaver, fire suppression, conifer competition, over browsing of young plants by deer, elk, and cattle, lower water tables resulting from historic logging practices and shifts in vegetation from grazing pressure, and road building.

Forested riparian areas are dominated by coniferous tree species in their overstories. Vegetative structure is dominated by the small tree category (9-20.9" dbh). Riparian shrubs such as willow and alder are present, however their distribution is widely scattered and localized. Other shrub species, such as snowberry, currant and serviceberry can be found. With the advent of effective organized fire suppression, natural fire return intervals have been greatly increased resulting in higher tree densities. Riparian areas exhibit high tree stocking densities (above historic levels) within the project area.

Mountain alder communities are the most common riparian hardwood communities in the watershed at the lower elevations in more open reaches of streams. They generally have understories dominated by sedges, with Kentucky bluegrass and other non-native grass species dominated terraces (timothy and mountain brome are examples) especially along the main roadways. Kentucky bluegrass is preferred as forage by livestock in many of the riparian areas across the project area; it is a competitive species capable of handling considerable grazing pressure. Shrubs in much of the project area show signs of heavy browse from both wild and domestic grazing animals. Aspen are scattered throughout the project area in small isolated pockets or single mature trees. Seedling recruitment is limited by browsing pressure. Meadow systems are dominated by grasses and forbs, with most areas seeing a relatively recent increase (last 30 years) in sedges and rushes along their wetted edge. Drainages with north aspects have denser vegetation and a higher moisture regime than southern aspects.

Direct and Indirect Effects

Alternative 1

Fire was historically the primary controlling factor for the vegetation within this project area. Fire suppression efforts have been effective across the project area since the turn of the 20th Century. With infrequent fire return intervals, plant communities tend to burn more severely and are replaced by vegetation different in composition, structure, and age. Fire has been mimicked or put back into much of the landscape within the project area between harvest, thinning, and burning activities that took place in the 1980's and 1990's. Where fire has not occurred in the last 50 years the risk is higher for severe fires and substantial loss of forage species in a wildfire situation. With increased fire frequency (reduced fire return intervals) vegetation tends to become dominated by grasses, forbs, and shrubby vegetation rather than by tree species. Plant vigor and plant community diversity is improved by fire, but forage production and palatability for ungulates are often improved as well (Adams, 1989).

Some sources maintain that livestock grazing has had definitive impacts on forest health, leading to dense stands of fire prone small trees (Belsky and Blumenthal are often cited). Currently prescribed intensities of livestock grazing are expected to result in negligible local reductions in fine fuels and, therefore, are not expected to contribute to the forest health issue of tree overcrowding. In addition, many sources indicate that, although reduced competition due to livestock grazing may result in greater individual tree growth rates, tree survival associated with grazing has either not been appreciably affected (Skoulin et al., 1976) (Karl, 1991), or has been reduced (Currie et al., 1978) (McLean and Clark, 1980) (Eissenstat et al., 1982) (Krueger, 1983) (Karl, 1991) (Kingery and Graham, 1991) (Allen and Bartolome, 1989).

No additional vegetation treatments would be implemented under this alternative. Vegetation would continue to evolve towards a later seral plant community dominated by forested types and juniper woodlands. In the plant communities found in the scab areas, juniper would continue to increase resulting in a decrease in the shrub, grass, and forb system components. Understory grass and shrub production (pounds per acre) in the forested areas would also decrease with the increase in tree density and canopy cover (Hall, 1976). Riparian species vigor and recruitment in portions of the project area would be decreased with the increase in shade and competition. Overall the forage available to livestock would decrease over time. As forage in the uplands decreases, grazing pressure on meadows and riparian areas would be expected to increase because of forage availability and palatability in these areas would suffer. Conifer expansion and increased stand densities would result in increased fuel loading, fire susceptibility and potential fire severity.

Livestock Management

Under this alternative grazing would continue to take place within the project area. With a decrease in understory grass production over time, the forage available to livestock would decrease. A decrease in forage would require an adjustment in stocking rates (in either duration of the grazing season or number of permitted head) to meet Forest Plan Standards and Guidelines. Grazing standards in the riparian areas would also be more difficult to meet with a decrease in riparian species vigor and recruitment.

Range Improvements

Under this alternative no activities would take place which could potentially impact or influence existing range improvements. Range improvements would continue to age and require maintenance and reconstruction as the improvements reach and exceed their functional lifespans.

Vegetation

The no action alternative would allow for forested/wooded vegetation types to occupy the landscape and would continually reduce the herbaceous and shrubby components in the scab and riparian areas. The annual production (in pounds per acre) available as forage for livestock and wildlife would steadily decline over time without activities to reduce tree density and canopy cover. Eventually wildfire would be expected to occur. Fire dependent ponderosa pine/ pinegrass sites can produce 500 to 600 pounds of forage per acre in pinegrass and elk sedge under 50% canopy cover (Hall, 1990). As crown cower of ponderosa pine increases or is replaced by fir, forage production decreases. Fewer than 100% crown cover grass production is only 50 to 100 pounds per acre (Hall, 1990).

Changing understory vegetation due to tree cover poses a problem in evaluating grazing impacts by livestock; adjustment in livestock management will not alter a downward trend in forage condition caused by increasing tree cover (Hall, 1990). Conversely thinning trees can result in an upward trend without change in animal management (Hall1990, Weaver 1967). Without harvest, thinning, or underburning to improve upland forage, livestock and wildlife pressure on riparian areas would continue to be a major grazing management challenge.

The vigor and recruitment of riparian hardwoods would be expected to decline as it is shaded by a conifer overstory and would be less likely to recover quickly from any wildlife or livestock browsing.

Under the no action alternative, the fuel load would accumulate and would be more susceptible to severe wildfire. A severe wildfire would be expected to reduce forage short term (two to three years depending on resource condition) and would be expected to make a site vulnerable to invasive species. This short term loss of forage on a large scale (pasture or allotment), and the required rest period would be expected to cause a large financial hardship on grazing permittees.

Alternatives 2, 3, and 4

Introduction

The "effect" of an activity may be described in terms of magnitude, intensity, direction and duration as described in the context of a given location (site specificity). Magnitude describes the area on which the activity occurs or the extent of the footprint of the activity. Intensity describes the severity or level of the activities disturbance. Direction describes the direction an activity moves the environmental attribute being effected, generally described as "improving" or "degrading", "increasing" or "decreasing", etc..

Duration describes the period of time estimated to reach a described "end point" or condition of an environmental attribute (i.e. three to five years until vegetative cover reaches or exceeds 60 percent).

As the three action alternatives under discussion include the implementation of the same types of activities but differ in the magnitude (area) and location of those activities, the discussion (table 117) below will describe the intensity, direction and duration of the effects of each type of activity, while the alternatives portion of this effects analysis will describe the magnitude (area) and location (as described by allotment, pasture and mapped display) of the impact.

Table 117. Direct and indirect effects of management activities on rangeland resources under Alternatives 2, 3, and 4.

ACTIVITIES	ATTRIBUTE AFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
Commercial Harvest	Range Improvements	Damage to fence from felling, skidding, access	High	negative	Short-term up to the length of operation within a given unit (days to a couple of weeks).
		Cutting line trees out of the fence	Moderate	negative	Onset of effect delayed until tree roots rot (10+ years), shortens effective life of improvement until the fence is reconstructed (5-10 years).
		Removes potential future trees falling on fence	Light to Moderate	positive	For the life of the fence (30+ years)
		Damage to water development from felling, skidding, access	High	negative	Short-term up to the length of operation for a given sale (days to a couple of months).

ACTIVITIES	ATTRIBUTE AFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
		Increased water yield from tree removal.	Moderate	positive	Mid -term until replacement tree density utilizes subsurface moisture at pre-activity levels (5-15 years).
	Livestock Management	Operations within an active unit and a long haul routes influence livestock travel and distribution	Light to Moderate	net negative (although there are some positive influences)	Short-term up to the length of operation within a given unit (days to a couple of weeks).
		Removal of barriers to livestock travel	Light to High	positive	Mid to long-term (15-30+ years), until tree and or fuel densities reach pre-activity levels.
	Upland Vegetation	Disturbance associated with heavy equipment operation favors annual grasses and provides seed bed preparation for invasive, opportunistic plant species when propagules are present. This results in an alteration of the historic successional functional processes within the system.	Moderate	negative	Short through long-term (3-30+ years) depending upon invasive plant propagules present and/or introduced and resilience of the understory vegetation.
		Increased availability of space light and nutrients would increase forage quantity and may increase forage quality. When introduced species do not alter historic successional processes system resilience is increased and vegetative condition is	Moderate to High	positive	Mid -term until replacement tree density utilizes resources at pre-activity levels (5-15 years).

ACTIVITIES	ATTRIBUTE AFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
		improved.			
	Riparian Vegetation	Disturbance associated with heavy equipment operation provides seed bed preparation for invasive, opportunistic plant species when propagules are present. This results in an alteration of the historic successional functional processes within the system.	Moderate	negative	Short through long-term (3-30+ years) depending upon invasive plant propagules present and/or introduced and resilience of the understory vegetation.
		Increased availability of space light and nutrients would increase forage quantity and may increase forage quality. When introduced species do not alter historic successional processes system resilience is increased and vegetative condition is improved.	Moderate to High	positive	Mid -term until replacement tree density utilizes resources at pre-activity levels (5-15 years).
Noncommercial Thinning	Range Improvements	Damage to fence from felling small trees	Light to Moderate	negative	Short-term up to the length of operation within a given unit (days to a couple of weeks).
		Removes potential future trees falling on fence	Light to Moderate	positive	For the life of the fence (30+ years)

ACTIVITIES	ATTRIBUTE AFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
		Increased water yield from tree removal.	Moderate	positive	Short-term until tree growth utilizes subsurface moisture at pre-activity levels (3-5 years).
	Livestock Management	Operations within thinning units influence livestock travel and distribution	Light to Moderate	net negative (although there are some positive influences)	Short-term up to the length of operation within a given unit (days to a couple of weeks).
		Increase barriers to livestock travel by placing thinning materials on the ground.	Light to High	negative	Short to long-term (15-30+ years), until thinning material is treated (fuels) or decompose2.
		Removal of barriers to livestock travel	Light to High	positive	Mid to long-term (15-30+ years), until tree and or fuel densities reach pre-activity levels.
	Upland Vegetation	Increased availability of space light and nutrients would increase forage quantity and may increase forage quality. When introduced species do not alter historic successional processes system resilience is increased and vegetative condition is improved.	Moderate to High	positive	Mid -term until replacement tree density utilizes resources at pre-activity levels (5-15 years).
	Riparian Vegetation	Increased availability of space light and nutrients would increase forage quantity and may increase forage quality. When introduced species do not alter historic successional processes system resilience is	Moderate to High	positive	Mid -term until replacement tree density utilizes resources at pre-activity levels (5-15 years).

ACTIVITIES	ATTRIBUTE AFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
		increased and vegetative condition is improved.			
Thinning in Hardwoods	Range Improvements	Damage to fence from felling small trees	Light to Moderate	negative	Short-term up to the length of operation within a given unit (days to a couple of weeks).
		Removes potential future trees falling on fence	Light to Moderate	positive	For the life of the fence (30+ years)
		Increased water yield from tree removal.	Moderate	positive	Short-term until tree growth utilizes subsurface moisture at pre-activity levels (3-5 years).
	Livestock Management	Operations within thinning units influence livestock travel and distribution	Light to Moderate	net negative (although there are some positive influences)	Short-term up to the length of operation within a given unit (days to a couple of weeks).
		Increase barriers to livestock travel by placing thinning materials on the ground.	Light to High	negative	Short to long-term (15-30+ years), until thinning material is treated (fuels) or decompose2.
		Removal of barriers to livestock travel	Light to High	positive	Mid to long-term (15-30+ years), until tree and or fuel densities reach pre-activity levels.
	Upland Vegetation	Increased availability of space light and nutrients would increase forage quantity and may increase forage quality. When introduced species do not alter historic successional processes system resilience is increased and vegetative	Moderate to High	positive	Mid -term until replacement tree density utilizes resources at pre-activity levels (5-15 years).

ACTIVITIES	ATTRIBUTE AFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
		condition is improved.			
	Riparian Vegetation	Increased availability of space light and nutrients would increase forage quantity and may increase forage quality. When introduced species do not alter historic successional processes system resilience is increased and vegetative condition is improved.	Moderate to High	positive	Mid -term until replacement tree density utilizes resources at pre-activity levels (5-15 years).
Fuels treatments (underburning)	Range Improvements	Damage to fence from burning wooden posts and heating wires.	Light to Moderate	negative	Mid-term shortens effective life of improvement until the fence is reconstructed (5-10 years).
		Burning line trees out of the fence	Light	negative	Onset of effect delayed until tree roots rot (10+ years), shortens effective life of improvement until the fence is reconstructed (5-10 years).
	Livestock Management	Operations within burning units influence livestock travel and distribution typically when livestock are coming off of the Forest	Light to Moderate	net positive (although there are some negative influences)	Short-term up to the length of operation within a given unit (days to a week).
		Removal of barriers to livestock travel	Light to Moderate	positive	Mid to long-term (15-30+ years), until tree and or fuel densities reach pre-activity levels.

ACTIVITIES	ATTRIBUTE AFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
	Upland Vegetation	Disturbance associated with burning favors annual grasses and provides seed bed preparation for invasive, opportunistic plant species when propagules are present. This results in an alteration of the historic successional functional processes within the system.	Light to Moderate	negative	Short through long-term (3-30+ years) depending upon invasive plant propagules present and/or introduced and resilience of the understory vegetation.
		Increased availability of space light and nutrients would increase forage quantity and may increase forage quality. When introduced species do not alter historic successional processes system resilience is increased and vegetative condition is improved.	Moderate to High	positive	Mid -term until replacement tree density utilizes resources at pre-activity levels (5-15 years).
	Riparian Vegetation	Disturbance associated with burning provides seed bed preparation for invasive, opportunistic plant species when propagules are present. This results in an alteration of the historic successional functional processes within the system.	Slight to Light	negative	Short through long-term (3-30+ years) depending upon invasive plant propagules present and/or introduced and resilience of the understory vegetation.

ACTIVITIES	ATTRIBUTE AFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
		Increased availability of space light and nutrients would increase forage quantity and may increase forage quality. When introduced species do not alter historic successional processes system resilience is increased and vegetative condition is improved.	High	positive	Mid through long-term until replacement tree density utilizes resources at pre-activity levels (5-30 years).
Grapple piling	Range Improvements	Damage to fence from grapple operation.	Slight	negative	Short term until the fence is repaired (< 1 year).
	Livestock Management	Operations within piling units influence livestock travel and distribution.	Light to Moderate	net negative (although there are some positive influences)	Short-term up to the length of operation within a given unit (days to a week).
		Removal of barriers to livestock travel	Moderate	positive	Mid to long-term (15-30+ years), until tree and or fuel densities reach pre-activity levels.
	Upland Vegetation	Disturbance associated with grapple operation favors annual grasses and provides seed bed preparation for invasive, opportunistic plant species when propagules are present. This results in an alteration of the historic successional functional processes within the system.	Moderate	negative	Short through long-term (3-30+ years) depending upon invasive plant propagules present and/or introduced and resilience of the understory vegetation.
	Riparian Vegetation	None			

ACTIVITIES	ATTRIBUTE AFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
Hand piling	Range Improvements	None			
	Livestock Management	Operations within piling units influence livestock travel and distribution.	Light to Moderate	net negative (although there are some positive influences)	Short-term up to the length of operation within a given unit (days to a week).
		Removal of barriers to livestock travel	Moderate	positive	Mid to long-term (15-30+ years), until tree and or fuel densities reach pre-activity levels.
	Upland Vegetation	None			
	Riparian Vegetation	None			
Pile burning	Range Improvements	Killing line trees in the fence from heat.	Light	negative	Onset of effect delayed until tree roots rot (10+ years), shortens effective life of improvement until the fence is reconstructed (5-10 years).
	Livestock Management	None			
	Upland Vegetation	Patches of heat sterilized soil provide seed beds for invasive, opportunistic plant species when propagules present or introduced. This may result in alteration of the historic successional functional processes within the system depending upon the resilience of surrounding plant communities.	Moderate to High	negative	Short through long-term (3-30+ years) depending upon invasive plant propagules present and/or introduced and resilience of the understory vegetation.

ACTIVITIES	ATTRIBUTE AFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
	Riparian Vegetation	Patches of heat sterilized soil provide seed beds for invasive, opportunistic plant species when propagules present or introduced. This may result in alteration of the historic successional functional processes within the system depending upon the resilience of surrounding plant communities.	Light to Moderate	negative	Short through long-term (3-30+ years) depending upon invasive plant propagules present and/or introduced and resilience of the understory vegetation.
Exclosure fence construction and caging	Range Improvements	Increases infrastructure which must be maintained.	Light to Moderate	negative	Short through long-term (3-30+ years) until exclosure is abandoned.
	Livestock Management	Prevents livestock from entering more intensely utilized areas when properly maintained.	High	positive	Short to mid-term until maintenance is formally or informally stopped (0-10 years).
		Traps livestock and intensifies livestock use when maintenance is not conducted.	High	negative	Mid through long-term until fencing material is removed (5-30+ years)
	Upland Vegetation	None			
	Riparian Vegetation	Where livestock and big game are excluded hardwood establishment and growth is expected	High	positive	Short to mid-term until maintenance is formally or informally stopped (0-10 years).
		Where only livestock use is excluded response of hardwoods is expected to be variable.	Slight to Light	positive	Short to mid-term until maintenance is formally or informally stopped (0-10 years).

ACTIVITIES	ATTRIBUTE AFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
		Where maintenance is not conducted browse pressure on hardwoods is expected to exceed pressure outside of the exclosure	Moderate	negative	Mid through long-term until fencing material is removed (5-30+ years)
Temporary Road Construction	Range Improvements	None			
	Livestock Management	None			
	Upland Vegetation	Removal of vegetation	Light to Moderate	negative	Short to mid-term until after scarified or otherwise de-compacted to facilitate their return to proper hydrologic function and vegetative productivity.
	Riparian Vegetation	Removal of vegetation	Light to Moderate	negative	Short to mid-term until after scarified or otherwise de-compacted to facilitate their return to proper hydrologic function and vegetative productivity.
Riparian Restoration	Range Improvements	None			
	Livestock Management	None			
	Upland Vegetation	None			
	Riparian Vegetation	Increase site potential to support riparian vegetation	Light to Moderate	positive	Mid through long-term as riparian vegetation establishes (5-30+ years)
Material Source Expansion	Range Improvements	None			
	Livestock Management	None			
	Upland Vegetation	Removal of one acre from grazing	Light	negative	Short to long-term (0-30+ years), until site is reclaimed
		Increase exposure of disturbance area to invasive species	Light	negative	Short to long-term (0-30+ years), until site is reclaimed

ACTIVITIES	ATTRIBUTE AFFECTED	TYPE OF EFFECT	INTENSITY OF EFFECT	DIRECTION	DURATION/ENDPOINT DESCRIPTION
	Riparian Vegetation	None			
Road Decommission	Range Improvements	None			
	Livestock Management	Inability to access areas with vehicles to check livestock	Light	negative	Short to long-term (0-30+ years) until road is reestablished
	Upland Vegetation	None			
	Riparian Vegetation	None			
New Water Developments	Range Improvements	Increase in infrastructure to be maintained.	Light to Moderate	negative	Long-term, the life of the water development or until deemed not needed.
	Livestock Management	Increase water availability to livestock.	Slight to Moderate	positive	Long-term, as long as the developments are maintained.
	Upland Vegetation	Upland vegetation can be used more uniformly.	Light	positive	Long-term, the life of the water development
	Riparian Vegetation	Decrease use of riparian vegetation by distributing livestock away from creeks.	Light to Moderate	positive	Long-term, as long as the developments are maintained.
Temporary Fencing (tied to some Riparian Restoration activities)	Range Improvements	Temporary increase in infrastructure to be maintained.	Light to Moderate	negative	Short-term up to the length need (1-3 years).
	Livestock Management	Increase barriers to livestock.	Slight to Moderate	negative	Short-term up to the length need (1-3 years).
	Upland Vegetation	None			
	Riparian Vegetation	Increase site potential to support riparian vegetation	Light to Moderate	positive	Mid through long-term as riparian vegetation establishes (5-30+ years)

Silviculture and fuels treatments, exclosure fencing and road construction/reconstruction can have the following types of impacts on range related resources:

Direct impacts on range improvements (fences and water developments) impact the livestock operators' ability to control and distribute use by domestic livestock. Tree felling, skidding, burning, and heavy equipment operation for road construction/reconstruction can result in detrimental impacts on fences and water developments. Avoidance and/or repair of range improvements are project design features built into all action alternatives. However, even with these project design features there are usually short periods of time during operations (days to weeks depending upon the duration of operations in each unit) when range improvements associated with treatment units are rendered nonfunctioning. Therefore, the amount of fence (miles) and number of water developments potentially impacted by the alternatives are one measure of the effect of alternative activities upon livestock grazing operations.

Direct impacts on barriers to grazing and/or browsing animal travel and access, indirectly effects the distribution and intensity of use by these animals. The effects are primarily upon domestic livestock use, but have some limited impact upon big game use. Dense stands of small diameter trees particularly of lodgepole pine and heavy concentrations of downed trees (i.e. areas of high fuel loading) considerably limit the distance domestic livestock travel and slightly limit the distance big game travel. In addition, new road corridor construction increases speed of travel and accessibility along the corridor for both domestic livestock and big game. Exclosure fencing erects barriers to livestock travel, not only within the area fenced but also between areas that the exclosure bisects. Depending upon location and gap placement, exclosure fences have the potential to dramatically impact the distribution and intensity of grazing animal use. Therefore the amount (acres of small diameter trees or heavy fuels treatment and the miles of road constructed/reconstructed and exclosure fence constructed) of barrier reduced and/or increased by the activities is one measure of the effect of the alternatives.

Direct and indirect impacts on upland and riparian non-forest vegetation (shrubs and herbaceous vegetation), would affect ecological processes, system health and resilience, and forage quantity and quality. While soil disturbances associated with all mechanical activities (commercial harvest, stream restoration, and road construction/reconstruction) and burning provide seed bed preparation favoring invasive and opportunistic plant species if their propagules are introduced and/or present.

Alternative 2 – Proposed Action

Table 117 described the type, intensity, direction and duration of the effects of each of the prescribed activities under the action alternatives. The tables 118 and 119 will relate the magnitude (extent) and location (by allotment and pasture) of these effects. Acres may be counted more than once in the following tables; i.e., one timber stand unit may be commercially and noncommercially thinned.

Under Alternative 2 the following actions would also occur:

- Two spring developments within the Horse Heaven pasture of the Pringle allotment and one spring development within the East B pasture of the Gray Prairie allotment.
- Eleven miles of stream restoration and 1,345 acres of associated riparian vegetation restoration within the One pasture of the Antler allotment; Williams Prairie Riparian pasture of the Fox Canyon allotment; Gray Prairie, Holding and North pastures of the Gray Prairie allotment; East and West pastures of the Lost Horse allotment; and the Holding A and Horse Heaven pastures of the Pringle allotment.
- Two exclosures, totaling approximately nine acres, would be constructed in the North pasture of the Gray Prairie allotment as part of the stream restoration work.
- Expansion of a mineral source (approximately one acre) in the Lower pasture of the Brush Creek Allotment.

- Four miles of temporary fencing to manage livestock during the restoration activities within the Williams Prairie Riparian pasture of the Fox Canyon allotment.

Table 118. Acres of treatments by allotment and pasture for Alternative 2 – Proposed Action.

Allotment and Pasture	Commercial Thinning	Noncommercial Thinning	Underburning	Grapple and/or Hand Pile Burning	Hardwood Treatments
Antler	**139**	**209**	**262**	**0**	**0**
One	*67*	*67*	*99*	*0*	*0*
Two A	*19*	*19*	*28*	*0*	*0*
Two B	*14*	*14*	*26*	*0*	*0*
Three	*24*	*24*	*24*	*0*	*0*
Four	*0*	*46*	*46*	*0*	*0*
Five	*0*	*0*	*0*	*0*	*0*
Six	*2*	*17*	*17*	*0*	*0*
Seven	*13*	*22*	*22*	*0*	*0*
Brush Creek	**1,945**	**2,016**	**2,167**	**814**	**9**
Lower	*1,174*	*1,192*	*1,180*	*456*	*6*
Middle	*543*	*543*	*798*	*302*	*0*
Upper	*228*	*281*	*189*	*56*	*3*
Fox Canyon	**870**	**1,214**	**1,643**	**3**	**1**
Long Prairie	*115*	*285*	*285*	*0*	*1*
Williams Prairie	*746*	*920*	*1,288*	*3*	*0*
Williams Prairie Holding	*0*	*0*	*0*	*0*	*0*
Williams Prairie Riparian	*9*	*9*	*70*	*0*	*0*
Gray Prairie	**3,680**	**4,358**	**4,061**	**1,185**	**53**
East B	*740*	*801*	*1,277*	*98*	*13*
Gray Prairie	*1,139*	*1,559*	*1,265*	*297*	*10*
Holding	*0*	*25*	*30*	*0*	*0*
Holding B	*0*	*13*	*13*	*0*	*0*
North	*1,781*	*1,940*	*1,456*	*790*	*26*
Spring Creek	*20*	*20*	*20*	*0*	*4*
Lost Horse	**3,473**	**3,942**	**5,583**	**14**	**2**
East	*1,392*	*1,448*	*2,091*	*0*	*1*
Sand Springs	*748*	*761*	*821*	*0*	*0*
West	*1,333*	*1,733*	*2,671*	*14*	*1*
North Fork	**1,036**	**1,099**	**1,431**	**0**	**2**
Five Corners	*46*	*46*	*90*	*0*	*0*
Horse Prairie	*990*	*1,053*	*1,341*	*0*	*2*
Pringle	**2,837**	**3,012**	**3,791**	**610**	**16**
Chev Spring	*204*	*227*	*78*	*127*	*15*
East A	*424*	*460*	*781*	*0*	*0*
Holding A	*137*	*154*	*229*	*81*	*0*
Horse Heaven	*661*	*726*	*1,135*	*57*	*0*
Prairie Hill	*1,411*	*1,445*	*1,568*	*345*	*1*
Area outside of an allotment	**54**	**62**	**45**	**9**	**0**
Total Area by watersheds	**14,034**	**15,912**	**18,983**	**2,635**	**83**

Table 119. Miles of fencing by allotment, number of water developments that may be effected in Alternative 2 – Proposed Action.

Allotment and Pasture	Fencing in Thinning Treatments	Fencing in Burning Prescriptions	Water Developments in Thinning Treatments	Water Developments in Burning Prescriptions	Acres of Aspen Exclosures
Antler	**2.8**	**3.0**	**0**	**0**	**0**
One			*0*	*0*	*0*
Two A			*0*	*0*	*0*
Two B			*0*	*0*	*0*
Three			*0*	*0*	*0*
Four			*0*	*0*	*0*
Five			*0*	*0*	*0*
Six			*0*	*0*	*0*
Seven			*0*	*0*	*0*
Brush Creek	**3.0**	**3.7**	**2**	**1**	**2**
Lower			*1*	*1*	*2*
Middle			*1*	*0*	*0*
Upper			*0*	*0*	*0*
Fox Canyon	**3.4**	**3.9**	**0**	**2**	**0**
Long Prairie			*0*	*0*	*0*
Williams Prairie			*0*	*2*	*0*
Williams Prairie Holding			*0*	*0*	*0*
Williams Prairie Riparian			*0*	*0*	*0*
Gray Prairie	**11.0**	**12.0**	**3**	**5**	**14**
East B			*1*	*1*	*3*
Gray Prairie			*2*	*3*	*2*
Holding			*0*	*0*	*0*
Holding B			*0*	*0*	*0*
North			*0*	*1*	*8*
Spring Creek			*0*	*0*	*1*
Lookout	**0**	**0**	**0**	**0**	**0**
Lost Horse	**8.4**	**11.4**	**9**	**10**	**2**
East			*2*	*3*	*2*
Sand Springs			*0*	*0*	*0*
West			*7*	*7*	*0*
North Fork	**0.9**	**1.9**	**2**	**2**	**0**
Five Corners			*0*	*0*	*0*
Horse Prairie			*2*	*2*	*0*
Pringle	**6.5**	**7.3**	**1**	**3**	**1**
Chev Spring			*0*	*0*	*1*
East A			*0*	*1*	*0*
Holding A			*0*	*0*	*0*
Horse Heaven			*0*	*0*	*0*
Prairie Hill			*1*	*2*	*0*
Totals	**36.0**	**43.2**	**17**	**23**	**19**

Alternative 3

Table 117 described the type, intensity, direction and duration of the effects of each of the prescribed activities under both action alternatives. Tables 120 and 121 will relate the magnitude (extent) and location (by allotment and pasture) of these effects. Acres may be counted more than once in the following tables; for example, one timber stand unit may be commercially and noncommercially thinned. Effects of the actions of this alternative to fences are expressed by allotment only as pastures fences are shared.

Under Alternative 3 the following actions would also occur:

- Two spring developments within the Horse Heaven pasture of the Pringle allotment and one spring development within the East B pasture of the Gray Prairie allotment.
- Eleven miles of stream restoration and 1,345 acres of associated riparian vegetation restoration within the One pasture of the Antler allotment; Williams Prairie Riparian pasture of the Fox Canyon allotment; Gray Prairie, Holding and North pastures of the Gray Prairie allotment; East and West pastures of the Lost Horse allotment; and the Holding A and Horse Heaven pastures of the Pringle allotment.
- Two exclosures, totaling approximately nine acres would be constructed in the North pasture of the Gray Prairie allotment as part of the stream restoration work.
- Expansion of a mineral source (approximately one acre) in the Lower pasture of the Brush Creek Allotment.
- Four miles of temporary fencing to manage livestock during the restoration activities within the Williams Prairie Riparian pasture of the Fox Canyon allotment.

Table 120. Acres of treatments by allotment and pasture for Alternative 3.

Allotment and Pasture	Commercial Thinning	Noncommercial Thinning	Underburning	Grapple and/or Hand Pile Burning	Hardwood Treatments
Antler	**92**	**152**	**220**	**0**	**6**
One	*30*	*63*	*100*	*0*	*6*
Two A	*16*	*9*	*28*	*0*	*0*
Two B	*11*	*14*	*26*	*0*	*0*
Three	*24*	*24*	*24*	*0*	*0*
Four	*0*	*3*	*3*	*0*	*0*
Five	*0*	*0*	*0*	*0*	*0*
Six	*0*	*17*	*17*	*0*	*0*
Seven	*11*	*22*	*22*	*0*	*0*
Brush Creek	**1,717**	**2,009**	**1,865**	**814**	**10**
Lower	*1,005*	*1,191*	*1,180*	*456*	*7*
Middle	*536*	*542*	*496*	*302*	*0*
Upper	*176*	*276*	*189*	*56*	*3*
Fox Canyon	**682**	**1,215**	**1,649**	**3**	**1**
Long Prairie	*92*	*285*	*285*	*0*	*1*
Williams Prairie	*583*	*920*	*1,294*	*3*	*0*
Williams Prairie Holding	*0*	*0*	*0*	*0*	*0*
Williams Prairie Riparian	*7*	*10*	*70*	*0*	*0*
Gray Prairie	**2,550**	**3,894**	**4,102**	**1,079**	**53**
East B	*500*	*787*	*1,277*	*85*	*13*
Gray Prairie	*835*	*1,359*	*1,266*	*296*	*10*

Allotment and Pasture	Commercial Thinning	Noncommercial Thinning	Underburning	Grapple and/or Hand Pile Burning	Hardwood Treatments
Holding	*0*	*26*	*31*	*0*	*0*
Holding B	*0*	*13*	*13*	*0*	*0*
North	*1,215*	*1,689*	*1,495*	*698*	*26*
Spring Creek	*0*	*20*	*20*	*0*	*4*
Lookout	**0**	**0**	**0**	**0**	**0**
Lost Horse	**2,959**	**3,732**	**5,584**	**14**	**2**
East	*1,284*	*1,401*	*2,092*	*0*	*1*
Sand Springs	*500*	*599*	*821*	*0*	*0*
West	*1,175*	*1,732*	*2,671*	*14*	*1*
North Fork	**621**	**870**	**1,385**	**0**	**2**
Five Corners	*46*	*46*	*90*	*0*	*0*
Horse Prairie	*575*	*824*	*1,295*	*0*	*2*
Pringle	**2,228**	**3,166**	**3,713**	**583**	**13**
Chev Spring	*184*	*227*	*78*	*126*	*12*
East A	*339*	*460*	*781*	*0*	*0*
Holding A	*135*	*154*	*150*	*55*	*0*
Horse Heaven	*439*	*726*	*1,136*	*57*	*0*
Prairie Hill	*1,131*	*1,599*	*1,568*	*345*	*1*
Area not within an allotment	**54**	**62**	**45**	**9**	**0**
Total Area by watersheds	**10,903**	**15,100**	**18,563**	**2,502**	**87**

Table 121. Miles of fencing by allotment, number of water developments that may be effected in Alternative 3.

Allotment and Pasture	Fencing in Thinning Treatments	Fencing in Burning Prescriptions	Water Developments in Thinning Treatments	Water Developments in Burning Prescriptions	Acres of Aspen Exclosures
Antler	**2.8**	**3.0**	**0**	**0**	**0**
One			*0*	*0*	*0*
Two A			*0*	*0*	*0*
Two B			*0*	*0*	*0*
Three			*0*	*0*	*0*
Four			*0*	*0*	*0*
Five			*0*	*0*	*0*
Six			*0*	*0*	*0*
Seven			*0*	*0*	*0*
Brush Creek	**3.0**	**3.7**	**2**	**1**	**2**
Lower			*1*	*1*	*2*
Middle			*1*	*0*	*0*
Upper			*0*	*0*	*0*
Fox Canyon	**3.4**	**3.9**	**0**	**2**	**0**
Long Prairie			*0*	*0*	*0*
Williams Prairie			*0*	*2*	*0*
Williams Prairie Holding			*0*	*0*	*0*

Allotment and Pasture	Fencing in Thinning Treatments	Fencing in Burning Prescriptions	Water Developments in Thinning Treatments	Water Developments in Burning Prescriptions	Acres of Aspen Exclosures
Williams Prairie Riparian			*0*	*0*	*0*
Gray Prairie	**10.3**	**12.2**	**3**	**5**	**14**
East B			*1*	*1*	*3*
Gray Prairie			*2*	*3*	*2*
Holding			*0*	*0*	*0*
Holding B			*0*	*0*	*0*
North			*0*	*1*	*8*
Spring Creek			*0*	*0*	*1*
Lookout	**0**	**0**	**0**	**0**	**0**
Lost Horse	**8.1**	**11.6**	**9**	**10**	**2**
East			*2*	*3*	*2*
Sand Springs			*0*	*0*	*0*
West			*7*	*7*	*0*
North Fork	**0.9**	**1.9**	**2**	**2**	**0**
Five Corners			*0*	*0*	*0*
Horse Prairie			*2*	*2*	*0*
Pringle	**6.5**	**7.3**	**1**	**3**	**1**
Chev Spring			*0*	*0*	*1*
East A			*0*	*1*	*0*
Holding A			*0*	*0*	*0*
Horse Heaven			*0*	*0*	*0*
Prairie Hill			*1*	*2*	*0*
Totals	**35.0**	**43.6**	**17**	**23**	**19**

Alternative 4

Table 117 described the type, intensity, direction and duration of the effects of each of the prescribed activities under all action alternatives. Tables 122 and 123 will relate the magnitude (extent) and location (by allotment and pasture) of these effects. Acres may be counted more than once in the following tables; for example, one timber stand unit may be commercially and noncommercially thinned. Effects of the actions of this alternative to fences are expressed by allotment only as pastures fences are shared.

Under Alternative 4 the following actions would also occur:

- Two spring developments within the Horse Heaven pasture of the Pringle allotment and one spring development within the East B pasture of the Gray Prairie allotment.
- Eleven miles of stream restoration and 1,345 acres of associated riparian vegetation restoration within the One pasture of the Antler allotment; Williams Prairie Riparian pasture of the Fox Canyon allotment; Gray Prairie, Holding and North pastures of the Gray Prairie allotment; East and West pastures of the Lost Horse allotment; and the Holding A and Horse Heaven pastures of the Pringle allotment.
- Two exclosures, totaling approximately nine acres would be constructed in the North pasture of the Gray Prairie allotment as part of the stream restoration work.

- Expansion of a mineral source (approximately one acre) in the Lower pasture of the Brush Creek Allotment.
- Four miles of temporary fencing to manage livestock during the restoration activities within the Williams Prairie Riparian pasture of the Fox Canyon allotment.

Table 122. Acres of treatments by allotment and pasture for Alternative 4.

Allotment and Pasture	Commercial Thinning	Noncommercial Thinning	Underburning	Grapple and/or Hand Pile Burning	Hardwood Treatments
Antler	**140**	**167**	**219**	**0**	**0**
One	*67*	*67*	*99*	*0*	*0*
Two A	*20*	*20*	*28*	*0*	*0*
Two B	*14*	*14*	*26*	*0*	*0*
Three	*24*	*24*	*24*	*0*	*0*
Four	*0*	*3*	*3*	*0*	*0*
Six	*2*	*17*	*17*	*0*	*0*
Seven	*13*	*22*	*22*	*0*	*0*
Brush Creek	**1,945**	**2,016**	**1,665**	**813**	**9**
Lower	*1,174*	*1,192*	*1,180*	*455*	*6*
Middle	*543*	*543*	*296*	*302*	*0*
Upper	*228*	*281*	*189*	*56*	*3*
Fox Canyon	**870**	**1,511**	**1,643**	**292**	**1**
Long Prairie	*115*	*565*	*285*	*279*	*1*
Williams Prairie	*746*	*936*	*1,288*	*13*	*0*
Williams Prairie Holding	*0*	*0*	*0*	*0*	*0*
Williams Prairie Riparian	*9*	*10*	*70*	*0*	*0*
Gray Prairie	**3,680**	**4,372**	**4,061**	**1,183**	**66**
East B	*740*	*801*	*1,277*	*97*	*13*
Gray Prairie	*1,139*	*1,572*	*1,265*	*296*	*22*
Holding	*0*	*25*	*30*	*0*	*0*
Holding B	*0*	*13*	*13*	*0*	*0*
North	*1,781*	*1,941*	*1,456*	*790*	*27*
Spring Creek	*20*	*20*	*20*	*0*	*4*
Lost Horse	**3,473**	**3,942**	**5,598**	**14**	**2**
East	*1,392*	*1,448*	*2,092*	*0*	*1*
Sand Springs	*748*	*761*	*821*	*0*	*0*
West	*1,333*	*1,733*	*2,685*	*14*	*1*
North Fork	**1,036**	**1,099**	**1,385**	**0**	**2**
Five Corners	*46*	*46*	*90*	*0*	*0*
Horse Prairie	*990*	*1,053*	*1,295*	*0*	*2*
Pringle	**2,837**	**2,896**	**3,112**	**610**	**13**
Chev Spring	*204*	*227*	*78*	*126*	*12*
East A	*424*	*460*	*781*	*0*	*0*
Holding A	*137*	*154*	*147*	*82*	*0*
Horse Heaven	*661*	*726*	*538*	*57*	*0*
Prairie Hill	*1,411*	*1,329*	*1,568*	*345*	*1*
Area not within an allotment	**54**	**62**	**45**	**9**	**0**
Total Area by watersheds	**14,035**	**16,065**	**17,728**	**2,921**	**93**

Table 123. Miles of fencing by allotment, number of water developments that may be effected in Alternative 4.

Allotment and Pasture	Fencing in Thinning Treatments	Fencing in Burning Prescriptions	Water Developments in Thinning Treatments	Water Developments in Burning Prescriptions	Acres of Aspen Exclosures
Antler	**2.8**	**3.0**	**0**	**0**	**0**
One			*0*	*0*	*0*
Two A			*0*	*0*	*0*
Two B			*0*	*0*	*0*
Three			*0*	*0*	*0*
Four			*0*	*0*	*0*
Five			*0*	*0*	*0*
Six			*0*	*0*	*0*
Seven			*0*	*0*	*0*
Brush Creek	**3.0**	**3.7**	**2**	**1**	**2**
Lower			*1*	*1*	*2*
Middle			*1*	*0*	*0*
Upper			*0*	*0*	*0*
Fox Canyon	**3.6**	**3.9**	**0**	**2**	**0**
Long Prairie			*0*	*0*	*0*
Williams Prairie			*0*	*2*	*0*
Williams Prairie Holding			*0*	*0*	*0*
Williams Prairie Riparian			*0*	*0*	*0*
Gray Prairie	**11.2**	**12.2**	**3**	**5**	**14**
East B			*1*	*1*	*3*
Gray Prairie			*2*	*3*	*2*
Holding			*0*	*0*	*0*
Holding B			*0*	*0*	*0*
North			*0*	*1*	*8*
Spring Creek			*0*	*0*	*1*
Lookout	**0**	**0**	**0**	**0**	**0**
Lost Horse	**8.6**	**11.6**	**9**	**10**	**2**
East			*2*	*3*	*2*
Sand Springs			*0*	*0*	*0*
West			*7*	*7*	*0*
North Fork	**0.9**	**1.9**	**2**	**2**	**0**
Five Corners			*0*	*0*	*0*
Horse Prairie			*2*	*2*	*0*
Pringle	**6.5**	**7.3**	**1**	**3**	**1**
Chev Spring			*0*	*0*	*1*
East A			*0*	*1*	*0*
Holding A			*0*	*0*	*0*
Horse Heaven			*0*	*0*	*0*
Prairie Hill			*1*	*2*	*0*
Totals	**36.6**	**43.6**	**17**	**23**	**19**

Action Alternatives: Summarized Direct and Indirect Effects

Under all the action alternatives there would be thinning of trees, underburning of both live and dead fuels, treatment of activity-generated fuels, hardwood planting, headcut repair, stream restoration, exclosure construction, hardwood caging (for protection from livestock and wildlife herbivory), road closures, road decommissioning, temporary road construction, and a material source expansion. Roughly half of the burning would occur after the mechanical work is completed, while the other half is conducted in areas without prior thinning treatments.

All the action alternatives would increase access and available forage for livestock while livestock distribution throughout the project area allotments would improve. Utilization would be spread more evenly throughout Gap project area and riparian areas would receive less grazing pressure Because of the small amount of area in the other allotments within the project area, grazing distribution is not expected to appreciatively improve within them.

Commercial and noncommercial thinning would open up dense tree stands and allow understory production to increase. Increased availability of space, light and nutrients would increase forage quantity and may increase forage quality. There would be an increase in species such as: pinegrass, elk sedge and bunchgrasses. Treatments that open up the tree canopy would create more transitory range for domestic livestock (see table 124). Grazing management practices would be expected to improve with the increase of accessibility for herding cattle.

Table 124. Increase of transitory range due to thinning activities by alterative.

	No Action	Alternative 2 Proposed Action	Alternative 3	Alternative 4
Acres of increased access and forage	0	16,079	15,160	15,901

It is assumed that all harvest would result in a mosaic pattern on the landscape. Noncommercial treatments (noncommercial thinning, juniper thinning, and hardwood treatments) would be completed over a span of ten years. Loss of forage would be short-term, minimal, and would not be expected to affect livestock stocking rates.

Prescribed burning would most likely reduce available forage for the first year or two, post burn, but after recovery, forage would increase (see table 125). Burns would take place in a mosaic pattern, and over a span of ten to twenty years; loss of forage would be short-term, minimal, and would not be expected to affect livestock stocking rates. Forage species would no longer have to compete with small trees and shrubs. It is possible that permittees would be impacted economically if a rest period is required after burning large areas at the same time. Burned areas would be evaluated to determine if rest is needed; the necessity of rest depends on plant composition, accessibility for livestock, the degree of heat impact upon species, and how many acres are burned within each pasture.

Table 125. Increase of access and forage due to fuels treatments by alterative.

	No Action	Alternative 2 Proposed Action	Alternative 3	Alternative 4
Acres of increased access and forage	0	18,511	18,474	18,473

During management activities it is possible that domestic livestock would be temporarily displaced. Displacement would be minimal due to the fact that all harvest and burning activities would take place in a mosaic pattern and over a span of several years. This would be a short-term effect. Long-term benefits would include increased access and availability of forage.

Management activities may reduce the effectiveness of fences and water developments. Both are used to disperse domestic livestock throughout the allotment. Design elements have been included into the action alternatives to avoid or reduce the likelihood of damage to improvements.

Cumulative Effects (see table 167)

The cumulative effects analysis area for rangeland resources includes the areas of all of the allotments that wholly or partially fall within the Gap project area (Antler, Brush Creek, Fox Canyon, Gray Prairie, Lookout, Lost Horse, North Fork and Pringle allotments). The description of the affected environment is a culmination of all past activities upon the landscape within the Gap project area. Specifically, these activities have occurred within the project area and have affected current range condition and vegetation: historic livestock grazing, timber harvest, road construction and wildfire. Many practices have since been altered, but range condition continues to show evidence.

Federal livestock grazing has been altering upland forest vegetation in the project area since the early 1920s. According to Fleischner (1994), "livestock grazing is the most widespread land management practice in the western North America." Timber management activities in the past have affected stand condition in the project area. Past timber harvest concentrated on removal of large mature trees while thinning of small diameter understory trees was limited. As these stands matured and canopies became denser, many understory forage species would have been negatively affected by an increase in shading, competition for moisture, and a buildup of needle litter on the forest floor.

Historically, fire was the primary control factor for vegetation within the Gap project area. Historic fire return intervals for the project area were a 10-year fire return interval for the lower elevations and south slopes, and a 30-50 year fire return interval for the higher elevations and north slopes. However, during the past century, fire suppression in the project area has caused a significant decrease in the number of acres burned.

Current and reasonably foreseeable actions occurring within the project area have and will change resource conditions; there are many diverse activities as the following list indicates:

- Livestock grazing; May to mid-October (annually). (Fox Canyon and Bug Summit AMP EIS)
- Noxious weed treatments (annually).
- Fuelwood cutting (annually; limited opportunity due to permit restrictions).
- Maintenance of roads and culverts (annually).
- Recreation: hunting, camping, ATV/OHV use, snowmobile use, use of trail to wilderness (annually).
- Full-size vehicle use on open roads and ATV use on open and closed roads (annually).
- Reconstruction of range fence.
- Reconstruction and/or development range water developments.
- New construction of range improvements, i.e. fence, corral, or water development (one time actions).
    - 4.6 Miles of fence
    - 12 New water developments
    - 1 New corral
- New construction of livestock exclosures (one time actions).
    - 22 Acres.

Past activities and occurrences have shaped both the existing resource conditions and the current livestock use patterns within the analysis area. Cumulatively under the No Action alternative, it is expected that the entire project area (extent) would:

- Continue to have overstocked, dense forest stands which decrease available forage, retard riparian vegetation vigor and recruitment, and in some areas create barriers that impede livestock distribution.
- Would not provide any activity impacts or influences on existing range improvements.
- Present a much longer duration to vegetative recovery than do any of the action alternatives particularly in riparian areas.

Past activities and occurrences have shaped both the existing resource conditions and the current livestock use patterns within the analysis area. Cumulatively under Alternatives 2, 3, and 4 it is expected that the entire project area:

- Would be much more open over the short through mid-term (5-20 years) providing the best access for livestock as well as the most and highest quality forage.
- Provides potential conflicts associated with livestock management including the greatest overlap between mechanized equipment use, fuels treatments and rangeland improvements.
- Presents the potential for much more resilient plant communities than does the no action alternative.

Aquatic Species

This section summarizes the draft Aquatic Species specialists' report; information has been included almost verbatim, but some appendices were not included. Included is the Biological Evaluation (BE) for proposed, endangered, threatened, and sensitive aquatic species within the Gap project area. The entire draft report and appendices are located in the Gap project file, Prineville, Oregon.

Management Direction and Regulatory Framework

INFISH

INFISH (USDA 1995) provides direction to protect habitat and populations of resident native fish outside of anadromous fish habitat and is applicable to the Gap project area. The INFISH delineated Riparian Habitat Conservation Areas (RHCAs) where riparian-dependent resources receive primary emphasis, and management activities are subject to specific standards and guidelines. These RHCA include traditional riparian corridors, wetlands, intermittent streams, and other areas that help maintain the integrity of aquatic ecosystems. These areas will be managed to maintain or restore water quality, stream channel integrity, channel processes, sediment regimes, in stream flows, diversity and productivity of plant communities in riparian zones, and riparian and aquatic habitats to foster unique genetic fish stocks that evolved within the specific region. RHCA run through and are overlaid on other allocations. For the Gap project area, INFISH provides protection for redband trout.

Riparian Management Objectives (RMO)

INFISH established landscape-scale interim Riparian Management Objectives (INFISH p. A-7) that would be applied to watersheds with inland native fish. Riparian Management Objectives (RMO) describing good habitat was developed to describe desired condition for fish habitat. RMOs have been refined to better reflect conditions that are attainable in the Gap project area (table 126). To meet RMO, the implementation of projects is designed to not "retard" the rate of recovery of habitat (INFISH p. A-6). INFISH recognized that in many cases interim Riparian Management Objectives would not be met instantaneously, but would be achieved over time (INFISH A-2). There are no RMO that specifically address riparian vegetation; however, riparian vegetation can influence water temperature, large woody debris (LWD), pool frequency, width-to-depth ratios (W/D), and bank stability. All habitat features described in the interim RMO are inter-related.

Table 126. INFISH Riparian Management Objectives applicable to the Gap Project (USDA 1995).

Habitat Feature	Interim Objective
water temperature	No measurable increase in maximum water temperature (7-day moving average of daily maximum temperature measured as the average of the maximum daily temperature of the warmest consecutive 7-day period)
large woody debris (forested systems)	Natural amounts of large, woody material in the Blue Mountains (Cordova 1995)
pool frequency (all systems)	Pools per mile depending on wetted width. Applicable standards for streams in project area would be <10 ft. wide (96 pools/mi) and 10-20 ft. wide (56 pools/mi)
bank stability (non-forest systems)	>80 percent stable banks
lower bank angle (non-forested systems)	>75 percent of banks with >90 degree angle (i.e., undercut)
width/depth ratio (all systems)	<10, mean wetted width divided by mean depth See Table 137.Width to depth ratio by channel type (Rosgen 1996; Silvey 1998).: Width/depth ratio by channel type

To meet these objectives, site specific prescriptions have been developed on a unit by unit basis (see tables 15 and 17) based on slope, aspect, stream condition, soil conditions, and existing vegetation. These include no treatment buffers of various widths adjacent to steam channels, identification of trees to be felled to meet large wood requirements, equipment restrictions, and modifications to silvicultural prescriptions. These site specific prescriptions were developed to ensure attainment of the RMOs already identified in INFISH as well as provide for no significant increase in the potential for sediment delivery due to the PDFs and BMPs that would be implemented for this project.

Ochoco National Forest Land and Resource Management Plan

Direction for managing lands on the Ochoco National Forest to protect and enhance water quality and quantity, fisheries, aquatic habitat, and riparian areas is provided in the Ochoco National Forest Land and Resource Management Plan (Forest Plan) in the form of Forest-wide and Management Area Standards and Guidelines (USDA 1991). The project was developed in accordance with those standards and guidelines.

North Fork Crooked River Wild and Scenic River Management Plan

Segment 1 (recreation corridor, MA-F23, scenic corridor, MA-F23) of the North Fork Wild and Scenic River (NFCR W&S River) is located within the Gap project. Some relevant direction and information from the NFCR W&S River Management Plan are described in Appendix H.

Management Indicator Species

Aquatic Species

Forest Plan- Brook and rainbow trout

Fish species identified as management indicator species are listed in the FEIS for the Forest Plan. These species are rainbow trout (Oncorhynchus mykiss) and brook trout (Salvelinus fontinalis). Both trout species are present in the project area. In the past, both species were stocked on the Forest by the Oregon Department of Fish and Wildlife (ODFW). ODFW no longer stocks either species on the Forest. Both rainbow and brook trout naturally reproduce in project areas streams (Classes I and II).

Brook trout are a non-native trout that was planted for fishing opportunities in the 1920's and 1930's. They are known to exist in only a few streams on the Forest including Allen Creek, Lookout Creek, and Brush Creek. Lookout Creek is located within Gap project area.

For purposes of this analysis, effects to redband trout are described in the Threatened, Endangered, and Sensitive Species section and will act as a surrogate for MIS fish species effects analysis. Additionally, effects to redband trout are considered the same as effects to brook trout.

The Ochoco National Forest Management Indicator Species analysis is located in a separate document, Aquatic Management Indicator Species Analysis in the Gap project.

Essential Fish Habitat

Magnuson-Stevens Fishery Conservation and Management Act Public Law 94-265

The Pacific Fishery Management Council designated EFH (Essential Fish Habitat) for chinook salmon on September 27, 2000. This designation included current and some historic habitat in the Deschutes Basin. Historical habitat above Pelton Round Butte complex and Bowman Dam (fish barrier) was included. No EFH was located within the Ochoco National Forest but downstream on the mainstem Crooked River.

However, in 2013, the Pacific Fisheries Management Council's amendment 16 removed Middle Columbia River spring-run Chinook from their Fisheries Management Plan. No further evaluation of EFH will be discussed.

Threatened, Endangered and Sensitive Species (TES)

Endangered Species Act 1973

This Biological Evaluation (BE) documents possible effects of proposed activities on threatened and endangered species in the project area. There are no endangered species known or suspected to within the influence of the Gap project area. Threatened aquatic species that are known or suspected to occur elsewhere on the Ochoco National Forest include bull trout and mid-Columbia River steelhead trout. There would be no effect to bull trout or mid-Columbia River steelhead trout and they will not be further analyzed. Consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service is not required for the Gap project area.

R6 Sensitive and Strategic Listed Species (2011)* Species Considered in this Assessment:

Table 127. Aquatic species, their status and occurrence within the project area.

Species	Scientific Name	Status	Occurrence
Bull trout	*Salvelinus confluentus*	T	HN/N
Mid-Columbia steelhead trout	*Oncorhynchus mykiss ssp*	T	HN/D
Columbia spotted frog	***Rana luteiventris***	**S/C**	**HD/S**
Redband Trout	***Oncorhynchus mykiss ssp*.**	**S**	**HD/D**
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*	S	HN/N
Shortface lanx (Gastropoda)	*Fisherola nuttalli* (suspected)	S	HN/N
Pristine springsnail (suspected)	*Pristinicola hemphilli*	St	HN/N
Caddisfly	*Namamyia plutonis* (suspected)	St	HN/N
Western ridged mussel	*Gonidea angulata*	St	HN/S
Indian Ford juga	*Juga hemphilli s. nov.*	St	HN/N
Harney basin dusky snail (suspected)	*Colligyrus depressus*	St	HN/S

Status

E	Federally Endangered
DL	Federally Delisted
T	Federally Threatened
S or St	Sensitive or Strategic species from 2011 Regional Forester's ISSSP list
C	Candidate species under Endangered Species Act
P	Proposed species published in the Federal Register to list as endangered or threatened

Occurrence

HD	Habitat Documented or suspected within the project area or near enough to be impacted by project activities
HN	Habitat Not within the project area or affected by its activities
D	Species Documented in general vicinity of project activities
S	Species Suspected in general vicinity of project activities
N	Species Not documented and not suspected in general vicinity of project activities

*The Regional Forester's Special Status Species List was recently updated in July, 2015, resulting in a change of sensitive status for some plants documented or suspected on the Ochoco National Forest. Since the project was initiated prior to this update, the 2011 list which was in effect at the time of project initiation is used in this document. The provision for use of the prior list can be found in the letter dated July 21, 2015 from the Regional Forester to Forest Supervisors providing the updated list.

Analysis Methods

The following four analysis measures, comprised of parameters selected in part from stream data, represent the condition of aquatic habitat and water quality. The following is a discussion on redband trout, Columbia spotted frog and their habitat. The mechanisms influencing fish populations and habitat features for redband and CSF that could be affected by the proposed treatments are outlined in table 128 below. This section identifies and describes analysis measures, provides context through description of affected environment and documents existing conditions.

Table 128. Analysis Measures and Parameters.

Analysis Measure	Parameter
Direct Impacts to Aquatic Species	Physical Disturbance
Water Quantity and Quality	Water Yield
	Sediment & % Fine Sediment in stream bed materials
	Stream Shade
	Temperature/TMDL
Sensitive Species Habitat	LWD
	Pools
	Streambank Condition (% stream bank stability, channel width to depth ratio by Rosgen Stream Class)
Riparian Vegetation	Upland RHCA vegetation (outer zone)
	Riparian vegetation including hardwoods (inner zone)

Measure 1: Direct impacts to aquatic species

This measure addresses direct effects to fish and frogs from the implementation of project activities including: vegetation management (commercial and noncommercial thinning, underburning and aspen restoration) roads, stream crossings and riparian restoration within RHCAs. Direct impacts would include any direct mortality or disturbance to redband trout or Columbia spotted frog individuals, while indirect effects are those to associated habitats.

Measure 2: Water Quantity and Quality

Water Quantity: This measure addresses effects to aquatic species from implementation of project activities on water yield. Water yield is one of the primary drivers of aquatic species and their habitats. Changes in water yield can have effects on aquatic species.

Water Quality

Fine Sediment: This measure addresses the effects to aquatic species from sediment delivery via proposed activities: vegetation management roads and stream crossings and riparian restoration. Sediment delivered to stream systems can translate to increased suspended sediment and turbidity that can affect fish and aquatic life. Fine sediments in streams can also degrade channel form; these potential effects are addressed in Measure 4 – Aquatic Habitat.

Water Temperature and Stream Shade: This measure addresses the effects to aquatic species from changes to stream shading and riparian vegetation. Specific actions that have the potential to affect shade and temperature include: vegetation management, road and stream crossings and riparian restoration activities. Changes in stream shading can translate to increased temperature and affect aquatic life.

Measure 3: Riparian Vegetation

This measure addresses how the project effects the historic distribution, diversity, and complexity of vegetation within RHCA. Specific actions that have the potential to affect riparian vegetation include: vegetation management, roads and stream crossings and riparian restoration activities. Changes in riparian vegetation can affect aquatic habitats and ultimately influence aquatic species.

Measure 4: Aquatic Species Habitat

This measure addresses the potential effects to aquatic species from changes to stream habitats including: rates of large woody debris recruitment, pools and streambank condition (% stream bank stability, channel width to depth ratio). Specific actions that have the potential to affect these aquatic habitat parameters include: vegetation management in RHCAs, roads and stream crossings and riparian restoration activities. Changes in aquatic habitats can affect aquatic species populations.

Affected Environment

Watersheds

The project area is contained within portions of two watersheds (10th field); the Upper North Fork Crooked River and the Horse Heaven Creek-Crooked River. Within the Upper North Fork Crooked River, the project is located within portions of the Headwaters North Fork Summit River and Gray Creek Subwatersheds. The project lies within portions of three subwatersheds of the Horse Heaven Creek-Crooked River watershed: Upper Horse Heaven Creek Subwatershed, Lower Horse Heaven Creek Subwatershed and Lost Creek Subwatershed.

The Upper North Fork Crooked River watershed drains to the north and east into North Fork Crooked River, which eventually flows into the Crooked River off National Forest between Post and Paulina, Oregon. The Horse Heaven Creek-Crooked River watershed drains south into the Crooked river. These systems are all within the Upper Crooked Sub-Basin, and the larger Deschutes River Basin.

Additional information on stream flow, base flow, water yield, peak flow, water rights, water quality, springs and reservoirs are included in the hydrology report. For this analysis the Gap project boundary is the affected environment and cumulative effects boundary is the five subwatersheds listed above.

Streams

There are approximately 95.6 miles of mapped streams within the project area (figure 26 and table 129).

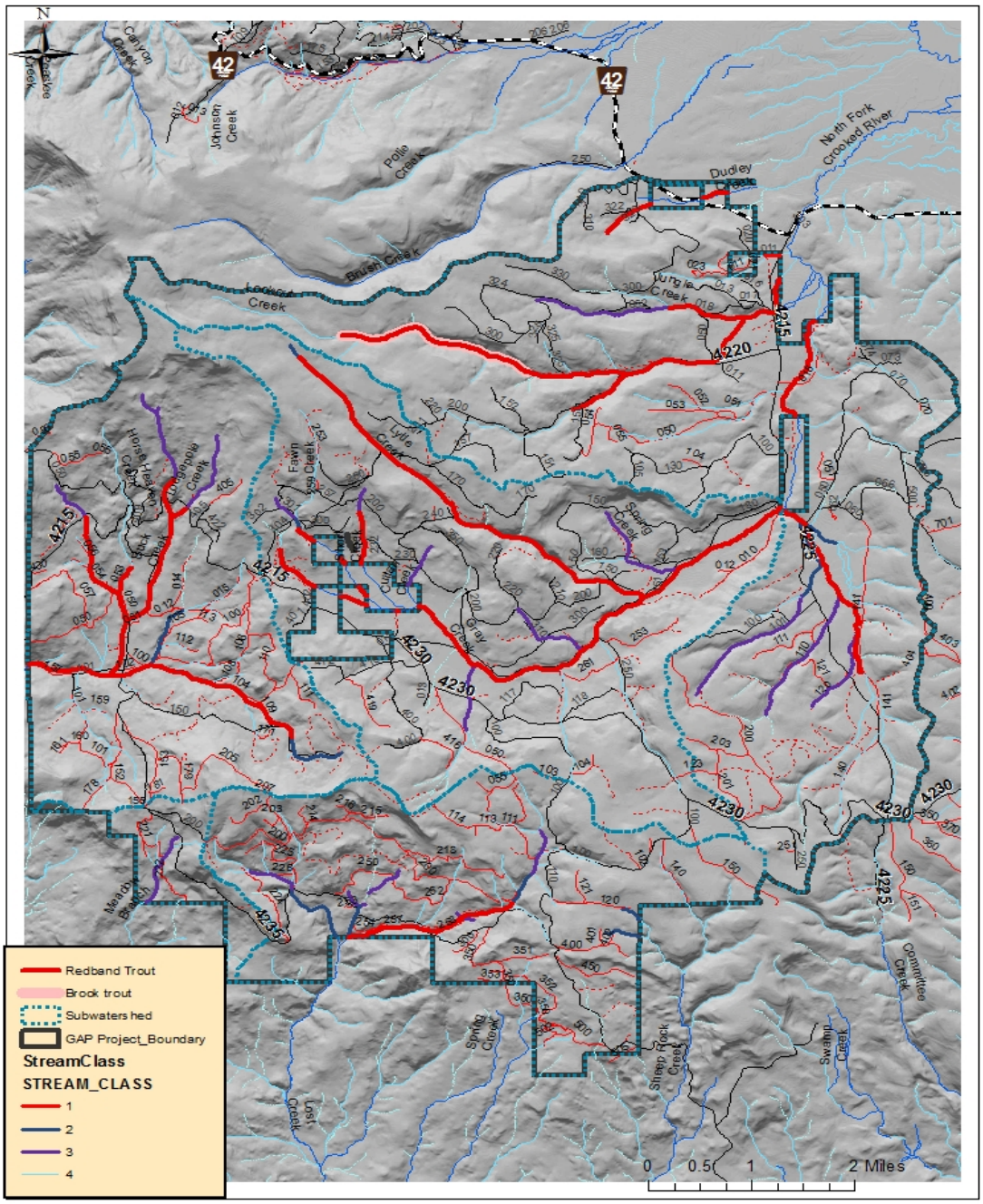


Figure 26. Stream Class and Mapped Extent of Fish Distribution in Project Area

Table 129. Miles of Stream (by class) in the Project Area.

	Class I	Class II	Class III	Class IV	Totals
Upper North Fork Crooked River					
Gray Creek Subwatershed					**20.87**
Cuitan Creek			0.49		0.49
Fawn Creek				1.35	1.35
Gray Creek	4.79	0.55	0.32		5.66
Lytle Creek		4.71			4.71
Short Creek		0.59	0.26		0.85
Spring Creek			1.15		1.15
Unnamed Creek(s)		0.85	1.64	4.17	6.66
Headwaters North Fork Summit River Subwatershed					**39.85**
Dudley Creek		0.81			0.81
Jungle Creek		0.79		0.57	1.36
Lookout Creek		4.64		1.62	6.26
N. Fork Crooked River	1.08	2.35		1.66	5.09
Unnamed Creek(s), includes Long Prairie Creek	0.15	2.37	5.57	18.24	26.33
Horse Heaven Creek-Crooked River					
Lost Creek Subwatershed					**14.17**
Lost Creek	0.69	1.42	0.51	0.62	3.24
Unnamed Creek(s)		1.74	1.41	7.78	10.93
Lower Horse Heaven Creek Subwatershed					**1.91**
Meadow Branch			0.44	0.48	0.92
Unnamed Creek(s)			0.42	0.57	0.99
Upper Horse Heaven Creek Subwatershed					**20.77**
Buck Creek		1.74	1.02		2.76
Horse Heaven Creek	0.87	1.27		1.67	3.81
Little Horse Heaven Creek		2.86			2.86
Lodgepole Creek		0.17	0.93		1.1
Unnamed Creek(s)		1.72	0.55	7.97	10.24

Riparian Habitat Conservation Areas

In accordance with the Ochoco National Forest LRMP and the Inland Native Fish Strategy (INFISH), all streams, wetlands and other water features in the watershed analysis area are designated Riparian Habitat Conservation Areas (RHCA's). There are 4993.3 acres (13.1%) of RHCA mapped within the project area. The width of each RHCA depends upon the stream category or class listed below (see draft Hydrology report). Table 130 provides detail for each RHCA type within the project area. Figure 26 provides a graphic of the mapped streams, their stream class and fish distribution.

Table 130. RHCA acres by stream class in the Gap project area.

	Gray Creek Sub-watershed		**Headwaters North Fork Summit River Sub-watershed**		**Lost Creek Sub-watershed**		**Lower Horse Heaven Creek Sub-watershed**		**Upper Horse Heaven Creek Sub-watershed**		**Total**	
Gap Project Acres	10,012.3		13,694.0		6,081.7		792.2		7,565.5		38,145	
RHCA Class	RHCA Acres	%	RHCA Acres	%	RHCA Acres	%	RHCA Acres	%	RHCA Acres	%	RHCA Acres	%
Stream Class I	344.9	3.4	90.3	0.7	49.2	0.8	NA	NA	65.7	0.9	550.0	1.4
Stream Class II	505.9	5.1	757.0	5.5	236.7	3.9	NA	NA	555.3	7.3	2054.9	5.4
Stream Class III	804.6	8.0	622.0	4.5	100.2	1.6	44.8	5.7	268.1	3.5	1839.8	4.8
Stream Class IV	68.8	0.0	256.6	1.9	100.1	1.6	12.1	1.5	111.0	1.5	548.6	1.4
Total	1,724	16	1,725	12.6	486.1	8.0	57.0	7.2	1,000	13.2	4,993	13

INFISH uses stream category and GIS data layers use stream class. Listed below are the RHCA acres within each stream category and the crosswalk to stream class.

Category I streams are fish bearing, perennially flowing streams (**Class I and II streams**) with RHCAs extending 300 feet slope distance from the stream channel (600 feet wide), including both sides of the stream channel. There are approximately 36.2 miles of Category I stream in the Gap project area. The RHCAs for the Category I streams encompass 2,605 acres.

Category II streams are non-fish bearing, perennially flowing streams (**Class III streams**) with RHCAs extending 150 feet slope distance from the stream channel (300 feet wide), including both sides of the stream channel. There are approximately 14.7 miles of Category II streams in the Gap project area. The RHCAs for the Category II streams encompass 1,840 acres.

Category III RHCAs are located along ponds, lakes, reservoirs, and wetlands greater than one acre (possibly fish-bearing) with RHCA buffer area extending 150 feet slope distance from the water. Category III RHCAs are 300 feet wide including both sides of the stream channel. The RHCAs for the waterbodies encompass 1,338 acres.

Category IV streams are seasonally flowing or intermittent streams (**Class IV streams**) and wetlands less than one acre and have RHCAs extending 50 feet slope distance for the water. Category IV RHCAs are 100 feet wide including both sides of the channel. There are approximately 46.7 miles of Category IV streams that encompass approximately 549 acres of RHCA in the Gap project area.

Existing Condition for Streams and RHCA

Stream and riparian conditions in the Gap project area were adopted from the Big Summit (2009) and Fox Canyon Allotment Management Plan (AMP) (2013), existing data (including GIS) and field reconnaissance (2014-2015); Proper Function and Condition (PFC) information and other monitoring indicators for allotments can be found in the Range report.

Historically, the Gap project area provided higher quality aquatic habitat than it does today (ODFW 1996). Over-time, channel alterations have occurred resulting in a loss of quality pools, spawning gravel, cold-water refugia, back-water rearing areas and hydrologic function. Riparian vegetation has been altered on most streams through direct impacts or indirectly through the loss of soil moisture retention characteristics. Thus, the current types of and densities of riparian vegetation lack the same capacity as historic vegetation to control bank stability, maintain channel stability, supply woody debris to streams and provide shade. Historically, streams in this area were once populated with aspen, willow, black cottonwood and dogwood. Today, forested riparian areas are dominated by coniferous tree species in their overstories and vegetative structure is dominated by the small tree category (9-20.9" dbh). Riparian shrubs such as willow and alder are present, however their distribution is widely scattered and localized. There are substantial stands of willow along lower Gray and NFCR (below William's Prairie). Other shrub species, such as snowberry, mock orange, hawthorne and serviceberry can be found. However, most shrubs show signs of heavy pressure from browsing animals.

With the advent of organized fire suppression, fire return intervals have been greatly increased, resulting in higher vegetation densities. Riparian areas exhibit high stocking densities above historic levels within the watershed. During the summer months, warmer temperatures reduce fuel moistures and increase the chance of large scale stand replacement fire. Drainages with north aspects have denser vegetation and a higher moisture regime than southern aspects. Forested riparian connectivity can be naturally broken due to the scabland stringer environment created by the geomorphic terrains within the watershed. However, riparian areas that have been associated with past management activities are dominated by smaller tree structure. Riparian areas that have been unroaded and unmanaged within the watershed consist of older seral structures. Factors contributing to changes in riparian vegetation communities with the Gap project area include timber harvest, road building, fire suppression, reduction in beaver activity, and livestock grazing. The Big Summit and Fox Canyon AMP were authorized in 2009 and 2013 respectively; it is anticipated that many of the riparian and stream channel conditions will improve (USDA Forest Service 2009, 2013).

Limited data of stream channel conditions makes it difficult to establish trends for most habitat parameters. Still, the Ochoco National Forest has conducted Bottom Line Surveys (BLS), Level II Surveys, and other stream inventories or surveys in the major drainages on Forest Service lands. Survey data provides comparative information on parameters such as width/depth ratios; entrenchment, shade, cutbanks, woody debris and pools by channel type (see table 135). Channel typing was based on the Rosgen stream classification system and is widely used for this purpose because it permits easy communication of channel characteristics and provides a method for interpretation of channel development and stability (Rosgen, 1996). In general terms, A-type channels are relatively steep, straight, and narrow (e.g. mountain stream), B-type channels are transitional between the A and C-type channels, and C-type channels are relatively low-gradient, with wide meanders in larger floodplain areas. E-type channels tend to be relatively narrow and deep while meandering even more than C-type channels. F and G-type channels are generally degraded channel forms that can roughly be described as troughs and gullies, respectively; refer to figure 27 below.

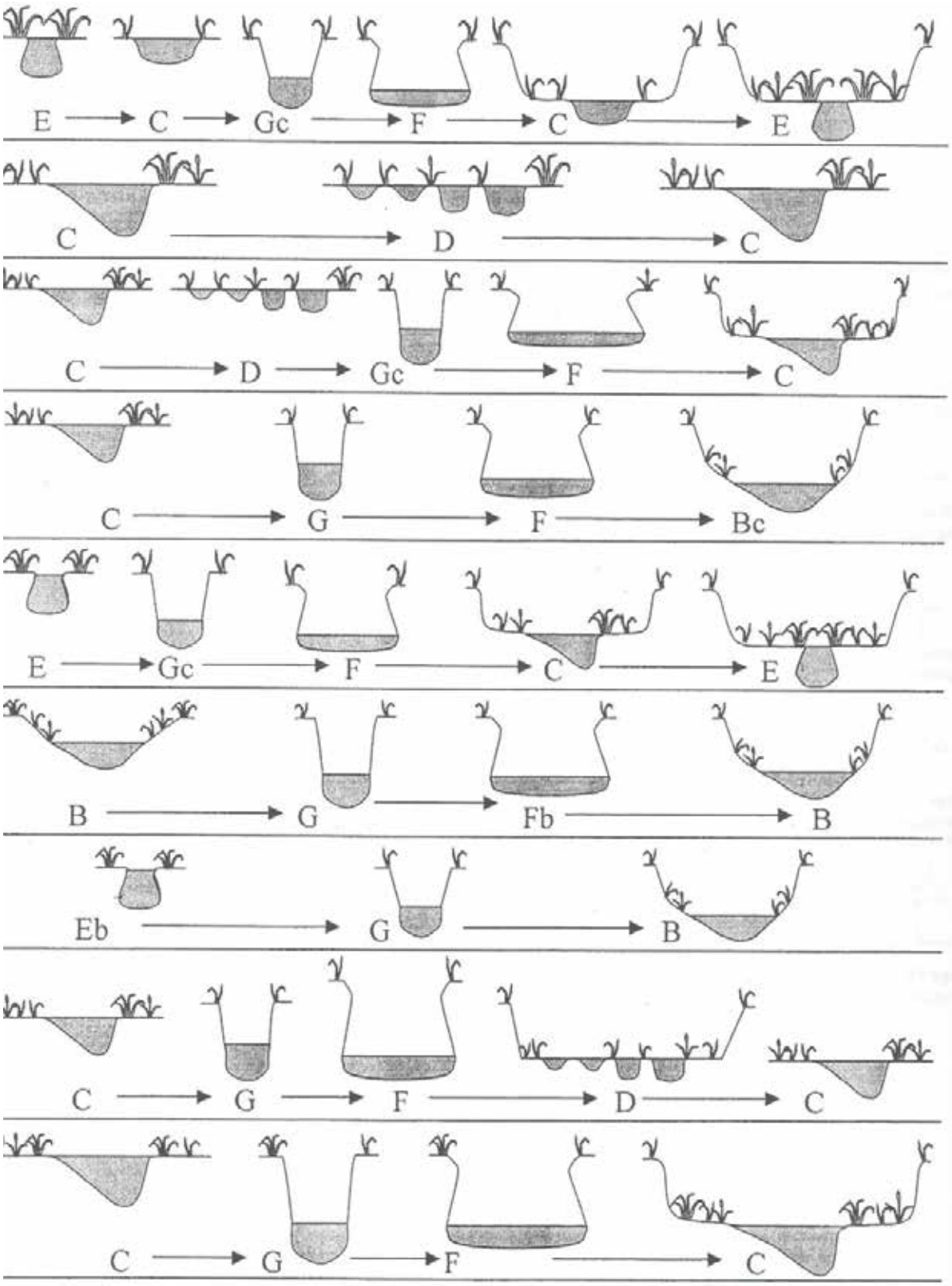


Figure 27. Channel evolution, stability and development diagram (from Rosgen 1996).

