Mud Den
Commercial Thinning
Environmental Assessment

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U.S. Department of the Interior
Bureau of Land Management
Roseburg District
Swiftwater Field Office
Roseburg, Oregon

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U.S. Department of the Interior, Bureau of Land Management
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Chapter 1. Purpose and Need for Action

A. Purpose & Need

The Bureau of Land Management (BLM), Swiftwater Field Office proposes commercial thinning of approximately 831 acres of mid-seral forest stands, 34-54 years old, in three separate proposed timber sales: Calahan Mudaxle (205 acres), Devils Den (263 acres), and Mud Slinger (363 acres). In addition, up to approximately five acres per timber sale would be cleared or brushed for spur right-of-ways or roads to access the harvest areas.

There is a need to treat mid-seral stands that are currently overstocked to maintain stand vigor in the Connectivity/Diversity Block (C/D) and General Forest Management Area (GFMA), maintain/enhance stand diversity in the Riparian Reserve and improve wildlife habitat within the occupied marbled murrelet habitat designated to be managed as Late-Successional Reserve. The purpose of the proposed project would be to reduce the stand densities and improve wildlife habitat through thinning prescriptions in a cost-efficient manner following 1995 ROD/RMP management direction.

These proposed sales are located in the Upper Umpqua River, Deer Creek-South Umpqua River, and South Fork Coos River watersheds. It is anticipated that the proposed timber sales would yield approximately 15 to 16 million board feet (15 to 16 MMBF) of timber in support of local and regional manufacturers and economies.

B. Conformance

This environmental assessment (EA) analyzes the environmental consequences of the No Action Alternative, Proposed Action Alternative, sub-alternatives A, B, and C (variations of the Proposed Action Alternative), and describes the environmental effects of each in the decision-making process. In addition to the 1995 *Roseburg District Record of Decision and Resource Management Plan* (1995 ROD/RMP) and periodic plan maintenance as published in the *Roseburg District Annual Program Summary and Monitoring Report Fiscal Year 2008* (2008 APS), this analysis tiers to the assumptions and analysis of consequences provided by the following NEPA analyses:

- *The 1994 Final Supplemental Environmental Impact Statement (FSEIS) on Management of Habitat for Late-Successional and Old-Growth Related Species Within the Range of the Northern Spotted Owl;*
- *The 2001 Final Supplemental Environmental Impact Statement (FSEIS) for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines in Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl.*

Implementation of the actions proposed in this analysis would conform to the requirements of the 1995 ROD/RMP, incorporating the standards and guidelines therein.

Survey & Manage

The proposed Mud Den Commercial Thinning project is consistent with Court Orders relating to the Survey and Manage mitigation measure of the Northwest Forest Plan, as incorporated into the Roseburg District's 1995 ROD/RMP.

On December 17, 2009, the U.S. District Court for the Western District of Washington issued an Order in *Conservation Northwest, et al. v. Rey, et al.* No. 08-1067 (W.D. Wash.) (Judge Coughenour), granting Plaintiffs' motion for partial summary judgment and finding a variety of NEPA violations in the BLM and USFS 2007 Record of Decision eliminating the Survey and Manage mitigation measure. Previously, in 2006, the District Court (Judge Pechman) had invalidated the agencies' 2004 RODs eliminating Survey and Manage due to NEPA violations. Following the District Court's 2006 ruling, parties to the litigation had entered into a stipulation exempting certain categories of activities from the Survey and Manage standard (hereinafter referred to as "Pechman Exemptions").

Judge Pechman's Order from October 11, 2006 directs: "Defendants shall not authorize, allow, or permit to continue any logging or other ground-disturbing activities on projects to which the 2004 ROD applied unless such activities are in compliance with the 2001 ROD (as the 2001 ROD was amended or modified as of March 21, 2004), except that this order will not apply to:

(a) Thinning projects in stands younger than 80 years old (emphasis added);
(b) Replacing culverts on roads that are in use and part of the road system, and removing culverts if the road is temporary or to be decommissioned;
(c) Riparian and stream improvement projects where the riparian work is riparian planting, obtaining material for placing in-stream, and road or trail decommissioning; and where the stream improvement work is the placement large wood, channel and floodplain reconstruction, or removal of channel diversions; and
(d) The portions of project involving hazardous fuel treatments where prescribed fire is applied. Any portion of a hazardous fuel treatment project involving commercial logging will remain subject to the survey and management requirements except for thinning of stands younger than 80 years old under subparagraph (a) of this paragraph."

Following the Court's December 17, 2009 ruling, the Pechman exemptions are still in place. Judge Coughenour deferred issuing a remedy in his December 17, 2009 order until further proceedings and did not enjoin the BLM from proceeding with projects. Because the Mud Den project entails no regeneration harvest and entails thinning only in stands 34-54 years old, the project meets exemption "a" of the Pechman Exemptions (October 11, 2006 Order) even if the District Court sets aside or otherwise enjoins use of the 2007 *Survey and Manage Record of Decision* since the Pechman Exemptions would remain valid in such case.

In addition, activities associated with the proposed thinning treatments include spur road construction, renovation, and decommissioning as described in *Chapter 2: Discussion of Alternatives* (pgs. 6, 9-13). Spur road construction would either occur within the treated stands, where right-of-way widths would be typically less than the tree-spacing following harvest. Road renovation and decommissioning activities would occur on existing road facilities where habitat for Survey and Manage species is absent and would not be considered habitat disturbing.

C. Objectives

The management objectives of the proposed action vary based on land-use allocation, in accordance with the 1995 ROD/RMP. Specific objectives of the proposed action are outlined below.

- Comply with Section 1 of the O&C Act (43 USC § 1181a) which stipulates that O & C Lands be managed "… for permanent forest production, and the timber thereon shall be sold, cut, and removed in conformity with the principal of sustained yield for the purpose of providing a permanent source of timber supply, protecting watersheds, regulating stream flow, and contributing to the economic stability of local communities and industries, and providing recreational facilities…"

- Select logging systems based on the suitability and economic efficiency of each system for the successful implementation of the silvicultural prescription, for the protection of soil and water quality, and for meeting other land use objectives (1995 ROD/RMP, pg. 61). Also, provide a harvest plan flexible enough to facilitate harvesting within a three year timber sale contract.

- Seek a balance between reducing the risk of wildfire and a fuel profile that supports land allocation objectives (1995 ROD/RMP, pg. 78).

Within the Connectivity/Diversity Block:

- Perform thinning on forest stands less than 120 years of age. Design thinning to usually assure high levels of volume productivity. Retain patches of denser habitat where desired to meet wildlife habitat criteria (1995 ROD/RMP, pg. 153).

Within the General Forest Management Area:

- Perform commercial thinning on forest stands less than 80 years of age. Design commercial thinning to assure high levels of volume productivity (1995 ROD/RMP, pg. 151).

Within the Riparian Reserve:

- Apply silvicultural treatments to restore large conifers in Riparian Reserves (1995 ROD/RMP, pg. 21) and perform density management to help forest stands develop late-successional characteristics and attain forest conditions that contribute to the Aquatic Conservation Strategy (1995 ROD/RMP, pgs. 153-154).

Within the Late Successional Reserve:

- Protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as the habitat for the northern spotted owl and other late-successional and old growth species (1995 ROD/RMP, pgs. 38, 153).

- Apply silvicultural treatments that would be beneficial to the creation of late-successional forest conditions and would put stands on a developmental pathway that would reduce the risk of stand loss to maintain long-term habitat viability (1995 ROD/RMP, pg. 153).

D. Decision Factors

Factors to be considered when selecting among alternatives would include:

The degree to which the objectives previously described would be achieved, including: the manner in which thinning would be conducted with respect to cost, the method(s) of yarding, and type of equipment; season(s) of operations; and the manner in which access

would be provided, including road renovation, and the types and locations of road construction;

The nature and intensity of environmental impacts that would result from implementation and the nature and effectiveness of measures to mitigate impacts to resources including, but not limited to, wildlife and wildlife habitat, soil productivity, water quality, air quality, and the spread of noxious weeds;

- Compliance with management direction from the 1995 ROD/RMP;

- Compliance with applicable laws including, but not limited to, the Clean Water Act, the Endangered Species Act, the O&C Act, and the National Historic Preservation Act; and

- Provide revenue to the government from the sale of timber resources in a cost efficient manner.

