Mighty Moose

Environmental Assessment and Finding of No Significant Impact

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BLM
Salem District

As the Nation's principal conservation agency, the Department of Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering economic use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

BLM/OR/WA/AE-14/024+1792

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FINDING OF NO SIGNIFICANT IMPACT

The Bureau of Land Management (BLM) has conducted an environmental analysis for a proposal to thin approximately 1290 acres of 35-62 year old forest stands. The project is located within Township 12 South, Range 3 East, Sections 8, 9, 10,15, 17, and 20; Township 12 South, Range 2 East, Sections 11, 12, 13, 14, 21, and 29.

The Mighty Moose Environmental Assessment (EA) (#DOI-BLM-OR-S040-2013-0003-EA) documents the environmental analysis of the proposed commercial thinning activity. The EA is attached to and is incorporated by reference in this Finding of No Significant Impact (FONSI) determination.

The analysis in this EA is site-specific and supplements analyses found in the Salem District Proposed Resource Management Plan/Final Environmental Impact Statement, September 1994 (RMP/FEIS). The proposed thinning activities have been designed to conform to the Salem District Record of Decision and Resource Management Plan, May 1995 (RMP) and related documents, which direct and provide the legal framework for management of BLM lands within the Salem District.

Finding of No Significant Impact[1]

The Finding of No Significant Impact (FONSI) is defined in Section (§) 1508.13 as a document briefly presenting the reasons why an action will not have a significant effect on the human environment which includes the natural and physical environment and the relationship of people with that environment.

If the agency "finds" that the action has "no significant impact", the agency is not required to prepare an Environmental Impact Statement (EIS) for the project. §1508.27 defines the factors to consider in determining whether a project is anticipated to "significantly" impact the human environment. The following FONSI documents the BLM's evaluation of the potential impacts of the Mighty Moose Thinning project.

Based upon review of the Mighty Moose EA and supporting documents, the proposed action is not a major federal action and would not significantly affect the quality of the human environment, individually or cumulatively with other actions in the general area. No environmental effects meet the definition of significance in context or intensity as defined in 40 CFR 1508.27.

Context [40 CFR 1508.27(a)]: Potential effects resulting from the implementation of the proposed action have been analyzed within the context of the project area boundaries, and the following 6th field watersheds: Lower Green Peter Lake, Lower Quartzville, McDowell, and Upper Crabtree Creeks. The project would affect approximately one percent of the 73,430 acre combined 6th field watersheds listed above.

[1]The Cascades Field Manager will finalize the FONSI in the Decision Rationale document following public comment.

Intensity refers to severity of impact [40 CFR 1508.27(b)]. The following ten sections refer to the specific conditions/concerns addressed in §1508.27 and document the BLMs consideration of the severity of the impacts as assessed in the Mighty Moose Thinning EA.

1. **Impacts that may be both beneficial and adverse** [40 CFR 1508.27(b) (1)]: The effects of commercial thinning are unlikely to have significant (beneficial and adverse) impacts (EA section 3.0) for the following reasons:

Vegetation and Forest Stand Characteristics (EA section 3.1): The proposed action would retain a forested environment with at least 40 percent average canopy cover. The proposed action would not adversely affect BLM Special Status or Survey & Manage Species because no suitable habitat for any botanical species known or likely to occur would be lost or altered to a degree that may impact these species, therefore, the project would not contribute to the need to list a species as Threatened or Endangered. Increases in the number of invasive/non-native plants are not expected with the application of Project Design Features (PDF) (EA section 2.2.4), and native species would naturally revegetate after thinning activities reducing the suitable habitat for invasive plant species.

Hydrology; Fisheries and Aquatic Habitat; and Soils (EA sections 3.4, 3.5,3.6): New and temporary road construction would mostly occur on gentle slopes with stable, vegetated surfaces, and would not cross streams so there would be no increase in the stream network or sediment from new roads. Stream protection zones (minimum of 70 feet on perennial streams, 35 feet on intermittent streams) would maintain current stream temperatures by retaining the current canopy cover in the primary shade zone. Stream protection zones (SPZ) are also expected to prevent sediment from reaching streams as a result of overland flow or surface erosion in logging units. The proposed action would meet ODEQ water quality standards because timber haul, road construction, decommissioning and road maintenance PDFs would prevent turbidity increases at stream/road junctions from exceeding Oregon Department of Environmental Quality (ODEQ) requirements. Sediment delivery to streams would be reduced over the long term by improving surface drainage, stabilizing road surfaces with rock, and reducing potential road failures by upgrading culverts.

Soils (EA section 3.5): No measurable reduction in overall growth and yield in the thinning area would be expected. Analysis and decades of BLM experience with similar projects demonstrate that soil compaction and road construction would cause little difference in average tree spacing, site utilization or overall stand stocking.

Wildlife (EA section 3.2): Stands proposed for thinning are not presently functioning as old growth habitat. Existing snags, large diameter trees (35 inches diameter or larger) and coarse woody debris (CWD, down logs ≥20" diameter and ≥20' long) would be reserved. The small number (≤ 10 percent) of large (≥ 15 inches diameter and ≥ 15 feet tall) snags expected to be felled for safety or knocked over by falling and yarding operations would be retained as CWD. The project would maintain the current seral stage and stand age; therefore, the project would not contribute to the need to list any BLM Special Status species. Thinning would not significantly change species richness (a combination of species diversity and abundance) of the Migratory and Resident Bird community. See # 9 of this section for effects to northern spotted owl.

Air Quality and Fire Hazard/Risk (EA section 3.8) The proposed project would comply with State of Oregon Air Quality Standards by strict adherence to smoke management regulations. Potential for human caused wildfire would be reduced by treating the fuels most likely to be ignited by human activities, especially fine fuels adjacent to roads that are open to public access. Within one year fire risk would diminish as the highly flammable "red needles" drop and ground cover/understory vegetation "greens up". Recreation, Visual Resources, and Rural Interface (EA section 3.7): Changes to the landscape character would be low and would comply with Visual Resource Management guidelines. Some disturbance to vegetation would be observable after thinning activities and would be expected to develop an undisturbed appearance within five years. The proposed project's effects on recreation are not significant because access and recreation opportunities to BLM lands would remain unchanged from current conditions after operations are completed.

2. **The degree to which the proposed action affects public health or safety** [40 CFR 1508.27(b) (2)]: The proposed project would not adversely affect public health or safety because the public would be restricted from the project area during operations and no lasting hazards would remain after operations are completed.

3. **Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas** [40 CFR 1508.27(b) (3)]: The proposed project would not affect historical or cultural resources because all known cultural resources that require protection are outside of the unit boundaries and would not be affected by operations. Any cultural resources discovered in the future would be protected as determined by the BLM Archaeologist. There are no parklands, prime farmlands, wild and scenic rivers, wilderness, or ecologically critical areas within the project area or affected by the project.

4. **The degree to which the effects on the quality of the human environment are likely to be highly controversial** [40 CFR 1508.27(b) (4)]: The proposed project is not unique or unusual. The BLM has experience implementing similar actions in similar areas without highly controversial effects.

5. **The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks** [40 CFR 1508.27(b) (5)]: Based on past experience implementing similar projects as directed in the RMP, there are no conditions or actions identified that involve a unique or unknown risk.

6. **The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration** [40 CFR 1508.27(b) (6)]: The proposed action would not establish a precedent for future actions with significant effects nor would it represent a decision in principle about a future consideration. The project is in the scope of proposed activities documented in the RMP/FEIS and similar actions in similar areas did not set a precedent for future actions or represent a decision about a further consideration. See # 4, 5 above.

7. **Whether the action is related to other actions with individually insignificant but cumulatively significant impacts** [40 CFR 1508.27(b) (7)]: The Interdisciplinary Team (IDT) evaluated the project area in context of past, present and reasonably foreseeable actions and

determined that the proposed action would be expected to temporarily increase stream turbidity as a result of road renovation, road maintenance, road decommissioning and road use (EA Sections 3.4, 3.6). This is not expected to significantly impact water quality because turbidity increase resulting from road renovation, road maintenance, road decommissioning and road use would not exceed ODEQ water quality standards, would dissipate within 800 meters downstream, and would decrease quickly over time, returning to current levels within minutes or hours. Cumulatively, the proposed and connected actions would be unlikely to result in any detectable change for water quality on a sixth or seventh field watershed scale and would be unlikely to have any effect on any designated beneficial uses, including fisheries (EA Section 3.4, 3.5, 3.6). Road improvements are expected to decrease sediment in the long term.

8. **The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources** [40 CFR 1508.27(b) (8)]: No features eligible for or listed in this register exist in the project area. Cultural resource inventory found no scientific, cultural or historical resources that could be affected by the project. If any such resources were to be found, operations would cease immediately until adequate protection is implemented (EA section 5.0).

9. **The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act (ESA) of 1973** [40 CFR 1508.27(b) (9)]: The proposed project is not expected to significantly impact ESA listed species or critical habitat for the following reasons:

ESA Wildlife - Northern spotted owl (EA Section 3.2): The project is not located in Critical Habitat, or stands which meet the criteria for Recovery Action 32 for the northern spotted owl. The project maintains dispersal habitat. All suitable habitat would be retained. Habitat conditions are expected to improve as thinned stands mature (>20 years). Residual trees would increase in size and be available for recruitment or creation of large diameter (>15 inches) snags, culls and coarse woody debris (CWD) for prey species and nesting opportunities, particularly in Riparian Reserves, sooner than would be expected without treatment. ESA Consultation is described in EA section 5.0.

ESA Fish – LCR Chinook salmon, LCR coho salmon, and LCR steelhead trout (EA Section 3.6). ESA fish are not present in the project area.

10. **Whether the action threatens a violation of Federal, State, or local law or requirements imposed for the protection of the environment** [40 CFR 1508.27(b) (10)]: The proposed thinning activities have been designed to follow Federal, State, and local laws (EA sections 1.2, 3.9).

Approved by: _____ 5/2/2014

John Huston — Date

Cascades Resource Area Field Manager

1.0 Purpose of and Need for Action

This EA analyzes the impacts of proposed commercial thinning operations and connected actions on the human environment providing the decision-maker, the Cascades Resource Area Field Manager, with current information to aid in the decision-making process. The analysis will also identify whether an Environmental Impact Statement is needed or if a Finding of No Significant Impact is appropriate.

Section 1 of this EA provides a context for the proposed Mighty Moose Thinning project. This section describes the types of actions and locations, states the need and objectives, and identifies criteria for guiding the selection of actions.

1.1 Proposed Action

The Cascades Resource Area, Salem District Bureau of Land Management (BLM), proposes to thin approximately 1290 acres of 37-62 year old forest stands. The project would occur in the General Forest Management Area, Late-Successional Reserves and Riparian Reserve land allocations. Due to the differing objectives associated within the land allocations, leading to varying forest stand treatments and locations on the landscape, the Mighty Moose project may result in offering more than one timber sale. Connected actions include activities such as fuels management; mulching, seeding, and fertilizing for soil stability as necessary; and improving road drainage and transportation routes.

Project Area[2] Location and Vicinity

The proposed actions lie in four 6th field watersheds; all are contained within the South Santiam River watershed. The project area is north east of Sweet Home in Linn County, Oregon (Map 1 - Vicinity Map).

The South Santiam 5th field Watershed contains about 665,000 acres. This project would thin approximately 1290 acres or 0.2% of the watershed. BLM-administered land is intermixed with privately-owned (industrial timber, agricultural and residential) and USFS land creating a mosaic of ownership patterns. The project is located within Township 12 South, Range 3 East, Sections 8, 9, 10, 11, and 15; 12 South, Range 2 East, Sections 11, 12, 13, 14, 21, and 29.

1.2 Purpose of and Need for Action

The Mighty Moose (MM) project implements the Salem District RMP, consistent with Land Use Allocation (LUA) objectives, and is designed in consideration of current forest stand conditions. Given the Matrix, RR and LSR land use allocations in the project area, this project responds primarily to two plan objectives: 1) the need for a sustainable supply of timber that will help maintain the stability of local economies; 2) the need for forest habitat conditions that will protect and enhance late successional habitat. With these primary objectives, the interdisciplinary team (IDT) of resource specialists that developed and designed this project

[2] Project Area is defined as that area that is directly affected by project operations (e.g. thinning units, area cleared for landings, roads and rights-of-way). BLM managed lands adjacent to or contiguous with the BLM units proposed for treatment are also within the project area.

analyzed forest inventory data and conducted field examinations with the intent to identify forest stands suitable for silvicultural treatments that would enhance habitat conditions and provide economical timber volume.

1.2.1 Need for the Action

Matrix LUA

Forest stands within the Matrix LUA are overstocked, or will soon grow into an overstocked condition. Overstocked stands have simplified structure and declining growth rates, resulting in reduced volume and production over the planned timber rotation. In addition, if these overstocked stands are not managed, then growth rates decline, the health and vigor of the trees and other vegetation decline, and the stands begin to "self thin" as the smaller trees die. This typically results in lower timber productivity and delays development of complex stand structure for late successional wildlife. Further, the high tree densities do not provide early seral habitats.

There is also a need to provide a sustainable supply of timber to contribute to local and state economies. In recent years state and county revenues dropped and timber related jobs decreased. Further, the Secure Rural Schools Act county payments which support numerous facilities and services are uncertain. These payments were designed, in part, to supplement declining income from counties' share of receipts from timber sold from Federal forest lands in lieu of taxes. The proposed forest management activities are needed in these stands to improve growth rates and forest diversity so the stands contribute to current and future forest production (RMP pp. 46-48).

Riparian Reserve (RR) LUA

Lands within the Riparian Reserve LUA are designated for restoring and maintaining the ecological health of watersheds and aquatic ecosystems (RMP p. 5), and for providing habitat for terrestrial species (RMP p. 9). The conifer stands identified for treatment exhibit simple stand structure and low species diversity. The stands also have declining growth rates that result in delayed development of large diameter snags and other habitat characteristics associated with late-successional forests.

Late Successional Reserve (LSR) LUA

Thinning forest stands in the LSR LUA, similar to the riparian reserve treatments, seeks to improve structural and species diversity leading to improved late successional habitat over time. Stands identified for treatment in this EA developed following clear-cut harvest and support a high number of trees per acre. In these stands, growth rates are declining due to competition, the stands are becoming less vigorous, and the lower limbs of the crowns are dying (a process called self-pruning). Most LSR understories tend to be sparse with little diversity, and suppressed trees are dying (a process called suppression mortality or self-thinning) creating small diameter dead wood.

1.2.2 Purpose (Objectives) of the Project

The purpose of the project is to implement actions addressing the identified needs. To achieve this purpose the following RMP and Northwest Forest Plan (NWFP) objectives would be applied:

Within the Matrix/GFMA LUA

- Supply a sustainable source of forest commodities from the Matrix LUA to provide jobs and contribute to community stability (RMP pp. 1, 46-48) by developing economically viable timber sales accounting for unit volume, logging systems and transportation design.
- Through silvicultural treatments, provide for the development and maintenance of ecologically valuable structural components such as down logs, snags, and large trees (RMP p. 20).

Within the Riparian Reserve LUA

- Apply commercial thinning treatments to reduce stocking levels and create stand heterogeneity intended to: increase species and structural diversity; develop late successional habitat characteristics; and provide future recruitment opportunities for large snags and coarse woody debris (RMP pp. 6, 10, 11).

Within Late-Successional Reserve LUA

- Through silvicultural prescriptions and commercial thinning treatments, increase structural and species diversity that benefit and enhance late-successional habitat (RMP p.16).

1.3 Decisions to be made

The following decisions will be made through this analysis:

- Whether a Finding of No Significant Impact (FONSI) or an Environmental Impact Statement (EIS) should be prepared based on the anticipated impacts to the human environment.
- At what level, where, and how to harvest trees on BLM-administered lands.
- What level of transportation is necessary for an economically viable timber sale that allows for protection of other resources.

<u>Decision Factors</u>

In making the decision, the Cascades Resource Area Field Manager will consider the anticipated environmental effects disclosed in this EA and the project record as well as the extent to which the proposed actions meet the identified objectives for each LUA.

Conformance with Land Use Plan, Statutes, Regulations, and other Plans

The BLM designed this project to comply the Salem District Record of Decision and Resource Management Plan, May 1995 (RMP) and related documents, which direct and provide the legal framework for management of BLM lands within the Salem District. In summary, the Mighty Moose thinning project conforms to the:

Salem District Record of Decision and Resource Management Plan, May 1995 (RMP): The RMP has been reviewed and it has been determined that the proposed thinning activities conform to the land use plan terms and conditions. Implementing the RMP is the reason for doing these activities (RMP p.1-3).

Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl and Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl, April 1994 (the Northwest Forest Plan, or NWFP).

Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines, January 2001 (2001 ROD), as modified by the 2011 Survey and Manage Settlement Agreement (July 2011). All units proposed for treatment are less than 80 years old, meeting exemption A of Judge Pechman's 2006 stipulated agreement.

In addition to the documents cited above, project planning drew from information and recommendations from the following:

- Quartzville Watershed Analysis, 2002.
- South Santiam Watershed Analysis, 2000.
- Mid-Willamette Valley Late Successional Reserve Assessment, 1996.
- Hamilton Creek Watershed Analysis March, 1995.
- Crab Tree Watershed Analysis July, 2001.

Relevant Statutes/Authorities

This section is a summary of the relevant statutes/authorities that apply to these projects. The BLM designed the Mighty Moose project to conform to these statutes and authorities.

- **Oregon and California Act (O&C Act) 1937** (43 U.S.C. §1181a et seq.) – The O&C Act governs BLM-administered O&C lands in western Oregon. It requires the BLM to manage O&C lands for permanent forest production, in accord with sustained-yield principles to protect watersheds, regulate streamflow, provide for recreational facilities, and contribute to the economic stability of local communities and industries.

- **Federal Land Policy and Management Act (FLPMA) 1976** – Defines BLM's organization and provides the basic policy guidance for BLM's management of public lands.
- **National Environmental Policy Act (NEPA) 1969** – Requires the preparation of EAs or EISs on federal actions. These documents describe the environmental effects of these actions and determine whether the actions have a significant effect on the human environment.
- **Endangered Species Act (ESA) 1973** – Directs Federal agencies to ensure their actions do not jeopardize threatened and endangered species.
- **Clean Air Act (CAA) 1990** – Provides the principal framework for national, state, and local efforts to protect air quality.
- **Archaeological Resources Protection Act (ARPA) 1979** – Protects archeological resources and sites on federally-administered lands. Imposes criminal and civil penalties for removing archaeological items from federal lands without a permit.
- **Clean Water Act (CWA) 1987** – Establishes objectives to restore and maintain the chemical, physical, and biological integrity of the nation's water.
- **Healthy Forests Initiative (HFI) 2002** - Focuses on reducing the risk of catastrophic fire by thinning dense undergrowth and brush in priority locations that are identified on a collaborative basis with selected Federal, state, tribal, and local officials and communities. The initiative also provides for more timely responses to disease and insect infestations.
- **Migratory Bird Treaty Act of 1918** - Protects migratory birds (16 U.S.C. 703).
- **Executive Orders 11644 (1972) and 11989 (1997)** - Direct the BLM to control off-road vehicle use so as to protect public lands.

Additional authorities and management direction are described in EA section 3.9 Table 10.

1.3 Scoping and Identification of Relevant Issues

The Interdisciplinary Team (IDT) identified relevant issues based on applicable law, management direction contained in the RMP, and information gathered during the scoping and project planning process. The IDT of BLM resource specialists conducted internal scoping incorporating record searches, on-site field examinations, literature reviews, and past experiences with similar projects.

The BLM conducted external scoping for this project by means of a scoping letter sent out to approximately 60 federal, state and municipal government agencies, nearby landowners, tribal authorities, and interested parties in September 2012. The BLM received five comment responses during the scoping period.

A variety of issues and concerns were raised during project scoping. These issues were used to formulate alternatives, identify appropriate design features, and guide effects analyses. In some cases, an issue was initially considered by the planning team and then eliminated from further analysis because it was not within the scope of the project, did not meet the purpose and need, or

the resource of concern was not present in the project area. Appendix C presents the issues considered but eliminated from detailed analysis. The pertinent planning issues for this project area are:

1. Road construction and skid trail effects to hydrologic connectivity and fine sediment delivery to streams.
2. Effects of thinning on current and future CWD and snags in Matrix, LSR and Riparian Reserve LUAs.
3. Thinning and resulting future stand development, including decadence.
4. Timber haul and conflicts with summer recreation use.
5. Riparian thinning and water quality.
6. Forest thinning and changes to Threatened and Endangered species (TES) habitat.
7. Effects of forest thinning and timber haul on fisheries resources.
8. Ground based harvest effects to compaction and disturbance to soil surfaces.
9. The effects of management actions on fire hazard and air quality.

2.0 Alternatives

Pursuant to Section 102 (2) (E) of the National Environmental Policy Act (NEPA) of 1969, as amended, Federal agencies shall "…study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." Conflicts identified by the IDT were resolved during project development. There were no unresolved conflicts concerning alternative uses of available resources; therefore, this EA will analyze the effects of the proposed action and No Action alternative. Associated with the proposed actions are a set of project design features (PDFs) designed to minimize/eliminate potential environmental effects and ensure consistency with effects disclosed in the RMP EIS. PDFs would be applied to all selected actions.

In developing the proposed actions, the IDT considered and evaluated public input related to proposed actions. Proposed actions submitted by the public analyzed in this EA were incorporated in the project design features and/or included in the proposed actions. Actions not incorporated in the proposed actions were considered and addressed (Appendix C.1) but eliminated from detailed analysis.

2.1 The No Action Alternative

Under the No Action alternative, no aspect of the proposed action would be implemented. Only normal administrative activities and other uses (e.g. road use, programmed road maintenance, harvest of special forest products on public land, recreation access) would continue on BLM land within the project area. On private lands adjacent to the project area, forest management and related activities would continue to occur. Defined this way, the no action alternative serves as a baseline or reference point for evaluating the environmental effects of the proposed action.

Inclusion of this alternative is done regardless of consistency with the Salem District RMP and without regard to meeting the purpose and need.

The No Action alternative is not a static alternative. It is implied that the present environmental conditions and trends will continue. This would include trends such as vegetation succession and consequent terrestrial and aquatic habitat changes, increases in fire hazard, and deteriorating road conditions.

2.2 Proposed Action

2.2.1 Commercial Thinning

The BLM proposes to commercially thin approximately 562 acres within the Matrix LUA; 467 acres within the Riparian Reserve LUA; and 258 acres within the Late Successional Reserve LUA. Table 1 displays the units, acreage, and logging systems. Prescriptions described below vary with land use allocation, reflecting the objectives and goals discussed in EA section 1.2.

The proposed commercial thinning would reduce stand density by implementing a thin from below prescription in all units. Prescriptions generally select the largest and best formed trees to be retained and the smaller and more poorly formed trees would be cut. All known legacy trees (large trees retained from previous harvest) and any tree larger than 35 inches diameter in the vicinity have been excluded from the project area or would be individually designated for retention.

Matrix LUA

Matrix thinning emphasizes timber volume per acre and increases long term stand growth by reducing stem densities from all canopy layers and tree size classes. Diversity would be maintained through variable density thinning and untreated acres within the project area. Two-hundred and seventy eight (278) acres of connectivity are included in the Matrix LUA. Because RMP objectives and management direction for thinnings are similar for both matrix and connectivity, proposed actions are, likewise, similar. Specifically, the treatments designs include:

- Reduce current tree densities from 118-312 trees per acre (TPA) to 56-119 TPA; reduce relative densities (RD) (using the Curtis Relative Density Index, see EA section 3.1) of 43-76 to RD between 25-35.
- Retain the largest, healthiest and best formed dominant and co-dominant trees.
- Retain any trees with a diameter of 35” or greater. Retain all hardwood trees and protect them from structural damage as feasible with safe and efficient logging operations. Trees felled to facilitate safe and efficient logging operations would be left on-site for coarse woody debris.
- Maintain a mix of tree species.
- Retain at least 90 percent of existing large (>15 inches diameter) snags and protect them from damage during timber harvest activities. Up to 10% of existing snags may be felled for operational safety.

- Maintain an average canopy closure of at least 40 percent over the treated units.
- Retain some deformed, forked topped or broken top trees for future cavity nesters.
- Implement one-half to one acre low density (12-14 green trees per acre) thinning areas to provide early seral habitat and create habitat diversity.
- Vary tree spacing by diameter size class – the larger the diameter the wider the spacing, resulting in a variable number of trees per acre retained.

Riparian Reserve LUA

The IDT evaluated all Riparian Reserve stands for potential thinning adjacent to proposed harvest units to determine whether treatment would contribute to attaining ACS objectives. Consistent with the NWFP and RMP, three general criteria were used in this screening process: 1) Stands with simple structure that would benefit from thinning to accelerate development of elements of complex structure for habitat enhancement; 2) Stands lacking species diversity; 3) Stands that can be treated in conjunction with the adjacent Matrix unit using only existing roads and/or roads that would be constructed to manage Matrix land (no road construction for the sole purpose of treating Riparian Reserve stands) . Stands not meeting these criteria were dropped from consideration.

The BLM proposes to enhance riparian reserve characteristics by thinning 467 acres (Table 1) to accelerate development of a large tree component and to increase structural and species diversity. The proposed riparian treatments would include:

- Maintain dominant and co-dominant trees; retaining any trees with a diameter of ≥35" where the RR overlays Matrix LUA and ≥24" where the RR overlays LSR LUA.
- Providing 25-75% variability in retained tree spacing.
- Retaining a canopy closure of at least 50 percent in the secondary shade zone.
- Riparian areas lacking in species diversity or dominated by hardwoods may be planted with western red cedar.
- Following thinning, the units would be evaluated for snag deficit conditions. Areas found to be in deficit would be targeted for snag creation via girdling or topping. Snag creation is anticipated to occur in year 2, 5, and 10 years following harvest.

Approximately 90% of the Riparian Reserves in the project vicinity would not be treated. Untreated RR stands would provide for recruitment of smaller diameter snags and denser growing conditions to create structural variability across the project area. Stream protection zones (SPZ) on all perennial and intermittent streams would be applied. Consistent with DEQ guidelines to comply with the Clean Water Act, no harvest or direct disturbance would take place within the SPZ. For this project, a minimum width of 70 feet on each side of all perennial streams and 30 feet on each side of intermittent streams would be applied. In many instances the SPZ would be larger as delineations would follow breaks in vegetation pattern or topography.

Late-Successional Reserve LUA

BLM would apply silvicultural prescriptions and commercial thinning treatments to increase structural and species diversity to provide a variety of habitat conditions that enhance conditions of late-successional habitat.

The BLM proposes to enhance late successional characteristics by thinning 258 acres (Table 1) to accelerate development of a large tree component, good snag distribution and density management. The proposed LSR treatments would include:

- Provide 25-75% variability in retained tree spacing. Larger diameter residuals will have wider spacing while smaller diameters will have closer spacing.
- Retain the largest dominant and co-dominant trees.
- Retain all trees >24 inches in diameter.
- Implement one-half to one acre low density (12-14 green trees per acre) thinning areas to provide early seral habitat and create habitat diversity.
- To increase coarse woody debris and snags, trees would be felled, topped or girdled following logging and review of stand structure. Falling, topping and girdling could occur in year 2, year 5 and year 10 following thinning.

Table 1. Acres Proposed for Thinning organized by Logging Systems and by Land Use Allocation

Unit No.	Unit Acres	Ground-based Yarding			Skyline Yarding		
		Matrix	RR	LSR	Matrix	RR	LSR
11A	53		3	13		20	18
11D	22					18	4
11E	15					9	7
12A	98		7	20		43	27
13A	142		7	67		24	44
14A	21		1	8		9	4
14B	25		1	6		10	9
15A	81	30	19	17	3	7	5
15B	19	5	6		6	2	
15C	34	3	7	10	3	10	2
15D	213	84	80		33	16	
15E	8	2	6				

15F	2	1	1				
17A	10	5	1		1	2	
20A	44	38	6				
21A	44	20	24				
29A	285	115	39		101	31	
29B	17	13	4				
29C	12	12					
8A	27	8	9		3	6	
9A	44	28	3		10	3	
9B	6	6					
9C	19	10	6		3		
9D	2	1	2				
9E	5	1	1		1	3	
9F	42	20	22				
Totals	1289	399	254	139	164	214	119

Logging Systems

The logging system designs for the Mighty Moose thinning project incorporate the needs to protect resources and provide for economic viability. Prior to implementation, the BLM requires the logging operators to submit a detailed proposed logging operations plan describing the equipment and operating techniques that would be used to ensure consistency with project goals and project design features (PDF).

All actions incorporate PDFs described in section 2.2.4. The logging systems would include:

- Approximately 732 acres (56%) of the thinned area would be harvested using conventional ground-based logging equipment such as: track mounted harvesters that cut and process trees into logs, track mounted loaders that pick logs up and place them closer to a skid trail or landing (called shovel swing), track mounted and/or rubber tired skidders that drag logs to a landing, or forwarders that carry logs to a landing like an off-road log truck. Within designated ground based areas, the purchaser must designate skid trail patterns and landings necessary for minimal soil compaction and to meet the PDFs.
- Approximately 557 acres (44%) of the thinned area would be harvested using a skyline yarding system. Low-impact ground-based machinery designed for steep slopes (up to 70%) would be permitted for use on slopes up to 45% to fell and bunch trees into designated skyline yarding corridors (called "pre-bunching"). Pre-bunching minimizes damage to residual timber by allowing greater control during felling operations and reduces the need for lateral yarding, as well as improving economic viability of the harvest.

- All roads used during the wet season, normally October 15 through April 15, would be surfaced with at least 4" of aggregate (rock) unless the weather is unseasonably dry.

2.2.2. Roads and Transportation Management

The objectives are to minimize permanent road construction, improve road drainage, and maintain existing roads at levels consistent with the planned long term use of the roads. New roads would be constructed to meet multiple resource management objectives. Table 2 displays the road segment and proposed road work; maps (Appendix A) displays the locations.

The roads identified for suitable winter haul ("all" in Table 2) maintain a sound road bed of aggregate (rock) or pavement, cross drains to route water away from stream channels, and functioning culverts. The remaining roads would not be used in winter haul to protect infrastructure and resources.

Table 2. Proposed Road Work

Road number	Road Use Season	Temporary New Construct Miles	Maintenance (maintained)	Renovate (not maintained)	Road Improvement	Stabilize & Close	Associated Unit(s)
11-1E-19	All		1.39				11A
12-3E-7	All		0.78		0.10		11A,12A
12-2E-11	All			0.38		0.38	11A
12-2E-11.1	Dry		0.50				14A
12-2E-12	All		1.63				11A,12A
12-2E-13	Dry		3.70	1.10		1.10	11D, 11E, 13A, 14A, 14B
12-3E-19	All		1.59				20A
12-3E-19.10	Dry		0.62				13A
12-3E-29	All		4.72				11A, 11D, 11D, 14A, 14B, 12A, 13A, 20A
12-3E-29	All				0.10		11A, 11D, 11D, 14A, 14B, 12A, 13A
12-3E-20.1	Dry	0.29				0.29	20A
Spur 14	All	0.10				0.10	13A
Spur 15	All			0.10		0.10	12A
Spur 17	Dry			0.10		0.10	11D
Spur 19	Dry	0.04				0.04	13A
Spur 20	Dry	0.10				0.10	12A
Spur 21	Dry			0.20		0.20	14B

Road number	Road Use Season	Temporary New Construct Miles	Maintenance (maintained)	Renovate (not maintained)	Road Improvement	Stabilize & Close	Associated Unit(s)
semi-total		**0.53**	**14.93**	**1.88**	**0.20**	**2.41**	
12-2E-7	Dry		1.32				21A
12-2E-20	Dry		0.83				21A
12-2E-20.1	Dry			0.36		0.36	21A
12-2E-29.2	Dry		1.10				29A
12-2E-29.5	Dry			0.53			29A
12-2E-29.9	Dry			0.03			29A
12-2E-29.10	Dry			0.04			29A
12-2E-29.11	Dry			0.06			29A
12-2E-29.13	Dry		0.13				29A
12-2E-29.14	Dry			0.02			29A
12-2E-30	Dry			0.20		0.20	29A
12-2E-30.1	Dry		1.22			0.10	29B
12-2E-30.3	Dry			0.20		0.20	29B
12-2E-31	All		5.50				21A
13-1E-1	All		3.34				29B
Spur 18	Dry	0.30				0.30	29A
Spur 22	Dry			0.10		0.10	29A
Spur 23	Dry			0.10		0.10	29A
semi-total		**0.30**	**13.44**	**1.64**	**0.00**	**1.36**	
12-3E-8.1	All		0.20				9E
12-3E-8.6	All		0.28				9E
12-3E-8.6 EXT	All			0.06		0.06	9E
12-3E-9	All		1.44				9A-D
12-3E-9	All		1.08				9A-D
12-3E-9.1	All		0.29				9A
12-3E-9.2	All			0.05			9A
12-3E-9.3	All		0.30				9F
12-3E-9.4	All			0.07			9F
12-3E-9.6	All			0.11			9A
12-3E-10	Dry			0.30			15A
12-3E-10.1	All		0.42				15A
12-3E-14, A-B	All		0.43				15A, 15B

Road number	Road Use Season	Temporary New Construct Miles	Maintenance (maintained)	Renovate (not maintained)	Road Improvement	Stabilize & Close	Associated Unit(s)
12-3E-14.1	All	0.04				0.04	15A
12-3E-14.2	All	0.03				0.03	15B
12-3E-15	Dry			0.38		0.38	15D
12-3E-15.1	All			0.22		0.22	15D
12-3E-15.1 EXT	All				0.14	0.14	15D
12-3E-15.3	All		1.33				15C, 15D
12-3E-15.4	All		0.25				15A, 15B
12-3E-15.4 EXT.	All				0.24	0.24	15A, 15B
12-3E-15.4 EXT.	All	0.30				0.30	15A, 15B
12-3E-16	All		4.58				15A-F
12-3E-16.1	All		0.92				8A, 9E, 9F
12-3E-16.3	All		1.20				8A, 9E, 9F, 17A
12-3E-17.1	All		0.94				8A, 9E, 9F, 17A
12-3E-29.1	All		4.60				8, 9A-F, 15A-F, 17A
Spur 1	All			0.08		0.08	15D, 15E
Spur 2	Dry			0.29		0.29	15D, 15E
Spur 2	Dry	0.06				0.06	15E
Spur 3	Dry			0.22		0.22	15D
Spur 4		0.10				0.10	15D
Spur 5	All				0.13	0.13	15D
Spur 6	Dry	0.15				0.15	15D
Spur 7	All				0.20	0.20	15C
Spur 8	All				0.39	0.39	15A
Spur 9	Dry	0.23				0.23	15A
Spur 10	All				0.14	0.14	9C
Spur 10	All	0.10				0.10	9C
Spur 11	Dry	0.20				0.20	9F
Spur 12	All			0.05		0.05	8A
12-3E16.4	All		1.09				
12-3E-19.1	All		0.17				
12-3E-19.13	All			0.05			
12-3E-19.13	Dry	0.06				0.06	
12-3E-29	All		0.07	0.05			

Road number	Road Use Season	Temporary New Construct Miles	Maintenance (maintained)	Renovate (not maintained)	Road Improvement	Stabilize & Close	Associated Unit(s)
semi-total		1.21	18.26	1.83	1.24	3.81	
Total		2.0	48	6	2	7.5	

Season of Use: Roads to be used in all weather conditions would have an adequate rock surface to prevent sediment from being transported to streams and protect the structure (road prism or subgrade) of the road from damage.