Gray Creek Subwatershed

Based on electro-fishing evaluations, conducted by the Oregon Department of Fish and Wildlife (ODFW) and stream surveys conducted by Ochoco National Forest personnel, redband trout have been and are currently present in Gray Creek, Lookout Creek, Dudley Creek, Jungle Creek and Lytle Creek. Formal Columbia spotted frog surveys have not been conducted, but past habitat surveys have documented sightings and suitable habitat exists for them. Spring Creek is a class III intermittent stream and may see some seasonal use by fish and frogs.

Stream-side trailing by cattle is common along portions of these streams, which is attributing to downcutting, bank instability, headcuts and the stream channel to become braided and undefined in places (figure 28).

Figure 28. A downcut section of Lower Jungle Creek above confluence with Lookout Creek.

Lost Creek Subwatershed

Past Forest Service, Bottom Line Surveys (1993, 1999) and personal observations (A. Martin 2008) indicate the presence of redband trout in the lower reaches of Lost Creek. Fish were found in relatively high abundance up to an upstream fish migration barrier, formed by a six foot high bedrock outcropping, in the East Pasture. Excellent spawning and rearing habitat is present up to this point. For example, in 1999, ODFW collected over 30 redband trout in a 300-foot reach. Formal Columbia spotted frog surveys have not been conducted, but past habitat surveys have documented sightings and suitable habitat exists for them throughout the area

Upper Horse Heaven Creek Subwatershed

ODFW electrofishing surveys show that redband trout as well as bridgelip suckers and speckled dace exist in various areas of Horse Heaven Creek, Little Horse Heaven Creek and Buck Creek on the ONF. Formal Columbia spotted frog surveys have not been conducted, but past habitat surveys have documented sightings and suitable habitat exists for them throughout the area. Fish and Columbia spotted frog distribution and abundance information is lacking for Lodgepole Creek.

Lower Horse Heaven Creek Subwatershed

Meadow Branch Creek

Fish and Columbia spotted frog distribution and abundance information is lacking for Meadow Branch Creek. Based on fish distribution information for streams in the south-central region of the ONF, it is unknown but redband trout could occupy the lower end of this stream during the wet season, but relocate downstream to the perennial portion of the stream off the Forest during the low water season. Columbia spotted frogs may be found in the meadow/spring areas at the headwaters of Meadow Branch Creek. Habitat data are lacking for this stream; however, Meadow Branch Creek is a Class 4 channel within the Lost Horse Allotment.

Status of fish and frog populations and factors affecting populations

Redband trout

Redband trout are still distributed widely throughout their historic range, however, hybridization with hatchery rainbow trout and habitat loss have produced dramatic declines in the number of strong[11] populations (USFS 2000a). Within the Gap project area they are widely distributed but are still sensitive to disturbance and considered vulnerable to local extirpations due to habitat connectivity issues related to fish passage barriers (culverts and headcuts). In the 1996 Crooked River Basin Plan (ODFW), population conditions were described for the entire Crooked River basin:

- North Fork Crooked River: The status of redband trout populations is mixed. Redband trout are moderately abundant in tributaries with good habitat and cool water but are depressed in tributaries with poor fish habitat or degraded riparian conditions. Much of the basin has fragmented and isolated populations of redband trout due to temperatures barriers and culverts that block upstream passage.
- A study conducted by Stuart et al. (2007) that included areas of the Ochoco National Forest and Crooked River National Grassland, found the following on habitat condition and population status:
    - Redband trout inhabit most major watersheds and tributaries in the basin. However, relative abundance appears to be directly related to quality of habitat, which range from excellent to very poor. Streams with good to excellent habitat generally had redband trout densities > 1 fish/m2. Streams with poor habitat had lower abundance of fish, generally < 0.5 fish/m2.
    - Redband trout were present in all or parts of 45% of the watersheds in the basin. Strong populations were limited to 7% of the basin mostly in the headwater sections found on Federally owned lands.
    - Despite the overall degraded condition of the habitat in the basin, abundance and growth of redband trout are similar to other streams in central and eastern Oregon. Redband trout were in both large and small streams were found to live at least 6 years and sometimes longer.

[11] Strong populations have the following characteristics: a) All major life-history forms that historically occurred within the subwatershed are present; b) numbers are stable or increasing and the local population is likely to be at half or more of its historical size or density; c) the population or metapopulation within the subwatershed, or within a larger region of which the subwatershed is part, probably contains at least 5,000 individuals or 500 adults.

Redband trout in the Crooked River are composed of two populations; one above the falls on the North Fork, the other throughout the rest of the basin (Stuart et al. 1996). The Gap project area is located above the falls. Within the known occupied habitat in the Crooked River, 85 percent of the redband trout populations are depressed and only 15 percent are considered strong. Historically, redband trout were found throughout many of the perennial waterbodies within the Upper North Fork and Lower North Fork watersheds. Most of these populations were interconnected during spring runoff events and into early July, which allowed fish to access abundant spawning areas and distribute to higher quality, summer rearing habitat before the low-flow season. However, due to past and current habitat degradation (e.g. loss of riparian plants, excessive erosion and sedimentation, loss of water table) from past road building, logging, and grazing management and impassable barriers from culverts and headcuts, many of these populations are no longer interconnected and are depressed from their historic levels.

Based on electro-fishing evaluations, conducted by the Oregon Department of Fish and Wildlife (ODFW) and Ochoco National Forest personnel, redband trout have been and are currently present in the project area. However, the population numbers of redband trout have decreased throughout the historic range over time and non-native species have been introduced. ODFW's Crooked River Basin Plan (Stuart et al. 1996) states that "Those streams with good habitat exhibit redband trout densities greater than 1/yd², whereas those with poor habitat have redband trout densities less than 0.50/yd²."

Lower numbers of redband have resulted from the cumulative effects of loss of riparian vegetation (particularly hardwood trees) bank erosion, increased sedimentation (which can suffocate incubating trout eggs), entrenched streams, loss of beaver and woody debris, and altered stream channels.

In Brush Creek very close to the Gap project area, Dambacker and Jones (2007) indicated that population densities were 0.39 fish/m^2 for redband and 0.27 fish/m^2 for brook trout for the ≥ age 1 fish. In Stuart et. al (2007), studies from 1990-1994 indicated that fish abundance varied from <0.1-1.4 fish/$m^{2.}$ It is unknown at this time what the trend is in population numbers (table 131).

Table 131. Redband Trout densities on streams within the project area (Data from ODFW).

Watershed	Stream	Date	Fish/m^2
North Fork Crooked River	N. F. Crooked River	July 1990	<0.1
	Gray	**July 1994**	**0.1**
	Lookout	**August 1991**	**0.8**
	Brush	August 1991	1.4
	E. Fork Howard	July 1991	0.5-0.7
	W. Fork Howard	July 1991	1.0
	Howard	July 1991	0.8
	Porter	August 1992	0.4

Brook trout (Salvelinus fontinalis)

Brook trout are another non-native salmonid introduced to the west. Their native range covers much of eastern North America (Page and Burr 1991). While browns can out-compete native rainbows at higher temperatures, brooks tend to do best in cold streams, below 18°C (Wydoski and Whitney 1979).

Brook trout spawn in October or November and redds are typically built in headwater reaches with good flows and temperatures colder than 50°F. Eggs hatch in approximately 3 months, and juveniles emerge in the spring. Sexual maturity is reached at 2 or 3 years of age.

Length frequency distributions of fish sampled in August in Lookout and Brush creeks suggest that young of the year are 0-2 inches, age 1+ are 2-3 inches, age 2+ are 4-6 inches, and the largest fish reach approximately 9 inches. Brook trout are carnivorous and eat a wide variety of organisms including aquatic and terrestrial insects, crustaceans, spiders, mollusks, amphibians and other fish.

Fish Distribution

Fish distribution information on the Ochoco National Forest (ONF) and Paulina RD comes from several sources. First, physical habitat stream surveys conducted by ODFW and the Forest Service often note the presence of redband when they're encountered. Second, the ONF stream classification nomenclature assigns a number from I-V, with class I and II being fish bearing waterbodies. This information has been gathered and revised by fishery biologists and hydrologists over a period of many years and is based on visual observations. While both of these classifications are indeed field verified, there are often discrepancies between methods and some uncertainty still exists, as noted in the table below.

Stream surveys and field visits are primarily conducted during the warm summer months when many streams are at or near base flow. Thus we should expect that the distribution information in table 132 below, and figure 26 to be a very conservative determination. When flows are higher, particularly during spring runoff, it is reasonable to expect that individuals move farther upstream, especially during the spawning periods of March, April and May. Also, due to considerable inter-annual flow variability actual distributions probably vary significantly.

Table 132. Amount (miles) of Redband trout and Brook Trout habitat in the Gap Project Area by subwatershed.

Species	Gray	Headwaters North Fork Crooked River	Lost Creek	Upper Horse Heaven Creek	Lower Horse Heaven Creek	Total
Redband Trout	11.5	12.2	3.9	6.9	0.0	**36.2**
Brook Trout	0.0	0.0	2.0	0.0	0.0	**2.0**

Habitat connectivity for redband trout is moderately compromised in the project area. Several culverts are not passable to fish or likely other aquatic organisms including priority culverts in the lower and mid-level in the drainage and on the lower portions of significant tributaries where the higher value fish habitat exists. This information is important for understanding intra-watershed connectivity and identifies those culverts in need of maintenance and/or replacement. Besides degrading habitat and affecting water tables, headcuts also restrict fish connectivity; the project area contains numerous headcuts that were identified in field reconnaissance and other analyses (USDA Forest Service 2008, 2013). No active water diversion ditches exist within the project area. Several historic diversion ditches can be found within the project area.

Dunham et al (2003), suggests that the vulnerability of fish to large scale disturbance events (including fire) is contingent upon the quality of affected habitats, the amount and distribution of habitat and habitat specificity of the species in question. Species with narrow habitat requirements in highly degraded and fragmented systems are likely to be the most vulnerable to fire and fire-related disturbance. The authors suggest that pre-fire management may be the most likely to be effective activity that will address factors that may render fish populations more vulnerable to the effects to fire (e.g., habitat degradation and fragmentation). In places where these factors pose threats, persistence of populations is already compromised, and the effects of fire could be more severe. Common examples include restoration of fish passage and management of roads.

Similarly, climate change poses risks to aquatic species driven by an alteration of ecological systems. Lawler et al., 2008, summarize that in Oregon, climate models generally project increases in atmospheric temperature and decreases in snowpack. Slight increases in winter precipitation and small decreases in summer precipitation are predicted.

Increased atmospheric temperatures will exacerbate the effects of loss of riparian vegetation and ongoing stream-water withdrawals, resulting in higher stream temperatures and further fragmenting and reducing redband trout habitat in the Gap project area. Higher temperatures may also reduce snowpack and will probably alter flow regimes and sediment loads, potentially burying gravel essential for spawning.

Lawler et al., 2008 and others suggest that in order to protect biodiversity and natural resources it will be necessary to address climate change in management plans. The authors suggest that strategies designed to increase connectivity or remove other stressors, such as dams and other barriers (e.g., headcuts and culverts) and restoration of riparian ecosystems are likely to be most effective to combat the uncertainties of climate change.

Columbia spotted frog

Historically the Columbia spotted frog was found at elevations ranging from near sea level to 7,370 feet. Their range extended from southeast Alaska through British Columbia, eastern Washington and Oregon to northeast California and eastward to western Montana and Wyoming, and northern Utah. Columbia spotted frogs have been found on the Ochoco National Forest and the Crooked River National Grassland, and are present within the project area.

Columbia spotted frogs are highly aquatic, thus they are generally found in close proximity to water in riparian habitat. In winter months, the frogs burrow into mud in wet meadows or in streams. They breed in shallow water areas such as stream margins or pond edges, flooded meadows, or in pools of water formed by snow melt from early March through the end of May. Timing of breeding is dependent on snowmelt and rising water temperatures. After hatching, the larval stage (tadpole) remains in the water until metamorphosis into the adult form. Adults utilize both water habitat and nearby riparian areas for foraging and refuge needs.

Columbia spotted frogs habitats are generally near permanent bodies of water which can include lakes, ponds, slow-moving streams, and marshes. Improvements in fish habitat, riparian plant communities, sediment production, and channel stability would also improve Columbia spotted frog habitat.

Little is known about amphibian populations within the Gap project area. Most information is anecdotal and limited to occasional presence/absence notes taken during Level II stream surveys. Sightings where the observer could not identify the animal to species-level are not been included here, although several such instances occurred (Paulina ranger district stream survey files). The Columbia spotted frog is the only amphibian on the Region 6 Sensitive Species list found in the project area. Potential CSF (Columbia spotted frog) habitat includes class I, II and III streams on in the project area.

Of the commonly known threats to this species, loss of wetland habitat due to drought, channel incision (i.e., loss of floodplain connectivity), and agricultural water withdrawals are of greatest concern here. The most widely distributed predator, the American bullfrog (*Rana catesbeiana*), is not known to exist within the watershed although populations are nearby. Non-native, predatory fishes such as brook trout (*Salvelinus fontinalis*) are present in Lookout creek and may negatively impact local populations. Climate change may exacerbate degraded water quality parameters specifically through increased temperature and advance the distribution of non-native species (into habitats occupied by redband and CSF) potentially further affecting stressed populations (USDA 2012). The true distribution and population trend in spotted frog populations remains unknown.

The quantity and quality of amphibian habitat varies considerably throughout the project area. Breeding habitat for most species is usually limited to perennial streams, wetlands and springs. These habitats are relatively numerous in the project area but, many of are moderately to severely degraded, upper north fork Crooked river (Williams Prairie), Gray Creek (Gray Prairie), and lower Horse Heaven Creek.

Similar to fish, it could be assumed that the vulnerability of amphibians to fire, disturbance and climate change is contingent upon the quality of affected habitats, the amount and distribution of habitat and habitat specificity of the species in question. Species with narrow habitat requirements in highly degraded and fragmented systems are likely to be the most vulnerable to fire and fire-related disturbance. A recent study by Hossack et al., 2013, documented rapid growth in restored wetlands in areas of historical population declines that provided strong evidence of successful management. The results highlight the importance of maintaining and restoring large areas of habitat and underscore the greater vulnerability of small areas of habitat to environmental changes. Similar long-term growth rates in modified and natural water bodies and rapid, positive responses to restoration suggest pond construction and other forms of management can effectively increase population growth. These tools are likely to become increasingly important to mitigate effects of increased drought expected from climate change.

Water Quantity and Quality

Information on stream flows, peak flows, water yield and EHA are discussed in detail in the Hydrology report.

Water Quantity

Flows are highly variable within the project area. Primary runoff typically occurs between late-March and mid-May although ground water resources (base flow) remain available in several project area streams throughout the year although the upper reaches may become dry. The lower reaches of the larger tributaries maintain flow on Forest Service Lands during most years. Perennial springs along several named and unnamed streams provide isolated habitat for fish of various age classes or supply thermal refugia to stream that are otherwise temperature impaired for spawning or rearing.

Water Quality

Fine Sediment:

Potential sediment delivery for the existing condition has been modeled in the Hydrology report and summarized in the DEIS. Occurrence of more than 20% of unstable banks can be an indication of degraded aquatic habitat resulting in changes in substrate composition, and reduced ability of woody and riparian plants to increase and expand (USDA 1995[a] [b]). Unstable banks can result from management or acute natural disturbance event. Increases in fine sediment in streams due to erosion from unstable banks, and corresponding reduction in spawning and rearing success are indirectly tied to the amount of unstable banks within stream drainages. Percent cutbanks are exceeded in Jungle Creek (R1&3), Gray Creek (R1) and Lytle Gray Creek Trib 3 (R1). Many of these streams currently have active headcuts that are migrating upstream; contributing fine sediment, eliminating pools, and simplifying stream habitat. Substrate is important in the breeding and incubating of fish, but is also important in over wintering inland fish seeking thermal protection. Unstable banks can lead to changes in substrate, which in turn can reduce the frequency and quality of pools, as infilling of pools occurs and interstitial spaces between gravel and cobble fills. Changes in substrate that decrease the percentage of gravel and cobble or that armor the stream bed are associated with reduced survival of eggs and alevins, reduced primary and secondary productivity, interference with feedings, behavioral avoidance and breakdown of social organization, and pool filling (USDA 2012 GTR-290).

Where data exist, some streams within the Project area contain greater proportions of fine sands than what one would expect from the overall morphological classification of individual streams and reaches. These streams include: Dudley (R1), Gray (R1&2), Jungle (R1), Lookout (R2), Lytle (R1) and most of the Horse Heaven system This occurrence is linked with the strong occurrence of unstable stream banks within those area. Given the number of streams with reaches not meeting RMO for unstable banks, it is reasonable to conclude that substrate is also impaired. Cobble embeddedness is a filling of the interstitial spaces of stream bed materials with fine sediment. As exhibited by surveys, fine sediment varies tremendously across the watershed and even within streams. Lows of 12% fine sediment and highs of 100% show that variability.

Roads can also have an effect on fine sediment delivery to streams and aquatic habitat. During rain or melt off events water can run on compacted road surfaces until it leaves the road and enters a ditch. If ditches or relief culverts run into stream networks without adequate filtration (buffers) they can introduce fine sediments. Roads have been analyzed for their impacts to water quality and quantity in the Hydrology report. Table 133 displays road miles in RHCA by stream class.

Table 133. Miles of road in RHCA for each stream class by maintenance level.

Maintenance Level	Class 1	Class 2	Class 3	Class 4	Grand Total
1 - BASIC CUSTODIAL CARE (CLOSED)	1.5	5.5	3	4.2	14.2
2 - HIGH CLEARANCE VEHICLES	47	8.9	8	2.3	23.9
Grand Total	**6.2**	**14.4**	**11.0**	**6.5**	**38.1**

Sediment (embeddedness) is not identified in the RMOs for INFISH but is an important habitat feature for fish and is defined as an Ochoco National Forest Plan Monitoring Action (ONFLRMP section 5-3). For purposes of this analysis, average % fines <2mm, is being used as a surrogate for % embeddedness. A study by Suttle et al (2004) looked at how fine sediment in riverbeds impairs growth and survival of juvenile salmonids, defined fine sediments as particle sizes <2mm. This study found that there is no threshold below which exacerbation of fine sediment delivery and storage in gravel bedded rivers will be harmless, but also that any reduction could produce immediate benefits for salmonid restoration.

The National Marine Fisheries Service (NFMS) defines a range of sediment relative to functional categories (Properly Functioning, Functional at risk and Non Functional) for use in analysis of effects to salmon and steelhead trout. However it is important to point out that NMFS uses a 0.85mm to define fine sediment. Though the project area does not contain T&E species (salmon or steelhead trout), these 'thresholds' provide a useful surrogate for effects to redband trout. When comparing the most recent (2007- 2013) survey data (Wolman pebble count) some of the major tributaries in the project area, would rate as Not - Properly – Functioning under the criteria found in table 134.

Table 134. MATRIX of PATHWAYS AND INDICATORS (for fine Sediment)

PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
< 12% fines (<0.85mm) in gravel3, turbidity low	12-20% (east-side)2, turbidity moderate	>20% (east side)2 fines at surface or depth in spawning habitat2, turbidity high

PACFISH/INFISH Biological Opinion (PIBO) data (table 135), on NF Crooked, illustrates that average % fines <2mm remained roughly the same in 2006 (8.1%) and 2011 (8.8%) well within the Properly Functioning range. It is important to note that these data were the result of a single survey in a single location.

The same survey recorded streambank stability to be nearly 100% up from 97.9% in 2006 and 83.3% in 2001, indicating an improving trend consistent with the low percentage of fine sediments found in the streambed substrate.

Table 135. PIBO data for Gap Project Area.

Stream	Year	% Pool	Width to Depth Ratio	% Fines <6mm	% Stable banks	LWD Frequency	Lower Bank Angle
N.F. Crooked	2001	72.73	14.08	NA	83.33	24.24	135
N.F. Crooked	2006	26.46	18.02	8.1	97.87	10.58	126
N.F. Crooked	2011	21.37	10.04	8.84	100	10.68	132
Gray	2011	63.24	12.13	8.16	100	15.81	112

Water Temperature and Stream Shade

The Existing Condition for stream shade and temperature have been analyzed in the Hydrologist report.

Stream temperature and flow vary considerably both seasonally and spatially, despite the spring-fed nature of many of these streams. In the winter months, water temperatures throughout the watershed are typically cool and certain shallow reaches may freeze completely (particularly those with excessively high width: depth ratios and reduced riparian vegetation). State standards for temperature are often exceeded in the summer months from June to September when stream flows are low and incoming solar radiation is high. The Oregon Department of Environmental Quality (ODEQ) stipulates that, for support of resident fish, the average of the daily maximum stream temperature during any seven consecutive days shall not exceed 64°F (ODEQ).

The maximum seven-day average stream temperatures from many streams in the project area have consistently surpassed the ODEQ 64°F standard. The Gap Hydrology report displays the ODEQ 303(d) listed streams found in the project area.

Temperatures of 60 degrees °F are considered ideal for rapid growth of rainbow trout (Leitritz and Lewis 1980). For the Gap project area, water temperatures are above 60 degrees °F during the hottest time of the year (July and August) and are below 56 degrees °F during the cooler months of October to March prior to fish spawning. Females are most productive when they are in water where temperatures do not exceed 56 degrees °F for six months before spawning (Leitritz and Lewis 1980). It is generally understood that inland rainbow (redband) trout are most successful in habitats with temperatures of 70 degrees or slightly lower, but can survive if there is cooler, well-oxygenated water into which they can retreat as the surface waters warm over 70 degrees °F. Water temperatures of 70 degrees °F or higher, except under otherwise ideal conditions may cause stress to fish, which may lead to disease or in some cases death for all age categories.

For aquatic ecosystems, particularly those containing rare salmonids, stream temperature is a critical variable structuring species distributions, patterns of abundance, and life history characteristics (Brannon and others 2004; Portner and Farrell 2008: Wenger and others 2011a – in USDA 2010). Both climate change and fire have strong influences on the energy balance of streams, primarily increasing temperatures, meaning that shifts to stream temperature regimes are among the principal processes driving changes to fish populations (Dunham and others 2003; Rieman and others 2007; Isaak and others 2010 in USDA 2012).

(Luce and others, 2012 in USDA 2012) warn that stream warming, through a variety of means, is predicted to shrink the extent of habitat patches for cold-water fish of conservation concern and increases the isolation of populations by pushing them farther into headwater streams.

At the same time, decreases in lows flows and increased debris flood responses in steep tributaries may shrink habitats from above, further restricting populations and increasing the potential for debris flows disturbances. If decreases in low flows and temperature related growth and productivity changes also decrease the number of migratory fish from these areas, the populations may increase in their vulnerability to individual fire or flood events.

Shade: Shading from vegetation and topography is often thought of as having the largest effect on stream temperatures. Hardwood shrubs are particularly effective at shading the stream as they provide a dense canopy close to the water surface, while conifers usually have lighter foliage that is farther above the surface of the water. Narrow valley-bottoms, often in concert with vegetation, can also provide significant shading.

While shade from vegetation and topography are the primary factors regulating the amount of solar energy reaching the stream surface, several other features such as the surface area of the stream (i.e., width to depth ratios) can effect water temperatures.

Width to depth ratios tend to increase with lateral instability. That is, as streambanks erode or are trampled, the stream becomes wider and this ratio increases. A wider stream has greater exposure to sunlight and can become warmer in summer and cool faster in winter if no mitigating factors are present. The majority of streams within the project area are not meeting the Forest standard of 80 percent surface shade. However, several streams or reaches of streams are near the Forest standard. Overall, riparian vegetative potential (and associated stream shade) is assumed to be much greater than what currently exists, particularly hardwood shade.

Riparian Vegetation

Outer Zone: The majority of this project area, including RHCAs outside of the perennially wetted riparian areas, historically experienced frequent low intensity wildfire as a dominant disturbance process. This disturbance regime maintained areas in a more open, less dense condition that was often dominated by large trees of fire tolerant species. Today large trees are less abundant, stands are denser, within stand spatial diversity has declined, fire intolerant species have become established and fuel loads have increased. Currently, about 64% of the area within RHCA is in a condition considered to be at high risk to insects and disease (see Silviculture report).

More of the watershed is covered by dense stands of small trees than were present historically. Prior fuels treatments including stands that were thinned and/or burned in the 1980s, 90s, and early 2000s have most likely suffered decreased effectiveness as fuel loadings can be expected to trend toward pre-treatment conditions in 7 – 20 years after treatment (see Fuels report). For the Gap project, Fire Regime I is characterized by ponderosa pine, Douglas-fir, and dry grand fir vegetation types. It has a fire frequency of 0-35 years with low to mixed fire severity. These fires generally replaced less than 25% of the dominant overstory (low severity), but could have replaced as much as 75% of the overstory during a mixed severity fire event (see Fuels report). Fire Regime Condition Class I-III is present within the Gap project area. Within the Gap project 17% of the forested project area is classified as low departure Fire Regime CC1, while 35% is moderate departure Fire Regime CC2 and 48% is high departure Fire Regime CC3. Fire regimes were not calculated for RHCA because they are intended to be analyzed on the landscape scale, but it is assumed that because of the small sizes of most streams in the planning area (<15 feet wide), vegetation in RHCA is generally represented by the project level fire regime analysis.

***Inner zone*:** As described in the Water Temperature and Stream Shade section, and other resource areas, in many areas hardwoods have declined due to competition from conifers, big game and livestock grazing and stream down-cutting. Riparian vegetative potential (and associated stream shade) is assumed to be much greater than what currently exists.

A large percent of native vegetation attributes along stream corridors, wetlands and water bodies are not in proper functioning condition (see above Existing Condition of Streams section). These ratings were based upon the Vegetation Condition Attribute of the Watershed Condition Framework (see Hydrology report) and PFC survey data. Riparian woody species (long rooted species) bind the soil together and create a stable streambank; these woody species also create a shaded climate for fish, frogs and insects. Woody species provide hiding cover from predators for redband trout and Columbia spotted frogs.

Aquatic Habitat

Besides stream flow and temperature (and by extension, shade), the greatest factors affecting redband trout life history within the project area are aquatic habitat parameters. Several physical attributes of stream channels can be used to describe the amount and quality of habitat available to fish. These data is derived from surveys conducted on the Paulina RD using the Region 6 Level II protocol and Bottom Line Surveys (BLS) (table 141). Physical habitat parameters such as width: depth ratios, bank stability, flood frequencies, and sediment inputs have a significant influence on fisheries populations.

However, those metrics are generally a result of geophysical processes acting upon the landscape at the basin or sub-basin scale and are reflective of the current climatic regime, lithology, and discharge but can nonetheless be influenced by management activities. By contrast, large woody debris inputs are more a function of site-specific factors that lead to vegetative heterogeneity within sub-watersheds. Although large wood can certainly alter pool frequencies within a stream reach, pool spacing at the sub-basin scale is more often a function of slope and bankfull width (Rosgen 1996). These parameters are all linked by common processes acting within the watershed to produce the stream channel habitat and riparian conditions that we observe today.

Cumulatively, these indices provide important quantitative information that can be used to describe the overall channel conditions throughout the watershed. By quantifying the extent and quality of stream habitat we can examine the broader relationship of management activities to fish populations in a watershed.

Large woody debris

LWD is an important factor in fish habitat creation in forested stream systems. It can have a significant effect on channel morphology, especially in small, lower gradient channels with unconfined reaches (Beschta and Platts 1986) as are quite common in the lower portions of the sub-watersheds. LWD often creates pools, provides cover and rearing habitat for adult and juvenile fish, stores sediment, decreases flow velocity, helps retain additional organic material important for macroinvertebrate production, and is itself a source of organic input to the system. In areas subject to livestock grazing, LWD also provides microsites for riparian plants to thrive, protects banks and provides wildlife habitat.

Most trees, snags and rootwads that exist on the floodplain and in the riparian zone are potentially available to the active channel. When a tree becomes entrained by the stream's flow, it is routed and decomposed within the system, or becomes part of the bank. In turn, this can affect channel morphology by changing the pattern (e.g., meander pattern), profile (gradient), and dimension (bankfull width) at all spatial scales. These physical effects are well summarized by Montgomery (Montgomery et al. 2003) who states that wood can have geomorphic effects at small scales such as roughness and bed-surface grain size, to large scales of channel-reach morphology and the formation of valley-bottom landforms. The stability, longevity, and the degree to which wood can influence channel morphology depends on its abundance, size, length of submersion, orientation, degree of burial, and its anchorage within the bank (Bisson et al. 1998).

Large woody material provides an important interaction with episodic disturbances creating aquatic habitats and shade for streams. Redband trout, like many other salmonids have evolved in stream systems in which large woody material helps retain organic and inorganic particulate matter that is important for channel stability, biological diversity and productivity (Nakamura and Swanson 1993). Large woody debris can influence habitat for fish and other aquatic organisms by serving as energy dissipaters, flow deflectors, and dams. These down trees also reduce grazing and browsing impacts on bank stability by reducing accessibility to the riparian vegetation. LWD in streams and the adjacent flood plain provides streambank stability, decreases flow velocities, increases storage time (decreases downstream flood risk), stores sediment, and forms pools in the stream channel. The deep water of the pools lowers water temperature.

Fish use pools for hiding cover from predators, to seek refuge in cooler water during the summer months and as resting areas while feeding. Typically, higher densities of LWD within the bankfull channel have led to increased pool frequency, cutbank protection and fish densities.

Levels of LWD are influenced by living, dead and dying trees within, and potentially outside, the riparian corridor. Trees with a height to distance from stream ratio of greater than one will directly influence the stream if they fall towards the stream channel. In western Oregon and Washington, the probability that a falling tree will enter the stream is low at distances greater than about one tree height away from the stream channel (McDade and others 1990; Van Sickle and Gregory 1990).

Similarly, the effectiveness of upland forests to deliver large wood to riparian areas is expected to decline at distances greater than about one tree height from the upland forested edge and depends on steepness of slope. Timber harvest adjacent to riparian buffers can eliminate large wood recruitment to the riparian area while increasing the potential for windthrow (Grizzel and Wolff 1998).

The extent and type of impacts that LWD has also varies by channel type and local wood availability. Rosgen (1996) observes that A, B, and G stream types generally respond to a reduction of LWD input with an increase in both channel scour and pool spacing. Thus, a decrease in LWD input would likely produce a reduction in available pool habitat for fish. It is this interaction between LWD, the channel and the floodplain that greatly impacts the quantity and quality of habitat available to fish and other aquatic organisms.

In heavily forested areas, the density and location of large wood has proven a useful indicator of complexity (Stuart et al 2007). Cordova (1995) found that 63% of the pools were formed by 11% of the pieces of LWD measured. The density of LWD as a factor in pool formation was more important in moderately constrained channels. In addition, larger sizes of LWD were significantly more likely to form pools than small sizes of LWD. In surveys of headwater streams in the Crooked basin, Stuart et al 2007, found a lack of deep pools and a paucity of LWD, particularly large sized wood.

Table 138 summarizes the amount of LWD measured in Gap project area streams (FS land only). Only those pieces that are >12 inches in diameter at 35 feet from the base were counted (INFISH 1995). LWD is generally lacking in project area streams. Several streams meet the INFISH standard of ≥20 pieces LWD per mile, few meet reference conditions (Cordova 1995 –table 136). Values range from 0 - 227 pieces of LWD/mile in part, reflecting the range of ecological types in project area e.g., open meadow systems to headwater forests. PIBO data reveals that both the number and volume of LWD has decreased between 2001 and 2011 in the N.F. Crooked River (table 135).

Table 136. Natural amounts of large, woody material in the Blue Mountains (Cordova 1995).

Large Woody Debris Size	Amount per mile
>12 inches diameter >35 foot length[1]	>69 pieces/mile (Class 1, 2, 3)
>12 inches diameter >35 foot length[1]	>48 pieces/mile (Class 4)

1 -- (>12 inch diameter; >35 foot length). Instead, Cordova includes all pieces over 1 meter in length in a wood frequency by diameter table. For moderately constrained channel types (most similar to Class 1, 2, and 3 streams in the project area), there was a frequency of 69 pieces per mile for pieces greater than 12" diameter. For constrained channel types (most similar to Class 4 streams in the project area), there was a frequency of 48 pieces per mile for pieces greater than 12" diameter. Separate length and diameter frequency distributions indicate that roughly 50% of all wood pieces were over 35 feet in length and 37% of all wood pieces were over 12" diameter. Based on personal communications with Cordova, diameter was tightly correlated to length (i.e. the larger diameter pieces were more likely to be greater in length). Therefore, we are making the assumption that *most* of the pieces over 12" diameter were over 35 feet in length. Although 69 and 48 pieces per mile aren't an exact representation of the data, we feel it is a much better depiction of natural conditions than the interim objective of 20 pieces per mile.

Pool Frequency

Pools provide a number of benefits to fish including cover, rearing habitat, and slow water for resting and feeding. In addition, of particular importance in the Crooked River sub-basin, deep pools provide thermal refugia from cold-winter and high-summer temperatures. Since many project area tributaries dry-up during the summer on NF lands, larger, deeper pools become particularly important to redband trout and other aquatic organisms. Fish may become stranded in isolated pools until either flows return or food and oxygen resources are used up, in which case they die. Therefore, streams with a greater number of high-quality pools provide more individuals opportunities to survive and prosper.

Pools per mile is the metric used in INFISH (USFS 1995) under its interim Riparian Management Objectives (RMO) and Level II stream survey data has been collected and summarized for this. The number of pools per mile varies according to a stream's wetted width. Although most pool scour occurs at flows near or above bankfull, INFISH uses wetted widths since field technicians can measure it more easily.

The pool frequency RMO does not specify a target for those streams with wetted widths (ww) less than 10 feet. However, a smaller stream would be expected to have more than 96 pools per mile. Thus, data in table 138 illustrates that project area streams are considerably below the target, even though many streams measured were less than 10 feet in width with the exception of the N.F. Crooked River (<20 feet). In other words, we would expect ≥ 96 pools per mile for streams with a wetted width <10 and ≥ 56 pools per mile for streams with a wetted width <20.

Most of these stream surveys were conducted during annual flow of mid- to late-summer. Hydrographs in this area are generally single-peaked (i.e., snowmelt driven), although rain-on-snow events can occur frequently below about 4500 ft. in elevation. Thus it is accurate to state that flows tend to vary considerably from season-to-season and even within the same stream.

Hence, some might keenly note that bankfull width is a more accurate descriptor of stream size and since summertime field surveys continue to be used we should base expected pool frequencies on channel type and bankfull width values. Yet even if we use the INFISH standard for pool frequency based on the bankfull width (bfw) of these streams, few come close to the objective of 56 pools per mile (for a ww of 20 ft.). Most project area streams are <50% of the objective and would seem to be lacking sufficient pool habitat to support robust fish populations. As in the case of LWD, this data suggests that streams in the watershed are either not providing good habitat or the INFISH standard for pool frequency is inappropriate for the area. The pool percentage data measured by PIBO monitoring (table 135) has been decreasing over the monitoring period.

Streambank Condition (bank stability and width to depth ratio)

Turbidity/Bank Stability

State of Oregon water quality standards require that turbidity levels not cumulatively increase by more than 10% as a result of any proposed activities (relative to a control point immediately upstream).

The Ochoco LRMP mandates that this will be accomplished by maintaining streambank stability (since bank erosion is often the most significant contributor to higher turbidity levels) and implementing BMP's (Best Management Practices). The LRMP states that stream channel cutbank disturbance should not exceed 20% for any given stream drainage. Likewise, the RMOs established by the INFISH require that the amount of unstable streambank in any reach not exceed 20%. Management activities cannot increase current levels of unstable banks if they are above 20% and Forest activities must not inhibit the "near natural rate of recovery." Therefore, by measuring the amount of cutbank disturbance, one can develop an indication of turbidity levels and the degree of sediment impacts that exist within the watershed.

As described in the Water Quality (sediment) discussion many streams have some amount of unstable Stream reaches that exceed standards include: Gray Creek (R1), Jungle Creek (R1 and R3) and a tributary to Dudley Creek (table 141). Some streams currently have active headcuts that are migrating upstream; contributing sediment, eliminating pools, and simplifying stream habitat. Additionally, many of these streams have segments that can be classified as G and F-type channel segments although the overall reach is classified differently. G and F-type channels are those that have entrenched and would not likely have existed prior to stream and riparian modifications. Continued down cutting will occur until the source of the problem(s) is addressed and vegetation is established on streambanks to provide roughness and establish a new floodplain.

Occurrence of more than 20% of unstable banks can be an indication of degraded aquatic habitat resulting in changes in substrate composition, and reduced ability of woody and riparian plants to increase and expand (USDA 1995[a] [b]). Unstable banks can result from management or acute natural disturbance event. Increases in fine sediment in streams due to erosion from unstable banks, and corresponding reduction in spawning and rearing success are indirectly tied to the amount of unstable banks within stream drainages.

Turbidity sampling has not been done on the Paulina RD; however, ocular surveys of turbidity have shown that streams are generally "clear" during summer months. It is believed that turbidity increases during higher flows, particularly downstream of actively eroding streambanks, headcuts, road crossings, and areas of heavy livestock use (e.g., water-gaps).

Width to Depth Ratios

Width to depth ratios naturally vary by channel-type (Rosgen 1996) and are often very sensitive to management actions. For example, removal of riparian vegetation due to timber harvest or excessive browsing can reduce a stream's ability to withstand high flows. Floods will then erode streambanks and increase the width to depth ratio. A channel in dis-equilibrium that is degrading, aggrading, or experiencing changes in its flow regime due to nearly any factor, anthropogenic or natural, will usually exhibit changes in its width to depth ratio. Therefore, an examination a stream's width to depth ratio, by channel type, and its trend can be very expressive indicators of watershed condition.

RMOs defined in INFISH, recommend that width to depth ratios be less than 10 for all stream types; however, these ratios naturally vary by stream type (Rosgen, 1996). A, E, and G stream types generally have width to depth ratios of less than 12 and B, C, and F stream types generally are greater than 12 (table 137).

Table 137.Width to depth ratio by channel type (Rosgen 1996; Silvey 1998).

Channel Type	A	B	C	D	DA	E	F	G
Width/Depth Ratio	<12	>12	>12	>40	<40	<12	>12	<12

Currently, width to depth ratios are not within a natural range of variability for each stream type, where they are within range, it is likely that many of these channels have been converted to types different than their historic condition.

As previously described, many streams within the watershed have down-cut and not laterally migrated (e.g., C to G to F to B) or have lost their riparian vegetation and become laterally unstable (e.g., C to D or C to G to F to C) and thus are not maintaining a reasonable width to depth ratio. Some stream reaches are excessively wide (F channels) and have not yet re-achieved a stable equilibrium.

Table 138. Stream Survey Data for Gap Project area.

Stream	Reach #	Year	Rosgen Channel Type	W/D Ratio	Pools/mi.	*LWD/mi.	Un stable Bank (%) Level II	Cutbank (%) BLS	fines < 2mm (%)	Shade (%)	Hard-wood Shade (%)	Survey Type	Map Miles
Gray Creek Subwatershed													
Cuitan Creek	1	1995	E	11.4	15.8	10.6	ND	4.7	ND	46.2	24.6	BLS	0.6
Fawn Creek	1	1994	A	8.7	73.9	15.8	ND	1.7	ND	82.5	11.6	BLS	0.4
Fawn Creek	2	1994	B	10.0	15.8	21.1	ND	0.0	ND	55.9	0.0	BLS	0.9
Fawn Creek T1	1	1994	E	5.5	42.2	26.4	ND	0.0	ND	53.7	13.3	BLS	0.5
Gray Creek	1	2012	E	14.2	59.2	ND	24.5	ND	40	22.1	20.1	Level II	1.5
Gray Creek	2	2013	E	9.8	56.4	5.5	7.6	ND	48	47.5	30.4	Level II	2.0
Gray Creek T1	1	1995	B	13.6	42.2	42.2	ND	0.9	ND	42.4	12.3	BLS	2.5
Gray Creek T2	1	1995	E	7.7	10.6	15.8	ND	0.0	ND	43.2	4.6	BLS	0.9
Gray Creek T3	1	1995	E	8.5	0.0	26.4	ND	0.5	ND	43.7	0.7	BLS	1.3
Gray Creek T4	1	1995	E	6.6	0.0	10.6	ND	0.8	ND	14.1	2.3	BLS	0.8
Gray CreekT5	1	1995	E/DA	11.3	37.0	68.6	ND	5.7	ND	16.3	0.0	BLS	1.4
Lytle Creek	R1	2012	A	10.5/ 16.8	38.1	15.2	17.9	ND	33	78.0	44	BLS	0.8
Lytle Creek	R2	2012	A	9.8/ 14.6	50.9	48.7	16.2	ND	27	72.0	40	BLS	1.3
Lytle Creek	R3	2012	A	9.8/ 15	34.4	32.3	16.2	ND	31	74.0	19	BLS	1.5
Lytle Creek	R4	2012	E	6.2	ND	13.2	13.1	ND	69	30.0	0.0	Level II	1.5

Stream	Reach #	Year	Rosgen Channel Type	W/D Ratio	Pools/mi.	*LWD/mi.	Un stable Bank (%) Level II	Cutbank (%) BLS	fines < 2mm (%)	Shade (%)	Hard-wood Shade (%)	Survey Type	Map Miles
Spring Creek	R1	1995	E	10.1	26.4	0.0	ND	12.9	ND	8.4	2.8	BLS	0.9
Spring Creek	R2	1995	B	8.5	10.6	15.8	ND	15.0	ND	76.0	3.0	BLS	0.3
Spring Creek T1	R1	1995	C/E	14.0	15.8	15.8	ND	11.4	ND	43.8	0.4	BLS	0.1
Short Creek	R1	1995	E	4.2	31.7	10.6	ND	1.6	ND	67.2	35.2	BLS	1.5
Headwaters North Fork Summit River Subwatershed													
Jungle Creek	1	2007	B3a	10.4/ 13.4	7.9	18.3	21.7	ND	60	94.0	94	Level II	0.5
Jungle Creek	2	2008	B4	12.3	58.1	13.2	16.6	ND	14	54.0	57	Level II	1.6
Jungle Creek	3	2008	ND	ND	26.4	11.6	32.1	ND	48	93.0	33	Level II	0.6
Dudley Creek	1	2007	E6b	7.9	760.3	68.6	9.4	ND	100	56.5	55	Level II	0.1
Dudley Creek	2	2007	E6b	ND	0.0	227.0	0.5	ND	ND	90.4	0.0	Level II	0.1
Dudley Creek T1	1	2007	ND	4.5	86.2	12.3	31.5	32	ND	ND	ND	Level II	ND
Lookout Creek	2	2002	B	9.8	37.1	6.3	12.6	ND	29	52.8	33.3	Level II	1.0
Lookout Creek	3	2002	B	17.5	48.2	13.8	4.7	ND	19	84.0	53.4	Level II	0.9
Lookout Creek A	4	2002	A4	13.8	39.4	23.2	13.5	ND	26	91.1	87.3	Level II	0.9
NF Crooked River (NFCR)	10	1994	C	17.5	ND	10.6	ND	3.4	ND	35.1	0.0	BLS	1.8
NFCR	R8	1994	C	11.6	ND	10.6	ND	14.5	ND	5.0	0.1	BLS	3.0
NFCR	R9	1994	F	9.0	ND	10.6	ND	14.5	ND	7.7	0.5	BLS	2.5
NFCR T21	R1	1995	A	8.4	ND	ND	ND	0.0	ND	64.8	0.0	BLS	0.2
NFCR T22	R1	1995	B	12.1	ND	ND	ND	ND	ND	49.5	0.0	BLS	2.0
NFCR T23	R1	1995	B	10.1	ND	ND	ND	ND	ND	52.3	0.0	BLS	1.2

Stream	Reach #	Year	Rosgen Channel Type	W/D Ratio	Pools/mi.	*LWD/mi.	Un stable Bank (%) Level II	Cutbank (%) BLS	fines < 2mm (%)	Shade (%)	Hard-wood Shade (%)	Survey Type	Map Miles
NFCR T23a	R1	1995	B	9.2	ND	ND	ND	ND	ND	64.7	0.0	BLS	1.0
NFCR T24	R1	1995	E/C	17.0	ND	ND	ND	ND	ND	0.0	0.0	BLS	1.0
NFCR T24	R2	1995	B	12.8	ND	ND	ND	ND	ND	19.6	0.1	BLS	0.3
NFCR T24	R3	1995	A	11.3	ND	ND	ND	ND	ND	68.7	0.0	BLS	0.3
NFCR T25a	R1	1995	B	8.0	ND	ND	ND	ND	ND	24.2	0.0	BLS	0.8
NFCR T25b	R1	1995	B	7.3	ND	ND	ND	ND	ND	59.0	0.0	BLS	1.1
NFCR T25c	R1	1995	A	8.3	ND	ND	ND	ND	ND	58.1	0.0	BLS	0.5
NFCR T26	R1	1995	C	14.3	ND	ND	ND	ND	ND	25.8	0.0	BLS	0.6
NFCR T26	R2	1995	B	9.7	ND	ND	ND	ND	ND	39.6	0.0	BLS	0.6
NFCR T26	R3	1995	A	11.0	ND	ND	ND	ND	ND	29.0	0.0	BLS	0.7
NFCR T27	R1	1995	E/C	5.6	ND	ND	ND	ND	ND	21.7	0.2	BLS	0.8
NFCR T28	R1	1995	C	18.8	ND	ND	ND	ND	ND	30.3	0.0	BLS	0.5
NFCR T28	R2	1994	ND	22.0	37.0	0.5	5.4	ND	ND	14.9	0.1	BLS	
NFCR T28	R3	1994	ND	20.0	42.2	0.5	1.0	ND	ND	25.9	0.0	BLS	0.9
NFCR T29	R1	1994	ND	39.7	52.8	0.0	0.0	ND	ND	32.6	0.0	BLS	0.7
NFCR T29	R2	1994	ND	27.0	15.8	0.5	14.6	ND	ND	9.8	0.0	BLS	0.6
SF Lookout Creek	R1	1994	B	13.0	174.2	163.7	ND	3.5	ND	71.8	2.2	BLS	1.3
South Fork Lookout Creek	R2	1994	A/B	20.0	n/a	84.5	ND	13.9	ND	64.9	0.1	BLS	0.9
SF Lookout Creek T1	R1	1994	A/B	10.0	79.2	63.4	ND	3.2	ND	62.4	13.6	BLS	0.4
Long Prairie Creek	R1	1995	E	3.3	26.4	0.0	ND	0.0	ND	0.2	0.0	BLS	0.5
Long Prairie Creek	R2	1995	B/E	3.9	63.4	10.6	ND	2.5	ND	32.6	0.2	BLS	0.5
Long Prairie Creek	R3	1995	E	7.6	21.1	0.0	ND	0.5	ND	0.1	0.0	BLS	0.8
Lost Creek Subwatershed													
Lost Creek	1	1997	A/B	ND	47.5	37.0	1.0	ND	ND	81.5	68.7	BLS	0.8

Stream	Reach #	Year	Rosgen Channel Type	W/D Ratio	Pools/mi.	*LWD/mi.	Un stable Bank (%) Level II	Cutbank (%) BLS	fines < 2mm (%)	Shade (%)	Hard-wood Shade (%)	Survey Type	Map Miles
			4										
Lost Creek	2	1997	A/4	ND	105.6	37.0	3.0	ND	ND	82.5	61.4	BLS	1.3
Lost Creek	3	1997	C4	ND	42.2	21.1	5.5	ND	ND	46.8	0	BLS	0.6
Upper Horse Heaven Creek Subwatershed													
Horse Heaven Creek	1	2008	G4	*17.2*	63.4	5.8	4.8	ND	29	22.9	18.2	Level II	0.9
Horse Heaven Creek	2	2008	G5	10.2	58.1	9.0	3.1	ND	12	48.0	48	Level II	0.6
Horse Heaven Creek	3	2008	G4	10.3	35.4	24.3	11.3	ND	36	68.0	76	Level II	0.6
NW Fork of Horse Heaven	1	2008	G5	9.2	205.9	34.8	4.7	ND	66	80.0	72	Level II	0.4
Little Horse Heaven Creek	1	2008	E5b	8.0	73.9	1.6	6.4	ND	15	43.0	30	Level II	1.7
Little Horse Heaven Creek	2	2008	A3	10.4	121.4	11.1	8.8	ND	27	72.0	47	Level II	1.0
Buck Creek	1	2003		8.8	ND	44.9	15.6	ND		39.0	NA	Level II	0.7
Lower Horse Heaven Creek Subwatershed													
no survey			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

** Surveys conducted prior to 1996 counted LWD differently and may be an over-estimation of total instream LWD.*
ND = No Data
Stream Name and T (i.e. NFCR T28) = unnamed tributary to that stream

Environmental Effects

For purposes of this analysis, short-term is defined as up to 10 years – the approximate duration of project implementation activities. Long-term is defined as 10+ years; unless otherwise stated. Effect Common to All Action Alternatives can be found in Appendix G.

Direct and Indirect Effects

Alternative 1

Alternative 1 is the No Action alternative. No vegetation or fuels management activities would be implemented to accomplish project goals. There would be no stand density management treatments or associated road (temporary) construction or utilization of the road network from implementation activities, i.e., timber haul.

Stands would continue to incur mortality and large diameter trees would continue to be at risk of loss due to competition among trees. LOS stands would remain multi-strata with dense stand conditions causing competition for resources among trees. Large diameter trees, such as ponderosa pine, would remain at a high risk of mortality.

Aspen stands, riparian and upland grass and shrub communities would continue to decline (see Silviculture, Botany and Range reports). Departure from HRV and FRCC would remain elevated across the landscape including within RHCAs. Landscape resiliency including within riparian areas would continue to be stressed. There would be no fuels reduction treatments. Areas would continue to accumulate fuels with the potential for a wildfire causing unwanted damage to forested stands including riparian areas, wildlife habitat, soils, and water quality (reference specialist reports). Fire suppression activities can be harmful to fish and their habitats; many fire retardants are toxic to fishes (Norris et al, 1991 in USDA 2010) and physical disruption resulting from construction of roads, fire breaks, and other activities can affect aquatic habitats.

Effects of Wildfire*:* No treatment of overstocked stands in the Gap project increases the risk of a large wildfire but there are many factors that would contribute to such an event. The immediate and short-term effects of fire to fish are commonly harmful to individual fish and even local populations, but the intensity of the effect varies. Direct heating of water by fire and dissolution of ammonia and other chemicals from smoke has resulted in fish kills (Minshall and others 2003), but fish also appear to simply avoid affected areas if refuge is available (Rieman and Clayton 1997). Introductions of toxic materials and ash flows shortly after fire have resulted in in local extirpations (Rinne 2003). The response of fish populations to these impacts is varied. Some extirpations are permanent while some locations see re-establishment of fish populations within a relatively short time frame (Howell 2006). Sublethal temperature increases after canopy removal has been observed to alter the growth and maturation of fish (Dunham and others 2007). Fine sediment increases can also interfere with life stages that use gravel interstices.

It should be noted that many aquatic organisms (such as salmonids) have evolved strategies to survive perturbations occurring at the frequency of wildland fires (greater than 100 years) (USDA – GTR-231, 2010). The long-term benefits of fire effects have been noted as well. The renewal of spawning gravels is cited (e.g., Reeves and others 1995; Benda and others 1998 in USDA 2012).

Inputs of nutrients released by fires may also provide at least a temporary boost in productivity (Spencer and others 2003). Fires are one of the many disturbances that regulate sunlight coming to streams; so they contribute to maintaining a diversity of invertebrates that use both algae growing in streams as well as detritus falling from riparian forests (Minshall 2003). The legacy left behind by fire, including both the renewed material availability and the presence of fish to use those materials, is important in the net benefit of a fire (USDA 2012 GTR-231).

No riparian restoration activities (stream restoration, including grade stabilization, hardwood stand improvement, planting and protection, culvert replacement) and road closure and decommissioning would occur.

This alternative serves as a baseline for comparison of the effects of all of the alternatives. Routine activities such as road maintenance and suppression of unplanned fires would continue. Activities authorized under separate decisions would also continue. These activities include livestock grazing, noxious weed treatments, recreational use of the area, including camping, hunting and fishing and motorized and non-motorized use, would continue.

Alternative 1 -- Measure 1: Direct impacts to fish and frogs

Short-term risks from implementation activities specifically, exposure to direct impacts to redband trout and CSF at stream crossings would not occur. Similarly, no short-term impacts that have potential to injure or kill aquatic species would occur from stream restoration and other active riparian restoration activities.

Alternative 1 -- Measure 2: Water Quantity and Quality

Water Quantity and Quality was analyzed in the Hydrology report and has been incorporated into the analysis below.

Water Quantity

There is potential for indirect effects to occur under this alternative. Over time, continued forest health deterioration and fuels build-up within the project area could lead to stand-replacing wildfires in the planning area that have the potential to change peak/base flows and water yield because of decreased infiltration. Changes in flow would depend on variables such as size, timing, location, and severity of fire, and climatic conditions post-fire. A fire of high severity, which results in severe heating of soils, reduces ground cover and can form a water repellant layer (hydrophobic) that restricts infiltration and percolation, can result in increased surface runoff. Severely burned soils are more likely to occur in the mixed conifer stands rather than the ponderosa pine dominated stands because of the greater ground fuels accumulation. The potential for hydrophobicity of the ash dominated soils within the RHCA's of the project area is generally considered to be low (see Soils report). In addition, reduced evapotranspiration and interception by the tree canopy could compound runoff (Ice, 2004). However, hydrologic changes would be limited because of the groundwater influenced nature of the landscape and moderately permeable soils within the forested draws of the scab stringer landscape, and the moderate near-stream slopes in much of the drainage that results in restricted surface runoff – see Soils report. Forested stands in the project area are more likely to experience a crown fire than a surface dominated high severity fire under existing conditions. Watersheds would remain susceptible to a moderate risk of uncharacteristic wildfire that may result in measurable increases in peak flows that could affect aquatic species by scouring redds, altering habitats, and dislodging individuals into downstream habitats.

However, no short-term risks from implementation activities that might impact water yield (vegetation treatments, roads and Rx fire) would occur but no short and long-term benefits that reduce the hydrologic net (road closures and decommissioning) would occur.

Similarly, no riparian restoration activities (stream restoration and culvert replacement) that would reconnect streams with their floodplains, increase and stabilize stream flows would occur, leaving fish and frogs more vulnerable to the effects of uncharacteristic wildfire and climate change.

Water Quality

Fine Sediment & Turbidity

Alternative 1 has no proposed treatments and would not result in additional ground disturbance that would result in potential effects to sediment delivery. However, increased risk of uncharacteristic wildfire could lead to consumption of riverbank vegetation, decreased riverbank stability, increasing bank erosion and sediment introduction (Shakesby and Doerr 2006) that could increase turbidity until riverbank vegetation and stability recover. The prevailing winds are from the west and southwest which would lend itself to driving a fire up the drainage with a chimney effect into the upper elevation mixed conifer stands with steeper side slopes and greater accumulations of surface fuels; fire severity would be greater here with increased adverse effects to riverbank stability and overland flow of sediments.

In the event of an uncharacteristic wildfire, turbidity may be increased overland flow on bare soils and from toppling of trees on the riverbank, introducing sediment as they fall. Turbidity from windthrow trees is likely to result in minimal increases in turbidity and may be immeasurable in the streams. Rashin and others (2006) found that windthrow trees were a minor contributor to the total extent of chronic (long term small inputs) sediment delivery from harvest sites. A storm that resulted in heavy precipitation soon after a fire could introduce overland flow of sediments within the RHCA into project area streams that would measurably increase turbidity. Chronic inputs of sediment from the RHCA that increase turbidity could continue for several years until vegetative groundcover is re-established. Fine sediment volumes within substrates of streams may show a measurable increase for several years depending on rainfall and flow events. In the lower watersheds, moderately permeable soils and gentle slopes within much of the RHCA within the project area would limit the volume of sediments introduced into the streams from overland flow. Elevated turbidity and fine sediment levels can be harmful to fish and other aquatic organisms.

The pathways for sedimentation and the effects of the fire on sedimentation are similar to those listed under turbidity above. Sedimentation occurs as suspended and other larger sediments deposit on and in the river substrate and could have negative impacts to fish spawning, survival and habitat alteration.

No short-term risks from vegetation implementation activities (vegetation treatments, roads and stream crossings and Rx fire) that might impact sediment and turbidity would occur but no short and long-term benefits from improvements in sediment delivery from post-harvest PDF (tree felling/pushing, road closures and decommissioning would occur either. Similarly, no riparian restoration activities (stream restoration and culvert replacement, hardwood stand treatments and planting) that stabilize stream flows, decrease bank instability thereby reducing sediment delivery and ultimately turbidity would occur, leaving fish and frogs more vulnerable to the effects of uncharacteristic wildfire and climate change.

Shade and Stream Temperature

Due to past management of RHCA in the project area, several stream reaches are not currently meeting INISH standards for shade. Many of streams in the project area are on the Oregon DEQ 303d list for water temperature impairment (see Hydrology report). Under this alternative, most streams would continue to be below the shade RMO and summer water temperature would remain above allowable Oregon DEQ and Ochoco National Forest standards. Aquatic habitats would remain in this condition due to the low densities of hardwoods, over-grazing of hardwood species that has occurred, and the overstocked densities of conifers inhibiting expansion and establishment of riparian plants. Riparian vegetation (hardwood) recovery would slowly occur (up to 15 years) as grazing conditions incrementally improve from changes in management activities due to implementation of the Big Summit and Fox Canyon AMPs (see Range report). Conifers would continue to suppress hardwoods without thinning and prescribed fire. Also reference discussion on W/D ratios below (Measure 4) for effects related to stream temperature.

There is increased potential for adverse effects to water quality if an uncharacteristic wildfire occurs due to the amount of stands in the project area that are in Fire Condition Class 2 or 3 (See Fuels report). The zone of riparian vegetation adjacent project area streams varies from ~300’ in the lower floodplain along larger Creeks, to ~3 ft. in upper headwater streams. This zone of inner riparian vegetation is composed of primarily grasses and sedges with sparse woody shrubs. In many places outside of the broad meadow and prairie systems NFCR, Gray Creek, Horse Heaven Creek, the riparian area would likely experience fire behavior and severity similar to upland conditions. The following is a description of effects to water quality should stand replacing wildfires occur near streams in the planning area.

In the event of an uncharacteristic wildfire within the RHCA, water temperature may be increased from the heat of the fire itself. The increase in temperature would depend on the intensity of the fire, size of the fire, proximity to streams, discharge at the time of the fire, and duration of the fire. Post-fire, shade would be reduced, which would allow increased solar radiation and increased water temperatures in the summer and decreased winter temperatures due to the loss of buffering capacity. Albin (1979) found that water temperatures increased an average of 1.5° C in a burned watershed 35 years after the fire. This research was conducted on small 1st and 2nd order streams similar to numerous streams in the planning area. Summer maximum water temperatures have been shown to remain significantly elevated for at least a decade following wildfire (Dunham, et al 2007). During the course of wildfire dissolved oxygen would be decreased as water temperatures increase. Post-fire, dissolved oxygen would be decreased as water temperatures increase from the lack of shade until vegetation recovers to heights capable of shading. Full shade recovery could take several decades. Oxygen could also be depleted from metabolism of increased runoff of organic matter, until ground cover becomes re-established to limit runoff.

With the No Action Alternative, forested stands within the RHCAs would be at increased risk of insect and disease damage and reduced vigor and growth (see Silviculture report). Presently the stocking exceeds the Upper Management Zone in all the RHCA units. Many forested stands within the project area have not previously been thinned and fire has been excluded. These stands are currently at risk of insect and disease damage. Increased mortality of trees would reduce shade, potentially increasing water temperature, and would in turn increase the severity of wildfire effects discussed above.

Short-term risks from implementation activities, specifically RHCA treatments and riparian restoration activities would not occur. Conversely, none of the other benefits to stream shade short and long-term from implementation of riparian restoration activities (stream restoration, hardwood stand enhancement and riparian planting and protection) would occur either.

Alternative 1 -- Measure 3: Riparian Vegetation

Outer Zone: Under this alternative no activities would occur that would improve RHCA stand resiliency. The amount of area that is at high risk to unwanted disturbance would remain unchanged and increase over time as fire intolerant understories continue to develop and large fire tolerant trees are lost due to within stand competition. Tree mortality would potentially contribute to large down wood but over time inputs of large trees would decline as the development of large replacement trees would be retarded by dense stand conditions. High intensity wildfire could also contribute to loss of existing down wood.

Lack of active management (commercial treatments, PCT and Rx fire and riparian restoration – see below) within forested stringers and RHCA would leave these stands exposed to risks from uncharacteristic wildfire and climate change as described above under Measure 2.

Inner Zone*:* As described in the existing condition section, a large percent of native vegetation attributes along stream corridors, wetlands and water bodies are not in proper functioning condition. Existing shade would be maintained at current levels; however shade generated by hardwood species is expected to decline as these species are replaced by conifers. In the event of high intensity wildfire or insect epidemic, high amounts of existing shade may be lost. Lack of active management (riparian restoration activities: stream restoration, head cut repair, hardwood stand improvements and riparian planting) would not occur. Recovery of this zone of riparian vegetation including hardwoods would take several decades, if at all (in areas with severe channel incision), forgoing short and long-term benefits and leaving riparian vegetation susceptible to uncharacteristic wildfire and climate change.

Alternative 1 -- Measure 4: Aquatic Habitat

Large Woody Debris (number of large wood pieces/mile)

No change to existing in-stream LWD or recruitment rates would occur as a result of this alternative that would allow natural and human induced processes to continue. As discussed under Measure 3 (Riparian Vegetation), tree mortality would potentially contribute to large down wood but over time, but inputs of large trees would decline as the development of large replacement trees would be retarded by dense stand conditions. In dense young stands, development of large wood would be retarded due to inter-tree competition (see Silviculture report). Severe wildfire could reduce the availability of future large trees if riparian areas burn even though it would initially create a large pulse in available down wood. Growth and development of large trees greater than 21 inches dbh requires <150 years on most forested sites. Potentially, there could be a shortage of future large wood available in the event of stand replacing fire.

Analysis and field reconnaissance suggest densities of LWD would continue to be below RMO minimums established by INFISH and reference conditions. Lack of active management within forested stringers and RHCA would leave these stands exposed to risks from uncharacteristic wildfire and climate change. Increasing stand density and accumulating fuels both in the uplands and within RHCAs increase fire hazard and reduce growth on individual trees. LWD recruitment would remain unchanged from current trajectories because no stream restoration and LWD felling/tipping within RHCA units would occur.

Pool Frequency (pools/mile & Pool Quality)

Under this alternative, there would be no short-term (1-10 years) changes to pool frequency and quality. Generally, pool habitat would continue to be insufficient and would likely become scarcer as the current channel form is maintained. Pool frequency would not change because no actions would be taken to change large wood recruitment (in the near future) to form pools; the rate of pool development would remain slow. Similarly, no short and long-term benefits from active riparian restoration would occur; stream restoration and unit by unit LWD placement. Conversely, there would be no negative short-term changes to pool quality through active restoration. As described in Measure 2, elevated risks to sediment production from moderate risk of uncharacteristic wildfire would remain that would likely negatively affect pool quality.

Streambank Condition (% stream bank stability, channel width to depth ratio)

In streams where hardwoods exist in closed canopy forests, expanding conifer cover would prevent growth and development of hardwood riparian vegetation. As a result, stream banks would continue to lack well rooted riparian plants that stabilize banks, reduce sedimentation and can prevent further increases in width-to-depth ratios and subsequent increases in temperature.

Similarly, no short and long-term benefits from unit by unit LWD placement and riparian restoration (stream restoration, hardwood stand improvements and riparian planting and protection) would occur.

As described above riparian conditions would continue to slowly degrade from the absence of active management and prescribed fire. However there would be no negative short-term effects to streambank conditions from project activities in the Gap project area because no change would occur to the riparian vegetation, channel processes or utilization of roads and crossings. As described in Measure 2, uncharacteristic wildfire could also contribute to decreases in bank stability after riparian vegetation is consumed, and increased w/d ratios from loss of existing down wood and potential increases in sediment.

Since no project activities would occur there would be no direct effects. However as described above some indirect effects to habitat would continue to occur even without the implementation of the Gap project. There would be no cumulative effects as a result of the Gap project.

Alternative 1 – Cumulative Effects

Under Alternative 1 no proposed Gap project activities would occur, therefor there would be no cumulative effects from the project. Habitat conditions would remain largely unchanged from existing conditions other ongoing management activities would continue.

Alternative 1 -- Determination for Redband trout and Columbia spotted frog

There would be 'No Impact' to redband trout and Columbia spotted frog species or habitat from the Gap project because there would be no stream restoration, no culvert replacements and no vegetation treatment and associated road construction or utilization in RHCAs or in the uplands. As described above, no potential short-term negative effects to individual fish and frogs and RMO's from project activities would occur but there would be no long-term benefits to RMOs and fish and frog populations because no aquatic restoration, commercial thinning treatments or prescribed fire would occur in RHCA including subsequent LWD additions, riparian restoration activities, road closure and decommissioning and culvert replacement. Because of poor water quality and habitat conditions, redband trout and Columbia spotted frogs would continue to have low growth rates, low spawning and rearing survival rates, and depressed population densities (ODFW 1996, ONF MIS report 2011 and Stuart et al 2007). Fish passage barriers would persist; aquatic species connectivity would continue to be compromised. The relatively vulnerable aquatic species populations within the project area would continue to be less resilient to the potential affects from moderate risks to uncharacteristic wildfire and climate change.

Alternatives 2 & 4

Alternatives 2 and 4 are very similar with regard to activities proposed in RHCA and that have the potential to affect water resources and aquatic species. Table 139 summarizes activities within RHCA that are included in the action alternatives for the Gap project. Corresponding maps for activities in RHCA by alternative are located in figures 29-32.

Table 139. Summary of Gap project activities within RHCA by alternative.

Activity in RHCA	Alt. 2	Alt. 3	Alt. 4
Commercial thinning (would be followed by noncommercial thinning and prescribed burning) Commercial thinning trees >21" dbh	1,041 ac. 0 ac.	0 ac. 0 ac.	1,041 ac. b) 154 ac.
Noncommercial thinning (outside of harvest units; would be followed by prescribed burning)	1,249 ac.	1,190 ac.	1,249 ac.
Noncommercial thinning only Noncommercial thinning only up to 21" dbh	5 ac. 62 ac.	5 ac. 62 ac.	5 ac. 75 ac.
Underburning (outside of harvest units)	1,725 ac.	1,727 ac.	1,725 ac.
Riparian restoration	13.7 miles/1,345 ac.	13.7 miles/1,345 ac.	13.7 miles/1,345 ac.
Aspen Restoration	55 ac.	71 ac.	76 ac.
Culvert Replacement	6 locations	6 locations	6 locations
Road closure	3.1	3.1	3.1
Road decommission	1.7	1.7	1.7
Temporary roads	<0.1 mile	<0.1 mile	<0.1 mile
Temporary roads on existing disturbance	4.7 miles	4.6 miles	4.7 miles
Buck and Pole Fence	.9 mile	.9 mile	.9 mile
Barbed Wire Fence	4 miles	4 miles	4 miles

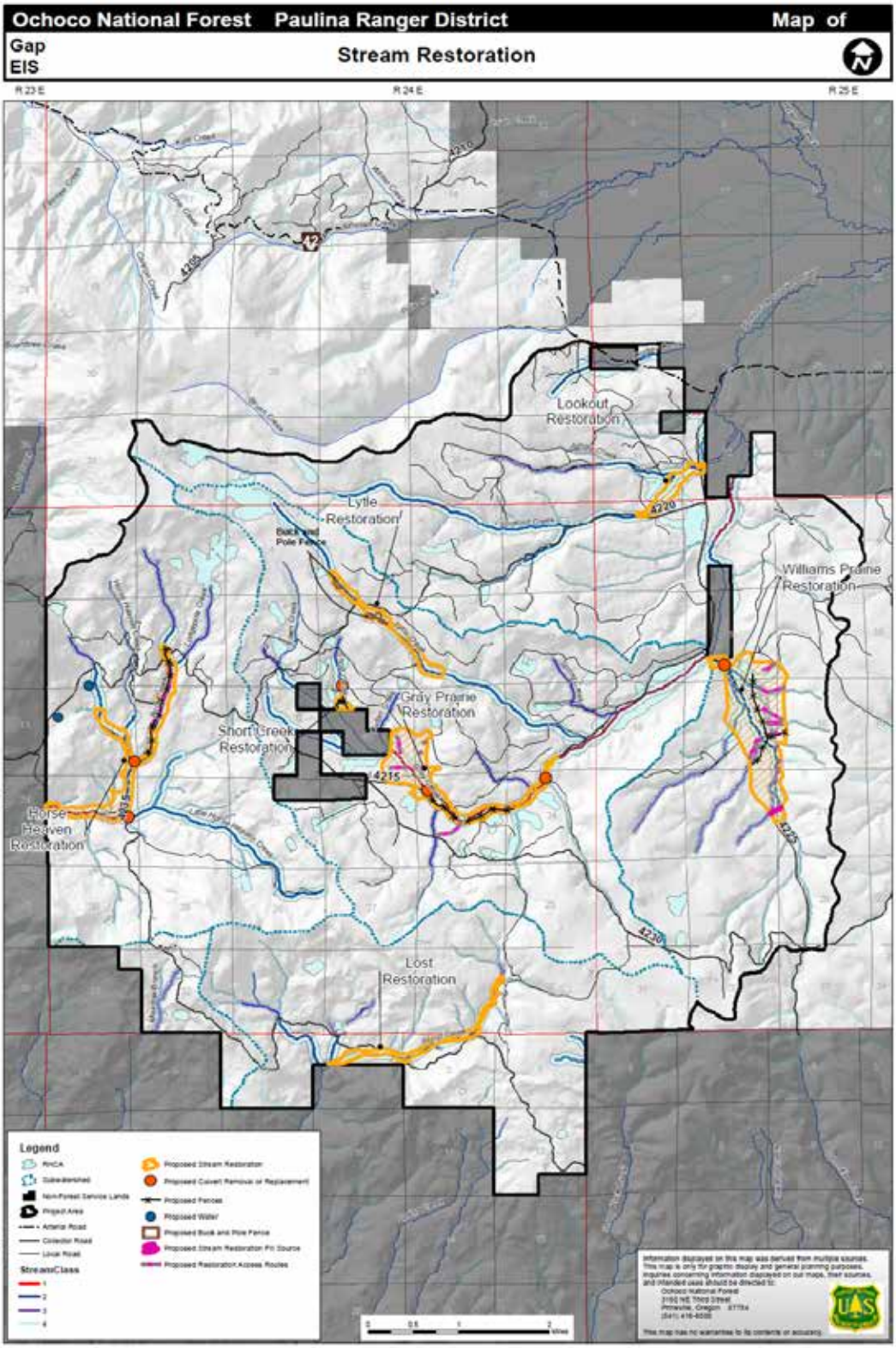


Figure 29. Stream restoration and culvert replacements sites in the Gap Project.

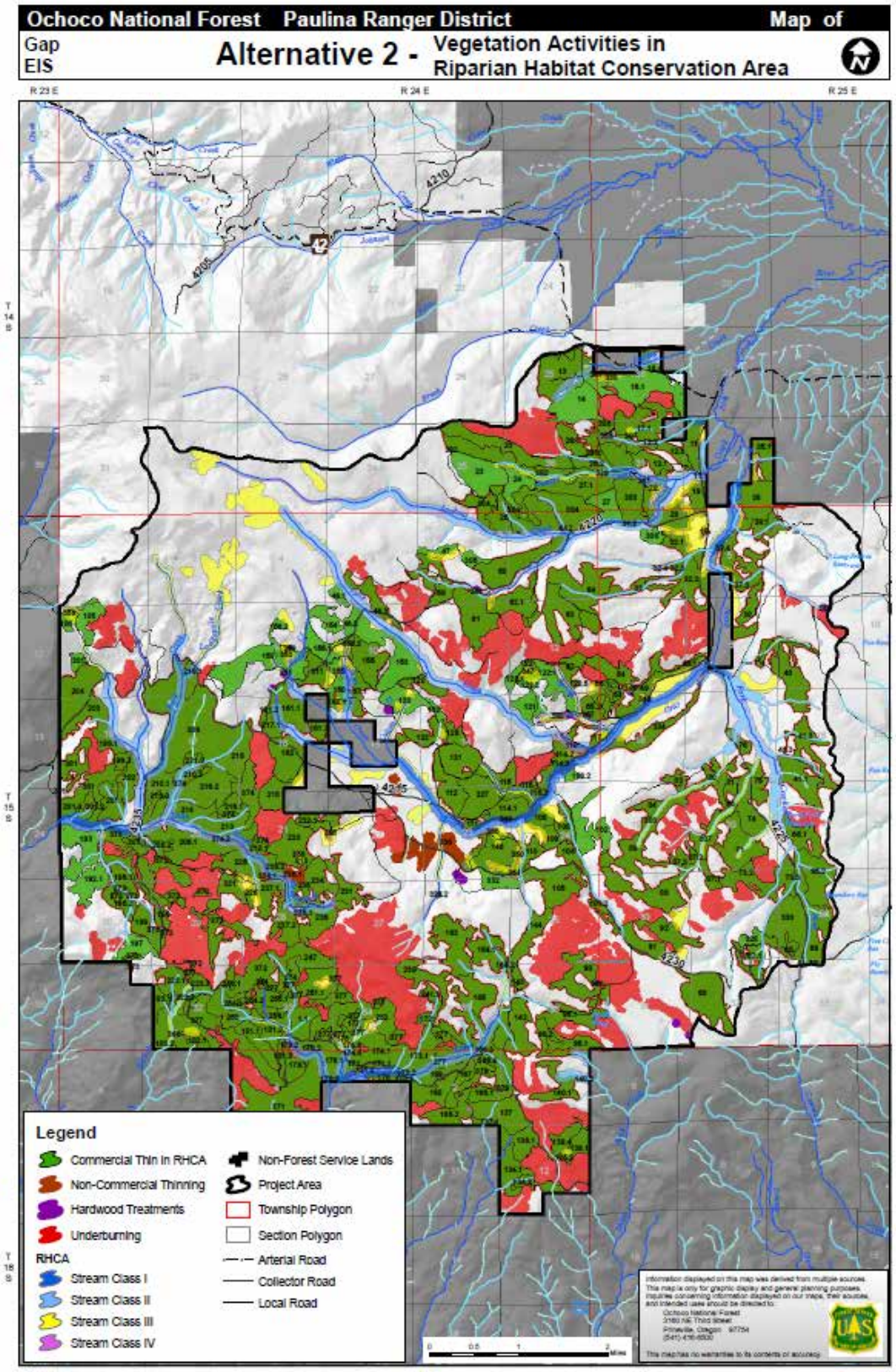


Figure 30. Alternative 2 commercial thin, noncommercial thinning and RHCA areas.