Chapter 2. Discussion of the Alternatives

This chapter describes the basic features of the alternatives being analyzed. In this EA, five alternatives were analyzed: the No Action Alternative, the Proposed Action Alternative, and sub-alternatives A, B, and C. Sub-alternatives A, B, and C are essentially the same as the Proposed Action Alternative except that variations in yarding systems (e.g. helicopter yarding) are considered and different options for managing the existing 26-7-29.0 road (in Calahan Mudaxle) and the 26-7-32.0 road (in Mud Slinger) are considered. All five alternatives are described in detail below.

A. The No Action Alternative

The No Action Alternative provides a baseline for the comparison of the alternatives. This alternative describes the existing condition and continuing trends anticipated in the absence of the proposal but with the implementation of other reasonably foreseeable federal and private projects. If the no action alternative were selected there would be no thinning of timber or treatment of the mid-seral stands within the bounds of the project area at this time.

Selection of this alternative would not constitute a decision to re-allocate these lands to non-commodity uses. Future harvesting in this area would not be precluded and could be considered again under a subsequent EA. Road maintenance would be conducted as-needed to provide resource protection, accommodate reciprocal users, and protect the federal investment.

B. The Proposed Action Alternative

The proposed action alternative would consist of three timbersales (i.e. Calahan Mudaxle, Devils Den, and Mud Slinger) that would result in thinning approximately 831 acres of mid-seral stands and would yield approximately 15 to 16 million board feet of timber (Appendix F, Figures 1-4). The proposed action consists of the following activities, summarized in Table 1.

Mud Den includes lands within the C/D, GFMA, LSR, and Riparian Reserve land use allocations and would total approximately 831 acres. The extent of the Riparian Reserve within the proposed sales would be determined following completion of field work to define the spatial arrangement of intermittent, perennial, and fish-bearing streams. The distribution of project acreage between the C/D, GFMA, LSR, and Riparian Reserve would be disclosed in the individual timbersale decisions once work delineating the extent of the Riparian Reserves is completed.

In the Upper Umpqua River and Deer Creek-South Umpqua River watersheds, the Riparian Reserve width for perennial, fish-bearing streams would be 360 feet (two site potential tree heights). The Riparian Reserve width would be 180 feet (one site potential tree height) for perennial, non-fish bearing streams and also for intermittent streams.

In the South Fork Coos River Watershed, the Riparian Reserve width for perennial, fish-bearing streams would be 440 feet (two site potential tree heights). The Riparian Reserve width would be 220 feet (one site potential tree height) for perennial, non-fish bearing streams and also for intermittent streams. Of the units proposed for thinning, Mud Slinger

units 31B and 31D are within the South Fork Coos River watershed.

Table 1. Mud Den Proposed Action Summary.

Activity		Total
Commercial Thinning*	Connectivity/Diversity Block General Forest Management Area Riparian Reserve Late Successional Reserve	831 acres
Yarding	Cable Yarding Ground Based Yarding Combination of Cable & Ground Based Yarding Helicopter Yarding**	8 acres 22 acres 801 acres 85 acres
Hauling	Dry Season Haul Only Wet or Dry Season Haul	82,405 feet 17,080 feet
Road Activities	New, Temporary Construction New, Permanent Construction Renovation of Existing Roads Decommissioning (i.e. water-bar, block, and mulch) Decommissioning (i.e. subsoil, water-bar, block, and mulch) Total Decommissioning	14,145 feet 3,925 feet 81,415 feet 8,875 feet 7,070 feet 15,945 feet
Fuels Treatment	Machine Pile and Burn at Landings	

* The distribution of project acreage between the C/D, GFMA, LSR, and Riparian Reserve would be disclosed in the individual timbersale decisions.
** Helicopter yarding portions of Devils Den 21C, Mud Slinger 29A, and Mud Slinger 33A would be considered under Action Alternative A. These areas are analyzed as being cable or ground based yarded under the Proposed Action Alternative

Most of the Mud Den proposed units are located on Revested Oregon and California Railroad Lands (O&C Lands); however, Mud Slinger Unit 32A is located on Public Domain (PD) lands. The land use allocation and yarding method(s) for each of the proposed units is displayed in Table 2.

1. Timber Harvest

a) Treatment Prescription

Tree Marking

Stands in GFMA would have an average of 120 square feet of basal area retained. In C/D, Riparian Reserves, and LSR an average of 70 to 80 square feet of basal area would be retained. A variable spacing marking prescription would be used in all land use allocations. Minor conifer and hardwood species would be retained, where possible, to maintain stand diversity. Canopy openings would be created or enlarged to maintain trees with large limbs, full crowns, promote tree regeneration, shrubs, and forbs.

Older remnant trees may be present, but are not the numerically predominant stand components or the focus of the treatments. Trees would primarily be removed from the suppressed and intermediate canopy classes, although some co-dominant and dominant trees would be removed where necessary to meet specific land use

objectives. Since thinning would focus on removal of intermediate and suppressed canopy layers, it is possible that suppressed trees designated for cutting may be older than the prevailing stand age.

Table 2. Mud Den Land Use Allocations & Proposed Action Yarding Methods.

Unit	Township-Range-Section	Acres	Land Use Allocation	Yarding Method(s)
Calahan Mudaxle				
29A	T26S-R07W-Sec. 29	182	C/D; Riparian Reserve	Cable; Ground-based
29B	T26S-R07W-Sec. 29	23	C/D; Riparian Reserve	Cable; Ground-based
Devils Den				
17A	T26S-R07W-Sec. 17	22	C/D; Riparian Reserve	Cable; Ground-based
21A	T26S-R07W-Sec. 21	31	GFMA; Riparian Reserve	Cable; Ground-based
21B	T26S-R07W-Sec. 21	18	LSR	Cable; Ground-based
21C	T26S-R07W-Sec. 21	192	GFMA; LSR; Riparian Reserve	Helicopter*; Cable; Ground-based
Mud Slinger				
29A	T26S-R07W-Sec. 29	15	C/D; Riparian Reserve	Helicopter*; Ground-based
31A	T26S-R07W-Sec. 31	13	GFMA; Riparian Reserve	Cable; Ground-based
31B	T26S-R07W-Sec. 31	38	GFMA; Riparian Reserve	Cable; Ground-based
31C	T26S-R07W-Sec. 31	8	GFMA; Riparian Reserve	Cable
31D	T26S-R07W-Sec. 31	22	GFMA; Riparian Reserve	Ground-based
32A	T26S-R07W-Sec. 32	29	LSR	Cable; Ground-based
33A	T26S-R07W-Sec. 33	238	LSR	Helicopter*; Cable; Ground-based
Total		**831**		

* Helicopter yarding portions of Devils Den 21C, Mud Slinger 29A, and Mud Slinger 33A would be considered under sub-alternative A.

Snags & Coarse Woody Debris

In all land use allocations, conifer and hardwood snags would be reserved from cutting unless they are a safety concern. Snags felled for safety reasons in the LSR and Riparian Reserve would be retained on site as coarse woody debris. Existing coarse woody debris in decay classes 3, 4, and 5 would be retained in GFMA and C/D lands, and all coarse woody debris would be retained in the LSR and Riparian Reserve.

The residual stands following harvest would provide a pool of candidate trees for future snag and coarse woody debris recruitment. Additional coarse woody debris and snags may be created incidentally through the harvest operations (e.g. damage leading to broken-out tops or individual tree mortality) or through weather damage (e.g. wind and snow break).

b) Stream Buffers

Perennial or Fish-bearing Streams

The thinning prescription would not be applied within a "no-harvest" buffer that would extend 60 feet (slope distance) on either side of the edge of the stream channel, as measured from the ordinary high water line for perennial or fish-bearing streams.