Temporary Road Construction: Approximately 2 miles of temporary roads would be constructed to facilitate thinning and fuel reduction actions and subsequently would be decommissioned following project implementation. All temporary roads would be constructed and decommissioned in the dry season to prevent erosion and sedimentation. Construction involves clearing vegetation within the road Right-of-Way (R-o-W) using ground based logging equipment. Clearing would average 30 feet wide.

Close and Stabilize Roads: Following project completion, the BLM would close and stabilize all temporary roads (3 miles). Road stabilization seeks to prevent erosion and damage to the subgrade and consists of the following actions:

- Seeding with native plant species and mulching with logging slash or approved sterile mulch to establish effective ground cover prior to the wet season;
- Using water bars or other drainage features to prevent water erosion of exposed soil;
- Blocking vehicle access, typically with earth/debris barricades.

When natural surface roads would be kept intact over winter for use on this project the next year, the road would be stabilized to prevent erosion and sediment transport to streams. Methods may include: matting, mulching, constructing water bars or other surface shaping to drain runoff water to vegetated slopes, seeding, creating sediment traps, and blocking the entrance to prevent unauthorized motor vehicle use.

Road Maintenance: The BLM would perform maintenance on approximately 47 miles of existing, maintained roads to bring them up to safe timber haul standards by adding rock as needed, blading and shaping the road, cleaning ditches and culverts, and cutting roadside brush.

Road Renovation: The BLM would renovate approximately six miles of existing unmaintained, closed or decommissioned roads to bring them up to safe timber haul standards by blading and shaping the road, cleaning ditches and culverts, cutting roadside brush, and replacing rock on deteriorating surfaces. Additional drainage structures such as culverts or drain dips would be installed to improve drainage. These roads have a visible road prism for most of their length, and have only low growing vegetation such as ferns, Oregon grape, and salal growing in the road prism.

Road Improvement: The BLM would improve approximately 1.5 miles of existing roads to a higher design standard than the original construction and restore them to safe timber haul standards. These roads are damaged, unsafe for modern log trucks, have trees growing in the roadbed or need to be upgraded from natural surface to aggregate surface. Road 12-3E-29 is currently blocked by a landslide and would be improved to clear the landslide, realign and reconstruct part of the road in a stable location and surface the road with aggregate.

Approximately eight culverts would be replaced or installed in streams to improve hydrologic connectivity, reduce sedimentation and prevention of future culvert failures. All proposed in-stream culvert work would take place during the dry season (Oregon Dept. Fish and Wildlife in-water work period in the project area is June 1 – October 15) when most of these streams have very low or no flow in order to protect fish and wildlife resources. Approximately 15 cross-drain culverts would be replaced or installed between streams to drain water to stable vegetated slopes, prevent saturating the road structure and prevent channeling runoff to streams. After the completion of project operations, the BLM proposes to stabilize disturbed soils with seed and mulch.

Aggregate Source: Aggregate needed for roads would come from rock sources located on BLM and private timberlands and from commercial sources. Potential BLM sources are in the SE¼ Section 10, NW¼ Section 15 and NW¼ Section 30, Township 12 South, Range 3 East. BLM intends to expand the quarry in Section 30, which is owned and operated by a private timber company. The proposed expansion would excavate the quarry north into BLM administered lands. Vegetation on approximately ½ acre of BLM managed lands would be cleared for the expansion. The expansion would provide needed rock for road maintenance and improvement in the short and long term.

2.2.3 Fuels Treatments

Post-treatment fuels hazard surveys would be conducted and site-specific fuels treatments would be recommended. Fuel reduction treatments would be conducted in selected areas to reduce the potential for human caused wildfire ignition, to reduce the potential for wildfire to cross property lines between BLM and private land, and to reduce both the intensity and severity of potential wildfires in the long term (after fuels reduction has occurred).

Fuel reduction treatments would occur at at various points selected within the project area, at log landings, along roads, and property lines. The primary fuels reduction method used would be pile burning. Piles would be covered with plastic to keep them dry until appropriate burn conditions allow for ignition. Other fuel reduction options include slash pullback, removal of brush and small diameter (4 inches) lopping and scattering, and firewood cutting. In lieu of burning, the BLM and/or operator may remove slash at landing areas to be used as mulch to cover roadbeds during stabilization.

2.2.4 Project Design Features

Project design features (PDFs) are included in the proposed action for the purpose of reducing potential environmental impacts that might stem from project implementation. These design features are based on the management guidance (RMP, consultation, etc.), collective team experience and professional judgment, as well as landscape conditions.

Table 3. Project Design Features

Applicable Affected Resources / Objectives → Project Design Features (RMP/FEIS references for key points)	Vegetation	Soil	Water	Fish	Wildlife	Invasives	Fire / Air	Public	Cultural	Economic
In All Logging Operations:										
1. Limit the area compacted by logging operations (skidding, yarding and landings) to less than10% of the harvest area in each unit, outside of road rights-of-way.		♦		♦		♦		♦		
2. Locate skid trails and skyline corridors to avoid concentrating runoff water flows that could cause erosion with potential to displace soil more than a few feet.		♦		♦						
3. Lift the leading end of all logs off of the ground during yarding (one-end suspension) to prevent the blunt ends of logs from displacing soil in order to prevent creating a channel for erosion. Applies to both skidding and skyline yarding.		♦		♦						
4. Limit the size and number of landings to the minimum needed for safe and efficient operations. Size varies with terrain, area served, equipment size and log size and usually averages approximately 0.1 acre located on and adjacent to roads.		♦				♦				
5. Implement erosion control measures where BLM management operations have exposed or disturbed soil such as shaping to modify drainage (water bars, sloping, etc.); tilling; placing logging slash and debris on exposed soil; and seeding with native species.		♦		♦		♦				
6. Prevent unauthorized off-highway motor vehicle (OHV) use through security measures during operations and physically blocking access and/or making potential routes impassible after operations.		♦		♦		♦		♦		
7. Retain all existing snags. If any snags must be felled for safe logging operations, leave them on site to create CWD habitat.				♦						♦
8. Install traffic control/protection measures such as signing to reduce potential for conflicts between harvest activities and recreation users.								♦		

Applicable Affected Resources / Objectives → Project Design Features (RMP/FEIS references for key points)	Vegetation	Soil	Water	Fish	Wildlife	Invasives	Fire / Air	Public	Cultural	Economic
In Ground-based Logging Operations: RMP/FEIS (pp. 2-34 through 2-37; 4-11 through 4-13; G-2)										
9. Allow ground-based yarding operations only when the site specific combination of soil moisture (25% soil moisture measured at 6 inches below soil surface), rainfall and operating methods would not result in concentrating water flow or causing erosion.	♦	♦	♦	♦		♦				♦
10. Re-use existing skid trails whenever feasible for logging operations according to the approved logging plan.	♦	♦	♦	♦	♦	♦				♦
11. Locate new skid trails generally on slopes not greater than 35 percent.	♦	♦	♦	♦		♦				♦
12. Generally limit uphill skidding to slopes where skidders would not break traction to avoid soil displacement.	♦	♦	♦	♦						♦
13. Allow use of mechanized falling/processing and log handling machinery on slopes up to 45 percent where the machinery design and operating techniques would not result in concentration of water flow or routing sediment to streams or exceed unit compaction by more than 10%.	♦	♦	♦	♦						♦
In Skyline Yarding Operations: RMP/FEIS (pp. 2-34 through 2-37; 4-11 through 4-13; G-1,2)										
14. One-end suspension during yarding. For lateral yarding operations where it is not feasible to achieve one-end suspension (cable angles may not create enough lift to achieve one-end suspension until logs get close to the skyline), fall trees to orient logs so that they cause the least soil disturbance and damage to retained trees during lateral yarding.	♦	♦	♦	♦	♦					♦
In Other Operations: RMP/FEIS (pp. 2-34 -- 2-37; 4-8 -- 4-13; G-1,2)										
15. Hazardous fuels surveys would be conducted and site specific plans for hazard fuels reduction treatments would be implemented by the Authorized Officer following harvest operations.							♦	♦		♦
16. A Prescribed Fire Burn Plan would be initiated and signed by the Authorized Officer prior to any prescribed burning activity.	♦	♦				♦	♦	♦		♦

17. Burning would be conducted in accordance with the Salem District RMP, Oregon State Implementation Plan and Oregon Smoke Management Plan as administered by the Oregon Department of Forestry and would comply with the provisions of the Clean Air Act. It would be conducted under good atmospheric mixing conditions to lessen the impact on air quality in Smoke Sensitive Receptor Areas.	♦	♦				♦	♦	♦		♦
18. Swamper burning, or hand, machine, and landing pile construction and burning may be used individually or in combination in any harvest areas where fuel loading is heavy, the fire risk is determined to be high, or site preparation is required to help facilitate tree planting or other restoration treatments.	♦	♦				♦	♦	♦		♦
19. When hand, machine, or landing piles are identified by the Authorized Officer as the specified fuels treatment the following requirements would apply: ➢ Piles would be located as far as possible from large snags, green trees, and other reserved trees to minimize damage. Piles would not be constructed on top of stumps or existing coarse woody debris (CWD). ➢ Retain Large woody debris greater than six inches. ➢ Constructed machine and landing piles within 25 feet of designated roads and landings. Equipment used would remain on the roads or landings during the construction. ➢ In ground-based yarding areas: machine piles would not be constructed within twenty-five (25) feet of property lines or unit boundaries. ➢ Piles would be covered with 4 mil. thick black polyethylene plastic to facilitate fuel consumption							♦			
20. Lopping and scattering of slash and/or slash pullback of fuels may be incorporated in areas where the fuel load is light.	♦	♦			♦		♦	♦		♦
21. Utilization of small diameter slash for firewood or energy production from biomass would be incorporated where logging debris less than six (6) inches in diameter that is accessible from existing roads and landings would be available for removal.	♦						♦	♦		♦
22. Placing signs, temporarily block roads with vehicles or moveable barricades, and/or use flaggers to ensure public safety during active logging, hauling, and fuel treatment operations.	♦						♦	♦		
23. Restrict or suspend ground disturbing activities immediately if prehistoric cultural resources are encountered during project implementation and develop appropriate management practices to protect the site/cultural values.									♦	
Road Construction, Renovation, Maintenance, Stabilization and Closure: RMP/FEIS (pp. 2-22,68,69; 2-75,76; 4-11 -- 4-19; G-2 -- G-7)										

24. Locate, design and construct roads wherever feasible to drain surface water to adjacent slopes where it would infiltrate into the soil and groundwater.		♦	♦	♦						
25. Locate, design and construct roads in upland areas on stable ground with side slopes generally less than 30 percent		♦	♦	♦						♦
26. During wet period road use (haul or maintenance) create small settling basins; or install artificial filters such as straw bales or wattles as needed in ditches that drain to stream crossings.			♦	♦						♦
27. BLM personnel would visually monitor turbidity at stream crossings along the haul route to ensure compliance with ODEQ water quality standards.			♦	♦						♦
28. Dewater streams during culvert installation/removal operations in flowing streams by pumping or piping water around the construction site.		♦	♦	♦						
Stand Structure, Wildlife Habitat and other Vegetation: RMP/FEIS (pp. 2-17,22,26,32--3337--38,59--62;80--92; 4-11 through 4-13; G-1,2; K-1--3)										
29. Clean all ground-disturbing logging and road construction equipment to be free of plant parts/seeds prior to entering the project area to prevent introducing invasive and non-native plants.						♦				
30. Clean equipment prior to leaving project areas that have existing populations of high priority weed species at an approved industrial wash facility to prevent spreading invasive weeds.						♦				
31. Restrict or suspend operations or modify project boundaries at any time if plant or animal populations that require protection are found	♦				♦					
32. Retain hardwoods larger than 7 inches DBH where feasible with safe and efficient logging operations. Trees felled to facilitate safe and efficient logging operations would be left on site as CWD.	♦				♦					
33. Design skid trail location and operating techniques to retain existing CWD.	♦				♦					

Some of the PDFs are accomplished by restricting operations during certain seasons or conditions which are often correlated closely with seasons. Restricted typically means that the specified operations are not allowed unless the BLM determines that conditions or approved operating procedures are in place to avoid resource impacts. Table 4 shows the anticipated seasonal restrictions for the project.

Table 4. Summary of Seasonal Restrictions and Operational Periods

Seasonal Restriction	Reason	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hauling	Water quality and sedimentation												
Harvest operations	Wildlife												
Skidding operations	Soil compaction												
Road Construction / Decommis-sioning	Soil damage/ erosion control												
In-water work: stream culvert installation	Protect fish and aquatic habitat												
Logging operations	Fire season, ODF regulated use												

KEY	Operations generally allowed.	Operations restricted, modified or allowed depending on conditions.	Operations generally restricted

Seasonal restrictions also apply to all habitat modifying activities in units 12S-2E-11D, 11E, 13A, 14A, and 14B. Operations would be restricted from March 1st to July 15th for protection of spotted owls. Seasonal restrictions could be waived if protocol surveys indicate no presence of nesting spotted owls within disturbance distance (0.25 miles for most activities).

3.0 Environmental Consequences

Introduction

The Environmental Consequences portion provides the analytical basis for the comparisons of the alternatives and the reasonably foreseeable environmental consequences to the human environment. Impacts can be beneficial, neutral, or detrimental. This analysis considers the direct impacts (effects caused by the action and occurring at the same place and time), indirect impacts (effects caused by the action but occurring later in time or offsite), and cumulative impacts (effects caused by the action when added to other past, present and reasonably foreseeable future actions on all land ownerships). The temporal and spatial scales used in this analysis may vary, depending on the resource being affected.

As the Council on Environmental Quality (CEQ) points out in guidance issued on June 24, 2005, the "environmental analysis required under NEPA is forward-looking," and review of past actions is required only "to the extent that this review informs agency decision-making regarding the proposed action."

The CEQ stated in this guidance that "[g]enerally, 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." This is because a description of the current state of the environment inherently includes the effects of past actions. Following review of the guidance and examining the proposed project, the team found that an exhaustive listing of past projects and speculation on the effects of each would not provide needed data to make an informed decision.

Information on the current environmental condition is comprehensive and more accurate for establishing a baseline condition for a cumulative effects analysis than attempting to establish such a starting point by adding up the effects of individual past actions. Unlike current conditions, past actions and perceived effects can no longer be verified by direct examination.

Analysis Assumptions

- Timber management activities would re-use the transportation system of existing skid trails, landings and truck roads proposed for this project, where feasible.
- Most private industrial forest lands in these watersheds will be intensively managed with regeneration harvests scheduled on commercial economic rotations occurring at 50-60 year intervals (RMP/FEIS 1994, p. 4-3). BLM observations of recent trends in industrial forest management indicate that this interval may be reduced to 30-40 years for some landowners. The harvest rotation will maintain the lands in early to mid seral stand conditions.

Watershed Overview

This summary of the watershed and the future foreseeable actions provides a big picture look at the watershed and provides context and intensity with which to analyze the effects of the Mighty Moose project.

The proposed actions lie in four 6th field watersheds; all are contained within the South Santiam River watershed (Table 5).

Table 5. Watershed and Treatment Acres

Watershed – 6th field	Watershed Acres	Acres BLM in the Watershed	Proposed Treatment Acres	Treated Percent of the Watershed	Treated Percent of BLM Lands in the Watershed
Lower Green Peter Res.	14,999	4,289	270	2%	6%
Lower Quartzville	16,208	8,199	663	4%	8%
McDowell Creek	15,449	1,033	308	2%	30%
Upper Crab Tree	26,774	9,117	48	0.2%	0.5%

Stand Conditions and Historic Actions

Current forest stand conditions reflect past actions. The following section provides a broad overview of the stand's history that led to current forest conditions. The discussion also provides an overview of recent sales within the project area since the Northwest Forest Plan and identifies current and foreseeable projects in the watersheds.

The project area, due to the spatial pattern of identified units and varying histories, is divided into three blocks.

Current and foreseeable actions in all three blocks:

- The BLM assumes that private industrial timberlands in the area will be managed on economic rotations and will be assessed for regeneration harvest beginning at approximately age 40.
- Neither the BLM nor the US Forest Service (FS) have identified future actions in these three blocks.
- Normal road maintenance includes replacing undersized and deteriorating culverts as needed.

Whitcomb Block – 12S-2E Sections 11, 12 13, 14: All of the stands were clear-cut logged during the 1940s through 1950s. Most of these stands were likely aerially seeded and/or regenerated naturally, although a few stands in the block were planted with Douglas-fir. Many stands in the block have been pre-commercially thinned to even spacing.

Current or recent sales since the NWFP: There have been no commercial harvest actions in the Whitcomb block since 1995.

Quartzville Block – 12S-3E Sections 8, 9, 10, 15, 17 and 20: Stands in this block were clear-cut logged in the 1950s through 1971. The majority of these stands were planted. Some stands, especially in sections 10 and 15 were aerially seeded. The majority of these stands were pre-commercially thinned to even spacing between 1972 and 1990.

Current or recent sales since the NWFP: The Middle Fork Fire burned 1070 acres in September 2006. The fire burned 260 acres on BLM managed lands. Approximately 200 of those acres are within the same drainage as project activities. The burned areas in other drainages are considered hydrologically disconnected from project activities. The BLM completed salvage logging and reforestation on 25 acres and thinned 7 acres in 2007-2009. Private lands were also salvage logged within the fire and planted with conifers, predominately Douglas-fir. In 1997-2001 BLM conducted 45 acres of regeneration harvest and commercially thinned 288 acres in this block. None of these treated units are included in the current proposed action.

The Forest Service completed a thinning project within their late-successional reserve, approximately 9 miles to the East of the Mighty Moose Project Area.

Current or recent actions since the NWFP: BLM recently completed a thinning treatment on approximately 1000 acres within the Quartzville Late Successional Reserve. Twenty five to thirty two year old stands were thinned to increase vertical and species diversity.

McDowell Creek Block – 12S-3E Sections 21 and 29: The stands proposed for logging were logged in the 1940s and planted in the 1950s. Some stands were pre-commercially thinned in the late 1970s and some stands were commercially thinned in the late 1990s.

Recent and current actions since the NWFP: BLM thinned 144 acres in 1997 in section 29. These units are included in the proposed actions.

3.1 Vegetation Resources

Incorporated by Reference: Bonney, D. 2013. Mighty Moose Thinning and Silvicultural Prescriptions (Silviculture Report), Cascades Resource Area, Salem District, Bureau of Land Management. Salem, OR.

USDA, Forest Service, USDI, Bureau of Land Management. 1998. Mid-Willamette Late Successional Reserve Assessment (LSRA).

Assumptions

- As relative density (RD)[3] increases above 50, competition for light, nutrients and water begins to reduce growth rates and increase stress on individual trees and on the stand as a whole.
- Forest stands with relative densities above 65 have lower tree vigor, higher mortality of suppressed trees, and higher susceptibility to insects, disease, and more severe fire behavior than stands with lower densities (Perry 1994; Hann and Wang 1990; Curtis 1982). These conditions reduce stand resiliency and resistance to environmental stresses.

Methodology

- For stand structure and age information, Stand Exams were conducted in 2006-2010. Additional stand information was gathered by BLM personnel, including additional core

[3] Relative density (RD) is a measure of crowding in a stand of trees, expressed as a percentage of density (based on number and size of trees) relative to a theoretical maximum density.

samples for tree age and evaluating characteristics of large diameter trees (over 36 inches DBH). In addition, the analysis utilized GIS data, aerial photographs and satellite imagery, BLM's Forest Operations Inventory (FOI) records, and resource specific field surveys.

- The stand exam plot data was analyzed by the Resource Area Silviculturalist using BLM's EcoSurvey Program and the ORGANON growth model (Hann et al. 2006). The BLM analyzed and incorporated stand exam data into the description of existing vegetation and forest stand characteristics and for developing the prescriptions that would be implemented under the proposed project. Stand ages were calculated by the EcoSurvey and ORGANON models by calculating the weighted averages of sample tree ring counts (cores) to determine the stand's age.

3.1.1 Affected Environment

Private lands adjacent to BLM sections maintain an early seral to mid-seral forest condition, reflecting rotation harvest management. These stands exhibit very little to no vertical structure, large snags or CWD.

On BLM lands the vegetation environment was split into three areas, or blocks, defined by the continuity of units in space and land use. These are: Whitcomb Block – T12s-R2E sections 11, 12, 13, 14; Quartzville block – T12s-R3E sections 8, 9, 10, 15, 17 and 20; McDowell Block – T12S-R3E sections 21 and 29. Appendix B provides detailed information on current stand ages, trees per acre, tree diameter, and density for each timber stand proposed for treatment.

All stands surveyed on BLM managed lands are generally healthy with little evidence of disease. The exception is dwarf mistletoe in some of the western hemlock.

<u>Stand Characteristics Whitcomb Block Units</u> (LSR LUA) **12S-2E Sections 11, 12 13, 14**:

All of the stands were clear-cut logged during the 1940s through 1950s. They were likely aerially seeded and/or regenerated naturally with the exception of portions of unit 13A which were planted with Douglas-fir. These stands have been pre-commercially thinned to even spacing, except units 11A and 13A which have never been thinned. The stands that were not pre-commercially thinned maintain much higher tree densities with limited understory diversity than the others and suppression mortality is more prevalent in the small size classes.

The stands are now in the mid-seral stage with high canopy closures and poor to moderate understory development. Stands consist primarily of Douglas-fir and Western hemlock. There are few residual old-growth remnants present in unit 13A. There are few large/hard snags or down logs present. The hardwood component is minor, consisting mostly of red alder, with some big-leaf maple and trace amounts of golden chinquapin.

<u>Stand Characteristics Quartzville Block Units</u> (Matrix LUA) **12S-3E Sections 8, 9, 10, 15, 17 and 20**:

These stands were clear-cut logged in the 1950s through 1971. The majority of these stands were planted in the mid to late 1950s. Stands in section 15 and 10 were aerially seeded in 1958, portions of unit 9A were aerial seeded in 1965 and a portion of unit 8A was planted in 1972.

The majority of these stands were pre- commercially thinned to even spacing between 1972 and 1990; units 8A, 9B, 9C, 9D, 9F, 17A and 20A were not pre-commercially thinned. The stands that were not pre-commercially thinned maintain much higher tree densities than the others and suppression mortality is more prevalent in the small size class.

These stands are all early mid-seral to mid-seral. They range in age from 35 years to 57 years old. These stands have high canopy closures and poor to moderate understory development. Stands consist primarily of Douglas-fir with a component of western hemlock. In unit 20A there are a few remnant old growth trees. The units have an understory layer of western hemlock ranging from 50 to 200 trees per acre. This layer is suppressed under the dense canopy and growth is slow. Ground vegetation is sparse and consists mainly of sword fern, dwarf Oregon grape, salal and vine maple.

Stand Characteristics McDowell Block Units (Matrix LUA) **12S-3E Sections 21 and 29:**

The stands in McDowell are in the mid-seral and late mid-seral stages and range in age from 55 to 62 years old. They are even aged stands. They were logged in the 1940s and planted in the 1950s. Unit 29A was pre-commercially thinned in 1977. Unit 29C and portions of 29A and 29B were commercially thinned in 1997. The remaining units were not pre-commercially thinned.

Units 21A and 29A are dominated by Douglas-fir with a large component of western hemlock. Units 29B and 29C are dominated by western hemlock with a large component of Douglas fir. There are no known residual old growth remnants in these stands. There is a range of approximately 50 to 300 western hemlock per acre naturally regenerating in the understory. Understory shrub species consist of pacific rhododendron, Oregon grape, sword fern, Oregon oxalis, vine maple, red and blue huckleberry, bear grass and salal.

The stands that were not pre-commercially thinned maintain much higher tree densities than the others and suppression mortality is more prevalent in the small size class.

3.1.2 Environmental Consequences

A. No Action Alternative

The stands would continue to grow but at an increasingly reduced rate. Crowns would close and there would be more suppression mortality resulting in more snags and down wood, especially in the smaller (<15 inches DBH) size classes. Understory vegetation would be reduced in quantity and diversity because of the reduced light levels reaching the forest floor. The live crown ratio (live crown height/total height of the tree, expressed as percent) would continue to decline as lower limbs die from shading. In the Matrix LUA, at rotation age there would be smaller trees of lower quality to harvest and total net yield would be reduced below site potential.

The dense stands would decline in vigor, making them more susceptible to disease, insects, windthrow and fire. This condition would not meet O&C Act, or RMP objectives and would not fulfill the Purpose and Need for this project (EA chapter 1).

Due to high tree densities within the Riparian Reserve and Late-Successional Reserve LUAs, there would be slow development of the 15+ inch DBH trees desirable for future snag and 20+ inch diameter trees desirable for future CWD recruitment. Structural and species diversity would

remain low until suppression mortality begins and the trees die and fall over. In the absence of a disturbance event such as fire, snags, CWD and structural diversity are expected to remain low for 30-60 years.

B. Proposed Action

Appendix B displays current forest unit characteristics and expected characteristics following proposed treatments.

Matrix

In the short term (0-10 years) the stands would appear healthy with uniform spacing and tree size. Tree crowns would be more widely spaced than prior to treatment, allowing more light to reach the forest floor. The low density thinning areas would create openings that encourage the growth of native shrub species and understory conifer and deciduous trees.

The average diameter of the forest stand would be larger than prior (Appendix B) to thinning because "thinning from below" primarily removes the smaller and less healthy trees from the stand and any large conifers ≥35" in diameter (DBH) would be retained. There would be some visible damage to some retained trees. A few damaged trees are considered desirable to provide source material for decaying standing and down logs.

In the long term, diameter growth of residual trees should increase then continue at a steady rate over the next 20 to 30 years. Due to increased light reaching lower branches, crowns should expand and fill the gaps left in the canopy by the thinning until the site is fully occupied. Tree crowns would continue to grow as limbs grow longer and lower limbs continue to grow instead of dying. Crown closure would increase as limbs grow and fill in the open space in the tree canopy and the amount of light reaching the forest floor would slowly diminish. Understory brush, conifer seedlings, and ground cover species would grow rapidly in response to increased light reaching the forest floor then would begin to decline in vigor in the second decade as crown closure increases.

Diameter growth rates on retained trees would increase because of decreased competition for site resources (light, water, nutrients) resulting in larger trees available for future harvest or other management options (Appendix B). Retaining 48-119 trees per acre combined with increased growth rates would ensure sufficient growing stock for future harvest or other management options. Crown ratios would increase because lower limbs would not self-prune for a decade or more, resulting in healthier trees with larger crowns and larger limbs compared to trees in an overstocked stand, as is currently the case in these units. Stand structure would become more complex over current conditions as understory and ground cover develops, compared to an overstocked stand with limited light reaching the forest floor.

Small gaps created by uneven spacing provide additional opportunities for understory vegetation growth. Forest structure and species diversity would increase across the project area through low density thinning (LDT) areas of up to one acre in size by providing additional light to the forest floor, creating early-seral habitat. Some conifer regeneration is expected. Advanced regeneration already in the stands will increase in growth and vigor.

Disturbed soil would become fully revegetated with herbaceous species (especially the native species used for seeding) within two years and woody species would be expected to become established on some of the disturbed soils over a five year period. Logging slash would lose its needles within one year and decay over a three to seven year period and become part of the mat of duff and litter.

Tree mortality, tree blow down and decay that began as a result of injury to some trees would add snags and CWD elements of structural complexity to the stands over the next several decades. The BLM expects that wind throw may continue after treatment, especially in proposed thinning areas that are adjacent to private plantations and other open areas.

Riparian Reserves (RR) and Late Successional Reserve (LSR)

Stands identified for treatment within the RR and LSR are generally too dense to facilitate immediate development of older forest characteristics. Thinning in these stands would enhance the growth of retained trees and facilitate development of large conifers for future snags and CWD. Larger trees competing for growing space untreated clumps and forest stands would lead to future snags and CWD. Gaps created from variable spacing would increase available light to the forest floor leading to understory tree and shrub development. New conifer regeneration and conifer regeneration already in the stand would benefit from the increased available light and would develop into a second canopy layer.

Stand variability would be increased through variable marking and thinning with 25-75 percent variation in spacing would effectively create small clumps and gaps, adding structural and species diversity both in the short and long term. Low density thinning (LDT) areas in the LSR would provide additional early-seral habitat within the stands. Shrub species would increase in size, abundance and species diversity. Some conifer regeneration should occur within the LDT areas. Enough light would reach the forest floor to allow establishment of native ground cover species and brush understory with some conifer tree regeneration within three to five years. The small clumps and gaps created by spacing variation of retained trees would also introduce variation in the density, distribution and species mix of ground cover plants and brush and conifer understory.

Any trees ≥35” DBH would be retained throughout the RR and trees ≥24” DBH would be retained throughout the LSR. . The proposed action would retain hardwood trees and conifer species with low local abundance. These trees would have less competition for site resources and should have higher survival and growth rates than would be expected without treatment.

Cumulative effects

Past actions within units proposed for treatment, including clear-cutting, planting and pre-commercial thinning led to the current stand structure and composition. Private lands adjacent to BLM administered lands in the project area are dominated by early-seral stands due to recent clear-cuts. Based on the rotational management plans, private lands are expected to be maintained in early- to mid-seral conditions.

No cumulative effects are expected with regard to stand structure and development because the proposed actions would maintain the current seral stage and stand age. The proposed actions are

expected to improve current and future stand characteristics by increasing both structural and species diversity. Due to the retention of large trees and anticipated increased growth of those trees, larger material would be available for future snags and down wood which is currently lacking on both BLM and adjacent private lands.

In the RR and LSR LUAs, stands identified for treatment lack vertical and species diversity, large standing and down wood. Private lands are assumed to provide few to no large snags and CWD and little species diversity. The proposed action would expedite the development of complex forest structure through increasing growth rates, stimulating undergrowth, and creating tree density variability. Ninety percent of RR and LSR stands would not be treated and would continue to provide dense forest conditions leading to suppression mortality and subsequent recruitment of smaller snags and down woody debris which does not meet size requirements for CWD. The mixture of treated and untreated stands would lead to unit and landscape diversity which is currently lacking.

3.2 Wildlife

Incorporated by Reference: Bonney, 2013. Mighty Moose Thinning and Silvicultural Prescriptions (Silviculture Report), Cascades Resource Area, Salem District, Bureau of Land Management, Salem, OR.

USDA, Forest Service, USDI, Bureau of Land Management. 1998. Mid-Willamette Late Successional Reserve Assessment (LSRA).

England, 2013. Mighty Moose Wildlife Report, Cascades Resource Area. Salem District, Bureau of Land Management, Salem, OR

USDI, Bureau of Land Management, Salem District, Cascades Resource Area; USDA, Forest Service, Willamette National Forest, Sweet Home Ranger District. September 2002. Quartzville Creek Watershed Analysis (QWA 2002).

USDI, Bureau of Land Management; Fish and Wildlife Service; USDA Forest Service. August 2013. Biological Assessment of Not Likely to Adversely Affect Projects with the Potential to Modify the Habitat of Northern Spotted Owls, Willamette Planning Province – FY2014 (BA 2014).

USDI Fish and Wildlife Service. September 2013. Letter of Concurrence Regarding the Effects of Habitat Modification Activities within the Willamette Province, FY2014, Proposed by the Eugene District, Bureau of Land Management; Salem District, Bureau of Land Management; Mt. Hood National Forest; Willamette National Forest; Columbia River Gorge National Scenic Area on the Northern Spotted Owl and its Critical Habitat; FWS Reference #01EOFW00-2013-I-0187 (LOC 2014).

3.2.1 Affected Environment

Dead wood in the form of snags and down logs of all sizes including coarse woody debris (CWD)4, remnant large live trees, and vertical and horizontal variation in tree and understory

[4] The RMP classifies Coarse Woody Debris (CWD) as down logs ≥20 inches diameter and ≥20 feet long. RMP p. 21

canopies are structural and compositional aspects that have been found to be important contributors to habitat diversity and species richness. Hardwood trees and shrubs have also been found to be important contributors to forest biodiversity. These features are generally lacking in the previously managed stands proposed for thinning.

Snags, CWD, Remnant Legacy Trees and Special Habitats

Stand exams, aerial photos, and field reviews by specialists provided data on the presence of special habitats and the amount of CWD (Table 6).

Table 6: Summary of Special Habitats, Remnants, and CWD by Project Unit.

Name/Unit	Location	Seral Stage	Remnant Legacy Trees	Special Habitats*	CWD***
Mighty Moose Project Area					
11A	12S-2E-11	Mid Seral	No	No	0'/468'
11D	12S-2E-11	Mid Seral	No	No	0'/495'
11E	12S-2E-11	Mid Seral	No	No	0'/961'
12A	12S-2E-12	Mid Seral	No	No	0'/660'
13A	12S-2E-13	Mid Seral	Yes	No	0'/728'
14A	12S-2E-11,14	Mid Seral	No	No	57'/600'
14B	12S-2E-14	Mid Seral	No	No	0'/151'
21A	12S-2E-21	Mid Seral	No	No	0'/616'
29A	12S-2E-29	Mid Seral	No	#wetland	0'/550'
29B	12S-2E-29	Mid Seral	No	No	0'/345'
29C	12S-2E-29	Mid Seral	No	No	0'/260'
8A	12S-3E-08	Mid Seral	No	No	0'/0'
9A	12S-3E-09	Early Mid Seral	No	No	0'/230'
9B,C,D	12S-3E-09	Mid Seral	No	#talus	0'/200'
9E,F	12S-3E-09	Mid Seral	No	# wetland	24'/282'
15A(part)	12S-3E-10,11	Mid Seral	No	No	0'/153'
15C(part)	12S-3E-10	Mid Seral	No	No	0'/622'
15A(part),B, C(part),D,E,F	12S-3E-15	Mid Seral	No	No	0+'/422'
17A	12S-3E-17	Mid Seral	No	No	0'/316'
20A	12S-3E-20	Mid Seral	Yes	No	0'/260'

Seral Stage Age Classes (years) based on Stand Exam data: Early Seral = 0-30; Early Mid Seral = 30-40;

Mid Seral = 40-60; Late Mid Seral = 60-80; Early Mature Seral = 80-120; Mature = 120-200; Old Growth = 200+ + (See RMP/FEIS glossary, p. 6-13)

* Special habitats within the units include: wet and dry meadows, talus, cliffs & rock outcrops.