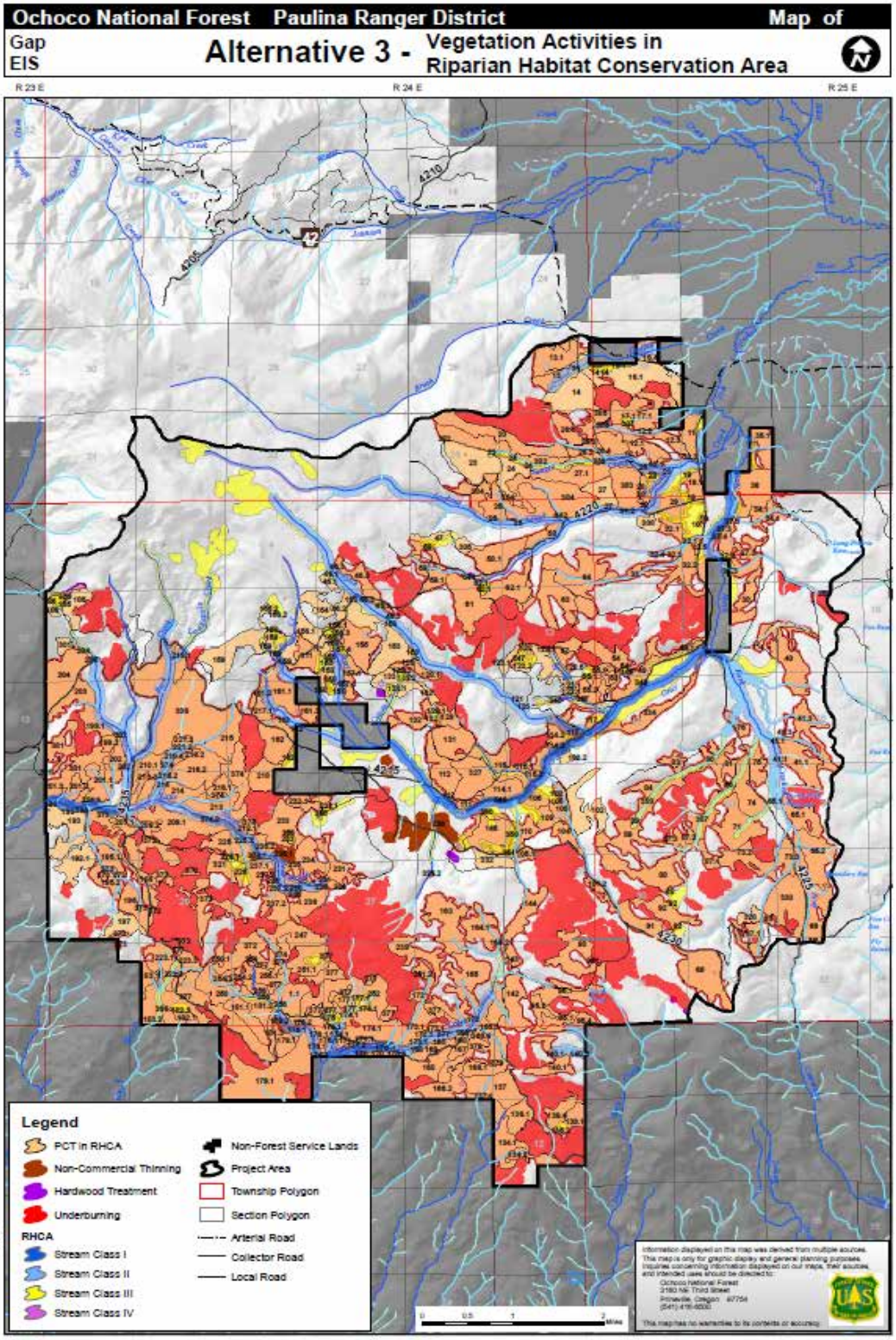


Figure 31. Alternative 3 PCT, noncommercial thinning units and RHCA areas.

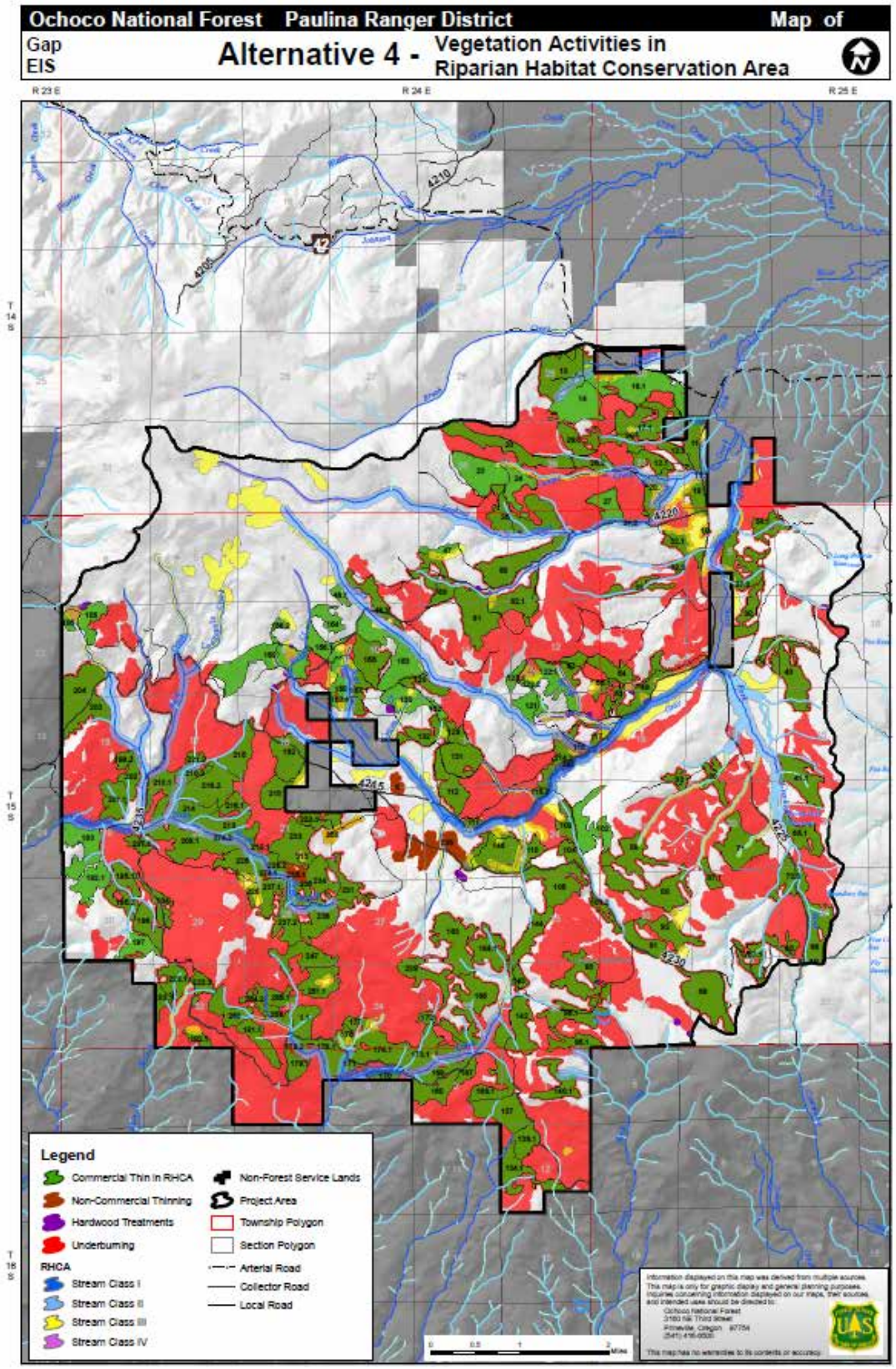


Figure 32. Alternative 2 commercial thin, noncommercial thinning and RHCA areas.

Effects Common to All Action Alternatives: Can be found in Appendix G

Alternatives 2 & 4 -- Measure 1: Effects to individuals and sub-populations of redband trout and Columbia spotted frog

Direct and Indirect Effects

***Vegetation management**:* Proposed activities within RHCAs are planned to improve redband trout and CSF (Columbia spotted frog) habitat features and meet and improve RMO (INFISH 1995). For commercial treatments, site specific prescriptions were developed on a unit by unit basis based on slope, aspect, stream condition, soil conditions and existing vegetation (table 15). These site specific prescriptions include no treatment buffers of various widths adjacent to steam channels, identification of trees to be felled/tipped to meet large wood requirements, equipment restrictions, and modifications to silvicultural prescriptions. These site specific prescriptions were developed to ensure attainment of the RMO already identified in INFISH as well as provide for a potentially minimal increase in the potential for sediment delivery.

Site specific prescriptions were developed for all units adjacent to class I, II and III streams and a some class IVs. PDF were developed that would maintain RMOs for the remainder of the units adjacent to class IV streams and for class IV streams that are unmapped and discovered as a result of implementation activities (see applicable PDF). Within RHCAs, equipment restrictions would exclude ground disturbance within the 'inner riparian zone' (zone of obligate riparian species e.g., sedges, willows, etc.) and limit stream crossings, thereby substantially limiting the risk of direct impacts to fish and frogs. As part of the PDF, this project would be implemented during low-flow periods (July, August, and September), or in some cases in winter (over frozen ground), to avoid effects to spawning fish or incubating embryos and fry as well as breeding frogs.

Redband trout and CSF habitat is represented by class I-III streams. There are approximately 4,444 acres of class I-III RHCA within the project area. The project area contains a total of 9,438 acres of RHCA along class I-IV streams. The remainder of treatments would occur in class IV streams which are not fish bearing or primary frog habitat, only marginal summer frog foraging habitat. Class IV streams are intermittent and would generally be dry during project implementation.

Within RHCAs, potential direct effects to redband trout or CSF are possible where felled or pushed trees may strike individuals during thinning operations. However, risk would be extremely low due to the limited scope of operations, i.e., small amount of thinning adjacent wet areas and application of PDF - thinning in RHCAs. In most cases, primary frog habitat would be protected by PDF that require a minimum 50 ft. but up to 100 ft., sometimes greater, no equipment buffer adjacent streams. Risk to sub-populations would be especially low when considering the size of the proposed action in relation to the amount of untreated areas within the watershed.

***Roads and stream crossings**:* PDF are included to protect frogs; such as prohibiting operations within the channel migration zone. However, mortality of CSF may occur on haul routes and stream crossings when adult frogs are traveling to new feeding/breeding locations are driven over by vehicles.

Potential interactions with frogs at stream crossings would pose the highest risk to frogs. Roads have been implicated in reducing amphibian dispersal (Gibbs 1998 in USDA 2010), increased mortality (Fahrig and others 1995 Gibbs in USDA 2010), and reduced genetic diversity (Reh and Seitz 1990 in USDA 2010).

In the Gap project area, road densities in RHCA are relatively high. There are 38.1 miles of road in RHCAs; 23.9 designated as open and 14.2 designated as closed. No new permanent/system roads would be constructed in the project area.

For all action alternatives, approximately 40 miles of temporary roads would be constructed; 39 miles on existing disturbance and 1 mile of new temporary road. Of those totals, 4.7 miles of temporary road on existing disturbance and <0.1 miles of new temporary road would be in RHCA. Using small spur roads within RHCAs would prevent building new roads or opening longer segments of roads that would increase exposure and potential of more sediment entering the stream and reducing vegetation. With implementation of road closure (20.6 miles) and decommissioning (3.3 miles), the miles of road (closed) in RHCA would be decreased by a similar amount in all action alternatives (about 4-5 miles) (see Transportation report). Direct impacts to fish and frogs would be anticipated to be very low from proposed road closure and decommissioning because of the small amount of roads in RHCA or adjacent primary habitats.

The additional amount of road and commensurate stream crossings during project implementation would incrementally increase exposure of CSF to mortality, but the effects would be short-term when considering the temporary nature (1-3 years) of road utilization, timing, and the amount of currently open roads. They are also a riparian obligate species and would typically utilize habitats far from perennial streams. No direct effects to fish are anticipated because unimproved stream crossings (temporary roads and skid trails) would dry during implementation (reference PDF).

Riparian Restoration*:* 13.7 miles of stream restoration, six culvert replacements, aspen restoration and hardwood planting and protection would be accomplished in Alternative s 2 and 4. Implementation of riparian restoration and associated activities may cause incidental direct mortality of fish and frogs (approximately 1 month per year/10 years) from in-channel physical disturbance (mechanized equipment). This disturbance while occurring could also create indirect effects to redband trout and CSF by altering their feeding behavior or causing them to seek out new habitats exposing them to other stressors or predation. Potential impacts would be mitigated by application of PDFs. Short (post-implementation) and long-term benefits to fish and frogs from implementation of these activities would occur as habitat conditions improve substantially over the current condition. In addition, fish and frog populations would be less exposed to impacts from wildfire, fire suppression and climate change via these actions because of riparian restoration activities e.g., improved habitat and connectivity between populations. Efforts to relocate individuals before culvert replacements occur will be undertaken but these activities may directly impact fish or frogs residing around the culvert when instream work occurs. Culvert replacements would not facilitate expansion of brook trout populations.

Alternative 2 and 4 -- Measure 2 (Water Quantity and Quality)

Effects to water quantity and quality have been analyzed in the Hydrologist report. Those results have been incorporated into the effects discussion below.

Water Quantity

Vegetation management and roads*:* A change in timing or peak flow magnitudes may affect fish via scouring redds or embedding them (USDA 2010). After the project is complete Equivalent Harvest Acres (EHA) values could increase to 17.1 for Alternatives 2 and 4, respectively. This would still be below the Forest Plan Standard of 30% for the Upper Nork Crooked River watershed and 35% for the Horse Heaven Creek-Crooked River watershed. EHA values would increase during the initial phases of implementation (year 2) and decrease over the course of project implementation. This increase in EHA illustrates the potential to increase peak flows. However, through the application of the PDF and BMP there are no expected measureable adverse effects to flow (see Hydrology report). Roads and associated ditch systems increase watershed drainage networks, intercept overland flow, and shift timing of peak flows. Though the potential for increases in peak flow and overland flow from road and skid trail crossings are acknowledged, potential effects would be largely minimized by using BMPs and PDFs. Additionally, road closures and decommissioning would incrementally reduce the net hydrologic effect in the short and long-term.

Therefore, increases in peak flows are not expected to negatively impact fish and fish habitat (substrate). The potential for severity of fire effects (hydrophobic soils, decreased ground cover, severely burned soils) is decreased over that of the No Action alternative, thus decreasing the potential for changes in peak/base flows or water yield as a result of uncharacteristic wildfires, although changes would be limited. As described under the No Action alternative, the potential for changes in peak flows would be limited by the moderately porous soils on the landscape.

Riparian Restoration*:* Riparian restoration activities including stream restoration, headcut repair and culvert replacement) would reconnect streams with their floodplains and stabilize stream flows. The noncommercial treatments (NCT) and associated skid trails and access routes used to facilitate equipment and materials to stream projects may increase hydrologic net short-term. However, phased implementation, PDFs and BMP would reduce substantially reduce impacts.

Overall, riparian restoration projects would help to reduce scour-related mortality (and increase survival) of eggs and alevins, reduce involuntary downstream movement of juveniles during freshets, increase substrate interstitial spaces used for refuge by fry, restore timing of discharge-related life cycle cues (e.g., migrations), and increase spatial structure (USDA 2010). These actions have the potential to reduce the vulnerability of fish and frogs to uncharacteristic wildfire and climate change.

Water Quality – Sediment & Turbidity

Vegetation management: Indirect effects include potential sediment delivery to streams that are inhabited by fish and frogs from overland flow during and after harvest activities, temporary road construction, re-use of closed roads, open road utilization including associated stream crossings and prescribed fire and riparian restoration activities (see below). Elevated sediment delivery to streams increases suspended sediment and turbidity levels, fine sediments in streams can degrade channel form; reference below (*measure 4*) for effects to channel form (pools and streambank condition). Increases in fine sediment in streams can negatively affect salmonids and other aquatic biota (Meehan, 1991; Rhodes et al., 1994; Waters 1995 in USDA 2010) and may be more problematic in degraded systems.

The extent to which hillslope and riparian soils are disturbed and mobilized to the stream channel can decrease the survival of incubating salmonid eggs (Reiser and White 1990 in USDA 2010). Elevated turbidity and suspended sediment levels can impair sight feeding by fish and, at higher levels, causes gill damage in fish (Rhodes et al., 1994). Gravel embeddedness of less than 20% is essential to maintain healthy salmonid population, especially in those areas identified as potential or existing spawning areas (Bjornn and Reiser 1991). If sediment exceeds 20%, the spaces between the rocks in the substrate can be filled leading to less available oxygen for fish eggs.

However, unlike many other land uses that disturb soil for long periods, any increase in sediment yields from timber management activities is usually short-lived (<5 years). Surface soil disturbances provide a sediment supply, but once the finer materials are transported and revegetation occurs, the site is less apt to continue eroding. Pushing/tipping trees within the RHCA would cause a temporary removal of vegetation from the top of the soil for the first one to three months until vegetation regrows. Vegetation would return (after one full growing season) to the disturbed sites eventually re-stabilizing any disturbed areas. The vegetated buffers along streams depending on the location and size of buffer would trap most or all fine sediment that may move as a result of harvest activities. Rashin et al. (2006) found buffers on private land in Washington State to be effective at preventing chronic sediment inputs. A literature review of buffer widths needed to protect water quality found buffers of 10 ft. and 90 ft. trapped ~65% and ~85% of sediment from commercial harvest activities (Sweeney and Newbold 2014). Sediment yields or measured suspended sediment concentrations decrease over time as a negative exponential (Beschta 1978).

***Roads and stream crossings**:* The majority of sediment from timber harvest activities is related to roads and road construction (Chamberlin et al. 1991; Furniss et al. 1991; Megahan and Hornbeck 2000 in USDA 2010) and associated increased erosion rates (Beschta 1978; Meehan 1991; Rhodes et al. 1994 in USDA 2010). Serious degradation of aquatic habitat can result from poorly designed, constructed, or maintained roads (Furniss et al. 1991; MacDonald et al. 1991; Rhodes et al. 1994 in USDA 2010). Road networks interact with stream networks and lake basins at the landscape scale and affect biological and ecological processes in stream and riparian systems (USDA 2010). During precipitation events, fine sediments can be washed from the road surface into streams. This is especially true for poorly maintained roads. Roads constructed in close proximity to streams constrain the stream channel and eliminate the stream's access to its floodplain.

Streams that have the following characteristics are the most sensitive to increases in fine sediment: steep terrain, granitic geology, significant mass erosion, snow melt dominated hydrology, relatively arid climates, low gradient streams, and low frequency of large woody debris (Everest et al., 1987). Habitat for redband trout in the planning area have several of these characteristics, primarily the latter, and therefore, may be generally more susceptible to increases in fine sediment.

Similarly, potential negative effects of mechanized fuels treatments may be worse in areas where riparian conditions are already degraded by a variety of past and ongoing activities including grazing, logging, and roads (Leopold 1937;, USFS et al; Henjum et al.; CWWR, 1996; Moyle, 1996a; b; Espinosa et al., 1997; NRC, 1996; 2002; and Beschta et al. 2004 in USDA 2010). Habitat degradation has also compromised the ability of riparian areas to buffer the effects of upslope disturbance (Rhodes et al 1994). Dwire et al. (in USDA 2010), notes the lingering effects of land management prior to the establishment of buffers are likely to influence the structure and composition of riparian areas for decades to centuries (Young and others 1994 in USDA 2010). Legacies of past management within watersheds could potentially confound responses to fuel reduction treatments (USDA 2010).

For Alternatives 2 and 4, the Hydrology report modelled the combined overall potential maximum sediment delivery to be 19.97 tons during implementation, or a .5 ton increase above the existing condition annual rate. Closed and temporary roads would be rehabilitated after the project has occurred, thus the minor increase in road density, and therefore effects, would be short-term (<5 years). Long-term(>5 years), the action alternatives have the potential to improve conditions over existing condition because all reopened closed roads (within RHCA and potential sediment delivery zone) would be closed and rehabilitated; many closed roads are actually physically open and are still hydrologically connected to the stream network, e.g. lack water bars and berms.

Some roads would be improved that do not receive recurring maintenance, primarily low standard roads (ML 2) would see some improvements in their ability to handle surface runoff and the resultant sediment; this would result in an improvement over the existing condition.

In terms of road related sediment, both alternatives have the potential to improve conditions over the existing condition. In the long-term, for Alternatives 2 and 4, sediment delivery would be reduced to 2.11 tons or 91% less than the existing condition. Proposed road closure and decommissioning have the potential to generate short-term localized effects, but would reduce sediment related impacts from road systems in the long-term. Sediment levels would be below current levels (>5-10 years) following project completion mainly due to revegetation, road decommissioning and road improvements. Individual streams and reaches would return to below background levels as projects in those areas are completed.

Associated benefits include the following: eliminating or reducing erosion and mass-wasting hazards associated with roads; eliminating or reducing human access and use-disturbance associated impacts to aquatic systems. Actions such as subsoiling or ripping of road surfaces, outsloping, waterbarring, fill removal, sidecast pullback, re-vegetating with native species and placement of large woody material and/or boulders are included.

There may be a short-term increase in sediment from implementing closure and rehabilitation but, PDFs are included to reduce the potential for these types of adverse effects from occurring. Additionally, BMPs related to roads include road location, road design, time of use, road construction and maintenance, and road obliteration would be applied. In the long-term (upon project completion), re-closing and rehabilitating temporary roads would decrease watershed drainage networks, eliminate some stream-road crossings, and reduce areas of soil compactions improving watershed function and habitat conditions for fish and frogs.

As acknowledged in the Hydrology report, temporary road construction, and reopening of closed roads for temporary use near streams would have short-term construction related effects (<5years) or during the duration of implementation that would include short-term (< 5 years) increases in turbidity and fine sediment inputs to streams. These are likely to happen during high flow events within the drainage as fine sediments would only be moved during summer thunder storms or during spring snow melt.

All stream crossings would be limited to roads over culverts on perennial streams (Class I-III) and on existing roads that cross dry channels of class IV streams over a temporary culvert, an armored ford or logs with geotextile. The greatest potential for sediment contributions to streams would be associated with class IV crossings. Sediment contributions would be negligible and short-term (<5 years); reference Hydrology section. To minimize effects, as few crossings as reasonable would be used in these streams and crossings would be rocked or a temporary culvert would be placed or logs with geotextile would be placed to reduce sediment transport. After proposed activities are completed, any placed culverts or logs with geotextile would be removed and the channel would be restored (reference PDF & Hydrology report).

Since channels in class IV streams would likely be dry during the project, minimal amounts of sediment would be moved into the channel. The addition of sediment, via dust and rain-induced erosion at road crossings may attribute to the movement of fine silt downstream during high flows. This may disturb individual redband trout or Columbia spotted frogs on a short-term basis (duration of activity, several days to weeks), but would not adversely affect them because of the relatively minor additional amounts and limited scope and duration of activities. In general, sediment that is displaced into streams would be dispersed through the streams during fall, winter and spring runoff events and would not adversely affect spawning/breeding or rearing redband trout and CSF. However, some sediment may accumulate in low in low gradient reaches and intermittent features (pool tail outs, channel margins, etc.) within the project area, but would likely be immeasurable.

***Rx burning and fuels treatments*:** In both alternatives, prescribed fire and noncommercial thinning treatments are designed to reduce smaller fuels within RHCAs and can be used to reduce stocking of conifer seedlings, and to rejuvenate grass and shrub cover. The primary beneficial effect of reducing fuel loads in riparian areas is reduced chance for uncharacteristic wildfire. This alternative proposes prescribed burning within riparian areas across the project area to achieve multiple resource objectives. Prescribed burns would increase species diversity and plant vigor. Some short term (<5 years) negative effects from burning may include an increased potential for invasive plant species (see Botany report and PDF). The objective of the aspen enhancements is to stimulate growth and prevent competition for aspen sprouts. In addition, there are incremental benefits to reducing fuel loads in riparian areas and reducing the risk riparian areas from more intense wildfires – see Measure 3.

As summarized in Appendix G (effects common to all action alternatives), prescribed burning has the potential to cause some short-term adverse effects on salmonids and their habitats. However, it is reasonably certain that individual fish behavior would not be affected directly by the patchy low-intensity fires caused by low to moderate behavior prescribed fires (Minshall and Brock 1991).

Recent research (Beche, et al., 2005) indicates that fuels management in riparian areas can produce short-term (within the year) changes in water chemistry, macroinvertebrate composition and decreases in periphyton. These changes are unlikely to pose major threats to aquatic species because of the limited sizes of prescriptive burns, their short duration and low intensities (USDOC 2007). In a recent study, (Arkle and Pilliod 2010), the authors found no detectable changes in periphyton, macroinvertebrates, amphibians, fish and riparian and stream habitats when comparing burned and unburned controls three years after a prescribed fire treatment.

In general, effects from low to moderate intensity prescribed burns will be much less severe than the effects of intense wildfires considered by Gresswell (1999) and observed by Rinne (1996). Although dead salmonids have been discovered after severe wildfires (Minshall and Brock 1991), it is reasonably certain that individual fish behavior will be not be affected directly by the patchy low-intensity fires caused by this proposed activity.

Indirect effects such as reduced forage for juvenile salmonids would be minor and last for a maximum of approximately one to two years after burning. Over time, juvenile salmonids that receive less food have lower body condition and smaller size at smoltification. However, low-intensity fires should not result in effects this severe.

Prescribed burning would be implemented in different seasons resulting in reduced potential for sedimentation. Fuels treatments would occur in the spring and fall. Hand piles would be burned later in the year after the first snow. Residual slash and the unharvested areas are expected to filter loosened sediment before it reaches the streams. Sedimentation as a result of implementing fuels projects would be filtered through vegetation along the streambanks and throughout the RHCAs during overland flows due to the mosaic fire patterns in the area (see PDF). For frogs, egg deposition occurs for frogs soon after snowmelt. Eggs are normally deposited in water at temperatures of approximately 57.2 degrees F. Fire does not burn well in wet, humid areas along streams and springs. Hand-dug fire lines would be avoided through these areas. Summer foraging areas would not be affected by fuels treatments which would take place in the spring and fall.

Erosion resulting from prescribed burning is generally less than that resulting from roads, skid trails, and site preparation techniques that cause soil disturbance, which are often a necessary component of prescribed burn projects (EPA 2005). Application of PDF would likely minimize risk from these activities. Therefore, effects from prescribed fire activities are not expected to adversely impact fish or frogs or measurably affect fine sediment delivery to streams.

Riparian Restoration*:* The collection of whole trees for LWD source material, associated skid trails and access routes would be similar to the potential effects from commercial thinning as analyzed above. As analyzed in Effects Common to all Action Alternatives, short-term effects (individual project implementation) would occur but would be minimized by staggered and phased implementation and PDF and BMP. Short and long-term, a substantial reduction in sediment from restoration of degraded areas (cutbanks and moderate to severe channel incision) would be anticipated given the scope and scale of proposed activities, 13.7 miles of stream restoration and 1,345 acres. Cumulatively, these projects would restore >38% of redband trout and CSF bearing streams in the project area.

Summary

Short-term (<5 years/duration of individual project – timber sale, stream restoration, etc.), indirect effects to fish and aquatic habitat (substrate) could occur from elevated sediment delivery during project implementation activities. Effects to fish and aquatic habitat (substrate) from inputs of fine sediments are very difficult to measure. Nonetheless, project activities may produce localized effects to redband trout immediately below project sites.

However, PDFs and BMPs including timing and magnitude of these localized effects are not expected to result in measurable effects to fish and aquatic habitat (substrate). Upon project completion, effects to fish and aquatic habitat (substrate) would improve as sediment levels are reduced below the existing condition (pre-project) from closure and rehabilitation of roads in RHCAs. In addition, long-term (>5 years), sediment production would decrease due to tree felling, and riparian restoration activities that would serve to capture and reduce sediment and develop pool habitat including pool tailouts (spawning substrate). Alternative 2 and 4 would move the measure towards the desired future condition.

Stream Shade and Temperature

Effects to Stream Shade and Temperature have been analyzed in the Hydrology report.

***Vegetation management*:** In Alternatives 2 and 4, commercial harvest in Class I, II and III RHCAs is not expected to reduce shading on perennial streams due to application of site specific unit PDF that maintains the primary shade zone with two exceptions. The first exception is the removal of conifers around incidental hardwoods encountered during implementation. The 2nd exception is the pushing or felling of trees for LWD as prescribed in the site specific RHCA PDF (table 15). For the 1st exception, the number of incidental hardwoods that would be encountered is expected to be very low and spatially intermittent. For the 2nd exception, the number of trees to be pushed or felled is also relatively low (~200) and also spatially intermittent. Therefore, no measureable short-term effect to shade from either action is anticipated, especially considering the scope of activities (1,041 acres) that would occur in a small portion of those acres. Removing conifers from hardwood stands to improve alder or willow production in commercial units may incrementally reduce shade but should not result in a measurable increase in water temperatures.

In Alternatives 2 and 4, NCT would occur in 1,371 and 1,405 acres of RHCA respectively (table 139). NCT would occur to within five feet of stream channels. With the application of site specific unit PDF and shade 'setbacks', mostly trees that do not provide primary shade or provide bank stability would be removed so that the existing amount of stream shade is maintained with the exception of removal of conifers around incidental hardwoods encountered during implementation. Similar to above, the number of incidental hardwoods that would be encountered is expected to be low and spatially infrequent. Therefore, no measureable effect to shade is anticipated. NCT would reduce the competition between riparian-associated species and conifers resulting in more woody, shrubby species. NCT would result in increased growth rates for both conifers and riparian shrubs (see Silviculture report).

Aspen restoration is proposed on 55 acres (Alt. 2) and 76 acres (Alt. 4) (included in above NCT totals). Thinning in these stands would specifically target suppressed riparian hardwoods by thinning out encroaching conifers up to 15" dbh. Removing conifers from hardwood stands or to improve alder, willow and aspen production in these noncommercial units may reduce a minor, short-term (<5 years) amount of shade but should not result in a measurable increase in water temperatures. No measureable increase in temperature is anticipated, especially considering the scope of activities in relation to the size of the watershed.

Roads and stream crossings: Temporary road construction (existing and new) and re-use of closed roads would not measurably affect shade or stream temperature because the majority of roads occur outside the primary shade recruitment zone and in most cases would not have mature vegetation tall enough to affect shade. Similarly, no new crossings are planned for class I, II or III streams. Some temporary road stream crossings (reference Measure 1) on existing road disturbance would occur on class IV streams throughout the project area but would not measurably affect existing shade or temperature because of their limited number, intermittent spatial distribution across the project area and application of PDF and BMPs.

New temporary roads would not cross any streams. Selection of stream crossing locations would be coordinated with fish/hydro/soils and would be located in the least impactful areas where minimal disturbance would occur, typically on previous disturbance. Stream crossings would be rehabilitated upon completion of activities; reference PDFs.

Rx burning: In Alt. 2 and 4, prescribed fire is proposed on a total of 4,015 acres of RHCAs (table 139). There is a risk that application of prescribed fire could reduce shade in RHCAs short-term. Although fire can have a wide range of effects on aquatic ecosystems ranging from minor to severe, prescribed burns are planned for spring and fall when fuel moisture and relative humidity are high. Under these conditions, burns in riparian areas tend to occur in a mosaic pattern, leaving considerable unburned area and resulting in low tree mortality. Areas with the highest moisture levels, immediately adjacent to streams, tend to receive the least damage from fire (USDA 2010 - GTR-231). Potential effects from low to moderate intensity prescribed fire in riparian areas include minor reductions in stream shade that would not measurably increase water temperatures, (Reiman et al. 2003). Effects from low to moderate intensity prescribed burns would be much less severe than the effects of intense wildfires considered by Gresswell (1999) and observed by Rinne (1996).

The application of prescribed fire would be consistent with direction in project PDFs and BMP. Underburning would occur within the RHCA but outside the riparian vegetation. Ignition of burns would occur outside of RHCA, but could be allowed to creep into riparian vegetation. Ignition of burns would occur outside of RHCA (except hand piles) and no fire line construction in the RHCA (Reference specific design criteria/features for Rx burns in RHCAs).

To meet RMOs, fire prescriptions for RHCAs would provide for a mosaic of burned and unburned areas to retain sufficient soil cover for infiltration and maintain vegetation that provides shade. In general, burning in RHCAs would be expected to burn 10-50% of the riparian area, while exposing less than 5% mineral soil. Mineral soil exposure would be expected to last less than one year. The above ground growth of grasses and shrubs in the burned areas would be killed but would respond with new growth within the first growing season after the burn. Observations of similar prescribed fire treatments show burned grasses begin to sprout with new growth within one to three months of the first growing season. Within the first year after burning, shrubs and grasses would be rejuvenated. The Gap project Fuels and Botany reports contains a discussion of fire effects specific to common shrub species in the project area. Based on this discussion, most shrubs produce basal sprouting following disturbance or require mineral soil exposure to germinate and establish new plants. Prescribed fire and associated harvest and noncommercial thinning would reduce fire hazard and the potential for severe wildfire within the RHCA and reduce competition for resources between hardwoods and conifers. There would be a risk of prescribed fire reducing shade, however short-term increases in temperature (up to 6 months) are allowed even on streams over threshold during riparian restoration activities to restore riparian vegetation (Oregon Water Quality Standards 340-041-0004(5)(a)).

With application of PDFs and BMPs, any reduction of stream shade would be spatially intermittent and short-term (<5 years) and would not be expected to measurably increase water temperatures. Short and long-term, it is anticipated that shade would increase over the next 5-10 years due to higher vigor of existing (and recently planted) hardwoods once some of the conifer canopy and understory is removed and/or consumed via implementation activities. Increased shade from the hardwoods would lead to incrementally lower temperatures in streams which is a critical element fish need for survival during low flow periods when air temperatures increase in the summer months.

***Riparian Restoration**:* short term (<5 years) reduction in shade is anticipated but impacts would vary by individual project. Generally, shade, especially hardwood shade, is lacking or severely depressed in project areas; thereby limiting any effects. Restoring stream channels to more natural patterns and profiles, e.g., narrow an over widened channel (can also create deeper channels and pools), would physically reduce the areas exposed to solar radiation. Reducing areas of channel incision would also increase the areas colonized by shade producing riparian vegetation. A concurrent objective is to reconnect streams with their floodplains which would increase shade producing vegetation but would also have the effect of storing more ground water which would be released slower and longer throughout the year.

Improving base flows is critical to maintaining and improving fish habitat especially considering the predicted effects of climate change. Climate change is predicted to increase precipitation events but will shift from snowfall events to more rain events, which could lead to increased peak flows and flooding (Lute et al. 2015). This could be more pronounced in the Blue Mountains of the Ochoco NF because most of the forest is not at high elevation.

The NCT within or adjacent to stream restoration projects would reduce some shade short-term but the number of trees to be pushed over and collected would be relatively low and spatially intermittent; few trees would come from within the primary shade zone. Removing conifers may incrementally reduce shade but should not result in a measurable increase in water temperatures.

It is anticipated that any short-term shade reduction would be outweighed by the substantial short and long-term benefits especially given the scope and scale of projects; the majority of the highest value riparian ecosystems in the project area. Road closure and decommissioning may also increase shading long-term through the development of vegetation on bare surfaces. Short-term effects would be mitigated by staggered and phased (same project) implementation and application of PDFs and BMP.

In summary, through the application of PDFs, there would be no measurable increase in water temperatures resulting from any proposed activities or from elevated sediment delivery. A minor amount of shade would be reduced short-term (<5 years) in the commercial RHCA units (LWD placement), aspen/hardwood RHCA units (portions of) and potentially through Rx burning and riparian restoration, but no measurable increase in water temperatures resulting from these activities is anticipated. Short and long-term, the proposed action would move the measure towards the desired future condition and HRV. These actions would substantially benefit fish and frogs and their habitat in the short and long-term.

Alternative 2 & 4 -- Measure 3 – Riparian Vegetation

***Vegetation management and Rx fire*:** Alternatives 2 & 4 includes commercial and noncommercial thinning designed to improve vegetative resiliency and lessen the likelihood of uncharacteristic wildfire from occurring. Proposed treatments include protections for existing RMO as summarized in the unit by unit PDF (tables 15 and 17). In Alternative 2, approximately 1,041 acres (<12% of RHCAs in the project area) of silvicultural activities would occur with RHCAs. The proposal for Alternative 4 is the same but would add an additional 15 acres of noncommercial hardwood thinning (table 139). No trees >21” would be harvested within RHCA in Alternative 4.

The maintenance of existing large trees would occur and treatments would promote the development of additional large trees. Mortality of large trees would not be eliminated, but would be reduced below the level associated with Alternative 1. This would result in a reduction of potential large wood recruitment within RHCAs in the short term but would increase the likelihood of a long term supply of large trees. To offset this potential short fall, unit prescriptions include requirements to fall trees to meet the INFISH LWD RMO – see proceeding LWD discussion under Measure 4. In addition, unit prescriptions include no treatment zones and modified or no commercial harvest zones adjacent to stream channels so that future recruitment trees are available near stream channels.

Potential tree heights in the project area range from about 150 feet in the more productive upper reaches of Lookout Creek to approximately 75 to 100 feet in some of the ponderosa pine sites in the southern portion of the project area. No harvest zones prescribed in RHCAs typically range from 50 to 100 feet in width. These widths encompass roughly one third to one half of the entire potential wood recruitment zone.

Several of the key points presented in the (Spies et al. 2013) synthesis paper titled, '*Effects of Riparian Thinning on Wood Recruitment*' were considered and applied to this project area. Though the paper focused on forests in NW Oregon, several of the key points were incorporated into the planning and design of riparian treatment both at the reach and watershed scale. The majority of the key points are relevant to this project area, those include:

1. Thinning is most beneficial in dense young stands.

4. Conventional thinning generally produces fewer large dead trees.

5. Conventional thinning can accelerate the development of very large diameter trees.

6. Nonconventional thinning can substantially accelerate dead wood production.

8. Dead wood in streams comes from multiple sources.

9. 95% of near-stream wood inputs come from within 82 to 148 feet of a stream.

10. Thinning can increase the amount of pool-forming wood under certain conditions.

11. The function of instream wood varies with size and location.

12. Effects of thinning on instream wood needs to be placed in a watershed context.

14. Variation in thinning is essential (i.e. don't do the same thing everywhere).

The Gap project would meet the key points listed above by predominantly thinning younger trees and by leaving large trees which would leave some exposed and more susceptible to windthrow for dead wood recruitment. Thinning would be done in a variable mosaic on the landscape. Instream and downed wood would be placed in RHCA as part of the project to meet these standards.

An additional 1,725 acres of underburning outside of commercial and noncommercial thinning units are proposed within this project. This activity is primarily focused on the reduction of existing ground fuels and includes design features which are intended to meet INFISH RMOs. It is anticipated that there would be a minor amount of understory conifer mortality resulting from underburning. Reducing unwanted density of understory trees would complement the silvicultural activities and improve landscape resiliency but is not expected to be of a magnitude that would meaningfully change this analysis.

Reducing stand densities, managing for more historic and fire tolerant species compositions, and reducing fuel loads would lessen the risk of a high intensity event such as a stand replacement wildfire or insect epidemic occurring. Post treatment, Alternative 2 reduces Fire Return Condition Class (FRCC) 2 and 3 within the project area by an avg. of 10% and 27% respectively, over the existing condition. While Alternative 4 reduces Fire Return Condition Class (FRCC) 2 and 3 within the project area by an avg. of 14% and 27% respectively, over the existing condition (see Fuels report). Lessening the likelihood of a stand replacement event would help ensure that shade in the long term would be maintained or increased.

As described in the existing condition section, riparian vegetation conditions within the inner zone are generally poor within the project area. Each alternative enhances 200+ acres of aspen stands. Maintaining and increasing hardwoods can also help improve bank stability as many of these species have rhizomatous root systems – see Measure 4 below.

Table 140. Vegetation Management Activities in RHCA by stream class – Alternative 2 & 4

Alternative 2	Stream Class				
Activity	**I**	**II**	**III**	**IV**	**Total Acres**
Commercial Thin	54.6	412.5	368.6	205.1	**1040.8**
Non-comm. Thin	6.6	48.3	7.1		**61.9**
Total	**61.1**	**460.7**	**375.7**	**205.1**	
Aspen thinning	1.6	6.7	41.9	5.0	**55.2**
Non-comm. Thin	90.5	511.3	421.9	225.0	**1248.6**
Underburn			5.5		**5.5**
Total	**92.2**	**518.0**	**469.3**	**230.0**	
NCT only			5.5		**5.5**
Underburn only	127.6	734.2	570.6	292.1	**1724.5**
Total	**127.6**	**734.2**	**576.1**	**292.1**	
Alternative 4					
Commercial Thin	54.6	412.5	368.6	205.1	**1040.8**
Non-comm. Thin	6.6	48.3	19.8	0.2	**74.8**
Total	**61.1**	**460.7**	**388.6**	**205.3**	
Aspen thinning	1.6	6.7	62.3	5.2	**75.8**
Non-comm. Thin	90.5	511.3	421.9	231.9	**1255.5**
Underburn			5.5		**5.5**
Total	**92.2**	**518.0**	**489.6**	**237.1**	
NCT only			5.5		**5.5**
Underburn only	127.6	734.2	570.6	292.1	**1724.5**
Total	**139.7**	**801.1**	**685.6**	**309.4**	

Roads and stream crossings*:* As described under Measure 1 above, both alternatives would increase the amount of closed roads and road decommissioning within RHCAs. These actions would help improve riparian vegetation (outer zone) conditions over the no action alternative.

Riparian Restoration*:* These activities would improve riparian vegetation by restoring water tables critical to the functionality of stream and riparian ecosystems. As addressed in Measure 2 above, NCT within or adjacent to stream restoration projects would address over stocked stands in the much drier outer zones and have minor impacts on actual riparian vegetation (inner zone) from access routes and ground based machinery operations. Long-term benefits would substantially outweigh short-term effects as the complexity and diversity of vegetation responds to active restoration. Projects/activities would restore departed riparian vegetation conditions towards HRV and ecological site potential.

In areas where LWD placement is the primary restoration action, minor, short-term (individual project implementation) disturbance from projects within RHCA would occur to inner riparian veg. conditions but they would be minimized by scope and scale, staggered implementation, PDFs and BMP. Short and long-term benefits from riparian restoration activities that reduce impacts to RHCA and improve riparian vegetative conditions long-term would occur.

Compared to Alternative 1, vegetation management activities and riparian restoration within forested stringers and RHCA would reduce risks to riparian vegetation and increase resiliency from uncharacteristic wildfire and climate change.

Alternative 2 and 4 -- Measure 4 – Aquatic Habitat

Large Woody Debris

Vegetation management: In Alternative 2, commercial harvest is proposed on 1,041 acres or 12% of RHCA in the project area (tables 15 and 17). The proposal for Alternative 4 is the same but would add an additional 15 acres of noncommercial hardwood thinning (table 139). RHCA treatments were developed with an IDT (interdisciplinary team) with the goal of improving RMOs and reducing risk from uncharacteristic wildfire. The treatments described in tables 15 and 17 (PDF) were designed to protect RHCAs while carefully managing to attain RMOs. These treatments were developed on a unit-by-unit basis after analysis determined specific RHCAs in which management strategies could be applied to attain RMOs; site-specific analysis was also used to ensure that water temperature, bank stability, and large woody material recruitment zones would be protected.

As described in the Silviculture report, commercial harvest of conifers is combined with NCT and underburning to promote the attainment of Forest Service standards and guides for forest and stream health. When combined with NCT, commercial harvest can lead to increased conifer tree growth which would increase future recruitment of large woody material. Commercial harvest and associated treatments would also benefit riparian-associated trees along streams, meadows and wetlands. Commercial harvest in RHCAs would reduce competition among conifers by thinning overstocked, live trees, which would lead to increased growth rates of the trees that remain. The maintenance of existing large trees would occur and treatments would promote the development of additional large trees. Mortality of large trees would not be eliminated, but would be reduced below the level associated with Alternative 1. This would result in a reduction of potential large wood recruitment within RHCAs in the short term but would increase the likelihood of a long term supply of large trees. Trees that remain would contribute to stream LWD over the long-term (present-100 years) as they mature to greater size, die and blow/fall over into the stream.

As described in the Existing Condition discussion, the project area is generally depauperate of in stream LWD. To offset this potential short fall, unit prescriptions include requirements to fall trees to meet the INFISH LWD RMO – see below. In addition, unit prescriptions include no treatment zones and modified or no commercial harvest zones adjacent to stream channels so that future recruitment trees are available near stream channels. Potential tree heights in the project area range from about 150 feet in the more productive upper reaches of Lookout Creek to approximately 75 to 100 feet in some of the ponderosa pine sites in the southern portion of the project. For purposes of this analysis, the LWD recruitment zone is defined as up to 150 feet of stream channels (>1 site potential tree height); this zone protects the primary LWD recruitment zone which maintains approximately 90% of LWD recruitment (USDA 2010/GTR-231). In many category I & II RHCAs, treatments were designed to occur in the outer-most zone (150-300 feet) of the RHCA, e.g., upslope of a road.

Thinning prescriptions also include maintaining skips, gaps, and clumps that would maintain natural rates of LWD recruitment in portions of treated areas. Other leave areas include protections for sensitive plants and archaeological sites. No harvest zones prescribed in RHCAs typically range from 50 to 100 feet in width, primarily to protect the primary shading zone – see measure 2 above. These widths encompass roughly one third to one half of the entire potential wood recruitment zone (see unit specific project design features). However, due to application of PDF ‘shade setbacks’(see measure 2) this would only apply to trees between 50 and 100 feet because PDFs limit harvesting trees greater than 9” within 50 feet of stream channels (class I-III).

In class IV streams, harvesting of trees may be reduced relative to class I-III streams because PDF are less restrictive. Additional PDF include felling of snags (if determined to be a hazard during implementation) towards stream channels that may facilitate LWD recruitment.

In all RHCA units where treatments are proposed within the primary LWD recruitment zone (150 ft.), trees would be felled or pushed over to meet the minimum INFISH RMO. For purposes of this analysis, it is assumed all project area streams are deficient in LWD. The amount of individual tree recruitment would vary by unit as determined by the distance of stream within the unit. For example, a unit that encompasses 0.25 miles of stream would require 5 trees to be felled/pushed to meet the PDF. Approximately 94 trees would be felled/pushed into primary fish and frog habitat (class I-III streams) in Alternative 2 and 4 (table 141). While it is recognized that reference conditions for LWD in project area streams is higher than the INFISH standard (as determined by watershed analysis), the active recruitment of trees to meet the INFISH standard combined with the existing LWD present in streams, would move the RMO towards the reference standard. Additionally, INFISH recognized that in many cases interim RMO would not be met instantaneously, but would be achieved over time (INFISH A-2).

Table 141. LWD by stream class within RHCA units in Alternatives 2 and 4.

Stream Class	# of trees >12” dbh
I	3
II	71
III	20
IV	110
All streams	**203**

In most cases, standing trees would be recruited from 25-75 feet from the edge of streams to function effectively as in–stream LWD while protecting bank stability. Trees recruited for LWD would be of appropriate size for the stream channel. Trees of variable species, heights and dbh would be recruited. Generally, larger streams would require larger trees to function effectively as LWD, while small tributaries would require smaller trees (USDA 2010 – GTR-231). Large wood strongly influences channel form in small streams, creating pools and waterfalls and affecting channel width and depth (Montgomery et al. 2003).

The presence of LWD in streams affects erosion, transport and deposition of sediment, the creation of growth and gravel bars and channel and floodplain sedimentation (Montgomery and others 2003). Dams formed by accumulations of LWD increase channel complexity and facilitate deposition of organic matter, thus providing a food source for numerous invertebrate species and contributing to nutrient cycling and retention (Bilby and Bisson 1998; Wondzell and Bisson 2003; Montgomery and others 2003). All trees would be >12” dbh to meet the criteria for LWD in INFISH. As a general rule, pushing or tipping trees would be favorable to felling trees as whole trees with rootwads attached are more effective in achieving project objectives e.g., sort and store bedload, including fines, pool formation and as fish habitat. Rootwads likely function to increase the probability of pool formation by anchoring LWD (Braudrick and Grant 2000 USDA 2010) and, as with larger diameter LWD, by providing a larger surface area for obstructing flow and forcing bed scour.

There would be no reduction in the amount of LWD as a result of proposed thinning activities in RHCA due to application of INFISH standards and PDF. Proposed riparian restoration activities that specifically add LWD would provide additional LWD inputs – see below.

Rx burning and fuels treatments*:* Prescribed fire (4,015 acres) and noncommercial thinning treatments are designed to reduce smaller fuels within RHCAs and can be used to reduce stocking of conifer seedlings, and to rejuvenate grass and shrub cover. Prescribed fire, commercial and noncommercial thinning would reduce fire hazard and the potential for severe wildfire within the RHCA (reference Fuels and Silviculture reports).

Reducing fuels protects large wood on the ground and standing trees for future large wood recruitment needed for fish habitat and riparian function. While some LWD may be consumed, fire would be expected to kill some standing trees that over time would be recruited as LWD in to streams. Reducing competition would promote the growth of residual trees that would be future large woody debris. LWD creates slow water habitats, side-channels, and off-channel alcoves critical for fish rearing and amphibian breeding. With more pool habitat, water temperatures can decrease (due to reduction of surface area compared to riffles) and more complex habitat is created for fish and frogs. Redband trout, like many other salmonids have evolved in stream systems in which large woody material helps retain organic and inorganic particulate matter that is important for channel stability, biological diversity and productivity (Nakamura and Swanson 1993). Additionally, humidity and shade created by the increase in cover (e.g. LWD, hardwoods, and riparian forbs) and the increase in pool numbers would improve habitat conditions for frogs.

PDFs have been developed to maintain RMO including protection of in-stream LWD and to maintain future recruitments. The application of prescribed fire would be consistent with the Programmatic BA that includes the following PDF: underburning would occur within the RHCA but outside the riparian vegetation. Ignition of burns would occur outside of RHCA, but could be allowed to creep into riparian vegetation, Ignition of burns would occur outside of RHCA (except hand piles), and no fire line construction in the RHCA. Additionally, PDF include units of site specific treatments for noncommercial thinning that includes felling trees up to 16” to provide for LWD – these typically occurs adjacent small streams. General PDFs also includes felling trees up to 12” and in some cases up to 15” (hardwood stands) towards stream channels. NCT would generally increase the recruitment of small woody debris to edges of stream channels. Perhaps more importantly, thinning debris would protect streambanks and riparian plants by increasing streambank roughness and reducing livestock access – see streambank condition below.

As described above and in subsequent measures, fire can have a wide range of effects on aquatic ecosystems ranging from minor to severe (Reiman et al. 2003); prescribed burns would be planned for spring and fall when fuel moisture and relative humidity are high. Under these conditions, burns in riparian areas tend to occur in a mosaic pattern, leaving considerable unburned area and resulting in low tree mortality. Areas with the highest moisture levels, immediately adjacent to streams, tend to receive the least damage from fire. Potential effects from low to moderate intensity prescribed fire in riparian areas include minor reductions in large woody debris recruitment. However, in some cases, LWD levels would increase due to prescribed fire (Chan 1998). Local monitoring conducted on the ONF revealed similar results (see Fuels report).

Roads and stream crossings*:* Temporary road construction and re-use of existing temporary roads within RHCAs (<0.1 miles), re-use of closed roads (4.6 miles) could affect LWD recruitment (short and long-term >150 years) by limiting recruitment from these areas via vegetative disturbance, i.e., road clearing and improvement. However, when considering that vegetation on closed roads is typically small in size due to the age of past road construction (20-50 years old) and subsequent regeneration, most of the trees would not be of sufficient size to be recruited as LWD >12” dbh. Potential effects from construction of new temporary roads on LWD recruitment would be limited by the scope and scale of proposed activities: approximately <0.6 acres within RHCA, and even less acres within the LWD recruitment zone. Therefore, LWD recruitment is not anticipated to be measurably affected via road construction and utilization. In regards to stream crossings, LWD could be increased incrementally short-term if crossings need to be improved and displaced trees would be used upon rehabilitation of crossings. PDF state LWD would be incorporated, where possible, into the rehabilitation of the disturbed areas (reference PDFs).

***Riparian Restoration**:* given the scope and scale of projects the amount of LWD in streams would work towards meeting INFISH goals. Projects/activities would restore highly departed LWD loading towards the historic range of variability and reference conditions. These projects would have a long-term beneficial effect on this critical aquatic habitat component to the structure and function of streams, fish habitat and aquatic species.

In summary, through application of PDF, and the effects described above, effects to LWD and long-term recruitment would be beneficial short and long-term. There may be a short and long-term increase as some thinned material (small (<6" dbh) and medium (12-15"dbh) size classes) is recruited to the stream including areas where standards are not currently met from PCT thinning. Underburning may cause minor reductions (PDF limit to <20% loss) in LWD (short-term) but would be off-set with an increase due to recruitment of fire killed trees and windthrow (including thinning) over time (short and long-term).

Long-term (duration of avg. fire return interval) fire resiliency would be increased in all treatment areas. Active vegetation management in RHCAs as proposed in Alternatives 2 & 4 would increase the amount of LWD and maintain LWD recruitment substantially over the No Action Alternative. Alternatives 2 and 4 would reduce risks of reducing LWD recruitment and existing in-stream LWD from impacts to uncharacteristic wildfire and impacts from climate change – thereby providing more resilient aquatic habitats over the no action alternative.

Pool Frequency/Pool Quality

***Vegetation management, Rx fire and roads and stream crossings*:** As described in the Existing Condition section, pool densities are low in project area streams due to increased W/D ratios, sedimentation from accelerated bank erosion and lack of LWD. As described above, elevated sediment delivery reduces the quality and volume of pools and impedes pool development via several mechanisms. Fine sediment tends to be deposited and sequestered in pools during low flows, reducing pool volume and quality (Buffington et al., 2002). The loss of pool depth from sedimentation has been shown to be correlated with increased levels of fine sediment in streams caused by increased sediment delivery (Appeaser, 2002). Increased sediment delivery increases stream width and decreases stream depth in depositional reaches (Dose and Roper, 1994 in USDA 2010), which is also associated with reduced pool dimensions (Buffington et al., 2002). The loss of pool volume and quality can negatively affect native salmonids. Pools provide multiple habitat functions and are an essential habitat feature of native salmonids at a variety of life stages (McIntosh et al., 2000). Furthermore, studies have repeatedly shown that salmonid production is positively correlated with pool quality, volume, and frequency (Meehan, 1991; McIntosh et al., 2000 in USDA 2010).

The extent to which hillslope and riparian soils would be disturbed and mobilized to the stream channel would potentially reduce pool habitats (McIntosh and others 1994, 2000 in USDA 2010). As described in measure 2, RHCA treatments would not be anticipated to negatively affect pool frequency or quality due to the buffer zones and no treatment areas (PDF) and limited scope of activities < 12% of RHCA within project area. Residual slash and the unharvested areas are expected to filter loosened sediment before it reaches the streams. Sediment transport as a result of implementing vegetation treatments including Rx burning, would be filtered through vegetation along the streambanks and throughout the RHCAs during overland flows due to the limited scope of treatments and their proximity to streams (see Hydrology report). For areas outside of RHCAs, analysis conducted in the Hydrologist section indicates that Alternatives 2 and 4 could potentially elevate sediment delivery above background during project implementation. However, with application of PDFs and BMPs, fine sediment inputs are expected to be minor and likely negligible (see Hydrology report).

Prescribed burning would be implemented over approximately 10 years and in different seasons resulting in reduced potential for sedimentation; reference Measure 2. In addition, LWD additions as described in the site specific PDF would increase pool quantity and quality as described below.

Reconstruction of roads within RHCAs and potential sediment delivery zone (PSDZ) would improve drainage and reduce sedimentation from the existing condition via installation of temporary culverts and/or armored drainage dips. Some of the road reconstruction or improvements would occur on Class IV stream crossings; (see Measure 2).

Riparian Restoration*:* As described under measure 2, short-term increases in sediment delivery to streams would occur especially at large scale 'plug and fill' projects and culvert replacements. Minor amounts of sediment would be anticipated from LWD placement projects. Sediment may affect pool quality and quantity. However, sediment inputs would be anticipated to be short-term as restoration would reduce bank generated sediment to below pre project levels relatively quickly (<5 years).

As a whole, these activities would increase the amount of LWD added to streams substantially, which would in turn increase the amount and quality of pools thereby improving fish and frog habitat short and long-term. Connectivity would be improved for redband trout and CSF. Many species use pools formed by large wood as habitat and in-stream wood for cover (Bilby and Bisson 1998; Wondzell and Bisson 2003 in USDA 2010).

In summary, minor, short-term (<2 years/project implementation period) impacts to pool frequency and quality could occur in streams across the project area from elevated sediment delivery during project implementation but effects would likely be negligible and immeasurable; reference Measure 2. Pool frequency and quality would be expected to increase in the short and long-term due to restoration work and PDFs. After completion of the project, pool frequency and quality would improve as sediment levels are reduced below the existing condition (pre-project) from closure and decommissioning of roads in RHCAs (see Hydrology report). Reducing the density of conifers within the RHCAs would likely lead to an increase in density of riparian species that can reduce sediment transport and create additional refuge for fish, thus improving quality and the quantity of pool habitat for aquatic species. In addition, long-term (10+ years), pool frequency and quality would increase due to large trees falling into the channel, capturing sediment and developing pool habitat. Alternatives 2 and 4 would move the measure towards the desired future condition as described in chapters 1 and 2 and affected resource reports.

Streambank Condition (% stream bank stability, channel width to depth ratio)

Vegetation management**:** The proposed treatments inside RHCAs and across the project area would not be expected to measurably affect streambank stability and channel width-to-depth ratios. In RHCAs, treatments would not affect bank stability or channel width-to-depth ratios because of the limited scope of activities and proximity to streambanks. PDFs stipulate that all logging equipment and off road vehicles would be kept to a minimum of 50 feet, typically 75 to 100' away from stream banks on class I, II and III streams and generally 25 feet from the banks on low gradient class IV streams and 50 ft. on steeper streams (>10% slope). In some cases, equipment would be permitted to be within 5 feet of class IV's. In a few cases it was determined that 5 feet would be an effective buffer to maintain bank stability on an intermittent stream channel less than 5 feet wide, with zero to less than 5% slope and sparse conifer vegetation.

Bank stability would increase due to denser stands of hardwoods and other riparian plants along the stream channel once the conifer canopy is reduced. With an increase in hardwoods and other riparian plants (over the next 5+ years) the width-to-depth ratio would decrease as the channels narrowed (over the next 10-20 years) due to sediment being captured by the reestablishing riparian plants and other woody debris. PDFs include felling/tipping trees to mitigate limited timber harvest from large wood recruitment zones; trees would be recruited from 25-75 ft. away from streambanks.

These additional trees would facilitate bank stability and decrease w/d ratios overall short and long-term. Noncommercial thinning would not cause soil or bank disturbance.

Elevated sediment delivery to streams can also degrade channel form, i.e., width-to-depth ratios; increased sediment delivery increases stream width and decreases stream depth in depositional reaches (Richards, 1982; Dose and Roper, 1994 in USDA 2010). Both width and depth can respond rapidly to changes in sediment load and/or discharge. Whether a stream erodes downward or outward is influenced by both local shear stresses and whether the bed or banks are the most easily eroded. As described in Measure 2, potential, short-term (<5 years effects) from elevated sediment delivery may occur but would be not be expected to affect width to depth ratios in the project area. (see Hydrology report for assumptions on timing of peak flows and sediment delivery).

Roads and stream crossings: In class I, II and III streams, mechanized equipment would be limited to existing disturbance, only existing skid trails, crossings and landings are allowed between 50 and 100 feet from stream channels. In class IV streams, there would be a short-term reduction in bank stability at stream crossings associated with project activities (reference measure 2) but effects would be minimized by placing temporary culverts or armoring crossings and restoring banks through planting, seeding and placing LWD to reestablish banks and narrow the stream channel .

Rx burning: Impacts from prescribed fire activities are not expected to impact bank stability (or w/d ratios) due to application of PDFs.

Riparian Restoration: Restoration activities would improve bank stability and w/d ratios directly via channel reconstruction and restoration, headcut repair and culvert replacement. Active restoration would dramatically accelerate recovery of actively eroding cutbanks and restore stream channels to the appropriate pattern, dimension and profile. Minor, localized impacts to banks stability and w/d ratios would be anticipated from LWD placement; effects would be short-term as bank stabilization would develop over 1-3 years post disturbance. As a whole, 13.7 miles of stream restoration would improve streambank condition substantially over the no-action alternative short and long-term. Additionally, thinning debris from aspen restoration would reduce pressure on banks, improve site conditions for riparian vegetation and facilitate reductions in w/d ratios. Minor impacts would occur short-term from implementation of these activities but short and long-term benefits would be provided.

In summary, minor, short-term impacts may occur to bank stability at stream crossings and during implementation of riparian restoration projects. Additionally, potential short-term impacts via elevated sediment delivery and, to a lesser extent, higher peak flows during project implementation. Similarly, small, incremental changes to w/d ratios in localized areas may occur during project implementation but would not likely be measurable. Long-term improvements (post implementation) to bank stability and width-to-depth ratios would occur overtime as crossings are rehabilitated, improvement of riparian vegetative condition, roads are closed and rehabilitated, peak flows and potential elevated sediment delivery reduces to below background levels, LWD is recruited and channels narrow and riparian restoration activities are implemented. Alternatives 2 and 4 would move the measure towards the desired future condition as described in chapters 1 and 2 of the DEIS.

Cumulative Effects

The cumulative effects boundary includes the five subwatersheds that fall within the Gap project boundary: Headwaters North Fork Summit River, Gray Creek, Lost Creek, Upper Horse Heaven Creek and Lower Horse Heaven Creek. (see figure 37).

Past, present and reasonably foreseeable projects are summarized in table 167. Projects/activities that may affect fish and frogs include, but are not limited to: livestock grazing under the Big Summit and Fox AMPs, the Deschutes and Ochoco Travel Management EIS (Travel Management Plan), Deschutes and Ochoco Invasive Plant FEIS (Invasives Plant FEIS),

The Nature Conservancy Juniper Preserve, Lookout Mountain Multi-use Trail project and ongoing recreation activities, including fishing.

Measure 1 – Direct Impacts to Aquatic Species

Livestock grazing has the potential to add cumulatively to the Gap project via trampling of young fish and frogs. However, planned riparian restoration, fences and water developments would reduce the potential of those incidents. Because the project area is located within and near streams, there are substantial ongoing human activities including vehicular traffic (project and non-project related) that may occasionally result in mortalities of individual frogs. There are several dispersed camping sites located along streams throughout the project area that are used during the summer and fall months. Rock dams are often constructed at these sites which often result in fish barriers and reduction of stream flow. Furthermore, fishing is permitted on streams within the project area during the summer months, resulting in hooking and harvest mortalities.

There are 91 acres currently proposed for treatment under the Invasive Plant FEIS within RHCA (see Botany report). In addition to these acres, the FEIS enables the Forest to treat new invasive plant infestations with herbicides. To protect aquatic species and water quality, PDFs in the Invasive Plant FEIS prohibit most prohibit treatments near perennial streams (USDA 2012). Manual treatments are applied between stream and herbicide application buffer to reduce potential impacts; in most cases, this buffer is 15 ft. (USDA 2012). Therefore, chemical treatments are not expected to impact frogs and fish, especially when considering the very small amount of treatments dispersed across the project area.

A minimal number of mortalities of fish and frogs could result from present and reasonably foreseeable activities. Under Alternatives 2 and 4, this project could add cumulatively to these incidental deaths; however, the project implementation would be staggered over several years and on a small area within RHCAs, limiting any potential cumulative effects to fish and frogs. It is anticipated that direct impacts would be decreased to below baseline levels due to conclusion of project activities and closure/decommissioning of roads; decreasing potential effects to fish and frogs. Riparian restoration and culvert replacement activities may have direct and indirect effects to fish and frogs, including some mortality during implementation at project sites but would produce substantial long-term benefits to populations and aquatic habitat. Alternative 2 and 4 would be consistent with the applicable INFISH, ONFLRMP and NFCR W&S River Management Plan standards and guidelines. BMPs and PDF developed for the project area would provide sufficient protection and avoidance of redband trout, CSF and their habitats to the extent practical, while still meeting project objectives.

Measure 2 – Water Quality and Quantity

Water Quantity

Project(s) with the potential to reduce peak flows and stabilize the hydrologic regime in the project area short and long-term include implementation of the Deschutes Ochoco Travel Management EIS (2011) and Range AMP's. The Range AMP's would increase the amount, diversity and health of riparian areas including vegetation through a combination of improved management and active restoration. The indirect effects of the Travel Management EIS would reduce the potential for increasing overland/peak flows and moving towards a more stable hydrologic regime long-term through restriction of vehicle access in the Travel Management EIS via hydrologic stabilization of closed roads. This project would help to reduce scour-related mortality (and increase survival) of eggs and alevins, reduce involuntary downstream movement of juveniles during freshets, increase substrate interstitial spaces used for refuge by fry, restore timing of discharge-related life cycle cues (e.g., migrations), and increase spatial structure (USDA 2010).

The Gap project would not add cumulatively to measurably increasing peak flows in the short or long term from project implementation activities including: commercial and non- commercial thinning including within RHCAs, Rx burning, road construction, stream crossings, riparian restoration or culvert replacements (see Hydrology report).

Water Quality – Sediment & Turbidity

In summary, the treatment history in the project area has affected the ability of these watersheds to provide vigorous and stable riparian habitat; elevated background levels of sediment are likely occurring due to roads and ongoing and past watershed management activities. Specifically, present and reasonably foreseeable projects that may affect fish and frogs and their habitats via sediment delivery in the project area include: livestock grazing, Travel Management EIS, DES/OCH Invasive Plant FEIS, portions of the proposed Lookout Mountain Multi-use Trail project and ongoing recreation.

Livestock grazing has the potential to add cumulatively to the Gap project sediment delivery from bank alteration and suppression of riparian hardwoods but PDFs been developed to improve grazing conditions long-term. Implementation began in 2010 under the Big Summit AMP and in 2014 under the Fox AMP. Since the inception of these two AMP projects only two pastures have not met standards. In each year, 2013 and 2014, one pasture did not meet standards out of 30 that are within the project area (see Range Specialist report).

There are several dispersed camping sites located along streams throughout the project area that are used during the summer and fall months (Recreation report) that have the potential for minor reductions in riparian vegetation and streambank disturbance within RHCAs. These activities coupled with implementation of the project treatments may impact minor amounts of sediments along streams, but any effects would not likely be measureable.

Grazing also has the potential to reduce but not eliminate sediment delivery, from current amounts, in the project area short and long-term from improved management and implementation of active and passive riparian restoration. Implementation of the Travel Management EIS would restrict access to designated open roads, decreasing access and impacts to streams and would likely reduce the spread of invasive plants. Treatments implemented under the Invasive Plant EIS would improve native riparian plant communities with greater root strength that could reduce sediment delivery over time via increased soil stabilization.

Still, the project has the potential to add cumulatively to increasing fine sediment delivery in the short-term (<5 years) from project implementation activities including: commercial and non-commercial thinning within RHCAs, Rx burning, road construction, stream crossings, stream restoration and culvert replacement. In the long-term (>5 years) after project completion, it is anticipated that sediment would be decreased to below baseline levels due to conclusion of project activities, specifically through riparian restoration, road improvements and road decommissioning activities; therefore decreasing long term potential effects to fish, frogs and aquatic habitats.

Stream Shade and Temperature

Projects that have the potential to negatively affect stream temperature via reductions in stream shade include: livestock grazing, Gray Prairie Rx burn, and ongoing recreation.

Historic grazing practices contributed to the removal of deciduous woody vegetation and compaction of alluvial terraces. Livestock grazing continues in the project area, but levels have been reduced from historic amounts and riparian vegetation is slowly improving, but is still below desired conditions. Activities within some RHCAs would likely attract livestock because removing small trees as well as surface and ladder fuels would remove barriers to livestock movement. In other areas higher slash levels and downed trees retained in RHCAs may impede cattle access to the streams.

Increasing sunlight to the ground by removing some of the canopy cover would also increase growth of grasses, shrubs, and hardwoods. This would increase the amount of forage available which would attract livestock. Livestock are expected to continue to use riparian areas and are expected to consume some of the increased forage. However, more strict grazing management criteria are being implemented under the Big Summit and Fox Canyon Range AMPs as discussed previously (see Range report).

There are several dispersed camping sites located along streams throughout the project area that are used during the summer and fall months that have the potential for minor reductions in riparian vegetation and disturbance within RHCAs. These activities coupled with implementation of the project treatments may impact stream shade in a few areas scattered within the project, but would not likely contribute to any measurable increases in water temperature.

Projects that have the potential to improve stream shade include implementation of the Travel Management EIS, Invasive Plant FEIS and Range AMPs. Under the Big Summit and Fox Canyon AMP implementation, riparian species have more protection from being overly utilized by cattle and would likely exhibit more vigorous growth due to the increased resources from thinning. Additionally, planned riparian restoration, fences and water developments would improve riparian conditions. Implementation of the Travel Management EIS may incrementally reduce negative impacts to riparian vegetation from motorized vehicles short and long-term by restricting access of vehicles to open roads including stream crossings allowing some closed roads to revegetate. Invasive plant treatments would improve native riparian plant communities that provide more potential shade in the long-term.

Still, the project could add cumulatively to decreasing shade in the short-term (<5 years) by thinning out competing conifers in hardwood stands on a very limited scale, distributed across the subwatersheds. Additionally, shade may be impacted by application of limited prescribed burning activities within RHCAs (4,015 acres) but any effects would likely be short-term (<5 years). Due to application of buffers PDFs and BMPs there should not be any measurable increase in water temperatures in any fish bearing or non-fish bearing perennial streams in the planning area. In the long-term, it is anticipated that shade would be improved due to increased growth of riparian hardwoods or increased growth rates of residual trees and implementation of riparian restoration activities.

Alternative 2 and 4 would be consistent with the applicable INFISH, ONFLRMP and NFCR W&S River Management Plan standards and guidelines and state water quality standards. PDF and BMPs would provide protection of water temperature and avoid adverse effects to aquatic species.

Measure 3 – Riparian Vegetation

Projects with the potential to affect riparian vegetation include: livestock grazing under the Big Summit and Fox Range AMP, Invasive Plant FEIS, Ochoco T, ongoing recreation and the District firewood program. The Travel Management EIS would restrict vehicle access including within RHCA across the planning area. Short and long-term indirect benefits would be anticipated provided that, overtime, closed roads in RHCA are able to revegetate. Livestock grazing has the potential to add cumulatively to the Gap project via degradation of riparian vegetation but PDF were developed to improve grazing conditions long-term – see measure 2. Additionally, planned riparian restoration, fences and water developments would improve riparian vegetative conditions.

There are several dispersed camping sites located along streams throughout the project area that are used during the summer and fall months that have the potential for minor reductions in riparian vegetation and disturbance within RHCAs but not at a scale that would have measurable effects. The Invasive Plant EIS proposes to treat 91 acres of weeds in RHCAs within the project area. Weed treatments would improve native riparian vegetation in some locations.

As described previously under direct/indirect effects for this measure, a minimal amount of short-term disturbance to riparian vegetation may result from project activities. Under Alternatives 2 and 4, this project could affect riparian vegetation in the short term primarily through prescribed burning and riparian restoration activities; however, BMPs and PDF developed for the project including site specific RHCA PDF would provide protection and avoidance of sensitive areas within RHCAs.

Following project implementation, it is anticipated that impacts would be decreased to below baseline levels due to conclusion of project activities specifically closure/decommissioning of roads including within RHCA, release of hardwoods following thinning and prescribed burning and revegetation of stream banks following riparian restoration. For active stream restoration, project implementation would be staggered (one project per year), and in the case of the larger projects, phased implementation would limit short-term effects to riparian vegetation. In the long-term, substantial benefits are anticipated due to the significant scope and scale of proposed treatments relative to the amount of high value aquatic ecosystems in the project area. Alternative 2 and 4 would be consistent with the applicable INFISH, ONFLRMP and NFCR W&S River Management Plan standards and guidelines.

Measure 4 - Aquatic Habitat

Past, present and reasonably foreseeable future projects that may affect redband trout and CSF habitat include: livestock grazing, Travel Management EIS, Invasive Plant FEIS, ongoing recreation and the district firewood program. RHCAs are deficient in large standing trees due to past harvest emphasis on overstory removal. Instream habitats are deficient in pools due to past riparian management. Width-to-depth ratios and streambank stability are consistently below Forest Plan standards across the watershed due to past riparian area management.

Large Woody Debris

Projects with the potential to affect LWD recruitment and in-channel LWD include Travel Management EIS, ongoing recreation and the ONF firewood program.

There are several dispersed camping sites located along streams throughout the project area that are used during the spring, summer and fall months. Incidental manipulations to aquatic habitat or factors that may impact aquatic habitat may occur at these sites. The ONF firewood program prohibits firewood cutting within 150 ft. of streams, springs, ponds, wet areas or floodplains. This restriction adequately protects the primary LWD recruitment zone (up to 150’) which maintains approximately 90% of LWD recruitment (USDA 2010 GTR-231).

The amount of class IV (intermittent) stream channels adequately protected by the restriction is unknown. Additionally, illegal firewood cutting has likely reduced LWD recruitment within the project area and has occasionally removed in-channel LWD across the planning area (personal observation). These activities coupled with implementation of the project treatments may impact aquatic habitat parameters, but the limited size and scope of impacts would not likely contribute to any measurable impacts short and long-term.

Projects that may improve LWD recruitment include implementation of the Travel Management EIS and the Invasive Plant FEIS. Implementation of the Travel Management EIS would restrict access to designated open roads, decreasing access and impacts to streams, and possibly reduce illegal wood cutting. Implementation of the Invasive Plant FEIS will improve all aquatic habitat parameters by increasing the amount of native riparian vegetation.

Still, the project could add cumulatively to decreasing LWD (minor amounts) in the short-term from application of prescribed fire, along 4,015 acres of RHCAs. Impacts would be relatively minor when considering scope of the project area, timing of implementation and distribution of activities across the watershed. These potential impacts would be off-set by short and long-term recruitment from tree

mortality following prescribed fire, windthrow following riparian thinning and especially from implementation of riparian restoration activities which proposes to add several thousand trees to streams within the Gap project. Implementation of Alternative 2 and 4 would allow for increased growth rates of large trees that are within the area of recruitment of LWD to streams (up to 150 feet) and additions from tree felling/pushing (approximately 204 trees) as outlined in PDF. A substantial increase to the amount of LWD (>5,000 trees) in streams would occur via riparian restoration.

Pools and Streambank Condition

Specifically, Present and Reasonably Foreseeable projects with the potential to decrease pool frequency and quality and streambank condition include: livestock grazing, Travel Management EIS, Invasive Plant EIS, ongoing recreation and the ONF firewood program.

Similar to Measure 2, livestock grazing under the Big Summit and Fox Range AMPs has the potential to add cumulatively to reductions in pool quantity and quality and w/d ratios via localized fine sediment delivery and bank alteration. However, grazing conditions are expected to incrementally improve from changes in management activities due to new NEPA initiated in 2010 and 2014, respectively. Reference the Range Resource report, specifically environmental effects, existing condition trend and monitoring data and Measure 2 & 3, for additional discussion on effects from livestock grazing.