Intermittent Streams

The thinning prescription would not be applied within a "no-harvest" buffer that would extend 35 feet (slope distance) on either side of the edge of the stream channel, as measured from the ordinary high water line for intermittent streams.

c) Timber Cruising

Timber cruising would employ methods that could include the felling of sample trees to formulate local volume tables. Felled sample trees would become part of the offered sale volume.

A small amount of additional timber could potentially be included as a modification to this project. These additions would be limited to the removal of individual trees or small groups of trees that are blown down, are a safety hazard, or trees needed to facilitate the proposed action. Historically, this addition has been less than ten percent of the estimated sale quantity.

d) Firewood

Firewood cutting and salvaging of logging debris (slash) could occur in cull decks, logging landings, and in the units, near roads, after the thinning activities are completed.

2. Timber Yarding

Proposed units would require a mixture of skyline cable yarding and ground-based yarding (Table 2). Up to ten acres of additional, incidental ground-based logging within each of the timbersales may be necessary (i.e. removal of guyline anchor trees, isolated portions of units, etc.).

Prior to attaching any logging equipment to a reserve tree, precautions to protect the tree from damage would be taken. Examples of protective measures include tree plates, straps, or synthetic rope, where possible, and minimal notching (less than half the tree diameter) where necessary. If it would be necessary to fall a reserve tree for safety reasons then it may be harvested or left as coarse woody debris at the discretion of the government's contract administrator.

Cable Yarding

Cable logging systems that limit ground disturbance would be used to obtain partial or full suspension (1995 ROD/RMP, pg. 130). Intermediate supports would be used as necessary to obtain partial suspension at slope breaks. Where excessive soil furrowing occurs, it would be hand waterbarred and filled with limbs or other organic debris.

Cable yarding would not be permitted on very steep slopes (i.e. 70 percent and greater) when soil moisture levels are high enough to squeeze water from soil samples by hand. Soil moisture would be considered too high if cable yarding creates glazed imprints on soil that channels water down slope. This generally occurs when the soil moisture is greater than 30 percent.

Where practical, cable yarding would require full suspension over streams.

Ground-Based Yarding

Ground-based logging would be limited to the dry season (normally May 15th to October 15th (1995 ROD/RMP, pg. 131)). If soil moisture levels would cause the amount of compaction to exceed ten percent or more of the ground-based area (including landings, log decks, and trails), operations would be suspended during unseasonably wet weather in the dry season. The soil scientist and the contract administrator would monitor soil moisture and compaction to determine when operations may need to be suspended.

Ground-based yarding equipment would be limited to slopes generally less than 35 percent (2001 Plan Maintenance; 2008 APS, pgs. 65-66). Ground-based equipment would be confined to designated skid and forwarder trails and would re-use existing skid trails as much as practical. Skid trails would have an average spacing of at least 150 feet apart and harvester/forwarder trails would be spaced at least 50 feet apart where topography allows. In addition, machines used for ground-based logging would be limited to a track width no greater than 10.5 feet.

Harvesters would also place tree limbs in the trails in front of the equipment to minimize compaction. In harvester trail segments that are within five feet of reserved trees, slash would be placed to protect the large roots at or near the surface.

3. Timber Hauling

Approximately 17,080 feet of rocked roads would be hauled across either in the dry- or wet-season while 36,400 feet of natural surface roads and 46,005 feet of rocked roads that have inadequate rock to support winter haul would be limited to dry-season hauling (Tables 3a, 3b, and 3c).

Prior to any wet season haul on surfaced roads, sediment reducing measures (e.g., placement of straw bales and/or silt fences and sediment filters) would be placed near stream crossings, if necessary, to prevent sediment from reaching the streams. Timber hauling would be suspended during wet weather if road run-off would deliver sediment at higher concentrations than existing conditions to the receiving stream.

4. Fuels Treatment

Prescribed burning (burning under the direction of a written site specific prescription or "Burn Plan") of machine-piled slash would occur at landings. Additionally, all slash between three and six inches in diameter within 50 feet of roads would be hand piled and burned in the Calahan Mudaxle units, Devil's Den Unit 21C, and Mud Slinger Units 32A and 33A. All prescribed burning (i.e. slash piles) would have an approved "Burn Plan," and be conducted under the requirements of the Oregon Smoke Management Plan and in a manner consistent with the requirements of the Clean Air Act (Oregon Department of Environmental Quality and Oregon Department of Forestry, 1992).

Slash would be burned during the late-fall to mid-spring season when the soil, duff layer (soil surface layer consisting of fine organic material), and large down log moisture levels are high (1995 ROD/RMP, pg. 140).

5. Road Activities

The proposed project would include dry season and wet season logging activities and use existing roads to the greatest extent practical. Roads and landings would be located on geologically stable locations; e.g., ridge tops, stable benches or flats, and gentle-to-moderate side-slopes (1995 ROD/RMP, pg. 132). Roads and spurs would be designed no wider than needed for the specific use (i.e. 14 foot running surface) to minimize soil disturbance (1995 ROD/RMP, pg. 132). Approximately twelve acres would be cleared or brushed for spur right-of-ways or roads to access the harvest units.

Road construction, renovation, maintenance, overwintering, and decommissioning would be restricted to the dry season (normally May 15th to October 15th). The operating season could be adjusted if unseasonable conditions occur (e.g. an extended dry season beyond October 15th or wet season beyond May 15th). In-stream work, including culvert replacement and/or installation, would be limited to periods of low or no flow (between July 1st and September 15th).

Construction

Approximately 14,145 feet of new, temporary spur roads and 3,925 feet of new, permanent roads would be constructed (Tables 3a, 3b, and 3c). New cut and fill slopes would be mulched with weed-free straw, or equivalent, and seeded with a native or sterile hybrid mix. Temporary spurs would be decommissioned after harvest. Up to approximately five acres per timber sale (i.e. up to 15 acres in total for Mud Den) would be cleared or brushed for spur right-of-ways or roads to access the harvest areas.

Temporary spur roads may be rocked at purchaser's expense *except* for eleven spurs proposed to be subsoiled (identified in Tables 3b and 3c) because they would be within the newly designated Late-Successional Reserve and are not anticipated to be used for subsequent stand treatments. Spurs that are rocked at purchaser's expense would be decommissioned by blocking with trench barriers. Existing roads may have additional rock placed at the purchaser's expense and would remain open following thinning.

Renovation

There would be a total of approximately 81,415 feet of renovation in Mud Den. Approximately 22,255 feet of existing, native surfaced roads in Mud Den would be renovated by brushing, grading, and replacing drainage structures (Tables 3a, 3b, and 3c). Approximately 54,975 feet of existing, rock surfaced roads in Mud Den would be renovated by brushing, grading, replacing drainage structures, and adding rock where needed (Tables 3a, 3b, and 3c). These existing, rocked roads would remain open following thinning. Road renovation would generally be performed by the purchaser.

Approximately 4,185 feet of the 26-7-29.0 road that would be used for thinning operations in Calahan Mudaxle would be renovated by brushing, grading, adding or replacing drainage structures, and adding rock. Another 2,150 feet of the 26-7-29.0 road would be realigned and rocked. Following harvest the renovated and realigned portions of the 26-7-29.0 road would remain open.

Maintenance

Approximately 44,465 feet of existing roads would be maintained. Road maintenance would consist of brushing, grading, maintaining or replacing drainage structures (culverts and drainage ditches), and adding spot rock where needed (1995 ROD/RMP,

pgs. 137-138). Road maintenance would generally be performed by the Roseburg BLM District maintenance crew.

Table 3a. Calahan Mudaxle Roads & Spurs[1]

Spur/Road #	Temporary Construction (feet)	Permanent Construction (feet)	Renovation (feet)	Surfacing		Decommissioning
				Existing	Proposed	
Spur CM1	200	0	1,800	Native	Native[2]	Water-bar, mulch, block
Spur CM2	100	0	0	none	Native[2]	Water-bar, mulch, block
Spur CM3	0	600	0	none	Rock	none
Spur CM4	0	200	0	none	Rock	none
Spur CM5	0	475	0	none	Rock	none
Spur CM6	0	500	0	none	Rock	none
26-7-7.0	0	0	8,970	Rock	Rock[3]	none
26-7-29.0	0	0	4,185	Native	Rock	none
26-7-29.0 realignment	0	2,150	0	Native	Rock	none
TOTAL	**300**	**3,925**	**14,955**			

[1]Approximately 10,935 feet of existing roads would be maintained for Calahan Mudaxle in addition to the roads and spurs described in the table.
[2] Allow purchaser to rock road at their expense; block and mulch when harvest completed.
[3] Rocked roads that would not support winter haul without the addition of a suitable amount of surfacing rock.