*** Linear ft/acre ≥20" diameter & ≥20' long, hard (decay classes 1-2)/soft (decay classes 3-5) logs.

\# Presence of adjacent special habitat, wetland, or pond adequately protected with no treatment buffer.

BLM's management direction for CWD in the Matrix is to leave a minimum of 240 linear feet of down logs per acre. Logs should be at least 20 inches in diameter at the large end, 20 feet in length, and in hard decay classes 1 and 2 (RMP, p. 21). Existing hard down logs in the project areas are smaller than 20 inches in diameter. Hard logs in smaller size classes are the result of recent suppression mortality in overstocked stands. These small logs are much less useful for forest floor-associated wildlife species because they have less volume and persist for shorter periods of time (usually less than two decades) than larger material.

There is an abundance of existing soft down logs (decay classes 3-5) throughout the proposed units and in adjacent stands. These logs provide valuable habitat for many CWD associated wildlife species including various rodents, amphibians and reptiles (O'Niell et al. 2001), and they persist for many decades before passing through advanced decay classes to become unrecognizable as down logs.

Table 7 summarizes the snags currently present in the project area. A diameter of 15+ inches was used because most wildlife species that utilize snags are associated with snags greater than 14.2 inches (Rose et al., 2001). Smaller material has less volume, provides less habitat, and does not persist as long in the forested environment as larger material.

The use of 0+ in the table denotes trace numbers of snags present that did not appear in the stand exam.

The snag habitat within the proposed units does not meet the management actions/direction of 40 percent of maximum population densities (RMP p. 21). Trees that could have developed into large snags and CWD were removed by past clear-cutting. Most of the existing snags are small (<15" diameter) and the large logs that are present are in advanced decay classes. However, high quality large remnant legacy trees, large cull material, CWD and large snags are abundant in the mature/old-growth stands in the Upper Quartzville Watershed where the Mighty Moose project area is located. There are also scattered residual large, old legacy trees in units 13A and 20A. There is a small component of large second growth remnants (≥35 inches DBH) present in units 8A, 9F, 11A, and 20A.

There are wet areas with seasonal ponds adjacent to unit 29A, a small wetland in 9F, and some small talus slopes adjacent to 9C. These features will be buffered and posted outside of the unit boundaries.

Table 7: Summary of existing snags by project unit based on stand exam data and field review.

Mighty Moose Project Area: Snags at least 15' tall/ 100 acres						
Unit #	Snags 15-25"		Snags greater than 25"		Total snags (15"+)	
	Hard	Soft	Hard	Soft	Hard	Soft
11A	0+	0+	0	0	0+	0+
11D	80	120	0	0	80	120
11E	0	0	0	0	0	0
12A	60	70	0	0	60	70
13A	0	0	0	0	0	0
14A	0	0	0	0	0	0
14B	0	0	0	0	0	0
21A	0	0	0	0	0	0
29A	0+	0	0+	0	0+	0
29B	0	0	0	100	0	100
29C	0	0	0	0	0	0
8A	0	0	0	0	0	0
9A	160	0	0	0	160	0
9B,C,D	0+	0	0	34	0+	34
9E,F	110	0+	0	0	110	0+
15A(part)	0+	0	0	0	0+	0
15C(part)	0	0	0	0	0	0
15A(part),B, C(part),D,E,F	30	0	0	0	30	0
17A	0+	0+	0	0	0+	0+
20A	0	0	0	0	0	0

Federally Listed Species

Threatened - Northern Spotted Owls

The proposed thinning units provide 1,290 acres of dispersal habitat in the Quartzville, Crabtree and McDowell Creek Watersheds. None of the units are located in 2012 Critical Habitat and/or unmapped Late Successional Reserves (LSRs) which are 100 acre core areas for known spotted owl sites as of January 1994. None of the units meet the stand level conditions characteristic of Recovery Action (RA) 32 Habitat according to the Northern Spotted Owl Recovery Plan (NSO 2011 pp. III-67-68).

There are five known spotted owl sites within the provincial home range (PHR) radius (1.2 miles) of the Mighty Moose Project. In addition, there are two historic sites that have had no known occupancy during the last five years or more. There are no units or activities planned within disturbance range (0.25 miles) (BA pp. 8-9; LOC pp. 15) of any of these sites.

There is a long history of barred owl presence in the Whitcomb/Quartzville area going back to the 1980s. Barred owls are common and have been detected in all five known and two historic spotted owl sites.

Special Status, Survey and Manage, and other Species of Concern

Vegetation surveys (stand exam data) indicate that most of the stands proposed for thinning lack habitat elements that support diverse populations of wildlife species, especially snags, CWD, deciduous understory and ground cover vegetation, or deep accumulation of leaf litter.

Johnson's Hairstreak - Bureau Sensitive

Johnson's hairstreak (Callophrys johnsoni) is an obligate old growth butterfly typically found between 2,000 and 3,500 feet elevation. The currently known geographical distribution of the Johnson's hairstreak indicates that it could be present in the Mighty Moose area. It is a forest canopy species, which may account for the rarity of sightings and its low detection rate. Old-growth forests with dwarf mistletoe present are important to the survival of Johnson's hairstreak. There are no old-growth or late successional stands proposed for thinning in the Mighty Moose project area. However, younger forests that contain dwarf mistletoe may have the potential to support populations of the Johnson's hairstreak (Hoffman and Lauvray 2005). The currently known geographical distribution of the Johnson's hairstreak indicates that it could be present in the Mighty Moose area, however, there are low amounts of Western hemlock dwarf mistletoe in the Mighty Moose area.

Bats

There are no Bureau Sensitive bat species suspected to occur in Mighty Moose project area. Four bat species of concern are suspected to occur in the Mighty Moose project area (silver-haired bat, long-eared myotis, long-legged myotis, and Yuma myotis). These species are associated with caves and mines, bridges, buildings and cliff habitat. None of these features are present in the proposed thinning units. Decadent live trees (old-growth) and large snags, particularly ones with bark attached that extend above the tree canopy, are used variously as solitary roosts, maternity roosts, and hibernacula by these species and other bat species associated with Douglas-fir forests (Christy and West 1993, Weller and Zabel 2001, Waldien et.al. 2000).

Red Tree Vole – Survey and Manage

The red tree vole is a Survey and Manage species under the Northwest Forest Plan. It is an arboreal vole associated with conifer forests west of the Cascades summit, below about 3,500 feet elevation. The project area is within the "Northern Mesic Zone," the upper elevation range of the species. None of these stands meet the stand-level criteria as described in the Red Tree Vole Protocol (Huff et al 2012). No surveys for red tree voles were conducted because all of the stands proposed for treatment are younger than 80 years of age (IM-OR-2011-063, "2006

Pechman Exemptions," 2011). Red tree voles could be present in the stands proposed for thinning, but the habitat is marginal, due to its young age and simplified structure.

Cascades axe tailed slug (Carinacauda stormi) – Bureau sensitive

The Cascades axe tailed slug's current known distribution is in montane forests of the Western Cascades ecoregion of Oregon between about 1,700 to 4,000 feet elevation (Leonard et al., 2011). The Cascades axe tail slug is associated with conifer and leaf litter debris in Douglas-fir, western hemlock and vine maple woodlands. The slug is usually detected in the layer between the most recent leaf litter and the previous year's litter. Forest age class does not seem to be an important element of this species' habitat as it has been found in forests 25 years to over 200 years of age (Leonard et al., 2011). Habitat conditions for the slug are poor due to a lack of understory vegetation characteristic of the slug's habitat. The Cascades Resource Area has 15 sightings, and the adjacent Mount Hood and Willamette National Forest have over 300 records of its occurrence, indicating that it may be more common than previously thought.

Migratory and Resident Bird Species

Bird species richness at the stand level has been correlated in some recent studies with habitat patchiness, densities of snags, and density by size-class of conifers (Hagar, McComb, and Emmingham 1996; Hansen et al. 2003). Even-aged conifer stands provide habitat for a relatively high abundance of a few bird species, many of which feed on insects gleaned from conifer foliage. The most common species include chestnut-backed chickadee, Pacific-slope flycatcher, hermit warbler, golden-crowned kinglet, varied thrush, winter wren, red-breasted nuthatch, and Swainson's thrush. These species are also common or more abundant in mature conifer stands as well (Hansen et al. 1995).

The proposed thinning areas are in mid-seral stands in the stem exclusion stage. These forest conditions are structurally simple and characterized by an even-aged, single-layered, closed-canopy with poor understory development, and are low in landbird species richness. The light-limited understory of unthinned stands does not provide for a diverse community of shrub and ground cover plant species that are important in providing insect and plant food resources for bird species which rely on living deciduous trees, shrubs, and leaf litter (Hagar 2004). Abundance of arthropod prey species has been correlated with understory and midstory vegetation, particularly tall shrubs and hardwoods. These habitat elements are lacking or poorly-developed in the stands proposed for thinning.

Big Game

Big game species that are found in the project areas include Roosevelt elk (Cervus elaphus roosevelti) and black-tailed deer (Odocoileus hemionus). The project areas are in mid-seral stands which provide hiding and low quality thermal cover. Early- to mid-seral stage stands are abundant in the Quartzville Watershed, especially on private lands in the vicinity. The Salem District RMP (p. 26) identifies no critical winter or summer range in the project areas. Big game use is highest during the snow free months which varies from year to year, typically occurring from late spring through early fall.

3.2.2 Environmental Consequences

A. No Action Alternative

Habitat Structure, Snags and Coarse Woody Debris

The majority of the stands in the project area have low vigor, high stocking and small crowns. Self-thinning would occur but snags and down logs created by suppression mortality would not be large enough to meet RMP standards for approximately 30 to 60 years when suppressed co-dominants achieve these diameters before dying. CWD development would occur over a longer time period than snags through self-thinning, death, and recruitment to the forest floor. Understory and ground cover development would not be established until a disturbance such as fire or windthrow removes overstory trees, allowing light to reach the understory. Similarly, late successional habitat conditions would develop slowly; these stands are expected to maintain low species and vertical diversity for 30-60 years.

Northern Spotted Owl

There would be no immediate change in spotted owl habitat and no effect to spotted owls from management action. Habitat conditions would remain as described in the Affected Environment section, and would continue to develop slowly over time for reasons stated above. Currently dispersal habitat would take approximately 30 to 60 years to develop into suitable habitat.

BLM Special Status Species and Survey and Manage

In the short term, there would be no immediate change in current habitat conditions for Survey and Manage and BLM Special Status Species. In the long term trees would grow more slowly, and material available for CWD recruitment would average smaller in diameter than if thinning were to occur. The amount of dwarf mistletoe in these stands would steadily increase, and marginal habitat for Johnson's hairstreak would remain unaffected. Since no new disturbance to the conifer canopy would occur, no undetected red tree vole nests would be affected. Optimal habitat for Johnson's hairstreak and the red tree vole would develop more slowly without thinning, and stands would remain as closed mid seral stands longer or until self-thinning or disturbance such as fire occurs.

Migratory and Resident Birds

Habitat conditions would remain as described in the Affected Environment section, and would continue to develop slowly over time. Current low species richness of bird communities reflect the simple single storied mid-seral stages present in the stands. Bird species richness may not noticeably increase, and legacy features in the future stand would likely be smaller and less persistent, especially those that provide habitat for cavity-nesting species.

Big Game

In the short term, there would be no disturbance effects due to the proposed action. Thermal and hiding cover quality would remain the same as current conditions. There would be no increase in vegetative forage due to increased light to the forest floor. In the long term, thermal and hiding cover quality would gradually decrease as overstocked stands mature and hinder mobility. Forage quantity would continue to decrease over time as less light reaches the forest floor.

B. Proposed Action

Habitat

All Land Use Allocations

The proposed treatments would have both short (less than 5 years) and long term (more than 5 years) effects. In the short term, thinning these structurally simple mid-seral stands would result in a reduction of suppression mortality, canopy cover, understories and ground vegetation. In the longer term, thinning would increase stand structural complexity. While thinning these stands would reduce the number of small diameter (<15 inches DBH) snags that would otherwise die from suppression mortality, there would be an increase in understory development, crown structure and growth of the residual trees. In the long term, thinning would increase understory development as well as canopy structure, tree diameters and spacing of the retained trees. Stand conditions and structural complexity would improve as canopies close, habitat quality for mid- to late-successional wildlife species would improve as well.

Research since the 1980s found that it is possible to develop desired structural and compositional diversity in young managed stands through specific actions (Bailey and Tappeiner 1997, Chan et al. 2006). Thinning forest stands produces what has been described as "cascading ecological effects" (Hayes, Weikel and Huso 2003) that result from reduced competition between overstory trees and increased availability of solar radiation to the forest floor. Growth, size, branch diameter, and crown ratio of the remaining trees is increased, and development of understory and ground cover vegetation is stimulated. These changes effectively increase structural complexity and habitat quality. The increase in structural diversity would improve habitat for many species by providing more opportunities for foraging, nesting/breeding, resting, hiding and escape cover/habitat for a variety of species in the forest environment, including invertebrates, songbirds, and small mammal species. These changes are considered to be beneficial since there is an abundance of simplified mid-seral stands in the Quartzville Watershed (QWA Chp. 5 pp. 4-9).

Proposed road construction and renovation, skid trails and skyline corridors under the proposed action would create narrow linear openings through the vegetation, disturbing, reducing or removing ground vegetation and creating breaks in the canopy, which would allow more light to reach the forest floor. The effects on wildlife habitat would be a short term disturbance and reduction in ground vegetation and canopy closure that would increase access to the stand by certain wildlife species, specifically larger mammals such as big game, coyotes, and avian predators. In the long term ground vegetation would become re-established due to increased light to the forest floor, and the breaks in the canopy would close.

The proposed action includes up to twenty one acre low density thinning patches. These openings would increase understory layering, structural diversity, ground cover, and complexity to both the forest stands and landscape. Species which are expected to benefit from low density thinning patches are ruffed grouse, Wilson's warbler, warbling vireo, song sparrow and big game species.

Late Successional and Riparian Reserves

The age classes proposed for thinning provide the greatest opportunities for acceleration of tree diameter growth and understory development through thinning and density management (QWA, Chp. 7, p. 8). It is anticipated that thinning would improve habitat conditions in the LSR and RR for wildlife by accelerating development of late seral forest stand characteristics. Desirable late seral forest stand characteristics include larger trees for a large green tree component and recruitment of large snags and CWD in future stands, multi-layered stands with well-developed understories, and multiple species that include hardwoods and other minor species.

At the landscape level, connectivity for species such as the spotted owl is expected to improve as late successional conditions develop in the LSR and RR. Other species which would benefit from the development of older forests in these Reserves include many species of mollusks, amphibians, bats, the red tree vole, blue grouse, red-breasted sapsucker, pileated woodpecker, Cooper's hawk, Pacific-slope flycatcher, Swainson's thrush, black-throated gray warbler, black-headed grosbeak, olive-sided flycatcher, brown creeper, and hermit warbler.

Snags, Down Logs (CWD), Old-Growth Remnants and Special Habitats

All Land Use Allocations

Thinning these stands would reduce the number of small diameter (<15 inches DBH) snags over the next 20 to 40 years because thinning from below removes the smaller suppressed and intermediate trees that would otherwise die from suppression mortality and become snags within that time period. Also, more of the existing smaller diameter/taller snags (between 9 and 15 inches DBH and greater than 25 feet tall) would be felled for safety reasons or fall incidental to thinning operations. These smaller snags have less value for wildlife species than the larger material over 15 inches (Rose et. al., 2001).

In unmanaged forests the presence of cavity nesting birds has been linked to the presence of snags, particularly greater than 50 cm (19.26") (Carey et al. 1991, Huff and Raley 1991). Snag associated species such as chestnut backed chickadees, red breasted nuthatches, brown creepers and hairy woodpeckers have shown selectivity to foraging habitats based on deciduous trees, large diameter conifers, and large diameter heavy decayed snags and logs (Weikel and Hayes 1999). Within thinning units, approximately 90 percent or more of existing snags ≥15 inches diameter would remain standing after treatment, retaining the best available habitat. The remaining ten percent or less of these large snags may need to be felled to maintain safe project operations.

Up to two trees per acre would become snags or CWD through logging where damage to retained trees occurs and retained trees are felled to facilitate logging and left in place. All felled snags and some retained trees would remain on-site as CWD, providing important habitat for dead-wood associated species.

Small dead wood created through suppression mortality would be abundant in adjacent untreated areas. Analysis shows that there are about 3,300 total acres of mid seral stands of the same age in the sub-basin near the proposed units on BLM lands. A total of 1,290 acres are planned for thinning, leaving 60 percent of these mid seral stands untreated. There would be untreated areas

to provide small dead wood from suppression mortality. The proposed thinning would improve growth rates of residual trees to provide for future recruitment of larger diameter dead wood.

The proposed commercial thinning would retain many more trees per acre than the RMP management actions/direction (p. 25) describes for retention at regeneration harvest. Throughout the project area, approximately 48 to 119 green trees per acre would be retained, including adequate numbers for recruitment of snags and down logs in the future stands. As a result of thinning, growth of retained live trees would be accelerated, so larger trees would be available sooner for recruitment as snags and CWD than without thinning.

Existing large diameter CWD in more advanced decay conditions would persist and contribute to forest floor wildlife habitat conditions for many decades before passing through decay class five to become unrecognizable as down logs. It is anticipated that fewer than ten percent of existing down CWD would be directly impacted by logging. Less than ten percent of the thinning area would be directly impacted by skidding/yarding, which is the operation with the highest potential impact to existing CWD. BLM oversight of skyline corridor and skid trail locations would ensure that they were located to avoid impact to high value CWD wherever feasible.

There would be no effects to large legacy remnants since most of the proposed units lack these structures. The few scattered legacy remnants within units would be retained and it has been determined to be feasible to leave these legacy remnant trees standing and undamaged. Approximately 15 percent of the thinning boundaries are adjacent to old-growth stands. These adjacent stands represent less than 6 percent of the old-growth stands on BLM lands in the Quartzville Watershed. Past clear-cuts created high contrast edges. All of these edges were created as high contrast edge when the stands were clear-cut 40 to 60 years ago. Understory layers and conifer reproduction is much thicker along these edges as a result. As the new stands grew, the edge contrast decreased. Currently they are low contrast edge, and would remain low contrast edge after thinning. The conifer reproduction and understory edge would remain intact and would buffer impacts of thinning on adjacent old-growth stands.

Through retention of existing large trees, snags and CWD combined with expediting large tree development, there would be a long-term increasing trend in snag and CWD quantity and quality across the project area.

Late Successional Reserves and Riparian Reserves

In addition to retaining existing and expediting development of new snags and CWD, up to two snags and down logs per acre would be created in LSR and Riparian Reserves upon completion of thinning. Periodic post treatment surveys would be conducted to evaluate the amount and quality of snags and down logs. Based on the findings, subsequent girdling and tree topping treatments would be implemented to meet Late-Successional Reserve Assessment (LSRA) guidelines for snags and down logs in mid seral stands. Snag and down CWD guidelines in the LSR could be met in 20 to 40 years.

Matrix

In the Matrix LUA, the treatment units are expected to remain in a snag deficit condition for two to four decades, until live trees become large enough (at least 20 inches diameter) to provide for recruitment of large snags and CWD. As a result of increased growth rates of retained trees, the

RMP Management Actions/Direction guidelines for snags (40 percent maximum population densities) and CWD (240 linear feet per acre or more of material in decay classes 1 or 2, at least 20 inches in diameter at the large end, and 20 feet in length) in the Matrix could be met in two to four decades.

There would be no impacts to the wetland in unit 9F, the wetlands adjacent to unit 29A, and the talus adjacent to 9C due to protection buffers. CWD created adjacent to these special habitat features could result in beneficial effects by providing more snags and down logs closer to these areas for wildlife use.

Federally Listed Species

Threatened - Northern Spotted Owl

The proposal would thin 1,290 acres of dispersal habitat in the Quartzville, Crabtree, and McDowell Creek Watersheds, including 258 acres in LSR. Thinning would occur in Dispersal habitat within the provincial home range of five known spotted owl sites. No harvest would occur within disturbance range of any known spotted owl sites. No suitable habitat would be treated and the viability of these sites would remain unchanged. None of the units are located in 2012 Critical Habitat and or unmapped Late Successional Reserves (LSRs) which are 100 acre core areas for known spotted owls as of January 1994.

The Mighty Moose proposal is consistent with the Revised Northern Spotted Owl Recovery Plan (NSO 2011), and conforms to Recovery Actions 6 and 32. Recovery Action 6 recommends implementation of silvicultural treatments in plantations, overstocked stands and modified young stands to accelerate the development of structural complexity and biological diversity (NSO 2011 p. III-19). Recovery Action 32 recommends land managers maintain high quality suitable habitat. Since the proposed units do not meet the stand level conditions characteristic of Recovery 32 Habitat (NSO p. III-67) there would be no alteration to this habitat.

Current habitat function for the spotted owl would be maintained after treatment. Forest stands can be altered in a manner that is not necessarily expected to change the habitat function for spotted owls (Forsman et al. 1984, USFWS 2007c). "Maintain" habitat means light to moderate thinning in which forest stand characteristics are altered but the components of spotted owl habitat are maintained such that spotted owl life history requirements are supported. For spotted owl dispersal habitat a canopy cover of over 40 percent along with other habitat elements (e.g. including snags, CWD, tree-height class-diversity, and older hardwoods) would be maintained post treatment to adequately provide for spotted owl dispersal. As a result, the functionality of the habitat used by spotted owls remains intact post treatment (Table 8).

Thinning treatments can have long-term benefits to spotted owls by encouraging late-successional characteristics to occur more rapidly (BA p.19; LOC p.20). Thinning would accelerate the development of suitable habitat characteristics, especially in LSRs and Riparian Reserves. As thinned stands mature, habitat conditions are expected to improve.

Canopy closures would increase and the stands that are currently dispersal habitat could attain suitable habitat conditions within 20 to 40 years. These stands would develop foraging and

nesting structure and residual trees would increase in size and be available for recruitment of snags, culls and CWD for prey species, and nesting opportunities for spotted owls. Subsequent treatments to create snags and CWD to meet LSR objectives would help move these stands toward suitable habitat conditions.

Disturbance associated with thinning (logging, road-building, etc) may have temporary effects on the presence or movement of spotted owls. However, thinning would maintain dispersal habitat, therefore maintaining the ability of the habitat to accommodate movement of birds after thinning is completed.

Seasonal restrictions on all activities on Units 12S-2E-11D, 11E, 13A, 14A, and 14B during the critical nesting season would minimize the risk of disturbance to spotted owls (BA pp. 8-9, 10-11; LOC pp. 15, 16-17).

Table 8: Spotted Owl Habitat Modification by Treatment Type and Land Use Allocation

5th. Field Watershed	Project	Township-Range-Section#	Acres	Land Use Allocation	Pre/Post Treatment Habitat Type1	Habitat Modification 2
Quartzville Creek	Mighty Moose	12S-3E-8, 9, 15, 17, 20, 21	355 ac	Matrix	Dispersal/Dispersal	Maintain
Quartzville Creek	Mighty Moose	12S-3E-8, 9, 15, 17, 20	160 ac	Matrix/RR	Dispersal/Dispersal	Maintain
Quartzville Creek	Mighty Moose	12S-2E-11-14; 12S-3E-10, 11	420 ac	LSR	Dispersal/Dispersal	Maintain
McDowell Creek	Mighty Moose	12S-2E-29	235 ac	Matrix	Dispersal/Dispersal	Maintain
McDowell Creek	Mighty Moose	12S-2E-29	70 ac	Matrix/RR	Dispersal/Dispersal	Maintain
Crabtree Creek	Mighty Moose	12S-2E-21, 29	30 ac	Matrix	Dispersal/Dispersal	Maintain
Crabtree Creek	Mighty Moose	12S-2E-21	20 ac	Matrix/RR	Dispersal/Dispersal	Maintain
TOTAL			1,290 ac			

Notes and definitions for Table 8 (BA 2014, pp. 7-8, 18-19; LOC 2014, pp. 13-15, 20-21, 28).

1 Habitat Types:

Suitable habitat is conifer-dominated forest, 80 years old or older and multi-storied in structure, and has sufficient snags and downed wood to provide opportunities for owl nesting, roosting and foraging. The canopy cover generally exceeds 60 percent. No suitable habitat is proposed for thinning.

Dispersal habitat is conifer and mixed mature conifer-hardwood habitats with a canopy cover greater than or equal to 40 percent and conifer trees greater than or equal to 11 inches average diameter at breast height (DBH). Generally, spotted owls use dispersal habitat to move between blocks of suitable habitat, roost, forage and survive until they can establish a nest territory. Juvenile owls also use dispersal habitat to move from natal areas. Dispersal habitat lacks the optimal structural characteristics needed for nesting.

2 Habitat Modifications:

Maintain habitat means to alter forest stand characteristics but maintain the components of spotted owl habitat within the stand such that spotted owl life history requirements are supported (i.e. the functionality of the habitat used by spotted owls remains intact post treatment). For spotted owl dispersal-only habitat a canopy cover of >40 percent along with other habitat elements (e.g. including snags, CWD, tree-height class-diversity, and older hardwoods) will be maintained post treatment to adequately provide for spotted owl dispersal.

Special Status, Survey and Manage, and other Species of Concern

Johnson's Hairstreak - Bureau Sensitive

Primary habitat for Johnson's hairstreak is older forests with dwarf mistletoe. There are no older stands proposed for thinning in Mighty Moose. Habitat within in the units is considered to be marginal due to its young age and low to moderate amounts of dwarf mistletoe. The proposed project would reduce the amount of hemlock dwarf mistletoe in the stand. The reduction in dwarf mistletoe may have effects on Johnson's hairstreak, but the impacts would be limited to individual trees in habitat that is marginal due to the young stand age. Johnson's hairstreak would be more likely to be present in adjacent old-growth stands which have a high incidence of dwarf mistletoe in the western hemlock. Hemlock dwarf mistletoe is known to be very persistent and virtually impossible to eliminate without aggressive clear-cutting (Hawksworth, Wiens 1996) and would persist after treatment.

Bats

Adverse impacts to bat species are expected to be low. Old-growth forests provide higher quality roost sites than younger forests and many species prefer older forests (Thomas and West 1991; Perkins and Cross 1988). No older forests are proposed for thinning. There are virtually no snags within the units proposed for thinning and no large snags with sloughing bark. These habitat elements are present in the surrounding old-growth stands, some of which are adjacent to the proposed units. Within the project area, there are few large legacy remnant trees which extend above the canopy in units 8A, 9F, 11A, 13A, and 20A. All of these structures would be posted outside of the unit boundaries and/or reserved from harvest. Structural changes in stands caused by thinning may benefit bats by creating habitat structure in young stands that bats are able to use more effectively (Humes, Hayes, Collopy 1999). Bat species are also associated with buildings, bridges, mines, cliff crevices and caves. None of these features are present in the Mighty Moose project area.

Survey and Manage – Red Tree Vole

The effects to red tree voles are expected to be minimal due to poor quality of existing mid-seral habitat. No suitable RTV habitat is being removed as a result of this proposal. In the short-term, undetected nests could be destroyed or disturbed during thinning. Thinning can temporarily

inhibit dispersal and make habitat less suitable because of wider spacing between crowns (Hayes et al. 1997). After thinning is completed, stands would acquire older forest characteristics sooner than without thinning. Habitat conditions for red tree voles would gradually become more suitable after thinning as the stands continue to mature and develop older forest characteristics. Optimal habitat is available in old-growth stands in the vicinity of the units.

Cascades axe tailed slug (Carinacauda stormi) – Bureau Sensitive

Habitat conditions for the slug are poor due to a lack of understory vegetation characteristic of the slug's habitat, and heavy ground disturbance from the previous clear-cut harvests. Due to seasonal restrictions on ground based logging, activity would occur during the drier seasons when mollusks are less active. Habitat conditions in adjacent old-growth stands are more favorable, with undisturbed ground, abundant vine maple, and well-developed understories.

Migratory and Resident Birds

Unintentional take of nests, eggs, nestlings and nesting failure would be likely if harvest operations occur during active nesting periods. However, the impacts would be short term, involving loss of nests and unintentional take during one nesting season, and would not reduce the persistence of any bird species in the watershed or populations at the regional scale.

Some individual birds may be displaced during harvest operations in the project area due to disturbance. Adjacent untreated areas and areas where active operations are not occurring would provide refuge and nesting habitat, which would minimize short term disturbance.

Changes in habitat structure are expected to have immediate effects on bird communities in thinned stands. Thinning densely-stocked conifer stands would be expected to immediately enhance habitat suitability for species which prefer a less dense conifer canopy, and reduce habitat suitability for species that prefer continuous conifer canopies. Reducing the canopy closure and opening up stands is expected to have short term negative effects on the brown creeper, golden-crowned kinglet, hermit warbler, Pacific-slope flycatcher and varied thrush. However, these species are common and more abundant in mature conifer stands as well (Hansen et al. 1995). In the long term, thinning would have positive effects on this same set of species as understories develop and habitat quality improves.

Overall bird species richness (a combination of species diversity and abundance) would be expected to gradually increase for up to 20 years as hardwood components of stand structure develop, plant species composition becomes more complex, and hardwood shrub layers, epiphyte cover, and snag density become more prominent within the stands. The future development of hardwood/deciduous, tree/bush components and canopy layers would favor species such as the band-tailed pigeon, ruffed grouse, red-breasted sapsucker, Wilson's warbler, Hutton's Vireo and black-throated gray warbler. The low density thinning patches would encourage the development of hardwood/deciduous tree/shrub components and canopy layers more rapidly, and would further benefit this same set of species. Bird species which utilize snags and down logs would benefit from moving stands toward the long term CWD objective in the LSR and RR.

Big Game

Big game species would be temporarily disturbed during the implementation of the proposed action. Logging equipment noise and human presence may cause animals to avoid or disperse from the project areas temporarily, during times of operation.

Thermal and hiding cover would be maintained after harvest. However, thermal and hiding cover quality would decrease in the short-term as a result of thinning, opening new roads, renovating roads and road improvements (Cole, et al. 1997, Trombulak and Frissell 1999). Saplings and vegetative forage such as shrubs, grasses and forbs would increase as a result of thinning and road closures after thinning. As a result of increased light, forage quantity would increase and attract early successional species such as elk and deer to the thinned areas. This response of early seral plant species would be especially evident in the low density thinning areas.

In the long term (5 plus years), thermal and hiding cover quality would increase and vegetative forage would gradually decrease as a result of canopy closure decreasing the amount of light reaching the forest floor. Vegetative forage would persist longer in the low density thinning areas.

Cumulative Effects

Snags and Down Logs (CWD)

Thinning these stands would reduce the number of small diameter (<15 inches DBH) snags over the next 20 to 40 years that would otherwise die from suppression mortality and become snags. Analysis shows that 60 percent of the sub basin would remain untreated. Closer analysis shows that in the immediate vicinity of the treated areas, 45 to 50 percent of these stands would remain untreated. Small dead wood would still be present and available in adjacent untreated areas. Design features would retain existing ≥CWD 20+ inches and snags ≥15+ inches in diameter. Any snag that falls for any reason as a result of thinning operations would remain on-site to become down logs, providing important habitat for a different key group of dead-wood associated species (Aubry 2000; Bowman et al. 2000; Butts and McComb 2000). Up to two trees per acre would become snags or CWD through logging where retained tree damage occurs and reserve trees are felled and left to facilitate logging.

Beneficial long term (20 to 40 years) cumulative effects to larger CWD and associated wildlife species would occur as a result of implementing the projects, since larger trees would be available sooner than without thinning to contribute additional large snags and CWD recruitment in future stands. To further improve quantity and quality of snags and down logs, as larger trees develop in the residual stands they would provide source material for girdling and topping, directly increasing the amount and quality of snags and CWD across the project area.

Northern Spotted Owl

The Northwest Forest Plan (NWFP) goal for conservation and recovery for spotted owls is to maintain suitable owl habitat within LSRs and the provincial home range of known owl sites; and maintain dispersal habitat between LSRs and known owl sites. Hence, the scale for cumulative effects for the northern spotted owl is the provincial home range radius of known

spotted owl sites, or 1.2 miles for the Cascades of Western Oregon (BA, p. 7-8; LOC, p. 13-14), and the location of the project in relationship to adjacent known spotted owl sites and Late Successional Reserves (LSRs).

Private lands are not expected to provide spotted owl habitat due to a rotation harvest plan, maintaining stands in early to mid-seral habitat. Other federal projects in the watershed include thinning in the Crabtree watershed and LSR habitat enhancement in the Quartzville LSR. Each of these projects intends to promote late-successional habitat via thinning young to mid-seral stands, setting a trajectory to complex structure and diverse species composition. Likewise, this proposal would establish forest conditions favorable to large high quality snag and CWD recruitment, multi structural stand conditions, and greater species diversity. Currently, the project areas support dispersal habitat for spotted owls; however, in the long run late-successional habitat conditions would improve within stands and across the watershed. Further, the proposed action would maintain dispersal habitat within and between known owl sites. Therefore, due to the retention of existing habitat and promotion of future habitat, the proposed action would not reduce spotted owl habitat.

BLM Special Status Species and Survey and Manage Species

The proposed action would maintain the current seral stage and stand age and thus would not adversely contribute to cumulative effects to any Special Status or Survey and Manage wildlife species. Habitat within the project areas is low quality due to young age classes, dense stands, and a lack of important habitat elements required to be suitable for Special Status/Survey and Manage wildlife species. A high percentage of similar habitat in the vicinity would remain untreated, and high quality suitable habitat for Special Status/Survey and Manage species would remain intact. Implementation of the project would not eliminate connectivity between proposed units or adjacent untreated stands under BLM management.

In the long term, larger trees would be available sooner than without thinning to contribute additional large CWD in future stands. The creation of snags and down logs with the objective of meeting long term CWD objectives would be beneficial. Stand conditions and structural complexity would improve as canopies close and thus improve habitat quality for mid- to late successional wildlife species.