Projects that may improve pool frequency and quality and streambank condition include implementation of the Travel Management EIS and the Invasive Plant FEIS. Implementation of the Travel Management EIS would restrict access to designated open roads, decreasing access and impacts to streams, reduce the spread of invasive plants and reduce illegal firewood cutting can that can reduce the amount of LWD recruited and impact pool formation. Implementation of the Invasive Plant FEIS could potentially increase bank stability through recovery of native vegetation and stabilization of disturbed/denuded areas.

Still, this alternative may add cumulatively to increasing, minor, short-term impacts to pool frequency and quality from elevated sediment delivery during project implementation and impacts to streambank condition. However, impacts would be relatively minor when considering the scope of the project area, duration of implementation over several years, and distribution of activities across the watershed.

Long-term (>5 years) post project completion, pool frequency and quality and streambank condition would improve as sediment levels are reduced below the existing condition (pre-project) from closure and rehabilitation of roads in RHCAs. LWD supplementation is expected to narrow stream channels over time, thus incrementally reducing w/d ratios and potentially increasing bank stability. Potential elevated sediment delivery reduces to below background levels, and LWD is recruited and channels narrow therefore reducing impacts to streambank stability and width-to-depth ratios short and long-term (>5 years) following project completion. However, potential negative impacts would be off-set by short and long-term recruitment of LWD from thinning (PCT) hardwood stands, prescribed fire and most significantly, riparian restoration (>5,000 trees).

Alternatives 2 and 4 would be consistent with the Programmatic BA, applicable INFISH, ONFLRMP, and WSR standards and guidelines. BMPs and PDF developed for the project area would provide protection to aquatic habitat parameters and improve habitat conditions for redband trout and CSF.

Alternative 3

Alternative 3 is similar to Alternatives 2 & 4 except there would be no commercial harvest within RHCA. Commensurately, there would be less temporary roads (on existing disturbance) in Alternative 3 compared to Alternative 2 and 4.

The amount of additional NCT is in RHCAs is approximately 60 acres less than Alternatives 2 and 4; the amount of Rx burning, remains the same in all alternatives. Proposed riparian restoration activities would be the same as in Alternatives 2 and 4.

Alternative 3 -- Measure 1: Direct Impacts to Aquatic Species

Direct and Indirect Effects

Effects would be very similar to Alternatives 2 and 4 except that there would be a reduced potential of impacts to fish and frogs because there would be no commercial vegetation treatments and associated roads, skid trails and stream crossings in RHCAs.

Specifically, there would be a less risk to impacting frogs because no treatments would occur near primary habitats. Mortality of frogs may still occur on haul routes and stream crossings when adult frogs are traveling to new feeding/breeding locations are driven over by vehicles and logging equipment.

Riparian restoration activities are the same as in Alternatives 2 and 4. Short-term risks to injury and death of fish and frogs would remain from implementation of in-stream restoration. However, short (post-implementation) and long-term (10+ years) benefits to fish and frogs from implementation of these activities would occur as habitat conditions improve substantially over the current condition. Fish and frog populations would be more exposed to potential future impacts from wildfire, fire suppression and climate change than compared to Alternatives 1, but riparian restoration activities would reduce risk to fish and frogs from wildfire and climate change because of improved habitat and connectivity between populations.

Alternative 3 -- Measure 2 (Water Quality and Quantity)

Direct and Indirect Effects

Water Quantity

Effects would be very similar to Alternatives 2 and 4 – see Hydrologist report. In Alternative 4, the potential effects of impacts to fish and frogs from increased peak flows would be reduced over Alternatives 2 and 4 because there would be no commercial vegetation treatments and less road construction/utilization skid trails and stream crossings project wide and within in RHCAs. The slight increases in NCT and Rx burning would not be expected to have a measurable affect over Alternatives 2 and 4. The potential for severity of fire effects (hydrophobic soils, decreased ground cover, severely burned soils) is decreased over that of the No Action alternative, but less than would be accomplished by Alternatives 2 and 4 thus decreasing the potential for changes in peak/base flows or water yield as a result of uncharacteristic wildfires, although changes would be limited.

Water Quality – Sediment & Turbidity

Effects would be very similar to Alternatives 2 and 4. In Alternatives 3, the potential effects of impacts to fish and frogs and their habitats from increased sediment yield would be reduced over Alternatives 2 and 4 because there would be no commercial vegetation treatments and less road construction/utilization skid trails and stream crossings within in RHCAs and throughout the project area. The slight increases in Rx burning would not be expected to have a measurable affect over Alternatives 2 and 4. The potential for severity of fire effects (hydrophobic soils, decreased ground cover, severely burned soils) is decreased over that of the No Action alternative, but slightly more than Alternatives 2 and 4 thus decreasing the potential for increases in sediment delivery as a result of uncharacteristic wildfires, although changes would be limited. Alternative 3 would move the measure towards the desired future condition as described in chapters 1 & 2 of the DEIS.

Stream Shade and Temperature

Effects would be very similar to Alternatives 2 and 4. In Alternative 3, the potential effects of impacts to fish and frogs from reduced shade and increased temperatures would be reduced over Alternatives 2 and 4 short-term because there would be no commercial vegetation treatments, within in RHCAs.

Long-term, Alternative 3 would be less beneficial to increasing shade and reducing temperature because RHCA stand conditions would continue to depress hardwoods, stands would remain at risk to insect and disease and uncharacteristic wildfire. The potential for severity of fire effects as manifested by decreased riparian vegetation is decreased over that of the No Action alternative, but slightly more than Alternatives 2 and 4 thus decreasing the potential for reductions in shade and increases in temperature as a result of uncharacteristic wildfires, although changes would be limited. This action would move the measure towards the desired future condition as described in chapters 1 and 2 of the DEIS.

Alternative 3 -- Measure 3 (Riparian Vegetation)

Direct and Indirect Effects

Effects would be very similar to Alternatives 2 and 4. In Alternative 3, the potential effects from riparian vegetation would be decreased over Alternatives 2 and 4 short-term because there would be no commercial vegetation treatments, within in RHCAs (table 142). The slight increases in NCT within RHCAs would not be expected to have a measurable affect over Alternatives 2 and 4 but would complement long-term benefits to increasing landscape resiliency. Long-term, Alternative 3 would be less beneficial to improving riparian vegetation because RHCAs would continue to be at risk from insect and disease and uncharacteristic wildfire, and hardwood vegetation communities would continue to be suppressed. Alternative 3 would be equally beneficial short and long-term to riparian vegetation because the amount of riparian restoration is the same. The potential for severity of fire effects is decreased over that of the No Action alternative, but slightly more than Alternatives 2 and 4 thus decreasing the potential for negative impacts to riparian vegetation and riparian areas as a result of uncharacteristic wildfires. Alternative 3 would move the measure towards the desired future condition as described in Chapters 1&2 of the DEIS.

Table 142. Acres of vegetation management treatment types by RHCA Class – Alternative 3.

Alternative 3	**Stream Class**				
Activity	I	II	III	IV	Total Acres
Commercial Thin	0.0	0.0	0.0	0.0	0.0
Non-comm. Thin	6.6	48.3	7.1	0.0	61.9
Total	**6.6**	**48.3**	**7.1**	**0.0**	**62.0**
Aspen thinning	1.6	13.1	51.3	5.0	71.1
Non-comm. Thin Only	90.4	504.8	374.5	219.9	1189.6
Underburn	0.0	0.0	5.5	0.0	5.5
Total	**92.1**	**517.9**	**431.4**	**224.9**	**1286.3**

Alternative 3	**Stream Class**				
NCT only	0.0	0.0	5.5	0.0	5.5
Underburn only	127.6	734.2	573.2	292.1	1727.1
Total	**127.6**	**734.2**	**578.7**	**292.1**	**1732.6**

Alternative 3 -- Measure 4 – Aquatic Habitat

Direct and Indirect

Effects would be very similar to Alternatives 2 and 4. In Alternative 3, the short-term potential for alteration to aquatic habitats would be decreased over Alternatives 2 and 4 because there would be no commercial vegetation treatments within RHCAs. The slight decrease in Rx burning and NCT within RHCAs would not be expected to have a measurable effect over Alternatives 2 and 4 but would provide for incremental decreases in large tree recruitment over time, hardwood stand improvement and small woody debris felling towards streams. Alternative 3 would be less beneficial to improving aquatic habitat short and long-term because RHCAs would continue to be at risk from insect and disease and uncharacteristic wildfire, and hardwood plant vegetation would continue to be suppressed. Effects from riparian restoration would be the same as in Alternatives 2 & 4. The potential for severity of fire effects is decreased over that of the No Action alternative, but slightly less than Alternatives 2 and 4 thus increasing the potential for negative impacts to riparian areas and aquatic habitat parameters as a result of uncharacteristic wildfires. Similarly, aquatic habitat would be less resilient long-term because no RHCA treatments and subsequent tree felling/tipping would occur to improve habitat and buffer against potential effects from climate change. Alternative 3 would move the measure towards the desired future condition as described in chapters 1 and 2 of the DEIS.

Cumulative Effects - Alternative 3

The same list of past, present and reasonably foreseeable activities was used for Alternative 3 cumulative effects analysis as was the analysis area consisting of the five subwatersheds contained within the Gap project (see figure 37).

Measure 1 – Direct Impacts to Aquatic Species

Effects would be similar to Alternatives 2 and 4. A minimal number of mortalities of redband trout and CSF could result from project activities, mainly riparian restoration, culvert replacement and some road activities. These restoration actions would have a long term beneficial effect for aquatic species. Under Alternative 3, this project could add cumulatively to these incidental deaths; but those risks would be less than Alternatives 2 and 4 but more than the no action alternative. However some mortality to fish and frogs is expected to occur under the no action alternative from activities such as recreation and fishing. Alternative 3 would be consistent with the applicable INFISH, ONFLRMP and WSR standards and guidelines (INFISH Goals Consistency – Appendix E). BMPs and PDF developed for the project area would provide protection and avoidance for fish and frog populations and their habitats.

Measure 2 – Water Quality and Quantity

Effects would be similar to Alternatives 2 and 4. Minor increases in peak flows and water yield, sediment delivery and very small impacts to shade could result from project activities but would likely be minimized by PDFs and BMPs.

Still, Alternative 3 could cumulatively increase sediment and turbidity at certain project sites in the short term (<5 years) but is expected to decrease sediment and turbidity in the long term (>5 years) from road improvements, closures and decommissioning's. Potential impacts to water quantity and quality would be less than Alternatives 2 and 4 but more than the no action alternative. Alternative 3 would be consistent with the applicable INFISH, ONFLRMP, and WSRA standards and guidelines. BMPs and PDFs developed for the project area would provide protection and avoidance of sensitive areas.

Measure 3 – Riparian Vegetation

Similar to Alternatives 2 and 4, a minimal amount of disturbance to riparian vegetation may result from present and reasonably foreseeable projects. Under Alternative 3, these projects could add cumulatively to these impacts. However, the project duration is short term and of a relatively small area within RHCAs, limiting any potential cumulative effects. In the long-term (>5 years) following project implementation, it is anticipated that impacts would be decreased to below baseline levels due to conclusion of project activities including closure/decommissioning of roads and especially riparian restoration activities. Riparian restoration activities would have limited short-term effects to riparian vegetation but substantial long-term benefits. Alternative 3 would be consistent with the applicable INFISH, ONFLRMP and WSRA standards and guidelines (INFISH Goals Consistency). BMPs and PDF developed for the project area would provide protection and avoidance of sensitive areas within RHCAs.

Measure 4 – Aquatic Habitat

Similar to Alternatives 2 and 4, a minimal amount of disturbance to aquatic habitat parameters may result from project activities, mainly stream restoration and culvert replacement. Under Alternative 3, this project could add cumulatively to these impacts; however, the project duration would be short term and of a relatively small area within RHCAs, limiting any potential cumulative effects. In the long-term (>5 years) following project implementation, it is anticipated that impacts would be decreased to below baseline levels due to conclusion of project activities including closure/decommissioning of roads and especially riparian restoration activities. Riparian restoration activities would have limited short-term effects to aquatic habitat paramters e.g., bank stability but substantial long-term benefits to all parameters. Alternative 3 would be as equally beneficial short and long-term compared to Alternatives 2 and 4 because the amount of riparian restoration would be the same. However less thinning in RHCA would occur under Alternative 3 reducing positive effects to streamside hardwoods and health of conifer stands in RHCA. Alternative 3 would be consistent with the applicable INFISH, ONFLRMP and WSRA standards and guidelines (INFISH Goals Consistency). BMPs and PDF developed for the project area would provide protection and avoidance of aquatic habitat within RHCAs.

Aquatic Species Determination Summary

Summary of Determinations

Redband trout & Columbia spotted frog

Alternative 1

- Determination for Alternative 1 is **NI, no impact** to redband trout as there would be no aquatic restoration, vegetative, fuels or road projects.
- Determination for Alternative 1 is **NI, no impact** to Columbia spotted frogs as there would be no aquatic restoration, vegetative, fuels or road projects.

Alternative 1 may not meet INFISH RMOs for riparian vegetation, water temperature, large wood, pool frequency, width depth ratios or stream bank stability as rapidly as the action alternatives because no commercial treatments would occur in RHCA including subsequent LWD additions, riparian restoration activities, culvert replacements, road closures and decommissioning. There is increased risk of forest mortality from insects, disease and catastrophic wildfire under this alternative.

Alternatives 2 & 4

- Determination for Alternatives 2 and 4 is MIIH, **may impact individuals or habitat of redband trout, but would not likely contribute to a trend towards federal listing or loss of viability to the population or species**. Application of PDFs and BMPs would substantially minimize detrimental effects to redband trout. Vegetation treatments would generally occur outside spawning periods (April to June) and riparian restoration would occur outside of spawning and incubation times during the in-water work period (ODFW 2008) to further reducing risks.
- Determination for Alternatives 2 and 4 is MIIH, **may impact individuals or habitat of Columbia spotted frog, but would not likely contribute to a trend towards federal listing or loss of viability to the population or species**. Application of PDFs and BMPs would substantially minimize detrimental effects to CSF. Treatments activities would occur outside breeding season (March 1 to May 1) within channel migration zone to reduce vulnerability of frogs to potential effects. These dates are also within the in-water work period (ODFW 2008).

Redband and CSF populations would increase long-term as the entire suite of riparian restoration activities, culvert replacements, road closures and road decommissioning would occur, thereby improving habitat conditions and RMOs and reducing risks to aquatic resources from climate change and uncharacteristic wildfire. Treatments in RHCAs would translate to short and long-term improvements to fish habitat, riparian function and RMOs including the addition of large woody debris and PCT materials within units. The additions of large woody debris would provide refuge and material for food sources, and improve RMO by reducing width-to-depth ratios, improving bank stability, increase pool quantity and quality and improve riparian vegetation which would increase shade and reduces sediment input to the stream. Any short-term disturbance, injury or death from project implementation activities would be limited to a few individuals. Redband and CSF populations would be anticipated to increase in the long term as a result of the proposed treatments in Alternatives 2 and 4.

The most significant difference between Alternative 2 and 4 is a slight increase in noncommercial thinning and thinning for aspen restoration, relatively insignificant at the project scale. Alternatives 2 and 4 would also include an additional 61 and 54 acres respectively of NCT in RHCA over Alternative 3; equally insignificant at the project scale.

Compared to alternative 1, active management (commercial treatments, PCT and riparian restoration) within RHCA would increase the amount of LWD and maintain LWD recruitment. Furthermore, by improving fish habitat alternatives 2 & 4 would reduce the potential risk of reducing LWD recruitment and existing in-stream LWD and ultimately redband trout and CSF populations from impacts due to potentially uncharacteristic wildfire and impacts from climate change.

Alternative 3

- Determination for Alternative 3 is **MIIH, may impact individuals or habitat of redband trout, but would not likely contribute to a trend towards federal listing or loss of viability to the population or species**. Vegetation treatments would generally occur outside spawning periods (April to June) and riparian restoration would occur during the in-water work period (ODFW 2008) thereby reducing risks to redband trout.
- Determination for Alternative 3 is **MIIH, may impact individuals or habitat of Columbia spotted frog, but would not likely contribute to a trend towards federal listing or loss of viability to the population or species**. Treatments activities would occur outside breeding season (March 1 to May 1) within channel migration zone to reduce vulnerability of CSF to potential effects. These dates are also within the in-water work period (ODFW 2008).

Redband and CSF populations would increase long-term as the full suite of riparian restoration and road closure and decommissioning would occur, improving habitat conditions, RMOs and reducing risks to aquatic resources. However, no commercial treatments in RHCAs would occur, thereby forgoing short and long-term improvements to fish habitat, riparian function and RMO including unit specific LWD placement. Streams and aquatic species would still be at risk from uncharacteristic wildfire, insect and disease, i.e., conditions related to departure from HRV.

Minor, short-term (<5 years after implementation) impacts to RMOs would still occur due to implementation of riparian restoration activities. Any short-term disturbance from vegetation treatments (RHCA Rx burns and NCT) to a few individuals is not expected to be adverse, nor would it impact the growth or survival of those individuals. Redband populations would not decline as a result of the proposed treatments in Alternatives 3. This alternative would meet INFISH and WSRA RMOs for water temperature, LWD, pool frequency, width/depth ratios and stream bank stability.

Monitoring

Implementation monitoring would occur as directed by the ONFLRMP. BMP Implementation and Effectiveness monitoring would occur as described in the Hydrology report. The ONFLRMP states "Evaluate monitoring results and mitigate where necessary to minimize impacts from activities where BMP's do not perform as expected (4-236). In addition, PIBO effectiveness monitoring would continue (every 5 years); COFMS (Central Oregon Fire Management Service) Riparian Fire Effects Monitoring on selected sites in the future is expected. Region 6 Level II stream surveys would be conducted (w/in 10-15 years), depending on program funding. Monitoring of stream restoration projects and culvert replacements would occur and this may include but is not limited to; vegetative success surveys, stream temperature, photo points, cross sections, longitudinal profiles and pebble counts.

Hydrology

This section summarizes the draft Hydrology report; information has been included almost verbatim, but some appendices were not included. The entire report and appendices are located in the Gap project file, Prineville, Oregon.

Management Direction

Management of the Gap Landscape Restoration project (Gap project), as it relates to hydrologic and riparian function, is directed by the Ochoco Land and Resource Management Plan (LRMP 1989), the Inland Native Fish Strategy (INFISH 1995), the Clean Water Act (1972) and Executive Orders 11988, 11990, and 12088. Additional scientific guidance and background information is available within the National Best Management Practices for Water Quality Management on National Forest System Lands (April 2012), the Joint Aquatic and Terrestrial Programmatic Biological Assessment (2014) and the Watershed Condition Framework (WCF) process (2011). Existing Condition

Characterization of the Planning Area

Watersheds

The Gap project area consists of two watersheds. The Upper North Fork Crooked River (UNFCR) Watershed drains northeast into Big Summit Prairie. The Horse Heaven Creek-Crooked River Watershed (HHCCR) drains southwest into the main-stem of the Crooked River. These systems are all within the Upper Crooked Sub-basin, and the larger Deschutes River Basin.

Table 143. Watersheds Associated with the Project Area

Fld	Area	Name	Hydrologic Unit Code	USFS Area (ac.)	%USFS
2nd	Region	Pacific Northwest	17	-	-
4th	Sub-Region	Middle Columbia River	1707	-	-
6th	Basin	Deschutes River	170703	-	-
8th	Sub-Basin	Upper Crooked	17070304	-	-
10th	Watershed	Upper North Fork Crooked River	1707030403	23724	-
12th	Sub-Watershed	Gray Creek	170703040301	10007	95
12th	Sub-Watershed	Headwaters North Fork Crooked River	170703040304	13717	88
10th	Watershed	Horse Heaven Creek-Crooked River	1707030406	14477	-
12th	Sub-Watershed	Lost Creek	170703040601	6038	30
12th	Sub-Watershed	Upper Horse Heaven Creek	170703040605	7585	41
12th	Sub-Watershed	Lower Horse Heaven Creek	170703040606	854	6

The Gap project area follows watershed boundary delineations in the northwest and southeast, and the Forest boundary in the southwest and northeast. The project area is approximately 38,145 acres, ranging in elevation from approximately 6800 feet to 4560 feet. Much of the project area lies within the upper elevational boundary of the rain-on-snow zone (approx. 3,500-5,000 ft.).

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Climate and Precipitation

The climate of the Upper North Fork Crooked River and Horse Heaven Creek-Crooked River Watersheds has evolved from a warm moist tropical regime (60 million years ago) to the temperate four distinct seasons of today. Most precipitation occurs between October and March in the form of rain and snow. Precipitation in the summer months is dominated by convective thunderstorms resulting in short duration, high intensity thunderstorms, as well as dry lightning storms. Annual precipitation within the project area ranges from 19 inches at the lower elevations to 29 inches at higher elevations. Precipitation levels are highly variable, both within and between years. Periods of drought and temperatures in excess of 90 degrees Fahrenheit are common during the summer months. Mean temperatures range from approximately 20-40 degrees Fahrenheit during the winter to 40-70 degrees during the rest of the year with the driest and hottest weather occurring during July and August.

Stream System/ Hydrologic Conditions

There are 97.57 miles of classified stream in this planning area, see table 144.

Table 144. Miles of Stream by Class in the Gap project area

	Class I	Class II	Class III	Class IV	Class V	Unclassified	Totals
Upper North Fork Crooked River Watershed							**73.5**
Gray Creek Subwatershed							**25.35**
Gray Creek	4.79	0.55		1.35			6.69
Horse Gulch				1.91			1.91
Lytle Creek		4.55		0.16			4.71
No Name		0.85	3.6	2.26	4.47		11.19
Short Creek		0.59	0.26				0.85
Headwaters North Fork Crooked River Subwatershed							**48.15**
Dudley Creek		0.81	0				0.81
Jungle Creek		0.79	1.36				2.15
Long Prairie				1.91	0.33		2.23
Lookout Creek		5.17		1.4			6.57
No Name	0.12	2.02	4.21	14.9	7.34	0.18	28.77
North Fork Crooked River	1.08	2.35		2			5.44
UNFCR Trib 28				1.47	0.71		2.18
Horse Heaven Creek-Crooked River Watershed							**41.81**
Lost Creek Subwatershed							**17.93**
Lost Creek	0.69	1.42	0.51	0.62			3.24
No Name		1.91	1.41	7.93	2.61	0.29	14.14
Sheep Rock Creek					0.56		0.56
Upper Horse Heaven Creek Subwatershed							**21.97**
Buck Creek		1.74	1.02				2.77
Horse Heaven Creek	0.87	1.27		1.67			3.8
Little Horse Heaven Creek		2.86					2.86

	Class I	Class II	Class III	Class IV	Class V	Unclassified	Totals
Lodgepole Creek		0.17	0.93				1.1
No Name		1.72	0.55	7.97	1.19		11.44
Lower Horse Heaven Creek Subwatershed							**1.91**
Meadow Branch Creek			0.44	0.48			0.92
No Name			0.42	0.57			0.99

Riparian Habitat Conservation Areas

In accordance with the Ochoco NF LRMP and INFISH (USFS 1995) all streams, wetlands and other water features in the Gap project area have designated Riparian Habitat Conservation Areas (RHCA's). The streams and RHCA's in the project area were recently updated and reclassified for this project. Table 145 provides detail for each RHCA type within the project area.

Within this project area there are treatment units within RHCAs. It is important to note that a portion of these units are on sections of stream that are dry during peak summer temperatures even though they are designated as perennial. Sometimes referred to as "interrupted", it is the nature of the streams in the project area to have sections of seasonally dry streambed with perennial sections upstream and downstream from these sections. Since the extent of these dry sections are unknown, whole reaches are designated as perennial. Because these perennially interrupted (dry) sections of streams go dry before peak water temperatures occur in the watershed, similar to that of intermittent streams, they are often managed like intermittent streams.

Table 145. RHCA and Stream Class Information by Subwatershed.

	Gray Creek Subwatershed		Headwaters North Fork Summit River		Lost Creek Subwatershed		Lower Horse Heaven Creek Subwatershed		Upper Horse Heaven Creek Subwatershed		Total	
Analysis Acres	10,012.34		13,694.04		6,081.72		792.24		7,565.47		38,145.81	
RHCA Class	RHCA Acres	% of subwatershed analysis area	RHCA Acres	% of subwatershed analysis area	RHCA Acres	% of subwatershed analysis area	RHCA Acres	% of subwatershed analysis area	RHCA Acres	% of subwatershed analysis area	RHCA Acres	% of subwatershed analysis area
Stream Class I	344.9	3.44%	90.26	0.66%	49.15	0.81%			65.67	0.87%	549.98	1.44%
Stream Class II	505.91	5.05%	756.96	5.53%	236.66	3.89%			555.35	7.34%	2054.88	5.39%
Stream Class III	804.61	8.04%	621.99	4.54%	100.22	1.65%	44.83	5.66%	268.13	3.54%	1839.79	4.82%
Stream Class IV	68.83	0.69%	256.56	1.87%	100.06	1.65%	12.13	1.53%	111.03	1.47%	548.61	1.44%
Total	**1724.25**	**17.22%**	**1725.77**	**12.60%**	**486.10**	**7.99%**	**56.96**	**7.19%**	**1000.17**	**13.22%**	**4993.25**	**13.09%**

Stream Flow

Snowmelt is the principal source for run-off from the planning area. Elevated flows and groundwater recharge occur from February through May, with greatest runoff usually occurring in April. Stream flow during the summer months may be attributed almost entirely to groundwater discharge (baseflow). As summer groundwater levels decline, discharge from springs and seeps decrease and flow in low-ordered channels become intermittent. Stream losses to groundwater and evaporation become apparent in lower-elevation reaches. Flows vary annually.

There are currently no established United States Geological Survey (USGS) stream discharge gaging stations within the watershed. Historical flow data indicate that, on average, flows generally followed a snowmelt hydrograph with a primary peak in the early spring. However, the individual water years 1943, 1948, and 1954 more closely resembled a rain-on-snow hydrograph. Within these years, multiple peak flows occurred from December through April. More recent flow data from Ochoco Creek, collected on the western side of the Forest also depicts a Rain on Snow Hydrograph (meaning multiple peaks in flow). This data also compares a wet and a dry year, which illustrates that flow can vary annually.

Base Flow

Base flows related to detention storage capacity (the ability of soil to store and slowly release water) are important in providing cold-water discharge to streams during summer low-flow conditions when streams are typically warm. Detention storage capacity is particularly important in wet meadows and at spring sources. There are many known stream reaches within the watershed where entrenchment has occurred (downcutting) and water detention storage capacity has been reduced. Generally, storage capacity is reduced as the water table loses enough elevation that it comes in contact with a control point such as bedrock. Known downcutting has occurred in segments of creeks within the planning area watersheds.

Peak Flow

Peak flows can be highly variable within the watersheds but primary runoff typically occurs sometime between late-March and mid-May. In the summer months it is not uncommon for many of the streams on Forest Service Lands within the watersheds to become interrupted, intermittent, or dry up. Most high stream flows in the project area watersheds result from snowmelt sometimes in combination with direct rainfall. High intensity summer rainstorms are also common. Water quality, quantity and timing may all be affected. These changes may be negative and often are cumulative.

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Water quality, quantity & timing may all be affected. These changes may be negative and often are cumulative.

Water Rights

There exists Forest Service and private land water rights within and adjacent to the project area. For further water rights information in the watersheds contact the Ochoco National Forest Headquarters Special Uses Specialist or go to http://www.wrd.state.or.us.

Water Sources

Water sources that may be used during implementation are identified in the Ochoco National Forest Water Conservation Plan 1996. The Forest Water Conservation Plan (June, 1996) has been implemented to reduce impact on surface water sources.

Analysis Background/Environmental Consequences

The primary factors that are assessed in this analysis are those hydrologic features that are directly and indirectly influenced by vegetation management and other activities outlined in the action alternatives. The critical features that may be affected by vegetation manipulation are stream discharge characteristics (which may lead to changes in channel morphology), less vegetative interception and decreased evapotranspiration, increased overland flow due to soil compaction, sediment delivery to streams from ground disturbing activities and increases in stream temperature through the reduction of riparian shade. This analysis will be quantitative and qualitative and will describe effects and differences between alternatives in terms of relative magnitude and trend. The effects within this analysis are based on the completion of all design features outlined in Chapter 2 of the EIS.

The following paragraphs discuss the hydrologic parameters of peak flow, sediment delivery and stream temperature as they are affected by the proposed project. Table 146 displays the potential effects and the measurement indicator used to analyze the potential effect(s).

Table 146. Potential effects associated with the Gap Project and the measurement parameter used to assess the degree of the effect.

Parameter	Potential Effects	Measure
Peak Flow	Increased Peak Flows from Timber Harvest and Fuels Treatment	Equivalent % of Forested Area Harvested (EHA)
Sediment Delivery (surrogate for Turbidity)	Sediment Delivery to Streams from Soil Disturbance by Proposed Vegetation Treatments and Road Activities	Sediment Yield % difference from the Existing Condition
Stream Temperature	Increased Stream Temperatures from Shade reduction by the Proposed Vegetation Treatments	Acres of RHCA within one site potential tree height (approximately 70') on Ochoco RHCA Class I-III streams

Peak Flow

Harvest treatments and associated activities have been shown to alter stream discharge conditions and overland flow conditions. Altered stream flow conditions are important to recognize as they can lead to changes in sediment input to streams and alteration of stream channel morphology (i.e. width to depth ratios, entrenchment, sinuosity, etc.). Literature indicates that there may be a threshold around 20-30% of a watershed that can be "equivalently clearcut" before there is an effect on flow (J. Seymour 2008). Watershed thresholds can vary depending on a variety of physical attributes that include but are not limited to topography, elevation, soil type, and precipitation regime. The Ochoco LRMP (1989) established a 30% threshold of Equivalent Harvested Area (EHA) for the Upper North Fork Crooked River Watershed and a 35% threshold of EHA for the Horse Heaven Creek-Crooked River Watershed based on these physical attributes.

Sediment Delivery and Turbidity

Increased sediment delivery and turbidity in streams have been documented following vegetation manipulation and associated activities. Sediment effects from anthropogenic disturbance are primarily due to changes in the quantities and patterns of overland flow, and the increased mobility of soils due to ground disturbing activities. Studies of buffer effectiveness have shown varying results but have found that buffers of less than 200 feet wide were effective in controlling sediment delivery under most harvest and road building activities. Most of the studies found the highest risk of sediment delivery resulted from ground disturbing activities ranged from 30 to 10 meters (98.4-32.8 feet). (Broderson, 1973; Lynch et al., 1983; Clinnic, 1985; Rashin et al., 2006; Heade, 1990).

Overland flow is a naturally occurring process in portions of the project area depending on factors of soils, topography, geology, antecedent moisture conditions, and the timing and magnitude of storm events. It is often an occurrence in scab stringer land type areas. The magnitude and frequency of overland flow can be increased in areas where infiltration rates have been reduced, such as compacted or frozen areas, or where there is increased snowpack from canopy removal. It can occur from a reduction in evapotranspiration due to timber harvest activities, some of which can and has resulted in elevated rates of sheet and rill erosion and sediment delivery. However, recent studies suggest that current forest harvest procedures and Best Management Practices are largely effective in reducing rilling and sediment delivery (Litschert 2009). For this analysis, the focus will be on treatment activities within 200 feet of stream channels as the primary zone for potential sedimentation effects to occur. This zone was delineated to encompass the dominant sediment contributing area for the project area. This determination was based on field observations and professional judgment, and was supported by the findings from peer-reviewed literature and research.

The analysis focuses on the amount of sediment delivered from surface erosion and mass soil movement outside the stream channel dependent on existing and proposed ground disturbance, soil erodibility, slope, and distance to the stream. Because areas within 200 feet of the stream have largely been unaffected by management activities besides road building, existing condition levels of sediment from surface erosion was modeled using existing roads including those not used for the proposed activities or for haul.

Forest Plan standards for sediment and turbidity correspond with State of Oregon standards. There is no quantitative standard for sediment in the Oregon DEQ water quality rules. Narrative Criteria (section 340-041-0007-12) states that activities can not result in the formation of appreciable organic or inorganic deposits deleterious to fish or other aquatic life. Currently, there are no streams listed for sedimentation/turbidity on the Oregon 303(d) list within the project area.

State water quality standards direct that turbidity levels should not exceed background levels by more than 10 percent. Turbidity is the degree to which suspended material in the water impedes light penetration and is expressed in Nephrometric Turbidity Units (NTUs). Because turbidity typically only fluctuates during storm or peak flow events, while it may affect beneficial uses such as domestic use, it is not an enduring condition that affects the longevity of individual aquatic organisms, or the viability of populations. Most measurable effects to aquatic life result from sediment instead of turbidity. For this reason, this analysis will focus on sediment. Current stream surveys have measured percent fines in some stream channels in the project area to be relatively high. Some streams in the watershed are inherently high in sediment due to local soil types and geology, but documented streambank instability, high embeddedness, and the occurrence of ground disturbing activities that have the potential to produce and deliver sediment, indicate that sediment levels are likely above historic values.

Stream Temperature

Six streams within the two sub-watersheds are on Oregon DEQ's 303(d) list due to elevated summer water temperature (table 147). Water temperatures over the criteria threshold are not to be increased further except in accordance with Water Quality Standards direction.

Table 147. ODEQ 303(d) listed streams

Water Body (Stream/Lake)	River Miles	Parameter	Season	Criteria	Beneficial Uses	Status
Gray Creek	0 to 6.7	Temperature	Summer	Rearing: 17.8 C	Anadromous fish passage; Salmonid fish rearing	Cat 5: Water quality limited, 303(d) list, TMDL needed
Horse Heaven Creek	0 to 14	Temperature	Summer	Rearing: 17.8 C	Anadromous fish passage; Salmonid fish rearing	Cat 5: Water quality limited, 303(d) list, TMDL needed
Little Horse Heaven Creek	0 to 2.9	Temperature	Summer	Rearing: 17.8 C	Salmonid fish rearing; Anadromous fish passage	Cat 5: Water quality limited, 303(d) list, TMDL needed
Lookout Creek	0 to 1.5	Temperature	Summer	Rearing: 17.8 C	Anadromous fish passage; Salmonid fish rearing	Cat 5: Water quality limited, 303(d) list, TMDL needed
Lytle Creek	0 to 4.2	Temperature	Summer	Rearing: 17.8 C	Salmonid fish rearing; Anadromous fish passage	Cat 5: Water quality limited, 303(d) list, TMDL needed

Water Body (Stream/Lake)	River Miles	Parameter	Season	Criteria	Beneficial Uses	Status
North Fork Crooked River	0 to 44.7	Temperature	Year Round (Non-spawning)	Salmon and trout rearing and migration: 18.0 degrees Celsius 7-day-average maximum	Salmon and trout rearing and migration	Cat 5: Water quality limited, 303(d) list, TMDL needed

Shade from vegetation and topography have the largest effect on stream temperatures and are the primary factors regulating the amount of solar energy reaching the stream surface. Hardwood shrubs are particularly effective at shading the stream as they provide a dense canopy close to the water surface, while conifers usually have lighter foliage that is farther above the surface of the water. Narrow valley-bottoms, often in concert with vegetation, can also provide significant shading. The Ochoco LRMP (1991) requires that shade along streams will generally correspond to provisions for more than 80 percent of the surface shaded. Where this cannot be attained, 100 percent of the potential for shade is the standard. On average, across the project area the Forest standard of 80 percent surface shade is not being met (see table 148). There are 9 stream reaches in bold below out of 70 surveyed that have ≥ 80% of the surface shaded.

Table 148. Percent shade for creeks within the planning area.

Stream	Reach #	Year	W/D Ratio	Shade (%)	Hardwood Shade (%)	Valley Form
Jungle Creek	1	2007	10/13	**94**	94	Trough-like
Jungle Creek	2	2008	12	54	57	ND
Jungle Creek	3	2008	ND	**93**	33	ND
Dudley Creek	1	2007	8.0	57	55	ND
Dudley Creek	2	2007	ND	**90**	0.0	ND
Cuitan Creek	1	1995	11	46	25	Flat Bottom
Fawn Creek	1	1994	9.0	83	12	V-shaped
Fawn Creek	2	1994	10	56	0.0	V-shaped
Fawn Creek T1	1	1994	5.5	54	13	V-shaped
Gray Creek*	1	2012	14	22	20	Flat Bottom
Gray Creek	2	2013	9.8	48	30	U-shaped
Gray Creek	3	1994	8.3	12	0.1	U-shaped
Gray Creek	4	1994	3.6	0.2	0.0	Flat Bottom
Gray Creek	6	1994	6.3	72	22	V-shaped
Gray Creek	7	1994	7.8	62	12	U-shaped
Gray Creek T1	1	1995	14	42	12	U-shaped
Gray Creek T2	1	1995	7.7	43	4.6	U-shaped
Gray Creek T3	1	1995	8.5	44	0.7	Trough-like
Gray Creek T4	1	1995	6.6	14	2.3	Flat Bottom
Gray Creek T5	1	1995	11	16	0.0	Flat Bottom

Stream	Reach #	Year	W/D Ratio	Shade (%)	Hardwood Shade (%)	Valley Form
Long Prairie Creek	1	1995	3.3	0.2	0.0	Flat Bottom
Long Prairie Creek	2	1995	3.9	33	0.2	U-shaped
Long Prairie Creek	3	1995	7.6	0.1	0.0	Flat Bottom
Lookout Creek	2	2002	9.8	53	33	Trough-like
Lookout Creek	3	2002	18	**84**	53	Trough-like
Lookout Creek A	4	2002	14	**91**	87	ND
Lytle Creek	1	2012	11/17	78	44	Flat Bottom
Lytle Creek	2	2012	9.8/1	72	40	U-shaped/Flat Bottom
Lytle Creek	3	2012	9.8/15	74	19	U-shaped
Lytle Creek	4	2012	6.2	30	0.0	ND
North Fork Crooked River	10	1994	18	35	0.0	Flat Bottom
North Fork Crooked River	8	1994	12	5.0	0.1	Flat Bottom
North Fork Crooked River	9	1994	9.0	7.7	0.5	Flat Bottom
North Fork Crooked River T21	1	1995	8.4	65	0.0	U-shaped
North Fork Crooked River T22	1	1995	12	50	0.0	Flat U-shaped
North Fork Crooked River T23	1	1995	10	52	0.0	U-shaped
North Fork Crooked River T23a	1	1995	9.2	65	0.0	V-shaped
North Fork Crooked River T24	1	1995	17.0	0.0	0.00	Flat Bottom
North Fork Crooked River T24	2	1995	12.8	19.6	0.12	Flat Bottom
North Fork Crooked River T24	3	1995	11.3	68.7	0.00	Flat Bottom
North Fork Crooked River T25a	1	1995	8.0	24.2	0.00	Flat Bottom
North Fork Crooked River T25b	1	1995	7.3	59.0	0.00	Flat Bottom
North Fork Crooked River T25c	1	1995	8.3	58.1	0.00	Trough-like
North Fork Crooked River T26	1	1995	14.3	25.8	0.00	U-shaped
North Fork Crooked River T26	2	1995	9.7	39.6	0.00	U-shaped
North Fork Crooked River T26	3	1995	11.0	29.0	0.00	V-shaped
North Fork Crooked River T27	1	1995	5.6	21.7	0.23	Flat Bottom
North Fork Crooked River T28	1	1995	18.8	30.3	0.00	U-shaped
North Fork Crooked River T28	2	1994	22.0	14.9	0.10	ND
North Fork Crooked River T28	3	1994	20.0	25.9	0.00	ND
North Fork Crooked River T29	1	1994	39.7	32.6	0.00	ND
North Fork Crooked River T29	2	1994	27.0	9.8	0.00	ND
South Fork Lookout Creek	1	1994	13.0	71.8	2.2	U-shaped
South Fork Lookout Creek	2	1994	20.0	64.9	0.1	trough-like
South Fork Lookout Creek T1	1	1994	10.0	62.4	13.6	trough-like
Short Creek	1	1995	4.2	67.2	35.2	trough-like
Spring Creek	1	1995	10.1	8.4	2.82	ND
Spring Creek	2	1995	8.5	76.0	3.00	ND

Stream	Reach #	Year	W/D Ratio	Shade (%)	Hardwood Shade (%)	Valley Form
Spring Creek T1	1	1995	14.0	43.8	0.40	ND
Lost Creek	1	1997	ND	**81.5**	68.7	ND
Lost Creek	2	1997	ND	**82.5**	61.4	ND
Lost Creek	3	1997	ND	46.8	0	ND
Horse Heaven Creek	1	2008	17.2	22.9	18.2	ND
Horse Heaven Creek	2	2008	10.2	48.0	48	ND
Horse Heaven Creek	3	2008	10.3	68.0	76	ND
NW Fork of Horse Heaven	1	2008	9.2	**80.0**	72	ND
Little Horse Heaven Creek	1	2008	8.0	43.0	30	ND
Little Horse Heaven Creek	2	2008	10.4	72.0	47	ND
Buck	1	2003	8.8	39.0	0	ND
						ND= No Data

While shade from vegetation and topography are the primary factors regulating the amount of solar energy reaching the stream surface, other features such as the surface area of the stream (i.e., width to depth ratios) can effect water temperatures. Width to depth ratios tend to increase with lateral instability. That is, as streambanks erode or are trampled, the stream becomes wider and this ratio increases. A wider stream has greater surface area exposure leading to higher temperatures. Lateral instability (which can lead to high width to depth ratios contributing to high stream temperatures) can be reduced by improving the overall condition of the RHCA.

Increasing riparian vegetation and LWD improve RHCA conditions by increasing root mass, increasing channel roughness, decreasing stream velocity, and decreasing trampling of banks. An increased amount of riparian vegetation will increase lateral stability leading to a narrower stream that will be exposed to less surface area open to solar radiation, thus decreasing the potential for high stream temperatures.

More specifically, it is the root mass of riparian hardwoods that provides structure that contributes to the lateral stability to streambanks, prevent excessive erosion and sloughing. Roots of hardwoods also provide roughness to a stream which decreases the erosive power of a stream and also promotes sediment deposition and the building up of streambanks. Embedded LWD can function similarly as the roots of riparian hardwoods serving as an energy dissipater and flow deflector. Riparian vegetation and LWD can also reduce grazing and browsing impacts on bank stability by limiting access.

Hydrology Measure #1 – Peak Flow

Affected Environment

The flow regimes within the project area are driven primarily by spring snow-melt in March and April. However, peak annual flows resulting from rain on snow events in early winter have produced some of the highest flows in the project area over the last 50 years. High flows can also result from intensive convective thunderstorms that cause flash floods during the spring and summer. Flash flooding is generally not a major factor in the watersheds due to prevalent vegetation and ground cover and the buffering effect of the forest canopy.

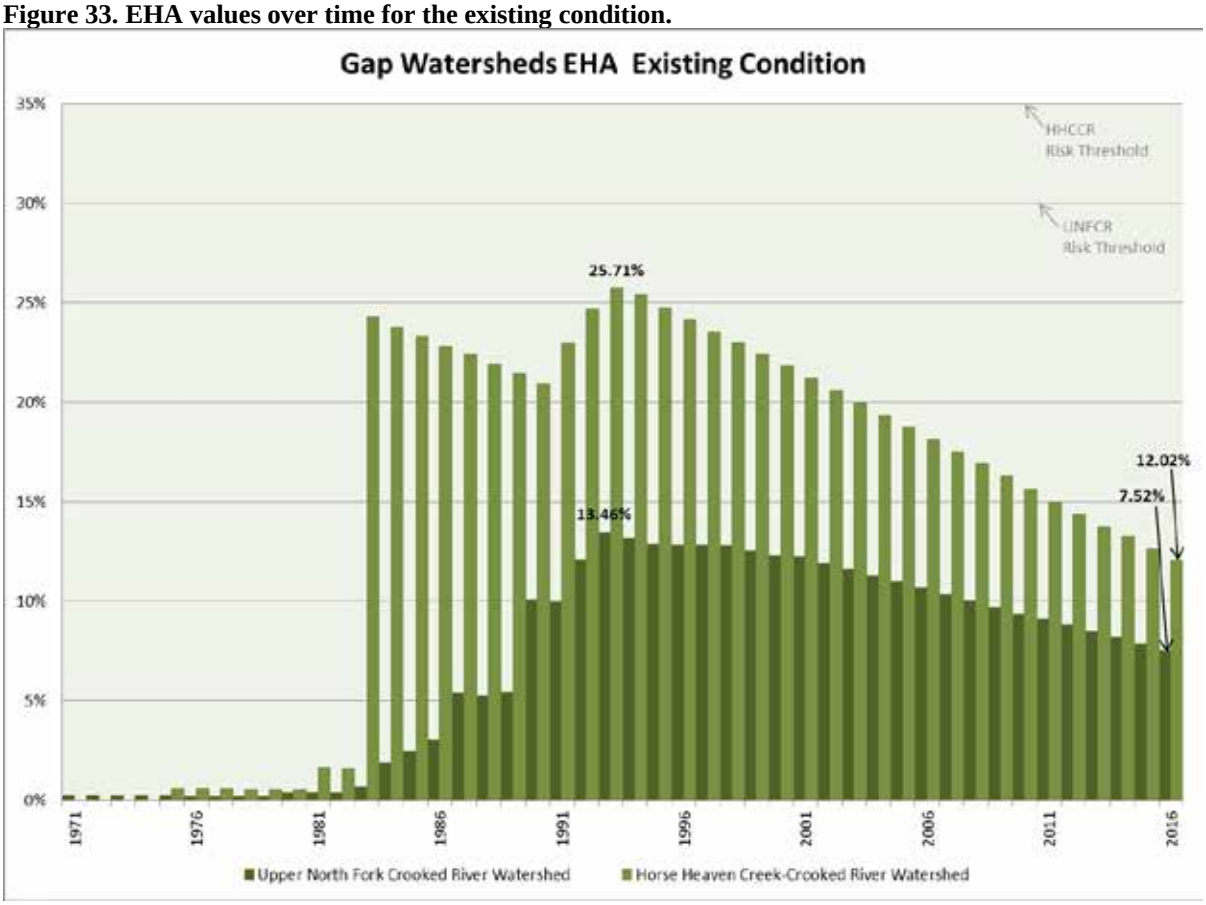
However, peak flows are probably earlier and higher than they were historically owing to channel entrenchment, soil loss, soil compaction, timber harvest, and road construction which, taken together, cause flashier hydrological responses. This has been offset somewhat by increased understory canopy cover.

Base flows were probably higher prior to watershed alterations which have occurred over the last 150 years. Stream entrenchment has reduced storage potential in alluvial aquifers. Upland storage has been lost due to road construction, erosion, and compaction. Prior to European settlement, frequent fires maintained lower evapotranspiration and interception rates by maintaining very open stands and substantially reducing juniper and marginal conifer stands. Water storage in wetlands and beaver ponds also contributed to higher base flows. Currently, many of the conifer stands are overstocked and conifers and juniper have moved into formerly un-forested areas and wet meadows.

Measure

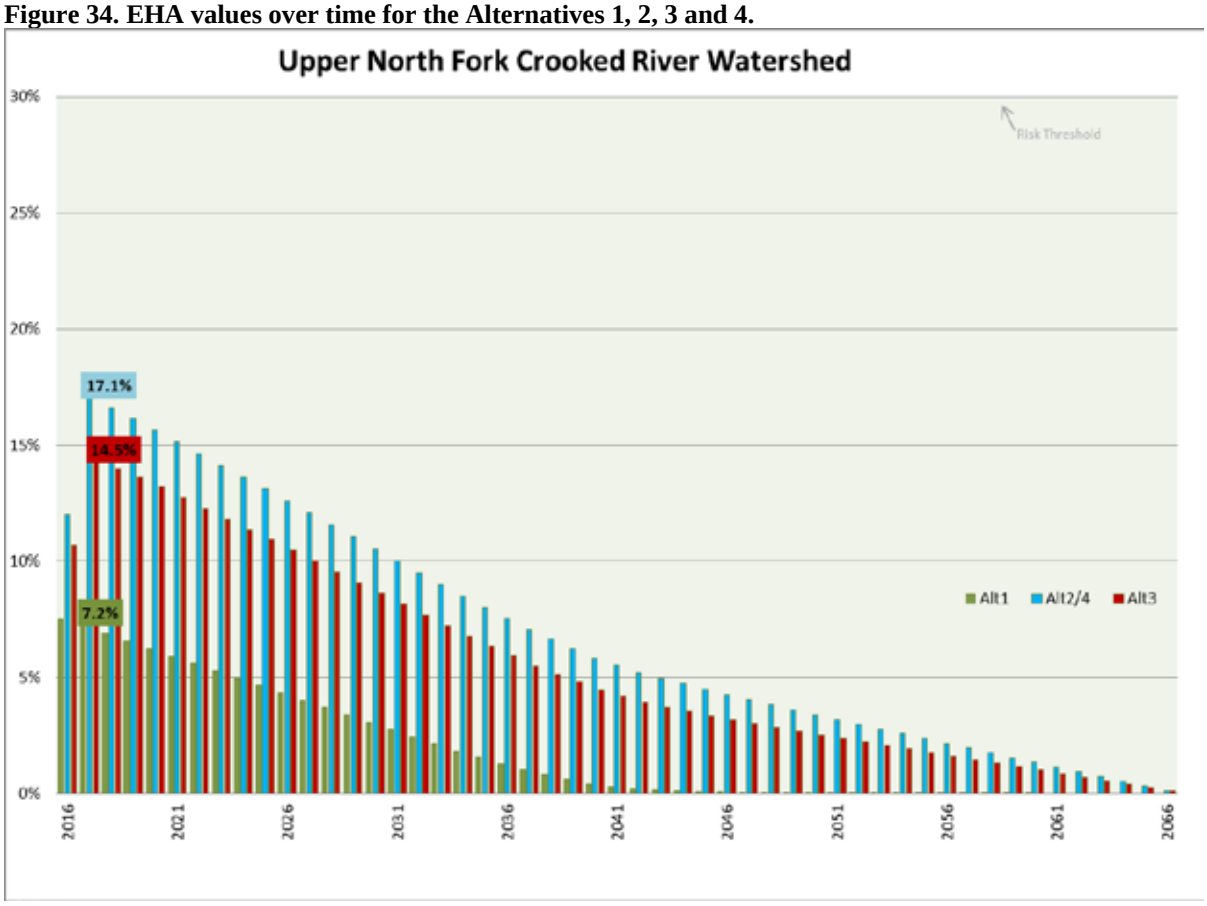
The Equivalent Harvest Area (EHA) model was used to determine the relative effects of timber harvest activities and forest vegetative conditions within the watershed. The EHA model is based on the principal that reduced stand density will reduce interception and evapotranspiration and may result in an increase in runoff and/or overland flow and snow accumulation. The EHA risk threshold should not be interpreted as a point above which detrimental impacts will occur but as a point above which detrimental impacts may occur should a 10-year or greater storm or runoff event take place. EHA is defined as that area, when harvested, which produces hydrologic effects similar to one acre of clearcut. The Ochoco Land Management Plan assigned an EHA threshold of 30 and 35 percent for the UNFCR and HHCCR Watersheds, respectively. These are the established points at which there is potential increase in flows for the watersheds (Anderson 1989).

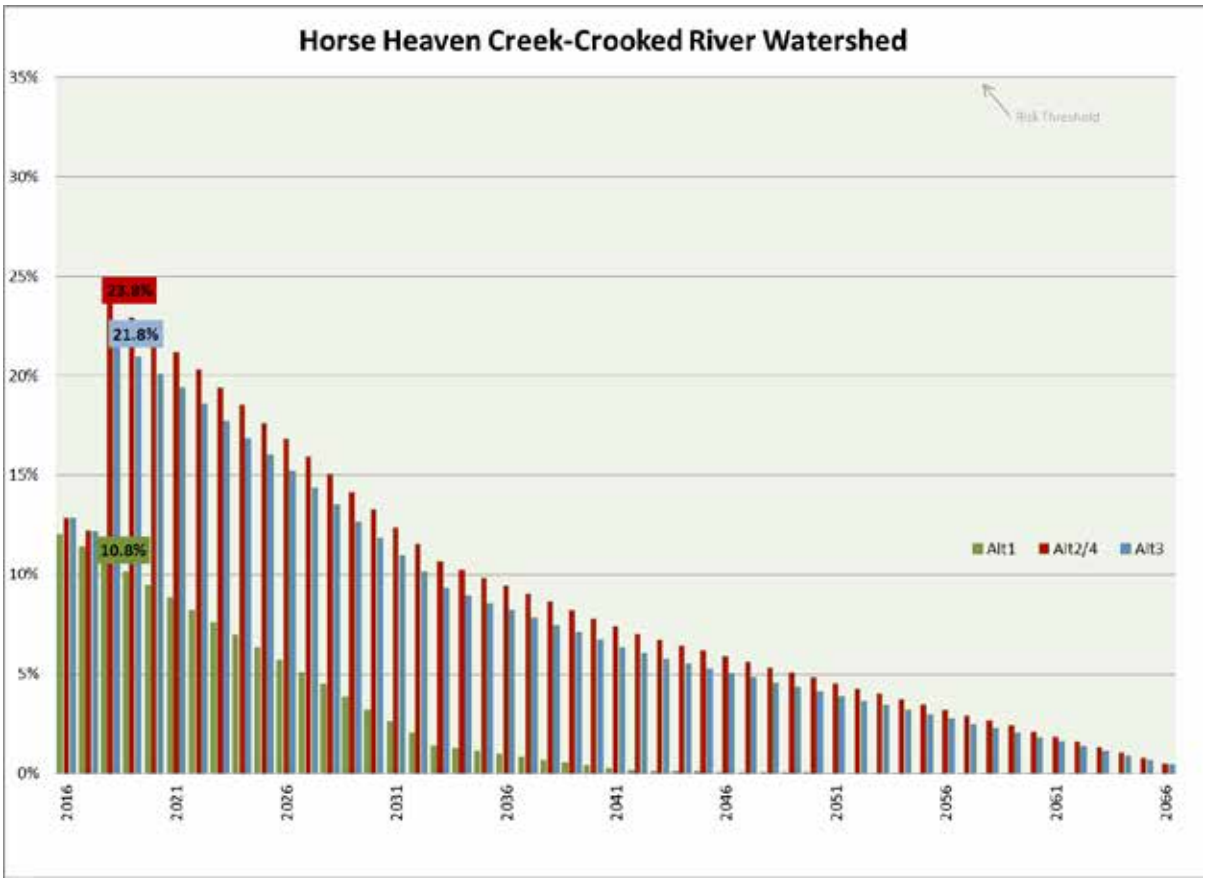
Figure 33. EHA values over time for the existing condition.



See figures 33 and 34 for the EHA values over time for each alternative including Alternative 1, the existing condition. The EHA for Alternatives 2 and 4 are on an average +/-0.05% different and will be considered the same in terms of EHA throughout this discussion and referred to as Alternative 2/4.The figure displays recovery over time and the future projections of these EHA values are incorporated into the EHA calculations for each alternative. For analysis purposes, the EHA calculations assume that for the action alternatives, one-third of the commercial harvest entries would occur in 2016 and two-thirds would occur in 2017, followed by noncommercial treatment 3 years later and prescribed fire activities 8 years later, (i.e. Year 1 – commercial thin, year 3 - noncommercial thin, year 8 – underburn). Other assumptions are that all sales would start on schedule, would take one year to complete, and associated activities including roadwork and channel restoration would occur as specified in the design criteria.

Figure 34. EHA values over time for the Alternatives 1, 2, 3 and 4.





Direct and Indirect Effects

Alternative 1

The current EHA value for the UNFCR and HHCCR Watersheds are 7.5 and 12.0 percent, respectively. The overall recovery of the watersheds has improved by 5.9 and 13.7 percentage points, around halfway, since the last treatments in the 1990s. With no treatments proposed within this alternative, the EHA value would continue to decrease over time, as displayed in figure 34, assuming no large scale disturbance events occur. The risk of catastrophic wildfire would remain unchanged as no vegetative treatments would occur. No treatments would occur to improve stand resiliency. Ladder fuels would not be reduced by noncommercial thinning and ground fuels outside the historic range of variability would not be treated. Noncommercial thinning would not be accomplished to reduce stocking levels of small diameter trees and promote recovery or riparian vegetation. If a wildfire was to occur, there would be an increase in EHA commensurate with the size and intensity of the fire. Such an event could have substantial adverse impacts to RHCAs in terms of changes in flow. The risk of vegetation mortality to disease would also remain unchanged. If this vegetation condition were to contribute to a wildfire, EHA values for the watershed could increase considerably.

Although this alternative displays the lowest EHA value (well below the 30% and 35% thresholds) when compared to Alternatives 2, 3, and 4, it has no activities to protect and enhance Riparian Habitat Conservation Areas (RHCAs) and promote attainment of LRMP standards and guidelines, and Riparian Management Objectives (RMOs) described in Inland Native Fish Strategy (INFISH) (1995). In the short term (<5 years) this alternative would be consistent with standards and guidelines and with the Clean Water Act and Executive Orders 11988, 11990, and 12088.

However, in the long term if no restoration activities were to take place within RHCAs, resource conditions would continue to trend away from management objectives for these areas. This alternative would not address the purpose and need of the project.

Cumulative Effects

Alternative 1

There would be no cumulative effects associated with this alternative because there are no proposed treatments that would result in additional disturbance.

Direct and Indirect Effects

Alternatives 2 and 4

Through the implementation of the proposed vegetation treatments in Alternative 2/4, the UNFCR Watershed EHA values are calculated to increase from 7.2 to 17.1 percent and the HHCR Watershed EHA values are calculated to increase from 10.8 to 23.8 percent. Although an increase in EHA is anticipated, the expected EHA value for these alternatives is well below the established threshold of concern of 30% and 35% as specified for the watersheds. The increase in EHA may result in small scale alteration of runoff/overland flow/groundwater storage potential, but the degree is still well below threshold and is not expected to result in measureable adverse effects to peak flows or stream condition from erosion.

Following implementation, it is anticipated that the effects to stream discharge and overland flow from project implementation would decrease to levels near pre-harvest conditions by the year 2032. The rate of recovery in the EHA model assumes that recovery would take place through natural processes of vegetation regeneration, increased ground cover, and restoration of soil properties conducive to site productivity and hydrologic function through mechanisms described in the Soils report. The vegetative condition is expected to recover to a condition closer to the Historic Range of Variability (HRV). Stream discharge and overland flow associated with HRV are desired over that associated to the pre-harvest condition for healthy hydrologic function. Historic stand conditions would promote healthy hydrologic function by promoting infiltration and increasing residence time (reduced evapotranspiration) for a slower release discharge to streams.

The EHA model does not account for the implementation of restoration measures that would be included with this project and potential future projects that would hasten recovery. Restoration activities that are included in this project include decompacting soil, seeding, and placing slash at the completion of the project on lengths of temporary roads, and lengths of re-opened closed roads within 200 feet of all streams. While the value of these projects cannot be calculated using the EHA model, these activities would advance recovery periods substantially.

While the EHA model accounts for treated acres throughout the watershed, the potential for increased peak flows can be augmented if treated units occur directly adjacent to, or in close enough proximity to stream channels that a direct hydrologic connection of surface runoff from the unit to the channel is created. A portion of the RHCAs within the watershed are proposed to be treated. Any potential for hydrologic connectivity from RHCA treatment units would be mitigated through the implementation of project design criteria and BMPs.

Roads and skid trails also have the potential to contribute to peak flows by conveying overland flow to streams. All existing, reconstructed, and temporary roads within the project area that would be used to implement Alternatives 2/4 would be improved or designed to minimize hydrologic connectivity using techniques, criteria, and BMPs. The majority of roads and skid trails developed for the project would be placed in areas of existing disturbance.

The potential for concentrated flow on road and skid trail surfaces would be dissipated through the implementation of road design features that include but are not limited to ditch relief culverts, dips, water bars and out sloping. Dissipation areas would be armored or located in areas with favorable gradient, surface roughness, and surface cover to avoid overland flow concentration, erosion and hydrologic connection to natural channels. Temporary roads and skid trails would be obliterated following use. The objectives and design considerations of these practices are described in the National U.S. Forest Service National Best Management Practices Program technical guide (USDA, 2011). Research and review of the effectiveness of individual practices in protecting soil and water resources has been shown to be effective to varying degrees, with overall effectiveness increasing with redundancy in implementation (Ice, 2009). Because of the application of multiple conservation practices, the contribution of roads and trails to potential increases in peak flows through the implementation of Alternatives 2 and 4 would be immeasurable.

Overall, Alternatives 2/4 would be consistent with the standards and guidelines in the Ochoco LRMP pertaining to EHA and flow and consistent with INFISH RMOs pertaining to channel condition. This alternative would be consistent with the Clean Water Act and Executive Orders 11988, 11990, and 12088. There are no expected measureable adverse effects to runoff and stream flow from Alternatives 2/4.

Alternative 3

In this alternative, there would be no commercial treatment within RHCAs. The difference in EHA values between Alternative 3 and Alternatives 2/4 is primarily due to no commercial harvest within RHCAs in this alternative. A portion of the RHCAs within the watershed are proposed to be noncommercially treated followed by prescribed fire and fuels treatments as summarized in Chapter 2 Alternative 3 would increase the UNFCR Watershed EHA values from 7.2 to 14.5, (compared to Alternatives 2/4 that increases EHA from 7.2 to 17.1). For the HHCCR Watershed, Alternative 3 would increase EHA values from 10.8 to 21.8, (compared to Alternatives 2/4 that increases EHA from 10.8 to 23.8).The values for the alternatives are well below the established threshold of 30% and 35% specified in the Forest Plan. With no RHCA commercial harvest in Alternative 3, there is a slightly lower potential for an effect to flow regimes than Alternatives 2/4. With this alternative, it is anticipated that the effects to stream discharge and overland flow from project implementation would decrease to levels near pre-harvest conditions by the year 2029. The rate of recovery in the EHA model assumes that recovery would take place through natural processes of vegetation regeneration, increased ground cover, and restoration of soil properties conducive to site productivity and hydrologic function through mechanisms described in the Soils report. The vegetative condition is expected to recover to a condition closer to HRV. Stream discharge and overland flow associated with HRV are desired over that associated to the pre-harvest condition for healthy hydrologic function. Current stands are dense and overstocked, lacking a healthy understory. Historic stand conditions would promote healthy hydrologic function by promoting infiltration and increasing residence time (reduced evapotranspiration) for a slower release discharge to streams. The potential for increases in peak flow and overland flow from road and skid trail crossings are basically the same for Alternatives 2, 3 and 4 and would be minimized by using BMPs and design criteria.

Alternative 3 would be consistent with standards and guidelines in the Ochoco LRMP pertaining to EHA and flow and consistent with INFISH RMOs pertaining to channel condition. This alternative would be consistent with the Clean Water Act and Executive Orders 11988, 11990, and 12088. This alternative would do less to meet the purpose and need than Alternative 2/4 but would also have a slightly lower risk for an effect to flows. There are no expected measureable adverse effects to runoff and stream flows from this alternative as the EHA value is well below threshold.

Cumulative Effects (see table 167)

Alternatives 2, 3, and 4

The cumulative effects boundary includes the five subwatersheds that fall within the Gap project boundary (see figure 37). There are no anticipated present or foreseeable future actions that would affect EHA other than the Deschutes and Ochoco Travel Management EIS (2011).

The Travel Management EIS decision reduces the potential for increasing peak flows and moving towards a more stable hydrologic regime long-term through prohibiting vehicle traffic, and administratively closing selected roads.

Hydrology Measure #2 - Sediment and Turbidity

Affected Environment

For this analysis, the focus will be on treatment activities within 200 feet of stream channels as the primary zone for potential sedimentation effects to occur as a result of this project. This zone was delineated to encompass the dominant sediment contributing area for the project. This determination was based on field observations and professional judgment, and was supported by the findings from peer-reviewed literature and research (Broderson, 1973; Lynch et al., 1983; Clinnic, 1985; Rashin et al., 2006; Heade, 1990).

The analysis focuses on the amount of sediment delivered from surface erosion and mass soil movement outside the stream channel dependent on existing and proposed ground disturbance, soil erodibility, slope, and distance to the stream. There is no substantial difference in the sediment footprint between Alternative 2 and Alternative 4 because the acres of harvest, haul routes, and restoration activities are nearly the same, besides the minor differences caused by >21" dbh harvest in Alternative 4. These alternatives will be considered the same in terms of potential sediment delivery throughout this discussion and referred to as Alternative 2/4.

Measure

The Water Erosion Prediction Project (WEPP) model was used to model the potential effects of sediment impairment to water quality.

WEPP models the potential erosion and sediment delivery based on ground disturbance, slope, climate, soil type, and buffer composition. For this analysis, the focus will be on treatment activities within 200 feet of stream channels as the primary zone for potential sedimentation effects to occur. This zone was delineated to encompass the dominant sediment contributing area for the project area. This analysis does not include changes in total sediment yield or sediment delivery from bank erosion. Analysis of commercial treatment activities incorporated potential skid trails and landings. Further background, details, and basic assumptions used for modeling WEPP are included in the Gap project record.

In terms of the overall watershed, this project proposes harvest treatments as summarized in Chapter 2. A portion of those treatment acres are proposed to occur in RHCAs. While RHCA treatment acres are sometimes used for discussion purposes, they are not equivalent to the acres used to calculate WEPP, because 200 feet was the zone designated for potential sediment delivery. More specifically, for Class I and II streams, only 200 feet of the 300 foot RHCA buffer is within the sediment delivery zone. For Class III streams and wetlands great than 1 acre, there is an additional 50 feet included in the WEPP sediment delivery zone that is beyond the 150 foot RHCA buffer. And for Class IV streams and wetlands less than 1 acre, there is an additional 150 feet included in the WEPP sediment delivery zone that is beyond the 50 foot RHCA buffer.

Therefore, although Alternative 3 does not include commercial harvest in RHCAs, commercial harvest is included in the WEPP analysis for Alternative 3 in the areas that are beyond the RHCA buffer but still within the sediment delivery zone.

The amount of roads located in the vicinity of streams is not uncommon for this watershed due to the nature of the stringer landscape. A majority of the resources, like streams and timber are located in the riparian areas, which has resulted in a network of roads in close proximity to streams. Due to the amount of roads it was not possible to model precisely how far away each was. Instead the minimums and maximum scenarios were the closest approximation possible. It is presumed that the true value lies between the minimum and maximum values. The minimum value is a scenario where all roads are 200' from a stream except for the portions that cross streams. The maximum value is a scenario where all roads are 50' from a stream except for the portions that cross streams. In order to consistently compare alternatives, the maximum value is used, although the actual value is definitely less.

Additionally, the model assumes that all of a road is contributing sediment when in reality there is most likely less. For instance, a break in slope, a water bar, or other run-off dissipating/erosion prevention feature could be within the 200 feet and as a result, the potential for sediment delivery is overestimated. Because these slope breaks and design features regularly occur on roads within the project area, actual sediment delivery rates would be substantially lower than predicted.

Due to the integrated project design features for the actions of the proposed action alternatives, there is a potential for a long term net decrease in sediment below that of the existing condition levels of the no action alternative following the implementation of the project. This potential net decrease in sediment delivery would be 95% for Alt.2/4 and 91% for Alt.3. This net decrease is largely attributed to the improvement of stand conditions with the risk of a high intensity wildfire decreased within the sediment delivery zone through the proposed treatments.

Table 149 displays the results of the WEPP analysis performed for this project. The purpose of this analysis was to compare the effects of the proposed action alternatives (during and post implementation) to the existing condition. These results take into account the condition of the vegetation, fuels and roads during and post action implementation as compared to the existing condition. To better compare the action alternatives, they were compared to the existing condition for during and post action implementation. Wildfire is used as a maximum for comparison to the existing condition. It is important to note that the WEPP derived values are potential maximum results and actual sediment delivery would be less due to the implementation of site specific design features and other BMPs.

Table 149. Summary of the total potential sediment delivery (tons/year)

	Existing Condition	**Existing Condition with Wildfire**	**During Implementation**		**Proposed Action Post Implementation**	
				w/BMPs		w/BMPs
Alt. 1	20.39	45.39	45.39	n/a	45.39	n/a
Alt. 2/4	20.39	45.39	79.46	19.87	8.46	2.11
Alt. 3	20.39	45.39	70.58	17.65	18.23	4.23

The WEPP analysis model does not model the BMPs, hence BMPs have been factored in after the WEPP analysis. Site specific design features are considered Best Management Practices and are part of the BMPs factored into table 149.These BMPs would be implemented in order to decrease the potential sediment delivery to streams. On the Idaho Panhandle National Forest, standard BMPs that are similar to those that would be implemented on this project (see Project Design Features) were shown to be at least moderately effective (75%) at reducing effects to soil and water (USDA, 2006). Precipitation regimes within the project area are at least one third that of northern Idaho, so effectiveness rates would be anticipated to be higher in this area.

A majority of the proposed treatment areas would also receive site specific project design criteria based upon observations from field visits, the professional judgment of aquatic specialists, and site specific data. When implemented, these practices have high effectiveness, and they would come close to eliminating potential sediment delivery during operations. However, effectiveness is essentially dependent upon onsite expertise to ensure proper design and implementation to conform to local site characteristics. Hence, Forest Service specialists would be intimately involved during implementation and rehabilitation so as to achieve maximum effectiveness.

Included in the analysis results are the restoration activities such as channel stabilization and LWD placement. All of these aforementioned activities would be expected to reduce sediment input long-term (>5-10 years). It is estimated that most of the sediment load in the project area is coming from in-channel erosion such as cutbanks, headcuts, and scour with a total of at least 50 tons of sediment per year, of which, >4 ton/yr. of sediment is eroded from the banks of the impaired sites proposed for restoration. In the long term, post implementation, it is expected that sediment yield would be reduced by >75% to near natural rates approximated to be <1 ton/yr.

Direct and Indirect Effects

Alternative 1

The overall potential sediment delivery for the Existing Condition has been calculated to be approximately 20.39 tons/year. This takes into account the current condition of the vegetation, fuels and roads.

Existing stand conditions, dense and overstocked, can limit the amount of herbaceous understory (Anderson 2009) and the effectiveness of stream buffers for the existing condition. The potential sediment delivery to streams from the adjacent forested hillslopes were modeled to be <5 tons annually or a 4 ton increase beyond background level of <1 ton. The background value has been included to provide context to the existing condition and is not intended as a goal that can be easily achieved, if at all.

The risk of catastrophic wildfire would remain unchanged as no vegetative treatments would occur. No treatments would occur to improve stand resiliency. Ladder fuels would not be reduced by noncommercial thinning and ground fuels outside the historic range of variability would not be treated. Noncommercial thinning would not be accomplished to reduce stocking levels of small diameter trees and promote recovery or riparian vegetation. If a wide spread high intensity wildfire was to occur, sediment delivery would potentially increase to 30 tons (see table 149). This would be an increase in sediment that is approximately 500% more than the annual rate of the existing condition.

This alternative would continue to contain hydrologically connected roads and stream crossings in various unknown states of disrepair. Existing roads are potentially contributing a maximum of 11.14 tons of the 45.39 tons annually, including crossings.

The state of the current road system within the 200’ sediment delivery zone would remain unchanged with Alternative 1. Roads located in the vicinity of streams are not uncommon for this watershed due to the nature of the scab stringer landscape. A majority of the resources, like streams and timber are located in the stringers, which has resulted in a network of roads in close proximity to streams.

Many of the roads that are planned to be re-opened with the action alternatives are a risk to aquatic resources in their current condition, (see Gap Roads Analysis). The project action alternatives propose to improve these roads in ways that minimize potential sediment delivery during operations followed by rehabilitation utilizing practices consistent with the Project Design Features, leaving the select roads hydrologically inert to the extent practical. This would result in a potential decrease in sediment delivery by 93% to 94% over Alternative 1

However, Alternative 1 would allow for a gradual recovery to portions of closed roads, temporary roads, and previously disturbed areas within the sediment delivery zone providing that the success of this type of passive restoration is possible at a site. This gradual hydrologic recovery would provide decreased stream turbidity, decreased embeddedness, and a lower percentage of fine sediment within spawning gravels and pool habitats.

When compared to Alternatives 2/4 and 3, Alternative 1 has no activities to protect and enhance Riparian Habitat Conservation Areas (RHCAs) and promote attainment of LRMP standards and guidelines, and Riparian Management Objectives (RMOs). In the short-term (<5 years) this alternative would be consistent with standards and guidelines and with the Clean Water Act and Executive Orders 11988, 11990, and 12088. However, in the long-term if no restoration activities were to take place within RHCAs, resource conditions would continue to trend away from management objectives for these areas. This alternative would not address the purpose and need of the project and the Watershed Condition Framework class would not be actively improved.

Cumulative Effects

Alternative 1

Alternative 1 has no proposed treatments and would result in no additional ground disturbance. Consequently, there would be no cumulative effects resulting from this alternative.

Direct and Indirect Effects

Alternatives 2 and 4

Analysis of Alternative 2/4 shows the combined overall potential maximum sediment delivery to be 19.87 tons during implementation, compared to 45.39 tons of the existing condition annual rate. Post implementation (>5-10 years) potential sediment delivery is expected to be reduced to approximately 2.11 tons, or a decrease of 95% below that of the existing condition.

The projected decrease below the existing condition for this alternative during implementation comes from a combination of factors discussed below.

Potential sediment delivery associated with commercial, noncommercial, and fuels treatments, as well as prescribed fire is much less (65% less) than if a wildfire were to occur with the existing condition of the landscape. Existing stand conditions are dense, overstocked, and have been excluded from fire for many years. The intent of the harvest and fuels treatment activities is to reduce the amount of fire excluded area that has become susceptible to high intensity wildfire and at high risk from insects and disease through commercial, noncommercial, and fuels treatments. The potential sediment delivery to streams from the adjacent forested hillslopes was modeled to be <5 tons annually in the existing condition. However, the effects of a widespread high intensity wildfire were calculated to increase overall sediment delivery to 30 tons in the existing condition. This would be a pulse of sediment that is approximately 500% more than the annual rate of the fire excluded existing condition. It is this maximum value that was used as the existing condition for comparison. Post implementation, the potential sediment delivery to streams from the adjacent forested hillslopes was modeled to be 1.25 tons annually or 96% decrease from the existing condition. Stand conditions would be much improved with the risk of a high intensity wildfire decreased through the proposed treatments (see Forested Vegetation and Fuels sections).

Implementation of restoration activities account for 1.31 tons due to the methods necessary to rehabilitate these degraded channels and riparian areas, such as access routes, earth moving and log placement activities. Detailed sediment calculations are performed prior to each restoration project's implementation and are submitted to the Division of State Lands. However, based upon the areas treated and types of restoration, i.e. 13.7 miles of stream restoration, it is estimated that sediment yield would be reduced to near natural rates approximated to be 0.25 ton annually.