Table 3b. Devil's Den Roads & Spurs[1]

Spur/Road #	Temporary Construction (feet)	Renovation (feet)	Surfacing		Decommissioning
			Existing	Proposed	
Spur DD1	780	0	none	Native[2]	Water-bar, mulch, block
Spur DD2	1,000	0	none	Native	Subsoil, water-bar, mulch, block
Spur DD3	640	0	none	Native	Subsoil, water-bar, mulch, block
Spur DD4	565	0	none	Native	Subsoil, water-bar, mulch, block
Spur DD5	1,440	0	none	Native[2]	Water-bar, mulch, block
Spur DD6	355	0	Native	Native[2]	Water-bar, mulch, block
Spur DD7	680	0	Native	Native[2]	Water-bar, mulch, block
26-7-19.1	0	13,415	Rock	Rock[3]	none
26-7-20.0	0	7,055	Rock	Rock[3]	none
26-7-20.3	0	8,170	Rock	Rock[3]	none
26-7-33.0	0	10,245	Rock	Rock[3]	none
TOTAL	**5,460**	**38,885**			

[1]Approximately 6,430 feet of existing roads would be maintained for Devil's Den in addition to the roads and spurs described in the table.
[2] Allow purchaser to rock road at their expense; block and mulch when harvest completed.
[3] Rocked roads that would not support winter haul without the addition of a suitable amount of surfacing rock.

Table 3c. Mud Slinger Roads & Spurs[1]

Spur/Road #	Temporary Construction (feet)	Renovation (feet)	Surfacing		Decommissioning
			Existing	Proposed	
Spur MS1	515	0	none	Native	Water-bar, mulch, block
Spur MS2	335	0	none	Native	Water-bar, mulch, block
Spur MS4	425	0	none	Native	Water-bar, mulch, block
Spur MS5	385	0	none	Native	Water-bar, mulch, block
Spur MS6	1,265	0	none	Native	Water-bar, mulch, block
Spur MS7	595	0	none	Native	Water-bar, mulch, block
Spur MS10	470	0	none	Native	Subsoil, water-bar, mulch, block
Spur MS11	390	0	none	Native	Subsoil, water-bar, mulch, block
Spur MS12	175	0	none	Native	Subsoil, water-bar, mulch, block
Spur MS13	1,515	0	none	Native	Subsoil, water-bar, mulch, block
Spur MS14	560	0	none	Native	Subsoil, water-bar, mulch, block
Spur MS15	555	0	none	Native	Subsoil, water-bar, mulch, block
Spur MS16	700	0	none	Native	Subsoil, water-bar, mulch, block
Spur MS17	500	0	None	Native	Subsoil, water-bar, mulch, block
26-7-29.2	0	15,535	Native	Native	none
Unnamed road in T26S, R7W, Section 31	0	2,785	Native	Native	none
26-7-31.0	0	2,135	Native	Native	none
26-7-33.0	0	4,790	Rock	Rock[2]	none
26-8-27.0	0	2,330	Rock	Rock[2]	none
TOTAL	**8,385**	**27,575**			

[1] Approximately 27,100 feet of existing roads would be maintained for Mud Slinger in addition to the roads and spurs described in the table.
[2] Rocked roads that would not support winter haul without the addition of a suitable amount of surfacing rock.

Decommissioning

Approximately 14,145 feet of newly constructed, native-surface spur roads and 1,800 feet of renovated, native-surface roads would be decommissioned following their use (Tables 3a, 3b, and 3c). Approximately 7,070 feet of the newly constructed spur roads would be decommissioned by subsoiling, water-barring, mulching with logging slash where available (or with straw if logging slash is not available), and blocking with trench barriers. The rest of these roads and spurs (approximately 8,875 feet) would be decommissioned by water-barring, mulching with logging slash where available (or with straw if logging slash is not available), and blocking with trench barriers.

Over-wintering

Over-wintering natural surface spur roads would be done by building, using, and winterizing natural surface spur roads prior to the end of the dry season. Over-wintering would include: installation of waterbars, mulching the running surface with weed-free straw, seeding and mulching bare cut and fill surfaces with native species (or a sterile hybrid mix if native seed is unavailable), and blocking.

C. Additional Project Design Features of the Action Alternative

1. Cultural Resources

If any objects of cultural value (e.g. historic or prehistoric ruins, graves, fossils, or artifacts) are found during the implementation of the proposed action, operations would be suspended until the site has been evaluated to determine the appropriate mitigation action.

2. Noxious Weeds

Manual, mechanical, or chemical treatments would be used to manage invasive plant infestations. Existing infestations of Scotch broom and Himalayan blackberry would be treated prior to thinning operations.

Logging and road construction equipment would be required to be cleaned, with a pressure washer, and free of weed seed prior to entering BLM lands (BLM Manual 9015-Integrated Weed Management).

3. Special Status Plants and Animals

Federally listed (Threatened or Endangered), or proposed, plants and animals and their habitats would be managed to achieve their recovery in compliance with the Endangered Species Act, approved recovery plans, and Bureau Special Status Species policies (1995 ROD/RMP, pg. 41). Bureau Sensitive species and their habitats would be managed so as not to contribute to the need to list, and to recover the species (1995 ROD/RMP, pg. 41).

If during implementation of the proposed action, any Special Status Species are found that were not discovered during pre-disturbance surveys; operations would be suspended as necessary and appropriate protective measures would be implemented before operations would be resumed.

Northern Spotted Owl

Suitable northern spotted owl habitat is present within 65 yards of nine of the thirteen Mud Den units (Appendix F, Figure 5). The proposed project area is located within the Tyee Demography Study Area and stands of suitable habitat within the proposed project area have had annual northern spotted owl surveys since the early 1990s. Based on current protocol survey data, one active northern spotted owl activity center (Camp Creek) is located within 150 yards of two proposed units (Devil's Den units 21A and 21C) but beyond the 65 yard disruption threshold for falling, bucking, and yarding of timber. Therefore, none of the proposed units in Mud Den would require seasonal restrictions until March 1, 2012 unless spotted owls are discovered within 65 yards of proposed units. Since this project is located within the Tyee Demography Study Area, annual surveys are expected to continue as funding allows.

If future surveys locate a spotted owl, operations within applicable disruption threshold distances (e.g. 65 yards for falling, bucking, and yarding of timber and 440 yards for prescribed burning) would be prohibited from March 1st to July 15th, both days inclusive. This restriction could be waived until March 1st of the following year if surveys indicate owls are not nesting or have failed in a nesting attempt.

Marbled Murrelet

To avoid disruption to nesting marbled murrelets, suitable nesting habitat adjacent to proposed units as well as scattered, potential nest trees within the proposed Calahan Mudaxle units were surveyed in 2008-2009. Marbled murrelets were not detected in the Calahan Mudaxle units; therefore, seasonal restrictions or Daily Operating Restrictions would not be required. The survey results are valid until April 1, 2015.

The other proposed Mud Den units (except Mud Slinger Units 29A, 31A, 31C, and 31D) were surveyed in 2009 following the Pacific Seabird Group (PSG) two-year protocol (Mack, et al. 2003). Surveys were not completed for Mud Slinger Units 31C and 31D because there is no suitable nesting habitat adjacent to or within the units. Surveys were not completed for Mud Slinger Units 29A and 31A because of access and time constraint issues.

A second year of surveys is scheduled to be completed in 2010. If surveys detect murrelet occupancy, then harvest activities (e.g. falling, bucking, and yarding of timber) within 100 yards of the occupied site would be seasonally restricted from April 1st through August 5th and would have Daily Operating Restrictions (operations may occur between two hours after sunrise until two hours before sunset) applied from August 6th through September 15th. If the second year of surveys does not detect murrelet occupancy, then seasonal restrictions or Daily Operating Restrictions would not be required. Once completed, the survey results would be valid until April 1, 2016.