In conclusion, thinning in the project area would not be expected to contribute to the need to list any Bureau Sensitive species under the Endangered Species Act (BLM 6840) because habitat for the species that is known to occur in the project areas would be maintained, habitat connectivity would not be changed, any habitat alteration would have only short-term negative effects, and long-term effects would be beneficial.

Migratory and Resident Birds

No cumulative effects to birds are expected. The proposed action would not reduce the persistence of any bird species in the watershed or populations at the regional scale. Thinning would not change seral stage habitat because the thinning retains 56-119 trees per acre and average stand diameter would increase after thinning (Appendix B). The thinning would not change seral stage habitat or any patch size, and therefore would not contribute to fragmentation of bird habitat. Thinning would not contribute to a change in the species composition of existing

bird communities within the watershed. In the long term, the thinning would have the potential to improve habitat for bird species as these stands reach maturity, resulting in greater bird species diversity.

Big Game

No adverse cumulative effects to big game species populations are expected. The proposed action would not fundamentally change or eliminate any forest cover type or change any habitat patch size; thermal and hiding cover present before treatment would be maintained after harvest, although short term decrease in quality would occur. However, the effect would be minimal due to ample high density vegetative cover types in the surrounding landscape and within the project area. In the long term, cover quality would increase with vegetation growth and development. Variable density thinning, including the low density thinning areas are expected to improve the quality of forage and cover both in the short and long term. Because of the maintenance of existing habitat and improvement in both cover and forage, there would be no adverse cumulative effects to big game.

3.3 Botanical Resources

Incorporated by Reference: Fennell, 2013. Mighty Moose Botanical Report, Cascades Resource Area, Salem District, Bureau of Land Management. Salem, OR.

Methodology

BLM conducted Known Site surveys (data search) and field surveys (botanical inventory) within the proposed harvest areas and vicinities. Prior to field surveys, specific harvest areas and vicinities were evaluated for the presence of known Threatened & Endangered (T&E), Special Status Species (SSS), Survey & Manage (S&M) and invasive/non-native plant species. Habitat requirements for T&E and SSS were reviewed and compared to habitat in the proposed harvest area(s) to identify suitable habitat areas.

Comprehensive botanical inventories of the proposed harvest areas were conducted in 2012 to look for any species that require protection or special management. These surveys include traversing through and around the proposed project area and visiting areas delineated on topographic maps or aerial photos as having probable habitat for T&E, SSS and S&M species. All surveys within the road corridors on both public and private lands were conducted using the 100% survey method. These surveys complete a 100% visual examination of the survey area. Additionally, road corridor surveys were conducted on both public and private lands to determine invasive/non-native species distribution.

3.3.1 Affected Environment

<u>Threatened & Endangered, Special Status and Survey and Manage Species</u>

Neither database searches nor field surveys found T&E vascular plant species or suitable habitat in the project area. Similarly, no SSS species were found during field surveys and there are no known sites within the proposed harvest area(s).

Three S&M lichen species (Chaneotheca chrysocephala (S&M-B), Chaenotheca ferruginea (S&M-B), Chaenotheca fufuracea (S&M-F) and one S&M fungi species (Cudonia monticola (S&M-B) were found during field surveys of the proposed project areas.

Invasive / Non-native Plant Species

During field surveys, the following invasive/non-native species were found to occur adjacent to the proposed harvest areas within road corridors: tansy ragwort (Senecio jacobaea), Canadian thistle (Cirsium arvense), bull thistle (Cirsium vulagre), St. John's wort (Hypericum perforatum), scotch broom (Cytisus scoparius) and false brome (Brachypodium sylvaticum).

3.3.2 Environmental Consequences

A. No Action Alternative

Under the No Action alternative natural disturbances such as wind, insects and disease would create openings and cause soil disturbance. Small openings and areas of soil disturbance would in most cases reestablish with native vegetation from the immediate area. On occasion some areas would become populated with invasive/non-native species from seed brought in by animals, wind or recreational users. Areas within the proposed project that have seen similar past disturbances are currently free of invasive/non-native species due to competition from native vegetation and this trend would be expected to continue. In time however, as the stand matures, larger openings due to insect, disease and wind damage are likely to occur as a result of the current over-stocking of the forest overstory. If areas of the forest are heavily impacted by natural disturbance, higher infestations of invasive/non-native species would be anticipated. Areas not impacted by natural disturbance would have complete canopy closure and the current forest understory (i.e. small trees, shrubs and herbs) would die back to only the most shade tolerant species. Presence and persistence of the identified S&M species would continue with natural disturbances and succession shaping the population densities and distribution.

B. Proposed Action

No suitable habitat to support any T&E species was identified within or adjacent to the proposed project areas. Hence, there would be no effects to T&E species or habitats. Although suitable habitat to support some SSS was identified within the proposed project areas, no SSS were found.

Due to the nature of the proposed project, a thinning project that retains 48-119 trees per acre and 50% canopy cover, some suitable habitat to support Special Status Species would be modified through changes in canopy and soil disturbances but would not be lost. Untreated areas would maintain habitat and substrate nearly or entirely intact for species needs and protection; suitable habitat would remain within units and reserve areas within and adjacent to the proposed harvest areas. Although indirect habitat changes (e.g. increased sunlight, temperature increase, etc.) to untreated adjacent stands may occur, no adverse impact to that habitat is anticipated. Due to a thinning prescription and the retention of habitats throughout the project area the proposed actions would not contribute to the need to list as T&E any SSS species. Similarly, retention of habitat in untreated areas and within thinning units provides suitable habitat for the S&M species known or suspected to occur in the vicinity.

A Noxious Weed Risk Assessment (BLM Manual 9015) of the proposed project area was conducted and the area was found to have a risk assessment rating of moderate. A moderate rating indicates the proposed project should proceed as planned with measures in place to control the spread of the existing invasive/non-native species populations and prevent the introduction of new invasive/non-native plant species.

Road work, areas of tractor harvest, trails, and landings represent opportunities for dispersal of noxious weed seed from outside the project area, as well as the spread of existing seed present in the project area.

However, due to PDFs designed to reduce the risk of weed spread such as equipment washing to remove dirt containing weed seeds or plants and seeding/mulching with native species to help native plants become established, increases in weed populations would be equal to the No Action alternative and are not anticipated to be distinguishable above current levels and mechanisms (vehicles, wind, animals, etc.).

Cumulative Effects

Threatened & Endangered, Special Status Species and S&M

There would be no cumulative effects to T&E or SSS species because there are no known occurrences and none were found during field surveys. Suitable habitat to support Special Status Species within the proposed project area would be modified but not lost. Thinning and untreated areas would maintain habitat and substrate nearly or entirely intact for species needs and protection; suitable habitat would remain within units and reserve areas within and adjacent to the proposed harvest areas. Therefore, because habitats and species would be protected by providing habitat throughout the project, there are no foreseeable cumulative effects.

Invasive/Non-native Plant Species

Given unpredictable vectors for weed spread such as vehicle usage, private land forest treatments, wildlife behavior, and wind currents, it is not possible to quantify with any degree of confidence the rate of weed spread in the future, or even the degree by which that potential would be increased by the proposed actions. However, PDFs would minimize the opportunities for spread of noxious weeds.

With project design features in place, the BLM does not anticipate that the proposed project would contribute measurably to the cumulative effects of invasive/non-native species in Oregon. If species establishment does occur, it is anticipated to be short lived (i.e. fewer than ten years) as native species repopulate disturbed areas out competing and shading out the invasive species. As evidenced on both public and private lands adjacent to the proposed project areas, no dramatic population increase in invasive/non-native species would occur if the proposed project proceeds as planned. Projects similar to that of the proposed project had little to no difference in their invasive/non-native species population composition or numbers, and these projects were completed without the project design features of this proposal.

3.4 Water Resources

Incorporated by Reference: Hawe 2013. Mighty Moose Hydrology Report, Cascades Resource Area, Salem District, Bureau of Land Management. Salem, OR.

3.4.1 Affected Environment

Project Area Precipitation and Basin Hydrology

The project area is located east of Sweet Home, Oregon in the Western Cascades at elevations ranging from 1,400 – 3,500 feet. Most of the project area lies in the transient snow zone (TSZ), an elevation zone subject to rain-on-snow events (ROS) that have the potential to increase peak flows during winter or spring storms. This zone varies with temperature during winter storms but is assumed to lie between 1,500 - 3,000 feet in elevation. The project area receives approximately 64-70 inches of rain annually.

The project area is located in three 6th field watersheds (Lower Green Peter Lake, Lower Quartzville Creek, and Upper McDowell) with approximately 46,502 acres (72 sq. miles) in combined drainage area. A very small acreage (40 acres) lies in the Crabtree Creek watershed, representing 0.1% of the watershed. All proposed units ultimately drain to the South Santiam basin. There are no key watersheds in the project area.

Stream flow

An analysis for the risk of increases in peak flow as a result of forest harvest in Rain On Snow elevations (ROS) was conducted using the Oregon Watershed Assessment Manual (OWEB 1997) watershed analysis methods for forest hydrology.

Table 9 displays statistics for the Lower Green Peter Lake and Lower Quartzville Creek 6th field watersheds and the Upper McDowell Creek 7th field watershed. These watersheds were used for determining the current risk of peak flow augmentation in project watersheds. The proportion of the watersheds in ROS is approximately 60%. The risk of peak flow enhancement will vary with the proportion of this area that has been recently harvested (see Figure 1, from OWEB assessment manual). The proportion of ROS area with current crown closure <30% was 20%, 16% and 65% respectively, indicating that there is currently a low risk for peak-flow enhancement area in the Quartzville and Lower Green Peter watersheds but a “potential risk” in the Upper McDowell Creek watershed. In the case of McDowell Creek, this is a result of extensive clear cutting on private forest lands in this watershed over the past decade. Due to the very small acreage in the Crabtree Creek watershed (40 acres, 0.1 percent of the watershed), actions are assumed to have no effect to hydrology or soil resources.

Table 9: Risk of Peak flow Enhancement by Sixth Field Watershed in Mighty Moose project area.

6th/7th Field Subwatershed Name	Watershed Area (acres)	Percent of Watershed in ROS Areas	Percent of ROS area with <30% Current Crown Closure	Peak-Flow Enhancement Risk
Lower Green Peter Lake 6th	14,987	59% (8,806 acres)	20% (1,794 acres)	Low
Lower Quartzville Creek6th	16,078	61% (9,758 acres)	16% (1,566 acres)	Low
Upper McDowell Creek 7th	3,485	61% (2,141 acres)	65% (1,392 acres)	Potential Risk

Figure 1: Graph for determining risk of peak flow augmentation (OWEB Assessment Manual Figure 3)

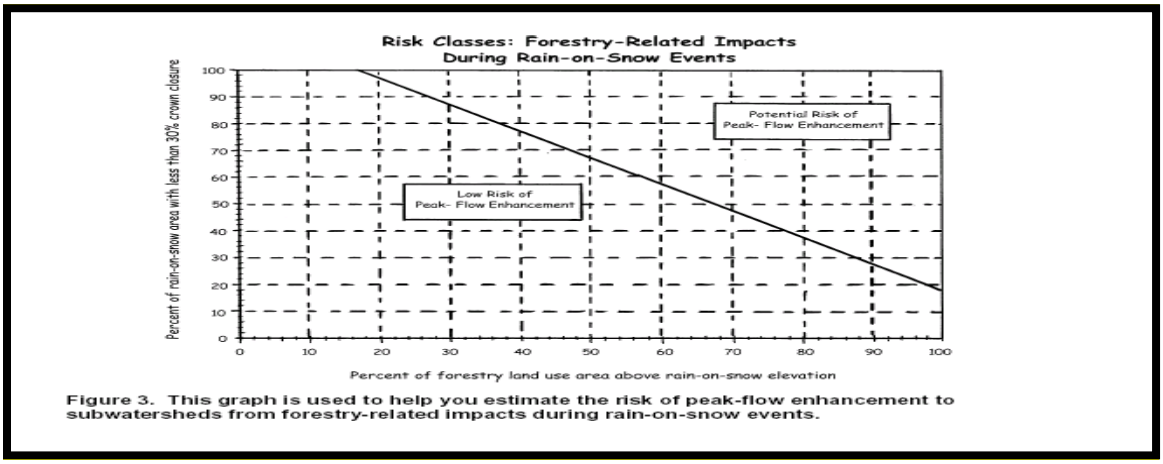


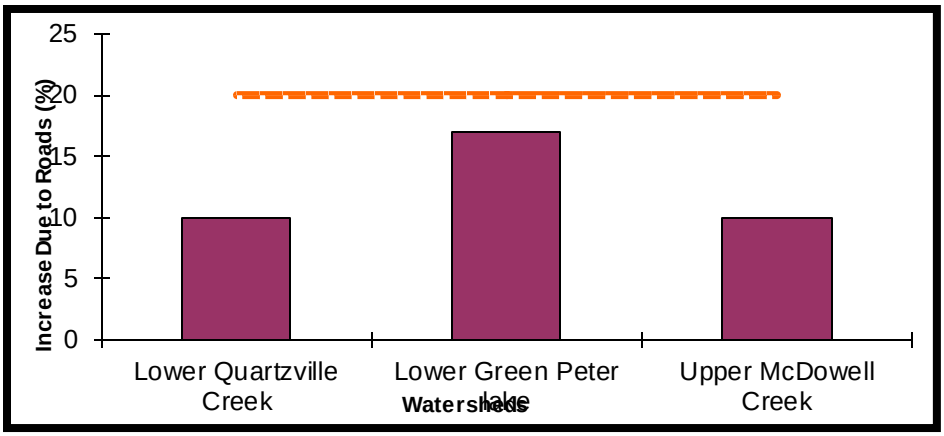
Figure 3. This graph is used to help you estimate the risk of peak-flow enhancement to subwatersheds from forestry-related impacts during rain-on-snow events.

Road surfaces have also been implicated as important contributors to increased peak flows in the Western Cascades. Under the worst case scenario, more than 50% of cut banks near stream channels may intercept groundwater and route it through road ditches (Toman 2004). In addition, when road ditches drain intercepted water directly to streams, they act as an extension of the stream network and can have a measurable effect on stream flow which may include an augmentation of peak flows on a watershed scale (Wemple et al. 2003).

The closer road surfaces are to streams, the greater the risk of altering stream flow, channel geometry and/or water quality. This relationship has not been quantified but is presumed to be highly variable across the landscape both in space and time. As a surrogate for risk, the increase

in drainage density due to road/stream intersections was calculated for the three sixth field watersheds in the project area. Figure 2 displays estimated channel network expansion at road-stream intersections for project watersheds (assumed to be a 100 foot average increase in stream length/intersection).

Figure 2. Estimated channel network expansion at road-stream intersections



Values in the project watersheds range from a low of 10 percent in Lower Quartzville Creek and Upper McDowell Creek to 17percent in Lower Green Peter Lake. The Wemple study implies that drainage density increases due to road stream intersections of approximately 20 percent or greater (indicated by the line on the chart) have the capacity to alter both the timing and quantity of peak flows. Based on this, watersheds in the project area are currently at low risk for augmentation of peak flows due to the road network in the watershed.

Streams near to roads are also at higher risk for water quality contamination from material washed off the road surface. During storms, runoff from unpaved forest roads may deliver sediment to streams resulting in increased sediment transport, deposition of fines in gravels and turbidity levels that exceed natural background levels. (Beschta 1978; Binkley and Brown 1993).

Roads in the project area were inspected by the Cascade RA engineers and hydrologist. Most road surfaces are well maintained and in good condition with little potential to contribute fine sediment to area streams. However, exceptions were noted on Roads 12-2E-13 which is in poor condition due to lack of maintenance. Road 12-3E-29 is blocked by a landslide and would need to be rerouted or cleared.

Stream Channels

Flow routing in the steep headwaters are often bedrock or boulder dominated, lack defined channels and are stable. These channels are often steep A3/4a+ channel types (Rosgen classification, 1996) incised into resistant bedrock and subject to debris flows. They have steep side slopes that are prone to landsliding. Because it is difficult for conifer trees to establish in these locations they tend to be dominated by deciduous species such as red alder and salmon berry. Due to the relatively frequent disturbance regime in these channels, they are often open (i.e., not fully stocked) and brushy with large quantities of small diameter down wood.

Downslope of these ephemeral steep headwater channels, typically at breaks in slope or change in soil depth, ground water seeps out onto the surface and begins to flow downhill. These small tributary channels exhibit intermittent surface flow, alternating between surface and subsurface flow. Flow initiation is associated with high water tables likely the result of subsurface flow patterns, as opposed to surface run-off, as evident by a lack of defined channels upslope.

Based on criteria provided in the BLM publication Riparian Area Management - A User Guide to Assessing Proper Functional Condition and the Supporting Science for Lotic Areas (U.S.D.I. 1998) - and comparing project area stream conditions to similar channels in the western Cascades, the Cascades Resource Area Hydrologist determined that channel reaches observed in the project area on BLM are currently in proper functioning condition (PFC). A determination of proper functioning condition means that the channel elements and physical processes are in working order relative to an area's capability and potential. It does not mean that the channel is functioning at full biological potential or that nothing could be improved by human intervention (e.g., placing additional wood structure, repairing infrastructure, thinning adjacent forest, etc.).

Downslope, the headwater tributaries become larger perennial channels that flow to the main Quartzville Creek channel. These larger 3rd order streams have entrenched into relatively resistant bedrock, forming constrained valleys with moderately steep adjacent slopes (average 50-60%). There is a low to moderate supply of gravel and cobble sized material actively transported in these Rosgen B3 channels (Rosgen 1996). Utilizing the Montgomery-Buffington (1997) typology, these perennial streams would be classified as step-pool channels: "Step-pool morphology generally is associated with steep gradients, small width to depth ratios, and pronounced confinement by valley walls."

Channels are shaded by dense stands of second growth conifer, often dominated by hemlock. Clearly small wood and shade are in abundant supply. Banks are stable and channel morphology is controlled by bedrock features with a cobble-boulder bed. These channel types are highly resilient and unlikely to be altered significantly by disturbance. Utilizing the same PFC criteria described and comparing conditions here to similar channels in Western Cascades, all of the perennial channels surveyed are currently in proper functioning condition.

Existing roads and stream channels

Where roads cross streams, channel morphology (the shape, size and slope of a channel) is generally altered in a predictable manner and this will affect water and sediment transport. Within the area occupied by the road prism (this volume varies with the length, width and depth of the road prism), vegetation and organic materials are removed and the channel surface, banks and bed are compacted.

In most locations culvert dimensions (shape, area and slope) are adequate to allow for the transport of most or all of the water, sediment and organic materials from upstream; the stream is said to be "at grade" and channel morphology upstream of the road fill is not affected. However, in other cases (culverts on road 12-2E-13), the reduced area imposed by failing or plugged culverts have restricted the passage of water, sediment and organic materials resulting in the deposition of sediment above the crossing. In these cases, the channel immediately upstream of the culvert collects sediment.

Project area wetlands

There are no wetlands identified on National Wetlands Inventory maps in the project area. The BLM GIS Water Bodies theme (for smaller wetlands, ponds and lakes), which has more detailed mapping of wet areas within the project, and the BLM GIS Timber Production Capability Classification (TPCC) theme, which has a category for sites with high water tables, identified several wet areas, particularly in section 15. These inventories are based primarily on review of aerial photographs with some field verification and thus small (<1 acre) areas with high water tables, ponds and/or wetlands may not have been identified, particularly when situated under forest canopy. In addition to mapping and database searches field surveys of the project area identified locations with high water tables, ponds and/or wetlands.

Water Quality and Beneficial Uses

Beneficial Uses: The State of Oregon designates the beneficial uses for all waters of the state. Water quality standards are ultimately meant to protect these uses. The designated beneficial uses identified in the South Santiam basin include salmon rearing and spawning, resident fish, irrigation, and domestic/municipal drinking water. Additional beneficial uses include industrial water supply, wildlife & hunting, fishing, boating, anadromous fish passage, water contact recreation, and aesthetic quality. The South Santiam River several miles downstream of the project area and Green Peter Reservoir supply domestic water.

Water Quality: The ODEQ's 2006 303d List of Water Quality Limited Streams is a compilation of streams which do not meet the state's water quality standards. The South Santiam and Quartzville were listed for exceeding summer stream temperature. In response, the ODEQ completed the Willamette Basin Total Maximum Daily Load assessment (TMDL) in 2005. Essentially, the TMDL requires the recovery or maintenance of full potential shade along all perennial streams in the Willamette basin. As part of the TMDL, the BLM submitted the Salem and Eugene District Water Quality Restoration Plan (WQRP) for the Willamette Basin which details how the BLM will implement the TMDL on federal lands. The plan was approved by the ODEQ on July 18, 2008. The water quality parameters with the potential to be affected by forest harvest and road construction and maintenance include stream temperature, dissolved oxygen (DO) concentrations (both inter-gravel and in water), hydrogen ion concentration (pH), and turbidity. Additional water quality parameters (e.g., nutrients, pesticide and herbicide residues, bacteria, etc.) are not highly sensitive to forest harvest and road construction (U.S.E.P.A., 1991) and were not reviewed for this analysis.

Temperature: Limited stream temperature data is available in the project area. The Quartzville Watershed Analysis (BLM, 2002) indicated that summer stream temperatures in the mainstem Quartzville Creek are above the State of Oregon's threshold of 17.8 degrees C.

Field surveys and review of aerial photographs indicate that shading is near to full potential along most of the small streams on BLM ownership in the project area with canopy closure exceeding 80% along most reaches. The current level of shade is preventing solar radiation inputs from increasing stream temperature. In addition, many of the tributaries adjacent to the proposed treatment units are intermittent and only flow during the wet season when exposure to solar heating is of no concern.

Sediment Supply, Transport and Turbidity: The following discussion provides a review of the processes that control the supply and transport of sediment in forested watersheds.

Mass wasting is the primary process responsible for the bulk of sediment production and transport in mountainous terrain. It is critical to recognize that sediment transport in headwater basins is dominated by highly episodic, large erosion events. For example 64% of the suspended sediment transport in the Little North Fork Santiam for the entire year of 2004 occurred in a single three day storm event (Bragg et. al. 2010). This is not atypical in the Western Cascades; sediment delivery and transport conditions are likely similar in the project watersheds.

Surface erosion (particularly following fire), channel cutting and bank erosion are the other important processes that have the potential to increase sediment transport and affect water quality in forested streams. Overland flow (water moving over the surface with the energy to erode soil) is rarely observed on forest slopes (Leopold 1997). Therefore, due to the high infiltration capacity of native soils, heavy vegetative growth and deep layers of surface organic material (i.e. soil duff layer), surface erosion on undisturbed forested land in the project area is rare. However, practices that compact the soil surface, remove the duff layer (hot burns), or concentrate runoff (such as road construction or tractor yarding trails) may lead to surface erosion with the potential for delivery to streams and a degradation of water quality (Johnson and Beschta 1980).

Stream bank erosion and channel cutting (horizontal or lateral) may be accelerated by reductions in channel roughness, increases in stream energy (e.g. stream power) or the redirection of stream-flow (Lane 1955). Increases in peak flows can also lead to increased erosion potential. However, within the project area, due to stream bed and bank armoring, ample small wood and dense riparian conditions, channels and banks are resilient to erosion. Stream surveys found very little to no bank erosion.

Data for stream turbidity or sediment delivery is lacking for the streams in the project area. However, field surveys during winter storms found water clarity appeared high and high turbidity levels were not noted.

3.4.2 Environmental Consequences

A. No Action Alternative

Under this alternative the existing water quality conditions, stream flows, and channel conditions at the project site would continue their current trends as described in the affected environment section above. Road related sediment noted for road 12-2E-13 would be reduced due to planned road maintenance and culvert replacement actions. The restricted passage of water, sediment and organic materials due to failed culverts would be alleviated and would result in reduced sedimentation.

B. Proposed Action

Channel and Wetland Morphology/Physcial Integrity (ACS Objective 3)

Direct and Indirect Effects - Channel and Wetland Morphology

With the exception of the proposed restoration at stream crossings there would be no direct alteration to channels or wetlands under this proposal. Stream banks, channel beds and wetlands would be protected with stream protection zones (SPZ) (i.e. no entry buffers) from direct physical alteration or disturbance by harvesting equipment.

In addition, as discussed below, the probability to alter stream flow is very low. Therefore any indirect effects to stream channels as a result of flow alteration or timing is unlikely. Thus, the proposed action would not result in detectable effects to channel morphology, such as increases in bank erosion, channel incision, scouring of substrates or gravel deposits utilized by fish for spawning, loss of floodplain connectivity or alteration of local wetland hydrology.

New road construction would not cross stream channels or wetlands and would not affect streams. However, repairing/replacing culverts to improve hydrologic connectivity at stream crossings is proposed. Replacement of these culverts would provide improved stream flow and passage of sediment, organic materials and aquatic organisms and would eliminate any chronic erosion and resulting turbidity that may occur at these sites. Some slight channel adjustment to grade or width may occur within the first year (varies with the timing and magnitude of storm events) following culvert replacement. Channel morphology adjustments would be unlikely to extend more than 100 feet upstream or downstream from the site of disturbance. Based on previous experience with these type of channel crossings, long term effects to channel function or morphology would be unlikely due to channel resiliency and short duration of activity.

Cumulative Effects- Channel and Wetland Morphology/Physical Integrity

Since channels in the project area currently maintain properly functioning dimensions and form there are no current cumulative effects to channel stability or function. With the exception of culvert replacements, the proposed action would not result in any direct or indirect effects to channel or wetland morphology; therefore, there would be no cumulative effects. At the locations of culvert replacement, adjustments would be limited to the site of disturbance and would not result in alterations to channels or floodplains downstream or elsewhere in the watershed. Channel adjustments at the site of disturbance, if they occur at all, would be very site specific and short duration (channel adjustment within one year). In the long term, culvert replacements would reduce chronic sedimentation and potential for future failures.

Project Area Hydrology (ACS Objective 6)

Direct and Indirect Effects - Channel and Wetland Morphology

Mean Annual Water Yield: Increases in mean annual water yield (the total yield of water from a watershed in one year averaged across the period of record) following the removal of watershed vegetation have been documented in numerous studies around the world (Bosch et al. 1982). Forest vegetation intercepts precipitation and through the processes of sublimation (the direct conversion of snow from a solid to a gas without entering a liquid phase) and/or evapo-transpiration, the forest returns over 50% of the annual precipitation to the atmosphere that might otherwise become runoff. Therefore, this proposal would likely result in some incremental, non-detectable, increase in annual water yield correlated to the removal of the conifer over-story (Troendle et al. 2006). However, other than the augmentation of peak and/or base flows

(discussed below) the "increase in fall and winter discharge from forest activities is likely to have little biological or physical significance" (USEPA 1991).

Peak flow: All of the proposed treatment units lay within the zone generally subject to transient snow accumulations (TSZ) in the winter. It can be assumed that the reduction in stand density would result in some increase in snow accumulation on the ground in these areas because there would be less canopy interception and sublimation. However, this proposal would not increase openings (areas <30% canopy closure) within the TSZ in project watersheds. Since canopy closure would remain >30% in this proposal, wind speeds above snow surfaces and snow melt-off during ROS events would remain at current levels. In addition, hardwoods, understory brush and riparian buffers would further prevent increased water delivery to streams. This proposal would not result in measureable increases in peak flows according to the State of Oregon risk assessment methodology (Affected Environment in this report).

The 2.0 miles of temporary new road construction are located on slopes generally under 30% and would not require extensive full bench or cut and fill construction. Roads constructed on these surfaces result in little or no sub-surface disturbance. These roads would have no effect on sub-surface or groundwater flow and thus have no effect on the timing or volume of stream flow in the watershed (Wemple et al, 2003). Since no additional permanent stream crossings are proposed, there would be no additional routes for water intercepted by road surfaces to reach streams. Intercepted rainfall on these roads would be drained to the adjacent undisturbed forest floor where, because of the high permeability of forest soils, it quickly infiltrates into the ground.

In addition, 2.0 miles would be temporary, receiving rehabilitation treatments (closing, water bars and placement of organic debris) following use. Under these circumstances, road construction has a low risk of altering watershed hydrology or peak flows because intercepted water does not reach stream channels any faster than precipitation which falls on the forest floor.

Groundwater: The proposed action is unlikely to affect peak or base flow and so, by extension, it has no capacity to affect groundwater patterns which are intimately linked to the surface. Compacted surfaces will be limited to less than 10 percent of the project treatment area and will mostly coincide with existing compacted surfaces. New road construction is unlikely to intersect ground water flow. These surfaces are located on topography with low to moderate slope, so water that does not infiltrate here would either evapo-transpire or infiltrate into adjacent non-compacted soils.

Cumulative Effects -Watershed Hydrology

In the McDowell sub-watershed, recent clear-cuts on private land have led to a potential risk for increased flows in channels draining the harvested units. Changes have not been quantified, as this takes numerous years to determine, but based on research and the harvest rotation plans, localized changes in peak flow are assumed.

The proposed action would not in result alterations to peak or base flow. Therefore it would not contribute to any cumulative effects to peak or base flows in these watersheds. This proposal would result in no net increase in forest openings in ROS areas with crown closure <30% and therefore would not contribute cumulatively to the augmentation of peak flows regardless of past and current private land forest practices. Proposed road use and construction is unlikely to alter

surface or subsurface hydrology in a manner that would alter stream-flow patterns or timing or contribute cumulatively to any change from current conditions in the watershed.

Since there would not be any direct or indirect effect to the watershed's ground water, the proposed action carries no risk for contributing to any existing cumulative effects to this resource.

Water Quality (ACS Objective 4)

Direct and Indirect Effects - Water Quality

Summer Stream Temperature Maximums in Perennial Streams: Field reviews of the perennial stream channels in the project area by area personnel found that they are well shaded and functioning properly on BLM land (see discussion under Affected Environment). This proposal would maintain effective shade above the range required under the Willamette TMDL which requires the recovery or maintenance of full potential shade along all perennial streams in the watershed.

To ensure that any harvesting adjacent to perennial streams would not increase summer temperature maximums, the BLM would not be removing shade producing trees. Other than the tops of a few alder trees the proposal would not remove any shade producing vegetation within the primary shade zone which is estimated to extend outward from the active stream channel to a maximum of 85 feet, decreasing with reduced tree height and slope gradient.

Two to three yarding corridors through the primary shade zone may be necessary to yard trees in unit 12A. Up to nine red alder trees may have to be topped or pushed over in the primary shade zone of a second order stream. The stream is fully shaded with an estimated 90 percent or more potential shade in its current condition. The cutting of up to nine red alder trees along 3 corridors would slightly increase canopy openings in the primary shade zone which would reduce existing shade by no more than one percent. At this level of shade retention the channel would remain adequately shaded to protect stream temperature and no increase in temperature would occur with this action.

Where riparian thinning is proposed beyond the primary shade zone, average canopy closure in the secondary shade zone (i.e. the area beyond the primary shade zone that contributes to effective shade) would be maintained above 50 percent. Retaining 50 percent of the secondary shade zone canopy closure would provide adequate shade for the prevention of any increase in stream temperature because it does not allow enough light to strike the water surface to increase the heat load (USDI, USDA. 2004).

Two recent research articles provide additional evidence in support of this conclusion. Wilkerson (Wilkerson et al. 2005) found no temperature effect on streams with a reduction in basal area to 60 percent of current conditions in the primary shade zone. In addition, Groom et al. (2011) detected no differences between pre-harvest and post-harvest stream temperatures on state forests in a study of shade retention under the Oregon Forest Practice Act on forested streams in Western Oregon. The State of Oregon findings examined units thinned to minimum densities of 25 percent within 8 meters of the channel (about 25 feet). This proposal would thin to densities of 50 percent and would not harvest in the primary shade zone (70-85 feet from the channel).

As noted in the description of the affected environment, most channels in the project area have an intermittent flow regime and do not flow on the surface during most summers. Water temperature in these channels is influenced directly by soil temperature which is a function of elevation, aspect and soil type. Therefore, these channels have little potential to be heated by exposure to direct solar radiation. A reduction in stand density in the riparian forest near these streams is unlikely to result in any measurable alteration of temperature regime. Nevertheless, an SPZ would be retained adjacent to intermittent streams under this proposal and most primary shade zone vegetation would be retained.

Road construction and maintenance: New roads would not be connected to the stream system and therefore no pathway would exist for delivery of fine sediment which could increase turbidity in streams. Most new road construction would occur on low to moderate slopes emanating from the existing road network, on stable surfaces (i.e. surfaces that are not contributing to land sliding or mass wasting) and therefore road related landslides in these locations are also unlikely. All road construction would utilize the BMPs (PDFs # 20-24, Table 3) required by the Federal Clean Water to reduce non-point source pollution to the maximum extent practicable. Since new road construction would occur on stable surfaces well away from streams and incorporate appropriate BMPs, there would be no opportunity for these roads to deliver sediment to the stream system.

Maintenance and improvements of existing roads and replacement of stream crossing culverts would occur during the driest period of the year to avoid increasing turbidity of local streams during periods of higher flow. Nevertheless, there may be a temporary increase in turbidity relative to background or upstream water clarity during the first winter storms following road maintenance. Storm events have the potential to wash some of the fine sediment off disturbed surfaces and deliver them to the stream. However, at the same period of potential turbidity increases, during first storm events of the year, sediment transport normally increases increasing natural turbidity. Hence, any turbidity increases resulting from this proposal would be unlikely to be discernible by the average observer.

Based on research (Foltz and Yanosek 2005) conducted at culvert replacement projects in forested watersheds, turbidity levels at the sites of replacement would be unlikely to exceed the State of Oregon WQ standards (>10 percent increase relative to background levels) beyond the mixing zone downstream (about 100 meters) and would decrease as disturbed surfaces and the channel bed become armored as fine sediments are removed. A turbidity plume downstream from the disturbance may be visible during the actual project but would likely decrease by an order of magnitude within two hours after work ceases. In-stream disturbance at these sites would probably be completed during one work day so any increase in turbidity would be unlikely to exceed eight hours.

Any increased turbidity would neither be visible or detectable beyond 800 meters below the site of the disturbance (Foltz and Yanosek, 2005), nor likely to exceed the standards set by the State of Oregon. Therefore, water quality standards would be maintained and beneficial uses protected.

Hauling: Much of the harvest would be conducted with ground based equipment and hauling would be primarily in the dry season. Based on BLM's previous field experience, haul on forest roads during dry conditions effectively eliminates fine sediment delivery to streams during or

after haul. However, cable yarding units would normally be available for work during winter months and winter haul may occur on roads accessing these units.