Road activities are estimated to potentially contribute 7.99 tons of sediment during implementation. This decrease of 3.15 tons from the existing condition of 11.14 tons during implementation is because all activity associated roads would be made suitable for activity during implementation resulting in an improvement from the existing condition. These are, however, the maximum values from the model where all roads are 50' from a stream except for the portions that cross streams. Roads are located at various distances away from streams and are often further than 50' from the channel so this model is an over estimate that is the closest approximation. Additionally, the model is assuming that all of a road is contributing sediment when in reality there could be less. For instance, a break in slope, a water bar, or other run-off dissipating/ erosion prevention feature could be within the 200 feet and as a result, the potential for sediment delivery is overestimated. Because these slope breaks and design features regularly occur on roads within the project area, actual sediment delivery rates would be substantially lower than predicted.

The amount of roads located in the vicinity of streams is not uncommon for this watershed due to the nature of the scab stringer landscape. Also, a majority of the resources like streams and timber are located in the stringers, which has resulted in a network of roads in close proximity to streams. Furthermore, many of the roads and crossings that are planned to be re-opened are a risk to aquatic resources in their current condition. The action alternatives propose to improve these roads in ways that minimize potential sediment delivery during operations followed by rehabilitation utilizing practices consistent with the Project Design Features, leaving the select roads and crossings hydrologically inert to the extent practical. Focusing on the sediment delivery zone of 200', the existing condition roads and crossings are estimated to potentially contribute a maximum of 11.14 tons of sediment annually.

In terms of road related sediment, this alternative has the potential to improve conditions over the existing condition. In the long-term, sediment delivery would be reduced to 0.61 tons or 94% less than the existing condition. Project associated design features and BMPs would include hydrologic stabilization and/or culvert removal, decompaction of all temporary roads, skid trails, and re-opened closed roads within the RHCA and sediment delivery zone, as well as seeding and applying slash. Many of the riparian roads and crossings that would be reopened for temporary use under an action alternative are currently in a bare and compacted condition, are in various stages of disrepair, and may be accessible by motor vehicles. While the opening and use of these roads for project implementation may result in small, short term (< 5 years) sediment generation, the long term field condition of these roads would be much improved.

Existing temporary roads, new temporary roads, and re-opened closed roads (including stream crossings) within the RHCA and sediment delivery zone (200 feet of Class I-IV streams), utilized during implementation are to be specified in the timber sale contract to have adequate practices (see DEIS Appendices) conducted after the completion of harvest activities in order to minimize the long-term potential for sediment delivery. Even though the best management practices are planned for use during operations, there would still be sediment produced associated with crossings during the installation and rehabilitation of these crossings. There would be sediment produced with the first sale, over the first sale's area, the first year, after the completion of commercial harvest activities and rehabilitation. This would be a temporary increase to occur mainly with the initial spring melt and is not expected to persist though the length of the season. Then there would be sediment produced with the second sale, over the second sale's area, the second year, after the completion of commercial harvest activities and rehabilitation. This also would be a temporary increase to occur mainly with the initial spring melt and is not expected to persist though the length of the season.

Actual anticipated sediment produced would be less because local site conditions vary, ranging from sites that are well armored to sites that are more sensitive and susceptible to disturbance. Sensitive areas would be avoided.

Examples of sensitive areas are: channels that have bed and banks composed of finer material; channels that have a high bank height; channels that have a vertical bank angle; all of which would be susceptible to bank erosion, compaction, collapse and/or channel widening. Conversely, there are areas that are naturally armored and would not require as much (if any) structural improvement, hence less susceptible to disturbance. These types of areas are channels whose bed and banks are well armored by large cobble, boulders and/or bedrock, whose bank angle and bank height are low enough to provide a smooth transition through the channel, thus not requiring the installation of a structure that would have disturbance associated with it, and are channels that are dry for portions of the season.

Minor amounts of sediment would be produced during the installation and/or removal of crossing structures, improvements, or fords; which can also contribute to temporary increases in turbidity during spring melt. During commercial harvest operations, stream crossings and roads within the sediment delivery zone could potentially contribute to an approximate maximum increase of 31.97 tons, but with BMPs it would be reduced to 7.99, which is 3.15 tons less than the existing condition. It is anticipated that Project Design Features and Best Management practices would prevent sediment production and delivery where practicable, to reduce the potential for sediment delivery to minimal or somewhat negligible amounts, and to restore areas that otherwise could have the potential to contribute so that the ground is left better than it is, in the long-term.

A majority of the proposed treatment areas would also receive site specific project design criteria based upon observations from field visits, the professional judgment of aquatic specialists, and site specific data. When implemented, these practices have high effectiveness, and they would come close to eliminating potential sediment delivery during operations. However, effectiveness is essentially dependent upon onsite expertise to ensure proper design and implementation to conform to local site characteristics. Hence, Forest Service specialists would be intimately involved during implementation and rehabilitation so as to achieve maximum effectiveness. Some of these practices Forest Service specialist would oversee are listed in Appendix C.

Through the combination of these site specific project design features and BMPs, the redundancy of conservation activities would reduce the potential for sediment delivery in the short-term from the proposed action during implementation to quantities that are the least amount practicable in order to achieve the purpose and need of the project.

When compared to Alternative 1, Alternative 2/4 consists of activities to protect and enhance Riparian Habitat Conservation Areas (RHCAs) and promote attainment of LRMP standards and guidelines, and Riparian Management Objectives (RMOs) and decrease theoverall potential sediment delivery by 95%. Alternatives 2/4 would address the purpose and need of the project, Alternative 1 would not.

Compared to Alternative 3, Alternatives 2/4 has more commercial harvest activities, more prescribed fuels management activities, more roadwork proposed, and the same stream restoration within the sediment delivery zone. This would result in the most improved landscape with an overall post-action potential sediment delivery decrease of 4% more than Alternative 3. Stand conditions would be improved the most with the risk of a high intensity wildfire decreased within the sediment delivery zone through the proposed treatments; risk to aquatic resources, when it comes to road delivered sediment, would be decreased the most; and the benefits to aquatic resources from stream restoration projects would be the same for Alternatives 2/4 & 3. Alternative 2/4 would be more beneficial than Alternative 3 because of the increased amount of proposed units treated and road improvements.

In summary, through the application of PDCs and BMPs there would be short-term and long-term net beneficial effects in terms of sediment delivery resulting from the proposed action Alternative 2/4. PDFs and BMPs would provide protection of water quality and avoid adverse effects to aquatic resources. Alternatives 2/4 would be consistent with the applicable INFISH and Ochoco LRMP standards and guidelines, Riparian Management Objectives (RMOs), the Clean Water Act and Executive Orders 11988, 11990, and 12088. Alternative 2/4 would meet the purpose and need of the project and would actively improve the Watershed Condition Framework class.

Direct and Indirect Effects

Alternative 3

Analysis of Alternative 3 shows the combined overall potential maximum sediment delivery to be 17.65 tons during implementation, compared to 45.39 tons of the existing condition annual rate. Post implementation (>5-10 years) potential sediment delivery is expected to be reduced to approximately 4.23 tons, or a decrease of 91% below that of the existing condition. The projected decrease below the existing condition for this alternative during implementation comes from a combination of factors discussed below.

Potential sediment delivery associated with commercial, noncommercial, and fuels treatments, as well as prescribed fire is much less (71% less) than if a wildfire were to occur with the existing condition of the landscape. Existing stand conditions are dense, overstocked, and have been excluded from fire for many years. The intent of the harvest and fuels treatment activities is to reduce the amount of fire excluded area that has become susceptible to high intensity wildfire and at high risk from insects and disease through commercial, noncommercial, and fuels treatments.

The potential sediment delivery to streams from the adjacent forested hillslopes was modeled to be <5 tons annually in the existing condition. However, the effects of a widespread high intensity wildfire were calculated to increase overall sediment delivery to 30 tons in the existing condition. This would be a pulse of sediment that is approximately 500% more than the annual rate of the fire excluded existing condition. It is this maximum value that was used as the existing condition for comparison. Post implementation, the potential sediment delivery to streams from the adjacent forested hillslopes was modeled to be 3.25 tons annually or a 89% decrease from the existing condition. Stand conditions would be much improved with the risk of a high intensity wildfire decreased through the proposed treatments.

Implementation of restoration activities account for 1.31 tons due to the methods necessary to rehabilitate these degraded channels and riparian areas, such as access routes, earth moving and log placement activities. Detailed sediment calculations are performed prior to each restoration project's implementation and are submitted to the Division of State Lands. However, based upon the areas treated and types of restoration, i.e. 13.7 miles of stream restoration, it is estimated that sediment yield would be reduced to near natural rates approximated to be 0.25 ton annually.

Road activities are estimated to potentially contribute 8.43 tons of sediment during implementation. This decrease of 2.71 tons from the existing condition of 11.14 tons during implementation is because all activity associated roads would be made suitable for activity during implementation resulting in an improvement from the existing condition. These are, however, the maximum values from the model where all roads are 50' from a stream except for the portions that cross streams. Roads are located at various distances away from streams and are often further than 50' from the channel so this model is an over estimate that is the closest approximation. Additionally, the model is assuming that all of a road is contributing sediment when in reality there could be less.

For instance, a break in slope, a water bar, or other run-off dissipating/ erosion prevention feature could be within the 200 feet and as a result, the potential for sediment delivery is overestimated. Because these slope breaks and design features regularly occur on roads within the project area, actual sediment delivery rates would be substantially lower than predicted.

The amount of roads located in the vicinity of streams is not uncommon for this watershed due to the nature of the scab stringer landscape. Also, a majority of the resources like streams and timber are located in the stringers, which has resulted in a network of roads in close proximity to streams. Furthermore, many of the roads and crossings that are planned to be re-opened are a risk to aquatic resources in their current condition. The action alternatives propose to improve these roads in ways that minimize potential sediment delivery during operations followed by rehabilitation utilizing practices consistent with the PDFs, leaving the select roads and crossings hydrologically inert to the extent practical. Focusing on the sediment delivery zone of 200', the existing condition roads and crossings are estimated to potentially contribute a maximum of 11.14 tons of sediment annually.

In terms of road related sediment, this alternative has the potential to improve conditions over the existing condition. In the long-term, sediment delivery would be reduced to 0.73 tons or 93% less than the existing condition. Project associated design features and BMPs would include hydrologic stabilization and/or culvert removal, decompaction of all temporary roads, skid trails, and re-opened closed roads within the RHCA and sediment delivery zone, as well as seeding and applying slash. Many of the riparian roads and crossings that would be reopened for temporary use under an action alternative are currently in a bare and compacted condition, are in various stages of disrepair, and may be accessible by motor vehicles. While the opening and use of these roads for project implementation may result in small, short term (< 5 years) sediment generation, the long term field condition of these roads would be much improved.

Existing temporary roads, new temporary roads, and re-opened closed roads (including stream crossings) within the RHCA and sediment delivery zone (200 feet of Class I-IV streams), utilized during implementation are to be specified in the timber sale contract to have adequate practices (see Appendices) conducted after the completion of harvest activities in order to minimize the long-term potential for sediment delivery. Even though the best management practices are planned for use during operations, there would still be sediment produced associated with crossings during the installation and rehabilitation of these crossings. There would be sediment produced with the first sale, over the first sale's area, the first year, after the completion of commercial harvest activities and rehabilitation. This would be a temporary increase to occur mainly with the initial spring melt and is not expected to persist though the length of the season. Then there would be sediment produced with the second sale, over the second sale's area, the second year, after the completion of commercial harvest activities and rehabilitation. This also would be a temporary increase to occur mainly with the initial spring melt and is not expected to persist though the length of the season.

Actual anticipated sediment produced would be less because local site conditions vary, ranging from sites that are well armored to sites that are more sensitive and susceptible to disturbance. Sensitive areas would be avoided. Examples of sensitive areas are: channels that have bed and banks composed of finer material; channels that have a high bank height; channels that have a vertical bank angle; all of which would be susceptible to bank erosion, compaction, collapse and/or channel widening. Conversely, there are areas that are naturally armored and would not require as much (if any) structural improvement, hence less susceptible to disturbance. These types of areas are channels whose bed and banks are well armored by large cobble, boulders and/or bedrock, whose bank angle and bank height are low enough to provide a smooth transition through the channel, thus not requiring the installation of a structure that would have disturbance associated with it, and are channels that are dry for portions of the season.

Minor amounts of sediment would be produced during the installation and/or removal of crossing structures, improvements, or fords; which can also contribute to temporary increases in turbidity during spring melt. During commercial harvest operations, stream crossings and roads within the sediment delivery zone could potentially contribute to an approximate maximum increase of 30.21 tons, but with BMPs it would be reduced to 8.43, which is 2.71 tons less than the existing condition. It is anticipated that Project Design Features and Best Management practices would prevent sediment production and delivery where practicable, to reduce the potential for sediment delivery to minimal or somewhat negligible amounts, and to restore areas that otherwise could have the potential to contribute so that the ground is left better than it is, in the long-term.

A majority of the proposed treatment areas would also receive site specific project design criteria based upon observations from field visits, the professional judgment of aquatic specialists, and site specific data. When implemented, these practices have high effectiveness, and they would come close to eliminating potential sediment delivery during operations. However, effectiveness is essentially dependent upon onsite expertise to ensure proper design and implementation to conform to local site characteristics. Hence, Forest Service specialists would be intimately involved during implementation and rehabilitation so as to achieve maximum effectiveness. Some of these practices Forest Service specialist would oversee are listed in Appendix C.

Through the combination of these site specific project design features and BMPs, the redundancy of conservation activities would reduce the potential for sediment delivery in the short-term from the alternative during implementation to quantities that are the least amount practicable in order to achieve the purpose and need of the project.

When compared to Alternative 1, Alternative 3 consists of activities to protect and enhance Riparian Habitat Conservation Areas (RHCAs) and promote attainment of LRMP standards and guidelines, and Riparian Management Objectives (RMOs) and decrease the overall potential sediment delivery by 91%. Alternative 3 would address the purpose and need of the project, Alternative 1 would not.

Alternative 2/4 would be more beneficial than Alternative 3 because of the increased amount of proposed units treated and road improvements.

Compared to Alternative 4, Alternatives 3 has less commercial harvest activities, less prescribed fuels management activities, less roadwork proposed, and the same stream restoration within the sediment delivery zone. This would result in an improved landscape, but with an overall post-action potential sediment delivery decrease of 4% less than Alternative 2/4. Stand conditions would be improved less, with the risk of a high intensity wildfire decreased within the sediment delivery zone through the proposed treatments; risk to aquatic resources, when it comes to road delivered sediment, would be improved less; and the benefits to aquatic resources from stream restoration projects would be the same for Alternatives 2/4 & 3.

In summary, the alternative that would have the most long-term reduction in potential sediment delivery, and thereby would be the most beneficial to the project area would be either Alternative 2 or 4, followed by Alternative 3 and 1. Due to the integrated project design features for the actions of the proposed action alternatives, there is a potential for a long-term (>5 years) net decrease in sediment below that of the existing condition levels of the no action alternative following the implementation of the project. Aside from the pulse of sediment produced from a widespread high intensity wildfire, the net decrease is largely attributed to the requirement to hydrologically stabilize all temporary roads, skid trails, and re-opened closed roads within the RHCA and sediment delivery zone. Therefor by implementing this project, there would be a long-term reduction in potential sediment delivery resulting in improved conditions in the project area and a long-term improvement to the watershed condition.

Alternatives 3 would be consistent with the applicable INFISH and Ochoco LRMP standards and guidelines, Riparian Management Objectives (RMOs), the Clean Water Act and Executive Orders 11988, 11990, and 12088. Alternative 3 would meet the purpose and need of the project and would actively improve the Watershed Condition Framework class.

Cumulative Effects (see table 167)

Alternatives 2, 3, and 4

The cumulative effects boundary includes the five subwatersheds that fall within the Gap project boundary (see figure 37). Projects with the potential to have cumulative effects regarding sediment delivery include the implementation of the Deschutes and Ochoco Travel Management EIS, the proposed Lookout Mountain Multi-use Trail project, Invasive Plant Treatment FEIS, ongoing road maintenance, livestock grazing under the Fox Canyon Cluster AMP and the Big Summit Cluster AMP and The Nature Conservancy's Juniper Hill's restoration project.

Implementation of the Travel Management EIS, the South Boundary Road Closure, and ongoing road maintenance, along with road closures and decommissioning in the Gap project, would restrict access to designated open roads only, decreasing access and impacts to streams and would likely reduce potential sediment delivery. Short and long-term, limiting travel access paired with rehabilitating and/or eliminating areas of road in disrepair would improve sediment filtration buffers of native riparian plant communities and reduce sediment delivery over time. The proposed Lookout Mountain Multi-use Trail Project is expected to have similar effects: access restricted to designated trail, decreasing access and impacts to streams and would likely reduce potential sediment delivery. Short and long-term, limiting trail access paired with rehabilitating and/or eliminating areas of user created trail in disrepair would improve sediment filtration buffers of native riparian plant communities and reduce sediment delivery over time.

Within the Invasive Plant Treatments FEIS, treatments would improve the vigor of native riparian plant communities which could aid in reducing sediment delivery by increasing the amount of sediment filtering herbaceous vegetation.

Livestock grazing via Fox Canyon Cluster AMP and Big Summit Cluster AMP has the potential to add cumulatively to the Gap project sediment delivery via bank alteration and suppressing sediment filtration buffers of native riparian plant communities. PDFs have been developed to improve grazing conditions long-term.

The implementation of restoration activities (within Gap EIS, Fox Canyon AMP, Big Summit AMP, and Juniper Hills project) is expected to have beneficial long-term cumulative effects to sediment yield. It is estimated that most of the sediment load in the project area is coming from in-channel erosion such as cutbanks, headcuts, and scour with a total of at least 50 tons of sediment per year. It is estimated that the additional instream restoration activities listed in the Gap project present and foreseeable future actions table would reduce sediment yield by 5-10 tons per year.

All of the foreseeable projects listed above are expected to have overall long-term (>5 years) beneficial effects to the watershed condition. The short-term (<5 year) effects, when added to the predicted Gap project effects are expected to be very localized in scale, more representative of background conditions and are not expected to extend more than a mile downstream of the project area, primarily due to deposition. The timing of this effect is most likely to be during 1-3 day runoff events corresponding to spring snowmelts or storms. The magnitude of this effect is predicted to be decreased below the existing condition.

Hydrology Measure #3 - Stream Temperature

Affected Environment

One aspect of INFISH is to ensure maintenance and improvement of water quality through the development of RHCAs. However, since the Forest Service began managing stream corridors with buffers zones along aquatic habitats, Forest managers have been reluctant to continue to actively manage RHCAs (USFS and BLM 2010). As a consequence, most of the RHCAs within the Gap project area have become overstocked with small diameter conifers and in several areas are at an increased risk for uncharacteristic wildfire; reference Fuels and Silviculture reports. The overstocked densities of conifers in the RHCAs prevent hardwoods such as alder, willow, aspen, and other shrubs from expanding due to competition for sunlight, nutrients and water. This competition for resources makes it difficult for hardwoods to reestablish. Without the hardwood component, stream banks lack strong root masses that can stabilize banks, make channels narrower, reduce water velocity during high flow events as well as provide quality habitat for aquatic species such as trout and amphibians.

There is a need to manage coniferous vegetation through commercial and noncommercial treatments within RHCAs to promote the growth of hardwoods (e.g., aspen, willow, alder) in order to increase the overall condition of riparian areas. In some areas these treatments would coincide with other riparian restoration actions including: in-stream restoration work, large wood placement, a culvert replacement, road closure and decommissioning, and several stream crossing rehabilitations. The objective of these additional restoration actions would be to address the limiting factors of prohibiting the expression of robust riparian plant communities.

Action Alternatives 2 and 4 are very similar with regard to activities proposed in RHCAs and that have the potential to affect water resources and aquatic species.

Stream shade provided by conifers comes from a primary and a secondary shade zone and trees could be thinned, and continue shading the stream, from RHCAs as long as the critical shading vegetation is left (USFS and BLM 2010). The Northwest Forest Plan Temperature Total Maximum Daily Load (TMDL) Implementation Strategies (2010) also identifies that thinning which reduces stream shade may lead to a short-term increase in temperature, but would ultimately lead to a long-term benefit in shade production by hardwoods, and a long-term decrease in stream temperature, if given adequate protection from grazing. Additionally, INFISH (1995) says to prohibit timber harvest within RHCA unless silvicultural practices can be used to acquire desired vegetation characteristics that will aid in attainment of RMOs while avoiding adverse effects to inland native fish species. Considering these findings and Forest Service guidelines, vegetation management would occur inside the RHCA buffer zones to commercially and noncommercially harvest conifers under Alternatives 2 and 4 on a limited scale. Unit by unit site specific prescriptions would be applied to all RHCA units and were developed with the guidance from tables 15 and 17.

Table 150. Minimum Width of Primary Shade Zone (feet) based on Slope (percent) and Tree Height (average height of stand in feet) (USFS & BLM. 2010).

Height of Tree	Primary Shade Zone (ft.)
Trees < 20 feet	12
Trees 20 to 60 feet	28
Trees >60 feet to 100 feet	50
Trees >100 to 140 feet	70

For this analysis, the focus will be on treatment activities within the Primary Shade Zone (PSZ) of 70 feet from stream channels as the area for potential effects to occur. The Primary Shade Zone is a minimum distance from which a tree of a determined height on a determined slope is providing shade during the period when peak temperatures occur. The PSZ of 70 feet for slopes up to approximately 30-35% were used for this project and were incorporated into detailed design features.

The highest potential for a reduction in shade would be from commercial harvest units, noncommercial hardwood units, and noncommercial LWD source units within the PSZ on perennial streams. It is important to note that approximately 25% of these units are on sections of stream that are dry during peak summer temperatures even though they are designated as perennial. Sometimes referred to as "interrupted", it is the nature of the streams in the project area to have sections of seasonally dry streambed with perennial sections upstream and downstream from these sections. Since the extent of these dry sections change seasonally and yearly depnding on snowpack and precipitation, whole reaches are designated as perennial. Because these perennially interrupted (dry) sections of streams go dry before peak water temperatures occur in the watershed, similar to that of intermittent streams, they are often managed like intermittent streams.

Listed in the Chapter 2 PDFs, are unit by unit site specific prescriptions for several units that have a potential shade concern. For class I, II and III streams, efforts were made to ensure that activities did not occur within the primary shade zone. In addition, the IDT recommended further setbacks in many cases since the PSZ was considered a minimum. Special cases/exceptions have been made for aspen, other hardwoods, and LWD source material.

Measure

To compare alternatives, the amount of stream miles along treated acres that are within the primary shade zone of perennial streams were used to model the potential effects to stream temperature. Refer to the data from the following table. The main variance between Alternative 2 and 4 is the commercial treatment of trees >21" in Alternative 4 and Alternative 4 has 0.28 more miles of treatment along a perennial stream than Alternative 2. This variance has little to no differentiating effect between Alternatives 2 and 4 in terms of shade, for reasons discussed below (i.e. PDCs and BMPs) and will be considered the same throughout this discussion -referred to as Alternative 2/4.

Table 151. Stream Miles with Treatments within the PSZ

Vegetation Treatments	Alt. 2	Alt. 3	Alt. 4
Commercial treatment	3.31	0	2.86
Commercial treatment >21"	0	0	0.73
Commercial treatment >21" w/Aspen	0	0	0.71
Commercial treatment w/Aspen	1.40	0	0.69
Noncommercial treatment for In-stream Source Material	1.86	1.61	1.86
Noncommercial Hardwood treatment. <15"dbh	0.21	0.32	0.21
TOTAL	**6.79**	**1.93**	**7.06**

There are approximately 51 total perennial stream miles in the project area.

Alternative 1

Direct and Indirect Effects

Alternative 1 has no proposed treatments and would result in no vegetation treatments, road utilization or riparian restoration actions that would result in potential effects to stream shade or temperature. Due to past management of RHCAs in the project area, few stream reaches are currently meeting INISH standards for shade. Under this alternative, most streams would continue to be below the shade RMO and summer water temperature would remain above allowable Oregon DEQ and Ochoco National Forest standards. Aquatic habitats would remain in this condition due to the low densities of hardwoods, over-grazing of hardwoods that are present, and the overstocked densities of conifers inhibiting expansion and establishment of riparian plants. Riparian vegetation (hardwood) recovery would slowly occur (up to 15 years) as grazing conditions incrementally improve from changes in management activities due to the Fox Canyon and Big Summit AMPs.

When compared to Alternatives 2/4 and 3, Alternative 1 has no activities to protect and enhance Riparian Habitat Conservation Areas (RHCAs) and promote attainment of LRMP standards and guidelines, and Riparian Management Objectives (RMOs). In the short-term (<5 years) this alternative would be consistent with standards and guidelines and with the Clean Water Act and Executive Orders 11988, 11990, and 12088. However, in the long-term, if no restoration activities were to take place within RHCAs, resource conditions would continue to trend away from management objectives for these areas. Conifers would continue to suppress hardwoods and the risk of uncharacteristic wildfire, insects and disease would remain high. This alternative would not address the purpose and need of the project and the Watershed Condition Framework class would not be actively improved.

Since there are no direct and indirect effects there would be no cumulative effects.

Alternatives 2 and 4

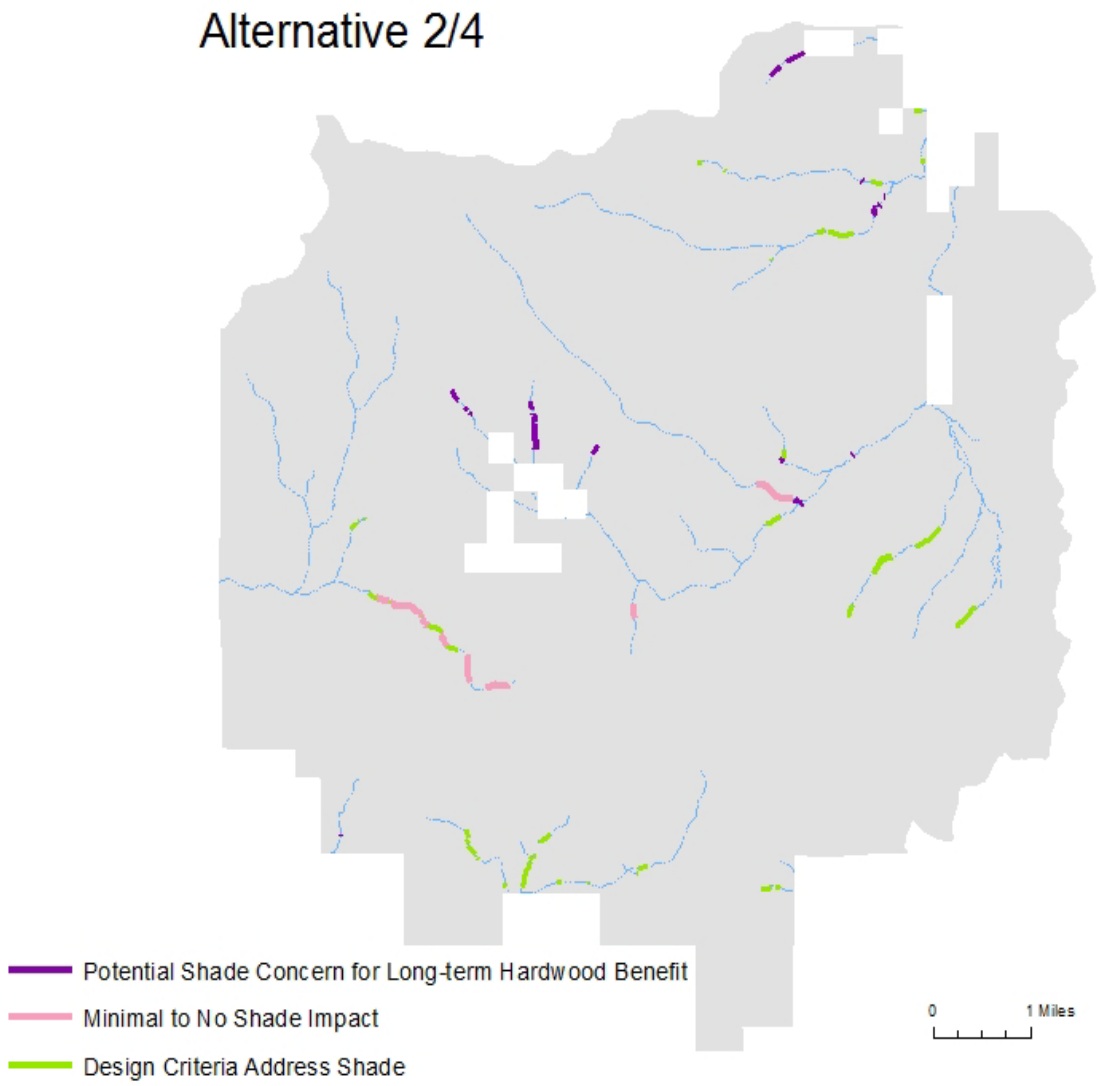
Direct and Indirect Effects

In Alternatives 2/4, proposed activities within the PSZ and RHCA of perennial streams are designed to improve attainment of RMOs. In Alternative 2, commercial harvest would occur along 4.71 miles of stream, with 1.4 miles having aspen in addition to the fuels treatments. In Alternative 4, commercial harvest would occur along 4.26 miles of stream, with 1.4 miles having aspen treatment. An additional 0.73 miles of stream has commercial harvest of trees >21”dbh in Alternative 4, however only outside of the RHCA. Alternative 2/4 has 1.86 miles of noncommercial treatment for LWD source material and 0.21 miles of hardwood treatments. Additional fuels treatments that are stand alone and are to follow harvest and noncommercial treatments, such as noncommercial thinning and prescribed underburning, have a very small potential to reduce shade in localized areas, but due to well-established PDCs and BMPs any potential effect would be immeasurable.

The highest potential for shade reduction would be within commercially harvested units. However, units for both alternatives have been planned and analyzed such a way to minimize effects. BMPs and site specific design criteria were developed for all RHCA units (see tables 15 and 17). Overlaying the unit boundaries with the PSZ highlighted the stream reaches where extra planning efforts were necessary to minimize the potential reduction to shade. These areas are labeled as ‘Design Criteria Address Shade’ in figure 35.

Known hardwood sites and aspen stands have been identified for specific treatments and may be within the PSZ, labeled as ‘Potential Shade Concern for Long-term Benefit’ in figure 35. Treatments in these areas would specifically target conifers encroaching upon hardwoods. Removing conifers from hardwood stands to improve aspen, alder, or willow production may reduce shade in a very minor amount and on a localized scale, is not expected to result in a measurable increase in water temperatures. These treatments would reduce the competition between riparian-associated species and conifers resulting in more woody, shrubby species. Thinning would result in increased growth rates for both residual conifers and riparian shrubs. Removing conifers from hardwood stands or to improve alder or willow production in these units may reduce a minor, short-term (<5 years) amount of shade but should not result in a measurable increase in water temperatures, especially considering the scope of activities in relation to the size of the watershed. Unmapped incidentally encountered hardwoods would also be treated. The amount of hardwood species incidentally encountered along streams in the PSZ during implementation is expected to be low and spatially infrequent. As stipulated in the unit by unit PDF, LWD would be felled/pushed to meet RMO. These trees would generally be recruited from within the PSZ (25 – 75 ft.) so that they would function effectively as in-stream LWD (reference Aquatic Species report). Very minor, likely immeasurable shade reductions would occur when considering the scope of activities across the planning area. These areas are labeled ‘Minimal to No Shade Impact’ in figure 35.

Figure 35. Select Units of Shade Consideration



Listed below are some of the design features included to minimize reductions of shade:

- Several of these units occur on sections of streams that are dry when peak stream temperatures are a concern. These sections of dry, perennially interrupted streams were field verified and noted, and would be treated as intermittent.
- Treatment boundaries are preliminary and have not been laid out in the field. Detailed unit by unit site specific design criteria would be followed for units on perennial sections of stream that do not go dry. Therefore, only trees that do not provide primary shade or provide bank stability would be removed so that the existing amount of stream shade is maintained.
- Hardwood units on streams that do not go dry are spatially intermittent and discontinuous so as to not have a concentrated reduction in shade.
- On well-shaded stream reaches there may be a small amount of commercial units that would reduce a small portion of potential shade producing vegetation. There would be few of these units, spread out spatially over the project area, and the amount of shade reduction would not result in a measurable increase in stream temperature.

- Only trees that do not provide shade or provide bank stability would be removed so that the existing amount of stream shade is maintained, unless hand thinning benefits hardwoods.
- Noncommercial thinning would reduce the competition between riparian-associated species and conifers resulting in more woody, shrubby species.

Although prescribed fire has the potential to reduce shade on a small localized scale, this potential would be diminished through the implementation of PDFs and BMPs (see Chapter 2, PDFs)

Prescribed fires would be implemented during planned for spring and fall when fuel moisture and relative humidity are high. Under these conditions, burns in riparian areas tend to occur in a mosaic pattern, leaving unburned areas and resulting in low tree mortality. Areas with the highest moisture levels, immediately adjacent to streams, tend to receive the least damage from fire (USDA 2010/GTR-231). Potential effects from low to moderate intensity prescribed fire in riparian areas include minor short term (<1 year) reductions in stream shade that would not measurably increase water temperatures (Reiman et al. 2003). Effects from low to moderate intensity prescribed burns would be much less severe than the effects of intense wildfires considered by Gresswell (1999) and observed by Rinne (1996).

The application of prescribed fire proposed in Alternative 2/4 would be consistent with standards and guidelines, underburning would occur within the RHCA but outside the riparian vegetation. Ignition of burns would occur outside of RHCA, (except hand piles) but could be allowed to creep into riparian areas. To meet RMOs, fire prescriptions for RHCAs would provide for a mosaic of burned and unburned areas to retain sufficient soil cover for infiltration and maintain vegetation that provides shade. In general, burning in RHCAs would be expected to burn 10-50% of the riparian area, while exposing less than 5% mineral soil. Mineral soil exposure would be expected to last less than one year. The above ground growth of grasses and shrubs in the burned areas would be killed but would respond with new growth within the first growing season after the burn. Observations of similar prescribed fire treatments show burned grasses begin to sprout with new growth within one to three months of the first growing season. Within the first year after burning, shrubs and grasses would be rejuvenated. Prescribed fire and associated harvest and noncommercial thinning would reduce fire hazard and the potential for severe wildfire within the RHCA and reduce competition for resources between hardwoods and conifers. There would be a very small localized risk of prescribed fire reducing shade, however short-term increases in temperature (up to 6 months) are acceptable even on streams over threshold during riparian restoration activities to restore riparian vegetation (Oregon Water Quality Standards 340-041-0004(5)(a)).

With application of Project Design Features and BMPs, any reduction of stream shade would be spatially intermittent and short-term (<5 years) and would not be expected to measurably increase water temperatures. Long-term, it is anticipated that shade would increase over the next 5-10 years due to higher vigor of existing (and recently planted) hardwoods once some of the conifer canopy and understory is removed and/or consumed via implementation activities (CT, PCT and Rx burning within RHCAs). Increased shade from the hardwoods would lead to incrementally lower temperatures in streams which is a critical element fish need for survival during low flow periods when air temperatures increase in the summer months.

Temporary road construction (existing and new) and re-use of closed roads would not measurably affect shade or stream temperature because the majority of roads occur outside the PSZ and in most cases would not have mature vegetation tall enough to affect shade. The majority of stream crossings would occur on existing disturbance and would occur on class IV streams where stream temperature is not a concern because these streams are generally dry during peak temperatures. Stream crossings will be rehabilitated upon completion of activities; reference PDFs.

Riparian restoration activities (stream restoration and headcut repair, hardwood planting and protection, weed treatments, road closures and decommissioning) would provide for increased shading from development of riparian vegetation, narrower stream channels, deeper pools and reconnected water tables would reduce water temperature short (<5 years) and long-term(>5-10 years). Short-term, the potential to reduce shade would be would be slightly higher in Alternative 3 but more beneficial long-term because of the increased amount of proposed restoration activities.

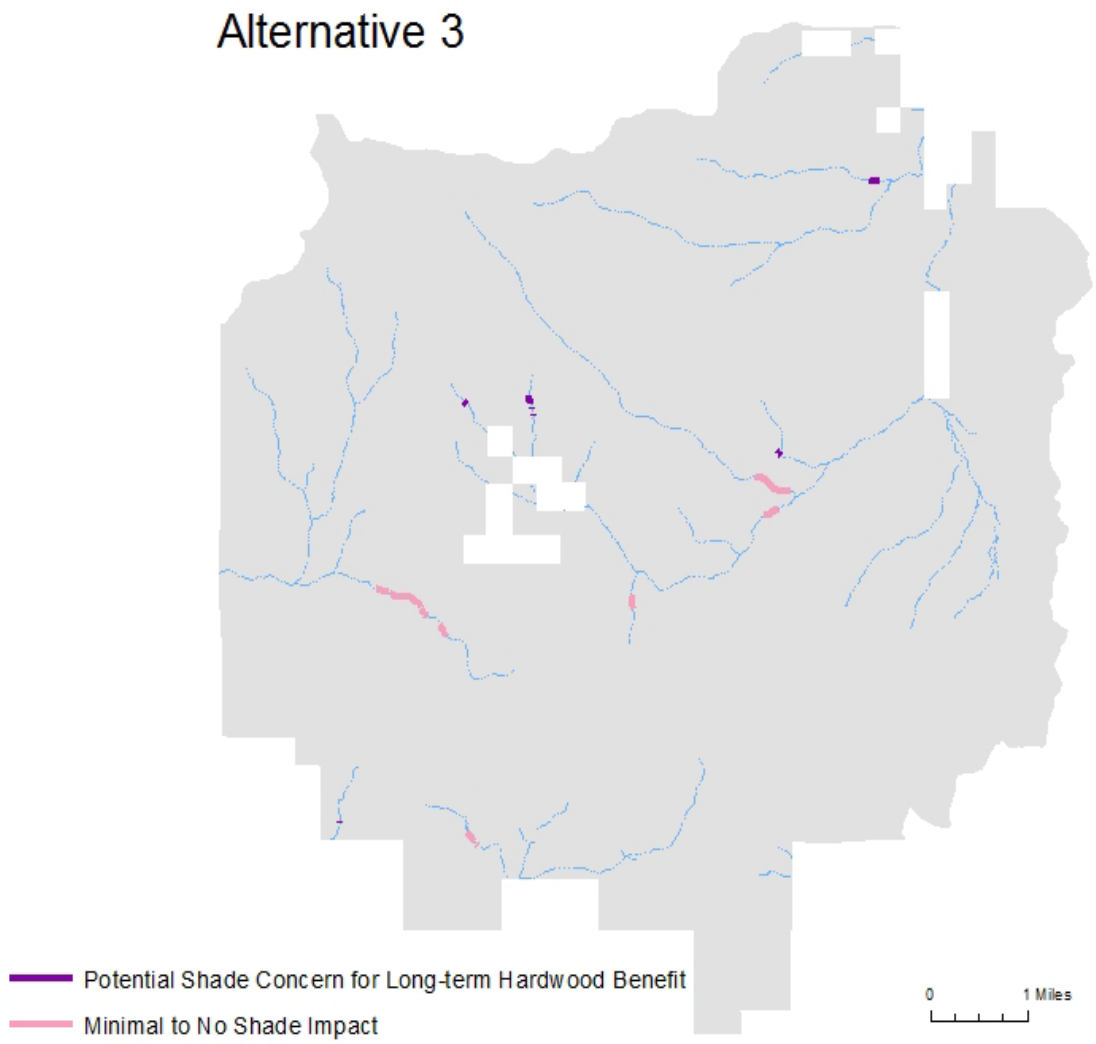
In summary, through the application of PDCs and BMPs there would be no measurable increase in water temperatures resulting from any proposed activities. A minor localized amount of shade would be reduced short-term (<5 years), but no measurable increase in water temperatures resulting from these activities is anticipated. In the long-term, it is anticipated that shade would be improved due to increased growth of riparian hardwoods or increased growth rates of residual trees and implementation of riparian restoration activities. Alternative 2/4 would be more impactful than Alternative 3 in the short-term but more beneficial long-term because of the increased amount of proposed road improvements. PDFs and BMPs would provide protection of water quality and avoid adverse effects to aquatic resources. Alternatives 2/4 would be consistent with the applicable INFISH and ONF LRMP standards and guidelines, Riparian Management Objectives (RMOs), the Clean Water Act and Executive Orders 11988, 11990, and 12088. Alternative 2/4 would meet the purpose and need of the project and would actively improve the Watershed Condition Framework class.

Alternative 3

Direct and Indirect Effects

Unlike Alternatives 2 and 4, this alternative has no proposed commercial harvest within RHCAs. A portion of the RHCAs within the watershed are proposed to be noncommercially treated followed by prescribed fire and fuels treatments as summarized in Chapter 2. While in this alternative there would be no commercial treatment within RHCAs or the PSZ, there would be 1.61 miles of noncommercial treatment for LWD and 0.32 miles of noncommercial hardwood thinning and fuels treatments. See figure 36, noncommercial hardwood units are labeled as ‘Potential Shade Concern for Long-term Hardwood Benefit’ and noncommercial LWD source units are labeled as ‘Minimal to No Shade Impact’. Combined, the treatments are along less than 3.8% of the perennial stream miles in the project area. Proposed activities within RHCAs are similar to those in Alternatives 2/4 in that they are planned to improve attainment of RMOs.

Figure 36. Select Units of Shade Consideration.



The risk of affecting stream shade and subsequently stream temperature would be reduced primarily through the reduction of the amount of treatments. Similarly, beneficial effects to promoting hardwoods, increasing shade over the long term, thus incrementally reducing temperature, would be reduced over Alternatives 2 & 4.

In summary, through the application of PDCs and BMPs there would be no measurable increase in water temperatures resulting from any proposed activities. A minor localized amount of shade would be reduced short-term (<5 years), but no measurable increase in water temperatures resulting from these activities is anticipated. In the long-term, it is anticipated that shade would be improved due to increased growth of riparian hardwoods or increased growth rates of residual trees and implementation of riparian restoration activities. Alternative 3 would be less impactful than Alternatives 2/4 in the short-term but it would also be less beneficial long-term because of less proposed road improvements. PDFs and BMPs would provide protection of water quality and avoid adverse effects to aquatic resources. Alternative 3 would be consistent with the applicable INFISH and ONF LRMP standards and guidelines, Riparian Management Objectives (RMOs), the Clean Water Act and Executive Orders 11988, 11990, and 12088. Alternative 3 would meet the purpose and need of the project and would actively improve the Watershed Condition Framework class but would be less than that of Alternatives 2/4.

Cumulative Effects Common to all Action Alternatives

Because a minor localized amount of shade would be reduced short-term, although no measurable increase in water temperatures resulting from these activities is anticipated, cumulative effects in regards to shade is discussed below.

The areas of analysis for cumulative effects are the boundaries of the five subwatersheds associated with the Gap project area (see figure 37): Headwaters North Fork Crooked River, Gray Creek, Lost Creek, Upper Horse Heaven Creek and Lower Horse Heaven Creek.

Present and foreseeable future projects (see table 167) with the potential to have cumulative effects regarding shade include the implementation of the Deschutes and Ochoco Travel Management EIS, Invasive Plant Treatment FEIS, the proposed Lookout Mountain Multi-use Trail project, ongoing road maintenance, livestock grazing under the Fox Canyon Cluster AMP and the Big Summit AMP FEIS, and the Nature Conservancy Juniper Hills Reserve Restoration project.

Implementation of the Travel Management EIS, the South Boundary Road Closure, and ongoing road maintenance, along with road closures and decommissioning in the Gap project, would restrict access to designated open roads only, decreasing access and impacts to streams and would likely reduce negative impacts to riparian vegetation. Short and long-term, limiting travel access paired with rehabilitating and/or eliminating areas of road in disrepair would improve buffers of native riparian plant communities and may improve localized stream shade along banks. The proposed Lookout Mountain Multi-use Trail project is expected to have similar effects: access restricted to designated trail, decreasing access and impacts to streams and would likely reduce negative impacts to riparian vegetation. Short and long-term, limiting trail access paired with rehabilitating and/or eliminating areas of user created trail in disrepair would improve localized stream shade along banks.

Within the Invasive Plant Treatments FEIS, treatments would improve the vigor of native riparian plant communities which could aid in reducing stream temperature by increasing the amount of shade producing herbaceous vegetation.

Livestock grazing via Fox Canyon Cluster AMP and Big Summit Cluster AMP has the potential to add cumulatively to the Gap project shade reduction via bank alteration and suppression of shade producing communities of native riparian vegetation. PDFs have been developed to improve grazing conditions long-term.

Historic grazing practices contributed to the removal of deciduous woody vegetation and compaction of alluvial terraces. Livestock grazing continues in the area, but levels have been reduced from historic amounts and riparian vegetation is improving on Forest Service lands, but is still below desired conditions. Activities within some RHCAs would likely attract livestock because removing small trees as well as surface and ladder fuels would remove barriers to livestock movement. In other areas higher slash levels and downed trees retained in RHCAs may impede cattle access to the streams. Decreasing competition and increasing sunlight to the ground by removing some of the canopy cover would also increase growth of grasses, shrubs, and hardwoods. This would increase the amount of forage available which would attract livestock. Livestock are expected to continue to use riparian areas and are expected to consume some of the increased forage. However, more strict grazing management criteria are being implemented within the Fox Canyon and Big Summit AMPs on Forest Service lands which will improve riparian conditions over time.

The implementation of restoration activities (within Gap EIS, Fox Canyon AMP, Big Summit AMP, and Juniper Hills Project) is expected to have beneficial long-term cumulative effects to shade by increasing riparian function and health. All of the restoration projects are expected to have overall long-term (>5 years) beneficial effects to the watershed condition. The short-term (<5 year) effects, when added to the predicted Gap project effects are expected to be very localized in scale and representative of background conditions.

In Summary, within the project area, a minor localized amount of shade would be reduced short-term (<5 years), but no measurable increase in water temperatures resulting from the project activities is anticipated. In the long-term, it is anticipated that shade would be improved within the project area due to increased growth of riparian hardwoods or increased growth rates of residual trees and implementation of riparian restoration activities. Therefore there should not be any cumulative increase in water temperatures in any fish bearing or non-fish bearing perennial streams in the cumulative effects analysis area.

Recreation

This section includes the draft Recreation report in its entirety. This section describes the effects of the proposed alternatives to the Ochoco National Forest's recreational visitors.

Recreational use in the Gap project area includes wildlife viewing, hunting, sightseeing, camping, hiking, biking, horseback riding, snowmobiling, and off-highway vehicle use. These recreation pursuits are primarily dispersed in nature as there are few developed recreation facilities and trails in the area. See Map 14 for locations of some recreation features in the Gap project area.

The Gap project area includes three developed recreation sites including: Biggs Springs campground and both East and West Line Butte trail heads. There are 52 General Forest dispersed sites that reside or are within a tenth (.1) miles of a proposed unit treatment among the alternatives. There are no trails within a tenth (.1) mile of any treatment unit or within any practical distance to warrant further analysis of effects to any of the proposed alternatives for trails.

The vision of Ochoco National Forest is to promote healthy watersheds, healthy communities, and sustainable ecosystems while providing abundant recreational opportunities. Visitors are invited to "discover their own special place," thus there are an abundance of dispersed recreation opportunities.

The central part of the Forest is easily accessible from Prineville on Forest Road 42. From Prineville, the watershed boundary is about an hour drive east of town on a well-maintained paved road. Approximately 80 percent of the total recreation use on the Ochoco National Forest is represented by dispersed recreation (National Visitor Use Monitoring Results, September 2001, Ochoco National Forest). The Gap project area has mostly been receiving a static amount of recreation use over the last 10 years primarily concentrated during holiday weekends and hunting season from September through November. The exception is a slight observed increase of trail use in Lookout Mountain Recreation Area, which overlaps with the Gap project area, throughout the year.

Dispersed Camping

Dispersed recreation camping sites are located throughout the Forest but are generally located along roads with easy access of flat spacious ground associated with at least some over story shade trees. The site applies to the barren core of centered activity and the influence area immediately around it. As stated in the Ochoco National Forest Management Area (LRMP), "The dispersed campsites will exhibit a relatively natural appearance, even though management activities (such as timber harvest) may be highly visible nearby". There are 52 dispersed campsites, as identified by the Ochoco Land and Resource Management Plan within Gap project area treatment units (see tables 152-154). It is likely that other dispersed camping sites have not been identified at this time due to the fact that users are continually creating new sites while others may be abandoned over time. Within the Gap project area, dispersed sites tend to concentrate near the major travel routes and streams such as FS Road 4215, 4220, 4225 and 4235. Other connecter roads also have occasional established campsites.

Table 152. Dispersed Campsites within Treatment Units- Alternative 2

Treatment Type	Unit #s	# of campsites
Commercial Thinning	13,19,40,69,97,134.1,146,156.2,159,186,210.1,212.2,216.1,223.3	18
Noncommercial Thinning	212,303,308	3
Fuels Treatment	29,311,321,374,384,386	9

Table 153. Dispersed Campsites within Treatment Units-Alternative 3

Treatment Type	Unit #s	# of campsites
Commercial Thinning	13.1,19.1,40,134.1,159,186,212.2,216.1	11
Noncommercial Thinning	97.1,156.2,159,210.1,212,303,308	7
Fuels Treatment	29,69,146,311,374,384,386	12

Table 154. Dispersed Campsites within Treatment Units-Alternative 4

Treatment Type	Unit #s	# of campsites
Commercial Thinning	13,19,40,69,97,134.1,146,156.2,159,186,210.1,212.2,216.1,223.3	18
Noncommercial Thinning	212,303,308	3
Fuels Treatment	29,311,321,374,384,386	9

Alternative 1

There would be no direct effect on dispersed camping sites in the project area. Use of these sites is not expected to change. This alternative does not include any treatment units. Over time, the visual character of the areas would change as understory trees are allowed to grow and stands become denser. Large diameter ponderosa pine would become less common. Associated risk of overstock stands could increase risk to disease, insect infestation and wildfire, which if occurs, would alter the character of the recreation experience at these sites.

Alternatives 2, 3 and 4

Treatment would improve the long-term health of timber stands adjacent to the above mentioned camping areas; however, short-term impacts (3-5 years) to the affected camping areas from commercial harvest activities would include increased noise from tractors, and dust from logging operations; increased traffic for log hauling; reductions in visual quality from logging slash, stumps, and post-logging treatments; slash from noncommercial thinning treatments; smoke and blackened ground and vegetation from under burning activities. Some dispersed site users may be temporarily displaced due to loss of access during harvest activities. This could increase camping use at other dispersed sites. Using developed campgrounds and heavily used dispersed sites for industrial camps would not be allowed. Visual evidence of treatment activities may be apparent to the casual forest visitor at or near some of these camping areas.

Noncommercial thinning and underburning activities would have short-term impacts on users including noise from thinning activities, smoke during underburning, and visible blackened ground and vegetation. In Alternative 2 and 4 there are 21 recognized dispersed sites within proposed thinning units and 9 within natural fuels under burn units. Visual evidence of treatment activities may be apparent to the casual forest visitor at or near some of the camping sites. In Alternative 3 there are 16 dispersed campsites within thinning units and 12 within natural fuels under burn units.

Cumulative Effects

Deschutes and Ochoco National Forests Travel Management EIS (Motorized Vehicle Use Map (MVUM)

This decision was signed in 2011, and is currently being implemented. Motorized vehicle use is allowed on designated routes only. Change of use patterns or use statistics are currently unknown. Due to an increase of public education and awareness with OHV access and legal use, reduced cross country travel and delineation of current campsites within 300 feet of accessible roads are expected. However, coupled with thinning and prescribed burning activities, illegal OHV use may increase due to more open vegetation adjacent to roads. Cumulatively, road closures proposed in Gap, along with restriction being implemented in the MVUM, could decrease the development of new, user-created, dispersed recreation sites.

Developed Recreation Sites

There are three developed recreation facilities within the Gap project area. The objective of these management areas is "to provide safe, healthful, and aesthetic facilities for people to utilize while they are pursuing a variety of recreational experiences within a relatively natural outdoor experience". Timber activities will normally not be visually evident, but may be used for safety and visual enhancement. Facilities, roads, and trails will have a well maintained appearance and provide a safe recreational environment.

Biggs Springs Campground is a non-fee site facility containing three camp sites located one hour drive SE of Prineville. This campground's notable features are its views of an open meadow and spring water adjacent to the campsites. The campground lacks potable water and motor home utility hookups. This facility is primitive and receives a small amount of use during spring and summer, usually only one group at a time due to its small size and personal character. Hunting season in fall into early winter encompasses the majority of use.

Dust, noise, smoke, and hauling activity may be observed during times of treatment for short durations that would include a portion or entire length of stay. Depending on location and timing of treatment activity, hunting and scenic values may be affected in specific locations. There are nine units within 1/2 mile of the campground that would have some type of treatment under Alternatives 2, 3 and 4 (see tables 155) Regardless of alternatives, treatment from other units within the greater area would likely use the routes 4215 and 4215150 within sight and sound of Biggs Springs that would add hauling traffic to the background experience of the visitor staying in this campground during treatment activity.

Table 155. Alternative 2, 3, and 4. Treatments within 1/2 mile of Biggs Springs Campground are same.

Treatment Type	Unit #s
Commercial Thinning	49, 53, 54, 55.1, 117, 118, 122.1
Noncommercial Thinning	49, 53, 54, 55.1, 117, 118, 122.1, 122.5, 334
Fuels Treatments	49, 53, 54, 55.1, 55.2, 55.3, 117, 118, 122.1, 122.5, 334

Line Butte Trail Heads both East and West amount to a kiosk board with non-delineated space for parking 1-3 vehicles. These trail heads are primitive, access the Lookout Mountain Recreation Area and serve non-motorized use for hiking, mountain biking, and horse riding. These are low use access points. No treatments are within Lookout Mountain Recreation Area; however, there are units approximate to the trail heads.

Dust, noise, smoke, and hauling activity may be observed during times of treatment for short durations that would include a portion or entire length of stay. Depending on location and timing of treatment activity, hunting and scenic values may be affected in specific locations. There are 12 units combined within ½ mile of both Line Butte Trail Heads that would have some type of treatment for alternatives 2, 3 and 4 (see tables 156 and 157)

Table 156. Alternative 2, 3 and 4 Treatments within 1/2 mile of Line Butte East Trail Head are same.

Treatment Type	Unit #s
Commercial Thinning	46.1, 154, 156, 156.1, 159
Noncommercial Thinning	46.1, 46.2, 154, 156, 156.1, 159
Fuels Treatments	46.1, 46.2, 154, 156, 156.1, 156.3, 159, 311

Table 157. Alternative 2, 3 and 4 Treatments within 1/2 mile of Line Butte West Trail Head are same.

Treatment Type	Unit #s
Commercial Thinning	185, 186, 188
Noncommercial Thinning	185, 186, 188, 302
Fuels Treatments	185, 186, 188

Alternative 1

This alternative does not include any treatment units and over time, the visual character of the areas would change as understory trees are allowed to grow and stands become denser. Large diameter ponderosa pine would become less common. Associated risk of overstock stands could increase risk to disease, insect infestation and wildfire which could alter the character of the recreation experience at these sites.

Alternatives 2, 3 and 4

Activities in Alternative 2, 3 and 4 would have direct and indirect activity in the general location and visitors would experience some temporary noise and smoke depending on treatment type during their stay. Parts or whole recreation sites such as Line Butte Trail Heads may be temporarily closed for public safety when activity is occurring. All three alternatives would present no long term direct changes to these facilities for its uses. Observations of treatment activity from these facilities would be limited to the time frames necessary to complete and would reasonably include only those treatments at and within a half mile.

Cumulative Effects for all Alternatives

The cumulative effects boundary is the Gap project area. A foreseeable future project that could affect the recreational experience in the Gap project area would be the Lookout Mountain Multi-use Trail project (see table 167). The trail project includes 22.3 of miles of trial within the Gap project area, 2.8 miles of which would be new construction. The project would see an increase in trail use for hikers, mountain bike and equestrian riders. The Gap project does not include a recreation proposal; therefore, the Gap project would add cumulatively to the Lookout Multi-use Trail project.

North Fork Crooked River Recreation Area

A portion of the North Fork Crooked River Recreation Area resides within the Gap project area. This upper most portion of the Crooked River begins at its source in Williams Prairie and continues to Big Summit Prairie. Much of this area has been historically grazed and continues to be grazed today. Some past logging and treatment activity has occurred in the past, but there are stringers of Old Growth designated forest that will be managed and maintained for such prescriptions. Generally this segment of river will remain free flowing with some evidence of past and ongoing logging activity. Motorized vehicle use will remain on designated routes. Prescribed fire may be evident where used to enhance retention of tree species and viewing areas. The primary recreation use is dispersed camping, scenic driving, and hunting.

Alternative 1

This alternative does not include any treatment units and over time, the visual character of the areas would change slowly as understory trees are allowed to grow and stands become denser. Large diameter ponderosa pine would become less common. Associated risk of overstock stands could increase risk to disease, insect infestation and wildfire which if occurs would alter the character of the recreation experience along this corridor.

Alternatives 2, 3 and 4

These alternatives share much of the same prescriptions and their recreation effects will be addressed together. There are some minor treatment differences in Alternative 3 as compared to Alternatives 2 and 4 and can be compared using the tables, however the general effect to the casual visitor traveling through the area would remain largely similar.

Table 158. Alternative 2 and 4 Treatments within North Fork Crooked River Recreation Area are same.

Treatment Type	Unit #s
Commercial Thinning	10, 19, 34.1, 36, 37.3, 38, 40, 41.1, 32.1
Noncommercial Thinning	10, 19, 34, 34.1, 36, 37.3, 38, 40, 41.1, 41.3, 32.1
Fuels Treatments	10, 19, 32.2, 34, 34.1, 36, 37.3, 37.4, 38, 40, 41.1, 41.3, 32.1, 48.1, 74, 75, 76

Table 159. Alternative 3 Treatments within North Fork Crooked River Recreation Area are similar with but limited treatment changes.

Treatment Type	Unit #s
Commercial Thin.	10, 19.1, 34.1, 37.3, 38, 40, 41.1, 32.5
Noncommercial Thin.	10, 10.1, 19.1, 32.1, 32.5, 34.1, 37.3, 36, 38, 40, 41.1, 41.3, 334
Fuels Treatments	10, 10.1, 19.1, 32.1, 32.2, 32.5, 34.1, 37.3, 37.4, 36, 38, 40, 41.1, 41.3, 48.1, 74, 75, 76, 334

For all action alternatives, there would be approximately 323 acres of underburning; much of this would not be visible from traveling on adjoining roads. Most recreational exposure to after treatment effects would be seen and experienced by hunters (see Wildlife section for more detailed effects to wildlife and big game). Most of this burning activity can be accomplished within one to two days. Grass forbs would be expected to establish themselves quickly and underbrush within a few years. The natural character would appear modified when viewing or walking through a treated unit. Stumps and burning activity would be present for several years. The treated areas would have greater depth of view and generally be easier to travel through. These qualities are popular with hunters provided there are mosaics of varying vegetation and terrain.

Cumulative Effects

There are present or foreseeable recreation project planned in the North Fork Crooked River Recreation Area; therefore, there would be no cumulative effects.

Heritage Resources and Plants of Cultural Value

This section includes the draft Heritage report in its entirety. This section describes the effects of the proposed alternatives to the Ochoco National Forest's heritage and cultural resources.

Affected Environment

A review of past archaeological surveys and known archaeological sites was conducted to determine how much of the proposed project had been previously surveyed and how many known archaeological sites are in the project area. Before the development of the Gap Landscape Restoration project (Gap project), twenty previous cultural resources surveys, totaling 14,100 acres, had been conducted within the boundaries of the current project area. The review of past work combined with the Ochoco National Forest predictive model was used to help establish areas to inventory within the projects Area of Potential Effect (APE). This review identified 1,390 acres of high probability for archaeological sites within the project boundary. Cultural resources survey for the Gap project undertaking entailed examining *thirty four* survey units and 79 segments of new temporary roads for a combined total of 27 linear mile or 39 acres. When previous and current cultural resource survey coverage is combined, a total of 15,490 acres have been examined for the presence of archaeological resources within the project boundaries. During the course of the past and present surveys, 126 archaeological sites have been discovered and documented in the Gap project area, 39 of those sites have been determined eligible for inclusion in the National Register of Historic Places (NRHP), 24 have been determined not eligible for inclusion in the NRHP, and 63 of those sites have not been evaluated for inclusion in the NRHP. The 63 unevaluated sites have no determination of eligibility for the NRHP and will receive the same status and protections as those sites determined eligible for inclusion in the NRHP (FSH 2309.12_33).

Environmental Effects

The effects analysis is based on the potential for damage to artifacts, features, environmental settings and alteration of the surface and subsurface arrangement by machinery, fuel loadings, potential temperatures and duration of fire treatment.

Dominant historical themes are largely represented by archaeological sites associated with stock grazing between 1880s and the 1950s, transportation routes ranging from the 1890s to the present and Agency administration. Site types associated with the stock grazing theme include stock driveway routes, log water troughs, inscribed aspen trees, refuse scatters, and log structures. Transportation routes include 1 historic road; the Gray Prairie Road (1890s to 1920s), and a historic phone line associated with agency administration. Lithic scatter sites, or those locations where stone debris was produced as a result of stone tool manufacture, are represented by slightly more than 84% of the documented archaeological sites within the Gap project boundary. Lithic scatter sites in this area are generally located where various resources could be exploited and/or harvested.

Those sites are largely open-air, surface sites consisting of debris left behind after the production of flaked stone tools. However, some of those sites have the potential for subsurface, cultural deposits.

Artifacts, features and their locations within the project area may be negatively affected by ground disturbing activities caused by logging methods and equipment, road construction, fuels treatments (under-burning and mechanical thinning of young trees) and unplanned wildfires. Machinery may crush artifacts and disturb the spatial arrangement of a cultural site or feature. The temperature, duration and intensity of wild land fire and prescribed fire may melt stone artifacts and alter the hydration bands on obsidian. Such conditions would be expected in wild land fire situations with high severity fire or where fuels are concentrated, such as machine piles. Prescribed fire conditions can be designed and implemented to achieve low burning temperatures and short duration fire and not adversely affect lithic scatter sites. Methods used for dating archaeological materials and environmental conditions rely on relatively stable environmental conditions and high burning temperatures can “reset” chronological indicators. Research has shown obsidian is altered with temperatures ranging from 200 to 300 degrees Celsius and grater (Lloyd, et. Al. 2002). The fire intensity and duration of burning are highly variable and dependent on the nature of existing fuels as well as weather conditions.

Traditional cultural areas are used today by tribal members for hunting, gathering, collecting, fishing and practicing traditional life ways. Ground disturbance from machinery may adversely affect those areas and habitats. The use of fire before plants are dormant may reduce plant populations and their abundance, making the timing of fire very important. Prescribed fire may also improve plant habitat and benefit plant populations when used during the appropriate plant cycle.

Access to use certain areas is a concern for neighboring tribes and activities such as closing roads may restrict or limit access. Similarly, limiting or controlling access from vehicles and all-terrain vehicles (ATVs) would reduce surface disturbances and potentially reduce vandalism and looting at cultural sites resulting in a positive effect.

Alternative 1

Existing management practices would continue under the No Action Alternative but no new vegetative treatments would be scheduled. Levels of natural fuels would continue to accumulate. Densely stocked understory trees would not be treated and thinning of larger trees would not occur. Untreated fuels under this alternative would increase the potential for unplanned high intensity wild land fire. Catastrophic stand replacement fire would have a negative effect on both surface and subsurface archaeological resources as well as natural settings.

Archaeological sites within the project area would continue to degrade from stock grazing, weathering, erosion, wild land fire suppression, recreational events, firewood cutting, vandalism and surface artifact collecting. Natural fuels would continue to accumulate, exposing lithic tool sites to heat from fires and possible damage from suppression activities. Fuel loading would not be reduced using commercial harvest methods and natural fuels burning along the Summit Trail. These types of conditions would increase the risk of unplanned wildfire and the subsequent need for fire suppression activities. Suppression activities have the potential to be more damaging than fire alone.

Tribal access, gathering and collection activities would continue under the No Action alternative because there would be no change to the current road system or current condition of vegetation.

Alternatives 2-4

Alternatives 2-4 would have the potential to disturb archaeological sites. However, design criteria built into this proposed project would protect those qualities of a site that make it eligible to the National Register of Historic Places (NRHP). For those archaeological sites within proposed harvest units, buffers would be placed around them to protect them from ground disturbing activities.

All skid trails and landings near sites would need approval before harvesting. Vulnerable historic sites would also be protected from fuel reduction activities proposed for alternatives 2-4. Those site types would either have fuel lines dug around them for avoidance from flames, or fuels surrounding the site would be pulled back to reduce threats from heat and flames. Road construction and stream restoration projects would avoid all eligible sites. In view of the design criteria developed for the protection of archaeological and historic sites, alternatives 2-4 conform to those Federal laws, regulations and guidelines that provide for the protection of NRHP-eligible sites. These alternatives would have no impact to the traditional life ways of local, federally recognized tribal members because no roads would be closed that may affect access to known traditional use areas.

Cumulative Effects

Alternative 1 – No Action

The cumulative effects boundary is the Gap project area. Surface and subsurface cultural materials on the Ochoco National Forest, both historic and prehistoric, have felt the effects of both natural and human-caused activities for thousands of years, sometimes since the day the materials were deposited in the archaeological record. Wildfires, flooding, erosion, and weathering are just some of the agents that cause natural damage and deterioration to archaeological sites. The human induced, cumulative effects of logging, road building, grazing, surface collecting and/or illegal digging, and natural fuels reductions accelerate the effects from natural causes. All those activities would still be reflected in the integrity of those sites. Early site records, dating from the 1970s, often document the disturbance of surface archaeological sites from logging activities, both past and present. Beginning in the mid-1980s, surface sites were given more protection in order to obtain a clearance for a proposed project with the State Historic Preservation Office (SHPO). However, those sites still reflect damage today. With this Alternative, archaeological sites would continue to be damaged from natural and human caused agents unless protective measures were implemented.

Alternatives 2 – 4

The Heritage design criteria for this undertaking would diminish damage that might affect archaeological sites for proposed projects under these alternatives. Nevertheless, natural elements, logging, road building, grazing, surface collecting and/or illegal digging for archaeological resources, recreation, firewood cutting, off-road activities and natural fuels reductions would continue to damage archaeological sites.

Visual Quality

This section includes the Visual Quality analysis in its entirety.

The existing scenery has a variety of disturbed and undisturbed areas. Human-caused activities have altered the natural-appearing landscape over time. Diverse vegetation stands and species (with various age, size classes, and health conditions) can be found throughout the project area. These vegetation stands include: ponderosa pine, lodgepole pine, western larch, Douglas-fir, white fir, and riparian species. They provide strong diverse lines and textural and color patterns most densely located on Northern slope and drainages while broken up by occasional view openings of dry upland scab flats into the foreground landscape.

Although the existing forest conditions may appear natural to a casual visitor, the forest conditions are not natural. Older trees are being suppressed by the densely stocked understory due to the change in fire regime caused by fire suppression. Densely stocked forest and canopy closure, due to the lack of low intensity fire regime, has led to the loss of the open, park-like ponderosa pine stands historically found within the area. Overstocked and dense understory stands in parts of the project area have led to increased fire risk. The natural processes can no longer function as they did historically because of these dense stand conditions. The competition for available space, nutrients, and the encroachment from shade-tolerant understories is prevalent along varied segments of Forest roads. The depth-of-field view deep into the forest is restricted to mostly the immediate foreground area of the landscape due to the high level of vegetation density.

Visual Management Corridor

FS Road 42: “Retention” emphasis for this corridor is to maintain the natural appearing character of the Forest along major travel routes, where management activities are usually not evident or are visually subordinate to the surrounding landscape. The management boundary would not exceed 600 feet either side of road. Retention objective would result in long term management where activities may be evident but are visually subordinate to the characteristic landscape. Vegetation would be manipulated but would reflect a natural forest setting.

Forest Road 42 is a popular well-traveled route for pleasure driving and access to other parts of the forest. This segment is proximity one hour drive from Prineville and two hours from John Day and provide for opportunities for scenic landscapes, wildlife viewing, etc. Visual road corridors provide opportunities for scenic vistas, wildlife viewing, and access to dispersed and developed camping. Maintaining a natural appearance and protection of natural resources along these roads accommodates visitors seeking of natural scenery and provides a high quality recreational experience. The general emphasis in these areas is to maintain the natural-appearing character of the forest.

Common observations may view within the 600 feet of roadway, cut stumps, hand piles, and blackened remains from burning to be visible for 1-3 years. Grapple Piles burn more intensely, having deeper soil heat penetration resulting with a barren core for up to 10 years. Noise and hauling traffic would be present at varying times of year summer and winter. Approximately 1/3 mile of Rd 42 would experience burning prescriptions totaling 60.7 acres. Such treatment would be accomplished in short duration of time, usually one day per unit. Recovery of grass, forbs and perennials would also vary differing stages of recovery contributing to a tapestry of open mosaics.

Forest Plan direction for Scenic Resources would be met with the retention of residual trees, post-treatment cleanup activities, implementation of design elements, and on-site monitoring.

Table 160. Alternative 2, 3 and 4 Treatments within FS Road 42 retention scenic corridor are same.

Treatment Type	Unit #s
Commercial Thinning	13, 16.1
Noncommercial Thinning	13, 16.1, 16.4, 16.5
Fuels Treatments	9, 13, 16.1, 16.4, 16.5

Alternative 1

Under this alternative, the existing vegetation within the project area would not be altered or changed by any management activity.

Scenery would remain essentially the same during the short-term duration (0-5 years) and may be adversely altered through time (5 years and longer) as multi-strata conditions continue to increase. Encroachment by shade-tolerant species would continue and stand densities would continue to increase. Views of open, park-like stands of older and larger ponderosa pine would become less frequent. Risk to disease and stand replacement high intensity wildfire would continue to increase.

Alternatives 2, 3 and 4

To the casual forest visitor traveling a linkage of several forest roads, the differences between Alternatives 2, 3 or 4 would not be noticeable. Therefore, the alternatives are being presented together. The Forest visitor could expect to see occasional sections of stumpage, hand piles, blackened woody debris from under burning and slash pile activity. Burning evidence would be evident from 1-3 years with fuel reduction benefits lasting much longer. After the short term effects of treatment activities recovered, the diverse scenic views would be expected to enhance a visitor's experience along visual corridors. Field of view would increase more consistently while traveling within these visual corridors. Multi- strata stands would decrease as overstory selections are retained. With field of view enhanced, more topographic features may be observed.

Management activities would occur within the Scenic Corridor, within Retention visual management allocation. The long term (20 years and longer) scenic quality within the treatment areas may improve slightly or would remain the same as the existing condition. Less alteration to the scenery would occur due to the removal of smaller, understory trees.

Air Quality

The Oregon Department of Environmental Quality is responsible for assuring compliance with the Clean Air Act. The DEQ monitors the emissions from prescribed fire through the Oregon State Department of Forestry smoke management program. (State of Oregon, 2005) Site specific fuels data is entered into a state database along with observations of environmental conditions taken while burning. This data is used to determine the amount of emissions produced statewide by prescribed fire, and maintain compliance with the Clean Air Act.

The Oregon Administrative Rules regarding smoke management encourages using wood or other biomass for making products or for energy production in order to reduce emissions from prescribed fire (OAR 629-048-0200(1)). Slash piles would be available for market. As the market for biomass increases, more piles would be removed from the forest, reducing the smoke from pile burning.

The OARs define Smoke Sensitive Receptor Areas as areas that are provided the highest level of protection under the smoke management plan because of their history of smoke incidents, density of population or other special legal status related to visibility. (OAR 629-048-0005(26)) The nearest SSRAs to the project area are Redmond, 40 miles to the west, and John Day, 85 miles to the east.

The OARs define Class I Areas as wilderness areas designated by Congress that are subject to visibility protection under the Environmental Protection Agency's Regional Haze Rule and the federal Clean Air Act. (OAR 629-048-0005(5)) The nearest Class I wilderness to the Gap project is the Strawberry Mountain Wilderness, 70 miles to the east.

Due to distance, prevailing winds, and the short duration and lower volume of smoke from prescribed fire, smoke from burning in the Gap project area would not likely effect Class I wilderness areas or Smoke Sensitive Receptor Areas. There is no history of smoke from burning in the Gap project area effecting Class I wilderness areas or Smoke Sensitive Receptor Areas.

Smoke from prescribed fires has occasionally pooled in the Paulina valley. Pooling occurs in the late evening/early morning hours as cold stable air settles into the valley bottoms, and generally lifts by mid-day as the valley heats up. Smoke from prescribed fires could impact hunter camps and forest roads, for the same reason. Prescribed burning would be suspended during persistent inversion conditions to avoid having smoke pool in the valley for more than a few days.

Prineville (25 miles west of the project) is not currently identified as a Smoke Sensitive Receptor, but recent occasional wintertime air quality issues have prompted the city to implement an action plan to reduce emissions and improve air quality to avoid a Federal non-attainment designation for exceedance of the National Ambient Air Quality Standards (NAAQS) for PM 2.5. Ochoco National Forest Fire Management Personnel are currently coordinating with Prineville, Crook County, and Crook County Fire and Rescue Officials for prescribed burning projects within Crook County.

A high percentage of wildfire smoke (by mass) is within the PM 2.5 particle class size. These are respirable particles less than 2.5 micrometers in diameter which are of the most concern to human health because they can be inhaled deeply into the lungs. (Ottmar, 2001) The example below compares the production of PM 2.5 from a wildfire before treatment and from a wildfire after treatment. The example Fire Regime I unit has fuels conditions characteristic of Condition Class 3; closed canopy, heavy surface fuels and ladder fuels. Condition Class 1 is the condition in the unit after it has been harvested, which opens the canopy; thinned, which reduces ladder fuels, and; burned, which reduces surface fuels. (See page 14 for other fire effects within this unit.)

Table 161. Smoke Production (PM 2.5). (USFS, 2005)

High Hazard/CC 3 **Wildfire before treatment**	Low Hazard/CC 1 **Wildfire after treatment**
.16 tons per acre PM 2.5 (total consumption 17.4 tons per acre)	**.08** tons per acre PM 2.5 (total consumption 9.7 tons per acre)

Wilderness, Inventoried Roadless Areas, Lands with Wilderness Characteristics and Other Undeveloped Lands

This section of the EIS includes the entire draft analysis of affected environment and environmental consequences for wilderness areas, Inventories Roadless Areas (IRAs), Lands with Wilderness Characteristics (LWCs) and other unroaded or undeveloped lands.[12]

Wilderness

Affected Environment

A wilderness area is designated by congressional action under the Wilderness Act of 1964 and other wilderness acts. Wilderness is undeveloped Federal land retaining primeval character and influence without permanent improvements or human habitation. The Ochoco National Forest contains about 36,200 acres of designated wilderness in three Wilderness Areas: Black Canyon (13,400 acres), Bridge Creek (5,400 acres) and Mill Creek (17,400 acres) (Forest Plan p. 4-46).

Environmental Consequences – All Alternatives

There are no designated wilderness areas within or directly adjacent to the Gap Landscape Restoration project (Gap project) area; the closest wilderness area, Bridge Creek is more than 10 miles away. Activities proposed in the action alternatives would have no effect on the wilderness character, including solitude, on any Wilderness Area on the Ochoco National Forest because of the distance between the Gap project area and the nearest wilderness. No activities would occur adjacent to or within any designated wilderness area.