The second year of marbled murrelet surveys for Devil's Den Units 21A and 21C would not be completed in 2010 to minimize the disturbance to nesting northern spotted owls. Those portions of proposed units within 100 yards of unsurveyed suitable habitat would have Daily Operating Restrictions from April 1st through August 5th (Appendix F, Figure 6).

Two occupied murrelet sites were discovered within the proposed project area in 2009. The Willow Creek site was located west of Mud Slinger Unit 33A and the Camp Creek site was located west of Devil's Den Unit 21A and east of Devil's Den Unit 21B (Appendix F, Figure 6). Harvest activities (e.g. falling, bucking, and yarding of timber) within 100 yards of the occupied sites would be seasonally restricted from April 1st through August 5th, and Daily Operating Restrictions would be applied from August 6th through September 15th. Under Daily Operating Restrictions, operations may occur between two hours after sunrise until two hours before sunset.

Prescribed burning (i.e. slash piles) within 440 yards of unsurveyed suitable habitat or the occupied murrelet sites would be seasonally restricted from April 1st through August 5th. Seven Mud Den units (Devil's Den units 17A, 21A, 21B, and 21C; and Mud Slinger units 29A, 31A, and 33A) would have seasonal restrictions for prescribed burning (see Appendix F, Figure 6).

Northern Goshawk

A known northern goshawk territory is located in T. 26 S., R 7 W., Section 29, which includes two known nest trees. Following management direction a 30 acre buffer of undisturbed habitat around active and alternate nest sites would be established (1995 ROD/RMP, pg. 49). No harvest would occur within the 30 acre buffer. Management direction to restrict human activity and disturbance within 0.25 miles of active sites between March 1st and August 30th, both days inclusive, or until such time as young have dispersed would also be followed.

Peregrine Falcon

A peregrine falcon nest has been located in T. 26 S., R 7 W., Section 16 (Appendix F, Figure 8), northeast of the Devil's Den timber sale. Devil's Den Units 17A, 21A, 21B, and the north portion of 21C fall within a one mile protection buffer and would be seasonally restricted from February 1st through August 15th, both days inclusive, for harvest activities (e.g. falling, bucking, and yarding of timber) to minimize disturbance to the peregrine falcon (Cade and Enderson, 1996, pg. 68).

4. Petroleum Products or other Hazardous Material

The operator would be required to comply with all applicable State and Federal laws and regulations concerning the storage, use, and disposal of industrial chemicals and other hazardous materials. All equipment intended to be used for in-stream work (e.g. culvert replacement) would be inspected beforehand for leaks. Accidental spills or discovery of the dumping of any hazardous materials would be reported to the Authorized Officer and the procedures outlined in the "*Roseburg District Hazardous Materials (HAZMAT) Emergency Response Contingency Plan*" would be followed.

Hazardous materials (particularly petroleum products) would be stored in appropriate and compliant UL-Listed containers and located so any accidental spill would be fully contained and would not escape to ground surfaces or drain into watercourses. Other hazardous materials, such as corrosives and/or those incompatible with flammable storage shall be kept in appropriate separated containment. All construction materials and waste would be removed from the project area.

D. Sub-Alternative A

Sub-alternative A would be essentially the same as the Proposed Action Alternative with the following exceptions:

- Approximately 23 acres in Devils Den Unit 21C would be yarded by helicopter,
- Mud Slinger Unit 29A (approximately 14 acres) would be yarded by helicopter, and
- Approximately 48 acres in Mud Slinger Unit 33A would be yarded by helicopter.

Helicopter yarding would be accomplished with a ship capable of fully suspending logs above the ground and surrounding treetops. All helicopter landing locations would be approved prior to construction and use. Helicopter use would be seasonally restricted from April 1st thru August 5th and Daily Operating Restrictions would be applied from August 6th thru September 15th within 440 yards (0.25 mile) of unsurveyed suitable marbled murrelet habitat or a known occupied marbled murrelet site, and seasonally restricted from March 1st thru July 15th within 440 yards (0.25 mile) of an active northern spotted owl activity center.

E. Sub-Alternative B

Sub-Alternative B would essentially be the same as the Proposed Action Alternative with the following exceptions:

- Approximately 6,335 feet of the existing, rutted 26-7-29.0 road that is in Calahan Mudaxle and used by off highway vehicles (OHVs) would be used for thinning operations and would therefore be renovated. Following harvest operations, this portion of the 26-7-29.0 road would be decommissioned by:
- Removing the stream crossing (i.e. culvert) on the 26-7-29.0 road and replacing with an armored dip.
    - Water-barring where necessary to improve drainage.
    - Subsoiling/ripping the soil, where feasible, to daylight and improve drainage.
    - Seeding with native grass.
    - Mulching with logging slash.
    - Blocking with a trench barrier at the beginning of the renovated road segment.
- The existing 26-7-32.0 road (approximately 700 feet on BLM administered land) near Mud Slinger Unit 32A currently used by OHVs would be decommissioned by:
    - Installing trench barriers.
    - Water-barring where needed.
    - Mulching with logging slash over the surface.

F. Sub-Alternative C

Sub-Alternative C would be essentially the same as Proposed Action Alternative with the following exceptions:

- Approximately 6,335 feet of the existing, rutted 26-7-29.0 road that is in Calahan Mudaxle and used by OHVs would be used for thinning operations and would therefore be renovated. Following harvest operations, this portion of the 26-7-29.0 road would be decommissioned by:
- Removing the stream crossing (i.e. culvert) on the 26-7-29.0 road and replaced with an armored dip;
    - Re-establishing nine trench barriers. The trench barriers would be improved for safety (e.g. the steepness of the trench barriers would be reduced).
    - Water-barring where necessary to improve drainage.
    - Blocking with a trench barrier at the beginning of the renovated road segment.
- The road would not be mulched with logging slash or other material to allow OHVs to continue using the road.
- The existing 26-7-32.0 road near Mud Slinger Unit 32A would be renovated and used to yard and haul the timber from that unit. Following harvest operations, this road would be decommissioned by:
    - Water-barring where necessary to improve drainage.
    - Blocking with a trench barrier

The road would not be mulched with logging slash or other material to allow OHVs to continue using the road.

G. Resources that Would be Unaffected by Any of the Alternatives

1. Resources Not in Project Area

The following resources or concerns are not present and would not be affected by any of the alternatives: Areas of Critical Environmental Concern (ACECs), Research Natural Areas (RNAs), prime or unique farm lands, floodplains/wetlands, solid or hazardous waste, Wild and Scenic Rivers, and Wilderness.

The Proposed Action Alternative is consistent with Executive Order 12898, which addresses Environmental Justice in minority and low-income populations. The BLM has not identified any potential impacts to low-income or minority populations, either internally or through the public involvement process. No Native American religious concerns were identified by the team or through correspondence with local tribal governments.

There are currently no energy transmission, transport facilities, utility rights-of-way, and/or energy resources with commercial potential in proximity to any of the proposed commercial thinning units.

2. Cultural Resources

Inventories for cultural resources in the proposed Calahan Mudaxle and Devil's Den units were completed. The proposed Mud Slinger units are scheduled to be inventoried in 2010. No cultural resources were discovered in the proposed Calahan Mudaxle and Devil's Den units. If any cultural resources are discovered in the proposed Mud Slinger units they would be excluded from the harvest unit. There would be no effect to any cultural resources since none would be included within the Mud Den units.

3. Visual Resource Management

The Visual Resource Management (VRM) classification for this area is Class IV. The basic elements of form, line, color and texture as required by the 1995 ROD/RMP (pg. 52) would be maintained under the Proposed Action Alternative and Sub-alternatives A, B, and C.

Chapter 3. Affected Environment & Consequences by Resource

This chapter discusses the specific resources potentially affected by the alternatives and the direct, indirect, and cumulative environmental effects of the alternatives over time. Cumulative effects are the impacts of an action when considered with past, present, and reasonably foreseeable future actions (40 CFR 1508.7). This discussion is organized by individual resource, and provides the basis for comparison of the effects between alternatives.