Timber hauling during periods when water is flowing on roads and into ditches could potentially increase stream turbidity and suspended sediment transport with indirect effects on the physical and biological attributes of streams (Cederholm et al. 1980). Research conducted by Oregon Department of Forestry (ODF 2003) found that turbidity increases below stream crossings during wet weather haul was limited to 20 NTUs in 90 percent of the cases studied. In the 10 percent of the cases where higher turbidity levels were found, contributing factors included three days of high precipitation, shallow depth of surfacing material, high percentage of fines in material, long ditch lengths which drain surface run-off from roads into streams, and high traffic levels (ODF 2003). By ensuring that these road surface conditions are avoided during wet season haul, BLM would prevent turbidity impacts that exceed State of Oregon standards. The roads identified for suitable winter haul maintain a sound road bed of gravel or pavement, cross drains to route water away from stream channels, and functioning culverts.

To further ensure prevention of sediment and turbidity entering the stream, the contract administrator would visually monitor the road network and turbidity levels at road/stream intersections during haul. If weather, road surface conditions and run-off approach levels of concern, either haul would be restricted or remedies would be mandated such as addition of rock, installation of relief culverts, or placement of sediment traps in the ditch to filter sediment out of the water. Therefore, any increases in turbidity attributable to hauling would be unlikely to exceed the State of Oregon WQ standards (>10% increase relative to background levels). Similarly, turbidity levels would be unlikely to reach levels that would cause additional treatment expense or technical difficulties for the downstream water providers.

Sediment Regime (ACS Objective 5)

Direct and Indirect Effects

Tree harvest, including ground based logging, would not increase sediment supply to streams because there would be no routing mechanisms to creeks and retaining a mosaic of vegetation and SPZs would filter any runoff or subsurface flow during high rainfall events. Ponding of water may occur in the compacted soils of skid and temporary roads. However, with no routing mechanisms and ample vegetation water would infiltrate rather than runoff and erode soil. There would be no off-site impacts from skid trails or temporary roads.

Yarding corridors, if sufficiently compacted and disturbed, have the potential to route surface water and sediment into streams. However, field reviews (Hawe, 2012) of cable logged units on BLM land during intense rainstorm events from 2007-2012 found no evidence of overland flow or sediment transport on cable yarding corridors where erosion models had predicted sediment transport under similar conditions.

As noted in these field reviews, several factors prevented surface erosion:

1) Even when compacted, large quantities of residual slash (brush, limbs and branches) on yarding corridors, both machine and cable, contributed to reducing the accumulation of runoff by deflecting and redistributing overland flow laterally to areas where it infiltrates into the soil.

2) Gentle to moderate slopes in much of the project area provides little opportunity for surface water to flow.

3) The SPZ bordering streams have high surface roughness which functions to trap any overland flow and sediment before reaching streams

4) Most skid road surfaces are too distant from stream channels to deliver any sediment.

Pile burning would be unlikely to have any influence over water quality, stream channels or watershed hydrology and any effects to soils and hydrology would be short term and limited to the immediate site.

Cumulative Effects- Water Quality

Road actions: The proposed actions would not have any measurable direct or indirect effect on stream temperatures, pH, or dissolved oxygen. Current conditions and trends in water quality would be maintained under the proposed action. Therefore, the proposal has little potential for contributing to any cumulative effects to these water quality attributes.

The risk of short term increases during the action and the first winter following in stream turbidity as a result of winter haul, road repair and maintenance may contribute to increased turbidity levels directly below road/stream intersections (direct effect). These would be maintained below the limits required by the Oregon State DEQ. Cumulatively the limited magnitude (not visible more than 800 meters downstream of the crossing) and duration (primarily in the first winter following road repairs and/or during brief periods of wet weather haul) of these actions would be non-detectable on the scale of the 6th field watershed and would be unlikely to contribute cumulatively to turbidity levels in the watershed.

Since there would be no detectable increase in sediment supply or transport as a result of the proposed action, there would be no cumulative effects.

As described above there would be no direct or indirect increases in stream sedimentation due to distances from streams, ample vegetative cover, SPZs and topography. Therefore, there would be no cumulative effects.

3.5 Soil Resources

Incorporated by Reference: Hawe 2013. Mighty Moose Hydrology Report, Cascades Resource Area, Salem District, Bureau of Land Management. Salem, OR.

3.5.1 Affected Environment

Typical soils in these project areas formed in colluvium (i.e., material rolling downhill) from basalt, andesite rock and volcanic ash. Soils series (USDA 2005) in the Quartzville Creek project area are primarily Blachly clay loams and Harrington-Klickitat Complex. Soils in the headwaters of McDowell Creek formed in volcanic ash and are primarily Keel gravely silt loam, Kinney cobbly loam and Henline very stony sandy loam. In the steeper forested slopes near the ridgelines, soils tend toward stony loams on 30-60% slopes with slightly higher hazard of erosion.

Project soils are well-drained to moderately well-drained and deep or moderately deep, with some local areas of rock outcropping on ridgelines. Project soils are suited for growing Douglas fir and western hemlock.

Because soil mapping in forested regions of Western Oregon was typically done on a large scale with minimal site verification, site specific conditions on BLM lands in the project area are mapped and field-verified in the Timber Production Capability Classification (TPCC) (USDI 1987). TPCC mapping and classification is both more precise and accurate than county soil maps and focused on forest productivity.

All lands on BLM are classified as either suitable for timber production, suitable but fragile for a variety of reasons (e.g., nutrient status, compacted surfaces, slope gradient, etc.) or non-suitable. All of the proposed treatments are within areas classified as suitable or suitable but fragile. Areas that are suitable but fragile would utilize design features listed in the TPCC to avoid potential effects to soils (PDFs # 1, 2, 5, 11, 20, 21, Table 3)

Non-suitable lands in the project area are wet areas, areas with high gradient and areas prone to mass movement. Proposed unit boundaries were developed to appropriately avoid areas that are non-suitable. Most of the wet areas are adjacent to streams and wetlands, all of which are within stream protection zones (SPZ) and would not be treated. Fragile withdrawn areas due to high slope gradient are concentrated along escarpments and ridges scattered throughout the project area; these areas are also excluded from treatment.

There is no existing inventory of compacted surfaces in the project area. For analysis purposes, to determine the scope and scale of existing compaction, compaction estimates were determined for the Lower Green Peter Lake 6th field watershed (14,987 acres) utilizing field observation and GIS data. There are approximately 114 miles of road in the Lower Green Peter Reservoir 6th field watershed. Assuming an average 25 foot wide road "footprint" on the soil surface, approximately 345 acres or 2.3 percent of the surface area in this watershed is road surface and therefore severely compacted. A severely compacted surface is assumed to be impermeable: water that reaches the surface will not infiltrate but run-off or evaporate. However, based on field observation by area specialists, the condition of these road surfaces varies widely from paved highways (e.g. the paved county access road) to barely discernible natural surface roads that were utilized at one point in time to haul cut trees to market. Therefore, the assumption of impermeability is a worst case scenario.

A few moderately compacted soil surfaces in which bulk density of the soil has been increased by over 10-20 percent relative to un-compacted soils have visibly persisted in some of the skid trails viewed by the area hydrologist during field visits. Moderately compacted soils are primarily located along skid trails (where trees were dragged along the ground) and are generally less than 10 feet in width and discontinuous since large portions of former skid trails have been obscured by the growth of trees and development of the duff layer. Based on the preceding observations, a conservative estimate is that approximately 2 percent of the soils in the project area are slightly to moderately compacted. Combined with the road surface estimates from above, an estimate of soil surfaces with discernible compaction is a maximum of 750 acres or 5 percent of the 6th field watershed. This assumes that conditions viewed on public lands are similar to those on adjacent private holdings.

3.5.2 Environmental Consequences

A. No Action Alternative

Under this alternative soil conditions on the project site would continue their current trends as described in affected environment.

B. Proposed Action

Direct Effects – compaction and erosion

Compaction: Following harvest completion, the majority of understory vegetation and root systems would remain, along with surface soil litter and slash from harvested trees. The expected amounts of surface soil displacement and soil compaction from harvest operations would not exceed 10 percent of each project area, due to utilization of existing skid roads and project design features limiting level and location of new skid trails. Consistent with RMP standards and guidelines (p.C-1-2) less than 10 percent of surface soils would be subject to operations that could result in compaction or soil displacement. In addition, the proposed action would maintain sufficient mycorrhizae populations because the root systems of most vegetation would remain undisturbed and there is no evidence that past disturbance of the area has affected mycorrhizae populations based on the level of brush and tree regrowth.

Typical ground based logging includes tree felling and bucking by hand followed by tree yarding, accomplished by rubber tired skidders dragging the trees along designated skid trails back to a landing. If all the ground-based units (732 acres) are treated in this manner, the percentage of total ground based area impacted by surface disturbance and soil compaction as a result of harvest and removal would be approximately 6-8 percent (between 43-58 acres). Based on past experience administrating timber sales approximately 40-80 percent of the skid trails were located on existing trails. Following review of ground based units in the proposed action, it is assumed that 50 percent of the skid trail needs would use existing routes. Reuse of existing routes reduces the expected compaction down to 22-29 acres. On the skid trail surfaces, a moderate amount of top soil displacement and moderate to heavy soil compaction would be expected to occur, assuming operation during conditions of low soil moisture, slopes under 35 percent, and an experienced operator.

A mechanized harvesting system would impose some soil disturbance in addition to that caused by tree yarding on designated skid trails. If utilized in place of hand falling, a tracked harvester moves through the area between skid trails, generally on top of a slash mat composed of limbs branches and organic materials derived from the tree processing. Trees are cut by the machine head, de-limbed and stacked adjacent to designated skid trails for removal. In mechanical harvester systems operating between skid trails, soil displacement would be minor and soil compaction would be light (not likely to measurably affect the reestablishment or growth of vegetation) due to the presence of a slash mat, single pass routes, low ground pressure equipment, low soil moisture conditions, and slopes generally less than 35 percent.

In skyline yarding areas (including special yarding), trees are typically hand felled and limbed before being pulled by suspended cable upslope (yarding) to the landing. Typically one end of the trees being yarded will drag on the forest surface in the cable yarding corridor. Impacts

usually consist of light compaction and surface disturbance of a narrow strip less than four feet in width. Compaction and surface disturbance along the skyline corridor (from the bottom of the slope to the landing) would not be uniform, varying with topography, the size and number of logs and suspension characteristics. Typically, short stretches of compacted and disturbed surfaces (<50 feet) would be interspersed with longer stretches (>100 feet) of fairly undisturbed soil. Compaction would range from 3-7 percent of the area proposed for skyline-yarded (557acres) or approximately 17-38 acres.

Temporary roads would displace topsoil and compact subsoil on 2 miles or 6 acres, assuming a width of 25 feet. The roads to be constructed would predominately be located on low to moderate topography (grades <35 percent). This narrow clearing would have a minimal effect on overall tree spacing and stocking. Placing slash debris over exposed surfaces, water bars, and blocking vehicle access would decrease surface erosion and runoff. The slash would also provide a source of organic material for soil nutrients and productivity.

Log landing construction and use would compact the soil and displace top soil at the site. However, about half of the surface area used for landings would be the existing road surface (which is already compacted). The additional area adjacent to roads that would be needed for landing area is estimated to be approximately 1 percent of the total project area (13 acres). Soil disturbance from landings would be local to the landing area and would not affect soil resources on a watershed or landscape scale.

For this proposal, the total area of disturbed surfaces would range from a minimum of 81 acres to a maximum of 115 acres or 9 percent of the 1290 treatment acres, assuming no reuse of existing routes. In this project area it is expected that approximately 50% of the needed skid trails would reuse existing routes; therefore, new compaction from project implementation is estimated at 61 acres to 90 acres, or 7 percent of the project area. Therefore, the proposal would maintain surface disturbance/compaction consistent with district guidelines of ≤10 percent of the harvested area in skid trails and landings (RMP C-2).

Soil Erosion: The proposal would not lead to any measurable increase in surface erosion, and soil erosion would remain within the range of background rates (see discussion in Sediment Regime, ACS Objective 5, above). Mass wasting is the primary cause of soil erosion in forested regions of the Pacific Northwest and this proposal would have no effect on mass wasting processes (see Hydrology Report).

In addition, as discussed above and in the PDFs, existing skid trails would be used to the extent possible for this project, reducing the level of new compaction. Following use, skid trails would be water-barred, seeded with grass, and covered with organics which would promote out-slope drainage and prevent water from accumulating in large quantities, running down the road surface, and causing erosion. After several seasons, the accumulated litter fall on the road surfaces would further reduce potential surface erosion.

Site Productivity: For skyline yarding systems, measurable effects on site productivity from light compaction on affected soils would be minimal to none. Alternatively, with mechanized harvester systems operating on slash, soil impacts between skid roads are expected to result in light compaction in two discontinuous, narrow strips less than three feet in width. There are no expected measurable reductions in productivity or yield from light compaction.

Soil impacts in yarding skid trails would be expected to result in moderate to heavy, fairly continuous compaction within the 10 foot wide skid roads. Impacts would be light to moderate and less continuous on less-traveled portions of skid roads. The estimated reduction in growth rate for newly planted trees on moderate to severely impacted areas is 15-30 percent during the first 10-20 years of growth. However, given the high residual tree densities following harvest, tree planting would not be necessary.

The residual stand presumably has root networks that extend into areas that would be disturbed by yarding traffic. For this review, no research was identified that has documented a reduction in residual tree growth following stand thinning that was attributable to compacted surfaces or soil disturbance. In fact, thinning typically leads to acceleration in tree growth attributed to the increased light resources. Therefore, it is reasonable to assume that this proposal would not affect residual stand tree growth.

New road surfaces and heavily compacted log landing areas would remain far below site productivity potential for many decades. Thus, approximately 19 acres of soils associated with these disturbances would not provide suitable growth sites for conifer until these surfaces were restored.

Cumulative Effects

Estimated compaction would meet RMP guidelines of less than 10 percent in all proposed units. At the project scale, there is an overall maximum increase, assuming no reuse of skid trails, of 115 acres in soil compaction/disturbance. Increasing compacted surfaces by 115 acres in this proposal would result in a 0.4 percent cumulative increase in the compacted surfaces on BLM managed lands in the project watersheds. At the watershed scale, the project would compact 0.1 percent of the watersheds. The increase in compaction would be dispersed across the landscape and would result in a discountable decrease to soil productivity and would not increase surface erosion. Therefore, this magnitude of compaction on either BLM administered lands or the watershed scale is unlikely to result in any discernible cumulative effect. Given consistency with RMP guidelines and the low level of compaction, detailed analysis at the 6th field watershed level is unnecessary.

3.6 Fisheries

Incorporated by Reference: Hawe 2013. Mighty Moose Hydrology Report, Cascades Resource Area, Salem District, Bureau of Land Management. Salem, OR.

3.6.1 Affected Environment

Cutthroat trout (Oncorhynchus clarki clarki; Behnke 1992) are uncommon in the project area because of very steep gradients (>20%) and bedrock barrier falls prevent trout access to most tributary streams in these basins. Cutthroat trout are only found in Trout Creek in Section 9 (T. 12S, R. 3E) adjacent to Green Peter Reservoir, the lower end of a 3rd order tributary to Trout Creek, and the lowest 100 m of a 2nd order tributary immediately adjacent to Green Peter Reservoir.

Threatened and Endangered Species

Both upper Willamette River (UWR) winter run steelhead trout (O. mykiss), and UWR spring Chinook salmon (O. tshawytscha) are native to Bald Peter, McDowell, and Quartzville Creeks. However, construction of Green Peter Dam in the 1950s blocked salmon and steelhead access to Quartzville Creek.

Winter steelhead trout and spring Chinook salmon are currently distributed up the South Santiam River to the base of Green Peter Dam, about 6 to 8 miles downstream of project units located adjacent to the Quartzville Creek arm of Green Peter Reservoir. Winter steelhead inhabit Bald Peter Creek about 2.4 miles downstream of the project unit in Section 21 (T.12S, R.3E) and are also present in McDowell Creek, >5 miles downstream of project units in Section 29.

Spring Chinook salmon have a more limited distribution in lower McDowell and Bald Peter Creeks. Their upper distribution in these creeks is more than 5 miles downstream of project units.

Most steelhead trout and Chinook salmon habitat in the McDowell and Bald Peter Creek basins is located on private land downstream of BLM-administered lands (USBLM and USFS 2002). Additionally, most salmon and steelhead habitat in the South Santiam River downstream of Green Peter dam is located on private land.

Aquatic Habitats

Stream channels of tributary streams in the project area are stable (generally gravel dominated; BLM Fish Inventories 2012) and well-shaded (>90% effective shading; Hydrology Report 2013), and streambanks are stable (>90% of banks vegetated with riparian and streamside vegetation; BLM Fish Inventories 2012). Most streams in the project area flow through steep confined valleys (gradients of >4%) with pool-step drops (Rosgen A-channel type; Rosgen 1994). First and second order headwater tributary streams in and adjacent to units drop steeply towards larger streams with channel gradients of >20%. Many streams have bedrock barrier falls that prevent upstream fish movement from Green Peter Reservoir and larger streams with lower gradient channels such as Whitcomb, Moose, McDowell, and Bald Peter Creeks.

ODFW inventoried instream habitats of Whitcomb, East Fork Whitcomb, Moose, and Trout creeks in the vicinity of the project area and found large wood (LW) levels are generally low (<160 pieces per mile; USBLM and USFS 2002). Generally, streambanks are stable with low levels of active erosion, and most channels have adequate pool habitats (USBLM and USFS 2002). Large wood recruitment potential is low in most sub-basins of the Quartzville watershed because most tree stands are <80 years of age, or streamside stands are dominated by hardwoods (USBLM and USFS 2002).

3.6.2 Environmental Effects

A. No Action Alternative

Populations of aquatic species would undergo natural increases and declines related to changes in stream temperature, sediment delivery events, and peak winter flows. Stream temperatures increase when shade from riparian canopy is lost (Johnson 2004). Substantial increases in stream temperatures can increase the metabolic costs of trout (Li et al. 2004), resulting in lower

survival and recruitment, and consequently reduced population abundance (Hicks et al. 1991). During periods of accelerated sediment delivery (flooding), recruitment success would be lower because of fine sediment reducing intragravel oxygen levels resulting in higher embryo mortality and reduced population abundance (Bjornn and Reiser 1991). High winter flows likely reduces overwinter survival of cutthroat trout in western Oregon streams (House 1995). Under the No Action Alternative, canopy closure in primary and secondary shade zones along stream channels would remain similar to current levels, except for changes to tree canopy and consequently stream shade levels resulting from snow or ice break, wind storms, and wildfire. Stream temperatures would follow changes in stream shading (Johnson 2004). Dense stands of riparian trees would self-thin over time, contributing LWD to stream channels, and windthrow from storms would also contribute LWD to streams. Natural sediment inputs to streams would vary as sediment contributing events (flooding) occur within RR.

Threatened and Endangered Species

The proposed action would not affect UWR steelhead trout and UWR spring Chinook salmon, resulting in a "no effect" determination. The project area is >2 miles upstream of habitat for winter steelhead trout and >5 miles upstream of spring Chinook salmon habitat.

B. Proposed Action

Units in Sections 11, 12, 13, 14, 21, 29 (12S-2E), and Sections 8, 10, 15, 20 (12S-3E)

Thinning trees in these units would not directly affect fish populations or their habitat because no fish are present in streams in these project units and because project design features would prevent impacts to fisheries habitats located downstream of these units (see discussion of project design features relevant to thinning in RR adjacent to fisheries habitat in and downstream of Section 9).

Units 9A, 9B, 9C, and 9D (12S-3E)

Stream Channels

Proposed tree thinning in Riparian Reserves (RR) would not impact channel conditions and fish habitat in Trout Creek and the lower end of a 3rd order tributary to Trout Creek due to SPZ ≥85 ft. wide on perennial streams, and ≥30 ft. wide on intermittent tributaries. These SPZ widths are adequate to intercept and infiltrate water carrying sediment preventing its delivery to streams and aquatic habitats (Olson and Rugger 2007; Rashin et al. 2006; CH2MHILL et al. 1999).

Stream Shading and Temperature

Perennial tributary streams would have ≥70 ft. wide SPZ. Thus, with no disturbance to the primary shade zone and with retention of >50% canopy closure in the secondary shade zone, no change in solar radiation input and stream temperatures would occur (Groom et al. 2011; Wilkerson et al. 2006; USFS and USBLM 2005). Summer stream temperatures of intermittent tributaries would not be affected by tree thinning as no surface water would be present in these channels during the summer.

Large Wood (LW)

Thinning in RR adjacent to Trout Creek and other perennial streams would result in faster tree growth rates and an increase in LW availability to streams over the long term. However, due to the width of the no-disturbance buffers, increased tree growth would occur at distances further (≥70 feet) from perennial channels where a small percentage of LW is recruited (McDade et al. 1990). Potential changes to LW supplies from thinning would be so small that effects to project steams in section 9 would be not be measurable. The size of perennial and intermittent tributaries are too small (<5 m wide, May and Gresswell 2003) to move LW downstream of units to other streams occupied by fish populations.

All units

Sediment and Roads

New roads would be located on gentle to moderate slopes, and are located >175 feet from stream channels. Road surfaces of new and renovated roads would be constructed to drain surface water to adjacent gentle slopes where it would infiltrate into the soil and groundwater. Thus, new and renovated roads would not increase the size of the stream network (Wemple et al. 1996). Culvert replacement on existing roads in units 15B and E are >0.5 mile upstream of cutthroat trout habitat, such that turbidity from culvert installations would move less than 800 m downstream (Foltz et al. 2005), and thus would not reach streams inhabited by cutthroat trout. Renovated roads are located >200 feet from stream channels with the exception of stream crossings on 1st and 2nd order tributary streams where the culverts would be replaced. Six stream crossing culverts would be replaced, but all are either located >0.5 mile upstream of cutthroat trout habitat, or if less than 0.5 mile, drain directly to Green Peter Reservoir. Thus, turbidity produced by replacing the culverts would either not reach downstream fish habitat, or upon reaching Green Peter Reservoir would be so small relative to the volume of the reservoir, that impacts to fisheries habitat in the reservoir would be undetectable. Thus, little if any sediment produced by road surfaces would reach stream channels and would not impact aquatic habitats or fish populations.

Timber Haul Roads

The Quartzville Road is the main haul route for the Mighty Moose timber sale units located adjacent to Green Peter Reservoir (all units except those in Sections 21 and 29, T.12S, R.2E). The Quartzville Road is paved and hauling on the road would have no impacts to fisheries habitat. Spur roads from individual units to Quartzville Road are well maintained gravel roads with no crossings on streams supporting fish populations. Thus, log hauling from units adjacent to Green Peter Reservoir will not impact fish populations.

Logs would be hauled from units in Sections 21 and 29 (T.12S, R.2E) on gravel roads 12-2E-31, and 13-1E-1 to Sunnyside Road. They would then either be hauled south to North River Drive and the lower end of Quartzville Road, or hauled west on McDowell Creek Road. North River Drive and McDowell Creek roads are paved with no mechanism for sediment delivery to streams. Sunnyside Road and roads 12-2E-31 and 13-1E-1 are graveled with generally flat or gently sloped approaches to drainage crossings. Thus, the amount of sediment moving from roads to tributary streams would likely be low and unlikely to impact fish populations.

Threatened and Endangered Species

The proposed action of tree harvest by thinning and associated road activities would have no effect on UWR steelhead and spring Chinook salmon, largely because of the large distances from project actions to listed fish habitat and because of project design features that result in few impacts to aquatic habitats. Thinning units adjacent to Green Peter Reservoir (Quartzville Creek subbasin) are >6 miles upstream of listed fish habitat, with Green Peter Reservoir located between project areas and listed fish habitat. Units in sections 21 and 29 (T.12S, R.2E) of the Bald Peter and McDowell Creek subbasins are >2 miles upstream of steelhead habitat, and >5 miles upstream of spring Chinook habitat.

Haul routes do not cross listed fish habitat except on paved roads (McDowell Creek Road or North River Drive) with no mechanism for sediment delivery. Consultation with the National Marine Fisheries Service (NMFS) on the potential effects of the Mighty Moose Timber Sale is not required, nor is consultation regarding potential project effects to Essential Fish Habitat (EFH).

Cumulative Effects

The proposed action would have no direct impacts to channel morphology (channel shape and form) of streams in the project areas and hence there would be no cumulative effects to channel morphology. With no direct or cumulative impacts to channel morphology, instream fish habitat (e.g. pool habitat, instream cover, stream depth, etc.) would not be affected.

Indirect impacts of the proposed action to fish habitat and fish populations would likely be limited to a potential short term increase in suspended sediment and turbidity in <0.5 mile downstream of culvert installations. Short-term increases in sediment delivery and turbidity could occur with the culvert installations, once surface flows resume during fall rains, but would only reach fish habitat in Green Peter Reservoir. The small amount of turbidity relative to the volume of water in the reservoir would make these potential turbidity effects so small as to not be measurable.

No direct or cumulative impacts to peak flows are expected (See Hydrology section).

Over the long term, culvert repairs should help reduce risks to water quality and watershed hydrology that these roads currently pose. Cumulatively, the limited magnitude and duration of sediment effects from roads in the project area would be unlikely to affect spawning and rearing success of fish populations.

3.7 Recreation and Visual Resources

3.7.1 Affected Environment

The project area lies in the vicinity of Quartzville Recreation Corridor and Back Country Byway. Evidence of man-made modifications (roads, timber harvest activities, buildings) is visible from both private and public lands. Along the byway recreationists view a highly managed landscape of timber thinnings and clear-cuts, as well as older timber stands and Quartzville Creek. The

corridor and byway support high recreation use and dispersed camping due to the proximity of Green Peter Reservoir and Quartzville Creek Wild and Scenic River.

The project areas provide dispersed recreation; there are no developed or designated recreation sites, trailheads, or trails (motorized or non-motorized) existing on BLM lands. Dispersed camping occurs between the Green Peter Reservoir or Quartzville Creek and the byway. Dispersed recreation activities include camping, gold panning, river and lake related activities, hiking, hunting, target shooting, driving for pleasure, and special forest product harvest; other dispersed recreation may occur as well but at a lesser rate. Any trail present is unauthorized.

Yellowbottom campground, Old Miner's Meadow group campsite, and Dogwood day-use site are upriver from the project areas in Township 11 South, Range 4 East, sections 19 and 29, and Township 12 South, Range 3 East, section 3, respectively. Moose Creek day-use site is on private land with a restroom in Township 12 South, Range 3 East, section 16 at the junction of Moose Creek Road (12-3E-16.3) and the Quartzville Back Country Byway (12-3E-29.1). Trout Creek campground, located in Township 12 South, Range 3 East, sections 9 and 16, is a lease agreement with Linn County on BLM lands, providing a restroom and dispersed camping. Downriver, along the reservoir there are Thistle Creek day-use boat launch and Whitcomb Creek Park campground managed by Linn County Parks. Linn County developed a recreation plan for Army Corps of Engineer Lands they manage along Green Peter Reservoir which includes closing dispersed camping and increasing developed sites.

Motorized and Off Highway Vehicle use within the project area is restricted to existing roads and designated trails; no designated OHV trails are within the project area.

3.7.2 Environmental Consequences

A. No Action Alternative

With the exception of unexpected changes (e.g. wildfire or disease), the proposed units would continue to provide a forest setting for dispersed recreation opportunities. A three to five year increase in log truck traffic, noise and other disturbances related to the harvest of the proposed units would not occur. Timber management activities and log truck traffic would continue on both private and public lands in the vicinity.

B. Proposed Action

Recreation

Dispersed recreation use within the proposed units would be restricted for approximately three to five years during timber harvest and associated management activities. Recreation visitation should return to prior usage upon completion of activities. Other BLM, Forest Service, or county lands in the vicinity will remain available for recreational opportunities. Recreation users nearby would hear the timber operations and truck traffic noises and may experience traffic delays of minutes to hours. Campers along the byway used as a haul route and at Trout Creek campground would hear log trucks coming down the mountain in the morning. Assuming dispersed camping along Green Peter Reservoir will close in 2014 as recommended in the Linn County recreation plan, more use would likely occur on BLM-administered lands.

Tree removal from the proposed units would leave the undergrowth vegetation crushed. Most undergrowth vegetation should return within five years. Harvest activities would impact and likely obliterate any unauthorized trails. There would be no reconstruction of unauthorized trails.

If roads and skid trails remain open and not blocked after harvest operations, then OHV use would be expected to increase. Passing vehicles and OHVs could create a fire ignition source for stumps and logging debris from vehicle sparks (from lack of proper spark arrestor or catalytic converter in the muffler system), heating grasses (fine fuels) from idle vehicles, or tossing out burning materials such as cigarettes. However the project proposes to close and block skid trails and temporary roads, which would prevent unauthorized OHV use.

Visual Resources

Except for 19 acres in Visual Resource Management (VRM) class II all treatment units lie within VRM class III and IV. The objective for class II is to retain the existing character of the landscape and manage for low levels of change: "Activities may be seen but should not attract attention of the casual observer". The objective for class III is to partially retain the existing characteristic of the landscape, managing for a moderate level of change: “Activities may attract attention but should not dominate the view of the casual observer” (RMP 37). The objective for class IV allows for major modifications to the landscape.

The proposed actions are consistent with the RMP objectives due to high tree retention (48-119 trees per acre), retention of 40-60 percent canopy closure, and prescriptions designed for variable tree densities. Further, no low density thinning areas would be visible from travel corridors or road systems. Although there would be a reduction in canopy cover, tree retention combined with variable density across units would preserve the characteristic landscape which consists of a mosaic of clear cuts, previously thinned units, and full canopy cover. Therefore, because the project is consistent with the RMP and preserves the characteristic landscape no further analysis is necessary.

Cumulative Effects

Timber harvest would interrupt recreation activities intermittently for approximately three to five years during times of active operations. Recreational visitation should return to prior usage. This project would have minimal impact on recreational uses due to the fact there are other opportunities available and no developed recreation is within the project area.

Dispersed campers along haul routes, which routinely receive log truck traffic from timber management activities on private lands, would be impacted by noise. This disturbance would be intermittent as well, occurring during times of timber haul. In addition, should Linn county implement the recreation plan, prohibiting dispersed camping along the reservoir, would greatly reduce potential disturbances to campers along the corridor. However, this project would not reduce recreation opportunities.

Looking at aerial photos it is evident that timber management, both thinning and regeneration harvest activities has occurred for many years and is expected continue to occur in the viewshed. Timber management activities are likely to continue on both private and public lands in the vicinity. Timber management activities would continue to result in temporary changes to visual

resources while logging debris and crushed undergrowth vegetation dies turning brown to red. If logging debris piles are burned, blackened areas would be visible until vegetation growth covers the scars. Smoke would dissipate. Vegetation would green up and return within five years leaving the units less noticeable from roads adjacent to harvest units. All units after treatment actions would blend into this existing landscape and would be consistent with the RMP Visual Resource management objectives.

3.8 Air Quality and Fire Hazard/Risk

Source Incorporated by Reference: Mortensen 2013. Cascades Resource Area Fuels Specialist Report, Mighty Moose Project. Salem District BLM, Salem, OR. (Fuels Report)

The modeling predictions for fire regime and condition class come from the LANDFIRE Rapid Assessment Vegetation Models. (http://www.fs.fed.us/database/feis/fire_regime_table/fire_regime_table.html)BLM

3.8.1 Affected Environment

Air Quality

The major source of air pollutants within the Mighty Moose analysis area would come from fire starts and from associated resource management activities including prescribed burning (hand, machine, and landing piles) and dust from the use of natural-surfaced roads.

The Willamette Valley experiences periods of air stagnation. When this occurs during winter months, cold air often becomes trapped near the valley floor with slightly warmer air aloft, creating temperature inversion conditions, causing air pollutants to become trapped near the ground. Wintertime temperature inversions contribute to high particulate levels. Stagnant periods in the summertime contribute to increases in ozone levels, causing the local air quality to deteriorate. The State of Oregon has designated the Willamette Valley as a Smoke Sensitive Receptor Area.

Fire Hazard/Risk

The climate in Northwest Oregon is generally mild and wet in the winter. In the North Cascade mountain range, snowfall will remain at higher elevations for an extended period of time. Summers are warm with periods of dry weather usually during the months of July, August, and September. Summer temperatures during this period average approximately 60° F with high temperatures reaching the mid to upper 90s, and occasionally topping 100° F for short periods of time. During average weather years, the conditions under the forest canopy remain relatively moist.

Fire is a natural disturbance process in the analysis area. Fire effects on forested areas are influenced by fire frequency, fire duration, and fire intensity (Van Wagner 1965). These factors vary with forest type, depending on fuel type and structure, topography, and weather variables. Fire can influence vegetation; nutrient cycling; successional pathways; fish and wildlife habitat; vegetative species composition, age and structure; and insect and disease susceptibility.

The main cause of wildfires across the analysis area is people. Dry lightning (lightning with no accompanying moisture) that occurs during the summer months is rare in Northwest Oregon.

Within the Oregon Department of Forestry's Northwest Oregon Area - South Cascades District - Sweet Home Unit over the last ten years four fire starts have been attributed to lightning while sixteen were human caused. The average size of lightning fires was approximately 29 acres. The average size of human caused fires was approximately 0.9 acre. http://oregon.gov/ODF/FIRE/HLCause.pdf. Most of the analysis area is located behind locked private gates, reducing access by the public and the risk of a fire start.

Fire Regime and Condition Class (FRCC)

Fire Regime classifies the role fire would play across the landscape in the absence of modern human mechanical intervention, including the influence of aboriginal burning. The analysis area falls within the Pacific Northwest Forested landscape. The analysis area's potential natural vegetation group is Douglas-fir-western hemlock (both dry mesic and wet mesic), and falls into two different Fire Regimes. Fire Regime III is characterized by a moderate to low fire return interval (35->100 years between fires) with a mixed severity (<75 percent of the dominant overstory vegetation replaced) and is associated with south and west facing slopes. Fire Regime V is characterized by a moderate to low fire return interval with a high severity (>75 percent of the dominant overstory vegetation replaced) and is associated with north facing slopes. More than 80% of fires are characterized as mixed or low severity.

The Condition Class classifies the departure from the natural fire regime. The timber stands in the analysis area generally fall within Condition Class 2 or 3 with species composition and structure functioning outside their natural (historical) range due to overstocking and past harvest treatments.

Management of the surrounding private land affects the Condition Class to such an extent that actions within the Mighty Moose project area are unlikely to change the Condition Class rating across the landscape.

Timber Stand and Fire History

The early fire history of the Mighty Moose analysis area is not well documented. Although it is known that Native Americans burned within the Willamette Valley, to what extent this burning extended into the valley foothills and up the river corridors is not specifically known. Fire does play a major role as a natural disturbance agent, as do people.