Inventoried Roadless Areas

Affected Environment

Inventoried Roadless Areas (IRAs) were identified in the 2001 Roadless Area Conservation Rule in a set of inventoried roadless area maps, contained in Forest Service Roadless Area Conservation Final Environmental Impact Statement, Volume 2, dated November 2000, which are held at the National headquarters office of the Forest Service, or any subsequent update or revision of those maps (36 CFR 294.11). These areas were set aside through administrative rulemaking and have provisions, within the context of multiple use management, for the protection of inventoried roadless areas. Most IRA boundaries are substantially identical to those identified as 'Roadless Areas', referred to in the 1982 planning rule (36 CFR 219.17) and identified by the Forest Plan, FEIS, Appendix C; however some localized, minor differences in boundaries may exist.

All roadless area acres were allocated to various management area strategies as disclosed in the Ochoco Forest Plan FEIS. Some management area strategies were intended to retain the undeveloped roadless character of the roadless area and some management area strategies were intended to develop the lands with timber harvest and road building activities; thus forgoing roadless character.

[12] The term 'other undeveloped lands' is presented and used in this document to provide a consideration for lands that do not contain roads and evidence of timber harvest.

Environmental Consequences – All Alternatives

There is one IRA within the Gap project area. The Lookout Mountain IRA is located in the northwestern portion of the Gap project area and includes 3,250 acres within the project area. There are no activities proposed within the Lookout Mountain IRA; therefore, there would be no direct, indirect or cumulative effects.

Lands with Wilderness Characteristics

Affected Environment

Lands with Wilderness Characteristics (LWCs) are identified using inventory procedures found in Forest Service Handbook (FSH) 1909.12 Chapter 71. The identification is conducted to assess whether project related actions have impacts on the ability of an undeveloped area to be considered in a future wilderness inventory conducted during forest plan revision.

Lands with Wilderness Characteristics are not a land designation decision, they do not imply or impart any particular level of management direction or protection, they are not an evaluation of potential wilderness (Chapter 72), and lastly they are not preliminary administrative recommendations for wilderness designation (Chapter 73). The inventory of LWCs does not change the administrative boundary of any IRA.

Typically, LWCs substantially overlap, and/or are contiguous with IRAs, and also may be contiguous with wilderness. Some newly inventoried LWCs may be stand-alone areas that were not identified as ‘roadless areas’ in Appendix C of the 1989 Ochoco Forest Plan and ‘inventoried roadless areas’ as identified in a set of maps in the 2001 Roadless Area Conservation Rule (RACR). LWCs overlap inventoried roadless areas only where those acres of land are consistent with the inventory criteria (FSH 1909.12 Chapter 71) and may extend beyond IRA and wilderness boundaries consistent with inventory criteria.

Methodology for Lands with Wilderness Characteristics

The Lands with Wilderness Characteristics (LWCs) GIS Analysis Tool (Deschutes National Forest, Thomas and Ferguson) was used to identify LWCs within the Gap project area. District Databases of the existing road system and past harvest were combined with GIS, Light Detection and Ranging (LiDAR), local knowledge of the area, and the examination of NAIP imagery to determine LWCs within the project area. As a result of the LWC analysis model, 56 areas were considered for LWC. The areas ranged in size from one acre to 16,515 acres. Next, using inventory procedures found in Forest Service Handbook (FSH) 1909.12 Chapter 71, the Gap IDT determined that only one of the 56 areas meet LWC criteria. The LWC area is identified as Area 52 of which 7,373 acres occur within the project area (the Gap project record contains the entire LWC GIS Analysis Tool report). The remaining acres occur within the Lookout Mountain IRA.

Environmental Consequences- All Action Alternatives

Table 162. LWC Area to be analyzed.

LWC	Acres Inside Gap Project Area
Area 52	7,373

Table 163. Activities proposed in Area 52

	Alternative 2	Alternative 3	Alternative 4
Commercial Harvest	1,043 acres	923 acres	1,043 acres
Noncommercial Thinning	31 acres	146 acres	31 acres
Fuels Treatments	224 acres	229 acres	224 acres
Stream Restoration	24 acres	24 acres	24 acres
Road Decommissioning	.7 mile	.7 mile	.7 mile
Temporary Road Construction	3.7 miles	3.7 miles	3.7 miles
Temporary Road on Existing Disturbance	.4 mile	.4 mile	.4 mile

The Gap interdisciplinary team analyzed LWC Area 52 against the criteria in FSH 1909.12 to determine if the LWC would be affected by road building and vegetation management activities that are substantially noticeable and made a determination if the LWC, or a portion of an area, would remain an LWC upon completion of project activities.

It was determined that the effects of commercial harvest, and associated temporary road construction, would be a substantially noticeable activity; therefore, all areas within LWC Area 52 planned for commercial harvest would not remain LWC after harvest. In addition, post-harvest, remaining areas not contiguous with the Lookout Mountain (LOM) IRA would not remain LWC.

The Gap IDT also determined that noncommercial thinning, fuels treatments and stream restoration would not be substantially noticeable; therefore, the areas with the LWC affected by those activities would remain LWC. A foreseeable future project that overlaps with Area 52 LWC would be the Lookout Mountain Multi-use Trail project. The trail project would not be a substantially noticeable activity and would not affect the character of the LWC.

Table 164. LWC Acres by Alternative Post-commercial Harvest

	Existing LWC acres	Commercial Harvest, plus remaining areas not meeting LWC criteria	LWC acres, Post Commercial Harvest
Alternative 2	7,372	2,807	4,565
Alternative 3	7,372	2,597	4,775
Alternative 4	7,372	2,807	4,565

Other Unroaded/Undeveloped Lands

These areas of land should have no modern history of harvest activity, should not contain forest roads, and are not classified as a wilderness area, potential wilderness area, or IRA.

The criteria used to analyze for these areas are contained in the Roadless Rule 294.11 "Roadless Area Characteristics." These are as follows:

High quality or undisturbed soil, water, and air: These three key resources are the foundation upon which other resource values and outputs depend. Healthy watersheds catch, store, and safely release water over time, protecting downstream communities from flooding; providing clean water for domestic, agricultural, and industrial uses; helping maintain abundant and healthy fish and wildlife populations; and are the basis for many forms of outdoor recreation.

Sources of public drinking water: National Forest System lands contain watersheds that are important sources of public drinking water. Maintaining these areas in a relatively undisturbed condition saves downstream communities millions of dollars in water filtration costs.

Diversity of plant and animal communities: Roadless areas are more likely than roaded areas to support greater ecosystem health, including the diversity of native and desired non-native plant and animal communities due to the absence of disturbances caused by roads and accompanying activities. Inventoried roadless areas also conserve native biodiversity by serving as a bulwark against the spread of non-native invasive species. Habitat for threatened, endangered, proposed, candidate, and sensitive species and for those species dependent on large, undisturbed areas of land: roadless areas function as biological strongholds and refuges for many species.

Habitat for threatened, endangered, proposed, candidate, and sensitive species and for those species dependent on large, undisturbed areas of land: Roadless areas function as biological strongholds and refuges for many species. Roadless areas support a diversity of aquatic habitats and communities.

Primitive, Semi-Primitive Non- Motorized, and Semi-Primitive Motorized classes of dispersed recreation opportunities: Roadless areas often provide outstanding dispersed recreation opportunities such as hiking, camping, hunting, fishing, Nordic skiing and canoeing. While they may have many wilderness-like attributes, unlike Wilderness, mountain bikes and other mechanized uses are often allowed.

Reference landscapes: Knowledge about the effects of management activities over long periods of time and on large landscapes is very limited. Reference landscapes of relatively undisturbed areas serve as a barometer to measure the effects of development on other parts of the landscape.

Natural appearing landscapes with high scenic quality: High quality scenery, especially scenery with natural-appearing landscapes, is a primary reason that people choose to recreate.

Traditional cultural properties and sacred sites: Traditional cultural properties are places, sites, structures, art or objects that played an important role in the cultural history of a group. Sacred sites are places with special religious significance to a group. Traditional cultural properties and sacred sites may be eligible for protection under the National Historic Preservation Act. However, many of them have not yet been inventoried, especially those that occur in inventoried roadless areas.

Other locally identified unique characteristics: Roadless areas may offer other locally identified unique characteristics and values. Examples include uncommon geological formations, valued for their scientific and scenic qualities, or unique wetland complexes.

Affected Environment/Environmental Effects Unroaded/Undeveloped: The areas analyzed for these unroaded/undeveloped characteristics are identified in table 165.

Table 165 summarizes the activities proposed within these areas and the environmental effects of the alternatives on these characteristics. The complete analysis and maps of these areas are available in the gap project record.

Table 165. Unroaded/Undeveloped Attribute Evaluation.

Area	Alt. 1 - No Action	Alt. 2 – Proposed Action	Alternative 3	Alternative 4
Area 7 1,723 ac.	No activities proposed. The landscape has been altered past harvest and associated road construction is apparent.	Commercial thinning (168 ac.), noncommercial thinning (2 ac.) and fuel treatment (13 ac.) would have some short-term impacts with long-term benefits.	Commercial thinning (40 ac.), noncommercial thinning (16 ac.) and fuel treatment (126 ac.) would have some short-term impacts with long-term benefits.	Commercial thinning (168 ac.), noncommercial thinning (2 ac.) and fuel treatment (13 ac.) would have some short-term impacts with long-term benefits.
Area 9 703 acres.	No activities proposed. The landscape has been altered by some past harvest and associated road construction.	Commercial thinning (404 ac.), noncommercial thinning (1 ac.) would have some short-term impacts with long-term benefits.	Commercial thinning (147 ac.), noncommercial thinning (106 ac.) and Rx burning (152 ac.) would have some short-term impacts with long-term benefits.	Commercial thinning (404 ac.) and noncommercial (1 ac.) would have some short-term impacts with long-term benefits.
Area 16 4,424 acres	No activities proposed. The landscape has been altered by past selective harvest and road construction.	Commercial thinning (1 ac.), would not have short-term impacts or long-term benefits.	Commercial thinning (1 ac.), would not have short-term impacts or long-term benefits.	Commercial thinning (1 ac.), would not have short-term impacts or long-term benefits.
Area 21 428 acres	No activities proposed. The landscape has been altered by past commercial harvest and road construction.	Commercial thinning (66 ac.) and noncommercial thinning (41 ac.) would have some short-term impacts with long-term benefits.	Commercial thinning (40 ac.), noncommercial thinning (42 ac.) and Rx burning (25 ac.) would have some short-term impacts with long-term benefits.	Commercial thinning (66 ac.) and noncommercial thinning (41 ac.) would have some short-term impacts with long-term benefits.
Area 21.1 3,181 ac.	No activities proposed. There is evidence of past selective harvest.	Commercial thinning (738 ac.), noncommercial thinning (134 ac.) and Rx burning (369 ac.), would have some short-term impacts with long-term benefits.	Commercial thinning (445 ac.), noncommercial thinning (407 ac.) and Rx burning of (389 ac.), would have some short-term impacts with long-term benefits.	Commercial thinning (738 ac.), noncommercial thinning (134 ac.) and Rx burning (369 ac.), would have some short-term impacts with long-term benefits.
Area 22 1,091 ac.	No activities proposed. The landscape has been altered by past commercial harvest and road construction.	Commercial thinning (326 ac.), noncommercial thinning (367 ac.), Rx burning (154 ac.) and stream restoration (29 ac.) would have short term impacts and long term benefits.	Commercial thinning (287ac.), noncommercial thinning (406 ac.), Rx burning (154 ac.) and stream restoration (29 ac.) would have short term impacts and long term benefits.	Commercial thinning (326 ac.), noncommercial thinning (367 ac.), Rx burning (154 ac.) and stream restoration (29 ac.) would have short term impacts and long term benefits.

Area	Alt. 1 - No Action	Alt. 2 – Proposed Action	Alternative 3	Alternative 4
Area 24 353 ac.	No activities proposed. The landscape has been altered by past commercial harvest and road construction	Commercial thinning (2 ac.), noncommercial thinning (14 ac.) and stream restoration (169 ac.) would have short term impacts and long term benefits.	Commercial thinning (2 ac.), noncommercial thinning (14 ac.) and stream restoration (169 ac.) would have short term impacts and long term benefits.	Commercial thinning (2 ac.), noncommercial thinning (14 ac.) and stream restoration (169 ac.) would have short term impacts and long term benefits.
Area 25 3,832 ac.	No activities proposed. The landscape has been altered by past commercial harvest and road construction	Commercial thinning (1,839 ac.), noncommercial thinning (116 ac.), Rx burning (856 ac.) and stream restoration (42 ac.) would have short term impacts and long term benefits.	Commercial thinning (1,538 ac.), noncommercial thinning (417 ac.), Rx burning (857 ac.) and stream restoration (42 ac.) would have short term impacts and long term benefits.	Commercial thinning (1,839 ac.), noncommercial thinning (116 ac.), Rx burning (856 ac.) and stream restoration (42 ac.) would have short term impacts and long term benefits.
Area 26 2,404 ac.	No activities proposed. The landscape has been altered by past commercial harvest and road construction	Commercial thinning (191 ac.), noncommercial thinning (88 ac.), Rx burning (147 ac.) and stream restoration (534 ac.) would have short term impacts and long term benefits.	Commercial thinning (187 ac.), noncommercial thinning (91 ac.), Rx burning (147 ac.) and stream restoration (534 ac.) would have short term impacts and long term benefits.	Commercial thinning (191 ac.), noncommercial thinning (88 ac.), Rx burning (147 ac.) and stream restoration (534 ac.) would have short term impacts and long term benefits.
Area 46 2,995 ac.	No activities proposed. The landscape has been altered by past commercial harvest and road construction	Commercial thinning (212 ac.), noncommercial thinning (175 ac.), Rx burning (17 ac.) and stream restoration (9 ac.) would have short term impacts and long term benefits.	Commercial thinning (177 ac.), noncommercial thinning (210 ac.), Rx burning (17 ac.) and stream restoration (9 ac.) would have short term impacts and long term benefits.	Commercial thinning (212 ac.), noncommercial thinning (175 ac.), Rx burning (17 ac.) and stream restoration (9 ac.) would have short term impacts and long term benefits.
Area 49 2,995 ac.	No activities proposed. The landscape has been altered by past commercial harvest and road construction	Commercial thinning (267 ac.) and Rx burning (33 ac.) would have short term impacts and long term benefits.	Commercial thinning (196 ac.), noncommercial thinning (71 ac.) and Rx burning (33 ac.) would have short term impacts and long term benefits	Commercial thinning (267 ac.) and Rx burning (33 ac.) would have short term impacts and long term benefits
Area 51 349 ac.	No activities proposed. The landscape has been altered by past commercial harvest and road construction	Noncommercial thinning (10 ac.) and Rx burning (1 ac.) would have short term impacts and long term benefits.	Noncommercial thinning (10 ac.) and Rx burning (1 ac.) would have short term impacts and long term benefits.	Noncommercial thinning (10 ac.) and Rx burning (1 ac.) would have short term impacts and long term benefits.

Summary

The analysis showed that the 12 identified areas were less than 5000 acres in size and, in general or in part, altered by past management activities and that activities proposed in the action alternatives in the Gap project would not affect existing roadless/undeveloped characteristics.

Table 166. Citizen identified unroaded areas

Area	Alt. 1 - No Action	Alt. 2 – Proposed Action	Alternative 3	Alternative 4
Little Round Prairie 5,083 ac.	No activities proposed. The landscape has been altered by past commercial harvest and road construction	Commercial thinning (8 ac.), noncommercial thinning (61 ac.), Rx burning (0 ac.) and stream restoration (23 ac.)	Commercial thinning (2 ac.), noncommercial thinning (67 ac.), Rx burning (0 ac.) and stream restoration (23 ac.)	Commercial thinning (8 ac.), noncommercial thinning (61 ac.), Rx burning (0 ac.) and stream restoration (23 ac.)
Lookout Mountain 709 ac.	No activities proposed. The landscape has been altered by past commercial harvest and road construction	Commercial thinning (730 ac.), noncommercial thinning (14 ac.), Rx burning (71 ac.), stream restoration (23 ac.), road decommissioning (.09 miles), road opening (.15 miles) and temp on existing (1.7 miles)	Commercial thinning (639 ac.), noncommercial thinning (100 ac.), Rx burning (76 ac.), stream restoration (23 ac.), road decommissioning (.09 miles), road opening (.15 miles) and temp on existing (1.3 miles)	Commercial thinning (730 ac.), noncommercial thinning (14 ac.), Rx burning (71 ac.) and stream restoration (23 ac.) road decommissioning (.09 miles), road opening (.15 miles) and temp on existing (1.7 miles)
Williams Prairie 798 ac.	No activities proposed. The landscape has been altered by past commercial harvest and road construction	Commercial thinning (267 ac.), noncommercial thinning (82 ac.), Rx burning (87 ac.), stream restoration (15 ac.) and temp on existing (.3 miles)	Commercial thinning (266 ac.), noncommercial thinning (83 ac.), Rx burning (87 ac.), stream restoration (15 ac.) and temp on existing (.3 miles)	Commercial thinning (267 ac.), noncommercial thinning (82 ac.), Rx burning (87 ac.), stream restoration (15 ac.) and temp on existing (.3 miles)

Climate Change and Carbon Cycling

The proposed action (Alternative 2) would treat approximately 14,037 acres in the project area. Harvest treatments proposed include commercial thinning; fuels treatments include mechanical treatments, post-harvest underburn, natural fuels underburn, and hazardous fuels treatments.

Climate change is a global phenomenon because major greenhouse gasses (GHG) mix well throughout the planet's lower atmosphere (IPCC 2013). Considering emissions of GHG in 2010 was estimated at 49 ± 4.5 gigatonnes globally (IPCC 2014) and 6.9 gigatonnes nationally (US EPA, 2015), a project of this magnitude makes an infinitesimal contribution to overall emissions. Therefore, at the global and national scales, the proposed action's direct and indirect contribution to greenhouse gasses and climate change would be negligible. In addition, because the direct and indirect effects would be negligible, the proposed action's contribution to cumulative effects on greenhouse gasses and climate change would also be negligible.

The Intergovernmental Panel on Climate Change has summarized the contributions to climate change of global human activity sectors in its Fifth Assessment Report (IPCC 2014). In 2010, anthropogenic (human-caused) contributors to greenhouse gas emissions came from several sectors:

- Industry, transportation, and building – 41%
- Energy production – 35%
- Agriculture – 12%
- Forestry and other land uses – 12%

The main activity in this sector associated with GHG emissions is deforestation, which is defined as removal of all trees, most notably the conversion of forest and grassland into agricultural land or developed landscapes (IPCC 2000). The Goose project does not fall within any of these main contributors of greenhouse gas emissions. Forested land would not be converted into a developed or agricultural condition. In fact, forest stands are being retained and thinned to maintain a vigorous condition that supports trees, and sequesters carbon long-term. US forests sequestered 757.1 megatonnes of carbon dioxide after accounting for emissions from fires and soils in 2010 (US EPA, 2015). There is agreement that the forestry sector contribution has declined over the last decade (IPCC, 2014; Smith et al., 2014; FAOSTAT, 2013).

However there is growing concern over the impacts of climate change on US forests and their current status as a carbon sink. There is strong evidence of a relationship between increasing temperatures and large tree mortality events in forests of the western United States. There is widespread recognition that climate change is increasing the size and frequency of droughts, fires, and insect/disease outbreaks, which will have major effect on these forests' role in the carbon cycle (Joyce et al. 2014).

The project is in line with the suggested practice of reducing forest disturbance effects found in the National Climate Assessment for public and private forests (Joyce et al. 2014). Here specifically, the project proposes to improve stand conditions, diversity, density and structure with thinning, gaps, and dominant tree release. Thinning the overstocked stands would make more growing space and resources available to the remaining trees, resulting in decreased tree stress and development towards larger diameter stands. The release of carbon associated with this project is justified given the overall change in condition increases forest resistance to release of much greater quantities of carbon from wildfire, drought, insects/disease, or a combination of these disturbance types (Millar et al. 2007). This project is also consistent with options presented by the IPCC for minimizing the impacts of climate change on forest carbon, and represents a potential synergy between adaptation measures and mitigation. Actions aimed at enhancing forest resilience to climate change by reducing the potential for large-scale, catastrophic disturbances such as wildfire also prevents release of GHG and enhances carbon stocks (Smith et al. 2014). The proposed action is consistent with these recommendations because it would improve stand conditions, diversity, density and structure, allowing the forest to adapt, persist and function better over time and into the future.

Timber management projects can influence carbon dioxide sequestration in three main ways: (1) by increasing new forests (afforestation), (2) by avoiding their damage or destruction (avoided deforestation), and (3) by manipulating existing forest cover (managed forests). Land-use changes, specifically deforestation and regrowth, are by far the biggest factors on a global scale in forests' role as sources or sinks of carbon dioxide, respectively (IPCC, Intergovernmental Panel on Climate Change, 2000). Projects that create forests or improve forest conditions and capacity to grow trees are positive factors in carbon sequestration. The proposed action (Alternative 2) falls into this category.

Civil Rights and Environmental Justice

Civil Rights legislations, especially the Civil Rights Act (CR) of 1964, Title VI, prohibit discrimination in Forest Service program delivery. The underlying principal behind the Civil Rights Act is that no activity shall negatively affect minorities, woman, or persons with disabilities by virtue of their race, color, sex, national origin, religion, age, disability, or material or familial status.

Environmental Justice, Executive Order 12898, demands the fair treatment and meaningful involvement of all people. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from the execution of our actions. Environmental Justice focuses on minority, low income groups, and subsistence lifestyles (including Indian Tribes). The purpose of involving these groups and analyzing the effects upon them is to determine whether adverse civil rights impacts are anticipated, or whether disparate or disproportionate impacts associated with the alternatives is anticipated on any of these groups.

With this project, there is no known potential for disparate or disproportionately effects, or to discriminate or negatively impact any individual or subset of the population described above. The vegetation treatments in the action alternatives would provide for easier access to firewood (landing/harvest units) which should positively affect low-income, older, or those with disabilities, who are not able to afford the type of vehicle needed to access, or physically manage gathering firewood from anything but very accessible sites. Also, the types of employment opportunities provided by the alternatives, timber harvest activities (logging, hauling, etc.), prescribed burning, noncommercial thinning, and millwork, etc., would have positive effects on the categories of individuals and population groups these laws and regulations are intended to protect.

The action alternatives would provide for human health and safety of all members of the public by reducing the risk of falling snags along travel ways, as well as reducing the risk of wildfire. The road closure and decommissioning, given the nature of the project area, there would still provide ample access throughout the project area. The actions proposed under Alternatives 2, 3 and 4 would not have any measurable impacts on Tribal rights (ceded lands) or Tribal traditional uses. The project is not located in a minority community nor would it affect residents of low or moderate income. Any impacts would not affect any specific subset of the American population at a disproportionately higher rate than others.

The effects of this project on the social and economic context of these groups are within those described in the Forest Plan. The benefits and risks associated with implementation of the proposed action are provided to all members of the public. Therefore, the project would not pose disproportionately high or adverse effects to minority communities or to low income groups. As a result, no formal Civil Rights Impact or Environmental Justice Analysis was undertaken.

Short-term Uses and Long-term Productivity

NEPA requires consideration of “the relationship between short-term uses of man’s environment and the maintenance and enhancement of long-term productivity” (40 CFR 1502.16). As declared by the Congress, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

The action alternatives propose short-term harvest of timber, while enhancing the long-term health of forested stands. Existing conditions are outside the HRV and may not be sustainable over the long term. Proposed treatments including prescribed fire, in part, mimic natural disturbance processes and move conditions toward a balance of sustainable vegetative conditions. Soil and Water are two key factors in ecosystem productivity and protection of these resources is provided by the design features discussed in Chapter 2. Sustainable wildlife habitat, water quality and other resources depend on maintaining the long-term soil productivity upon which vegetation relies. Quality and quantity of water from the project area would fluctuate as described previously, but no long-term effects to water resources are anticipated as a result of commercial harvest, noncommercial thinning, and fuels reduction treatments. All alternatives provide fish and wildlife habitat at levels necessary to maintain viable populations of the species within the project area. The amounts of suitable habitat vary with the level of density management in each alternative.

The stability of the toe slopes of the dormant landslide terrain along the creeks would be protected and maintained through the use of riparian buffers. Reducing slope erosion, due to mass wasting, would serve to maintain long-term productivity of the land.

Unavoidable Adverse Effects

All of the alternatives considered result in some adverse effects. Many of these adverse effects would be minimized through implementation of design features and resource protection measures identified in Chapter 2 or through mitigation measures. Even with implementing these measures, there would still be adverse effects that cannot be avoided.

Soils

Additional detrimental soil conditions are expected as a result of implementing any of the action alternatives. The use of ground-based tractor logging would result in additional compaction and displacement. The design criteria described in Chapter 2 provide resource protection measures to minimize these unavoidable adverse effects. The alternatives were designed to limit the amount of detrimental soil conditions consistent with R6 Supplement 2500-98-1 (Regional Guidelines), effective August 24, 1998.

Road construction would also result in adverse effects on soils. Temporary road construction results in soil compaction and displacement. On temporary and decommissioned roads, the road surface can be revegetated, but soil productivity is reduced because of compaction. These adverse effects to soils cannot be avoided.

Invasive Plants (Noxious Weeds)

The potential for introduction and spread of noxious weeds exists under every alternative considered, including no action. A noxious weed risk assessment concluded that the potential for introducing and spreading noxious weeds cannot be completely avoided. The action alternatives create conditions that are conducive to the introduction and spread of noxious weeds. Implementation of design features and resource protection measures would minimize these adverse effects. However, proposed activities such as temporary road construction, commercial timber harvest, and prescribed fire would result in conditions conducive to the introduction and spread of noxious weeds.

Sedimentation/Turbidity

All action alternatives propose new and temporary roads. Most sediment delivered to streams would come from stream crossings, road drainage close to streams and harvest and fuels treatments adjacent to Class IV streams and in ephemeral draws.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of-way or road.

Irreversible commitments are decisions affecting nonrenewable resources such as soils, wetlands, roadless areas, and cultural resources. Such commitments are considered irreversible because the resource has deteriorated to the point that renewal can occur only over a long period of time or at great expense or because the resource has been destroyed or removed. Removing aggregate (gravel) from mineral material sources would result in an irreversible commitment of resources. Once aggregate is removed from material source sites and placed on roads, it cannot be renewed except over long periods of time. The project includes the conversion of .9 acres of forested land to a mineral material source

Irretrievable commitments of natural resources involve the loss of production or use of resources. This represents opportunities foregone for the period of time that the resource cannot be used.

Timber stands that are not managed at this time present an irretrievable loss of growth potential. Although the lost growth is irretrievable, it is not irreversible because the stands could be managed at a later date.

Cumulative Effects

There are basically two methodologies the individual resource subjects use in discussing cumulative actions and consequences. The first method would be to describe each individual past, present, and reasonably foreseeable action – including mitigation (cataloging). The second would be to “lump” individual actions if the information regarding those actions would not be useful to illuminate or predict the effects of the proposed action and its alternatives. A mere “cataloging” of effects does not provide the most useful discussion. In some cases, lumping past actions and describing them in terms of “where we are today” can be the most informative. No matter which method is used, it would be formulated to provide the most relevant, useful, helpful, necessary and informative format for the public and deciding official.

The Environmental Consequences disclosures in this EIS include discussion of cumulative effects. Where there is an overlapping zone of influence, or an additive effect, this information is disclosed. In order to understand the contribution of past actions to the cumulative effects of the proposed action and alternatives, this analysis relies on current environmental conditions as a proxy for the impacts of past actions. This is because existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

This cumulative effects analysis does not attempt to quantify the effects of past human actions by adding up all prior actions on an action-by-action basis. There are several reasons for not taking this approach. First, a catalog and analysis of all past actions would be impractical to compile and unduly costly to obtain. Current conditions have been impacted by innumerable actions over the last century (and beyond), and trying to isolate the individual actions that continue to have residual impacts would be nearly impossible.

Second, providing the details of past actions on an individual basis would not be useful to predict the cumulative effects of the proposed action or alternatives. In fact, focusing on individual actions would be less accurate than looking at existing conditions, because there is limited information on the environmental impacts of individual past actions, and one can't reasonably identify each and every action over the last century that has contributed to current conditions. Additionally, by focusing on the impacts of past human actions, an analysis may risk ignoring the important residual effects of past natural events, which may contribute to cumulative effects just as much as human actions do. By looking at current conditions, we are sure to capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed those effects. Finally, the Council on Environmental Quality issued an interpretive memorandum on June 24, 2005 regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

The cumulative effects analysis in this EIS is also consistent with Forest Service National Environmental Policy Act (NEPA) Regulations (36 CFR 220.4(f)) (July 24, 2008), which state, in part:

CEQ regulations do not require the consideration of the individual effects of all past actions to determine the present effects of past actions. Once the agency has identified those present effects of past actions that warrant consideration, the agency assesses the extent that the effects of the proposal for agency action or its alternatives would add to, modify, or minimize those effects. The final analysis documents an agency assessment of the cumulative effects of the actions considered (including past, present, and reasonable foreseeable future actions) on the affected environment. With respect to past actions, during the scoping process and subsequent preparation of the analysis, the agency must determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects. Cataloging past actions and specific information about the direct and indirect effects of their design and implementation could in some contexts be useful to predict the cumulative effects of the proposal. The CEQ regulations, however, do not require agencies to catalogue or exhaustively list and analyze all individual past actions. Simply because information about past actions may be available or obtained with reasonable effort does not mean that it is relevant and necessary to inform decision making (40 CFR 1508.7).. is merely a listing of past present and foreseeable actions that have potential to overlap the project area. Because the project appears in this table does not necessarily mean it has an additive effect. Each resource specialist has reviewed this table and if there is a past, present, or foreseeable effect, it is disclosed in the individual resource area in Chapter 3.

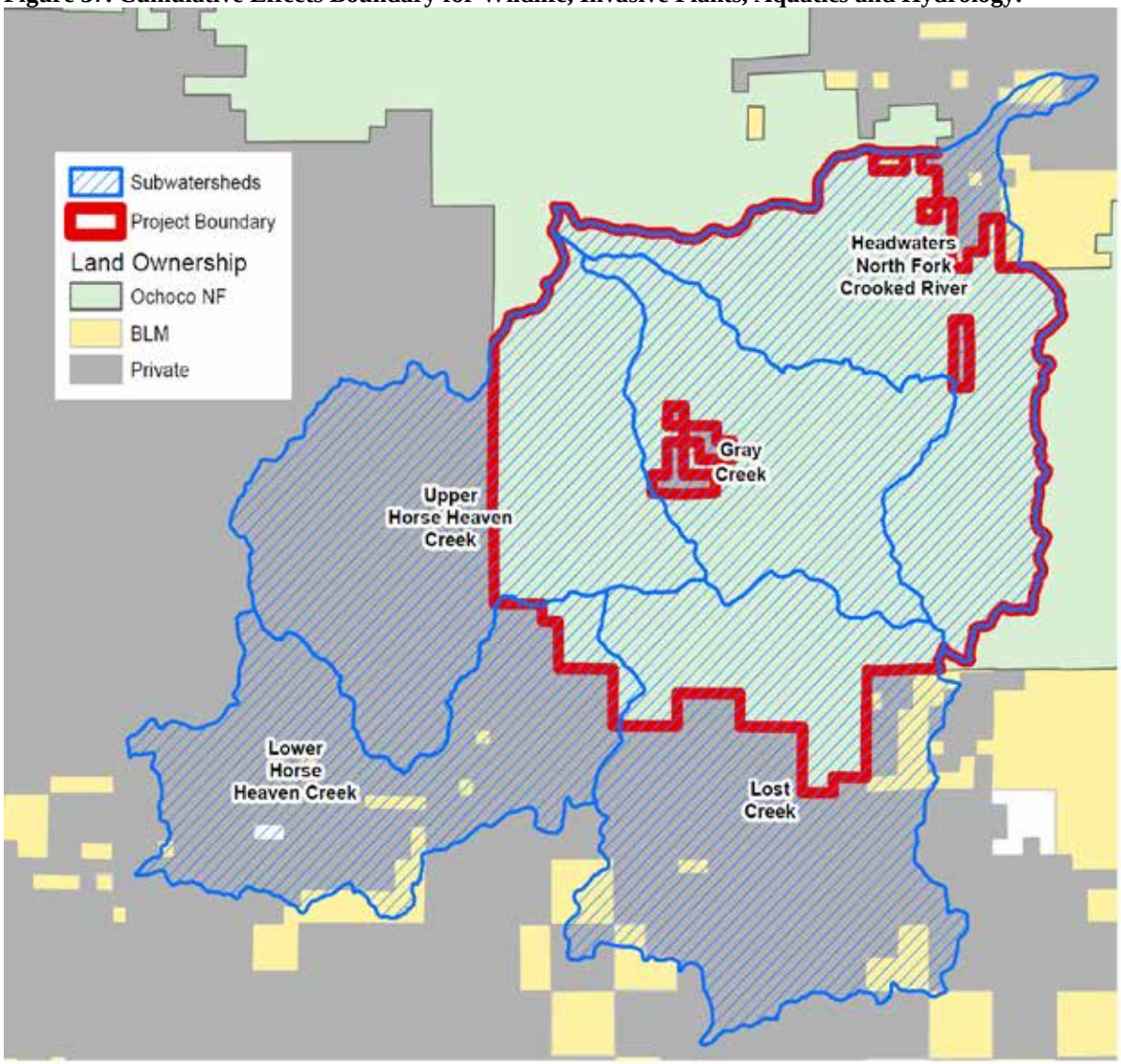
Past activities within the Gap project area are found in tables 22 and 23. Present and foreseeable future projects are found in table 167 below. The cumulative effects boundary for the Wildlife, Invasive Plants, Aquatics, and Hydrology reports is represented in figure 37 below.

Table 167. Projects that overlap with the Gap project area in space and/or time.

Project/ Activity	Description	Effects in the Gap project area	Status
Deschutes and Ochoco Invasive Plants EIS (2012)	Decision authorized treatment of invasive plants using chemical, manual and cultural method, as well as "early detection/rapid response" (EDRR) treatments of new weed populations.	Weed treatment has been ongoing and will continue in the project area; treatments appear to be successful in limiting populations. If new populations are discovered in the project area, EDRR may be successful in limiting or eradicating them.	Implementation
Deschutes and Ochoco Travel Management EIS (2011)	Decision permits motorized travel only on designated routes.	Decision precludes off-highway vehicles from travelling cross-country in the project area. Effects from such travel are still evident in the project area, and some illegal off-road use is still occurring.	Implementation
Big Summit AMP EIS (2009)	The decision reauthorized cattle grazing on three allotments, one of which has acreage within the Gap project area. The decision included adaptive management for livestock management, riparian restoration, water developments	Cattle distribution is expected to improve; riparian condition is expected to improve in localized areas; standards and guidelines for condition of upland and riparian range are expected to be met.	Implementation
Fox Canyon AMP EIS (2013)	The decision reauthorized cattle grazing on three allotments, three of which has acreage within the Gap project area. The decision included adaptive management for livestock management, riparian restoration, and water developments	Cattle distribution is expected to improve; riparian condition is expected to improve in localized areas; standards and guidelines for condition of upland and riparian range are expected to be met.	Implementation
South Boundary Road Closure	Establishes vehicular use restrictions on the southern end of the forest boundary, south of Big Summit Prairie	Improves habitat conditions for big game species.	Implementation
Nature Conservancy Juniper Hills Preserve	Approximately 13,920 acres, TNC will reduce fuels via thinning and RX on 2,860 acres from 2015-2018.	Improve juniper woodland habitat	Implementation
District Firewood Program	Allows for cutting of downed trees and lodgepole and juniper snags along approved Forest roads.	Downed tree and snag removal could reduce down wood and snag densities in designated firewood cutting locations within the Wolf project area.	Ongoing
Gray Prairie Fuels Reduction project CE (2009)	Implemented prescribed burning activities to reduce fuel loading.	Prescribed fire treatments planned in the Gray Prairie Fuels Project CE (2010) have been incorporated in the proposed treatments of all action alternatives and the effects are not analyzed as cumulative.	Completed

Project/ Activity	Description	Effects in the Gap project area	Status
Lookout Mountain Multi-use Trail Proposal	The project would create a 75.2 mile network of non-motorized multi-use trail on both existing and new trails. Approximately 22.3 miles overlap with the Gap project; 2.8 miles are new construction.	Create new recreational opportunities within the Gap project area.	Proposed
Private in-holdings	There are approximately 600 acres of private in-holdings in the Gap project area.	The majority of the land is utilized for cattle grazing.	Implementation

Figure 37. Cumulative Effects Boundary for Wildlife, Invasive Plants, Aquatics and Hydrology.



Other Required Disclosures

NEPA at 40 CFR 1502.25(a) directs "to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with …other environmental review laws and executive orders."

National Environmental Policy Act

NEPA establishes the format and content requirements of environmental analysis and documentation. The entire process of preparing the environmental impact statement was undertaken to comply with NEPA.

National Historic Preservation Act

Compliance with the National Historic Preservation Act falls under Section 106 of the Act, and it's implementing regulations 36CFR800. The Ochoco national forest is working under The Region 6 *Programmatic Agreement among the USDA Forest Service Region 6, the Advisory Council on Historic Preservation, And the Oregon State Historic Preservation Office*r (SHPO). For the Gap Landscape Restoration Project this included inventorying and locating Historic Properties that may be directly or indirectly affected by proposed activities. This included two inventories conducted in 2014 and 2015.The Gap Vegetation Management Cultural Resource report (R2014060702010) was submitted on June 24, 2015 to SHPO with a determination made under the terms of the 2004 Programmatic Agreement among the USFS R6, ACHP, and SHPO. The project complies with Section 106 of the National Historic Preservation Act under Stipulation III (B) 1 (Undertaking meets the criteria in the PA for a No Historic Properties Affected determination). The Addendum to the Gap Vegetation Management Cultural Resource report (R2015060701011) was submitted to SHPO on November 9th, 2015 with a determination made under the terms of the 2004 Programmatic Agreement among the USFS R6, ACHP, and SHPO. The project complies with Section 106 of the National Historic Preservation Act under stipulation III (B) 2 (Undertaking meets the criteria in the PA for a Historic Properties Avoided Determination). In addition to inventory letters describing the proposed action and requesting interagency consultation were mailed to the Confederated Tribes of the Warm Springs, the Burns Paiute Tribe and the Klamath Tribes on {June 4, 2015}; none of the Tribes submitted comments or concerns regarding religious or cultural sites in the project area.

Endangered Species Act

Biological Evaluations have been prepared to document possible effects of proposed activities on threatened and endangered species in the project area. There are no endangered species known or suspected to occur on the Ochoco National Forest. Threatened species that are known or suspected to occur on the Ochoco National Forest include bull trout, mid-Columbia River steelhead, and Canada lynx. On May 29, 2001 the Forest received concurrence from the U.S. Fish and Wildlife Service that implementation of any activities contained within the Forest Plan, as amended, is not likely to adversely affect the Canada lynx outside of an existing Lynx Analysis Unit. At the time this consultation took place there was, and continues to be, no Lynx Analysis Units existing on the Ochoco National Forest.

There would be no effect to bull trout.

Consultation with the U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration is not applicable for the Gap project area.

Clean Air Act

Both proposed alternatives are designed to be consistent with the Clean Air Act. The Oregon Department of Environmental Quality (DEQ) is responsible for assuring compliance with the Clean Air Act. In 1994, the Forest Service, in cooperation with DEQ, the Oregon Department of Forestry, and the BLM signed a Memorandum of Understanding to establish a framework for implementing an air quality program in Northeast Oregon. The Memorandum of Understanding includes a prescribed fire emission limit of 15,000 tons of PM-10 per year for the Malheur, Ochoco, Umatilla, and Wallowa-Whitman national forests.

All prescribed burning on these forests is coordinated with DEQ through the State of Oregon smoke management program. All prescribed fire treatments in the selected alternative would be conducted in compliance with the State of Oregon Smoke Management System and would meet smoke management objectives for total emissions.

Clean Water Act

The selected alternative would comply with the Clean Water Act, as amended. This Act establishes a non-degradation policy for all federally proposed projects. The selected alternative meets anti-degradation standards through project, application, and monitoring of BMPs. The EPA has certified the Oregon Forest Practices Act and regulations as BMPs. The State of Oregon has compared Forest Service practices with State practices and concluded that the Forest Service practices meet or exceed State requirements. Site-specific BMPs have been designed to protect beneficial uses. Chapter 2 lists the design criteria and resource protection measures that have been developed for all action alternatives. Chapter 3 documents the effects the proposed alternatives would have on streams listed on the 2012 State 303(d) list of Water Quality Limited Water Bodies for summer water temperature. These streams are Gray Creek, Horse Heaven Creek, Little Horse Heaven Creek, Lookout Creek, Lytle Creek, and the North Fork Crooked River. Implementation of either proposed action alternative should not result in any measurable increase in water temperatures to fish bearing or non-fish bearing streams in the project area. Commercial timber harvest and noncommercial thinning activities were designed so that they do not reduce shade. There is a possibility that conifer thinning in aspen stands would cause short-term reductions in shade. However, these slight reductions in shade should not result in any measurable increase in water temperature because the area affects is small. There is a potential to increase water temperature in intermittent non-fish bearing streams (Class IV) when they are flowing, but this should not result in a violation of state water quality standards because these streams go dry before peak water temperature occurs in the project area. Analysis determined that the cut-and-leave prescriptions along Gap project area streams that are authorized with this decision will limit access of livestock to project area streams, and therefore may reduce the amount of *E. coli* that is introduced to the creek through animal feces.

National Forest Management Act

To ensure consistency with the National Forest Management Act, the Ochoco National Forest Land and Resource Management Plan, as amended, was consulted. The Forest Plan contains several standards and guidelines that apply forest-wide or to specific management areas. Both forest-wide and management area specific standards and guidelines were reviewed. All alternatives were designed to be consistent with the Ochoco Forest Plan, except where noted in the following discussion. All of the action alternatives are consistent with long-term management objectives as discussed in the Forest Plan as amended. All alternatives are consistent with the seven management requirements listed in 36 CFR 219.29.

Forest Plan Amendment

Amendment #2: Cutting of Trees over 21 Inches in Diameter

In Alternative 3 the project proposes a site-specific amendment to the *Interim Eastside Screens Appendix B 6(2.a*) 'Maintain all remnant late and old seral and/or structural live trees greater to or equal to 21inches in diameter that currently exist within stands proposed for harvest activities." The proposed amendment would allow a timber sale to cut and remove trees greater than or equal to 21 inches in diameter in limited, specific locations.

Need for Amendment and the Change Being Proposed

The amendment is being proposed in Alternative 4 on 2,187 acres in order to move towards historic species compositions as well as increase the resiliency of existing old trees. It would be applied on dry mixed conifer sites where old ponderosa pine are under competitive stress from large grand fir and/or Douglas-fir which, although large, do not qualify as old trees. It would also be applied to remove grand-fir and/or Douglas-fir competition from aspen clones. Grand fir and Douglas-fir which qualify as old trees would not be removed. It is estimated that within the units where this prescription is applied there would be an average of 1 to 2 large trees/acre removed. Removal of large young trees (<150 years old) from the vicinity of old trees for approximately one canopy drip line of the old tree is consistent with the guidelines provided in *Restoration of Dry Forests in Eastern Oregon* (Franklin et al., 2013).

The proposal reflects the "*Criteria to Guide Decision-making on the Removal/Retention of Grand fir and Douglas-fir*" provided by the Ochoco Forest Restoration Collaborative for the Wolf project.

Management Indicator Species

Management Indicator Species (MIS) are discussed in Chapter 3 of the FEIS. The MIS discussion includes the Gap snag analysis. All activities associated with the action alternatives have been found to be consistent with the Ochoco National Forest Management Plan, as amended, for this category of species.

Compliance with INFISH

Project activities were designed to comply with INFISH (see tables 15 and 17 for unit-specific project design features in Alternatives 2 and 3, in Chapter 2 of this EIS). Moreover, the effects analysis disclosed in the "Hydrology and Aquatic Species" section of this EIS indicates that each action alternative is consistent with the Ochoco Forest Plan as amended by INFISH.

Chapter 4. Consultation and Coordination

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Glossary

Adverse Effects – INFISH defined adverse effects to fisheries as: Adverse effects include short- or long-term, direct or indirect management related impacts of an individual or cumulative nature, such as mortality, reduced growth, or other adverse physiological changes; harassment of fish; physical disturbance of redds; reduced reproductive success; delayed or premature migration; or other adverse behavioral changes. Adverse effects to designated critical habitat include effects to any of the essential features of critical habitat that would diminish the value of the habitat for the survival of native inland fish.

Albedo – A measure of reflectivity of the sun's radiation.

Alternative - In an EIS, one of a number of possible options for responding to the purpose of and need for action.

Arterial Road - Roads comprising the basic access network for National Forest System administrative and management activities. These roads serve all resource to a substantial extent, and maintenance is not normally determined by the activities of any one element. They provide service to large lands areas and usually connect with public highways or other Forest arterial roads to form an integrated network of primary travel routes. Usually they are developed and operated for long-term land and resource management purposes and constant service.

Basal Area – The area of the cross section of a tree stem including the bark, near its base, generally at breast height, or 4.5 feet above the ground.

Best Management Practices (BMPs) - Practices designed to prevent or reduce water pollution, including sedimentation.

Board Foot (bf) - A unit of wood that is 12 inches by 12 inches by 1 inch.

Canopy - In a forest, the branches from the uppermost layer of trees; in a shrub or grassland, the uppermost layer of shrubs; in a riparian area, the layers of vegetation that project over the stream.

Canopy Closure - The amount of ground surface shaded by tree canopies as seen from above. Used to describe how open or dense a stand of trees is, often expressed in 10 percent increments.

Closed Road - Generally local roads that are physically closed to public use.

Collector Road - Roads that serve smaller lands areas than a Forest arterial road, and usually connected to an arterial road or public highway. These roads collect traffic from local Forest roads and/or terminal facilities. The location and standard are influenced by both long-term multi-resource service needs, as well as travel efficiency. These roads may be operated for either constant or intermittent service, depending on land use and resource management objectives for the area.

Compaction - Packing together soil particles by exerting force at the soil surface and increasing soil density. Making soil hard and dense, decreasing its ability to support vegetation because the soil can hold less water and air and because roots have trouble penetrating the soil.

Connectivity - The arrangement of habitats that allows organisms and ecological processes to move across the landscape; patches of similar habitats are either close together or linked by corridors of appropriate vegetation.

Cover - (1) Trees, shrubs, rocks, or other landscape features that allow an animal to partly or fully conceal itself. (2) The area of ground covered by plants, litter, and coarse fragments, including tree crowns and shrubs that are in direct contact with the ground.

Cultural Resources - The remains of sites, structures, or objects used by humans in the past. They may be historic, prehistoric, archaeological, or architectural in nature.

Cumulative Effects **-** Impacts on the environment that result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.

Decommissioned Road **-** A road that is no longer needed and is not planned to be used again. It has been closed and generally has been returned to production. For example, a road that has been ripped (tilled) and planted with vegetation.

Density (stand) **-** The number of trees growing in a given area, usually expressed in terms of trees per acre.

Developed Recreation **-** Recreation that requires facilities that in turn result in concentrated use of an area; for example, a campground.

Direct Effects **-** Impacts on the environment that are caused by an action and occur at the same time and place.

Dispersed Recreation **-** Recreation that does not occur in a developed recreation sites; for example, hunting or backpacking.

Eastside Screens (aka Regional Forester's Interim Direction Establishing Riparian, Ecosystem and Wildlife Standards for Timber Sales) **-** Originally signed in 1994 and amended in 1995. The objective of this direction was to provide an approach for maintaining future planning options concerning wildlife habitat associated with late and old structural stages, fish habitat, and old forest abundance. The direction was intentionally restrictive, reflecting a conservative interpretation of riparian, wildlife, and ecosystem needs for the short term. The direction applies to timber sales.

Ecosystem **-** A complete, interacting system of living organisms and the land and water that make up their environment; the home places of all living things, including humans.

Endangered Species **-** A plant or animal species listed under the Endangered Species Act that is in danger of extinction throughout all or a significant portion of its range.

Endangered Species Act (ESA) **-** An act, passed by Congress in 1973, that directed all Federal departments and agencies to seek to conserve endangered and threatened species. Actions authorized, funded, or carried out by Federal departments and agencies should not jeopardize the continued existence of any threatened or endangered species or result in the destruction or adverse modification of their critical habitat. The act also mandates conferencing with the appropriate agencies.

Environment **-** The combination of external physical, biological, social, and cultural conditions affecting the growth and development of organisms and the nature of an individual or community.

Environmental Impact Statement (EIS) **-** A statement of environmental effects of a proposed action and alternatives to it. A Draft EIS is released to the public and other agencies for review and comment. A Final EIS is issued after consideration of public comments. A Record of Decision (ROD) is based on the information and analysis in the Final EIS.

Fire Regime **-** The characteristics of fire in a given ecosystem, such as the frequency, predictability, intensity, and seasonality of fire. Fire regimes can be grouped into three severity regimes: Nonlethal, Mixed, and Stand Replacement. Nonlethal fires are of low to moderate intensity, creeping, surface fires that consume primarily understory grasses, forbs, and shrubs, and leave the overstory trees intact. Stand replacement fires are of high intensity and consume most of an existing stand. Mixed fires are of moderate intensity and consume the understory and some of the overstory.

Forest Plan (Land and Resource Management Plan) **-** A document that guides natural resource management and establishes standards and guidelines for a National Forest; required by the National Forest Management Act.

Fragmentation (habitat) **-** The breakup of a large land area (such as a forest) into smaller patches isolated by areas converted to a different land type. The opposite of connectivity.

GIS (Geographic Information System) **-** An information processing technology to input, store, manipulate, analyze, and display data; a system of computer maps with corresponding site-specific information that can be combined electronically to provide reports and maps.

Ground Cover **-** Perennial vegetation plus litter and coarse fragments (greater than 2 mm sizes), including tree crowns and shrubs, that are in direct contact with the ground. Based on the erosion hazard class, ***effective ground cover*** is between 20% and 75% of the ground covered the first year after management activities.

Habitat **-** A place that provides seasonal or year-round food, water, shelter, and other environmental conditions for an organism, community, or population of plants or animals.

Headcut – a characteristic of a stream where bank instability and increased water yields have resulted in an entrenched gully that migrates upstream as the stream abandons its associated floodplain.

Hydrologically Closed Road **-** A road that has been modified to remove water as soon as possible off the road surface to facilitate infiltration into the soil. Generally, sidecast materials and culverts will be removed; relief drainage will be provided to prevent resource damage if culverts plug or fail; and a closure device (barricade, earthen berm, logs, rocks, gates, etc.) will be installed at the entrance.

Hydrologically Stablized Road **-** A road that has been modified to remove water as soon as possible off the road surface to facilitate infiltration into the soil. Generally, sidecast materials and unstable landings will be removed and relief drainage will be provided to prevent resource damage if culverts plug or fail.

Inactivated Road **-** A road that is managed in a stored or closed category for long-term intermittent use. Generally, a single purpose type road that remains open to motorized off-highway vehicles. An inactivated road can be hydrologically stabilized or hydrologically closed.

Indirect Effects **-** Impacts on the environment that are caused by an action and are later in time or farther removed in distance.

Interdisciplinary Team (IDT) **-** A team of people that collectively represent several disciplines and whose duty it is to coordinate and integrate the planning process.

Intermittent Stream **-** A stream that flows only at certain times of the year when it receives water from other streams or from surface sources such as melting snow.

Irretrievable **-** A category of impacts that applies to losses of production or commitment of renewable resources. For example, while a linear piece of land is being used as a road, some or all of the timber production there is irretrievably lost. If the road was rehabilitated after use and soil compaction was reduced, timber production could resume; therefore, the loss of timber production during the time the road was in use is irretrievable but not irreversible, because it is possible for timber production to resume if the piece of land is no longer used as a road.

Irreversible **-** A category of impacts that applies to non-renewable resources, such as minerals and archaeological sites. Losses of these resources cannot be reversed. Irreversible effects can also refer to effects of actions on resources that can be renewed only after a very long period of time, such as the loss of soil productivity.

Issue **-** A matter of controversy, dispute, or general concern over resource management activities or land uses. To be considered a "key" EIS issue, it must be well defined, relevant to the proposed action, and within the ability of the agency to address through alternative management strategies.

Ladder fuels - Vertical fuels are called ladder fuels. These are trees in the forests understory which provide a ladder for fire to move from the forest floor to the forest overstory.

Late and Old Structure (LOS) - Late and old structure forested stands. See Late Successional and Old Structured.

Late Successional - Forest late seral stages wherein shade tolerant species begin to occupy codominant and eventually dominant positions in the canopy. Most standing dead and down material is small to medium sized, but some mature and recently overmature overstory trees have recently died and are developing as snags. Specific definitions are dependent on current and potential vegetation composition and arrangements.

Local Road - Local roads are usually one-lane roads constructed to serve a dominant use or resource. Local roads do not access large land areas since they are more site-specific than arterial and collector roads.

Management Direction - A statement of goals and objectives, management prescriptions, and associated standards and guidelines for attaining them.

Management Indicator Species (MIS) - Vertebrate species whose population changes are believed to best serve as an index of a biological community's response to the effects of land management activities or which are important for fishing, hunting, and trapping.

Multiple Use Management - The management of public lands and their various resource values so they are used in a combination that best meets the present and future needs of the public.

National Environmental Policy Act (NEPA) - An act, passed by Congress in 1969, that declared a national policy to encourage productive harmony between humans and their environment. This act requires the preparation of environmental impact statements for Federal actions that are determined to be of major significance. (See 40 CFR [Code of Federal Regulations] 1500-1508 for implementing regulations. See also FSH [Forest Service Handbook] 1909.15, the FS Environmental Policy and Procedures Handbook.)

National Forest Management Act (NFMA) - An act, passed by Congress in 1976, that amends the Forest and Rangeland Renewable Resources Planning Act. The act requires the preparation of Forest plans and regulations to guide that development. (Implementing regulations are codified at 36 CFR 219.)

No Action Alternative - The most likely condition expected to exist in the future if current management direction were to continue unchanged.

Obliterated Road - see Decommissioned Road.

Old Growth Management Area - Management area or allocation in the Land and Resource Management Plan intended to provide habitat for old growth associated species.

Old Structure - A forest stand dominated by large trees with early to late seral species compositions. There may be multiple or single canopy layers, dependent on the plant association group and site potential.

Overstory - The upper canopy layer.

Perennial - A plant that lives for three or more years.

Perennial Stream - A stream that flows water year round.

Plant Association Group (PAG) - A group of plant associations that share similar productivities, disturbance regimes, and responses to disturbance. Eight major plant association groups have been described on the Ochoco National Forest.

Preferred Alternative **-** The alternative identified in a draft environmental impact statement which has been initially selected by the agency as the most acceptable resolution to the problems identified in the purpose of and need for action.

Proposed Action **-** A proposal made by the Forest Service to authorize, recommend, or implement an action on National Forest System lands to meet a specific purpose and need.

Record of Decision (ROD) **-** A document, based on information disclosed in a final environmental impact statement, that identifies the alternative chosen, mitigation and monitoring measures to be implemented, and other information relative to the decision.

Riparian Area **-** An area with distinctive soil and vegetation between a stream or other body of water and the adjacent upland; includes wetlands and those portions of floodplains and valley bottoms that support riparian vegetation.

Riparian Habitat Conservation Area (RHCA) **-** A portion of a watershed where riparian-dependent resources receive primary emphasis, and management activities are subject to specific standards and guidelines. RHCAs include traditional riparian corridors, wetlands, intermittent streams, and other areas that help maintain the integrity of aquatic ecosystems by (1) influencing the delivery of coarse sediment, organic matter, and woody debris to streams, (2) providing root strength for channel stability, (3) shading the stream, and (4) protecting water quality. The following Categories of Riparian Habitat Conservation Area have been established by INFISH:

Category 1: **Fish-bearing streams:** Interim RHCAs consist of the stream and the area on either side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of two site-potential trees, or 300 feet slop distance (600 feet, including both sides of the stream channel), whichever is greatest.

Category 2: Permanently flowing non-fish bearing streams: Interim RHCAs consist of the stream and the area on either side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of one site-potential tree, or 150 feet slope distance (300 feet, including both sides of the stream channel), whichever is greatest.

Category 3: Ponds, lakes, reservoirs, and wetlands greater than 1 acre: Interim RHCAs consist of the body of water or wetland and the area to the outer edges of the riparian vegetation, or to the extent of the seasonally saturated soil, or the extent of moderately and highly unstable areas, or to a distance equal to the height of one site potential tree, or 150 feet slope distance from the edges of the maximum pool elevation of constructed ponds and reservoirs from the edge of the wetland, pond or lake, whichever is greatest.

Category 4: Seasonally flowing or intermittent streams, wetlands less than 1 acre, landslides, and landslide-prone areas: This category includes features with high variability in size and site-specific characteristics. At a minimum the interim RHCAs must include:

a. the extent of landslides and landslide-prone areas,

b. the intermittent stream channel and the area to the top of the inner gorge,

c. the intermittent stream channel or wetland and the area to the outer edges of the riparian vegetation,

d. for Priority Watersheds, the area from the edges of the stream channel, wetland, landslide, or landslide-prone area to a distance equal to the height of one site-potential tree, or 100 feet slope distance, whichever is greatest,

e. for watersheds not identified as Priority Watersheds, the area from the edges of the stream channel, wetland, landslide, or landslide-prone area to a distance equal to the height of one-half site potential tree, or 50 feet slope distance, whichever is greatest.

Scoping - The early stages of preparation of an environmental assessment or environmental impact statement used to solicit public opinion, receive comments and suggestions, and determine the issues to be considered in the development and analysis of a range of alternatives. Scoping may involve public meetings, telephone conversations, mailings, letters, and other contacts.

Sensitive Species - Species identified by a Regional Forester for which population viability is a concern either (a) because of significant current or predicted downward trends in population numbers or density, or (b) because of significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

Seral Stage - A stage in the progression of an ecosystem from initial development to maturity; an age, structure, and development classification for a biological community.

Silviculture - The practice of manipulating the establishment, composition, structure, growth, and rate of succession of forests to accomplish specific objectives.

Species - A population or series of populations of organisms that can interbreed and reproduce freely with each other but not with members of other species.

Stand - A group of trees in a specific area that are sufficiently alike in composition, age, arrangement, and condition to be distinguishable from the forest in adjoining areas.

Stream Class - A classification system for streams according to their beneficial uses. **Class I** are perennial or intermittent streams containing one or more of the following characteristics: (1) are the direct source of water for domestic use; and/or (2) are used by large numbers of fish for spawning, rearing, or migration. **Class II** are perennial or intermittent streams containing one or more of the following characteristics: (1) are used by moderate numbers of fish for spawning, rearing, or migration; and/or (2) if fish are not present then flow enough water to have a moderate influence on downstream quality of a Class I or II stream. **Class III** are all other perennial streams not meeting Class I or II definitions. These streams are normally spring fed or have a length greater than 1¼ miles. No fish present due to gradient (steep) or physical or biological barriers. **Class IV** are streams with intermittent flow, defined channel and less than 1¼ mile in length. No fish are present or spring fed sources.

Subwatershed - An area mostly bounded by ridges or other similar topographic features contributing water, organic matter, dissolved nutrients, and sediments to a lake or stream.

Succession - A series of dynamic changes by which one group of organisms succeeds another through stages leading to potential natural community or climax. An example is the development of series of plant communities (called seral stages) following a major disturbance.

Surface fuels - Horizontally arranged fuels are called "surface" fuels. These are trees and other vegetation on the ground surface.

Threatened Species - Species listed under the Endangered Species Act that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

Understory - Grass, small trees, shrubs, and other plants found beneath the overstory.

Uneven-aged Stand - A stand of trees in which there are considerable differences in the ages of individual trees.

Unroaded Area - An undeveloped area of land where there are no improved roads for travel by means of motorized vehicles intended for highway use.

Viable Ecosystems Management Guide **-** A system to classify vegetation on a landscape basis. This system compares existing vegetation with site potential. It focuses on relationships between combinations of vegetation structure and species composition, and habitat requirements for animals, insects, and plants. This guide was devised by the Ochoco National Forest Viable Ecosystem Quality Action Team. The Viable Ecosystems Management Guide describes a seral/structural matrix for characterizing forest vegetation by plant association groups (PAGs). Each plant association group is further characterized by seral and structural stages. There are three seral stages: E (early), M (middle), and L (late). There are five structural stages: 1 (grass/forb/shrub), 2 (seedling and sapling, trees less than 4.9 inches dbh), 3 (pole, trees between 5 and 8.9 inches dbh), 4 (small, trees between 9 - 20.9 inches dbh), and 5 (medium and large, trees greater than 21 inches dbh). The seral/structural classification is based on the dominant vegetative features on the site.

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Appendix A. Explanation of Activities

Timeline

Based on the timelines of previous projects on the Ochoco, natural fuels underburning and thinning with fire in the Gap project area would occur over the next 10 years, depending on climate and workload. Activity fuels burning would also occur over the next 10 years, depending on when commercial and noncommercial thinning occurs.

Silvicultural Treatments

Various silvicultural treatments are being proposed to meet the vegetative objectives for the area and move the landscape towards the historic condition. They have been proposed to meet stand specific conditions including density, species composition, and stand structure. Often two or more treatments, for example commercial thinning (harvest) followed by noncommercial thinning, is prescribed for the same unit. The major emphasis of the silvicultural treatments would be to:

1. Maintain existing large (21”+ dbh) trees of fire tolerant species and accelerate the development of additional large fire tolerant trees.
2. Maintain existing old growth trees, especially ponderosa pine.
3. Reduce stand densities to increase tree vigor, reduce susceptibility to disturbance agents (insects, disease, and fire) and move towards historic conditions.
4. Select for species compositions that are closer to what occurred historically.
5. Increase the amount of acres in single strata stand structure.

Commercial thinning: This prescription would be used in overstocked stands with a surplus of merchantable sized trees between 7 and 20.9 inch DBH. Current stand conditions often include multiple canopies, a component of large (21+” DBH) trees, and dense stocking and may include all seral stages. The stands would be thinned, on average, to recommended stocking levels while retaining variable densities across the unit. Merchantable trees up to 20.9 inch DBH removed in a commercial thinning would be sold and removed from the stand. Following the commercial thinning most stands would be noncommercially thinned and the thinning slash would be treated, in most cases by prescribed fire. All of these treatments work together to attain the desired stand condition where future prescribed burning can safely be used as a forest management tool that mimics the role that fire historically had in these forests.

Variable density thinning prescriptions would be utilized in all units. Typically, variable density prescriptions, in use for the past several projects on the Ochoco National Forest, have resulted in a mixture of individual trees, small clumps, and leave areas (skips) as well as the creation of small openings (or gaps). Skips and gaps usually amount to about five to ten percent of each unit respectively. Skips often occur around unique habitat features such as seeps or rock outcrops, or to preserve areas with high levels of downed logs, snags, or dense cover. Gaps often are placed to enhance natural openings or to remove undesired trees such as heavily mistletoe-infected understories. Gaps of up to 2 acres may be created in some units to promote regeneration of early seral species such as larch where these were removed in past harvest. The proposed variable density thinning is intended to generally follow the guidelines provided in *Restoration of Dry Forests in Eastern Oregon* (Franklin et al., 2013).

These treatments can create immediate stand structure and species composition shifts to that of a single-strata stand with early seral species composition because the treated stands would no longer be dominated by a dense understory and trees that are removed tend to be mid and late seral species. Overall, species diversity would be retained after harvest, but the proportion of early seral/fire tolerant species would increase. Most treated stands would retain some irregular or uneven-aged structure and age distribution, resulting from some clumps of trees remaining un-thinned or small gaps up to 2 acres being created. Remaining large trees would become more vigorous following the harvest since between-tree competition would be reduced. The increased growth rates in retained trees would eventually augment the number of large diameter trees, helping to increase the amount of late and old structure. Post-harvest residual basal area per acre would be approximately 30 to 60 square feet on drier sites (pine and Douglas-fir) and 50 to 100 square feet on more mesic sites (grand fir). Residual basal area per acre could exceed 100 square feet if numerous trees larger than 21 inches DBH or old growth trees are already present.

Recommended stocking levels vary depending on site quality, tree size and species. For example, the desired density range for an uneven-aged ponderosa pine stand on a grand fir-pinegrass site is 89 to 133 trees per acre when the average diameter is 10 inches DBH and the corresponding basal area would be between 49 and 73 square feet per acre. If the average diameter were larger, then fewer trees would be retained but the residual basal area would increase. Fewer trees would be retained on drier sites relative to moister sites. Recommended stocking levels are derived from "Suggested Stocking Levels for Forest Stands in Northeastern Oregon and Southeastern Washington: An Implementation Guide for the Umatilla National Forest" (Powell, 1999).

No live trees 21 inch DBH or larger or dead trees (snags) would be removed in commercial thinning units except for those which are safety hazards. Hazardous trees and snags which are within Riparian Habitat Conservation Areas would be felled but not removed.

Commercial thinning within RHCAs would include the felling of trees to provide large in-channel wood where this habitat feature is lacking or absent. Site specific large wood requirements have been developed on a unit by unit basis to meet INFISH RMOs. Trees which could contribute to large wood requirements would not be removed until down wood requirements are met.

Commercial thinning prescriptions would also require that trees with old tree characteristics be retained, regardless of size or condition. Identification of old trees is based on tree characteristics discussed in *Identifying Old Trees and Forests in Eastern Washington* (Van Pelt 2008). These include bark characteristics, branching structure, and crown form.

Commercial thinning with 21"+ trees: This prescription is similar to commercial thinning except that harvest would include the removal of some trees 21" DBH or larger. This treatment is proposed to help restore historic species compositions as well as increase the resiliency of existing old trees. It would be applied on mixed conifer sites where there are old ponderosa pine that are under competitive stress from large grand fir and/or Douglas-fir which, although large, do not qualify as old trees. Grand fir and Douglas-fir which qualify as old trees would not be removed. It is estimated that within the units where this prescription is applied there would be an average of 1 to 2 large trees/acre removed. Large young trees would be removed if they are within one dripline distance (not to exceed) from an existing large old ponderosa pine. This is within the parameters of the guidelines provided in *Restoration of Dry Forests in Eastern Oregon* (Franklin et al., 2013).

Noncommercial thinning: The objective of this treatment is to reduce the amount of small non-merchantable trees (generally less than 9 inches DBH), or young junipers (up to 20.9 inches DBH). No trees meeting old tree criteria would be felled during these operations. The number of small trees to be left varies by stand conditions, depending on the overall stocking objectives and the amount of existing overstory. Where the objective in the stand is to have single-storied LOS and many large diameter trees exist, then few small understory trees would be retained (40 or less per acre). Where few overstory trees exist, such as in young plantations, then the noncommercial thinning could retain 135 or more small trees per acre. Species selection usually retains ponderosa pine, western larch, and sometimes Douglas-fir, or removes species infected with or susceptible to insects/disease. Noncommercial thinning can occur either following a commercial entry or as the only treatment. Trees felled during this activity are usually left on site and the slash treated by a variety of fuels treatments. Approximately 460 acres of noncommercial thinning would occur in existing plantations. Within these units, thinning may include girdling/killing of remnant overstory trees infected with dwarf mistletoe. This would create snags and prevent the spread of dwarf mistletoe to susceptible young trees. Within RHCAs trees up to 9.0 inches DBH may be felled into or towards stream channels and left intact. These thinning treatments would be designed to enhance hardwoods, by reducing competition of conifers and would provide woody debris and roughness to meet site specific RHCA prescriptions.

Noncommercial thinning in unit 370 (Alternative 2 and 4) would be designed to enhance and release existing mountain mahogany. Trees up to 9.0 inches DBH would be removed from within 20 feet of existing mahogany plants, in an effort to reduce competition for light and moisture. Trees would be felled and left to protect existing mahogany plants from potential browse damage. Underburning would avoid patches of mahogany, to the extent feasible.

Within seven proposed units (Units 118, 158.1, 179.2, 235.1, 374.1, 374.2 and 392) in Alternative 2 and 4, trees up to 20.9 DBH may be cut down or may be pushed or pulled over with low impact machinery (such as a walking excavator). The trees would be used as structures in the head-cut repair/stream restoration units.

Noncommercial hardwood treatments: These treatments are designed to enhance hardwood species such as aspen, willow, alder, and cottonwood. In addition, where noncommercial thinning is proposed within RHCA's, they would be designed to reduce competition by cutting down and/or girdling conifers that have encroached into hardwood communities. These conifers are often shading out the desirable hardwoods as well as occupying limited growing space. Conifers up to 16 inch DBH may be felled or girdled so long as they do not qualify as old trees. Conifer thinning would take place for an approximate distance of 75 feet from hardwoods to allow for sufficient sunlight, water, nutrient and growing space to be available.

Slash generated from this noncommercial activity would be left intact to provide protection to the hardwoods, lopped and scattered, or handpiled. Cut trees may also be felled or placed into stream channels for stream restoration purposes. To prevent browsing on hardwood seedlings and saplings, some form of protection, such as fencing or individual cages, may be installed. In some stands livestock fencing may be installed, in others big game fencing may be required. The type of fence needed would be determined on a site specific basis once implementation is underway. In some instances the cut conifers may be of sufficient size that they can be utilized to provide the protection needed. When aspen clones are encountered in stands that are planned for commercial harvest or noncommercial thinning, the silvicultural prescription would be modified within and adjacent to the clone to promote the retention and growth of aspen. Conifers up to 20.9 inches dbh in commercial units and up to 9.0 inches dbh in noncommercial units would be removed within a distance of one tree height from the aspen.

Head-cut repair/steam restoration projects have been proposed in conjunction with some hardwood restoration units to stop continued stream channel down-cutting and stabilize water tables where this is one cause of hardwood and riparian vegetation decline. For example in unit 235 up to 100 trees may be cut or pushed/pulled over to be used as stream structure material. These trees would range up to 20 inches in diameter. Tree selection would be coordinated with the wildlife biologist and Silviculturist so that wildlife habitat needs and silvicultural objectives are met or enhanced.

Juniper cutting: This noncommercial treatment (Unit 371) is primarily proposed to reduce juniper density. Younger junipers, up to 20.9 inch DBH would be cut and the slash would be lopped and scattered or left intact. Where other conifer species are encountered, trees up to 9.0 inches DBH would be removed at a specified spacing. Old trees would be retained, regardless of size. Concentrations of slash would be burned. Burning is expected to occur in patches as a continuous fuel bed of slash is not anticipated due to the low density of juniper. The vegetative objective of this treatment is to reduce juniper density and increase the amount of area that is dominated by grass and shrub vegetation.

The prescriptions for the juniper cutting would require that junipers with old tree characteristics be retained, regardless of size. Identification of old junipers is based on tree characteristics similar to those discussed in *Biology, Ecology and Management of Western Juniper* (Miller et al. 2005) and summarized in *Western Juniper Management: A Field Guide* (Barrett 2007). These include crown form, branching structure, bark, and decadence.

Fuels Definitions and Treatments

Natural Fuels Underburning would reduce naturally occurring debris on the forest floor and seedlings and saplings, maintaining low intensity fire conditions in stands that have been previously treated or in stands that are closely representative of their Historic Range of Variability (HRV).

Activity Fuels Underburning would reduce the forest debris (slash) from commercial and noncommercial thinning.

Grapple Piling of activity fuels with equipment is proposed in harvest units where post thinning fuel load would be too heavy to burn without damaging the residual stand. GP would occur on less than 35% slopes with equipment utilizing existing skid trails. Piled fuels would be burned outside of typical fire season.

Hand Piling would occur in non-harvested units, where equipment use is not desirable, or along property boundaries to reduce the risk of fire spread onto private property. Piles would be burned outside of typical fire season.

Juniper Jackpot Burning would dispose of concentrations of juniper slash from noncommercial thinning under cool conditions when soils and adjacent fuels are wet or frozen to reduce the risk of spread onto private property.

Landing piles are a product of commercial harvest using whole tree yarding. The footprint of landing piles in a unit where whole trees were yarded disturbs considerably less soil than in a grapple pile unit.

Prescribed Fire is the application of fire in pre-determined patterns and conditions in order to produce desired flame lengths, rates of spread, and fire effects. The combination of environmental conditions used to determine when to burn is called a “fire prescription”.

The general objectives of prescribed fire are:

• To lessen the severity, resistance to control and cost of future wildfires by reducing natural fuels (naturally occurring forest debris), activity fuels (thinning slash) and ladder fuels (seedlings and saplings).

• To maintain forest health, reducing seedlings and saplings to maintain open stands, promoting fire tolerant species (ponderosa pine, western larch Douglas fir), and reducing fire intolerant species (western juniper, grand fir).

• To increase the quantity and vigor of native grasses, forbs and shrubs.

Firelines (fuel breaks) are needed to control fire spread. Roads or natural fuel breaks are used where possible.

Handline is fireline constructed using handtools, and consists of clearing a 5-10 foot wide path of seedlings, saplings, brush and downed woody debris, and removing ground fuels (litter and duff layer) down to mineral soil, 1-3 feet wide.

Fire Hazard is a fuel complex defined by kind, arrangement, volume, condition, and location that form a special threat of ignition and resistance to control. For this analysis, a combination of flame length and crown fire potential is used to estimate fire hazard, demonstrating the potential level of loss of ecosystem components from uncharacteristic wildfire. This is based on vegetative (fuel) conditions and the resulting fire effects that could be expected from a fire burning in the 97th percentile weather conditions.

Appendix B. Soil Disturbance

Table B-1 summarizes unit-by-unit soil disturbance effects by harvest and alternative. All listed treatment units would have a ground based tractor logging system to commercially harvest (HTH) or source large woody debris for stream restoration (NCT).

Units with existing levels of soil disturbance over 20% may need tillage restoration activities to prevent levels from increasing and exceeding LRMP and R6 Standards and Guidelines. The total amount necessary would depend on the efficiency of skid trail and landing re-use during this entry. Potential tillage acres were identified as 4% of acreage in units with 20-29% existing soil disturbance and ash soils amenable to tillage. Approximately 347 acres of primary skid trails and landings were identified for potential tillage within proposed harvest units across all three action alternatives.