The cumulative effects of the BLM timber management program in western Oregon have been described and analyzed in the 1994 *Final - Roseburg District Proposed Resources Management Plan/Environmental Impact Statement* (1994 PRMP/EIS), incorporated herein by reference.

A. Forest Vegetation

1. Affected Environment

The proposed units are predominantly Douglas-fir forested stands 34-54 years old. Other conifer species in the stands could also include incense-cedar, western hemlock, western red cedar, and grand fir. Hardwoods and ground vegetation are common where there is sufficient light available (e.g. Pacific madrone, golden chinquapin, big leaf maple, red alder, salal, Oregon grape, and sword fern). All of the proposed units were originally harvested between 1956 and 1976. Approximately one-third of the stands had been precommercially thinned and one-sixth of the stands had fertilization treatments.

Current stand exam data was input into the ORGANON growth and yield model version 8.2 (Hann, et al. 2005). ORGANON model output was used to describe current stand conditions and to predict post-treatment conditions after the prescribed management is implemented. Harvest units may contain one or more stands, and may contain a mix of tree species, form, and distribution. The current stand conditions for the Mud Den sales are summarized in Table 4.

Table 4. Current Stand Conditions[1].

Sale Name	Stand Age (years)	Trees Per Acre	Basal Area (sq. ft.)	Quadratic Mean Diameter (inches)	Relative Density Index	Canopy Closure[2] (%)	Crown Ratio (%)
Calahan Mudaxle	50	241	180	11.8	0.59	100	28
Devil's Den	44-52	186-323	180-220	11.1-14.3	0.56-0.73	100	25-51
Mud Slinger	34-54	170-359	150-250	8.6-13.5	0.53-0.83	100	28-46

[1] Data shown are for trees 6 inches DBH and larger.
[2] Canopy Closure is the proportion of the forest floor covered by the vertical projection of tree crowns, which is adjusted for crown overlap in closed canopy stands.

2. No Action Alternative

Current stand relative densities exceed or are near suppression related mortality thresholds. In the absence of treatment, canopies would remain closed and the crowns of individual trees would continue to recede, resulting in increased suppression mortality and decreasing diameter growth as trees compete for water, nutrients, and sunlight.

Suppression mortality would occur primarily in the smaller size classes of trees and would be the main source for snag and coarse woody debris recruitment. The ORGANON model predicts that within 20 years, approximately 43,000 trees would become snags within the proposed units. Within 50 years, approximately 48,700 additional trees are predicted to become snags within the proposed project area. Continued suppression would also lead to a reduction in the hardwood and shrub components, which would further simplify the vegetative composition of the stands.

Live crown ratios of the overstory trees would continue to decrease from current levels as lower limbs are shaded out and die. Closely spaced trees with small crown ratios have reduced photosynthetic capacity, which results in decreased diameter growth and lower resistance to disease and insects. As trees increase in height, with little increase in diameter, they become unstable and more susceptible to wind damage (Oliver and Larson, 1996).

3. Proposed Action Alternative

Thinning would result in increased diameter growth, improved stem and root strength, cessation of crown recession, release of understory vegetation and increased potential for new tree and shrub understory regeneration (Bailey 1996; Bailey and Tappeiner 1998; Bailey, et al. 1998; Oliver and Larson 1996).

Thinning in the GFMA would leave relative stand densities on average from 0.35 to 0.40 while thinning in the C/D, Riparian Reserves, and LSR would result in averaged relative stand densities ranging from 0.21 to 0.29 (Table 5). The higher relative densities proposed would produce higher rates of volume growth while lower relative densities would produce higher rates of diameter growth (Curtis and Marshall, 1986). Reducing the canopy closure would allow sunlight to reach the forest floor to encourage establishment and/or further development of an understory and vertical stratification of canopy layers (Hayes, et al. 1997). The post-thinning stand conditions for the Mud Den sales are summarized in Table 5.

Generally, trees selected for retention would have at least a 30 percent live crown ratio. Trees with at least a 30 percent live crown ratio would be more likely to develop deeper crowns (i.e. increase live crown ratio) and accelerate diameter growth in response to thinning (Daniel, et al. 1979).

The proposed thinning would reduce tree densities, allowing selected trees more room to grow and harvesting the anticipated mortality. In the long-term, the treatment would maintain or increase growth rates of the residual tree species and promote stem quality and tree vigor. This would reduce stand susceptibility to disturbances, such as wildfire, disease, or insect infestation (Fettig, 2006)

Table 5. Post-Treatment Stand Conditions[1]

Sale Name	LUA	Trees Per Acre	Basal Area (sq. ft.)	Quadratic Mean Diameter (inches)	Relative Density Index	Canopy Closure[2] (%)	Crown Ratio (%)
Calahan Mudaxle	C/D, Riparian	86	70	11.8	0.21	46	28
Devil's Den	GFMA	126-179	120	11.1-13.2	0.37-0.4	72-81	25-51
	Riparian, C/D, LSR	71-119	80	11.1-14.3	0.24-0.27	47-71	28-51
Mud Slinger	GFMA	98-190	120	10.8-15	0.35-0.4	72-78	28-46
	Riparian, C/D, LSR	66-200	80	8.6-15	0.24-0.29	51-70	28-46

[1] Data shown are for trees 6 inches DBH and larger.
[2] Canopy Closure is the proportion of the forest floor covered by the vertical projection of tree crowns, which is adjusted for crown overlap in closed canopy stands.

Even though thinning would harvest most of the potential mortality, trees would continue to die from competition and other factors. The ORGANON model predicts that within 20 years, approximately 8,800 trees would become snags within the proposed project area. Within 50 years, approximately 10,800 additional trees are predicted to become snags within the proposed project area. Though fewer snags would develop over time when compared to the No Action Alternative, the snags developed post treatment are expected to be larger with more resiliency and limb structure (Reukema and Smith 1987) than snags that develop under a more competitive stand condition (Nietro, et al. 1985). Additionally, snags would be retained where they are not a safety hazard, and live trees would provide future source material for these structures.

While the proposed thinning would reduce tree densities in individual stands, it would not alter the seral stage of the stands, or the seral stage distribution of BLM-managed lands in the fifth-field watersheds. Approximately 10 acres of regeneration harvest in the Deer Creek-South Umpqua River Watershed and approximately 5 acres of thinning are planned in the Upper Umpqua River Watershed through 2014 in the Swiftwater Resource Area.

4. Sub-Alternatives A, B, and C

Sub-Alternatives A, B, and C would have the same effects to the vegetation in the proposed units as the Proposed Action because helicopter yarding portions of the proposed units and decommissioning roads would not change the proposed thinning prescriptions. Therefore, the post-treatment stand conditions would be the same between the Proposed Action and the sub-alternatives.

B. Wildlife

1. Federally Threatened or Endangered Species

a) Northern Spotted Owl

(1) Affected Environment

Home Range – The home range for northern spotted owls in the Coast Range Province is a 1.5 mile radius circle surrounding an activity center (i.e. nest site) and is used by spotted owls to obtain cover, food, mates, and to care for their young. The home ranges of owl pairs may overlap and the habitat within them is commonly shared between adjacent owl pairs and by other dispersing owls. These areas are important for the survival and productivity of spotted owls because owls are non-migratory birds that remain in their home ranges year-round.

There are eight known spotted owl activity centers, associated with four known spotted owl sites within 1.5 miles of the proposed Mud Den units. The closest spotted owl activity center (Melrose, IDNO 2150A) is currently located approximately 150 yards southeast of Devil's Den Unit 21A (Appendix F, Figure 5). The other seven activity centers are currently located between 320 and 2,460 yards (0.2 to 1.4 miles) away from proposed unit boundaries. The most recently occupied activity center associated with each Master Site is indicated in bold in Table 6.