In late August 2006, lightning storms passed through the analysis area tracking a line from the south and ran north up the divide between Quartzville Creek and the Middle Santiam. The storm started 17 fires all of which were contained quickly except for two blazes. The Boulder Creek and Rocky Top # 5 fires grew in size and complexity in old growth timber on steep inaccessible terrain. On BLM managed land the Boulder Creek Fire burned 63 acres and the Rocky Top # 5 fire burned 28 acres. Later the same year, in September 2006, the Middle Fork Fire burned approximately 1170 acres of which approximately 280 acres were located on BLM managed land. The south edge of Unit 15B and the southeast edge of Unit 15E form the northwest boundary of this fire.

The analysis area has experienced other forestry related management activities in the past. All of the proposed project areas were previously harvested during the 1940s, 1950s and 1960s. Many harvest units of this time period had broadcast burning or spot burning associated with them,

both for hazard reduction and for site preparation prior to planting. Tree cores and fire scars collected throughout the Willamette Province from trees harvested from 1950 to 1980 provide evidence that historic fire return intervals in the analysis area range from 50-150 years in the lower elevations and south facing aspects, and up to 300 years in the higher elevations and north aspects.

The average fire return interval increased following the advent of fire suppression in 1910. It has been decades since the most recent man-caused disturbance (logging) occurred. Although fire has been excluded from the landscape, the analysis area is still well within the range of a normal fire return.

3.8.2 Environmental Effects

A. No Action Alternative

Air Quality

Under the No Action alternative there would be no commercial thinning, road construction, log hauling, or any need for prescribed burning and, therefore, no localized effects to air quality. However, as the timber stands continue to grow, the increased stocking density would cause the stands to become more susceptible to a stand replacement fire event. In the event of a wildfire, poor air quality is expected due to the high volume of smoke that would be produced.

Fire Risk

The analysis area would continue on its current trend. The current risk of a fire start would remain low. There would be a slow increase in the coarse woody fuel load (1000 hour fuel class) and in the smaller size fuel classes (1, 10, and 100 hour fuels) in these timber stands as stress-induced mortality within the stands increases. Ladder fuel densities would increase as trees are suppressed in the understory, shade tolerant species seed in, and dominant trees grow larger. The potential for these stands to eventually succumb to a wildfire would continue to increase as they near the maximum fire return interval and the condition class departs further from the natural fire regime.

B. Proposed Action

Air Quality

Travel would occur over BLM and other roads. Dust created from vehicle traffic from proposed project activities on gravel or natural-surface roads would contribute short-term (during project work) effects to air quality. These effects would be localized to the immediate vicinity of the operations.

Following density management thinning, gap creation, and snag and coarse woody debris treatments, the fuel load would increase. Post treatment fuels surveys would be conducted and the Stereo Photo Series for Quantifying Forest Residues in the Douglas-fir Type of the Willamette National Forest (General Technical Report PNW-GTR-258, Ottmar, Hardy, Vihnanek May 1980) or the Stereo Photo Series for Quantifying Forest Residues in Coastal Oregon Forests (General Technical Report PNW-GTR-231, Ottmar, Hardy) would be used to

help identify areas with increased fuel loads. If these methods determine that an increased fire hazard exists, prescribed burning would be conducted and smoke would be generated.

The proposed fuel treatment targets roads or property lines for treatment because human activity and the risk of ignition is greatest in these areas. Approximately 100 acres could be treated with prescribed fire. This would remove approximately 50 tons of slash per acre or approximately 5000 total tons from the highest risk areas within the project.

Prescribed burning would cause short-term impacts to air quality that would persist for one to three days within one-quarter to one mile of units. None of the treatment units are sufficiently close to any major highways that motorist safety would be affected. The overall effects of smoke on air quality is predicted to be local and of short duration. Activities associated with the proposed action would comply with the provisions of the Clean Air Act.

All prescribed burning would require a project level Prescribed Fire Burn Plan that complies with the Northwest Oregon (NWOR) Fire Management Plan for the Eugene District BLM, Salem District BLM, Siuslaw National Forest, and the Willamette National Forest dated May 20, 2009. All burning would be coordinated with the local Oregon Department of Forestry office in accordance with the Oregon State Implementation Plan and Oregon Smoke Management Plan.

Burning would be conducted when the prevailing winds are blowing away from Smoke Sensitive Receptor Areas (SSRAs) in order to minimize or eliminate the potential for smoke intrusions. The potential for a smoke intrusion would be further reduced by burning under atmospheric conditions that favor good vertical mixing so that smoke and other particulate matter is borne aloft and dispersed by upper elevation winds.

Fire Hazard/Risk

Following treatments the fuel load, risk of a fire start, and the ability to control a fire would all increase as a result of the proposed action and would be greatest during the first season following treatment when needles dry but remain attached to tree limbs. The modeling predictions for fire behavior (Anderson, April 1982) based on the National Fire Danger Rating System (NFDRS) fuel models would move the variable density thinning stands from a Fuel Model 8 (Closed timber litter) to Fuel Model 11 (Light logging slash), or Fuel Model 12 (Medium logging slash). All treatment areas would see a short-term (0-5 year) increase in fire ignition potential because of the increase in fine dead fuels.

Thinning trees would decrease both the amount of potential ladder fuels and the available fuel density in the canopy (canopy bulk density). A relative density of 35-45% basal area or lower has been identified as the point where canopy bulk density is unlikely to sustain a high intensity crown fire (Agee 1996). The silvicultural prescription would result in basal areas below this range.

The project proposes to reduce the risk of a fire by decreasing the fuel load in areas that are accessible to people. Surface fuels would be reduced in strategic locations such as along roads and property lines and within commercial thinning areas. The treatments would reduce surface fuels resulting in lower fire intensity, rates of spread and flame lengths. In addition much of the analysis area is located behind locked private gates further reducing access by the public and the risk of a fire start.

The Oregon Department of Forestry has responsibility for fire protection on BLM managed land in western Oregon. Their ability to successfully control wildfires in the fuels treatment areas as small, low intensity ground fires would remain high. For the short-term (0-5 years), the fire risk would increase in the commercial thinning and low density treatment areas; however due to decreased crown density and reduction in ladder fuels, containment of wildfires at less than 10 acres in size should continue to be attainable during initial attack.

When harvest has been completed, fuels surveys would be conducted and project areas that are identified as containing hazardous fuels may have hand or machine piles constructed within areas containing dense slash. Machine piles may be constructed along roads or property lines, and landing piles may be constructed where logs are hauled to roads. If fuel loads are relatively light along roads and property lines, slash pullback may be incorporated as the desired fuels treatment.

Cumulative Effects

There would be no cumulative effects to air resources, as the direct and indirect effects from the project would be local and of short duration, and there would be no other uses in the project area affecting this resource. Based on past experience with pile burning in this and other similar areas confirming the short duration of smoke and effectiveness of adherence to smoke management plans, there are no expected cumulative effects on air quality from the planned fuels treatment under this proposal.

There would be an increase in fuel loading and resultant fire hazard in the short-term (0-1 year). In the commercial thinning areas and along roads and property lines, the hazard and risk would be minimized by the use of fuels reduction treatments. The localized increase in fire risk would diminish to background levels over time as slash decomposes. There would be positive benefits to the thinned stands in the longer term due to the wider spacing between tree crowns and the removal of most of the ladder fuels that are conducive to the spread of fire into the tree canopy. At a watershed scale, the thinning of approximately 1288 acres of forest habitat would have very little effect on fire intensity or starts. Due to reduced bulk density and ladder fuels, the potential for the stand to carry a crown fire would be reduced in the long term (>5 years).

3.9 Review of Elements of the Environment Based On Authorities and Management Direction

Table 10: Elements of the Environment Review based on Authorities and Management Direction

Element of the Environment /Authority	Remarks/Effects
Aquatic Conservation Strategy	EA sections 3.2-3.6 show how the Mighty Moose project meets the Aquatic Conservation Strategy.
Air Quality (Clean Air Act as amended (42 USC 7401 et seq.)	This project is in compliance with this direction because air quality impacts would be of short duration and would follow the ODF smoke management plan. Addressed in EA Section 3.8.

Element of the Environment /Authority	Remarks/Effects
Cultural Resources (National Historic Preservation Act, as amended (16 USC 470) [40 CFR 1508.27(b)(3)], [40 CFR 1508.27(b)(8)]	This project is in compliance with this direction and the project would have no effect (Section 5.0) on this element because cultural resource inventories found no cultural resources.
Ecologically critical areas [40 CFR 1508.27(b)(3)]	This project would have no effect on this element because there are no ecologically critical areas present within the project area.
Energy Policy (Executive Order 13212)	This project is in compliance with this direction because this project would not interfere with the Energy Policy (Executive Order 13212).
Environmental Justice (E.O. 12898, "Environmental Justice" February 11, 1994)	This project is in compliance with this direction because it would have no effect on low income populations.
Fish Habitat, Essential (Magnuson-Stevens Act) Provision: Essential Fish Habitat (EFH): Final Rule (50 CFR Part 600; 67 FR 2376, January 17, 2002)	This project is in compliance with this direction because the project would have no effect on listed fish species or on essential fish habitat (EA Section 3.6).
Farm Lands, Prime [40 CFR 1508.27(b)(3)]	The project would have no effect on this element because no prime farm lands are present on BLM land within the Cascades RA.
Floodplains (E.O. 11988, as amended, Floodplain Management, 5/24/77)	This project is in compliance with this direction because the proposed treatments would not change or affect floodplain functions.
Hazardous or Solid Wastes (Resource Conservation and Recovery Act of 1976 (43 USC 6901 et seq.) Comprehensive Environmental Repose Compensation, and Liability Act of 1980, as amended (43 USC 9615)	This project would have no effect on this element because no hazardous or solid waste would be stored or disposed of on BLM lands as a result of this project.
Healthy Forests Restoration Act of 2003 (P.L. 108-148)	This project is in compliance with this direction because treatments would help maintain forests in a healthy functioning condition with low risk of wildfire (EA Section 3.1, 3.8).

Element of the Environment /Authority	Remarks/Effects
Migratory Bird Act of 1918, as amended (16 USC 703 et seq.)	This project is in compliance with this direction because treatments would immediately increase the overall habitat diversity for migratory birds and increase overall bird species richness in the long term (20 years). (EA Section 3.2).
Native American Religious Concerns: American Indian Religious Freedom Act of 1978 (42 USC 1996)	This project is in compliance with this direction because no Native American religious concerns were identified during the scoping period.
Noxious Weed or Invasive Species (Federal Noxious Weed Control Act and Executive Order 13112)	This project is in compliance with this direction because project design features (PDF) would prevent establishment of new populations of invasive plant species and because vegetation development would result in a decline in both number and vigor of invasive plant populations in the project area. (EA Section 3.3).
Park lands [40 CFR 1508.27(b)(3)]	The project would have no effect on this element because there are no parks within or immediately adjacent to the project area.
Public Health and Safety [40 CFR 1508.27(b)(2)]	The project would have no effect on this element because the public would be restricted from the project area during operations, the project would not create hazards lasting beyond project operations, and traffic control would be implemented to provide for safe public passage through the project area during active operations.
Threatened or Endangered Species: Endangered Species Act of 1983, as amended (16 USC 1531)	This project is in compliance with this direction because there would be no adverse effects on Threatened or Endangered Species (EA Sections 3.2, 3.6).
Water Quality: Safe Drinking Water Act, as amended (43 USC 300f et seq.); Clean Water Act of 1977 (33 USC 1251 et seq.)	This project is in compliance with this direction because Oregon State water quality standards would be adhered to and the area hydrology would not be changed measurably. (EA Section 3.4).
Wetlands: E.O. 11990 Protection of Wetlands 5/24/77 [40 CFR 1508.27(b)(3)]	This project is in compliance with this direction because wetland areas have been removed from all activity. (EA Section 3.4)
Wild and Scenic Rivers: Wild and Scenic Rivers Act, as amended (16 USC 1271)) [40 CFR 1508.27(b)(3)]	This project is in compliance with this direction because there are no project units within or adjacent to any wild and scenic corridors. (Appendix C)

Element of the Environment /Authority	Remarks/Effects
Wilderness: Federal Land Policy and Management Act of 1976 (43 USC 1701 et seq.); Wilderness Act of 1964 (16 USC 1131 et seq.)	This project is in compliance with this direction because the proposed action is not within designated wilderness or lands containing wilderness characteristics. (Appendix C).

Compliance with the Aquatic Conservation Strategy (ACS)

Based on the environmental analysis described in the previous sections of the EA, Cascades Resource Area staff has determined that the project complies with the ACS on the project (site) scale. The project complies with the four components of the Aquatic Conservation Strategy, as follows:

ACS Component 1 - Riparian Reserves: The project would comply with Component 1 by maintaining canopy cover along all streams and wetlands, which protect stream bank stability and water temperature. Untreated riparian reserve areas adjacent to creeks would prevent any thinning treatment generated sediment from entering any creeks. Treatments in the riparian reserves are consistent with RMP objectives and direction. Road and landing locations have been minimized in Riparian Reserves. Addressed in text (EA sections 3.1, 3.2, 3.4, 3.6).

ACS Component 2 - Key Watershed: The project would comply with Component 2 because the project is not within a key watershed.

ACS Component 3 - Watershed Analysis: The project would comply with Component 3 by incorporating recommendations from the Quartzville Watershed Analysis, South Santiam Watershed Analysis, Hamilton Creek Watershed Analysis, and Crab Tree Watershed Analysis.

ACS Component 4 - Watershed Restoration: The project would comply with Component 4 by allowing natural processes to continue in the extensive unthinned areas in Riparian Reserves. Thinning in 467 acres of Riparian Reserve would further enhance terrestrial habitat complexity in the long and short term in the selected area to be thinned. Thinning in all LUAs would be expected to result in long-term restoration of large conifers and the potential for material that would contribute to in-stream habitat complexity in the long-term.

Project Compliance with the Nine ACS Objectives (ACSO)

The Cascades Resource Area staff reviewed this project against the ACS objectives at the project or site scale with the following results. The No Action alternative does not retard or prevent the attainment of any of the nine ACS objectives because this alternative would maintain current conditions. The proposed action does not retard or prevent the attainment of any of the nine ACS objectives for the following reasons.

1. ACSO 1: Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted. (EA sections 3.3.1, 3.3.5). In summary:

No Action Alternative: The No Action alternative would maintain the development of the existing vegetation and associated stand structure at its present rate. The current distribution, diversity and complexity of watershed and landscape-scale features would be maintained. Faster restoration of distribution, diversity, and complexity of watershed and landscape features would not occur.

Proposed Action: The proposed thinning from below in a selected 467 acre area of the Riparian Reserve Land Use Allocation (RR) would result in forest stands that exhibit attributes typically associated with stands of a more advanced age and stand structural development (larger trees, a more developed understory, and an increase in the number, size and quality of snags and down logs) sooner than would result from the No Action alternative. The remaining 4,128 acres of unthinned RR in the project vicinity would be "maintain" as described for the No Action alternative.

2. ACSO 2: Maintain and restore spatial and temporal connectivity within and between watersheds. (EA 3.4, 3.6). In summary:

No Action Alternative: The No Action alternative would have little effect on current connectivity.

Proposed Action: Connectivity of terrestrial watershed features would be improved by enhancing conditions for stand structure development in the 467 acres of Riparian Reserve proposed for thinning. Both terrestrial and aquatic connectivity would be maintained and improved over the long-term as the Riparian Reserve and LSR LUAs develops late successional characteristics.

3. ACSO 3: Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations. Addressed in Text (EA 3.4, 3.6). In summary:

No Action Alternative: It is assumed that the current condition of physical integrity would be maintained.

Proposed Action: Except to replace culverts all banks and channel morphology would be protected and maintained. Replacing culverts would improve hydrologic connectivity and improve existing channel morphology. In the short term and localized to the site, the channel would adjust to the new culvert. Current aggradation would cease and the grade would return to a channel profile matching the downstream and upstream conditions.

4. ACSO 4: Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. (EA 3.4, 3.6). In summary:

No Action Alternative: It is assumed that the current condition of the water quality would be maintained.

Proposed Action: Stream Protection Zones (SPZs) would be maintained in all Riparian Reserve LUA (RR) proposed for treatment. Ninety percent of the riparian reserves would not be treated. The protection zones would prevent sunlight from reaching the stream, preventing any degradation to water quality. Dissolved oxygen, pH and ground water would not be affected. The proposed new and temporary roads would be located on stable slopes away from streams; roads would not cross streams. There would be no routing mechanisms for water and sediment to reach streams.

The analysis identified potential short term (1 year) and small scale (800 meters) turbidity associated with road maintenance and culvert improvements. Sediment increases would not be visible beyond 800 meters (0.5 mile) downstream from road/stream intersections and would not be expected to affect fish, aquatic species or habitat, or human uses. Sediment transport and turbidity is expected to decrease in the long term (after the first wet season) with improved drainage, road surfacing and culvert improvements that reduce future potential culvert failures.

5. ACSO 5: Maintain and restore the sediment regime under which aquatic ecosystems evolved. (EA 3.4,3.5, 3.6). In summary:

No Action Alternative: It is assumed that the current levels of sediment into streams would be maintained.

Proposed Action: Stream protection Zones (SPZs) and untreated RRs would be maintained (minimum of 70-85 feet on perennial streams, and 35 feet on intermittent streams). No skid roads, temporary roads, or permanent construction would cross streams thereby preventing any sediment routing mechanisms to streams. PDFs restricting hauling to armored, stable roads and sediment control measures identified in the PDFs would minimize sediment delivery. See also number 4.

6. ACSO 6: Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. (EA 3.4, 3.6). In summary:

No Action Alternative: No change to in-stream flows would be anticipated because there would be no changes in the forest stands.

Proposed Action: No measurable change to in-stream flows would be anticipated, shown by a preliminary analysis for the risk of increases in peak flow as a result of forest harvest conducted by the BLM using the Oregon Watershed Assessment Manual watershed analysis methods for forest hydrology (OWEB, 1997). Further, the proposed project would retain 40 percent of the existing forest canopy and no new roads would cross streams; there would be no discernible increase in water availability or routing mechanisms to streams.

7. ACSO 7: Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands. (EA sections 3.4, 3.6). In summary:

No Action Alternative: The current condition of flood plains and their ability to sustain inundation and the water table elevations in meadows and wetlands is expected to be maintained since no changes would be made to these features or the surrounding forest.

Proposed Action: There would be no alteration of any stream channel, wetland or pond morphological feature because no changes would be made to these features due to riparian buffers. Thus, the current condition of floodplain inundation and water tables would be maintained.

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

sufficient to sustain physical complexity and stability. (EA sections 3.1, 3.2, 3.4,3.6). In summary:

No Action Alternative: The current species composition and structural diversity of plant communities would continue along the current trajectory. Diversification would occur over a longer period of time.

Proposed Action: The current species composition and structural diversity of plant communities in riparian areas and wetlands would continue along the current trajectory in 90 percent of RR acres in the project vicinity. SPZ would maintain current species composition and structural diversity of plant communities in riparian areas and wetlands in the 476 treated acres. In treated stands species diversity and structural complexity is expected to improve with thinning treatment.

9. ACSO 9: Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species. (EA3.1, 3.2, 3.4, 3.6). In summary:

No Action Alternative: Habitats would be maintained over the short-term and continue to develop over the long-term with no known impacts on species currently present.

Proposed Action: The proposed project would benefit riparian dependent species. Although thinning activities may affect some invertebrates within the treated acres, the 3660 acres of untreated riparian reserves would provide adequate refugia for the species. In the long term, the treatments would restore elements of structural and species diversity in the Riparian Reserve LUA. Increasing plant and structural diversity would provide resources currently lacking or of low quality and would enhance both aquatic and terrestrial species over the long term.

4.0 List of Preparers

Table 11: List of Preparers

Resource	Name
Writer/Editor	Mike Mathews/Shayna England
NEPA Review	David Simons
Botany	Terry Fennell
Cultural Resources	Heather Ulrich
Engineering	Dan Nevin
Fire/Fuels	Kent Mortensen
Fisheries	Bruce Zoellick
Hydrology/ Water Quality	Patrick Hawe
Logging Systems	Jason Bernards
Recreation, Visual Resources, and Rural Interface	Traci Meredith
Silviculture	Dugan Bonney
Soils	Patrick Hawe
Wildlife	Corbin Murphy/Jim England

5.0 Contacts and Consultation

Consultation

US Fish and Wildlife Service (USFWS): BLM submitted the BA containing the Mighty Moose thinning proposal for Informal Consultation with U.S. Fish and Wildlife Service (USFWS) as provided in Section 7 of the Endangered Species Act (ESA) of 1973 (16U.S.C. 1536 (a)(2) and (a)(4) as amended) during the FY2014 consultation process. The LOC (FWS reference #01EOFW00-2013-I-0187) concurred that the habitat modification activities described in the BA, including the Mighty Moose project, are not likely to adversely affect spotted owls and would have no effect on Critical Habitat (LOC, p. 47, 73, 92). All applicable General Standards described in the Letter of Concurrence have been incorporated into the proposal (LOC pp. 17-19).

National Marine Fisheries Service (NMFS): Consultation with the National Marine Fisheries Service (NMFS) on effects of the Mighty Moose Thinning project on Upper Willamette River (UWR) Chinook salmon and UWR winter steelhead trout is not required because the thinning sale would have no effect on these species or on essential fish habitat. The Proposed Action of tree harvest by thinning and associated road activities would have no effect, predominantly because of the long distances from project actions to listed fish habitat, and because of project

design features that result in little to no impacts to aquatic habitats. Thinning units adjacent to Green Peter Reservoir (Quartzville Creek subbasin) are >6 miles upstream of listed fish habitat, with Green Peter Reservoir located between project areas and listed fish habitat. Units in sections 21 and 29 (T.12S, R.2E) of the Bald Peter and McDowell Creek subbasins are >2 miles upstream of steelhead habitat, and >5 miles upstream of spring Chinook habitat. Haul routes do not cross listed fish habitat except on paved roads (McDowell Creek Road or North River Drive) with no mechanism for sediment delivery.

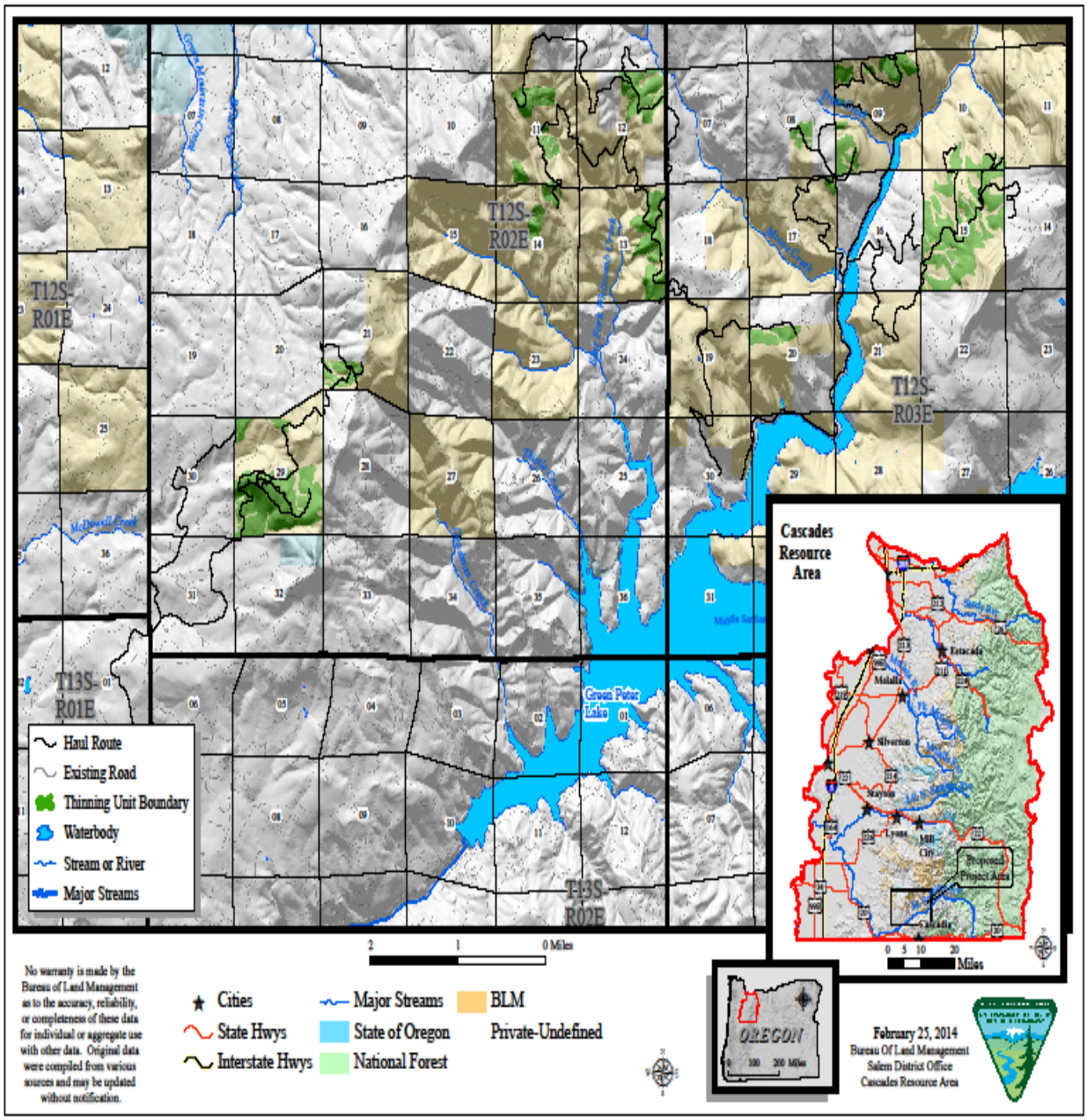
Cultural Resources - Section 106 Consultation with State Historical Preservation Office (SHPO): Compliance with Section 106 of the National Historic Preservation Act was completed according to Appendix A of the Protocol for Managing Cultural Resources on Lands Administered by the BLM in Oregon. Cultural resource inventories conducted according to the protocol did not yield any cultural resources; a cultural resources inventory report (Greatorex 2013) is being finalized and will be mailed to the State Historic Preservation Office and no further consultation is necessary.

Contacts and EA Public Comment Period

For the results of project scoping, see EA section 1.3. The EA and FONSI will be made available for public review from May 5th 2014 to June 6th 2014 and posted at the Salem District website at http://www.blm.gov/or/districts/salem/plans/index.php. The notice for public comment will be published in a legal notice in the Albany Herald Democratic newspaper. Written comments should be addressed to John Huston, Field Manager, Cascades Resource Area, 1717 Fabry Road S., Salem, Oregon 97306. Emailed comments may be sent to BLM_OR_SA_Mail@blm.gov. Attention: John Huston.

Appendix A — Project Area Maps

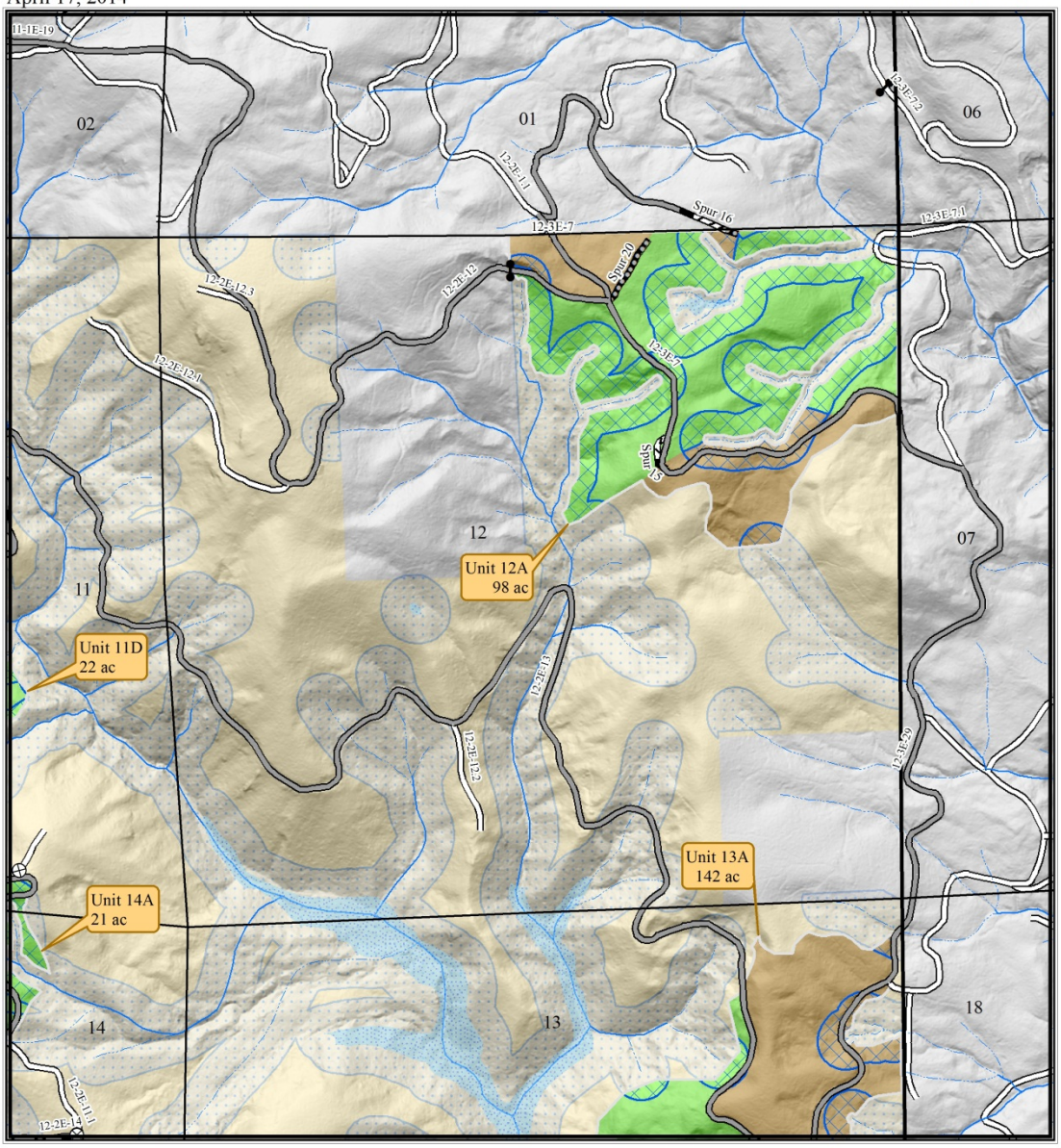
Mighty Moose EA (#OR-S040-2013-0003) Vicinity Map



Mighty Moose Proposed Projects

April 17, 2014

T12S-R02E Sec 12



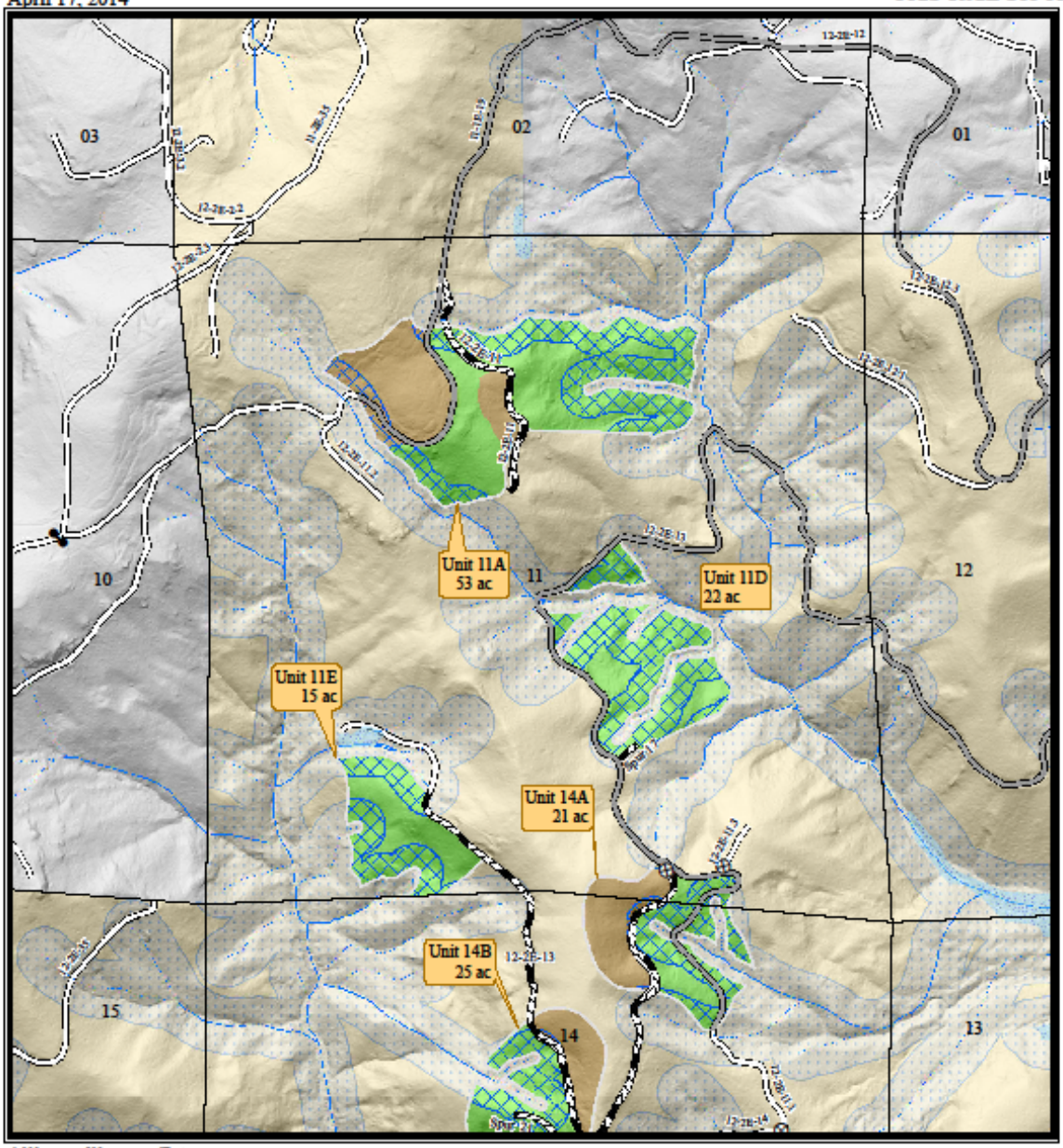
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources and may be updated without notification.