Table B-1. Soil disturbance by alternative.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
1.1	60	L3	HTH	HTH	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
3	12	L2	HTH	HTH	HTH	20-29	mod	0	20-29	Utilize existing disturbance, no net increase over 29%. Till 0.5acres. Meets standard.
4	64	L2	HTH	HTH	HTH	20-29	mod	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
6	13	M1	NCT	NCT	NCT	10-20	mod	0	20	Utilize existing disturbance for designated skid trails. Till primary skid trail and access routes. Meets standard.
10	7	P type	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
11	67	T3, P5, P2	HTH	-	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
12.1	101	P8, P2	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
12.3	30	P2	HTH	HTH	HTH	10-20	high	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
13	151	P32	HTH	-	HTH	20-29	low	6	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
13.1	104	P3, P2	-	HTH	-	20-29	mod	0	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
14	152	P3, P2	HTH	HTH	HTH	10-20	mod	0	20	Stay on existing disturbance, no net increase.Till 1 acre. Meeds S&Gs.
15	23	P8	HTH	HTH	HTH	20-29	low	1	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
16.1	145	P2, P8	HTH	HTH	HTH	20-29	mod	6	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
17.1	110	P8, P2	HTH	HTH	HTH	10-20	low	0	20	Designated skid trail/landing layout would keep unit below 20%. Meets standard.
18.1	31	P2, P8	HTH	HTH	HTH	10-20	mod	0	20	Designated skid trail/landing layout would keep unit below 20%. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
19	46	T3	HTH	-	HTH	20-29	low	2	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
19.1	37	T3	-	HTH	-	20-29	low	1.5	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
20	127	Y2, P2	HTH	HTH	HTH	20-29	high	5	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
21	166	Y3, P2	HTH	HTH	HTH	20-29	mod	7	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
22	149	P types	HTH	HTH	HTH_21	10-20	low	0	20	Skid trail/landing layout would keep unit below 20% Det. Soil conditions and meet S&Gs.
23	123	P types	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
24	60	Y2, P8	HTH	HTH	HTH_21	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
25	162	Y3, P2	HTH	HTH	HTH_21	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
26.1	47	P8	HTH	HTH	HTH	20-29	low	2	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
26.2	35	Y2, Y3	HTH	HTH	HTH	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
27	60	P8	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
28	45	T3	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
31.2	6	P8	HTH	-	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
32.1	52	P2, Y2	HTH	HTH	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
32.3	10	P2	HTH	HTH	HTH	10-20	high	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
32.5	9	P3	-	HTH	-	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
33	43	P2	HTH	HTH	HTH	20-29	high	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
34.1	51	T3	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
37.2	14	T3	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
37.3	102	T3	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
38	58	T3	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
40	146	Y3, T3	HTH	HTH	HTH	20-29	low	6	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
41.1	99	P8, P5	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
44	66	P2, P53	HTH	-	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
44.2	5	P2, P53	-	HTH	-	10-20	mod	0	20	Stay on existing trails. No net increase. Till 1 acre. Meets standard.
44.3	6	P2, P53	-	HTH	-	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
44.4	24	P2, P53	-	HTH	-	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
45	16	P53	HTH	HTH	HTH	20-29	low	1	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
46.1	18	P53	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
46.3	60	P53	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
47	25	P2, P53	HTH	-	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
49	81	Y3, P2 and L3	HTH	-	HTH	20-29	mod	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
50	68	P3	HTH	HTH	HTH	20-29	low	3	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
51	4	P3, P2	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
52	33	P3, P5	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
53	26	L3	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
54	53	Y3	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
55.1	20	L3	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
57	37	L3, P2	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
58	133	P3, P2 and Y3	HTH	-	HTH	20-29	low	5	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
58.1	95	P3, P2	-	HTH	-	20-29	low	4	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
59	82	P2, P53	HTH	HTH	HTH	20-29	mod	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
60	44	P2, P53	HTH	HTH	HTH_21	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
61	128	P8, P2	HTH	-	HTH_21	20-29	low	5	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
62.1	98	P35, P2	HTH	-	HTH_21	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
62.2	14	P8, P2	HTH	-	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
65.1	65	P8, P5	HTH	-	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
66	109	P8, P5	HTH	HTH	HTH	20-29	low	4	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
67.1	57	P58, P2	HTH	-	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
68	31	P8	HTH	HTH	HTH	20-29	low	1	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
69	150	P58	HTH	-	HTH	20-29	low	6	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
70	5	P5	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
71	117	P58, P8	HTH	-	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
72.1	42	P58, P5	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
73.1	37	P8	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
73.3	75	P3, P8	HTH	HTH	HTH	20-29	low	3	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
80	44	P3, P8	HTH	-	HTH_21	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
82	13	P8, P5	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
83	23	P8, P5	HTH	HTH	HTH_21	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
84	30	P8	-	-	HTH_21	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
85	92	P58, P5	HTH	HTH	HTH_21	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
87.1	23	P58, P5	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
88	135	P2, P8 and P58	HTH	HTH	HTH	20-29	mod	5	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
89	89	P8, P5	HTH	HTH	HTH_21	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
90	43	P8, P2	HTH	HTH	HTH	20-29	low	2	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
91	67	P8, P5	HTH	-	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
92	70	P2, P8 and P58	HTH	-	HTH	20-29	mod	3	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
93	38	P3, P5	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
94.1	33	P3, P5	HTH	HTH	HTH	20-29	low	1	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
95.1	54	P35	HTH	HTH	HTH	20-29	low	2	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
96.1	85	P35	HTH	HTH	HTH	20-29	low	3	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
96.2	33	P35	HTH	HTH	HTH	20-29	low	1	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
97	106	P3, P5	HTH	HTH	HTH	20-29	low	4	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
98	108	P3	HTH	-	HTH	20-29	low	4	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
99	68	P3	HTH	-	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
100	51	P3	HTH	-	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
101.1	115	P3	HTH	-	HTH	20-29	low	5	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
101.2	25	P2, Y3	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
102	101	L2; C2 and P8	HTH	HTH	HTH_21	10-20	high	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
104	32	L2, P2	HTH	HTH	HTH	10-20	high	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
105	121	P3, P2	HTH	HTH	HTH	20-29	low	5	20-29	Low tillage potential. Utilize existing disturbance, no net increase over 29%. Meets standard.
107	86	P2, P32	HTH	HTH	HTH_21	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
108	40	L2	HTH	HTH	HTH	20-29	high	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
110	34	L2	HTH	-	HTH	20-29	high	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
111	12	L3	HTH	-	HTH	10-20	high	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
112	81	L3	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
114.2	49	L3	HTH	-	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
115.2	10	L3	HTH	-	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
117	31	L3	HTH	-	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
118	25	L3 and Y2	NCT	NCT	NCT	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
121	51	Y3, P2	HTH	-	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
122.1	66	L3, P2	HTH	HTH	HTH_21	20-29	high	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
123.1	19	P2	HTH	-	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
123.2	15	P2	HTH	-	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
124	54	Y3, P3	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
125.1	52	P8, P53	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
125.2	17	Y3, P8	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
126	160	P2, P35	HTH	HTH	HTH	20-29	mod	6	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
127.1	43	Y3, Y2 and P3	HTH	HTH	HTH_21	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
127.2	41	Y2, P5	HTH	-	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
128	36	L87, Y2	HTH	HTH	HTH_21	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
129	39	Y3, L3	HTH	HTH	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
130.1	4	Y3	HTH	HTH	HTH	20-29	low	0	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
130.2	6	Y3	HTH	HTH	HTH	20-29	low	0	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
131	91	L3	HTH	HTH	HTH_21	10-20	high	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
132	50	L87	HTH	HTH	HTH	20-29	high	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
133	87	L87 and Y3	HTH	HTH	HTH_21	20-29	mod	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
134.1	97	L3	HTH	HTH	HTH	20-29	mod	4	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
135.1	66	L3	HTH	HTH	HTH	20-29	mod	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
136.1	53	L3	HTH	HTH	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
136.2	26	L3	HTH	HTH	HTH	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
137	107	L3	HTH	HTH	NT	20-29	mod	4	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
138.1	101	L3, C3	HTH	HTH	HTH	20-29	mod	4	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
139.3	24	L3	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
140.1	67	P35	HTH	HTH	HTH	20-29	low	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
141	24	Y3	HTH	HTH	HTH	20-29	low	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
142	114	Y3, P35	HTH	HTH	HTH	20-29	low	5	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
143	22	Y3	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
144	70	Y3, P5	HTH	HTH	HTH	20-29	low	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
146	140	L2	HTH	-	HTH	20-29	mod	6	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
147	24	L2	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
150	43	P53	HTH	HTH	HTH	20-29	low	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
152	14	P8, P53	HTH	HTH	HTH	20-29	low	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
153	145	P2, L87	HTH	HTH	HTH_21	10-20	high	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
154	43	Y1	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
155	86	Y1, Y3	HTH	HTH	HTH	20-29	low	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
156.1	59	L87	HTH	HTH	HTH	10-20	high	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
156.2	15	L2	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
157.1	46	L87	HTH	HTH	HTH	20-29	high	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
158	65	L87, T3B	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
158.1	2	T3B, L87	HWD	HWD	HWD	10-20		0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
159	168	L8, L7 and B8 (Clarno)	HTH	HTH	HTH_21	20-29	mod	7	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
162	110	T3, L7	HTH	HTH	HTH	20-29	low	4	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
163	132	P5, P3	HTH	HTH	HTH	20-29	low	5	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
164.1	85	P35	HTH	HTH	HTH	20-29	low	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
165	83	P35	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
166.1	68	L3, L2 and P35	HTH	HTH	HTH	20-29	mod	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
167	24	L2	HTH	HTH	HTH	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
168	73	L2	HTH	HTH	HTH	20-29	mod	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
169	50	L2	HTH	HTH	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
170	21	L2	HTH	HTH	HTH	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
171	13	L3	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
172	67	P35, L3 and C3	HTH	HTH	HTH	20-29	low	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
173.1	109	L3	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
174.1	111	L3	HTH	HTH	HTH	10-20	mod	0	0	Utilize existing disturbance for designated skid trails and landings. Meets standard.
175	25	L3	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
176.1	79	L3	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
177	22	L3	HTH	HTH	HTH	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
178	40	L3	HTH	HTH	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
179.1	43	L3; T2B and B4	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
179.2	9	L3	NCT	NCT	NCT	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
180.1	95	B74 (Clarno)	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
181.1	60	T2B, B74 (Clarno)	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
182.1	22	B4	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
182.2	18	B74 (Clarno)	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
183.1	30	L3, B4	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
184	47	L3, M2	HTH	HTH	HTH	20-29	high	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
185	52	T2, TB8 (Clarno)	HTH	HTH	HTH_21	20-29	low	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
186	13	T2 (Clarno)	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
188	59	TB8 (Clarno)	HTH	HTH	HTH	20-29	low	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
189.1	37	B89	HTH	-	HTH	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
189.2	16	B89; TB8	HTH	-	HTH	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
191	19	B5, T5	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
192.1	72	L2	HTH	HTH	HTH	20-29	mod	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
192.2	13	L2	HTH	HTH	HTH	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
193	105	L2, T7M	HTH	HTH	HTH	20-29	mod	4	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
194.1	72	L2, T5	HTH	HTH	HTH	20-29	mod	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
194.2	9	T5	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
195.1	44	L3, T7M (Clarno)	HTH	HTH	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
195.2	42	L2 and 3	HTH	HTH	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
196	59	T2, L2	HTH	HTH	HTH	20-29	high	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
197	61	L2, T5	HTH	HTH	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
198	62	L3	HTH	HTH	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
199	45	T3B	HTH	HTH	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
199.2	19	T2B	HTH	HTH	HTH	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
201.1	71	T3B, T7	HTH	HTH	HTH	20-29	mod	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
202	46	T7 (Clarno)	HTH	HTH	HTH	20-29	low	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
203	60	TB8 (Clarno)	HTH	HTH	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
204	128	TB8 (Clarno)	HTH	HTH	HTH	20-29	mod	5	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
205	25	T2B	HTH	HTH	HTH	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
206	32	T3B	HTH	HTH	HTH	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
207.1	28	L3, T7M (Clarno)	HTH	HTH	HTH	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
207.2	15	L3	HTH	HTH	HTH	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
207.3	5	L3	HTH	HTH	HTH	20-29	mod	0	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
208.1	39	L3	HTH	HTH	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
208.2	11	L3	HTH	HTH	HTH	20-29	mod	0.5	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
208.3	18	L3	HTH	HTH	HTH	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
209.1	148	L3; T3B and T7M	HTH	-	HTH	20-29	mod	6	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
210.1	84	T3, T7 (Clarno)	HTH	-	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
210.2	19	T7 (Clarno)	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
212.1	10	T3B	HTH	-	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
212.2	23	T3B	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
213	100	T3B	HTH	-	HTH	20-29	mod	4	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
214	52	T3B, T7	HTH	HTH	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
215	78	T3, 2 and 7; B8	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
216.1	31	T3B	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
216.2	132	T3B, T7	HTH	HTH	HTH	20-29	mod	5	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
217	81	T3, T2	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
218	59	T3	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
219.2	11	B8	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
221.2	19	T7 (Clarno)	HTH	HTH	HTH	20-29	low	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
222	62	L3	HTH	HTH	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
223.1	55	L3	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
223.3	35	L3	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
224	63	L3	HTH	HTH	HTH	20-29	mod	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
225	83	T3B	HTH	HTH	HTH	20-29	mod	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
226	14	T3B	HTH	-	HTH	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
227.1	76	T3B, L3	HTH	HTH	HTH	20-29	mod	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
227.2	6	L3	HTH	HTH	HTH	20-29	mod	0	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
228.1	18	L3	HTH	HTH	HTH	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
228.2	6	L3	HTH	HTH	HTH	20-29	mod	0	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
228.3	2	L3, C2	HTH	HTH	HTH	20-29	mod	0	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
228.4	16	C2	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
229	22	L2	HTH	HTH	HTH_21	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
230	36	L2	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
231	59	P35	HTH	HTH	HTH	10-20	low	2	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
232.1	48	L2	HTH	HTH	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
233	106	L3, L2 and P35	HTH	HTH	HTH	20-29	mod	4	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
234	79	L3, P35	HTH	HTH	HTH_21	20-29	mod	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
235	31	L3	HTH	HTH	HTH	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
235.1	18	L3	NCT	NCT	NCT	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
235.2	31	L3	HTH	-	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
236	86	T3B, P35	HTH	HTH	HTH	20-29	mod	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
237.1	57	T3B	HTH	-	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
237.2	68	T3B, C2	HTH	HTH	HTH	20-29	mod	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
238	126	P35, C3	HTH	HTH	HTH	20-29	low	5	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
239	77	P35	HTH	HTH	HTH	20-29	low	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
240.1	65	P35	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
241.1	14	P35, C2	HTH	HTH	HTH	20-29	low	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
243	32	L3, C3	HTH	HTH	HTH	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
244	52	L3, C3	HTH	HTH	HTH	20-29	mod	2	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
245	68	L3, C3	HTH	HTH	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
246	15	C3	HTH	HTH	HTH	20-29	low	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
247	92	C3, P8	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
249	44	P8, P5	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.

Unit	acres	SRI Landtype	Alt. 2 Logging System	Alt. 3 Logging System	Alt. 4 Logging System	Existing Soil Disturbance (%)	Tillage Potential	Tillage Estimate (acres)	Post Activity Soil Disturbance (%)	Unit-specific Analysis
250	66	T2B, L3 and B5	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
251.1	71	L3	HTH	-	HTH	20-29	mod	3	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
254.2	32	C3, B5	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
255.1	37	C3, B5	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
256	27	B5, L3	HTH	HTH	HTH	10-20	low	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
313	3	L3	HTH	-	HTH	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.
336	92	L2	HTH	HTH	HTH	20-29	mod	4	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
358	13	L2	-	-	HWD	20-29	mod	1	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
374.2	12	T3B, T7M	NCT	NCT	NCT	20-29	mod	0	20-29	Utilize existing disturbance, no net increase over 29%. Meets standard.
392	4	L2	NCT	NCT	NCT	10-20	mod	0	20	Utilize existing disturbance for designated skid trails and landings. Meets standard.

Appendix C. Guidelines Relative to Water Quality

The following table contains summaries the objectives of the National Core BMPs that are applicable to the Gap Landscape Restoration Project. Additionally, the table contains project specific practices which serve as Project Design Criteria. Some of these Project Design Criteria may not be listed in the main part of this document and some may be repeated here for the ease of implementation and monitoring.

Table C-1. Water Quality BMPs and Subsequent PDFs

Activity	BMP Objective/PDC Specific Practices'
AqEco-1 Aquatic Ecosystem Improvement and Restoration Planning	Reestablish and retain ecological resilience of aquatic ecosystems and associated resources to achieve sustainability and provide a broad range of ecosystem services.
	• Allow temporary refueling and servicing only at approved locations, located well away from the AMZ, groundwater recharge areas, and waterbodies. • Develop or use existing fuel and chemical management plans (e.g., Spill Prevention Control and Countermeasures [SPCC], spill response plan, and emergency response plan) when developing the management prescription for refueling and servicing sites. • Industrial camps would not be located in RHCAs.
AqEco-2 Operations in Aquatic Ecosystems	Avoid, minimize, or mitigate adverse impacts to water quality when working in aquatic ecosystems.
	• Use applicable practices of BMP Plan-2 (Project Planning and Analysis) and BMP Plan-3 (AMZ Planning) when planning operations in aquatic ecosystems. • Identify the aquatic and aquatic-dependent species that live in the waterbody, Aquatic Management Zone (AMZ), or on the floodplain and their life histories to determine protection strategies, such as timing of construction, sediment management, species relocation, and monitoring during construction. • Coordinate stream channel, shoreline, lake, pond, and wetland activities with appropriate State and Federal agencies. · Incorporate Clean Water Act (CWA) 404 permit requirements and other Federal, State, and local permits or requirements into the project design and plan. · Use suitable measures to protect the waterbody when preparing the site for construction or maintenance activities. · Clearly delineate the work zone. · Locate access and staging areas near the project site but outside of work area boundaries, AMZs, wetlands, and sensitive soil areas. · Refuel and service equipment only in designated staging areas (see BMP Road-10 [Equipment Refueling and Servicing]). · Develop an erosion and sediment control plan to avoid or minimize downstream impacts using measures appropriate to the site and the proposed activity (see BMP Fac-2 [Facility Construction and Stormwater Control]). · Prepare for unexpected failures of erosion control measures. · Consider needs for solid waste disposal and worksite sanitation. · Consider using small, low ground pressure equipment, and hand labor where practicable.

Activity	BMP Objective/PDC Specific Practices'
	· Ensure all equipment operated in or adjacent to the waterbody is clean of aquatic invasive species, as well as oil and grease, and is well maintained. · Use vegetable oil or other biodegradable hydraulic oil for heavy equipment hydraulics wherever practicable when operating in or near water. · Schedule construction or maintenance operations in waterbodies to occur in the least critical periods to avoid or minimize adverse effects to sensitive aquatic and aquatic-dependent species that live in or near the waterbody. · Avoid scheduling instream work during the spawning or migration seasons of resident or migratory fish and other important life history phases of sensitive species that could be affected by the project. · Avoid scheduling instream work during periods that could be interrupted by high flows. · Consider the growing season and dormant season for vegetation when scheduling activities within or near the waterbody to minimize the period of time that the land would remain exposed, thereby reducing erosion risks and length of time when aesthetics are poor. · Use suitable measures to protect the waterbody when clearing the site. · Clearly delineate the geographic limits of the area to be cleared. · Use suitable drainage measures to improve the workability of wet sites. · Avoid or minimize unacceptable damage to existing vegetation, especially plants that are stabilizing the bank of the waterbody. · Use suitable measures to avoid or minimize impacts to the waterbody when implementing construction and maintenance activities. · Minimize heavy equipment entry into or crossing water as is practicable. · Conduct operations during dry periods. · Stage construction operations as needed to limit the extent of disturbed areas without installed stabilization measures. · Promptly install and appropriately maintain erosion control measures. · Promptly install and appropriately maintain spill prevention and containment measures. · Promptly rehabilitate or stabilize disturbed areas as needed following construction or maintenance activities. · Stockpile and protect topsoil for reuse in site revegetation. · Minimize bank and riparian area excavation during construction to the extent practicable. · Keep excavated materials out of the waterbody. · Use only clean, suitable materials that are free of toxins and invasive species for fill. · Properly compact fills to avoid or minimize erosion. · Balance cuts and fills to minimize disposal needs. · Remove all project debris from the waterbody in a manner that will cause the least disturbance. · Identify suitable areas offsite or away from waterbodies for disposal sites before beginning operations. · Contour site to disperse runoff, minimize erosion, stabilize slopes, and provide a favorable environment for plant growth. · Use suitable species and establishment techniques to revegetate the site in compliance with local direction and requirements per FSM 2070 and FSM 2080 for vegetation ecology and prevention and control of invasive species. · Use suitable measures to divert or partition channelized flow around the site or to dewater the site as needed to the extent practicable. · Remove aquatic organisms from the construction area before dewatering and prevent organisms from returning to the site during construction. · Return clean flows to channel or waterbody downstream of the activity. · Restore flows to their natural stream course as soon as practicable after

Activity	BMP Objective/PDC Specific Practices'
	construction or before seasonal closures. · Inspect the work site at suitable regular intervals during and after construction or maintenance activities to check on quality of the work and materials and identify need for mid-project corrections. · Consider short- and long-term maintenance needs and unit capabilities when designing the project. · Develop a strategy for providing emergency maintenance when needed. · Include implementation and effectiveness monitoring to evaluate success of the project in meeting design objectives and avoiding or minimizing unacceptable impacts to water quality. · Consider long-term management of the site and nearby areas to promote project success. · Use suitable measures to limit human, vehicle, and livestock access to site as needed to allow for recovery of vegetation.
AqEco-3 Ponds and Wetlands	Design and implement pond and wetlands projects in a manner that increases the potential for success in meeting project objectives and avoids, minimizes, or mitigates adverse effects to soil, water quality and riparian resources.
	· Design the wetland project to create a biologically and hydrologically functional system. · Design for function, not form. · Keep the design simple and avoid over engineering. · Design the project for minimal maintenance needs. · Use natural energies, such as gravity flow, in the design. · Avoid use of hard engineering structures or the use of supplemental watering to support system hydrology. · Plan to allow wetland system time to develop after construction activities are complete. · Use wetland vegetation species and establishment methods suitable to the project site and objectives, consistent with local direction and requirements per FSM 2070 and FSM 2080 for vegetation ecology and prevention and control of invasive species. · Consider the timing of planting to achieve maximum survival, proposed benefit of each plant species, methods of planting, proposed use of mulch, potential soil amendment (organic material or fertilizer), and potential supplemental watering to help establish the plant community.
AqEco-4 Stream Channels and Shorelines	Design and implement stream channel and lake shoreline projects in a manner that increases the potential for success in meeting project objectives and avoids, minimizes or mitigates adverse effects to soil, water quality and riparian resources.
	· Determine design velocities appropriate to the site. · Limit maximum velocity to the velocity that is non-scouring on the least resistant streambed and bank material. · Choose vegetation appropriate to the site to provide streambank stabilization and protection adequate to achieve project objectives. · Use vegetation species and establishment methods suitable to the project site and objectives, consistent with local direction and requirements per FSM 2070 and FSM 2080 for vegetation ecology and prevention and control of invasive species.
Fire-2 Use of Prescribed Fire	Avoid, minimize or mitigate adverse effects of prescribed fire and associated activities on soil, water quality and riparian resources that may result from excessive soil disturbance as well as inputs of ash, sediment, nutrients and

Activity	BMP Objective/PDC Specific Practices'
	debris.
	· Locate access and staging areas near the project site but outside of AMZs, wetlands, and sensitive soil areas. · Keep staging areas as small as possible while allowing for safe and efficient operations. · Store fuel for ignition devices in areas away from surface water bodies and wetlands. · Install suitable measures to minimize and control concentrated water flow and sediment from staging areas. · Collect and properly dispose of trash and other solid waste. · Restore and stabilize staging areas after use (see BMP Veg-6 [Landings]). · Conduct prescribed fires to minimize the residence time on the soil while meeting the burn objectives. · Manage fire intensity to maintain target levels of soil temperature and duff and residual vegetative cover within the limits and at locations described in the prescribed fire plan. · Construct fireline to the minimum size and standard necessary to contain the prescribed fire and meet overall project objectives. · Locate and construct fireline in a manner that minimizes erosion and runoff from directly entering waterbodies by considering site slope and soil conditions, and using and maintaining suitable water and erosion control measures. · Consider alternatives to ground-disturbing fireline construction such as using wet lines, rock outcrops, or other suitable features for firelines. · Establish permanent fireline with suitable water and erosion control measures in areas where prescribed fire treatments are used on a recurring basis. · Maintain firebreaks in a manner that minimizes exposed soil to the extent practicable. · Rehabilitate or otherwise stabilize fireline in areas that pose a risk to water quality. · Alter prescribed fire prescriptions and control actions in the AMZs as needed to maintain ecosystem structure, function, and processes and onsite and downstream water quality. · Pretreat AMZs and drainage ways to reduce excessive fuel loadings. · Avoid building firelines in or around riparian areas, wetlands, marshes, bogs, fens, or other sensitive water-dependent sites unless needed to protect life, property, or wetlands. · Construct any essential fireline in the AMZ in a manner that minimizes the amount of area and soil disturbed. · Keep high-intensity fire out of the AMZ unless suitable measures are used to avoid or minimize adverse effects to water quality. · Avoid or minimize complete removal of the organic layer when burning in riparian areas or wetlands to maintain soil productivity, infiltration capacity, and nutrient retention. · Rehabilitate fireline in the AMZ after prescribed fire treatment is completed. · Remove debris added to stream channels as a result of the prescribed burning unless debris is prescribed to improve fisheries habitat. · Conduct prescribed fire treatments, including pile burning, for slash disposal in a manner that encourages efficient burning to minimize soil impacts while achieving treatment objectives. · Pile and burn only the slash that is necessary to be disposed of to achieve treatment objectives. · Locate slash piles in areas where the potential for soil effects is lessened

Activity	BMP Objective/PDC Specific Practices'
	(meadows, rock outcrops, etc.) and that do not interfere with natural drainage patterns. · Remove wood products such as firewood or fence posts before piling and burning to reduce the amount of slash to be burned. · Minimize the amount of dirt or other noncombustible material in slash piles to promote efficient burning. · Construct piles in such a manner as to promote efficient burning. · Avoid burning large stumps and sections of logs in slash piles to reduce the amount of time that the pile burns. · Avoid burning when conditions will cause the fire to burn too hot and damage soil conditions. · Avoid piling and burning for slash removal in AMZs to the extent practicable. · Minimize effects on soil, water quality, and riparian resources by appropriately planning pile size, fuel piece size limits, spacing, and burn prescriptions in compliance with State or local laws and regulations if no practical alternatives for slash disposal in the AMZ are available. · Evaluate the completed burn to identify sites that may need stabilization treatments or monitoring to minimize soil and site productivity loss and deterioration of water quality both on and off the site. · Provide for rapid revegetation of all denuded areas through natural processes supplemented by artificial revegetation where necessary. · Use suitable measures to promote water retention and infiltration or to augment soil cover where necessary. · Use suitable species and establishment techniques to stabilize the site in compliance with local direction and requirements per FSM 2070 and FSM 2080 for vegetation ecology and prevention and control of invasive species. · Clear streams and ditches of debris introduced by fire control equipment during the prescribed fire operation. · Consider long-term management of the site and nearby areas to promote project success. · Use suitable measures to limit human, vehicle, and livestock access to site as needed to allow for recovery of vegetation. · Burn plans (unit-specific prescriptions) would be developed as an on-the-ground, interdisciplinary process; team should include (at a minimum) a fuels specialist, a fisheries biologist, a hydrologist, wildlife biologist, and silviculturist. · Burn plans would incorporate the following guidelines: o Generally in RHCAs, there would be no intentional ignition within 100' of stream channels, (class I-IV). Fire would be allowed to back into the RHCAs and burn in a mosaic pattern. This criterion may be modified on a site-specific basis if: § There is a road or other existing fuel break within 50' of the stream channel that would provide a logical boundary to the burn unit; in this case, ignition may take place up to the fuel break, but not between the fuel break and the stream channel. § Site-specific conditions exist such that intentional ignition within 100' of the stream channel would be desirable. EXAMPLE: Excessive amounts of conifer seedlings within 100' of a stream channel are detrimental to the development of riparian hardwoods and fire is determined to be the tool of choice to remove them. EXAMPLE: Large fuels accumulations within 50' of the stream channel exist and fire is determined to be the tool of choice to reduce them.

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	o Where necessary, fireline would be constructed within RHCAs. § Fireline would be dug by hand or with a garden plow pulled by a four-wheeler or a small rubber-tired farm tractor. § Fireline would be a fuel break to mineral soil, 12-24 inches wide. § Fireline in RHCAs would not be constructed within 25' of streambanks or on slopes >35% § The end of the line would fishhook away from the stream channel and stop on the contour. § Fireline would be rehabilitated following completion of activities; waterbars would be constructed on hand line, and sod would be replaced on plow line. o Sensitive areas within each RHCA would be identified and site-specific plans to protect each area during burn operations would be developed prior to burn operations; site-specific plans would become part of each burn plan, and would be completed prior to the approval of the burn plan. EXAMPLE: A particular reach may contain down wood that is acting to prevent the progress of a headcut; site-specific plan would be developed to ensure retention of that piece of wood. EXAMPLE: A given stream might be so deficient in down wood that the retention of all in-channel down wood in a unit might be necessary. o Post-activity effectiveness monitoring would be conducted whenever site-specific plans are implemented. · Avoid using surfactants when there is a potential for stream contamination. Surfactants for suppression of prescribed burns are not allowed in the RHCA. · Require the use of pump spill containment kits to reduce the water quality effects from a potential spill. · Screen water pump intakes with appropriate size mesh (3/32") to prevent entrapping fish.
Min-1 Minerals Planning	Use the minerals planning process to develop measures to avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources during production, operations and reclamation activities.
	· Evaluate Plan of Operations to ensure that reasonable measures, including appropriate BMPs, are included to avoid and/or minimize adverse effects to soil, water quality and riparian resources from the mining activities. · Employ suitable design and construction measures to avoid, limit, or mitigate surface disturbances as well as maintain the reclamation potential of the site. · Use applicable Road Management Activity BMPs to manage roads and transportation at the project site. · Use applicable practices from BMP Fac-4 (Sanitation Systems) and BMP Fac-5 (Solid Waste Management) to avoid contamination of surface water or groundwater from sanitation or solid waste facilities. · Use applicable Chemical Use Management Activities BMPs, BMP Fac-6 (Hazardous Materials) and BMP Road-10 (Equipment Refueling and Servicing) to manage all chemicals, reagents, fuels and other hazardous or toxic materials utilized for construction, operations and beneficiation to avoid or minimize contamination of surface water or groundwater. · Use applicable practices from BMP Min-8 (Minerals Site Reclamation) to reclaim the project site once minerals production operations are completed.
Min-3 Minerals Production	*Mining-related Surface Activities*

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	· Limit clearing, excavation and other surface disturbing activities to the minimum necessary for mining needs. o Limit amount of exposed or disturbed soil at any one time to the minimum necessary for efficient operations during minerals production activities. o Clearly delineate the geographic limits of the area to be cleared. o Install suitable drainage measures to improve the workability of wet sites. o Avoid or minimize damage to existing vegetation, particularly that which is stabilizing the bank of a waterbody. o Stabilize mined areas and surface disturbance activities as soon as practicable before moving and opening up new areas. · Reduce surface disturbing activities to the minimum necessary for efficient minerals production activities during periods of heavy runoff or saturated soil conditions, to the extent practicable, to decrease the potential for soil compaction and erosion. · Stockpile biologically active topsoil removed during excavation for use in reclamation. o Store stockpiled topsoil separately from other vegetative slash or soil and rock materials and protect from wind and water erosion, unnecessary compaction and contaminants. · Conduct operations in such a manner as to avoid or minimize the production and transport of fugitive dust from the site. · Use suitable measures in compliance with local direction to prevent and control invasive species. o All equipment and vehicles to be used at the material site shall be cleaned and certified free of invasive plants and their seeds prior to the entrance onto the National Forest. The restriction shall include equipment and vehicles intended for off-road use as well as on road use, whether they are owned, leased, or borrowed by the permittee/contractor. (see additional Design Elements in the Winter Material Source Long Term Management Plan on file with the Ochoco NFS)
Min-5 Mineral Materials Resource Sites	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources when developing and using upland mineral materials resource sites.
	All Activities · Allow upland where consistent with Forest or Grassland Plan desired conditions, goals and objectives for soils, aquatic and riparian habitats and water quality. · Use applicable practices of BMP Min-3 (Minerals Production) and BMP Fac-2 (Facility Construction and Stormwater Control) for sanitation, solid waste and transport and storage of petroleum products or other hazardous materials and to control erosion, manage stormwater, keep the site dry and protect the waterbody when clearing the extraction and processing areas. · Use applicable practices of BMP Min-6 (Ore Stockpiles, Mine Waste Storage and Disposal, Reserve Pits and Settling Ponds) and BMP Min-7 (Produced Water) to avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources when processing materials. *Upland Gravel Pits* · Plan operations at the site in advance to minimize disturbance area and

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	more effectively and efficiently open and operate the site. o Limit the area of the facility to the minimum necessary for efficient operations while providing sufficient area for materials processing and stockpiling. o Phase development where practicable. o Use suitable measures to avoid, mitigate or treat metal leaching and formation of acid rock drainage. · Conduct extraction activities in such a manner as to minimize the potential for slope failures, limit slope steepness and length, limit disturbed areas to those actively used for extraction, retain existing vegetation as long as possible and allow for progressive reclamation of the site where practicable.
Road-2 Road Location and Design	Locate and design roads to avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources.
	· Locate roads as far from waterbodies as is practicable to achieve access objectives, with a minimum number of crossings and connections between the road and the waterbody. · Avoid sensitive areas such as riparian areas, wetlands, meadows, bogs, and fens, to the extent practicable. · Provide an AMZ of suitable width between the road and a waterbody to maintain desired conditions, goals, and objectives for structure, function, and processes of the AMZ and associated waterbody when a road must parallel a waterbody (See BMP Plan-3 [AMZ Planning]). · Relocate existing routes or segments that are causing, or have the potential to cause, adverse effects to soil, water quality, and riparian resources, to the extent practicable. · Obliterate the existing road or segment after the relocated section is completed (see BMP Road-6 [Road Storage and Decommissioning]). · Design a post-construction site vegetation plan, including short- and long-term objectives, using suitable species and establishment techniques to revegetate the site in compliance with local direction and requirements per FSM 2070 and FSM 2080 for vegetation ecology and prevention and control of invasive species.
Road-3 Road Construction and Reconstruction	Avoid or minimize adverse effects to soil, water quality and riparian resources from erosion, sediment and other pollutant delivery during road construction or reconstruction.
	· Construct pioneer roads using suitable measures to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources. · Confine construction of pioneer roads to the planned roadway limits unless otherwise specified. · Locate and construct pioneering roads to avoid or minimize undercutting of the designated final cut slope. · Avoid deposition of materials outside the designated roadway limits. · Use suitable crossing structures, or temporarily dewater live streams, where pioneer roads intersect streams. · Use suitable erosion and stormwater control measures as needed (see BMP Fac-2 [Facility Construction and Stormwater Control]). · Reconstruct existing roads to the degree necessary to provide adequate drainage and safety. · Avoid disturbing stable road surfaces. · Use suitable measures to avoid, to the extent practicable, or minimize direct discharges from road drainage structures to nearby waterbodies.

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Road-4 Road Operations and Maintenance	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources by controlling road use and operations and providing adequate and appropriate maintenance to minimize sediment production and other pollutants during the useful life of the road.
	· Use suitable measures to avoid or minimize adverse effects to soil, water quality, or riparian resources when proposed operations involve use of roads by traffic and during periods for which the road was not designed. · Strengthen the road surface in areas where surfaces are vulnerable to movement such as corners and steep sections. · Upgrade drainage structures to avoid, to the extent practicable, or minimize direct discharges into nearby waterbodies. · Restrict use to low-ground-pressure vehicles or frozen ground conditions. · Strengthen the road base if roads are tending to rut. · Adjust maintenance to handle the traffic while minimizing excessive erosion and damage to the road surface. · Ensure that drainage features are fully functional on completion of seasonal operations. · Shape road surfaces to drain as designed. · Construct or reconstruct drainage control structures as needed. · Ensure that ditches and culverts are clean and functioning. · Remove berms unless specifically designed for erosion control purposes. · Consider potential for water quality effects from road damage when granting permits for oversize or overweight loads. · Use suitable road surface stabilization practices and dust abatement supplements on roads with high or heavy traffic use (See FSH 7709.56 and FSH 7709.59). · Use applicable practices of Chemical Use Management Activities BMPs when chemicals are used in road operations. · Suspension of use of the transportation system would occur when road use is contributing to sediment detachment and transport (i.e. rutting 2 inches or deeper) or muddy ditch water to prevent siltation outside of the roadway. · Dust abatement on haul roads within RHCAs would occur to reduce sediment (i.e. dust) entering streams. Water used for dust abatement would be obtained from approved sources identified in the May 1996 Ochoco National Forest Water Conservation Plan. · Dry season/frozen haul conditions would be required on native surface roads to prevent rutting and muddy road surfaces that may interfere with drainage and contribute to sedimentation outside of the traveled way. Suspension of use would occur when rutting in road surface is 2 inches or deeper or ditch water is muddy. · All roads would have adequate road drainage designed to reduce the concentration of flow. · All roads would have adequate relief drainage installed prior to runoff reaching the stream channel. · Filter strips below drainage structures would be of sufficient size to catch sediment before runoff enters streams. If adequate filter strips are not available, slash, rock aprons, or other filtering structures would be installed. Vegetated or rocked buffer strips of sufficient size to catch sediment will exist between road drainage features (i.e. relief structures or road ditches) and stream channels.
Road-5 Temporary Roads	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources from the construction and use of temporary roads.
	· Schedule construction activities to avoid direct soil and water-disturbance during periods of the year when heavy precipitation and runoff are likely to occur.

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	· Maintain erosion and storm-water controls as necessary to ensure proper and effective functioning. · Use suitable measures in compliance with local direction to prevent and control invasive species. · Use temporary crossings suitable for the expected uses and timing of use (See BMP Road-7[Stream Crossings]). · Use applicable practices of BMP Road-6 (Road Storage and Decommissioning) to obliterate the temporary road and return the area to resource production after the access is no longer needed.
Road-6 Road Storage and Decommissioning	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources by storing closed roads not needed for at least one year (Intermittent Stored Service) and decommissioning unneeded roads in a hydrologically stable manner to eliminate hydrologic connectivity, restore natural flow patterns and minimize soil erosion.
	· Establish effective ground cover on disturbed sites to avoid or minimize accelerated erosion and soil loss. · Evaluate all stream and waterbody crossings for potential for failure or diversion of flow if left without treatment. · Remove culverts, fill material, and other structures that present an unacceptable risk of failure or diversion. · Reshape the channel and streambanks at the crossing-site to pass expected flows without scouring or ponding, minimize potential for undercutting or slumping of streambanks, and maintain continuation of channel dimensions and longitudinal profile through the crossing site.
Road-7 Stream Crossings (applicable also to skid trails stream crossings)	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources when constructing, reconstructing or maintaining temporary and permanent waterbody crossings.
	· Limit the location of crossings to areas of existing disturbance to the extent practicable. · Limit the number and extent to those that are necessary to provide the level of access needed to meet RMOs. · Guide design of crossing structures suitable for the site conditions and the RMOs. · Use suitable surface drainage and roadway stabilization measures to disconnect the road from the waterbody to avoid or minimize water and sediment from being channeled into surface waters and to dissipate concentrated flows. · Provide sufficient surface roughness so that there will not be concentrated flow. · Promote infiltration and minimize/decrease overland flow. · Use suitable measures to avoid, minimize, or mitigate damage to the waterbody and banks when transporting materials across the waterbody or Aquatic Management Zone (AMZ) during operations. · New and reconstructed stream crossings should be constructed to accommodate a 100-year flood conditions if the crossing structure is anticipated to remain in place during winter snowmelt or the spring. · Locate stream crossings where the channel is (non-complex) narrow, straight, and uniform, and has stable soils and relatively flat terrain to the extent practicable. Select a site where erosion potential is low. Orient the stream crossing perpendicular to the channel to the extent practicable. Keep approaches to stream crossings to as gentle a slope as practicable. · Consider natural channel adjustments and possible channel location changes over the design life of the structure. · Approaches to crossings during wet or winter season conditions for skid

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	trails, approaches to crossings during winter conditions will be protected by: o Four inches of frozen ground with dry ground beneath and one foot of snow; or o Two feet or more of snow with dry ground beneath; o And possibly, due to the probability that soil often remains wet near streams, corduroy (small diameter logs laid side-by-side perpendicular to the direction of traffic) for a distance of 30 feet on either side of the channel, or the width of the floodplain, whichever is greater. Corduroy will distribute the weight of machinery over a broader area, thus decreasing the potential for compaction, as well as providing an operating surface that will reduce to potential for soil displacement. Corduroy also provides surface cover and roughness that reduces the potential for overland flow from upland areas and the delivery of sediment to the channel. Due to site specific conditions, an alternative practice used as an exception could be considered if evaluated by a fisheries/hydrology specialist and it is deemed acceptable to implement only a portion or variation of the practice in order to adequately protect the resource (exceptions for corduroy will not be reduced less than 10 feet). If the whole practice is unacceptable or if alternatives are not feasible and/or not acceptable, then the dependent unit acres will be dropped. · Approaches to crossings during wet season conditions for new crossings or crossings that are planned to be improved on existing temporary roads, new temporary roads, and re-opened closed roads, will be protected by: o Four inches of surface frost and one foot of snow; or o Two feet or more of snow; o And possibly, due to the probability that soil often remains wet near streams, eight inches of gravel underlain by geotextile fabric (gravel size and construction is to be suitable for the site and traffic) for a distance of 30 feet on either side of the channel, or the width of the floodplain, whichever is greater. The gravel surface will distribute the weight of machinery over a broader area, thus decreasing the potential for compaction, as well as providing an operating surface that will reduce to potential for soil displacement. Gravel also provides surface cover and roughness that reduces the potential for overland flow from upland areas and the delivery of sediment to the channel. Due to site specific conditions, an alternative practice used as an exception could be considered if evaluated by a fisheries/hydrology specialist and it is deemed acceptable to implement only a portion or variation of the practice in order to adequately protect the resource. If the whole practice is unacceptable or if alternatives are not feasible and/or not acceptable, then the dependent unit acres will be dropped. · Approaches to crossings during dry season conditions for skid trails will be protected by a slash mat or corduroy for a distance of 30 feet on either side of the channel, or the width of the floodplain, whichever is greater. The decision to use slash mat or corduroy will be based on the predominant soil moisture regime for the site and will be determined by a soil scientist or hydrologist. Corduroy will be the preferred alternative for relatively wet areas as it distributes the weight of machinery more broadly and decreases the potential for rutting. Slash mats and corduroy both serve to distribute the weight of machinery over a broader area, thus decreasing the potential for compaction, as well as providing an operating surface that will reduce to potential for soil displacement. Due to site specific conditions, an alternative practice used as an exception could be considered if evaluated

Activity	BMP Objective/PDC Specific Practices'
	by a fisheries/hydrology specialist and it is deemed acceptable to implement only a portion or variation of the practice in order to adequately protect the resource. If the whole practice is unacceptable or if alternatives are not feasible and/or not acceptable, then the dependent unit acres will be dropped. · Approaches to crossings during dry season conditions for new crossings or crossings that are planned to be improved on existing temporary roads, new temporary roads, and re-opened closed roads, will be protected by eight inches of gravel underlain by geotextile fabric (gravel size and construction is to be suitable for the site and traffic) for a distance of 30 feet on either side of the channel, or the width of the floodplain, whichever is greater. The gravel surface will distribute the weight of machinery over a broader area, thus decreasing the potential for compaction, as well as providing an operating surface that will reduce to potential for soil displacement. Gravel also provides surface cover and roughness that reduces the potential for overland flow from upland areas and the delivery of sediment to the channel. Due to site specific conditions, an alternative practice used as an exception could be considered if evaluated by a fisheries/hydrology specialist and it is deemed acceptable to implement only a portion or variation of the practice in order to adequately protect the resource. If the whole practice is unacceptable or if alternatives are not feasible and/or not acceptable, then the dependent unit acres will be dropped. · For structured channel crossings during wet season conditions for skid trails, new crossings or crossings that are planned to be improved on existing temporary roads, new temporary roads, and re-opened closed roads: Channel crossings will utilize a Humboldt crossing, metal culvert , and/or log culvert installed to an elevation at least 6 inches above bank height. Crossing design will be selected to best convey the highest potential flows during the period of use. Crossings are designed to reduce to potential for disturbance to the bed and banks of streams and the potential for sediment to be generated from the crossing site. If a culvert and earthen material is used to cross a stream, geo textile fabric will be installed underneath the culvert and fill material, overlapping the bank for a distance greater than the introduced fill material. This will help to ensure complete removal of fill during the removal of the crossing. Due to site specific conditions, an alternative practice used as an exception could be considered if evaluated by a fisheries/hydrology specialist and it is deemed acceptable to implement only a portion or variation of the practice in order to adequately protect the resource. If the whole practice is unacceptable or if alternatives are not feasible and/or not acceptable, then the dependent unit acres will be dropped. · For structured channel crossings during dry season conditions for skid trails, new crossings or crossings that are planned to be improved on existing temporary roads, new temporary roads, and re-opened closed roads: Channel crossings will utilize a Humboldt crossing, metal culvert , and/or log culvert installed to an elevation at least 6 inches above bank height. While crossing design will be selected to best convey the highest potential flows during the period of use, preferred crossing sites for summer time operations will be dry. Crossings are designed to reduce to potential for disturbance to the bed and banks of streams. If a culvert and earthen material is used to cross a stream, geo textile fabric will be installed underneath the culvert and fill material, overlapping the bank for a distance greater than the introduced fill material. This will help to ensure complete removal of fill during the removal of the crossing. Due to site specific conditions, an alternative practice used as an exception could be considered

Activity	BMP Objective/PDC Specific Practices'
	if evaluated by a fisheries/hydrology specialist and it is deemed acceptable to implement only a portion or variation of the practice in order to adequately protect the resource. If the whole practice is unacceptable or if alternatives are not feasible and/or not acceptable, then the dependent unit acres will be dropped. For dry streams whose bed and banks are well armored by large cobble, boulders and/or bedrock, and whose bank angle and bank height are low enough to provide a smooth transition through the channel, skidding may proceed without a constructed crossing. o A common acceptable crossing type used to protect the morphology of Class IV stream channels and banks on temporary road crossings (either summer or winter haul) is a "log culvert". This would be constructed by laying logs in the channel; covering the logs with geotextile cloth (to prevent migration of soil/mud to the channel bed); and then placing soil on top to create a drivable travel surface. These "log culvert" crossing structures would be removed at the end of hauling activities and then rehabilitated. o At Class IV stream crossing locations (either summer or winter haul) where low bank height (less than 1 foot) and broad channel width would make a "log culvert" structure an impracticable choice, rock fords may be constructed to protect the bank and channel from damage by hauling equipment. When approved by the hydrologist, this is another acceptable crossing type. · Locate low water (or dry channel fords) crossings where streambanks are low (low bank height <1 foot) with gentle slopes and channels are not deeply incised. Construct the low water (dry channel fords) crossing to conform to the site, channel shape, and original streambed elevation, and to minimize flow restriction, site disturbance, and channel blockage to the extent practicable. · For stream crossings where the channels do not contain water during the periods of the operations, operators (after approval from the Fisheries biologist and/or Hydrologist) are not required to construct temporary crossings as long as disturbances are no greater than what would occur if structures were constructed. These unimproved fords will be located in stable reaches with a firm rock or gravel base that has sufficient load bearing strength for the expected vehicle traffic. Soil that enters the channels during the yarding operations must be removed after completion of the operation or prior to stream flow, whichever comes first. When removing such materials from the channels, operators shall place the materials in locations where they will not enter waters of the state. (629-630-0800 (5)Yarding; Ground-based Equipment Near Waters of the State). This would most likely be applicable only to bedrock, boulder, and/or cobble dominated stream segments. · Rock or material placed in channels or on approaches of drive through fords that are to remain in place after harvest activities would not obstruct/dam in channel or floodplain flows after the sale. · Monitor crossings regularly while installed to evaluate condition. · In channel work on Class I-III streams would be accomplished during low flow conditions in accordance with "Oregon Guidelines for Timing of in-Water Work to protect Fish and Wildlife Resources, June 2010." For the project area, the timing for in-water work is July 1 to October 31. The appropriate permits and/or authorizations will need to be obtained from agencies such as DSL, ACE, DEQ, NOAA/ODFW/USFWS. In channel work would occur when the channel is dry, either naturally or by diverting and dewatering the site. · In channel work on Class IV streams would occur when the channel is dry.

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	The fisheries biologist or hydrologist would coordinate specifications and locations. This would include the installation and removal of crossing structures (culverts, fords, log crossings, etc.) as well as the actual fording of dry channels during timber operations. · Existing temporary roads, new temporary roads, and re-opened closed roads within the RHCA and sediment delivery zone (200 feet of Class I-IV streams), utilized during implementation are to be specified in the implementation plan to have the following practices conducted after the completion of harvest activities in order to minimize the long-term potential for sediment delivery as modeled in the Hydrology Report. These specifications are to: o Block the road and eliminate motor vehicle access to the stream crossing approaches within the RHCA and sediment delivery zone, o Sub-soil, till and waterbar, or otherwise de-compact (as soil conditions allow, to be determined by the Soil Scientist) affected areas within the RHCA and sediment delivery zone. Sub-soiling is first preference, tillage is second preference. If tillage is not possible or feasible, large slash or woody debris is specified to be used. o Riparian associated vegetation would be planted or seeded as needed within the sediment delivery zone. o Hydrologically stabilize, waterbar, and provide slash cover to entire sections of road. o Inadequate crossing structures will be removed where practicable. This includes all existing and new temporary road crossing structures as well as re-opened closed road crossing structures that are not adequately designed to pass 100 year flood events conditions. o Have the approaches, banks and beds of the stream rehabilitated with such practices as removing berms, reshaping the channel, and other such suitable methods used to return areas to proper hydrologic functioning condition. Reshape the channel and streambanks at the crossing-site to pass expected flows without scouring or ponding, minimize potential for undercutting or slumping of streambanks, and maintain continuation of channel dimensions and longitudinal profile through the rehabilitated crossing site. Use suitable measures to avoid or minimize scour and downcutting. Use suitable measures to stabilize unstable road segments, seeps, slumps, or cut or fill slopes where evidence of potential failure exists. o Crossings that are deemed adequate may remain in place in low-risk situations where the culvert is not undersized, does not present an undesired passage barrier to aquatic organisms, and is relatively stable.
Road-10 Equipment Refueling and Servicing	Avoid or minimize adverse effects to soil, water quality and riparian resources from fuels, lubricants, cleaners and other harmful materials discharging into nearby surface waters or infiltrating through soils to contaminate groundwater resources during equipment refueling and servicing activities.
	· Allow temporary refueling and servicing only at approved locations, located well away from the AMZ, groundwater recharge areas, and waterbodies.
Road-11 Road Storm-Damage	Monitor road conditions following storm events to: detect road failures; assess damage or potential damage to waterbodies, riparian resources, and

Activity	BMP Objective/PDC Specific Practices'
Surveys	watershed functions; determine the causes of the failures; and identify potential remedial actions at the damaged sites and preventative actions at similar sites.
Veg-1 Vegetation Management Planning	Use the applicable vegetation management planning processes to develop measures to avoid, minimize, or mitigate adverse effects to soil, water quality and riparian resources during mechanical vegetation treatment activities.
	· Evaluate and field verify site conditions in the project area to design mechanical vegetation treatment prescriptions and a transportation plan associated with the mechanical vegetation treatment prescriptions that avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources. · Identify sources of rock for roadwork, riprapping, and borrow materials (see BMP Min-6 (Mineral Materials Resource Sites)). · Identify water sources available for purchasers' use (see BMP Uses-3 (Administrative Water Developments)). · Ensure the timber sale contract, stewardship contract or other implementing document includes BMPs from the decision document to avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources.
Veg-2 Erosion Prevention and Control	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources by implementing measures to control surface erosion, gully formation, mass slope failure and resulting sediment movement before, during, and after mechanical vegetation treatments.
	· The Timber Administrator shall work with the contractor to locate landings, skid trails, and slash piles in suitable sites to avoid, minimize, or mitigate potential for erosion and sediment delivery to nearby waterbodies. · Develop erosion control and sediment plan that covers all disturbed areas including skid trails and roads, landings, temporary road fills, water source sites, borrow sites, or other areas disturbed during mechanical vegetation treatments. · Apply soil protective cover on disturbed areas where natural revegetation is inadequate to prevent accelerated erosion before the next growing season. · Maintain the natural drainage pattern of the area wherever practicable. · Control, collect, detain, treat, and disperse stormwater runoff from disturbed areas. · Divert surface runoff around bare areas with appropriate energy dissipation and sediment filters. · Operate equipment when soil compaction, displacement, erosion, and sediment runoff would be minimized. · Avoid ground equipment operations on unstable, wet or easily compacted soils and on steep slopes unless operation can be conducted without causing excessive rutting, soil puddling or runoff of sediments directly into waterbodies.
Veg-3 Aquatic Management Zones	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources when conducting mechanical vegetation treatment activities in the AMZ.
	· Use mechanical vegetation treatments in the AMZ only when suitable to achieve long-term AMZ-desired conditions and management objectives (see BMP Plan-3 [AMZ Planning]). · Adjust operations in the AMZ to avoid, minimize, or mitigate detrimental soil impacts where they are occurring. · Clearly delineate Aquatic Management Zones-AMZ locations and boundaries in the project area. · In RHCAs, hazardous trees (live or dead) that are felled would be left on site or used for in-stream habitat improvement.

Activity	BMP Objective/PDC Specific Practices'
	· Retain trees as necessary for canopy cover and shading, bank stabilization, and as a source of large woody debris within the AMZ (identified in site specific unit prescriptions). · Avoid falling trees into streams or waterbodies, except as planned to create habitat features (identified in site specific unit prescriptions). · Minimize heavy equipment entry into or crossing channels, the RHCA, and sediment delivery zone as is practicable.
Veg-4 Ground-Based Skidding and Yarding Operations	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources during ground-based skidding and yarding operations by minimizing site disturbance and controlling the introduction of sediment, nutrients, and chemical pollutants to waterbodies.
	· Use ground-based yarding systems only where physical site characteristics are suitable to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources. · Use local direction or requirements for slope, erosion potential, mass wasting potential, and other soil or site properties to determine areas suitable for ground-based yarding systems (identified in site specific unit prescriptions). · Use existing roads and skid trail networks to the extent practicable. · Create new roads and skid trail where re-use of existing ones would exacerbate soil, water quality, and riparian resource impacts. · Avoid skidding logs in or adjacent to a stream channel or other waterbody to the extent practicable. · Design and locate skid trails and skidding operations to minimize soil disturbance to the extent practicable. · Skid across streams only at designated locations. · Use suitable measures at skid trail stream crossings to avoid or minimize damage to the stream channel and streambanks (see Road-7 Stream Crossings). · Use suitable measures during felling and skidding operations to avoid or minimize disturbance to soils and waterbodies to the extent practicable. · Directionally fell trees away from streambanks and other waterbody edges. · Remove logs from wet meadows or AMZs using suitable techniques to minimize equipment operations in the sensitive area and minimize dragging the logs on the ground. · Avoid long runs on steep slopes. Skidding within the AMZ is prohibited on slopes greater than 35%. Additional site specific provisions have been developed for slopes <35% and are identified in the site specific unit prescriptions. · Locate skid trails to avoid concentrating runoff and provide breaks in grade. Install suitable drainage features. · Directionally fell trees to facilitate efficient removal along predetermined yarding patterns with the least number of passes and least amount of disturbed area (e.g., felling-to-the-lead). · Use low ground pressure equipment when practicable, particularly on equipment traveling over large portions of units with sensitive soils or site conditions. · Perform skidding or yarding operations when soil conditions are such that soil compaction, displacement, and erosion would be minimized. · Suspend skidding or yarding operations when soil moisture levels could result in unacceptable soil damage. o Use suitable measures such as waterbars and slash to stabilize and restore skid trails after use. Reshape the surface to promote dispersed drainage. Apply soil protective cover on disturbed areas where natural revegetation is inadequate to prevent accelerated erosion before the

Activity	BMP Objective/PDC Specific Practices'
	next growing season. Mitigate soil compaction as per the Soils Report to improve infiltration and revegetation conditions. o Use suitable measures to stabilize and restore skid trails after use, i.e. Rehabilitate utilized skid trails within RHCAs and sediment delivery zones. Pull back/flatten out berms to reestablish drainage. Sub-soil; till and waterbar; or otherwise de-compact (as soil conditions allow, to be verified by the Soil Scientist); affected areas within the RHCA and sediment delivery zone. If tillage is not possible or feasible, large slash or woody debris is specified to be used. Riparian associated vegetation would be planted or seeded. Provide cover with large slash or woody debris to increase roughness, dissipation of flow and erosion control. o Skid trails that are located on a gravel road or at turnouts that will remain open to traffic use would be exempt from rehabilitation for hydrology purposes.
Veg-6 Landings	Avoid, minimize or mitigate adverse effects to soil, water quality and riparian resources from the construction and use of log landings.
	· Minimize the size and number of landings as practicable to accommodate safe, economical, and efficient operations. · Locate landings to limit the potential for pollutant delivery to waterbodies. · Locate new landings outside the AMZ and as far from waterbodies as reasonably practicable based on travel routes and environmental considerations. · Locate re-used landings as far from the waterbody as reasonably practicable based on travel routes and environmental considerations. o Avoid new landings within RHCAs (Existing landings may be reused after review by Fishery Biologist and/or Hydrologist). Re-use existing landings where their location is compatible with management objectives and water quality protection. Locate landings to limit the potential for pollutant delivery to waterbodies. · Avoid locating landings near any type of likely flow or sediment transport conduit during storms, such as ephemeral channels and swales, where practicable. · Do not place landings or slash piles in the bottom of ephemeral draws and swales. Where practical, skid trails would avoid ephemeral draws. Crossings would be perpendicular to ephemeral draws. · Locate landings to minimize the number of required skid roads. · Avoid locating landings on steep slopes or highly erodible soils. · Avoid placing landings where skidding across drainage bottoms is required. · Design roads and trail approaches to minimize overland flow entering the landing. · Re-use existing landings where their location is compatible with management objectives and water quality protection. · Use applicable practices of BMP Veg-2 (Erosion Prevention and Control) to minimize and control erosion as needed during construction and use of log landings. · Install and maintain suitable temporary erosion control and stabilization measures when the landing will be reused within the same year. · Use applicable practices of BMP Fac-6 (Hazardous Materials) and BMP Road-10 (Equipment Refueling and Servicing) when managing fuels, chemicals, or other hazardous materials on the landing. · Use suitable measures as needed to restore and stabilize landings after use. i.e. Rehabilitate utilized landings within RHCAs and sediment delivery zones. Pull back/flatten out berms to reestablish drainage. Sub-soil, till and waterbar, or otherwise de-compact (as soil conditions allow, to be

Activity	BMP Objective/PDC Specific Practices'
	verified by the Soil Scientist) affected areas within the RHCA and sediment delivery zone. Sub-soiling is first preference, tillage is second preference. If tillage is not possible or feasible, large slash or woody debris is specified to be used. Riparian associated vegetation would be planted or seeded. Provide cover with large slash or woody debris to increase roughness, dissipation of flow and erosion control. · Landings that are located on a gravel road or at turnouts that will remain open to traffic use would be exempt from rehabilitation for hydrology purposes. · Remove all logging machinery refuse (e.g., tires, chains, chokers, cable, and miscellaneous discarded parts) and contaminated soil to a proper disposal site. · Reshape the surface to promote dispersed drainage. · Install suitable drainage features. · Mitigate soil compaction to improve infiltration and revegetation conditions. · Apply soil protective cover on disturbed areas where natural revegetation is inadequate to prevent accelerated erosion before the next growing season. · Use suitable measures to promote rapid revegetation. · Use suitable species and establishment techniques to cover or revegetate disturbed areas in compliance with local direction and requirements per FSM 2070 and FSM 2080 for vegetation ecology and prevention and control of invasive species.
	Spring Developments · Locate the water trough, tank or pond at a suitable distance from the spring to avoid or minimize adverse effects to the spring and wetland vegetation from livestock trampling or vehicle access. · Locate the spring box to allow water to flow by gravity from the spring to the spring box to eliminate disturbance from pumps and auxiliary equipment. · Design the collection system to avoid, minimize or mitigate adverse effects to the spring development and downstream waters from excessive water withdrawal, freezing, flooding, sedimentation, contamination, vehicular traffic and livestock as needed. o Collect no more water than is sufficient to meet the intended purpose of the spring development. o Ensure that enough water remains in the spring to support the source groundwater-dependent ecosystem and downstream aquatic ecosystems. o Avoid or minimize sediment or bacteria from entering the water supply system. o Trap and remove sediment that does enter the system. o Intercept the spring flow below the ground surface upslope of where the water surfaces. o Size the spring box sufficient to store expected volume of sediment generated between maintenance and water for efficient operation of the system, and to provide access for maintenance and cleaning. o Avoid or minimize backing up of spring flow by providing overflow relief sized to carry the maximum flow expected from the spring during periods of wet weather. o Use suitable measures to avoid or minimize erosion at the overflow outlet. o Maintain fish and wildlife access to water released below the spring development to the extent practicable.

Activity	BMP Objective/PDC Specific Practices’
	· Construct the spring development in such a manner to avoid or minimize erosion, damage to vegetation and contamination. o Use applicable practices from BMP AqEco-2 (Operations in Aquatic Ecosystems) when working in springs. o Divert all surface water away from the spring to the extent practicable to avoid or minimize flooding near the spring development. o Use suitable species and establishment techniques for wet conditions to cover or revegetate disturbed areas near springs in compliance with local direction and requirements per FSM 2070 and FSM 2080 for vegetation ecology and prevention and control of invasive species. · Operate and maintain the spring development and associated water storage in such a manner as to provide water of sufficient quantity and quality for the intended uses and avoid or minimize failure of infrastructure causing concentrated runoff and erosion. o Disinfect the spring water as needed to maintain water quality sufficient for intended uses in such a manner as to avoid or minimize adverse effects to the spring source. o Use suitable measures to manage uses such as livestock grazing and vehicle traffic around the spring development to avoid or minimize erosion and sedimentation affecting the spring. o Avoid heavy vehicle traffic over the uphill water-bearing layer to avoid or minimize compaction that may reduce water flow. o Use suitable measures to avoid or minimize overflow of water trough, tank or pond. o Periodically monitor the spring development, and promptly take corrective action, for sediment buildup in the spring box, clogging of outlet and overflow pipes, diversion of surface water from the collection area and spring box, erosion from overflow pipes and damage from animals.

Appendix D. Project Design Features for Riparian Restoration Activities – Adopted from NMFS and USFWS ARBO

Design Criteria -- LWD and Boulder Placement

1. Place LW and boulders only in those areas where they would naturally occur and in patterns that closely mimic that which would naturally occur for that particular stream type.

2. LW includes whole conifer and hardwood trees, logs, and root wads. LW size (diameter and length) should account for bankfull width and stream discharge rates. When available, trees with rootwads should be a minimum of 1.5 x bankfull channel width, while logs without rootwads should be a minimum of 2.0 x bankfull width. Place wood in a manner that most closely mimics natural accumulations of LW for that particular stream type. Structures may partially or completely span stream channels or be positioned along streambanks.

3. No conifers should be felled in the riparian area for in-channel large wood placement unless conifers are fully stocked and are consistent with project design criteria in vegetation treatment categories. Felled hazard trees can be used for in-channel wood placement.

4. Key boulders (footings) or LW may be buried into the streambank or channel but shall not constitute the dominant placement method of boulders and LW.

5. Anchoring Large Wood – Anchoring large wood with cable should only occur after first reviewing feasibility of the following, in preferential order, avoid cabling except as a last resort:

a. The size and weight of the wood sufficient for stability, no anchoring is required.

b. The wood is oriented in such a way that movement is unlikely (sharp bends in the stream, naturally narrow reaches, placed within a functional riparian zone.

c. Ballasting (gravel and/or rock) is used to increase the mass of the structure to resist movement (the height of the structure generally must be above design flow elevations) (this works well in systems with intact floodplains).

d. Large boulders are used as anchor points for the large wood.

e. Wood is pinned with rebar to large rock to increase its weight (the wood/rock combinations are still independent in the overall structure).

6. Gravel Augmentation – Gravel augmentation should only occur in areas where the natural supply has been eliminated or significantly reduced through anthropogenic means. Gravel to be placed in streams shall be a properly sized gradation for that stream, clean, and non-angular. When possible use gravel of the same lithology as found in the watershed. After gravel placement, allow the stream to naturally sort and distribute the material.

7. Boulder Weirs:

a. Full channel-spanning boulder weirs are to be installed only in highly uniform, incised, bedrock-dominated channels to enhance or provide fish habitat in stream reaches where log placements are not practicable due to channel conditions (not feasible to place logs of sufficient length, bedrock dominated channels, deeply incised channels, artificially constrained reaches, etc.), where damage to infrastructure on public or private lands is of concern, or where private landowners will not allow log placements due to concerns about damage to their streambanks or property.

b. Install boulder weirs low in relation to channel dimensions so that they are completely overtopped during channel-forming flow events (approximately a 1.5-year flow event).

c. Place boulder weirs diagonally across the channel or in more traditional upstream pointing "V" or “U” configurations with the apex oriented upstream. Structures installed perpendicular to the streamflow are not covered in this consultation.

d. Boulder weirs are to be constructed to allow upstream and downstream passage of all native listed fish species and life stages that occur in the stream. This can be accomplished by providing plunges no greater than 6” in height, allowing for juvenile fish passage at all flows.

e. The use of gabions, cable or other means to prevent the movement of individual boulders in a boulder weir is not allowed.

f. Rock for boulder weirs shall be durable and of suitable quality to ensure permanence in the climate in which it is to be used. Rock sizing depends on the size of the stream, maximum depth of flow, planform, entrenchment, and ice and debris loading

g. The project designer or an inspector experienced in these structures should be present during installation.

h. Full spanning boulder weir placement should be coupled with measures to improve habitat complexity and protection of riparian areas to provide long-term inputs of LW.

8. Tree Removal for LW Projects

a. Trees may be removed by cable, groundbased equipment, horses or helicopters, or felled directly into the stream. Felled trees may be stock-piled for later use in instream restoration projects.

b. Individual trees or small groups of trees (<5) should come from the periphery of permanent openings (roads etc) or from the periphery of non-permanent openings

(e.g. plantations, along recent clear-cuts etc).

c. Single trees may only be removed from the first two lines of trees.

d. Trees selected for LW restoration projects must be spaced at least one site potential tree height apart and at least one crown width from any trees with potential nesting structure for ESA-listed bird species.

9. If other aquatic restoration activities included in this consultation are used as complementary actions, follow the associated design criteria and conservation measures.

Design Criteria—Headcut Stabilization

In an emergency head-cut event, armor the head-cut with sufficient appropriately sized material to prevent continued up-stream movement. Materials can include both rock and organic materials which are native to the area. The Action Agencies will focus stabilization efforts in the plunge pool, the head cut, and a short distance above the head-cut. Minimize lateral migration of channel around the head cut (“flanking”) by placing rocks and organic material at a lower elevation in the center of the channel cross section to direct flows to the middle of channel.

2. For non-emergency head cut stabilization actions, the following two grade control treatments are acceptable alternatives to stabilize a head cut and re-establish fish passage. These alternatives are also acceptable to complete channel stabilization and fish passage activities during the first in-water work period, for previously-treated emergency head-cut sites.

These alternatives may also include complete or partial removal of all materials placed at head-cut during emergency stabilization efforts, and replacement with carefully designed, long-term, fish passage friendly, head-cut stabilization options.

The choice of treatment should be based on site characteristics and limitations (i.e., channel slope, bed material type), but may also be based on material availability, economics, land use, design competence or familiarity, and/or regulatory restrictions (i.e., jump heights for fish). NMFS Level 1 Team members will assist the action agencies in choosing an appropriate treatment.

a. Large Roughness Elements: In many Pacific Northwest streams, large wood and boulders provide natural grade control in the form of channel spanning log jams or debris flow deposits. Hence, the designed rock and wood structure should mimic natural colluvial features, such as debris flow or landslide deposits, that provide this base level control or grade stabilization in areas where the risk of head-cut migration exists. This technique is applicable to a wide range of stream types, from low gradient meandering streams (less than 1%) to high gradient cascade channels (greater than 8%). The goal of using large roughness elements is not to completely halt the incision process, but rather to slow it down and spread the elevation change over a greater length of channel. Since log jams are porous structures, not all of the sediment will be held in place; however, sediment inputs will be spread out over time rather than introduced to the stream as one large pulse. A log jam is also self-maintaining as long as more large wood is available in the stream system. Rock and wood should be sized so that it is not mobile during the design flood. Buoyancy calculations to determine appropriate ballast requirements should be completed for structures that will be completely inundated.

b. Rock and Log Weirs: Rock and log weirs are very low channel spanning structures that are often used to stabilize streambeds and halt channel incision. These weirs are used in low gradient (generally less than 2%) streams. The weirs are ‘V’ shaped, oriented with the apex upstream, and are lower in the center to direct flows to the middle of channel. A series of V weirs will help to stabilize stream gradient, dissipate energy, provide some level of bank protection, and will maintain fish passage. Weirs should be keyed into the stream bed by a minimum of 2.5 x their exposure height to minimize structure undermining due to scour. The weir should also be keyed into both banks a minimum of 8 feet. If several structures will be used in series, weir spacing should be no closer than the net drop divided by the channel slope (for example, a one-foot-high weir in a stream with a 2% gradient will have a minimum spacing of 50 feet. Weirs can fail if flow goes subsurface flow below weir material. If placed material is coarse and unconsolidated, it is possible that upstream flows will go subsurface and reemerge at the downstream end of the structure, effectively causing a complete passage barrier. Careful consideration of subsurface flow is therefore required before weir construction.

Design Criteria – Fish Passage Restoration and Culvert Replacement

1. Fish passage projects will be designed by an experienced engineer with design input from an experienced fish biologist and hydrologist. Such personnel shall oversee or review the project during construction to ensure that project designs and conservation measures are being properly implemented.

2. Forest Service Design Assistance Teams or the BLM and Coquille Tribe equivalent will provide design review for projects that exceed $100,000 or will result in structures that are greater than 20 feet wide.

3. Assess sites for a potential to head-cut below the natural stream gradient. Projects that lead to head-cutting below the natural stream gradient are excluded from this consultation.

4. Design Standards

a. Structure Type – Structure types include closed-bottomed culverts, open-bottomed arch culverts, and bridges. Structure material must be concrete or metal.

b. Structure Width – The structure width shall never be less than the bankfull channel width. (The stream width inside the culvert or between bridge footings shall be equal to or greater than the bankfull width.) The minimum structure width and height for a closed bottom culvert shall be 6 feet to allow manual placement of stream simulation material. Structures must accommodate a 100-year flood flow while maintaining sediment continuity (similar particle size distribution) within the culvert as compared to the upstream and downstream reaches. To meet this requirement, unconfined channel types (Rosgen C, E, and B channel types (Rosgen 1996)) may require structures wider than bankfull and/or the addition of flood relief culverts or other comparable flood relief methods.

c. When possible, flood relief culverts will be designed to restore and maintain access to off-channel rearing and high flow areas for juvenile and adult fish. Therefore, existing floodplain channels should be the first priority for location of flood relief culverts which should be installed in a manner that matches floodplain gradient and does not lead to scour at the outlet.

d. Channel Slope – The structure slope shall approximate the average channel gradient of the natural stream up- and downstream of the structure. The maximum slope for closed-bottomed culverts shall not exceed 6% because of difficulties in retaining substrate in the culvert at higher gradients. Open-bottom arches can be placed in channel gradients that exceed 6%.

e. Embedded Culvert – If a closed culvert is used, the bottom of the culvert shall be buried into the streambed not less than 20% and not more than 50% of the culvert height. For open-bottomed arches and bridges, the footings or foundation shall be designed to be stable at the largest anticipated scour depth. Substrate and habitat patterns within the culvert should mimic stream patterns that naturally occur above and below the culvert. Coarser material may be incorporated to create velocity breaks during high flows, thereby improving fish passage, and to provide substrate stability.

f. Riprap – The use of riprap is permissible above bankfull height to protect the inlet or outlet of new culverts or open-bottomed arches. If the use of riprap is required for culvert stability, then an additional analysis may be required to ensure that the structure is not undersized. Riprap may only be placed below bankfull height when necessary for protection of abutments and pilings for bridges. However, the amount and placement of riprap around the abutments and/or pilings should not constrict the bankfull flow.

g. Grade Control Structures – Grade control structures are permitted to prevent head-cutting above or below the culvert or bridge. Grade control typically consists of boulder structures that are keyed into the banks, span the channel, and are buried in the substrate.

h. Where applicable, incorporate road dips into crossing designs, to ensure catastrophic flood events will transport overflow back into the downstream channel instead of the road bed.

i. Structures containing concrete must be sufficiently cured or dried before they come into contact with stream flow.

j. In cases of structure removal or when removing an existing structure and replacing it with a bridge, consideration should be given to restoring the stream channel and reconnecting the floodplain at the site.

k. When removing woody debris from the road-crossing inlet, place the debris downstream of the road crossing.

l. Monitor structures after high flow events, which occur during the first fall/winter/spring after project completion. Assess the following parameters: head-cutting below natural stream gradient, substrate embeddedness in the culvert, scour at the culvert outlet, and erosion from sites associated with project construction. Apply remedial actions (using project design criteria and conservation measures) if projects do not meet the intended goals.

m. If other aquatic restoration activities are used as complementary actions, follow the associated design criteria and conservation measures.

Conservation Measures Along with the general conservation measures summarized at the end of this section, the following conservation measures would be used to minimize sediment and turbidity and the effects of fish handling/transport:

1. Isolate construction area and remove fish from project area. Fish shall be removed from project area (see fish capture guidelines below). Dewater Construction Site – Upstream of the isolated construction area, coffer dams (diversions) constructed with non-erosive materials are typically used to divert stream flow with pumps or a by-pass culvert. Diversions constructed with material mined from the streambed or floodplain are not permitted. Pumps must have fish screens and be operated in accordance with NMFS fish screen criteria. Dissipate flow energy at the bypass outflow to prevent damage to riparian vegetation or stream channel. If diversion allows for downstream fish passage, (i.e., is not screened), place diversion outlet in a location to promote safe reentry of fish into the stream channel, preferably into pool habitat with cover. When necessary, pump seepage water from the dewatered work area to a temporary storage and treatment site or into upland areas and allow water to filter through vegetation prior to reentering the stream channel.