Core Area – Within the home range, the core area for spotted owls is a 0.5 mile radius circle around the spotted owl activity center used to describe the area most heavily utilized by spotted owls during the nesting season (USDI USFWS, *et al*. 2008). Core areas represent areas defended by territorial spotted owls and generally do not overlap the core areas of other spotted owl pairs. Seven proposed units fall within the core area of five known spotted owl activity centers (Table 7; Appendix F, Figure 5). Each of these core areas has less than 250 acres of suitable nesting, roosting, and foraging habitat.

Nest Patch – The nest patch is defined as a 300 meter radius circle around a known spotted owl activity center (USDI USFWS, *et al*. 2008). The two key elements of spotted owl habitat within a nest patch are: (1) canopy cover of dominant, co-dominant, and intermediate trees (conifers and hardwoods) and (2) the amount of down wood (USDI USFWS, *et al.* 2008; pg. 13). Research has indicated dispersal habitat within 300 meters (a 70 acre patch) of a spotted owl site is important for providing foraging and roosting opportunities, especially if suitable habitat is limited (Meiman, et al. 2003, Glenn, et al. 2004). Within this area, modification of dispersal habitat may affect the reproductive success of nesting spotted owls. Three proposed units would fall within the nest patch of two known spotted owl activity centers (Appendix F, Figure 5).

Known Owl Activity Centers (KOACs) – Known Owl Activity Centers have been designated to minimize impacts and protect nest sites found before 1994

(1995 ROD/RMP; pg. 48). There are two KOACs within the proposed project area. The proposed project would not treat habitat located within either KOAC.

Designated Critical Habitat – Critical Habitat is a specific geographical area designated by the USFWS as containing habitat essential for the conservation of a Threatened or Endangered species. Critical Habitat for the northern spotted owl was re-designated in 2008 (73 FR 47326-47374). The proposed Mud Den units are located outside of the 2008 Critical Habitat for the northern spotted owl. However, the 2008 Critical Habitat rule is currently the subject of legal review. All of the proposed Mud Den units are also outside of designated Critical Habitat for the northern spotted owl under the 1992 Final Rule for Determination of Critical Habitat for the Northern Spotted Owl (57 FR 1796-1838).

Dispersal Habitat – Forest types described as dispersal habitat are essential for dispersal of juvenile and non-territorial (e.g. single birds) northern spotted owls. Dispersal habitat can occur in intervening areas between or within blocks of nesting, roosting, and foraging (NRF) habitat. Dispersal habitat is essential for maintaining stable owl populations to fill territorial vacancies when resident owls die or leave their territories, and for providing adequate gene flow across the range of the species (73 FR 47236 - 47374). Dispersal habitat typically consists of stands with average tree sizes greater than 11 inches DBH and canopy closures greater than 40 percent, which provides protection from avian predators and minimal foraging opportunities (USDI BLM, 2009; pg. 18; Thomas, *et al.* 1990).

(2) *No Action Alternative*

The quality and availability of northern spotted owl habitat would be unaffected under the No Action alternative. The 831 acres of mid-seral stands included in the proposed Mud Den units would continue to function as dispersal habitat, however, stand diversity would decrease over time as hardwoods and shrubs (important components of owl habitat) are lost due to suppression as described in the *Forest Vegetation: No Action Alternative* previously. The development of suitable habitat characteristics, such as larger diameter trees with large crowns, would continue to develop but at a slower rate than with the proposed thinning treatment. Spotted owl activity centers would continue to function at current levels because habitat would not be modified.

(3) *Proposed Action Alternative*

No suitable habitat within the home range, core area, or nest patch of any known spotted owl activity center would be treated under the proposed action. Disturbance or disruption to nesting spotted owls would not occur because no known spotted owl activity centers are located in the proposed units or within 65 yards of the proposed units. In addition, the project design features include seasonal restrictions for harvest activities (e.g. falling, bucking, and yarding of timber) if nesting spotted owls within 65 yards of a proposed unit are discovered in the future.

Home Range –Approximately 831 acres of dispersal-only habitat would be modified by thinning activities within the home ranges of eight known spotted owl activity centers (Table 7).

Core Area – A total of 195 acres of dispersal-only habitat are proposed for commercial thinning within the core areas associated with six known spotted owl activity centers (Table 7). Thinning dispersal habitat within core areas consisting of less than 50 percent (250 acres) nesting, roosting, and foraging (NRF) habitat would likely adversely affect the suitability of the activity center temporarily until the canopy closes (USDI BLM 2009). All eight owl centers in the project area have less than 250 acres of NRF habitat within their core areas (Table 7). Two of the core areas (Camp Creek, IDNO 1917C and Melrose, IDNO 2150O) are associated with activity centers currently occupied by spotted owls.

- Camp Creek (IDNO 1917O, 1917A, and 1917C): The Camp Creek activity centers 1917O and 1917A are located within the same stand, which is currently occupied by barred owls. These activity centers have not been occupied by spotted owls since 2003 and 2004, respectively. Due to the lack of occupancy at these activity centers, direct impacts to spotted owls are not expected. Habitat conditions are expected to improve within the core area as canopy layers develop and canopy cover increases within the treatment area.

  During the 2010 survey season, an active new nest site was located between Devil's Den units 21A and 21C. Approximately 100 acres (20 percent) of the core area would be treated by the proposed action. Because this core area has less than 250 acres of suitable habitat, treatment of dispersal habitat within the core area is expected to cause adverse affects to the spotted owl by temporarily reducing foraging and roosting opportunities for the spotted owl. Foraging and roosting opportunities would improve as canopy layers, vegetative diversity, and canopy cover increases, which are expected to provide better habitat conditions for spotted owls and their prey.

- Melrose (IDNO 2150O and 2150A): The Melrose activity centers 2150O and 2150A are located within the same stand. The original activity center (2150O) was occupied by spotted owls in 2009. Approximately 16 acres (three percent) of this core area would be treated by the proposed action. This core area has less than 250 acres of suitable habitat; thus, treatment of dispersal habitat within this core area is expected to cause adverse affects to the spotted owl by temporarily reducing foraging and roosting opportunities for the spotted owl. However, these opportunities are expected to improve as canopy layers, vegetative diversity, and canopy cover increases.

  There has been no documented nesting activity in the alternate activity center (2150A) since 2001. Though approximately 72 acres (14 percent) of dispersal habitat would be treated within the alternate core area, the lack of occupancy at this alternate activity center means the treatment would not affect use of the alternate core area by spotted

owls. Commercial thinning would improve development of canopy layers and canopy cover within this core area.

***Table 6. Northern Spotted Owl Habitat within Known Home* Ranges.**

Northern Spotted Owl Site (IDNO)[1]		Federal Land (acres)	Habitat on Federal Lands Only (acres)			
			Suitable Habitat		Dispersal-Only Habitat	
			Current Condition	Habitat Modified by Proposed Action	Current Condition	Habitat Modified[2] by Proposed Action
Camp Creek (1917O)	Home Range (4,518 acres)	2,400	567	0	1,310	264
	Core Area (502 acres)	403	173	0	54	22
	Nest Patch (70 acres)	70	50	0	11	0
Camp Creek (1917A)	Home Range (4,518 acres)	2,462	537	0	1,420	236
	Core Area (502 acres)	412	182	0	61	9
	Nest Patch (70 acres)	70	38	0	21	0
Camp Creek (1917B)	Home Range (4,518 acres)	2,566	598	0	1,431	89
	Core Area (502 acres)	436	193	0	94	0
	Nest Patch (70 acres)	70	31	0	16	0
Camp Creek (1917C)	**Home Range (4,518 acres)**	**1,631**	**447**	**0**	**829**	**380**
	Core Area (502 acres)	**450**	**66**	**0**	**152**	**100**
	Nest Patch (70 acres)	**70**	**20**	**0**	**30**	**15**
Camp Rock (4660O)	**Home Range (4,518 acres)**	**2,981**	**843**	**0**	**1,349**	**13**
	Core Area (502 acres)	**340**	**66**	**0**	**179**	**0**
	Nest Patch (70 acres)	**59**	**18**	**0**	**38**	**0**
Melrose (2150O)	**Home Range (4,518 acres)**	**1,521**	**325**	**0**	**1,181**	**457**
	Core Area (502 acres)	**215**	**110**	**0**	**104**	**16**
	Nest Patch (70 acres)	**37**	**36**	**0**	**1**	**0**
Melrose (2150A)	Home Range (4,518 acres)	1,687	345	0	1,328	380
	Core Area (502 acres)	385	126	0	260	72
	Nest Patch (70 acres)	70	36	0	33	0.1

Northern Spotted Owl Site (IDNO)[1]		Federal Land (acres)	Habitat on Federal Lands Only (acres)			
			Suitable Habitat		Dispersal-Only Habitat	
			Current Condition	Habitat Modified by Proposed Action	Current Condition	Habitat Modified[2] by Proposed Action
Mill Trib (2207A)	Home Range (4,518 acres)	1,717	656	0	458	57
	Core Area (502 acres)	408	134	0	114	0
	Nest Patch (70 acres)	70	49	0	4	0

[1]Bold INDO indicates which activity center (based on most recent spotted owl use) within an owl site was used for the habitat analysis.
[2]Under the Proposed Action dispersal-only habitat would have a reduction in quality but would maintain its function.