- Earth Berm
- Gate
- Existing Road
- Haul Route
- Renovate
- Temporary Construction
- Intermittent
- Perennial
- Wet Areas
- Thinning Unit Boundary
- Untreated Riparian Reserves
- Skyline in Riparian Yarding
- Skyline Yarding
- Ground Based in Riparian Yarding
- Ground Based Yarding
- BLM
- Private/Unknown

Mighty Moose Proposed Projects

April 17, 2014

T12S-R02E Sec 11



Mighty Moose Proposed Projects

April 17, 2014

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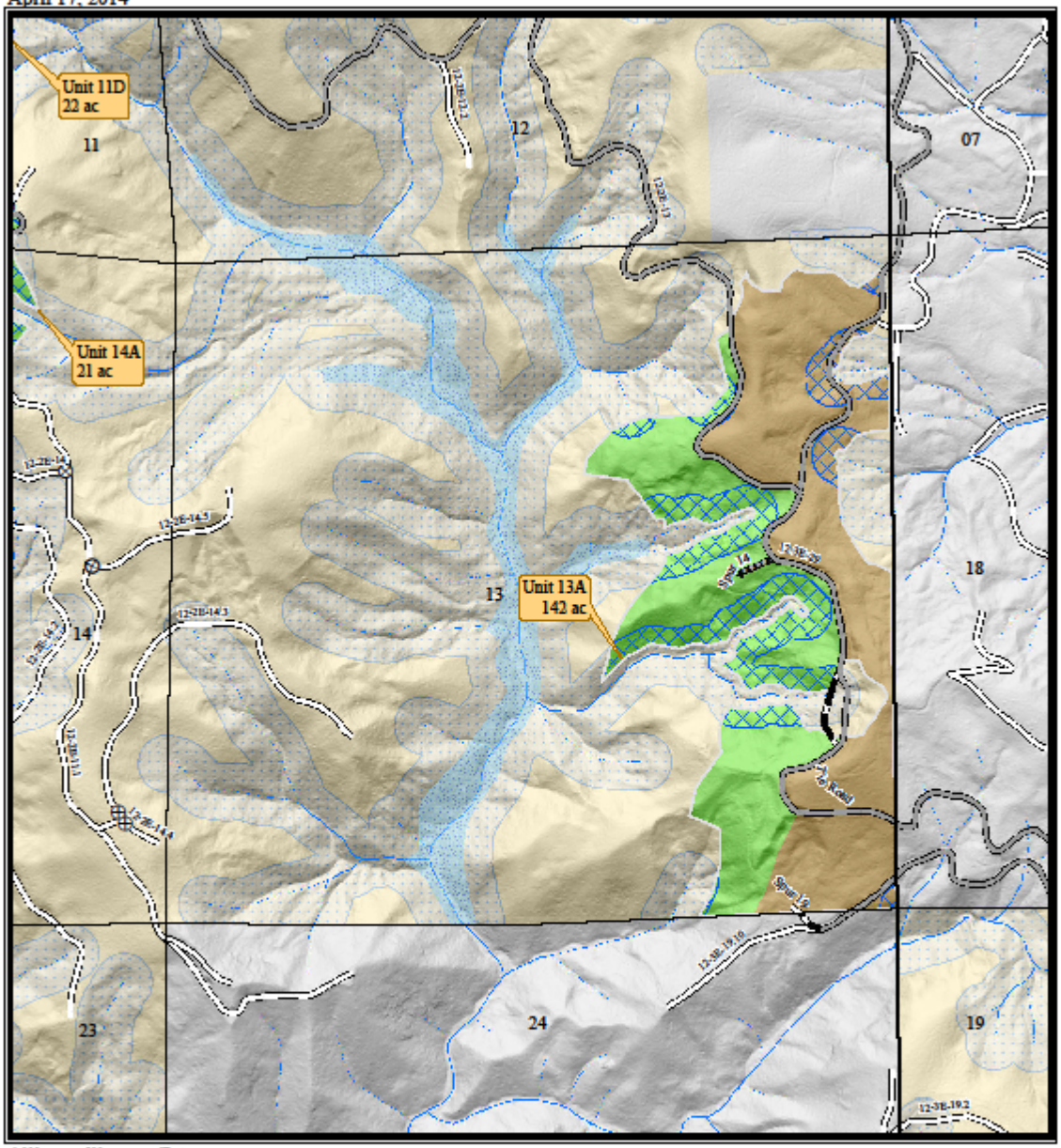

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- Haul Route
- Improve
- Renovate
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- Skyline Yarding
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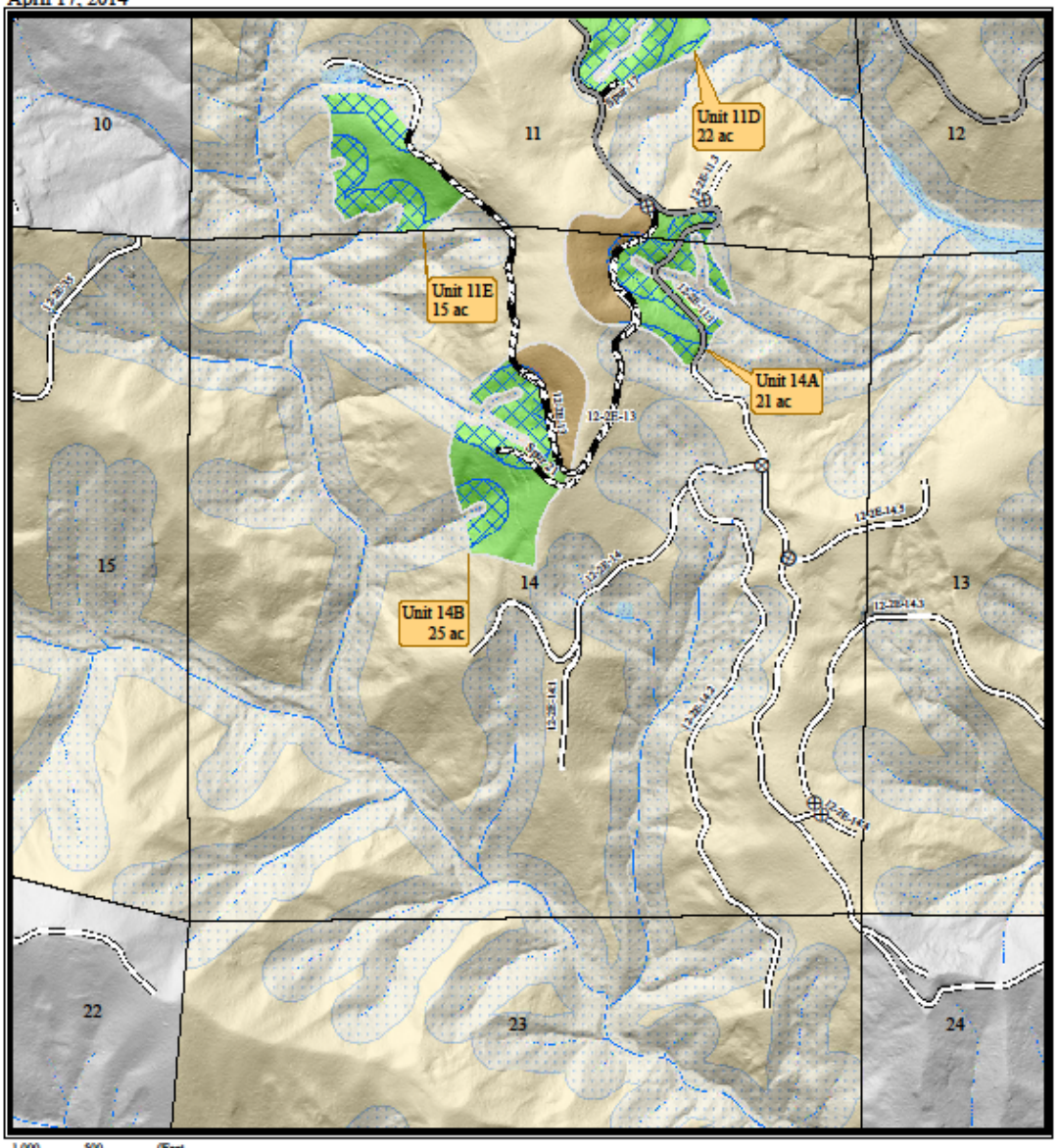
- Ground Based Yarding
- BLM
- Private/Unknown

Mighty Moose Proposed Projects

April 17, 2014

T12S-R02E Sec 14



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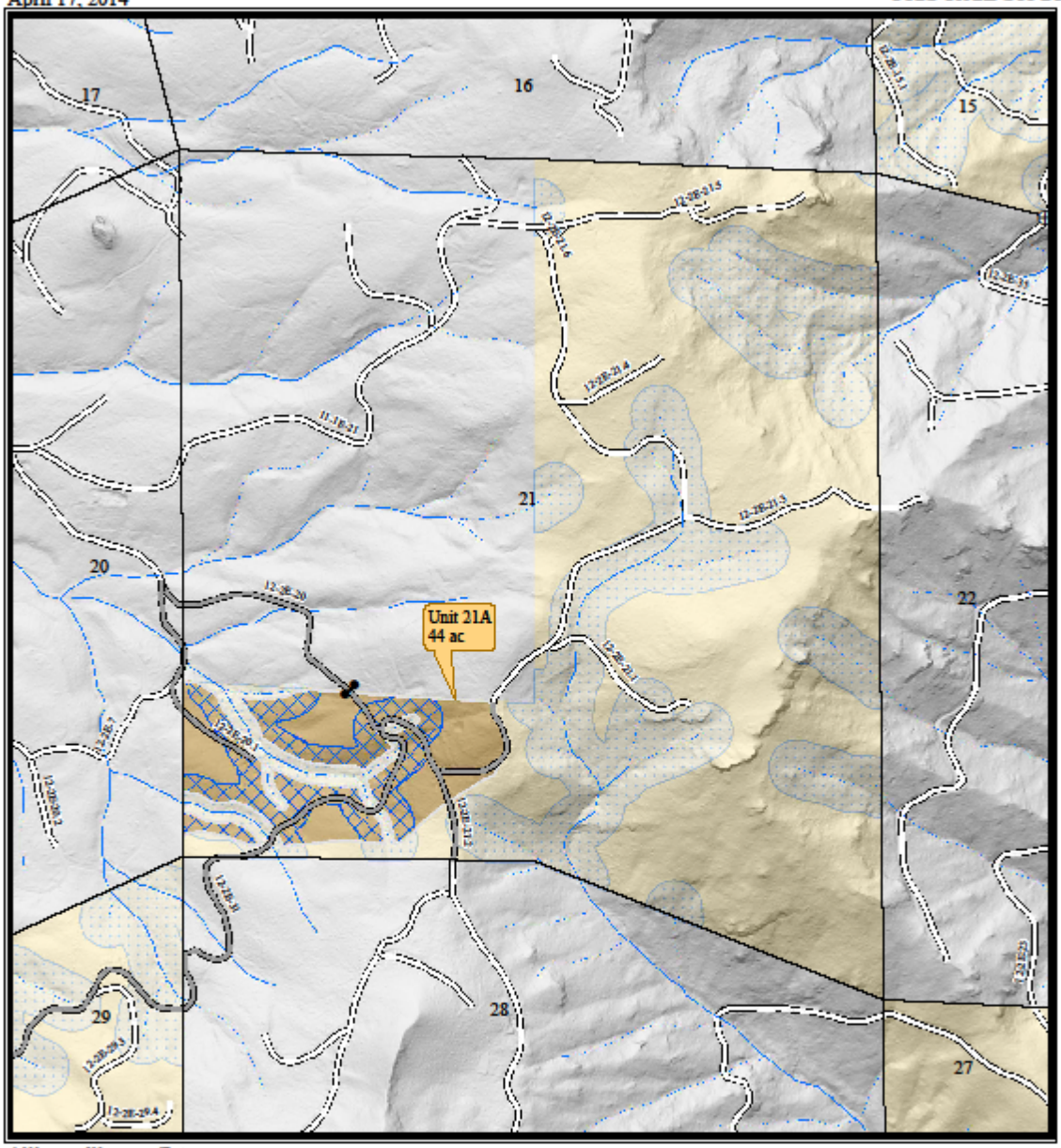
- Skyline Yarding
- Ground Based in Riparian Yarding
- Ground Based Yarding
- BLM
- Private/Unknown

Mighty Moose Proposed Projects

April 17, 2014

T12S-R02E Sec 21



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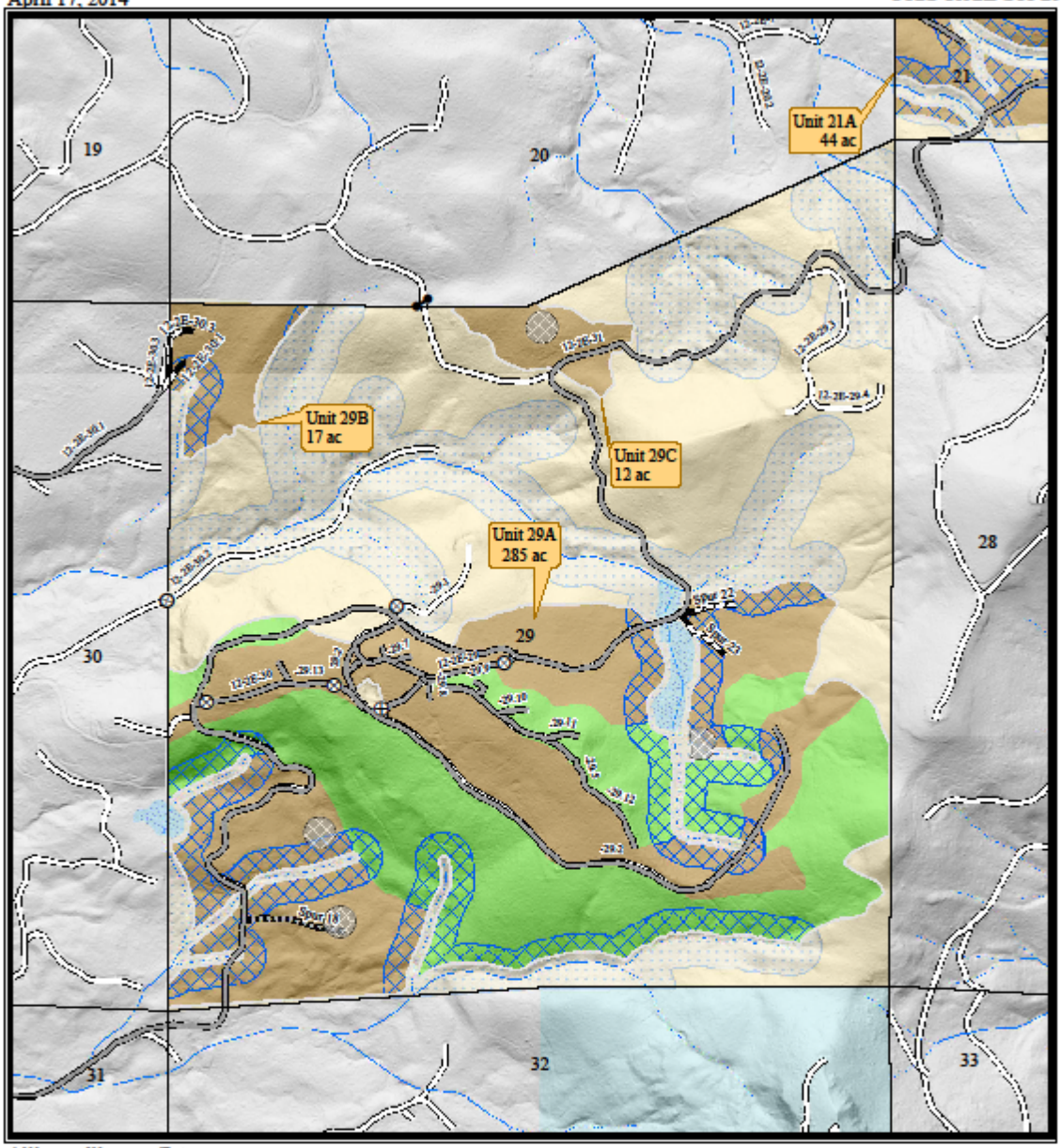
- Earth Berm
- Gate
- Existing Road
- Haul Route
- Intermittent
- Perennial
- Thinning Unit Boundary
- Untreated Riparian Reserves
- Ground Based in Riparian Yarding
- Ground Based Yarding
- BLM
- Private/Unknown

Mighty Moose Proposed Projects

April 17, 2014

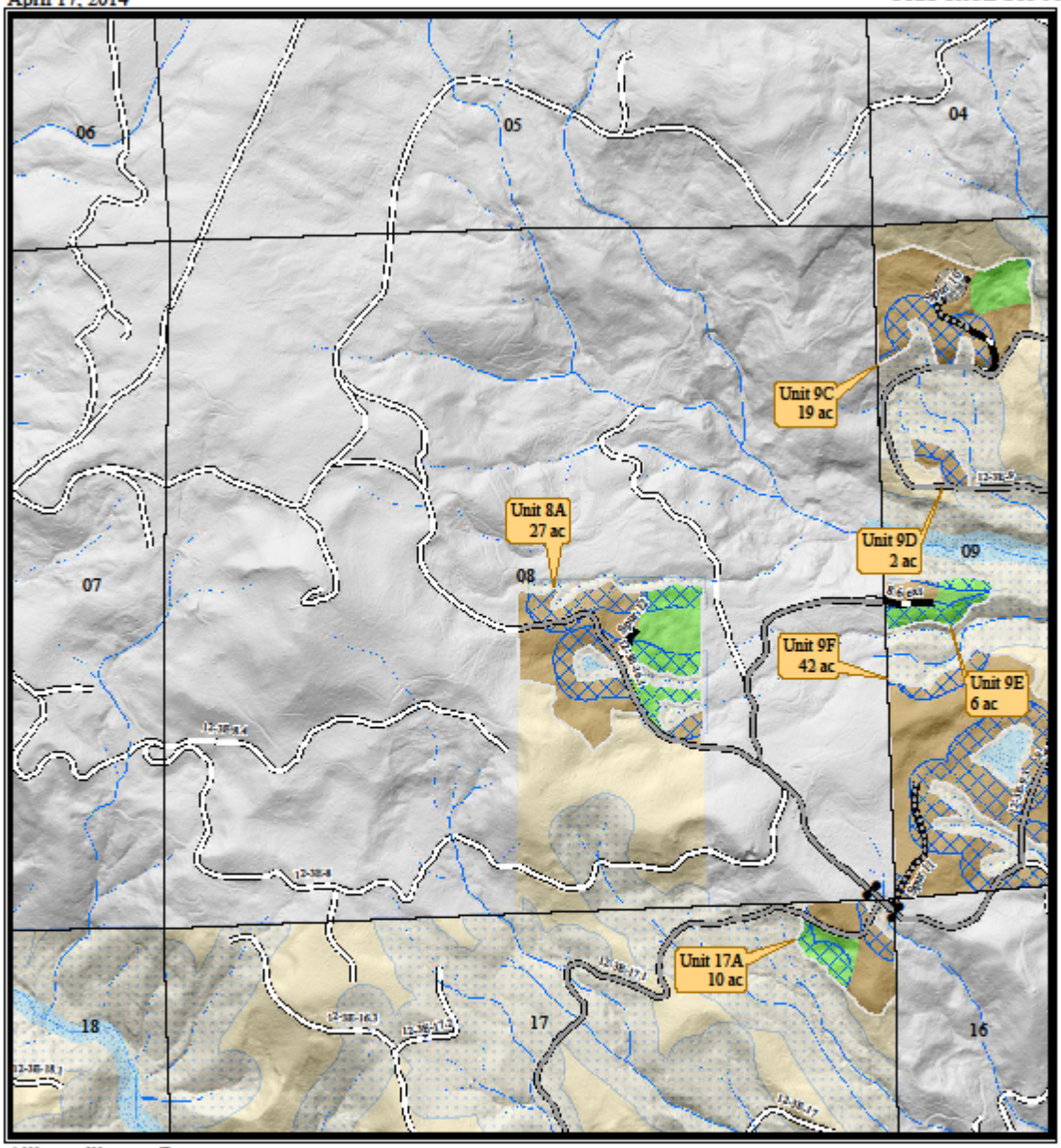
T12S-R02E Sec 29



Mighty Moose Proposed Projects

April 17, 2014

T12S-R03E Sec 08



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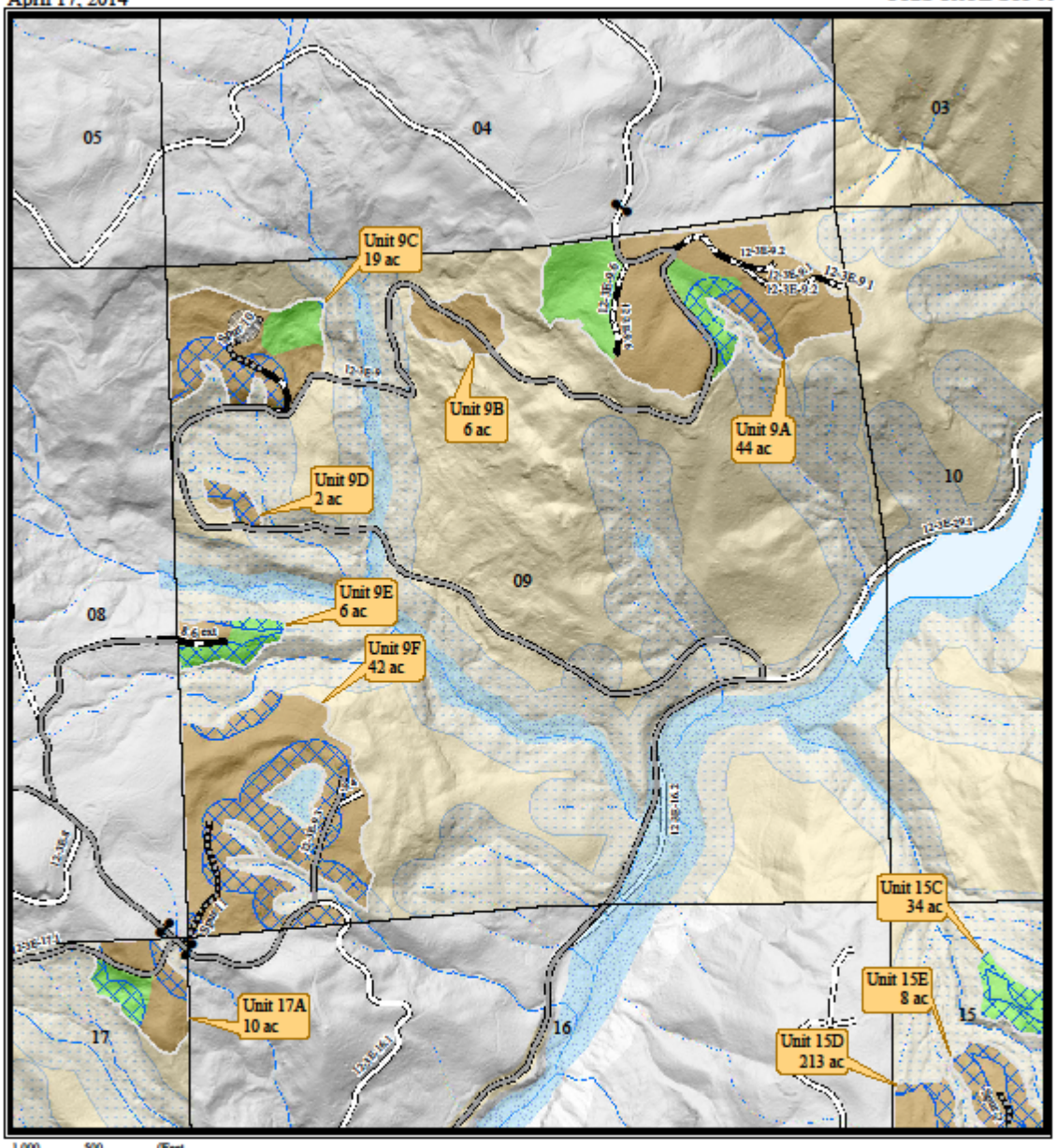
- Gate
- Existing Road
- Haul Route
- Improve
- Temporary Construction
- Intermittent
- Perennial
- Wet Areas
- Thinning Unit Boundary
- Untreated Riparian Reserves
- Skyline in Riparian Yarding
- Skyline Yarding
- Ground Based in Riparian Yarding
- Ground Based Yarding
- LDT Area
- BLM
- Private/Unknown

Mighty Moose Proposed Projects

April 17, 2014

T12S-R03E Sec 09



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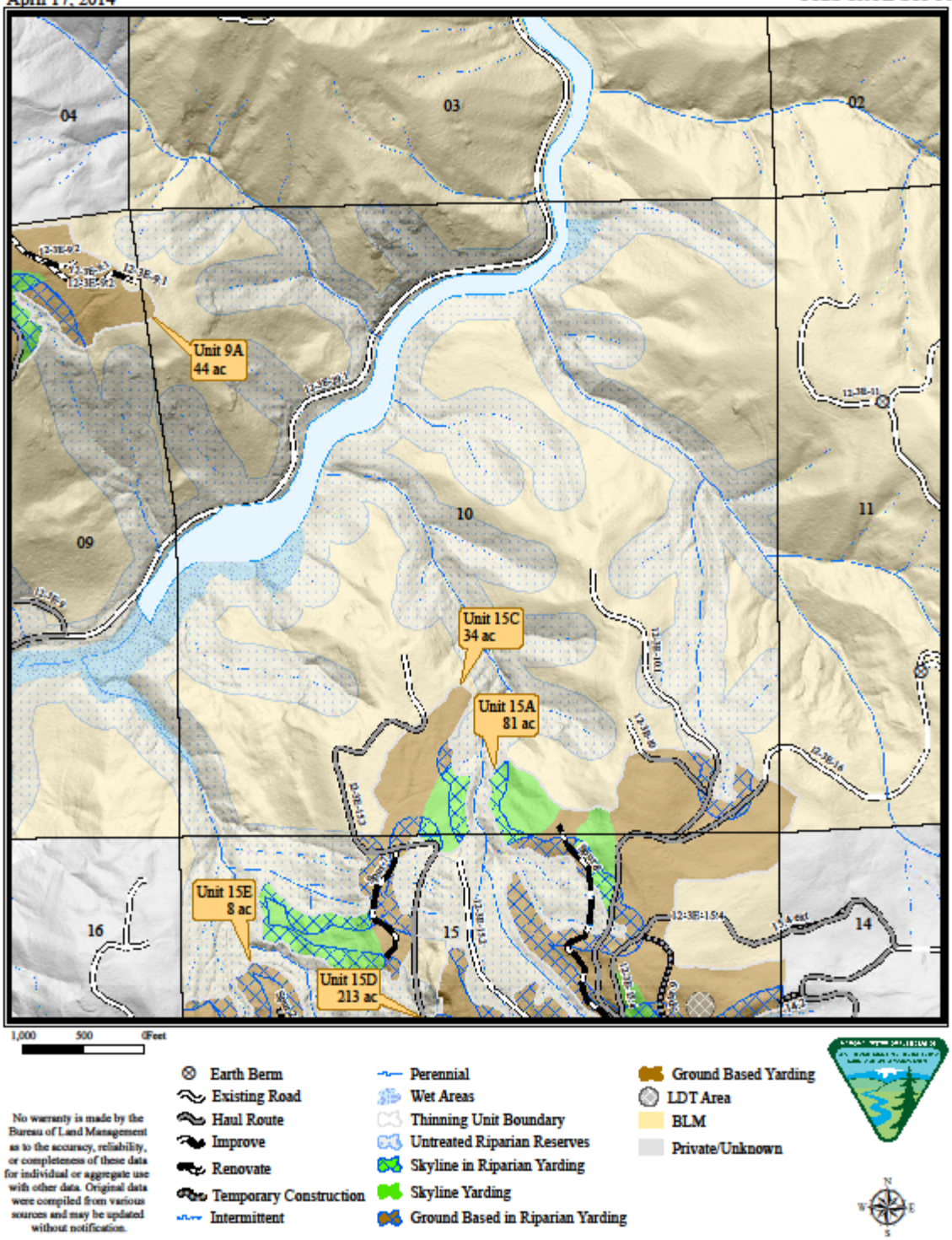
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources and may be updated without notification.

- Gate
- Existing Road
- Haul Route
- Improve
- Renovate
- Temporary Construction
- Intermittent
- Perennial
- Wet Areas
- Thinning Unit Boundary
- Untreated Riparian Reserves
- Skyline in Riparian Yarding
- Skyline Yarding
- Ground Based in Riparian Yarding
- Ground Based Yarding
- LDT Area
- BLM
- Private/Unknown