3. Stream Re-Watering – Upon project completion, slowly re-water the construction site to prevent loss of surface water downstream as the construction site streambed absorbs water and to prevent a sudden increase in stream turbidity. Monitor downstream during re-watering to prevent stranding of aquatic organisms below the construction site

4. Fish Handling – If capture, removal, and relocation of fish are required, follow these steps:

a. All fish capture, removal, and handling activities shall be conducted by an experienced fisheries biologist or technician.

b. Isolate capture area – Install block nets at upstream and downstream locations and leave in a secured position to preclude fish from entering the project area. Leave nets secured to the stream channel bed and banks until fish capture and transport activities are complete. If block nets or traps remain in place more than one day, monitor the nets and or traps at least on a daily basis to ensure they are secured to the banks and free of organic accumulation and to minimize fish predation in the trap.

c. Fish Capture Options

i. Collect fish by hand or dip nets, as the area is slowly dewatered.

ii. Seining – Use seine with mesh of such a size to ensure capture of the residing ESA-listed fish.

iii. Minnow traps – Traps will be left in place overnight and in conjunction with seining

iv. Electrofishing – Prior to dewatering, use electrofishing only where other means of fish capture may not be feasible or effective. The protocol for electrofishing includes the following:

If fish are observed spawning during the in-water work period, electrofishing shall not be conducted in the vicinity of spawning adult fish or active redds.

Only Direct Current (DC) or Pulsed Direct Current (PDC) shall be used.

Conductivity <100 use voltage ranges from 900 to 1100. Conductivity from 100 to 300 then use voltage ranges from 500 to 800. Conductivity greater than 300 then use voltage to 400.

Begin electrofishing with minimum pulse width and recommended voltage and then gradually increase to the point where fish are immobilized and captured. Turn off current once fish are immobilized.

Do not allow fish to come into contact with anode. Do not electrofish an area for an extended period of time. Remove fish immediately from water and handle as described below. Dark bands on the fish indicate injury, suggesting a reduction in voltage and pulse width and longer recovery time.

5. Handling and Release –Fish must be handled with extreme care and kept in water for the maximum extent possible during transfer procedures. A healthy environment for the stressed fish shall be provided—large buckets (five-gallon minimum to prevent overcrowding) and minimal handling of fish. Place larger fish in buckets separate from smaller prey-sized fish. Monitor water temperature in buckets and well-being of captured fish. As rapidly as possible (especially for temperature-sensitive bull trout), but after fish have recovered, release fish upstream of the isolated reach in a pool or other area that provides cover and flow refuge. Document all fish injuries or mortalities and include in annual report.sediment mix and construction techniques that include washing material into place to seal the weir to the channel bed is highly recommended.

3. If other aquatic restoration activities are used as complementary actions, follow the associated design criteria and conservation measures.

Appendix E. Assessment of Consistency with INFISH Riparian Goals.

The assessment of consistency with INFISH riparian goals is for the proposed action (Alt 2). Action alternative 4 would have similar effects to RHCA, redband trout and CSF as the proposed action. While Alt 3 would have less potential for short term effects in RHCA but would do less to achieve the desired future condition.

INFISH Goal 1: Maintain or restore water quality, to a degree that provides for stable and productive riparian and aquatic ecosystems.

The project would contribute to a restorative effect on Goal 1 at the project and watershed scale through implementation of project design features (PDF), BMPs and riparian restoration activities (described below). No-cut buffers along all stream courses would protect sensitive portions of riparian areas from disturbance; riparian buffer widths would be variable depending on fish presence, stream size, slope stability, shade cover, sediment delivery potential and water quality considerations.

PDF were developed to minimize adverse environmental effects of the proposed activities to streams, wetlands, and RHCAs. These PDFs comply with the standards and guides outlined in the Ochoco National Forest Plan, INFISH, as well as requirements for protection of water quality in the State of Oregon in accordance with the Clean Water Act (DEIS Appendices). The PDFs in this document were developed to comply with the National Core BMPs. These core BMPs are meant to provide direction in the development of project specific practices such as the PDF in this document. An extensive list of project applicable BMPs are included in the Hydrology Report on file. BMPs have guided the entire project process so as to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources to meet the intent of the Federal and State water quality laws and regulations, Executive orders, and USDA and Forest Service directives (BMP Guide). The Gap Project was planned to avoid or minimize adverse effects to soil, water quality and riparian resources when conducting mechanical vegetation treatment activities in the AMZ (BMP Veg-3). The project would thin overstocked stands in the RHCA to promote large tree development and would actively and passively add LWD to stream channels and RHCA.

Upon project completion, the potential net decrease in sediment delivery would be 95% for Alt.2/4 and 91% for Alt.3. Conditions of riparian and aquatic systems would improve as sediment levels are reduced below the existing condition (pre-project) from closure and decommission of roads; 20.6 and 3.3 miles respectively. In addition, long term (3-100-plus years), sediment production would decrease due to unit-specific prescription that require the felling/pushing of trees to meet the INFISH large wood RMO and the riparian restoration activities proposed throughout the Gap project area (see DEIS). Riparian restoration activities include instream work on 13.7 miles of fish bearing streams, hardwood aspen enhancement (213 acres), headcut repairs, floodplain reconnection and the replacement of six culverts. These activities would serve to capture and reduce sediment, provide increased development of riparian vegetation, narrow stream channels, deepen pools, and reconnect water tables thereby improving water quality including the temperature regime.

INFISH Goal 2: Maintain or restore stream channel integrity, channel processes, and the sediment regime (including the elements of timing, volume, and character of sediment input and transport) under which the riparian and aquatic ecosystems developed.

The project would contribute to a restorative effect on Goal 2 at the project and watershed scale through implementation of project design features (PDF), BMPs and riparian restoration activities. The Gap project would both maintain and move towards restoring stream channel integrity, channel processes, and the sediment regime (including the elements of timing, volume, and character of sediment input and transport). PDF were developed to protect stream channel integrity, channel processes and prevent sediment production and delivery where practicable, to reduce the potential for sediment delivery to minimal or somewhat negligible amounts, and to restore areas that otherwise could have the potential to contribute in the long-term (see Goal #1).

A majority of the proposed treatment areas would also receive site specific project design criteria based upon observations from field visits, the professional judgment of aquatic specialists, and site specific data. When implemented, these practices have high effectiveness, and they would come close to eliminating potential sediment delivery during operations. Through the combination of these site specific PDF and BMPs, the redundancy of conservation activities would reduce the potential for sediment delivery in the short-term from the proposed action during implementation to quantities that are the least amount practicable in order to achieve the purpose and need of the project.

Goal 2 would improve because bank stability would increase due to denser stands of hardwoods and other riparian plants along the stream channel through hardwood enhancement activities and a reduction in conifer canopy. With an increase in hardwoods and other riparian vegetation, the width-to-depth ratio would decrease as channels narrowed due to sediment being captured by reestablishing riparian plants and other woody debris. Additionally, the increase in large woody debris, through the felling/tipping of trees, positively affects erosion, transport and floodplain sedimentation. Dams formed by the accumulations of large wood would increase channel complexity and facilitate the deposition of organic matter. Lastly, bank stability and width-depth-ratio would be improved via channel reconstruction, floodplain reconnection and repair of downcut channels. It is estimated that most of the sediment load in the project area is coming from in-channel erosion such as cutbanks, headcuts, and scour with a total of at least 50+ tons of sediment per year. Therefore, addressing this legacy in channel erosion via riparian restoration activities is critical to long-term improvements in improving stream channel integrity, channel processes, and the sediment regime.

INFISH Goal 3: Maintain or restore instream flows to support healthy riparian and aquatic habitats, the stability and effective function of stream channels, and the ability to route flood discharges.

Through the implementation of the proposed vegetation treatments, EHA values are calculated to increase from 7.2% to 17.1% for the Upper North Fork Crooked River watershed and increase from 10.3% to 23.8% for the Horse Heaven Crooked River watershed. Although an increase in EHA is anticipated, the expected EHA value for these alternatives is well below the established threshold of concern of 30% and 35% as specified for the watershed. The increase in EHA may result in small scale alteration of runoff/overland flow, but the degree is still well below threshold and is not expected to result in measureable adverse effects to peak flows or stream condition from erosion. Site specific stream buffering developed from on-site field visits by the IDT (interdisciplinary team) would decrease overland flow due to adequate roughness provided by on-site buffer zones and localized equipment restrictions. Stream buffering zones are based on local slopes, existing stream conditions, shade and surface texture of soils.

The riparian restoration efforts, such as falling and pushing additional trees into stream courses, would increase hydraulic roughness, slow flow velocities and begin to build stream terraces and increase floodplain storage of water. The planting of additional hardwoods would help decrease bank erosion, help slow stream velocities and trap additional sediment thereby potentially raising water tables, improving the effective function of stream channels and ability to route flood discharges.

Channel and headcut repairs would help stop the upstream migration of headcuts and subsequent lowering of water tables. Gully formation would be stopped and water tables would remain intact above the headcut repairs. Increased water storage and resultant lower release rates would maintain the productivity of these riparian areas. Riparian restoration activities specifically, channel repair, culvert replacement and stream restoration would improve the ability of streams to route flood discharges by reconnecting streams with their floodplains.

Overall, the Gap Project would be consistent with the standards and guidelines in the Ochoco LRMP pertaining to EHA, flow and consistent with INFISH RMOs pertaining to channel condition. There are no expected measureable adverse effects to runoff and stream flow from the preferred Alternative.

INFISH Goal 4: Maintain or restore natural timing and variability of the water table elevation in meadows and wetlands.

The Gap project was planned to maintain and restore the condition of land around and adjacent to waterbodies. The project would contribute to a restorative effect on Goal 4 at the project and watershed scale through implementation of project design features (PDF), BMPs and riparian restoration activities. No-cut buffers along all stream courses would protect sensitive portions of riparian areas from disturbance thereby maintaining natural timing and variability of the water table elevation. RHCA boundaries were applied during unit design for the Gap project. Streams, wetlands/riparian areas, and ponds were identified using GIS and in many cases field verified.

As described in Goal 3, riparian restoration activities, specifically channel and headcut repair, culvert replacement and stream restoration would restore the natural timing and variability of the water table elevation in meadows and wetlands by reconnecting floodplains, restoring water tables and stabilizing streamflows; all critical to the functionality of meadows and wetlands.

INFISH Goal 5: Maintain or restore diversity and productivity of native and desired non-native plant communities in riparian zones.

The project would contribute to a restorative effect on Goal 4 at the project and watershed scale through implementation of project design features (PDF), BMPs and riparian restoration activities. No-cut buffers along all stream courses would protect sensitive portions of riparian areas from disturbance thereby maintaining and restoring the diversity and productivity of native plant communities in riparian zones.

Riparian habitat in the Gap project area is characterized by hardwood stream vegetation composed of mountain alder (*Alnus incana*) with remnant patches of quaking aspen (*Populus tremuloides*), willow (*Salix spp.)*, and a variety of riparian shrub species including dogwood (*Cornus sericea*), currents (*Ribes spp.*), along with sedges (*Carex spp.*), rushes (*Juncus spp.*), and grass/forb communities forming riparian meadows scattered across the project area. Riparian plant communities provide habitat for a diverse array of plant and animal species.

The majority of sensitive plant species on the Ochoco National Forest are associated with riparian habitats (see Botany report), including Peck's mariposa lily (*Calochortus longebarbatus* var. *peckii*), several species of moonworts (*Botrychium spp*.), several sedge species (*Carex spp*.), bladderwort (*Utricularia minor*), spikerush (*Eleocharis bolanderi*), Wolf willow (*Salix wolfii*), and several sensitive mosses (*Tomentypnum nitens, Helodium blandowii,* and *Schistidium cinclidodonteum*).

Some of these sensitive plant species occur in the Gap project area, but are at risk, particularly Peck's mariposa lily, because of degraded riparian conditions, including overstocking and conifer encroachment in riparian zones as well as the lowering of the water table as a result of stream down cutting. Other sensitive plants with habitat in the project area, such as *Botrychium montanum* and *B. crenulatum* are also at risk as a result of degraded riparian conditions. Proposed treatments in riparian zones would benefit sensitive plants and improve the overall diversity of riparian plants. Specifically, stream restoration (including planting with native vegetation), culvert replacement, LWD placement, road decommissioning, and hardwood enhancement would improve habitat for native and rare plants.

Non-native invasive plants are established in the Gap project area (see Botany Report). There are major roads along these riparian areas with most weeds occurring along the road shoulders, although some are beginning to invade the surrounding native habitat. Oxeye daisy is of particular concern because it readily establishes in riparian zones, and has the ability to form large patches of rhizomatous growth. Non-native invasive weeds in riparian areas with sensitive plant species have a significant negative effect. If there is no treatment of the invasive plants, they would continue to spread and new infestations are likely to spread into riparian areas. The ONF proposes to implement invasive plant prevention and control activities to be implemented before, during, and after project activities. These activities were analyzed under the Deschutes and Ochoco NFs Invasive Plant FEIS (USDA 2012).

INFISH Goal 6: Maintain or restore riparian vegetation, to:

a. provide an amount and distribution of large woody debris characteristic of natural aquatic and riparian ecosystems;

b. provide adequate summer and winter thermal regulation within the riparian and aquatic zones; and

c. help achieve rates of surface erosion, bank erosion, and channel migration characteristics of those under which the communities developed.

The Gap project would contribute to the restoration of Goal # 6 at the project and watershed scale by maintaining and restoring the composition and structural diversity of riparian vegetation both outside and within RHCA and protect their function and resiliency. Specifically, these treatments are intended to retain the abundance of large trees, restore fire tolerant species, restore LWD instream and in RHCA, reduce risk of high severity wildfire, restore meadow habitats and increase the abundance and vigor of hardwoods. Treatments were developed with site specific design features to maintain and improve RMO; PDF incorporated slope, aspect, stream condition, soil conditions and existing vegetation. PDFs include no-cut variable width buffers along stream-courses and avoiding any new stream crossings for temporary roads which would protect riparian areas from disturbance and maintain the existing riparian vegetation. Riparian restoration activities including: stream restoration, channel repair, hardwood enhancement units, road closure and decommissioning and culvert replacement would also contribute to this Goal. Active management (commercial treatments, PCT and Rx fire and riparian restoration) within forested stringers and RHCA would reduce risks to riparian vegetation and increase resiliency from uncharacteristic wildfire and climate change.

The Gap project requires no cut buffers along all riparian corridors and wetlands of various widths. These buffers encompass diverse plant communities, protect current shading levels for thermal regulation, protect stream banks from operational disturbances and ensure that potential sediment does not get routed to streams or wetlands. Designated no cut buffers along units in the planning area, would also protect channel migration processes. None of the new construction or existing disturbance temporary roads would cross class 1-3 streams. Some skid trail crossings are anticipated and would be limited to dry class IV intermittent stream channels; crossings would be rehabilitated per PDF. The proposed road decommissioning would initiate restoration along riparian corridors at current road crossings. How the selected alternative would maintain or restore aquatic habitat elements is described in the Gap DEIS.

The proposed thinning treatments are intended to retain the abundance of large trees, restore fire tolerant species, reduce risk of high severity wildfire, restore meadow habitats and increase the abundance and vigor of hardwoods. The maintenance of existing large trees would occur and treatments would promote the development of additional large trees.

Mortality of large trees would not be eliminated, but would be reduced below the level associated with No-Action Alternative. This would result in a reduction of potential large wood recruitment within RHCAs in the short term, but would increase the likelihood of a long term supply of large trees. To offset this potential short fall, unit prescriptions include requirements to fall trees to meet the INFISH LWD RMO (see Gap DEIS). In addition, unit prescriptions include no treatment zones and modified or no commercial harvest zones adjacent to stream channels so that future recruitment trees are available near stream channels. In many cases, PDFs maintain the majority of the LWD recruitment zone.

Underburning outside of commercial and noncommercial thinning units is also proposed within this project. This activity is primarily focused on the reduction of existing ground fuels and includes design features which are intended to meet INFISH RMOs. It is anticipated that there would a minor amount of understory conifer mortality resulting from underburning. Reducing unwanted density of understory trees would complement the silvicultural activities and improve landscape resiliency. Vegetative Landscape heterogeneity would be maintained and improved in RHCA via the scope and scale of treatments and through retention areas or no commercial harvest zones that allow for untreated stand conditions to provide different stocking levels and species composition. No treatment areas also protect existing snags and LWD. Existing LWD of all sizes would also remain on site in treated areas.

Riparian restoration activities would improve riparian vegetation and aquatic habitats by restoring water tables critical to the functionality of stream and riparian ecosystems. Riparian restoration would improve riparian vegetative conditions in the long-term. Riparian restoration would increase the amount of LWD to streams, improve current shading levels for thermal regulation, reduce surface and bank erosion, and restore floodplains and channel migration characteristics. Specific PDF and BMPs would be applied to reduce short-term impacts from riparian restoration activities (see PDFs).

INFISH Goal 7: Maintain or restore riparian and aquatic habitats necessary to foster the unique genetic fish stocks that evolved within the specific geo-climatic region.

This project maintains and improves INFISH Goal # 7 by protecting and restoring habitat for Redband trout. Activities within RHCAs including thinning, hardwood enhancement, stream restoration, culvert replacement, road closure and decommissioning, headcut repair and felling trees within RHCA units to meet large wood RMOs would be utilized to meet this objective. The project contributes to a restorative effect on Goal #7 through restoring aquatic organism connectivity by replacing six unpassable culvert within the project area.

The status of redband trout populations is the Upper N.F. Crooked River and Horse Heaven Creek-Crooked River Watersheds is mixed. Habitat is fragmented and isolated populations of redband trout due to temperatures barriers and culverts that block upstream passage (Stuart et al. 2007). Redband trout are moderately abundant in tributaries with good habitat and cool water but are depressed in tributaries with poor fish habitat or degraded riparian conditions. Within these watersheds they are widely distributed but are still sensitive to disturbance and considered vulnerable to local extirpations. Habitat connectivity for redband trout is severely compromised in the project area. Many of the culverts are not passable to fish including some priority culverts in the lower and mid-level in the drainage and on the lower portions of significant tributaries where the higher value fish habitat exists. Besides degrading habitat and affecting water tables, and water quality, headcuts can also restrict fish connectivity; the project area contains numerous headcuts and downcut channels were identified in the Upper N.F. Crooked River and Horse Heaven Creek-Crooked River Watersheds.

The Gap project would contribute to the restoration of Goal # 7. Site specific design criteria were developed to maintain and improve RMO; these include no-cut variable width buffers along stream courses and avoiding any new stream crossings for temporary roads would protect riparian areas from disturbance and maintain the existing riparian vegetation.

Riparian restoration activities would improve riparian and aquatic habitats by restoring water tables critical to the functionality of stream and riparian ecosystems. Riparian restoration would improve riparian vegetative conditions long-term, increase the amount of LWD to streams, increase the amount of pools, improve current shading levels, reduce surface and bank erosion, decrease width/depth ratios, restore floodplain function and restore channel migration characteristics. Specific PDF and BMPs would be applied to reduce short-term impacts from riparian restoration activities (Hydrology report and Appendix C).

INFISH Goal 8: Habitat to support populations of well-distributed native and desired non-native plant, vertebrate, and invertebrate populations that contribute to the viability of riparian-dependent communities.

This project contributes to the restoration of this INFISH goal through restoring habitat for riparian-dependent species by improving riparian conditions and upland vegetation within. Activities within RHCAs including thinning, hardwood enhancement, stream restoration, culvert replacement, headcut repair and felling trees within RHCA units to meet large wood RMOs would be utilized to meet these objectives. Proposed treatments in riparian zones would benefit rare plants and improve the overall diversity of riparian plants.

Riparian thinning would reduce the understory fir component on acres dominated by ponderosa pine and western larch and increase the abundance of more open stand structure with ponderosa pine contributing a relatively larger percentage of the species composition. Thinning in young stands promotes the development of large pine in the future, and thus benefits those species that rely on old forest single stratum forest such as the white-headed woodpecker and Lewis's woodpecker. Riparian thinning and aspen treatments are intended to improve riparian shrubs and riparian hardwoods; this would improve vegetation diversity and habitat for a variety of raptor prey species. The development of herbaceous and shrubby vegetation in the understory that results from reducing conifer density should also improve habitat for many species of shrub and ground nesting birds, and the ability of open forest avian predators to effectively hunt ground dwelling small mammals would be improved. Additionally, numerous species of raptors rely on mature trees within riparian areas for nesting and roosting including the bald eagle and osprey.

In 2000, the Oregon-Washington Partners in Flight published the *Conservation Strategy for Landbirds in the Northern Rocky Mountains of Eastern Oregon and Washington* (Altman 2000). The overall goal of the conservation strategy is to ensure long-term maintenance of healthy populations of native landbirds by identifying conditions and habitat attributes important to the landbird community. The conservation strategy identified riparian woodland and shrub habitat as a priority habitat and identified biological objectives such as: restoring natural hydrological regimes to reclaim natural features, restoring hardwood trees in riparian systems, enhance the size and connectivity of riparian woodland and shrub patches, and initiate actions to improve quality of degraded riparian woodland and shrub habitat (Altman 2000). The Gap project would contribute to meeting the objectives of the conservation strategy through riparian restoration activities including and the felling of trees within RHCAs to meet large wood RMO. Focal species associated with Riparian Woodland and Shrub habitat types including the Lewis' woodpecker, red-eyed vireo, veery, and the willow flycatcher would benefit as a result of enhancing hardwood species within riparian areas (See wildlife section in Gap DEIS).

Repair of headcuts and stream restoration to stop channel down cutting and provide for stable water tables would occur on six sites; increasing hardwood release and planting project success. These riparian areas would become more desirable for calving and fawning for rocky mountain elk and mule deer (See wildlife section in Gap DEIS). This project would not have any impact to the silver-bordered fritillary or the Johnson's hairstreak because habitat for these species does not occur within the project area. No known sensitive aquatic invertebrate species are known to be present in the project area.

The Columbia spotted frog (CSF) is the only amphibian on the Region 6 Sensitive Species list found in the project area. Of the commonly known threats to this species, loss of wetland habitat due to drought, channel incision (i.e., loss of floodplain connectivity), and agricultural water withdrawals are of greatest concern. Water is relatively scarce in the project area and the breeding habitat for CSF is generally limited to perennial streams, wetlands and springs, many of which are degraded.

This project maintains and restores habitat for CSF by improving riparian and aquatic habitats. As described in Goal #6 and 7, the Gap project requires no-cut buffers along all riparian corridors and wetlands of various widths. These buffers encompass diverse plant communities, protect current shading levels for thermal regulation, protect stream banks and ensure that sediment does not get routed to streams or wetlands. Designated no-cut buffers along units in the project area would also protect frog migration and foraging areas. None of the new or existing disturbance temporary roads would cross class 1-3 streams. Few skid trail crossings are anticipated and would be limited to dry class IV intermittent stream channels; crossings would be rehabilitated as per PDF in the (see Gap DEIS). How the selected alternative would maintain or restore aquatic habitat elements is described in the Gap DEIS.

Species with narrow habitat requirements in highly degraded and fragmented systems are likely to be the most vulnerable to fire and fire-related disturbance. Therefore, proposed riparian restoration activities, specifically stream restoration and culvert replacement would improve CSF habitat and connectivity by restoring water tables critical to the functionality of stream and riparian ecosystems.

The action alternatives provide 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.

Appendix F. Joint Aquatic and Terrestrial Programmatic Biological Assessment PDC

Table F-1. 2010 – 2013 Joint Aquatic and Terrestrial Programmatic Biological Assessment PDC.

Project Design Criteria Compliance Checklist (attach to BE/BA)	Applies to project (Yes/No)	Project Complies (Yes/No)
Oregon and Columbia Spotted Frogs		
A. Do not fragment or convert wetland habitat to upland habitat through management activities	No	X
B.1. Do not allow in channel, lake, or shoreline digging except as needed for restoration	No	X
B.2. Comply with Fish PDC: (c) Sediment and Substrate 1,2,3,6,7,8,9,10, (d) Bank Stability 1,2, and (g) Livestock Grazing 3,4,5	Yes	Yes
C. No changes in stream, spring, lake, or wetland hydrology except as needed for restoration	Yes	Yes
C.1. In reservoir habitats, maintain or develop shallow water habitat with emergent veg through July	No	X
C.2. Do not allow removal of fish passage if it causes introduction of non-native species	No	X
D. Activities within the channel migration zone or 100-year floodplain are restricted 3/1 thru 5/31	Yes	Yes
E. Maintain connectivity through properly functioning streams, marsh, in stream, and floodplain vegetation. Restore native sedges, rushes, and willows where possible and appropriate	Yes	Yes
F. Use of pesticides, herbicides, and similar potential contaminants are prohibited in and immediately adjacent to wetland habitat. Be conservative when estimating drift to avoid any contamination	No	X

Appendix G Aquatics: Effects Common to all Action Alternatives

The following analysis has been summarized from the 2015 USFS R6 Aquatic Restoration Biological Opinion as prepared by the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) for aquatic restoration activities in Region 6. Although this analysis was intended for TE species such as salmon, steelhead and bull trout it can be used as surrogate to describe generalized effects to redband trout and Columbia spotted frog. Project specific effects are discussed in discussion of measures 1-4 later in this document.

Riparian Vegetation Treatment (noncommercial, hand felling with chainsaws): Many riparian areas throughout Oregon were logged aggressively in the past 100 years. Additionally, fire suppression in dry forests has resulted in unnaturally high tree densities along stream corridors. As a result, many riparian areas are dominated by dense, even-aged stands of small diameter conifers or hardwood species such as alder (*Alnus sp.*). Large-diameter conifers that provide shade and appropriately-sized large woody debris are typically missing from these areas. The Forest Service proposes to carry out noncommercial thinning, primarily with chainsaws, to restore plant species composition and structure that would occur under natural disturbance regimes. The most common application of this activity would be to reduce small tree density prior to conducting prescribed fire (the effects of prescribed fire in riparian areas are discussed later in this document).

Some studies (Lindh and Muir 2004, Drever 2005 in USDA 2012) have shown that thinning of conifer or hardwood stands in the Pacific Northwest results in accelerated growth of trees. The Forest Service proposes this activity to accelerate the development of mature stands of large trees along streams to provide large woody debris and wildlife habitat. Spies et al. (2013) recognizes that thinning is most beneficial in young stands and that non-conventional thinning can accelerate dead wood production. The Gap project would not thin dead snags from the RHCA and would actively add LWD to RHCA and stream channels to meet RHCA objectives. Also, windthrow following thinning can add more downed wood to RHCA and stream channels. Benda et al. (2002) recognizes windthrow as a significant contributor of large wood to streams. The Short-term adverse effects include minor reductions in stream shade, input of allochthonous materials, and small woody materials. Since the proposed activity does not involve ground-disturbing actions, inputs of fine sediment would not occur.

Riparian and Upland Juniper Treatment (noncommercial): The Forest Service proposes to noncommercially thin western junipers (*Juniperus occidentalis*) to restore montane plant communities to a structure that would occur under natural fire regimes. Western junipers have expanded rapidly into neighboring plant communities in the past 130 years primarily due to climatic influences, livestock grazing, and fire suppression (Miller *et al.* 2005 in USDOC 2007). Some authors have concluded that the unnaturally large number of juniper trees currently present in some areas may cause decreased stream flow due to evapotranspiration and increased soil erosion (Miller *et al.* 2005 in USDOC 2007). Other authors (Belsky 1996 in USDOC 2007) conclude that these concerns are only based on anecdotal evidence and observations and potential effects of juniper expansion are generally overstated in their severity. Regardless of one's position on juniper expansion, the restoration of natural plant community structure to riparian areas would be beneficial to stream ecosystems. The goal of this activity is not to favor a particular species or life-history stage, but to provide habitat resembling that in which native species evolved so as to support complete assemblages of these species. For example, the restoration of a natural plant community structure would enhance the production of nutrients and food organisms appropriate for the juvenile life-history stages of native species.

Reductions in stream shade and compaction of soils would result from juniper thinning in riparian areas and associated uplands. Streams where juniper removal would take place are typically small (5 to 15 feet wide), as juniper expansion tends to occur in dry areas. Streams and riparian areas within this arid environment are typically dominated by willow communities, willow/herbaceous plant communities, herbaceous meadow plant communities, or sagebrush/herbaceous plant communities (Crowe and Clausnitzer 1997). Reductions in stream shade from juniper removal are likely to be short-lived (likely 1-5 years) as the removal of the juniper overstory should increase shrub vigor and stream shade provided by junipers would be replaced by native shrubs. Beneficial effects from juniper treatment to salmonids and their habitat include increased allochthonous inputs from native shrub leaves and potentially, reduced evapotranspiration from junipers.

Riparian Vegetation Treatment (prescribed burning): In general, prescribed burning would be planned and implemented to result in low severity burns as defined in the National Fire Plan (2000). An exception is allowed for burns designed to invigorate aspen (Populus sp.) and willow (Salix sp.) stands. In aspen, profuse sprouting occurs after moderate- to high-intensity fires; less sprouting occurs following light burns (Fitzgerald 2010). Therefore, a burn of moderate intensity as defined in the National Fire Plan (2000) would be allowed. Moderate burns would be confined to the observable historic boundaries of the aspen or willow sites and would generally not encompass more than 20% of the riparian area being treated.

This activity may cause some short-term adverse effects on salmonids and their habitats. Generally, fires burn in a mosaic pattern of differing severities across the landscape, depending on topography, aspect, vegetation, weather, and other factors. Riparian areas frequently differ from adjacent uplands in vegetative composition and structure, geomorphology, hydrology, microclimate, and fuel characteristics (Dwire and Kaufmann 2003). Consequently, riparian areas typically react to wildfire and prescribed fire differently than adjacent uplands. Deciduous streamside vegetation immediately adjacent to the stream can recover rapidly (5 year; e.g., willows and alders), whereas forest trees (e.g., Douglas fir) recover over decades.

Wildfire can have a wide range of effects on aquatic ecosystems ranging from minor to severe (Reiman et al. 2003). However, this project proposes to carry out prescribed burns in the spring and fall when fuel moisture and relatively humidity are high. Under these conditions, burns in riparian areas tend to occur in a mosaic pattern, leaving considerable unburned area and resulting in low tree mortality. Areas with the highest moisture levels, immediately adjacent to streams, tend to receive the least damage from fire. Effects from low to moderate intensity prescribed fire in riparian areas include minor reductions in stream shade, minor reductions in LWD recruitment and inputs of fine sediment and nutrients to streams. In some cases, LWD levels would increase following prescribed fire (Chan 1998).

Although there is considerable research available on the effects of wildfire on streams and riparian areas, there is less information available on the effects of prescribed burning, and considerably less on prescribed burns within riparian areas. In an Atlantic coastal pine forest, Richter (1982) concluded that prescribed fire had limited effects on nutrient cycling, soils, and hydrologic systems. In the western United States fires have a notably larger effect of wildfire on water quality (Gresswell 1999; Neary et al. 2005. (revised 2008); Spencer et al. 2003; in USDA 2010).

In the Payette National Forest in Idaho, the Joint Fire Science Program (Drohan 2009) found that a prescribed fire conducted in the spring when fuels were moist had negligible effects on stream communities. However, they concluded that even the lowest severity wildfires produced changes in stream communities. Streamside buffers are often difficult to exclude from a prescribed burn, but the soil and vegetation are usually moist and do not burn.

Prescribed fire effects in these forests on stream communities are negligible, at least when the riparian forest is not burned. They reached the following key findings:

- Habitat changes varied based on interactions of annual stream flow patterns and burn severity of the streamside forest.
- Changes in habitat were correlated with instabilities in macroinvertebrate communities.
- Macroinvertebrate communities in burned areas did not become similar to communities in unburned areas within 4 years after fire.
- Springtime prescribed fire effects on stream ecosystems were negligible and even lower than the effects observed after low severity wildfire.
- Riparian forest burn severity and extent were lower after prescribed fire than after wildfire, which may explain observed patterns.

In a study conducted in the Sierra Nevada Mountains of California, Bêche et al. (2005) concluded that low to moderate intensity prescribed fire that was actively ignited in the riparian area had minimal effects on a small stream and its riparian zone during the first year post-fire. The fire was most severe in those areas with large accumulations of conifer litter and debris and usually self-extinguished when it came into contact with moist soil and characteristic riparian vegetation. The prescribed fire did result in a tenfold increase in bare ground and a significant decrease in understory vegetation, but did not result in a measurable decrease in riparian canopy cover. Mortality of trees in the riparian areas was low (4.4%). Fine sediment in pools did not increase as a result of the fire, but the authors note that relatively little precipitation occurred post-fire. Little to no response was observed in the macroinvertebrate community. In contrast, Chan (1998) observed a reduced diversity of stream macroinvertebrates due to increased fine sediments one year after a prescribed burn in Sequoia National Park.

Gresswell (1999) states that even in the event of extensive high severity wildfires, local extirpation of fishes is patchy and recolonization is rapid. He also warns however, that in situations where native populations of fish have declined, effects from severe wildfires can be longer-lasting. In contrast, Rinne (1996) found that a large wildfire and subsequent hydrologic events on the Tonto National Forest in Arizona effectively extirpated three populations of salmonids in headwater streams and drastically reduced macroinvertebrate densities. In this study, severe effects to streams and aquatic communities were not observed immediately after the fire, but rather after subsequent precipitation events washed exposed fine sediments into streams. The wildfire addressed by this study burned in an area with heavy fuel build-up due to years of fire suppression. The proposed action does not include prescribed burning in areas with heavy fuel build up.

Changes in macroinvertebrate communities are generally associated with more intense burns (crown fires with at least 50% of a stream's catchment involved) (Minshall 2003). This is far above the expected fire severity that would result from implementation of this activity type. Minshall (2003) also concludes that in unfragmented habitats supporting functional ecosystems in the Rocky Mountain region, recovery from fire appears to be relatively rapid, and that fire can contribute to aquatic productivity and biodiversity. In Boise River basin streams (Idaho), Rosenberger et al. (2011) in USDOC 2007 compared the effects of wildfire on the invertebrate prey base for rainbow trout a decade after fires in watersheds unburned, burned, and burned followed by a debris flow. The quantity of macroinvertebrate drift (biomass density) was more variable within than among disturbance categories. Average body weight and taxonomic richness of drift were significantly related to water temperature and influenced by disturbance history.

During the autumn sampling period, the amount of terrestrial insects in rainbow trout diets varied with disturbance history and the amount of overhead canopy along the stream banks. Responses were better correlated with specific characteristics of the stream (water temperature, canopy cover) than with broad disturbance classes. Therefore, fuels reduction treatments implemented in heavily degraded watershed or treatments proceeded by high intensity rain would be expected to be negatively impacted and recovery would be more protracted.

Although dead salmonids have been discovered after the 1998 Yellowstone National Park wildfires, the reason for this mortality was unknown (Minshall and Brock 1991). One study that sampled a prescribed burn area found no detectable changes in periphyton, macroinvertebrates, amphibians, fish, and riparian and stream habitats compared to data collected over the same time period in four unburned reference streams (Arkle and Pilliod 2010). Beche et al. (2005) found no prescribed fire effects on instream wood and V* (residual volume of a pool comprised of fine sediment), but did observe short-term effects on the concentrations of four ions and periphyton biomass. Beche et al. (2005) also observed an immediate (10–19 day) effect on macroinvertebrate community composition, but no effects on benthic macroinvertebrates thereafter. These effects would not be long lasting enough to affect fish food supply and most likely not have any impact on macroinvertebrate communities. It is reasonably certain that no mortality would occur and individual fish behavior would not be affected directly by the patchy low-intensity fires and no debris flows would likely occur. Indirect effects such as reduced forage for juvenile salmonids would be non-existent to minor. Recolonization would restore macroinvertebrate abundance in one to two years after burning. Over this time, juvenile salmonids that receive less food have lower body condition and smaller size at smoltification. The primary beneficial effect of reducing fuel loads in riparian areas is reduced chance of severe wildfire. The short-term adverse effects caused by this activity are minor when compared to the potential adverse effects of severe wildfires.

Road and Trail Erosion Control and Decommissioning: Road and trail erosion control and decommissioning typically includes one or more of the following actions – culvert removal in perennial and intermittent streams; removing, installing or upgrading cross-drainage culverts; upgrading culverts on non-fish-bearing steams; constructing water bars and dips; reshaping road prisms; vegetating fill and cut slopes; removing and stabilizing of side-cast materials; grading or resurfacing roads that have been improved for aquatic restoration with gravel, bark chips, or other permeable materials; contour shaping of the road or trail base; removing road fill to native soils; soil stabilization and tilling compacted surfaces to reestablish native vegetation. A significant amount of information is available regarding the adverse effects of roads on aquatic habitats (Gucinski et al. 2001; Jones et al. 2000; Trombulak and Frissell 2000 in USDOC 2007). Increased introduction of invasive species and delivery of fine sediment derived from roads has been linked with decreased fry emergence, decreased juvenile densities, loss of winter carrying capacity, increased predation of fishes, decreased benthic production, and increased algal production. Improper culvert placement can limit or eliminate fish passage. Moreover, roads can greatly increase the frequency of landslides, debris flows, and other mass movements.

Unfortunately, much less information is available on the specific effects of road and trail restoration or removal, and its effectiveness for reversing adverse habitat conditions attributed to the presence of road and trail systems. The short-term effects of these actions using the proposed PDF would include the restoration construction effects and, in the case of culvert removal, fish passage restoration, discussed above.

The long-term effects of road and trail restoration or removal appear to include mitigation of many of the negative effects to aquatic habitats that have been associated with roads (Madej 2001; McCaffery et al. 2007 in USDOC 2007), but the large variance stream between substrate conditions and other stream habitat characteristics that are important to fish make it difficult to assign measurable effects to road decommissioning (Madej 2001; McCaffery et al. 2007 in USDOC 2007). Thus, road and trail erosion control and decommissioning are likely to result in restoration of riparian and stream functions as a result of reduced sediment yield and improved fish passage.

Fish Passage Restoration*:* Fish passage includes a broad range of activities to restore or improve juvenile and adult fish passage. For the Gap project six culverts would be repleaced to provide fish passage. Also headcuts that restrict passage would be restored by filling downcut channels and adding structure. Equipment such as excavators, bull dozers, dump trucks, front-end loaders and similar equipment may be used to implement such projects.

These activities usually require isolation of the work area from flowing water, relocation of fish, and significant instream construction. The construction-related effects described in the above section on restoration construction effects would occur at all culvert sites. The Forest Service proposes to replace culverts using the stream simulation method, in which natural stream substrates would be placed in the bottom of these structures. Under this activity, artificial obstructions that block fish passage would be removed or replaced with facilities that restore or improve fish passage. The beneficial effects of this activity category include improved fish passage and restoration of natural wood and bedload movement in streams. Removal of these structures requires instream construction with effects as described earlier.

Culverts: Long-term beneficial effects of culvert replacement or removal projects include restoration of fish passage and restoration of natural stream channel processes through removal of channel constricting structures. Removing fish-passage blockages would restore spatial and temporal connectivity of streams within and between watersheds where fish movement is currently obstructed. This, in turn, would permit fish access to areas critical for fulfilling their life history requirements, especially foraging, spawning, and rearing. At a larger scale this would improve population spatial structure.

However, the removal of fish passage barriers could have short-term (typically lasting less than one week, depending on the duration of instream work) temporary effects to fish and their habitat. Heavy equipment might be used in the stream for unblocking, removing and replacing culverts. In-water equipment use could temporarily affect salmonids and habitat, including impacts on redds, smothered or crushed eggs and alevins, increased suspended sediment and deposition, blocked migration, and disrupted or disturbed overwintering behavior. However, because of the seasonal restrictions imposed by in-water work windows, these effects would be avoided. Redband trout are particularly vulnerable during the winter and spring, when adults are migrating and spawning, and also in the spring, when eggs and fry are still present in the substrate. The activities could move juveniles out of overwintering habitats such as side channels and deep pools, into inferior habitats or high velocity waters. Fish passage impediments are common throughout Oregon and Washington and restoration planning efforts have highlighted the need to restore fish passage, particularly when the blockage occurs low in a subwatershed.

***Head-cut and Grade Stabilization**:* The stabilization of active or potential head-cuts with substrate, LWD, rock, or step structures primarily takes place in Rosgen (1996) C- and E-type channels. Many of the meadow restoration sites in the Gap project have active or historical headcuts that have caused downcutting and channel incision. In these areas, historic land management such as heavy livestock grazing has destabilized stream channels and increased the chance of head-cut formation. Stabilization requires channel filling and instream construction, so short-term construction related adverse effects as described below would occur.

The Forest Service proposes aggressive treatments to prevent further incision of stream channels and to connect channels with their floodplains, including use of fill material with rock and log jam plugs. These aggressive restoration techniques are sometimes necessary to stop the ongoing damage caused by migrating head-cuts and to reconnect stream channels with their floodplains.

The beneficial effects of this proposed activity result primarily from the action's prophylactic nature. Left unchecked, head-cuts lead to channel incision, deposition of fine sediments in downstream substrates, create fish passage barriers and disconnect the stream from its floodplain. Stabilizing head-cuts would stop the progression of these adverse effects. An increase in habitat functions, improvements to functional parameters, and a reduction in the risk of effects to redband trout and Columbia spotted frog is expected.

Large Wood, Boulder, Boulder Structures and Tree Removal for Large Wood Projects: Installation of wood and boulder instream structures is likely to require entry of equipment into the riparian area and channel would result in unavoidable short-term construction related effects as described below, but would increase stream habitat complexity, increase overhead cover, increase terrestrial insect drop, and help reestablish natural hydraulic processes in streams over time. LWD, in a stream, can accomplish multiple purposes by trapping gravel above the structure, creating pools and increasing the connection with the floodplain vegetation. Wood placement is likely to cause minor damage to riparian soil and vegetation, and minor disturbance of streambank or channel substrate.

However, the intensity and duration of disturbance is unlikely to increase total suspended sediment, or otherwise impair aquatic habitats or freshwater rearing and migration. Conversely, an increase in habitat functions and a reduction in the risk to sensitive species is expected long-term. Numerous authors have highlighted the importance of LWD to river ecosystems (Bilby 1984; Keller et al. 1985; Lassettre and Harris 2001; Spence et al. 1996 in USDOC 2007). LWD influences channel morphology, traps and retains spawning gravels, and provides food for aquatic invertebrates that in turn provide food for juvenile salmonids. LWD, boulders, and other structures provide hydraulic complexity and pool habitats that serve as resting and feeding stations for salmonids as they rear or migrate upstream to spawn (Spence et al. 1996).

Land management actions such as logging, road building, stream clearing, and splash damming carried out over the last 150 years have greatly reduced the amount of LWD and boulders in streams in Oregon and Washington (McIntosh et al. 1994; Murphy 1995 in USDOC 2007). This project proposes these activities to return these important elements to stream ecosystems. Addition of LWD is a common and effective restoration technique used throughout the Pacific Northwest (Roni et al. 2002 in USDOC 2007). Roni and Quinn (2001a in USDOC 2007) found that LWD placement can lead to higher densities of juvenile coho salmon during summer and winter and higher densities of steelhead and cutthroat trout in the winter. These authors also found that addition of LWD to streams with low levels of wood can lead to greater fish growth and less frequent and shorter fish movements (Roni and Quinn 2001b).

As with LWD, the addition of boulders and properly designed rock structures can help restore natural stream processes and provide cover for rearing salmonids. Boulders can accomplish the retention of gravel by physically intercepting the bed load or slowing the water, increase the interaction with the floodplain habitat by increasing the bed elevation and providing pool habitat. Boulders are most effective in high velocity or bedrock dominated streams. Roni et al. (2006 in USDOC 2007) found that placement of boulder step structures in highly disturbed streams of Western Oregon led to increased pool area and increased abundance of trout and coho salmon.

The proposed design features and BMP would ensure that the Forest Service would place LWD, boulders, and gravel in a natural manner to avoid unintended negative consequences. This action would result in numerous long-term beneficial effects including increased cover and resting areas for rearing and migrating fish, restoration of natural stream processes and improved spawning and off channel rearing areas.

Channel Reconstruction/Relocation*:* Forested areas that have a legacy of timber harvest and roads built in the floodplain may have simplified straightened channels with a scarcity of instream wood. Historically riparian meadows were often ditched and/or straightened to improve grazing. In general, the level of intervention dictates the scale or magnitude of a stream restoration project. As the streams were channelized or naturally returned to their original bed elevation, stream bank heights increased so that greater water depth and discharge became required before the stream could spread onto the floodplain. The increase in bank heights and bankfull discharge, in turn, increased bank erosion and may responsible for a significant portion of modern sediment loads in streams. Along many streams, this may cause channel spreading and, over decades, the re-establishment of a new “meander belt” (Knox 2006 in USDOC 2007). The resistance of bed materials to stream incision is one of the major factors that determine how this process manifests itself along each stream course.

Projects which involve significant channel reconfiguration over a considerable stream length or require extensive alteration of land management practices are likely to have more constraints, be more costly, and have a greater level of associated risk. For stream reaches that have evolved to a condition of greater instability, it may be necessary to adjust the channel’s geometry. This may involve minor adjustments such as narrowing the channel cross-section and stabilizing the eroding stream banks. At the opposite end of the intervention scale, extremely unstable conditions with poor potential for natural recovery may require complete reconstruction of the stream channel to provide a stable channel pattern, profile, and cross-section, utilization of bank stabilization techniques, and installation of flow diverting and grade control structures.

Therefore, the short-term negative and long-term beneficial effects of channel reconstruction would vary with the scale of the project. For some stream reaches, restoration may not be a realistic goal without intervention at the watershed level first. In addition to the restoration construction effects discussed above, channel reconstruction/ relocation projects using the proposed PDF are likely to have significant local and landscape level effects to processes related to sediment transport, energy flow, stream flow, temperature, and biotic fragmentation. Although the Forest Service can predict the worse-case effects of this activity, with the proposed PDF and BMP it is believed that the stream ecological condition would be measurably improved. Typically stream channel reconstruction/relocation projects are conducted in phases that would end with the full return of river flows to the historic channel and the filling of the old shortened channel. Fish passage is typically blocked until the restored channel can be activated. Mechanical manipulation and grading of hundreds, and in some cases, thousands of cubic yards of bed material may be required to recover floodplain width and elevations.

Fish evacuation and relocation of juvenile fish from the old channel to the restored channel can be challenging because of the long transport distances required. Some fish mortality would also likely occur from predation, suffocation, or temperature stress, in the old channel when it is dewatered unless they are relocated upstream or downstream promptly. Fish that are not located would also likely be stranded. Indirect mortality of aquatic species would be possible from high turbidities in lower third of reach and some distance downstream during channel relocation. In-water work windows, work area isolation, fish capture and release PDF are intended to minimize handling and mortality. With in-water work timing during low water periods and isolation of the work area, the release of suspended sediment is expected to be a short-term event. Sediment is likely to be carried by surface runoff when the newly configured channel(s) are reactivated and erosion control structures are removed. Localized suspended sediment increases are likely to cause some juveniles and adults to seek alternative habitat, which could contain suboptimal cover and forage and cause increases in behavioral stress (e.g., avoidance, displacement), and sub-lethal responses (e.g., increased respiration, reduced feeding success, reduced growth rates). Excessive sediment clogs the gills of juvenile fish, reduces prey availability, and reduces juvenile success in catching prey. However, the Forest Service's implementation procedures and pollution and erosion control plans would be designed to minimize suspended sediment. If turbidity is observed in the outflow, turbidity levels should be measured in the outflow using a hand-held turbidity meter. If these measurements indicate violations of State water quality standards, the Forest Service would work with the contractor to take appropriate corrective actions.

Disturbances associated with restoration have the potential to increase non-native plant abundance in the project area through influx of non-native species on equipment and by providing bare soil conditions. However, PDF for revegetation of native species and active removal/treatment of invasive plants would help to establish native species and reduce the overall presence of non-natives plants. Effectiveness monitoring for channel reconstruction/relocation projects would be designed to measure progress toward achieving the project objectives, inform maintenance needs, and provide input into whether the restoration project is trending towards or away from achieving project goals. Based on the project goals and compliance with this programmatic opinion, physical and biological parameters would be monitored using standard field techniques that would produce data compatible with the various protocols required. Monitoring may include evaluation of stream length and channel complexity, riparian and floodplain vegetation, channel-floodplain connectivity, thermal regime, and fish passage. The Forest Service would complete an existing conditions survey on the existing channel to determine the pre-project conditions and an as-built survey, which follows the same parameters, immediately upon completion of the new channel construction.

Post-project, hydrologic function of the stream channel would be restored to more natural conditions. Over time functional floodplains would promote riparian vegetation and stable banks. The restored corridor would provide an adequate riparian buffer zone. Aquatic habitat would be greatly improved in the short term and long term. Under this activity category streams that are made more self-sustaining and resilient to external perturbation would lead to improved aquatic habitat, which would help improve fish, frog and aquatic insect population abundance and productivity.

Effects of Near and Instream Restoration Construction*:* The direct physical and chemical effects of the construction associated with the proposed actions typically begin with surveying, minor vegetation clearing, placement of stakes and flagging, and minor movement of personnel and sometimes machines over the action area. The next stage, site preparation, is likely to require development of access roads or temporary access paths, construction staging areas, and materials storage areas that affect more of the action area.

If additional earthwork is necessary to clear, excavate, fill, or shape the site, more vegetation and topsoil are to be removed, deeper soil layers exposed, and operations may extend into the channel. The final stage of construction consists of any action necessary to undo the short-term disturbance, and includes replacement of LWD, native vegetation, topsoil, and native channel material displaced by construction.

Fish passage would be provided for any adult or juvenile fish likely to be present in the action area during construction, unless passage did not exist before construction, stream isolation and dewatering is required during project implementation, or where the stream reach is dry at the time of construction. When isolation and fish relocation are required, juvenile salmonids are likely to receive mechanical injury during capture, holding, or release, and potential horizontal transmission of disease and pathogens and stress-related phenomena. All aspects of fish handling, such as dip netting, time out of water, and data collection (e.g., measuring fish length), are stressful and can lead to immediate or delayed mortality (Murphy and Willis 1996 in USDOC 2007). Electrofishing causes physiological stress and can cause physical injury or death, including cardiac or respiratory failure (Snyder 2003 in USDOC 2007). There is also potential that some fish would be missed or stranded in substrate interstices after a site is dewatered. Although some salmonids would die during dewatering and relocation, fish would only be exposed to the stress caused by these activities once and the procedure is only expected to last a few hours. If construction took place without work area isolation, more fish would be injured or killed and more fine sediments would be introduced downstream.

Vegetation, soil and channel disturbance caused by construction can disrupt the vegetative and fluvial processes in the action area that create and maintain habitat function, such as delivery of wood, particulate organic matter, and shade to a riparian area and stream; development of root strength for slope and bank stability; and sediment filtering and nutrient absorption from runoff (Darnell 1976; Spence et al. 1996 in USDOC 2007). Although the sizes of areas likely to be adversely affected by actions proposed to be funded or carried out under the Gap project are relatively small, and those effects are likely to be short lived (weeks or months), even small denuded areas would lose organic matter and dissolved minerals, such as nitrates and phosphates. The microclimate at each action site where vegetation is removed is likely to become drier and warmer, with a corresponding increase in wind speed, and soil and water temperature.

Water tables and spring flows (if present) in the immediate area are likely temporarily reduced. Loose soil would temporarily accumulate in the construction area. In dry weather, this soil is likely to be dispersed as dust and, in wet weather; loose soil would be transported to streams by erosion and runoff, particularly in steep areas. Erosion and runoff during precipitation and snowmelt would increase the supply of sediment streams and rivers, where they would increase total suspended solids and sedimentation and, in some cases, stream fertility. Increased runoff also increases the frequency and duration of high stream flows and wetland inundation in construction areas. Higher stream flows increase stream energy that can scour stream bottoms and transport greater sediment loads farther downstream than would otherwise occur. Sediments in the water column reduce light penetration, and can increase water temperature and modify water chemistry. Redeposited sediments can fill pools, reduce the width to depth ratio of streams, and change the distribution of pools, riffles, and glides.

During dry weather, the physical effects of increased runoff would reduce ground water storage, lower stream flows, and lower wetland water levels. The combination of erosion and mineral loss can reduce soil quality and site fertility in upland and riparian areas. Concurrent in-water work can compact or dislodge channel sediments, thus increasing total suspended solids and allowing currents to transport sediment downstream where it would eventually be redeposited. Continued operations when the construction site is inundated can significantly increase the likelihood of severe erosion and contamination.

Using heavy equipment for vegetation removal and earthwork would compact soils, reducing soil permeability and infiltration. The use of heavy equipment also creates a risk that accidental spills of fuel, lubricants, hydraulic fluid, coolants, and other contaminants could occur. Petroleum-based contaminants, such as fuel, oil, and some hydraulic fluids, contain polycyclic aromatic hydrocarbons (PAHs), which can be acutely toxic to salmonid fish and other aquatic organisms at high levels of exposure and can cause sublethal adverse effects to aquatic organisms at lower concentrations (Heintz et al. 1999; Incardona et al. 2005; Incardona et al. 2004; Incardona et al. 2006 in USDOC 2007). The discharge of construction water used for vehicle washing, concrete washout, pumping for work area isolation, and other purposes can carry sediments and a variety of contaminants to riparian areas and streams. Some of these adverse effects would abate almost immediately, such as increased total suspended solids caused by boulder or LWD placement. Others would create long-term conditions that decline quickly but persist at some level for weeks, months, or years, until riparian and floodplain vegetation are fully reestablished. Failure to complete site restoration, or to prevent disturbance of newly-restored areas by livestock or unauthorized persons, would delay or prevent recovery of processes that form and maintain productive fish habitats.

For actions that include a construction phase, the direct physical and chemical effects of site clean-up after construction is complete are essentially the reverse of the construction activities that go before it. Bare earth would be protected by various methods, including seeding, planting woody shrubs and trees, and mulching. This would dissipate erosive energy associated with precipitation and increase soil infiltration. It also would accelerate vegetative succession necessary to restore root strength necessary for slope and bank stability, delivery of leaf and other particulate organic matter to riparian areas and streams, shade, and sediment filtering and nutrient absorption from runoff. Microclimate would become cooler and moister, and wind speed would decrease. Whether recovery occurs over weeks, months or years, the disturbance frequency (i.e., the number of restoration actions per unit of time, at any given site) is likely to be extremely low, as is the intensity of the disturbance as a function of the quantity and quality of overall habitat conditions present within the Gap project area.

Restoration of aquatic habitats is fundamentally about allowing stream systems to express their capacities, i.e., the relief of human influences that have suppressed the development of desired habitat mosaics (Ebersole et al. 1997 in USDOC 2007). The time necessary for recovery of functional habitat attributes sufficient to support species recovery following any disturbance, including construction necessary to complete a restoration action, would vary by the potential capacity of each habitat attribute. Recovery mechanisms such as soil stability, sediment filtering and nutrient absorption, and vegetation succession generally recover quickly (i.e., months to years) after completion of the proposed actions. Recovery of functions related to wood recruitment and microclimate require decades or longer. Functions related to shading of the riparian area and stream, root strength for bank stabilization, and organic matter input generally require intermediate lengths of time.

Additionally, this project proposes a suite of conservation measures intended to reduce the short-term effects caused by near and instream construction. Limiting instream construction to low flow periods and using sediment control measures greatly reduces the amount of suspended sediment created by the restoration actions. Refueling and servicing equipment outside the riparian area reduces the chance of spilling toxic fuels and lubricants. Development and implementation of a pollution and erosion control plan limit any potential adverse effects of a toxic material spill by ensuring that spill response materials are on site during all construction activities. Ensuring that all heavy equipment that would operate instream is cleaned and free of leaks would also reduce the introduction of contaminants into the aquatic environment. Project implementation would include several conservation measures to limit stress and mortality during work area isolation and fish relocation. Limiting in-water work activities to in-water work periods would greatly reduce the chance of affecting spawning adult fish and redds.

Temporary Site Access and Site Restoration*:* The direct adverse effects of temporary site access would include minor restoration construction effects (i.e., soil compaction, erosion, loss of upland vegetation) caused by the movement of personnel over the action area. Site restoration would be implemented to reverse these direct effects. However, the effects of temporary site access would be minimized by following PDF that would prohibit new permanent roads and sets limits and conditions for heavy equipment access would minimize adverse effects. Additionally, PDF are in place to minimize impacts from temporary travel ways and access trails within riparian areas. Site restoration would include treating exposed soils that may deliver sediment to streams with native grass seed, slash, water bars or other appropriate methods to minimize or eliminate sediment delivery.

Riparian Vegetative Planting*:* This project proposes to plant riparian vegetation that would naturally occur in the treatment area. Many authors have discussed the importance of riparian vegetation to stream ecosystems (Dosskey et al. 2010; Hicks et al. 1991; Murphy and Meehan 1991; Spence et al. 1996; Swanston 1991 in USDOC 2007). Streambanks covered with well-rooted woody vegetation have an average critical sheer stress three times that of streambanks weakly vegetated or covered with grass (Millar and Quick 1998). Riparian vegetation also plays an important role in protecting streams from nonpoint source pollutants and in improving the quality of degraded stream water (Dosskey et al. 2010 in USDOC 2007).

Planting in riparian areas may result in very minor fine sediment delivery to streams. It could also temporarily flush fish from hiding cover. In the long term, planting of riparian vegetation would increase shade, hiding cover, LWD, and streambank stability. This would improve the survival of yearling and other juvenile salmonids by providing appropriate substrate for fry and an increase in cover from predators and high flows. Beneficial effects to fish also include enhanced fitness through improved conditions for forage species and improved reproductive success for adult salmonids as a result of increased deep water cover and holding areas. As plantings mature, width-to-depth ratios of disturbed channels and fine sediment delivery would decrease.

Appendix H. Gap Landscape Restoration Project

Wild and Scenic River Section 7(a) Determination

Introduction

The following analysis is a summary of the impacts of the proposed action to implement riparian restoration activities along the North Fork Crooked River (NFCR) Wild and Scenic Corridor Segment 1. Stream restoration on the NFCR are proposed activities would occur within 7 'units' in the planning area totaling 13.7 miles and encompassing 1,345 acres of riparian, meadow and prairie habitats and forested toe slopes. These areas include the majority of, all major streams and aquatic ecosystems within the planning area that are not properly functioning including William's and Gray Prairies, Horse Heaven Meadow, Lytle Creek, Short Creek, Lost Creek and Lookout Creek. The primary goal of the restoration is to restore hydrologic function of aquatic ecosystems and therefore restore water tables. Also six culverts would be replaced that are currently migration barriers for aquatic species to improve connectivity between populations of redband trout, Columbia spotted frog and other aquatic species. In addition, the project proposes prescribed burning and thinning in portions of the Riparian Habitat Conservation Areas (RHCA) within the NFCR Wild and Scenic River (WSR) Corridor. These activities would improve stand health and reduce fuels within the 38,145 acre planning area.

Section 7(a) of the Wild and Scenic Rivers Act (WSRA) requires the river-administering agency to evaluate the effects of federally assisted water resource projects proposed within a WSR corridor on the river's free-flowing condition, water quality and Outstanding Remarkable Values (ORVs). Free-flowing is defined by section 15(b) of the Act as "existing or flowing in natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway. Rivers legislated under the Wild and Scenic River System must be managed as near to a natural state as reasonably possible; and activities that may alter the natural appearance and function of the river must be limited. The section 7(a) analysis should address the compatibility of the proposed action to the free-flowing character of the river and how it relates to the maintenance of the river's ORVs unique features the river should be recognized for. The WSRA describes rivers possessing ORVs that include scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values. Agency resource professionals develop and interpret criteria in evaluating river values (unique, rare, or exemplary) based on professional judgment on a regional, physiographic, or geographic comparative basis. The Section 7(a) analysis displays the potential impacts of the project on free flow, water quality, and scenery, recreation, fish, wildlife habitat, and botanical values along the North Fork Crooked WSR.

Implementation of the proposed action requires a Section 404 permit (under the Clean Water Act) from the Army Corps of Engineers. Prior to the issuance of that permit, the Forest Service, as the river-administering agency has the responsibility to determine whether the proposed project would have a direct and adverse effect on the river's free-flowing condition, water quality and ORVs.

Purpose and Need for Action

The following analysis outlines potential impacts of the proposed project on the free flowing nature and ORVs of the North Fork Crooked River segment 1. The ORV scenery and significant value botany were identified in the North Fork Crooked River Management Plan (North Fork Crooked River Wild and Scenic Rivers Environmental Assessment 1993).

Consistency with Management Goals and Objectives

The North Fork Crooked River was added to the National Wild and Scenic Rivers System as part of the Oregon Omnibus Wild and Scenic Rivers Act of 1988. The *North Fork Crooked River Management Plan* (River Plan) establishes a comprehensive approach to managing the free-flowing natural character of the North Fork Crooked River. The River Plan is a result of a coordinated effort with the USDA Forest Service (FS) and USDI Bureau of Land Management (BLM), as well as other federal, state and local agencies and concerned publics to identify a plan for protection and enhancement of river-related values. The River Plan establishes boundaries and details specific management direction and resource monitoring for each segment of the river. Portions of Gap project activities are within segment 1 of the North Fork Crooked River. This segment is not in the State Scenic Waterway program. The ORV identified for segment 1 is scenery and botanical resources are a significant value. The Gap project is located on US Forest Service lands. The proposed project would not adversely affect the ORVs.

Management direction emphasizes protection and enhancement of scenic values through riparian improvement and upland vegetation management. As a result of the Gap project fisheries and water quality would be improved. In order to achieve long-term desired future conditions, short-term projects (up to 5 years) may be implemented that may not meet short-term Visual Quality Objectives (VQOs) for retention. Culvert replacements and restoration of streams and riparian meadows within this river segment with impaired or non-functioning channel conditions may occur. Stream restoration activities would include channel reconstruction, plugs, fills, adding stream structures, planting vegetation and replacing culverts. Improving meadow function, bank stability, water retention, fish habitat and connectivity of fish populations with these site specific projects would meet long-term river management goals and would maintain and enhance the rivers flows.

Other management plans that are relevant to the proposed project area include the *Oregon Plan for Salmon and Watersheds* (1997), and the Oregon Department of Fish and Wildlife *Crooked River Basin (Fish Management) Plan* (1996). All of these plans encourage restoration of riparian zones and fish habitat. The North Fork Crooked River within the project area is included on the Oregon Department of Environmental Quality list of water quality impaired rivers (303(d) list) for water temperature.

The Proposed Activity

Stream Restoration: Activities would occur within 7 ‘units’ in the planning area totaling 13.7 miles and encompassing 1,345 acres of riparian, meadow and prairie habitats and forested toe slopes. These areas include the majority of, all major streams and aquatic ecosystems within the planning area that are not properly functioning including William’s and Gray Prairies and Horse Heaven Meadow. The primary goal of the restoration is to restore hydrologic function of aquatic ecosystems and therefore restore water tables. Aquatic ecosystems are currently significantly departed from historic conditions and are not properly functioning. Stream channel incision is currently negatively influencing riparian habitats, including hardwood vegetation and sensitive plants and fish and wildlife habitat. Additional goals include the advancement of Riparian Management Objectives and recovery of habitat for R6-listed sensitive aquatic species such as redband trout and Columbia spotted frog and other riparian dependent species.

The types and scope of treatments vary by and within streams or project areas. Stream restoration activities may include a combination of channel reconstruction, placement of stream structures (primarily trees, but also would include some rock and bedload material) including small-to medium sized debris jams and periodic ‘fill’ or ‘plugs’.

Channel reconstruction and limited 'plugs' and fill would occur in sections of the stream, or immediately adjacent to the stream, that are considerably incised and have lost connection with the floodplain. Stream structure placement would occur in areas where stream function and habitat conditions can be improved without significant channel manipulation. Stream structure placement would be intermittent and discontinuous along the linear length of the project. Whole tree placement would be the primary restoration activity in the forested upper portions of most streams including: Horse Heaven, Lost, Lytle, Short and majority the majority of Lookout Creek.

In the predominately meadow and prairie systems (lower portion of Horse Heaven and Lost creeks and Gray and William's Prairies (NFCR), aquatic restoration would be accomplished through the addition of large woody material, filling gullies and incised channels, abandonment of ditch networks, re-connecting the stream with historic flow paths and the valley floor. The general project design would be to "re-plumb" the flow paths through the meadow and provide all of the elements needed to set the meadow on a trajectory toward recovery (USDA FS 2011 – RAT report). Material for filling of gullies and severely incised channels would come from a combination of sources including adjacent dry terraces and anthropogenically manipulated features (berms and floodplain fills); some material would be transported in from off site. Design features would allow the meadow to evolve and become more dynamic over the coming years with the development of riparian vegetation and in response to an elevated groundwater table and mobilized sediments. Planting with native riparian dependent vegetation and fencing or other protection methods would be utilized.

Dynamic flow paths and complex aquatic habitats are extremely valuable for rearing native fishes including redband trout, Columbia spotted frog and other aquatic dependent wildlife. It is anticipated that beaver would play a significant role in the recovery and maintenance of the wet meadow complex. With the recovery of riparian vegetation, beaver would likely begin building channel and possibly valley spanning dams, resulting in distribution of flow and discontinuity of flow and sediment, resulting in greatly improved habitat complexity.

A variety of equipment would be used to accomplish the restoration, including, but not limited to: track mounted excavators, loaders, dump trucks, skidders and log trucks (tree collection). The duration of implementation would vary by project, the larger scale projects may be multi phased and implemented in 2-4 week segments; smaller project areas may be completed in 2-4 weeks.

Complimentary activities include: collection of trees, excavation of fill sources, access routes for equipment and materials, riparian planting and protection (fencing and caging), spring developments, and culvert replacement or removal. Additionally, Noncommercial treatment and underburning would occur in stands designated as tree sources; underburning may occur in those areas and overlap with riparian restoration areas. PDF for stream restoration and complimentary activities would be applied to minimize resource concerns, including protection of riparian restoration from underburning (see Appendix D).

Trees for Large Woody Debris: Projects would include the collection of whole trees to be used as material for stream restoration. It is estimated that approximately 5,000 trees would be needed to accomplish restoration goals and objectives. As part of the design, the majority of trees collected would come from individual stream restoration units. A variety of tree sizes/diameters would be utilized, the majority of trees selected would be between 12"-18"in diameter; none would be over 21" in diameter. No commercial harvest activities would occur in any units. There are three noncommercial units identified outside of the stream restoration units that would supplement on site sources. Tree selection would be coordinated with the wildlife biologist and Silviculturist so that wildlife habitat needs and silvicultural objectives are met or enhanced. Noncommercial thinning material may also be incorporated into projects.

Riparian Planting and Seeding: planting and restoration of disturbed areas would occur. This would involve planting and seeding with native plants (rooted, potted, sticks or bundles) by manual techniques (shovel, auger, etc.) and a small portion of larger trees/shrubs (5-10 gallon pots) with the heavy equipment at the time of implementation. A revegetation plan would be prepared in coordination with the project design.

Access Routes: In all units, access routes would be utilized during project implementation to facilitate equipment and materials (trees, soil, rock, plants) to project areas. Generally, these access routes are non-system roads that have visible previous disturbance (skid trails, old roads, etc.). In some cases, access routes would be utilized to bring equipment in but not materials. In Williams Prairie and Gray Prairie for example, access routes would be utilized to bring in trees, soil and fill for restoration. Access routes would be rehabilitated upon project completion (table H-1).

Fill Source: A fill source has been identified in William's Prairie. This material would be excavated and used as fill in ditches, gullies and incised channels.

Riparian Protection (Fences): Both buck and pole and standard wire fence is proposed within riparian specific units; standard fence is defined as four strand 'wildlife friendly' with a smooth bottom wire (see table H-1). The objective of the fencing is to protect and accelerate stream restoration actions directly via exclusion of livestock and in some cases indirectly by improving livestock management e.g. riparian pasture.

Spring Development: In lieu of additional fencing, spring locations are proposed in two locations within the Horse Heaven pasture to reduce impacts to riparian areas and accelerate recovery of aquatic restoration activities.

Culvert Replacement: Six culverts are proposed to be replaced within the stream restoration units to restore or improve passage for fish, other aquatic organisms, bedload and large woody debris (LWD). Replacements would improve riparian habitat and ecological function, e.g., reduction in floodplain fill. Replacement of culverts may be necessary to accommodate changes in location of or elevations of culverts post restoration activities. In all cases, culverts would be designed to accommodate 100 year flood event and prevent or reduce impacts to road network from storm damage.

Table H-1. Summary of instream and riparian restoration activities by project area.

Stream/Rest-oration unit	Stream Miles	Acres	Access Routes	Trees w/in project area	Tree source units (NCT)	Fill needed (Cu-yds)	Fence (miles)	Spring develop -ment	Riparian Planting (acres)	Culvert(s)
N.F. Crooked River (Williams Prairie)	2.3**	564	1.6	1,170	n/a	5,000 ident-ified	1.3	n/a	56.4	4225-050
Gray Creek (Gray Prairie)	2.6	292	1.1	1,120	6, 106 (PCT), 336** partial	***	1.1	n/a	29.2	4215 & 4215-250
Horse Heaven (meadow)	3.8	227.3	0.8	1,296	n/a	***	1.3	2	22.7	4235 (upper) & 4235 (lower)
Lytle	1.7	97.4	<0.6*	660	n/a	n/a	8.9 acres Buck & Pole	n/a	9.7	n/a
Lost	2.3	86	<0.5*	912	176.3 (PCT)	***	0	n/a	8.6	n/a

Stream/Rest-oration unit	Stream Miles	Acres	Access Routes	Trees w/in project area	Tree source units (NCT)	Fill needed (Cu-yds)	Fence (miles)	Spring develop -ment	Riparian Planting (acres)	Culvert(s)
Lookout	0.8	68	<0.5*	320	n/a	n/a	0	n/a	6.8	n/a
Short	0.1	10.3	<0.2*	212	n/a	n/a	0.2	n/a	1	4215-230
Total	**13.7**	**1,345**	**3.8**	**5690**	n/a	n/a	**12.9**	**2**	**134.4 acres**	**6**

*****Multiple short access routes, not yet specifically identified
**Adjacent to riparian restoration unit

*** Amount and location TBD

Describe How the Proposed Activity Will Directly Alter Within-channel Conditions

The proposed project may impact within-channel conditions with some short term influxes of fine sediment during instream work and culvert replacement. However, in the long term channel stability, floodplain function, water storage capacity, aquatic habitat and connectivity would be greatly improved. By restoring stream channels and planting riparian species, the result would be a decrease in the amount of unstable banks and long term fine sediment inputs. The fine sediment added as a result of project activities would be minor compared to the erosion prevention that is gained by the project. Placement of wood, bedload and rock would involve utilization of whole trees and native rock material. Placement would appear natural and would be consistent with Scenic values (ORVs). Low intensity prescribed burning and select thinning treatments in riparian areas would have a minimal effect on channel condition and function.

Describe How the Proposed Project Activity Will Directly Alter Riparian and/or Floodplain Conditions

The proposed activity would not adversely alter riparian and/or floodplain conditions, but improve them. Planting riparian vegetation, replacing culverts and reconstructing stream channels to improve bank stability would increase the density and diversity of riparian vegetation and increase floodplain roughness. Riparian restoration activities would enhance botanical values (ORVs) by improving sensitive plant habitat short and long-term by raising water table and creating more suitable habitats. During prescribed burning, hardwood riparian vegetation would be avoided as per PDC; therefore, shade would not be measurably affected. Thinning in riparian areas would also protect shade as most units are north of streams, in areas with little to no canopy cover or outside of the primary shade zone.

Describe How the Proposed Activity Will Directly Alter Upland Conditions

The North Fork Crooked River and the river banks are surrounded by intermittent patches of sedge and brush, or lodgepole and ponderosa pine over story with bitterbrush undergrowth. The upland slopes are flat to moderate.

The proposed activities would improve the diversity of vegetation composition, quantity, vigor and allow vegetation to become established. Prevention of erosion would benefit the upland vegetation by maintaining local water tables. Prescribed burning and thinning would have a beneficial effect on upland vegetative conditions by reducing tree densities and ladder fuels. These activities would help reduce the potential for catastrophic effects from a large wildfire.

Proposed activities are not expected to have adverse effects to any known heritage sites. Surveys were conducted by Ochoco National Forest cultural resource specialists; however, the possibility of cultural resources being uncovered in the project area remains. If any cultural resources are noticed during construction, activities would stop and a cultural resource specialist would be contacted.

Evaluate and Describe How Changes in On-site Conditions Can/will Alter Existing Hydrologic or Biologic Processes

The proposed project would improve the ability of the channel to change course, re-occupy former segments, or inundate its floodplain. There would be no effect to subsurface flows. There would be no effect to flood storage and aggradation/degradation of the channel would be closer to historical conditions. Our goal would be to enhance water storage and aggradation of incised channels by allowing the stream to access the floodplain and by increasing sediment trapping vegetation. The project is expected to stimulate and improve streamside vegetation reproduction, vigor, growth, and/or succession in the areas where stream channels are restored and floodplains are reconnected. Culvert replacements would not only allow passage of fish and other aquatic organisms but would also allow passage of LWD and bedload. Low intensity prescribed burning and thinning would have no adverse effects to hydrological processes.

There would be no adverse effects to nutrient cycling, fish spawning and/or rearing success, riparian dependent avian species, amphibians, and mollusks. Fish spawning habitat within the project area is limited. Rearing habitat, especially winter habitat within the North Fork Crooked River, is limited. Stream substrate is small gravel and sand. Small trout are known to over winter within cobbles and small boulders, LWD and overhanging banks, all of which are lacking in this area.

There is expected to be an increase in quality and quantity of riparian vegetation. Improved riparian vegetation would benefit avian species. With fish population increases in the area, foraging opportunities for avian species would be enhanced. Improved quality and quantity of riparian habitat would benefit amphibian and mollusk species by providing overhead cover and rearing areas. Prescribed burning would have no adverse effects to biological processes; burning of woody riparian vegetation such as willow and alder would be avoided.

Estimate the Magnitude and Spatial Extent of Potential Off-Site Changes

There would be little potential for upriver or downriver detrimental changes as a result of this project. The roughness created on banks and in the floodplain barriers would dissipate river energy, reducing the likelihood of transferring erosional energy to downriver areas. Sediment entrained from the project area would likely be deposited again on floodplains within 1-3 miles downriver of the project area in the short term. As channel conditions change over time, these sediments would continually migrate downriver, or be incorporated into floodplains and channels.

Define the Time Scale over Which Effects in the Last Four Paragraphs are Likely to Occur

The discussed effects in last for paragraphs would be expected to begin immediately after project implementation. The growth and spread of native plantings of vegetation would occur over a period of several years but could last several hundred years. The conditions, processes, and effects are considered to be persistent as long as the channel restoration and culvert replacements occur as described.

Compare Project Analysis to Management Goals

The proposed project is consistent with the North Fork Crooked River Wild and Scenic Rivers Environmental Assessment and North Fork Crooked River Management Plan (1993), the 1989 Ochoco National Forest Land and Resource Management Plan, and the Inland Native Fish Strategy (1995).

Section 7 Determination

Placement of the woody debris, bedload and rocks in and adjacent to the river bank would not affect the free-flow nature of the river but would reduce velocities against the riverbank, which would slightly reduce the rate of lateral migration. The project does not include structure designs that would block or make major changes to flow patterns of the river. Restoring channels, replacing culverts and planting riparian species would improve fish habitat, reduce bank erosion, and contribute to meeting the River Plan's long term goals and objectives

Based on these considerations, there would be no direct and adverse effect to the scenic and botanical ORVs. The values would either not be affected or would be enhanced from project implementation.

In conclusion, implementation of the project provides a net effect of protecting and enhancing river values for which it was designated, and restores natural characteristics of the river. Impacts to the rivers free-flowing characteristics would be negligible.