Mighty Moose Proposed Projects

April 17, 2014

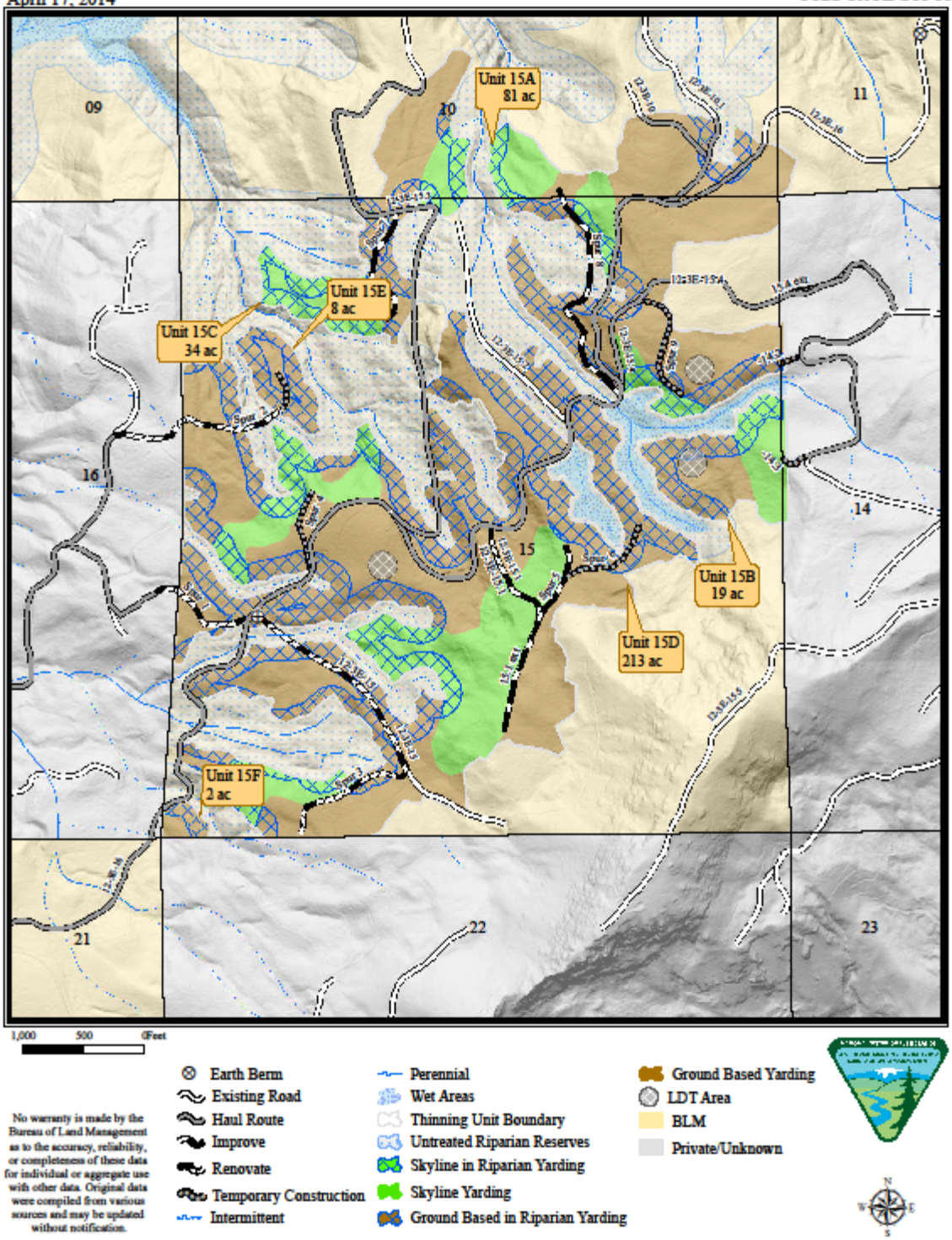
T12S-R03E Sec 10



Mighty Moose Proposed Projects

April 17, 2014

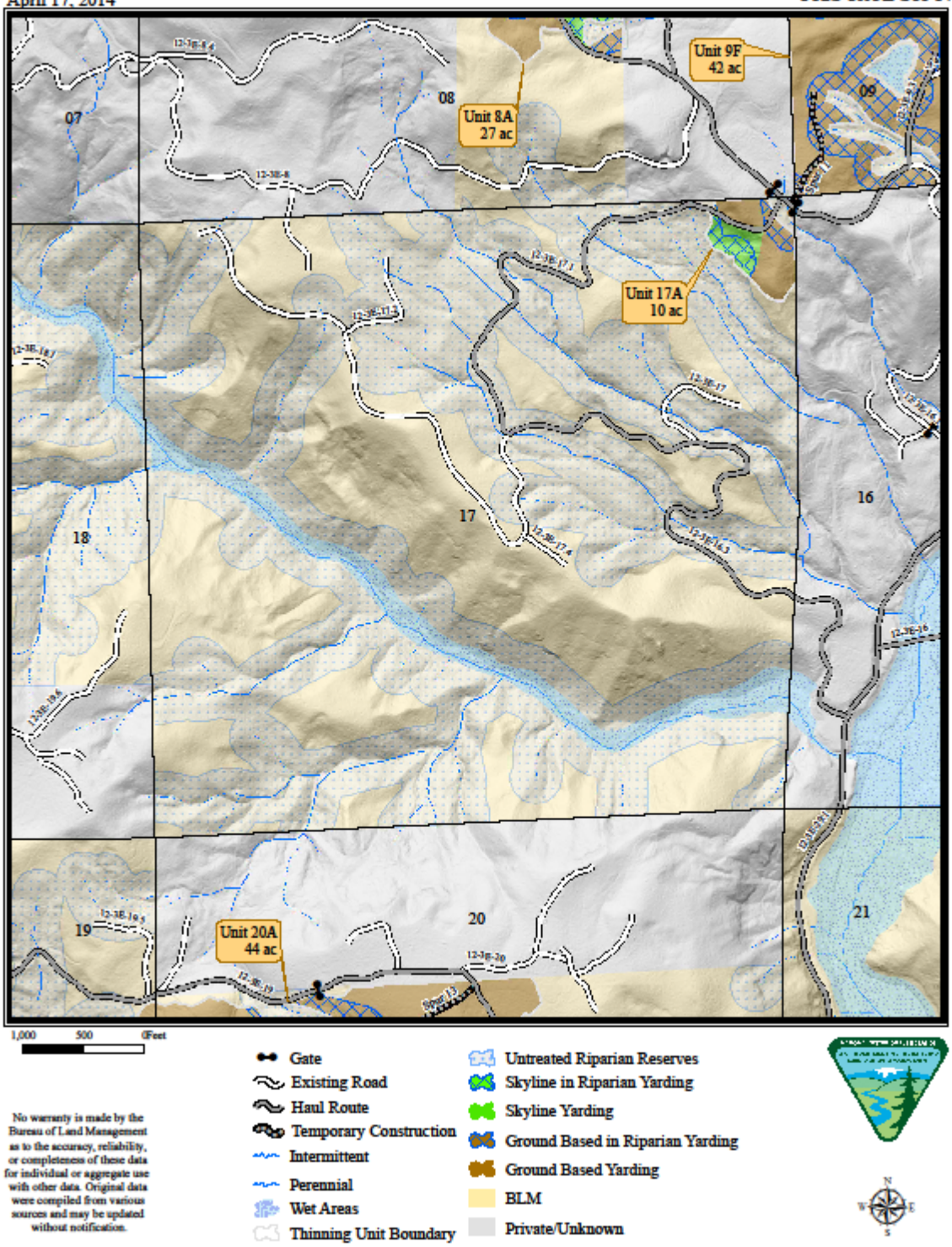
T12S-R03E Sec 15



Mighty Moose Proposed Projects

April 17, 2014

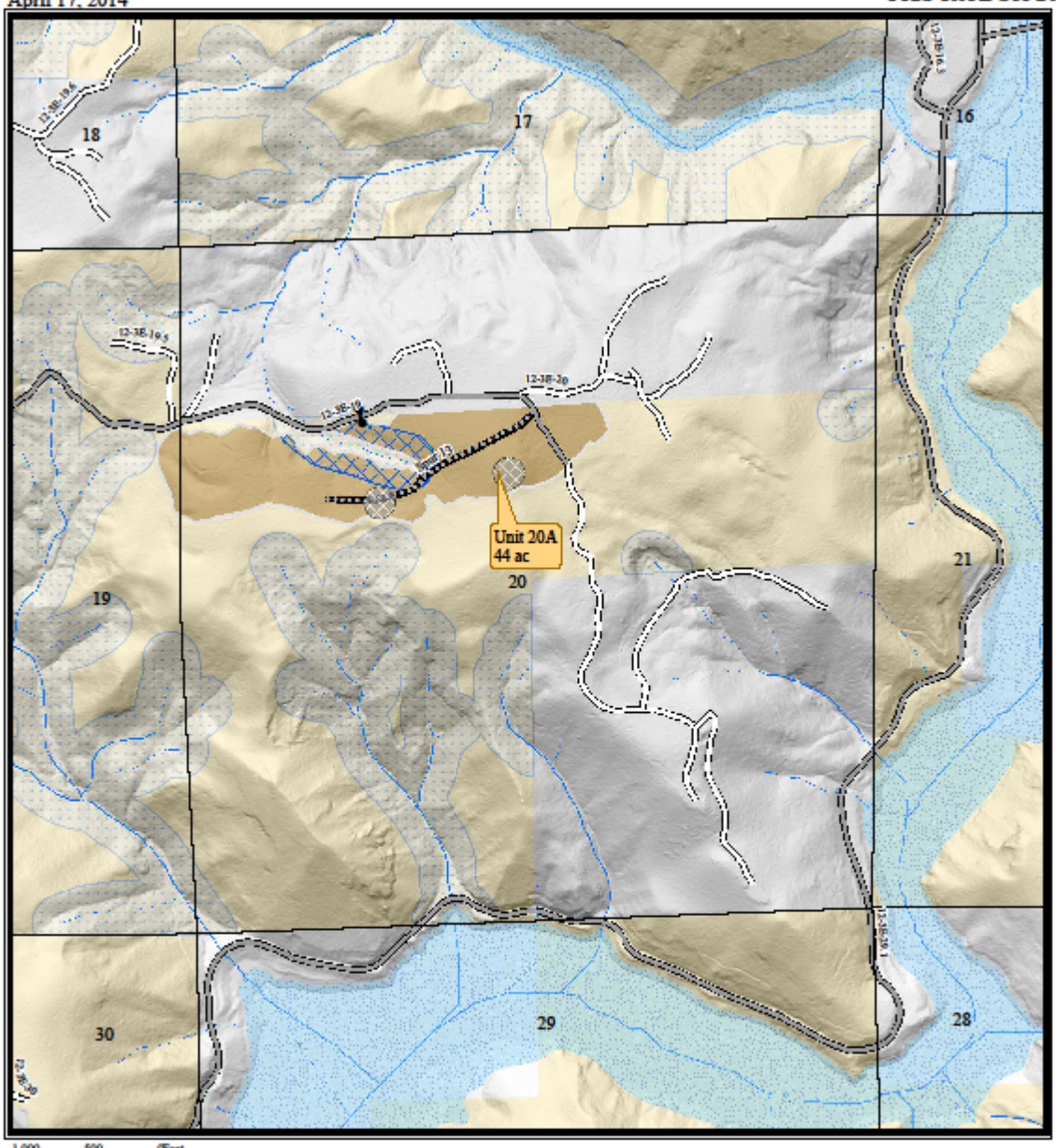
T12S-R03E Sec 17



Mighty Moose Proposed Projects

April 17, 2014

T12S-R03E Sec 20



Gate
Existing Road
Haul Route
Temporary Construction
Intermittent
Perennial
Wet Areas
Thinning Unit Boundary
Untreated Riparian Reserves
Ground Based in Riparian Yarding
Ground Based Yarding
LDT Area
BLM
Private/Unknown

No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources and may be updated without notification.

Appendix B — Stand information

Township, range, section, Unit	Unit Acres	Current Stand Age[1]	Trees per acre before treatment	Trees per acre after treatment	Current Average Diameter	Average diameter in 20 years without treatment	Average diameter immediately after thinning	Average diameter 20 years after thinning	Curtis RD[5] before treatment	Curtis RD after treatment	Crown closure before treatment (%)	Crown closure after treatment (%)
Whitcomb												
12S-2E-11A	53	53	219	72	14.3	17.1	16.1	21.0	65	25	84	52
12S-2E-11E	15	51	222	74	13.8	16.6	15.8	20.3	62	25	84	53
12S-2E-11D	22	51	162	76	14.5	17.4	15.4	19.5	49	25	75	52
12S-2E-12A	24	52	153	79	15.3	18.7	17.8	22.1	50	33	77	62
12S-2E-12A	74	55	143	76	16.1	19.9	18.3	22.8	51	32	77	61
12S-2E-13A	142	60	161	82	15.5	18.4	17.9	21.7	54	34	78	62
12S-2E-14A	16	48	120	75	16.6	19.9	17.1	21.4	44	29	74	59
12S-2E-11, 14A	5	48	120	75	16.6	19.9	17.1	21.4	44	29	74	59
McDowell												
12S-2E-14B	25	48	168	80	15.8	18.8	16.8	21.2	57	30	83	60
12S-2E-21A	44	55	298	74	12.9	15.4	18.0	21.6	76	31	90	62
12S-2E-29A	166	60	201	66	15.0	17.8	17.4	21.9	64	26	83	52
12S-2E-29B	8	59	172	78	15.0	17.3	15.4	18.9	55	26	81	54
12S-2E-29A_3	9	62	118	48	20.3	23.2	23.9	28.3	59	31	83	60

[1] As of 2012

12S-2E-29B_2	9	62	180	74	15.4	18.9	17.9	23.1	60	31	84	62
12S-2E-29C_1	12	55	140	59	17.3	19.8	20.1	23.6	55	29	83	61
12S-2E-29A_2	108	59	153	61	16.7	19.6	19.8	24.2	57	29	82	60
Quartzville												
12S-3E-8A	10	37	179	119	12.5	16.2	12.8	17.3	43	30	74	61
12S-3E-8A	17	49	160	74	15.4	18.5	18.6	22.1	53	28	78	61
12S-3E-9B, 9C	25	51	184	98	14.8	18.8	16.8	21.2	58	29	81	65
12S-3E-9E, 9F	21	46	214	70	14.3	18.6	18.1	24.0	63	30	86	62
12S-3E-9A	8	45	312	100	12.3	15.9	14.2	19.3	74	29	91	61
12S-3E-9A	16	40	246	113	12.5	15.9	13.1	18.0	59	29	87	65
12S-3E-9A	14	35	230	98	13.3	18.5	14.8	21.5	61	30	87	64
12S-3E-9A, 9E	8	40	277	98	12.6	17.0	14.3	20.7	68	29	89	61
12S-3E-9D	2	50	210	72	14.3	18.0	18.4	23.0	64	31	84	61
12S-3E-9F	24	52	179	56	15.5	19.1	20.6	25.0	59	29	82	57
12S-3E-10, 15A, 15C	22	50	163	71	15.2	18.8	18.3	22.7	53	30	79	59
12S-3E-10, 15A	7	50	163	71	15.2	18.8	18.3	22.7	53	30	79	59
12S-3E-10, 15C	13	41	173	70	15.1	20.1	18.8	25.1	55	31	82	64
12S-3E-11, 15A	1	50	163	71	15.2	18.8	18.3	22.7	53	30	79	59
12S-3E-15A, 15B, 15C, 15D, 15E, 15F	280	57	169	60	16.6	19.9	20.2	25.0	63	30	83	57
12S-3E-15C, 15D	35	57	169	60	16.6	19.9	20.2	25.0	63	30	83	57
12S-3E-17A	9	52	180	57	16.1	19.6	20.6	25.5	64	29	85	59
12S-3E-20A	44	55	209	56	15.3	18.1	21.0	23.4	68	30	86	57

Appendix C — Alternatives and Issues Considered but Eliminated from Detailed Analysis

C.1 – Alternatives Considered but Eliminated

The interdisciplinary team (IDT) of resource specialists considered alternatives identified by the IDT members and public input, but were not analyzed in detail. Alternatives considered by the team but eliminated include:

Comment: Avoid road building; consider dropping roads with a low cost to benefit ratio.

Response: BLM carefully considered the need for access to and into the units and determined that a proposal without new or temporary roads would not provide access to meet the need to treat many forest units. Further, a proposal with no new roads would not provide an economically viable sale, due to the high costs of helicopter use; economic viability is a key component of the purpose and need for this project.

BLM did consider and dropped several roads from consideration to improve the economic viability of the timber sale and protect sensitive resources. The following roads were considered but dropped from analysis:

- Section 15 NE ¼ to eliminate stream crossing and potential removal of trees within the SPZ
- Dropped in 15B to avoid riparian areas
- Dropped road in 29A due to marginal unit volume and economic viability
- Renovation of road in section 20 dropped to protect NSO core area

In addition, Table 12 - *Areas Considered but Dropped from the Proposed Action* below displays units dropped for economic feasibility. Road costs to potential benefits were deemed low leading to dropping units or portions thereof.

BLM considered constructing 0.6 miles of permanent road as an alternate route to utilizing a portion of road 12-3E-29 which is currently blocked by a slide. The costs associated with this option as well as high adverse slopes proved this consideration infeasible. As an alternative to constructing the reroute, the BLM identified a haul route east and south through private lands. Incorporating the haul distance, road maintenance/renovation needed, the agreements required and associated haul fees, the private land route was more costly in the long run and did not provide access across BLM managed lands for administrative purposes. Therefore, given the high user costs in the near and long term and increased route length the team eliminated this option from detailed analysis.

Table 12: Areas considered but dropped from proposed action

Units	Treat-ment Areas (Ac)	Deferred Areas (Ac)								TOTAL
		Stream Protection and WL	Uneco-nomical / Unfeasible	Good Condition	Poor Stocking	Access Problems	Too Young	Non-Forest	No Stand Exams	
11A	53	19	15							86
11B	0		12							12
11C	0	12								12
11D	22	20	8							50
11E	15	5	8							28
11F	0		6							6
12A	98	26		18						141
12B	0					21				21
12C	0	9	13							22
13A	142	13			3					157
13B	0								58	58
14A	21	3								24
14B	25	2								27
15 (A-F)	357	160	24		2		15	4	11	573
17A	10	2	4							16
17B	0		8							8
17C	0		13							13
17D	0		42							42
20A	44	3	4		1					53
21A	44	11								55
29A	285	30	7					1		323
29B	17	3								20
29C	12									12
8A	27	10	13							50
9A	44									44

	Treat-ment Areas (Ac)	Deferred Areas (Ac)								TOTAL
Units		Stream Protection and WL	Uneco-nomical / Unfeasible	Good Condition	Poor Stocking	Access Problems	Too Young	Non-Forest	No Stand Exams	
9B	6		14							20
9C	19	17	11							46
9D	2		9							11
9E	6		8							14
9F	42	8	3	1						53
TOTAL	1289	351	221	19	5	21	15	5	70	1995

Comment: Set aside no treatment areas; create "skips" in forest units.

Response: Developing variable structure is one of the primary objectives for the Mighty Moose project. BLM set aside several areas within units that will not receive treatment and will function to provide denser growing and smaller diameter wood recruitment for snags and CWD and to enhance landscape heterogeneity. Table 12 displays units considered but eliminated. Collectively, the project proposes to treat a small proportion (7 percent) of BLM managed lands within the watersheds.

Comment: Leave thinned trees on ground in riparian areas.

Response: Leaving cut trees on the ground cannot be included in a timber sale contract. As presented in proposed actions the BLM, following the timber sale, would evaluate the units for snag densities and if necessary would develop a separate service contract to implement girdling or topping trees.

Comment: Avoid Winter haul

Response: The project proposal via design features greatly restricts winter haul for the protection of BLM roads and stream habitats. However, there is a need for BLM to support winter employment and communities. To accommodate this need, BLM designated areas appropriate for winter haul and includes routes with rocked surfaces resistant to erosion and surface degradation.

Comment: Adjust retained tree spacing based on tree size and stream size.

Response: The prescriptions retain all size classes and spacing is a function of tree size, resulting in variable densities. The variable density nature of the prescription and retention of all size classes provides short and long term structural and species diversity as well as to expedite tree growth. These expected conditions are a primary objective to enhance riparian and mature habitat conditions regardless of stream size.

Comment: Design Matrix thin to support NSO prey species and small mammals

Response: The primary objective for matrix land allocation is to provide a sustainable supply of timber as directed in the RMP. Therefore, project designs were not driven by creating habitat for small mammals. However, the project would benefit small mammals as the resulting forest structure would be more complex, creating a diversity of habitat and development of understory brush species.

C.2 – Issues Considered but Eliminated from Detailed Analysis

BLM identified a number of issues through internal scoping, interdisciplinary team process, and public input. The team determined that further analysis or information was not necessary to fully inform the decision maker. The following issues were considered and addressed but not analyzed in detail.

Issue: Economic viability of management actions.

Economic viability is a primary objective for the project as reflected in the purpose and need. The team recognized that economic viability is greatly determined by market supply and demand for wood products, speculation on future prices, and efficiency of operators and processing. These variables are outside the control of BLM. However, the proposal development and elements thereof are within the control of BLM.

Due to the factors of market conditions and operations, a quantified analysis would be speculative and uncertain. Therefore, the EA did not analyze the issue in effects analysis; rather, the issue guided the development of the proposed action. The IDT evaluated logging system efficiency, volume per acre, project design features and hauling distance to design a proposal that best meets the needs for an economically viable timber sale. The proposed action specifically responds to the need for winter haul and work, flexible work dates, efficient logging systems, and high volume per acre.

During alternative development the team dropped 245 acres due to low volume and marginal economic viability and 21 acres due to high logging costs (Table 12 above – areas considered but dropped from the proposed action). Prescriptions and marking guidelines focused on maximizing volume within the constraints imposed by land use allocation and protection of sensitive resources.

Issue: Carbon and climate change.

The BLM did not analyze carbon storage or emissions specifically for this project because analysis results from four previous commercial thinning projects in the Cascades Resource Area (Gordon Creek, Highland Fling, Airstrip, and Power Mill) sufficiently inform the decision maker. The Mighty Moose project falls within the range covered by the projects analyzed in all particulars and is expected to have similar results. Therefore, analyzing quantitative carbon storage and emissions for this project would not provide any additional information needed for a reasoned choice among alternatives.

The following is a summary of information from those four analyses:

- Range analyzed for treated acres in the projects: 290 to 1,724 acres.
- Range of carbon storage in untreated project area at 30 years: 45,420 – 450,270 tonnes.

- Range of carbon storage in treated project area plus carbon in landfills and wood products at 30 years: 42,150 – 342,200 tonnes.
- Range analyzed for total carbon emissions [sum of carbon in harvested wood that would be released in the 30 year analysis period, plus the carbon in diesel fuel used for harvest operations and by burning piles of logging slash and debris.]: 1,850 - 17,080 tonnes.

The analysis of each of these projects shows that:

- The carbon emissions attributable to the projects, both individually and cumulatively, are of such small magnitude that it is unlikely to be detectable at any scale (global, continental or regional) and thus would not affect the results of any models now being used to predict climate change. For comparison, EPA's Mandatory Reporting of Greenhouse Gases Rule requires reporting emissions when 25,000 tons or more are emitted annually.

Issue: Project impacts to Wilderness/wilderness characteristics

There are no units within or adjacent to wilderness or areas found to contain wilderness characteristics. Therefore no further analysis is necessary.

Issue: Effects to Wild and Scenic or eligible Wild and Scenic rivers

There are no units within the Quartzville Creek Wild and Scenic River Corridor. Therefore no further analysis is necessary.

Issue: Project effects to Cultural Resources

Cultural Resource inventories were conducted (Greatorex 2012) for the Mighty Moose project area. No cultural resources were discovered during these inventories; therefore, no further analysis is necessary.

Issue: Gravel pit expansion and effects to TES and S&M species, wetlands, streams and fish habitat.

The team examined the proposed site for the gravel pit expansion. Less than ½ acres of trees less than 80 years would be removed. The site contains no known TES or S&M species. There are no wetlands, streams, or fish habitat within the area. Given the very small area and no sensitive species present, no issues were identified. Therefore, no further analysis was necessary.

Appendix D — References Cited

Agee, J. K. 1996. The influence of forest structure on fire behavior. In: Proceedings of the 17th annual forest vegetation management conference; 1996 January 16-18. Redding, CA: 52-68.

Anderson, Hal E. April 1982. Aids to Determining Fuel Models For Estimating Fire Behavior General Technical Report INT-122. National Wildfire Coordinating Group U.S. Department of Agriculture, U.S. Department of the Interior, National Association of State Foresters. National Interagency Fire Center, BLM Warehouse, Boise, Idaho.

Aubry, K. 2000. Amphibians in Managed, Second-Growth Douglas-fir Forests. Available at: http://www.blm.gov/ca/st/en/prog/weeds/9015.html

Bailey, J. and Tappeiner, J. 1997. Effects of Thinning on Structural Development in 40 to 100 Year-old Douglas-fir Stands in Western Oregon. Forest Ecology and Management, 108 (1998) 99-113

Beschta, R. L. 1978. Long-term patterns of sediment production following road construction and logging in the Oregon Coast Range. Water Resources Research 14(6):1011-1016.

Binkley, D. and Brown, T.C. 1993. Forest practices as nonpoint sources of pollution in North America. Journal of the American Water Resources Association 29(5):729-740.

USBLM. BLM Manual 9015 – Integrated Weed Management

Bosch, J.M., and Hewlett, J.D. 1982. A Review of Catchment Experiments to Determine the Effect of Vegetation Changes on Water Yield and Evaporation. Journal of Hydrology, 55:3-23.

Bowman, J.; Sleep, D.; Forbes, G.; and Edwards, M. 2000. The Association of Small Mammals with Coarse Woody Debris at Log and Stand Scales. Forest Ecology and Management, 129(1-3): 119-124.

Butts, S. and McComb, W. 2000. Associations of Forest-Floor Vertebrates with Coarse Woody Debris in Managed Forests of Western Oregon. Journal of Wildlife Management, 64(1): 95-104.

Carey, A.; Hardt, M.; Horton, S.; and Biswell, L. 1991. Spring Bird Communities in the Oregon Coast Range. U.S. Forest Service Pacific Northwest Research Station, Olympia, WA.

Cederholm, C.J.;Reid, L.M.; and Salo, E.O. 1980. Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington. In Proceedings of a conference on Salmon-spawning Gravel: a renewable resource in the Pacific Northwest? Seattle, WA. October 6-7, 1980.

Chan, S., Larson, D., Maas-Hebner, K., Emmingham, W., Johnston, S., and Mikowski, D. 2006. Overstory and Understory Development in Thinned and Underplanted Oregon Coast Range Douglas-fir Stands. Canadian Journal of Forest Research, 36: 2696-2711.

Christy, R.E., and S.D. West. 1993. Biology of bats in Douglas-fir forests. PNW-GTR-308. U.S.D.A. Forest Service, Pacific Northwest Research Station.

Cole, E., Pope, M., and Anothony G. 1997. Effects of Road Management on Movement and Survival of Roosevelt Elk. Journal of Wildlife Management 61(4): 1115-1126

Curtis, R.O. 1982. A simple index of stand density for Douglas-fir. Forest Science. 28(1): 92-94

Foltz, R.B. and K.A. Yanosek. 2005. Effects of Road Obliteration on Stream Water Quality. from Managing Watersheds for Human and Natural Impacts Engineering, Ecological, and Economic Challenges Watershed 2005 Glenn E. Moglen - Editor, July 19–22, 2005, Williamsburg, Virginia, USA.

Forsman, E., Meslow, E., and Wight, H. 1984. Distribution and Biology of the Spotted Owl in Oregon. Wildlife Monographs 87:1-64.

Groom, J.D., L. Dent, L.J. Madsen and J. Fleuret. 2011. Response of western Oregon (USA) stream temperatures to contemporary forest management. Forest Ecology and Management 262 (2011) pgs 1618-1629.

Hagar, J., 2004. Research Synthesis: Trophic Relations Among Birds, Arthropods, and Shrubs, in: CFER News, winter issue 2004. Cooperative Forest Ecosystem Research Program, Oregon State University, Corvallis, OR.

Hagar, J., Howlin, S., and Ganio, L. 2004. Short Term Response of Songbirds to Experimental Thinning of Young Douglas-fir Forests in the Oregon Cascades. Forest Ecology and Management, v. 199, no. 2-3, p. 333-347.

Hagar, J., McComb, W., and Emmingham, W. 1996. Bird Communities in Commercially Thinned and Unthinned Douglas-fir stands of Western Oregon Wildlife Society Bulletin 24(2).

Hann, David W., Chao-huan Wang. 1990. Mortality equations for individual trees in the mixed-conifer zone of southwest Oregon. Corvallis, OR: Forest Research Lab, College of Forestry, Oregon State University.

Hann, Ritchie, Wang, Zumrawi. 2006. Oregon Growth Analysis and Projection System, Growth and Yield Project for Northwest Oregon Forests (ORGANON), NW Oregon Version Edition 8.2 and 9.1, College of Forestry, Oregon State University.

Hansen, H., McComb, W., Vega, R., Raphael, M., and Hunter, M. 1995. Bird Habitat Relationships in Natural and Managed Forests in the West Cascades of Oregon. Ecological Applications 5:3. Ecological Society of America.

Hawe, W.P., 2012. Round Mountain Sale Monitoring. Internal working document available in specialist file for Round Mountain Timber Sale.

Hawksworth, F. 1993. Dwarf Mistletoes: Biology, Pathology, and Systematics. Agricultural Handbook 709, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Hayes, J., Chan, S., Emmingham, W., Tappeiner, J., Kellog, L., and Bailey, J. 1997. Wildlife Response to Thinning Young Forests in the Pacific Northwest. Journal of Forestry, August 1997.

Hayes, Weikel, J., and Huso, M. 2003. Response of Birds to Thinning Young Douglas-Fir Forests. Department of Forest Science, Oregon State University, Corvallis, OR.

Hoffman, S and Lauvray, L. 2005. Species Fact Sheet: Johnson's Hairstreak (Callophrys johnsoni). Revised by Huff, R. in 2011.

Huff, R., K. Van Norman, C. Hughes, R. Davis and K. Mellen-Mclean. 2012. Survey Protocol for the Red Tree Vole, Version 3.0. Portland, OR. U.S. Department of the Interior, Bureau of Land Management, Oregon/Washington, and U.S. Department of Agriculture, Forest Service Regions 5 and 6. 52 p.

Huff, M., Raley, C. 1991. Regional Patterns of Diurnal Breeding Bird Communities in Oregon and Washington. U.S. Dept. Agric. Gen. Tech. Rep. PNW-GTR-285 pages 177-205.

Humes, M., Hayes, J., and Collopy, M. 1999. Bat Activity in Thinned, Unthinned, and Old-growth Forests in Western Oregon. Journal of Wildlife Management 63(2): 553-561.

Johnson, M.G., and R.L. Beschta. 1980. Logging, Infiltration Capacity, and Surface Erodibility in Western Oregon. Journal of Forestry. June, 1980, 334-337.

Jones, J.A., and G.E. Grant. 1996. Peak flow responses to clear-cutting and roads in small and large basins, western Cascades, Oregon. Water Resources Research, Vol 32, No.4, 959-974.

Journal of Wildlife Management, 64(4): 1041-1052.

Lane, E. W. 1955. Design of stable alluvial channels. Transactions, American society of Civil Engineers. 120(2776):1234-1260.

Leonard, W.P., L. Chichester, C.H. Richart, and T. Young. 2011.Securicauda hermani and Carinacauda stormi, two new genera and species of slug from the Pacific Northwest of the United States (Gastropoda: Stylommatophora: Arionidae), with notes on Gliabates oregonius Webb 1959. Zootaxa 2746:43 – 56.

Leopold, L.B. 1997. Water, rivers and creeks. University Science Books. Sausalito, CA. Page 40-41.

O'Neil, T., Johnson, D., (Manag. Dirs.); and Barrett, C., Trevithick, M., Bettinger, K., Kiilsgaard, C., Vander Heyden, M., Greda, L., Stinson, D., Marcot, B., Doran, P., Tank, S., Wunder, L. 2001. Wildlife-Habitat Relationships in Oregon and Washington (and Matrices). Northwest Habitat Institute. 2001. Oregon State University Press, Corvallis, OR.

Oregon Dept. Of Environmental Quality. 2005. Willamette Basin Total Maximum Daily load Assessment. Portland , OR.

Oregon Department of Forestry. Wet Season Road Use Monitoring Report. Final Report. Forest Practices Monitoring Program Technical Report #17. June, 2003.

Oregon Watershed Enhancement Board (OWEB). Oregon Watershed Assessment Manual. Page IV-11. Salem, Oregon. (http://www.oweb.state.or.us/publications/wa_manual99.shtml

Perkins, M., and Cross, S. 1988. Differential Use of Some Coniferous Forest Habitats by Hoary and Silver-haired Bats in Oregon. Murrelet. 69: 21-24.

Ottmar, Roger D., and Hardy, Colin C., 1989. Stereo Photo Series for Quantifying Forest Residues in Coastal Oregon Forests: Second-Growth Douglas-Fir---Western Hemlock Type, Western Hemlock---Sitka Spruce Type, and Red Alder Type. General Technical Report PNW-GTR-231 U.S. Department of Agriculture - Forest Service, Pacific Northwest Research Station. Siuslaw National Forest.

Perry, D.A., 1994. Forest Ecosystems. John Hopkins University Press, Baltimore, MD, 649 pp.

Rose, C., Marcot, B., Mellen, T., Ohmann, J., Waddell, K., Lindley, D., and B. Schreiber. 2001. Decaying Wood in Pacific Northwest Forests: Concepts and Tools for Habitat Management. Chapter 24 In Wildlife Habitat Relationships in Oregon and Washington, OSU Press, Corvallis, OR.

Thomas, D., and West, S. 1991. Forest Age Associations for Bats in the Washington Cascade and Oregon Coast Ranges. In: Ruggeiero, L., Carey, A., Aubry, K. (tech coords). Wildlife and Vegetation of Unmanaged Douglas-fir Forests. Gen. Tech. Rep. PNW-285, Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 295-303.

Toman, E. T. 2004. Forest road hydrology: the influence of forest roads on stream flow at stream crossings. M.S. thesis. Forest Engineering Department, Oregon State University. Corvallis, Oregon. 78 pp.

Troendle, C.A., L.H. MacDonald, and C.H. Luce. May, 2006. Chapter 7 Fuels Management and Water Yield. from Cumulative Watershed Effects of Fuels Management: A Western Synthesis. Available at http://www.wy.blm.gov/fireuse/pubs/FuelsMgmt_WaterYield.pdf

Trombilak, S., and Frissell, C. 1999. Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities. Conservation Biology 14 (1): 18-30

USDA Natural Resources Conservation Service. 2005. Soil Data Mart.
Accessed http://soildatamart.nrcs.usda.gov/ December 2005-June 2006. Soil Survey of Linn County Area Oregon. United States Department of Agriculture. Soil Conservation Service.

U.S. Environmental Protection Agency, Region 10. EPA 910/9-91-001. Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in the Pacific Northwest and Alaska. Pgs.52-53. Seattle, Washington.

U.S. Forest Service and Bureau of Land Management. 2004. Northwest Forest Plan Temperature TMDL Implementation Strategies. Draft. Portland, Oregon.
http://www.blm.gov/nhp/efoia/or/fy2006/ib/p/ib-or-2006-014Att2.pdf (Final)

U.S. Forest Service and Bureau of Land Management. 2004. Northwest Forest Plan Temperature TMDL Implementation Strategies. Draft. Portland, Oregon. http://www.blm.gov/nhp/efoia/or/fy2006/ib/p/ib-or-2006-014Att2.pdf (Final)

U.S. Forest Service and Bureau of Land Management. 2004. Northwest Forest Plan Temperature TMDL Implementation Strategies. Draft. Portland, Oregon. http://www.blm.gov/nhp/efoia/or/fy2006/ib/p/ib-or-2006-014Att2.pdf (Final)

U.S.D.I. Bureau of Land Management. 1998. Riparian Area Management. A User Guide to Assessing Proper Functional Condition and the Supporting Science for Lotic Areas. TR1737-15. National Applied Resource Science Center. Denver, CO.

U.S.D.I.. Bureau of Land Management. 1987. Timber Production Capability Classification. Salem District.

U.S.D.I.. Bureau of Land Management. 2007. The Salem and Eugene District Water Quality Restoration Plan for the Willamette Basin. Internal document, Salem and Eugene district files

USDA, Forest Service, USDI, Bureau of Land Management. 1998. Mid Willamette Late Successional Reserve Assessment.

USDA, Forest Service; USDI Bureau of Land Management. July 2011. 2011 Settlement Agreement in Litigation over the Survey and Manage Mitigation Measure in Conservation Northwest et al. v. Sherman et al., Case No. 08-1067-JCC. BLM Instruction Memorandum No. OR-2011-063. Oregon State Office, Portland, Oregon.

USDA, Forest Service; USDI Bureau of Land Management. 1993. Final Supplemental Environmental Impact Statement Management of Habitat for Late Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl, and Record of Decision, April 1994. Portland, Oregon.

USDA, Forest Service; USDI Bureau of Land Management. January 2001. Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage Mitigation Measures Standards and Guidelines, Forest Service National Forests and Bureau of Land Management Districts Within the Range of the Northern Spotted Owl (ROD 2001).

USDA, Forest Service; USDI Bureau of Land Management. January 2004. Final Environmental Impact Statement to Remove the Survey and Manage Mitigation Measure Standards and Guidelines from Forest Service National Forests and Bureau of Land Management Districts Within the Range of the Northern Spotted Owl (SEIS 2004).

USDA, Forest Service; USDI Bureau of Land Management. July 2007. Record of Decision to Remove the Survey and Manage Mitigation Measure Standards and Guidelines from Forest Service National Forests and Bureau of Land Management Districts Within the Range of the Northern Spotted Owl (EIS 2007) and (July 2007 ROD).

USDI, Bureau of Land Management, Salem District, Cascades Resource Area. 1995. Hamilton Creek Watershed Analysis.

USDI, Bureau of Land Management, Salem District, Cascades Resource Area. July 2001. Crabtree Creek Watershed Analysis (CCWA 2001).

USDI, Bureau of Land Management, Salem District, Cascades Resource Area; USDA, Forest Service, Willamette National Forest, Sweet Home Ranger District. September 2002. Quartzville Creek Watershed Analysis (QWA 2002).

USDI, Bureau of Land Management. 1994. Salem District Proposed Resource Management Plan/Final Environmental Impact Statement. Salem, Oregon.

USDI, Bureau of Land Management. 1995. Salem District Record of Decision and Resource Management Plan. Salem, Oregon.

USDI, Bureau of Land Management; Fish and Wildlife Service; USDA Forest Service. April 2012. Biological Assessment of Not Likely to Adversely Affect Projects with the Potential to Modify the Habitat of Northern Spotted Owls, Willamette Planning Province – FY2013 (BA 2013).

USDI, U.S. Fish and Wildlife Service. 2007c. Draft: What are the Effects of Habitat Thinning on Northern Spotted Owls? Literature Summarized through 2005. Portland, OR.

Van Wagner, C.E. 1965 Describing Forest Fires - old ways and new. Forestry Chronicle 41:301-305

Waldien, D., Hayes, J., and Arnett, E. 2000. Day Roosts of Female Long-eared Myotis in Western Oregon. Journal of Wildlife Management 64(3):785-796.

Wemple, B.C., J.A .Jones, and G.E. Grant. 1996. Channel Network Extension by Logging Roads in Two Basins, Western Cascades, Oregon. WATER RESOURCES BULLETIN, VOL. 32, NO. 6, 1195.

Wemple, B.C., J.A. Jones. 2003. Runoff production on forest roads in a steep, mountain catchment. WATER RESOURCES RESEARCH, VOL. 39, NO. 8, 1220.

Wemple, B.C., J.A. Jones. 2003. Runoff production on forest roads in a steep, mountain catchment. WATER RESOURCES RESEARCH, VOL. 39, NO. 8, 1220.

Wilkerson, Ethel, J.M.Hagan, D.Siegel, and A.A. Whitman. 2006. The Effectiveness of Different Buffer Widths for Protecting Headwater Stream Temperature in Maine. Forest Science.