Table 7. Northern Spotted Owl Habitat within Mud Den Proposed Units.

Sale	Unit	Unit Acres	Unit Acres within…						Unit Total	
			Nest Patch		Core Area		Home Range			
			Suitable Habitat	Dispersal-only Habitat	Suitable Habitat	Dispersal-only Habitat	Suitable Habitat	Dispersal-only Habitat	Suitable Habitat	Dispersal-only Habitat
Calahan Mudaxle	29A	182	0	0.1	0	38	0	182	0	182
	29B	23	0	0	0	19	0	23	0	23
Sub-Total		**205**	**0**	**0.1**	**0**	**57**	**0**	**205**	**0**	**205**
Devils Den	17A	22	0	0	0	22	0	22	0	22
	21A	31	0	14	0	31	0	31	0	31
	21B	18	0	0	0	18	0	18	0	18
	21C	192	0	1	0	51	0	192	0	192
Sub-Total		**263**	**0**	**15**	**0**	**122**	**0**	**263**	**0**	**263**
Mud Slinger	29A	15	0	0	0	15	0	15	0	**15**
	31A	13	0	0	0	1	0	13	0	13
	31B	38	0	0	0	0	0	38	0	38
	31C	8	0	0	0	0	0	8	0	8
	31D	22	0	0	0	0	0	22	0	22
	32A	29	0	0	0	0	0	29	0	29
	33A	238	0	0	0	0	0	138	0	138
Sub-Total		**363**	**0**	**0**	**0**	**16**	**0**	**263**	**0**	**263**
TOTAL		**831**	**0**	**15.1**	**0**	**195**	**0**	**731**	**0**	**731**

Nest Patch – Under the proposed action, approximately 15 acres of dispersal-only habitat would be thinned within the nest patches associated with two known spotted owl activity centers.

- Camp Creek (IDNO 1917C): Approximately 15 acres (21 percent of the nest patch) would be treated by the proposed action. Modification of dispersal habitat within the nest patch would reduce the quantity and quality of thermal and hiding cover, as well as roost tree availability to

an extent that would disrupt the normal use of the nest patch for breeding, feeding and shelter by spotted owls (USDI USFWS, et al. 2008; pg. 14).

- Melrose (IDNO 2150A): Approximately one-tenth of an acre (0.1) (less than one percent of the nest patch) would be treated within this activity center (Tables 6 and 7). There has been no documented nesting activity since 2001. Thus, direct impacts to owls at this activity center are not expected from the proposed action. The thinning would maintain the suitability of the activity center (USDI BLM, 2009) and the condition of the habitat would improve as the stand grows and canopy closes.

Dispersal Habitat – Though the quality of dispersal-only habitat within the proposed units would be temporarily reduced by commercial thinning, the capability of the habitat to function for dispersing spotted owls would be maintained. Vertical and horizontal cover would be reduced within the proposed units through the reduction in canopy cover with varying levels of residual tree density. These stands are expected to continue functioning as dispersal habitat because post-treatment canopy closure would be maintained between 46-81 percent and the quadratic mean diameter would be 8.6-15.0 inches (Table 5). Canopy closure exceeding 40 percent and an average tree diameter exceeding 11 inches are figures widely used as minimum criteria describing functioning dispersal habitat (Thomas, *et al.* 1990). Those stands that currently are below the typical definition for dispersal habitat (i.e. they have a quadratic mean diameter less than 11 inches diameter) would also continue to function as dispersal habitat. Foraging opportunities would improve post-thinning in all treated stands as the canopies develop and crown closure occurs.

The proposed thinning would accelerate the development of some late-successional characteristics used by spotted owls such as large diameter trees, multiple canopy layers, understory development, and hunting perches. Development of late-successional characteristics and suitable habitat from dispersal-only habitat would be expected in approximately 50 years; roughly 100 years sooner than through natural stand development (pers. comm., Craig Kintop, Roseburg District Silviculturist).

Research has shown that spotted owls are likely to increase the size of their home ranges to utilize untreated stands in preference to newly treated stands both during and after harvest. Factors that reduce the quality of habitat within a home range or cause increased movement by owls in order to meet prey requirements may decrease the survival and reproductive fitness of owls at that site (Meiman, *et al.* 2003). Thinning of 831 acres of dispersal habitat in the proposed Mud Den units could temporarily reduce the quality of habitat; however, there are an additional 34,300 acres of dispersal habitat (suitable habitat and dispersal-only habitat) available within a ten mile radius of the proposed project area.

There are also approximately 27,025 acres of Late-Successional Reserves within a ten mile radius of the proposed project area that would, over the long-term, provide both dispersal and suitable habitat for spotted owls. Currently, there are approximately 16,090 acres of suitable habitat and approximately 5,110 acres of dispersal-only habitat in Late-Successional Reserves within a ten mile radius of the proposed project area.

Although the proposed action would temporarily reduce the quality of dispersal habitat within the project area, it would still continue to function for the dispersal of spotted owls. Therefore, the proposed project would not preclude or appreciably reduce spotted owl movement between Critical Habitat Units or within the physiographic province.

(4) *Sub-Alternative A*

Affects would not differ from the proposed action alternative.

(5) *Sub-Alternative B*

Decommissioning 7,035 feet of road would return approximately three acres into forest habitat production. Re-establishment of forbs, shrubs, and seedlings would provide habitat for prey species for the spotted owl. In addition, decommissioning the roads would minimize OHV use in the area, thus reducing noise and visual disturbances to foraging spotted owls.

(6) *Sub-Alternative C*

Decommissioning 7,035 feet of road but not mulching with logging slash or other material would allow OHVs to continue using the road. Continued OHV use would prevent re-establishment of forbs, shrubs, and seedlings, which provide habitat for prey species for the spotted owl. In addition, decommissioning the roads would minimize but not eliminate vehicle use in the area and reduce but not eliminate the noise and visual disturbances to foraging spotted owls.

b) Marbled Murrelet

(1) *Affected Environment*

The proposed Mud Den project is located between 37and 40 miles from the coast within the Marbled Murrelet Inland Management Zone 2 (within 36-50 miles of the coast). Suitable nesting habitat adjacent to proposed units, as well as, potential nest trees within the proposed Calahan Mudaxle units were surveyed in 2008-2009. The other proposed Mud Den units (except Mud Slinger Units 31C and 31D) were surveyed in 2009 following the Pacific Seabird Group (PSG) two-year protocol (Mack, et al. 2003). Surveys were not completed for Mud Slinger Units 31C and 31D because there is no suitable nesting habitat adjacent to or within the units.

During surveys in 2009, two occupied murrelet sites were discovered within the proposed project area. The Willow Creek site was located west of Mud Slinger Unit 33A and the Camp Creek site was located

west of Devil's Den Unit 21A and east of Devil's Den Unit 21B (Appendix F, Figure 6). These stands and contiguous existing and recruitment habitat for marbled murrelets (i.e. stands that are capable of becoming suitable habitat within 25 years) within 0.5 mile radius would be protected and designated as Late-Successional Reserve (1995 ROD/RMP pp. 29 and 48). The Late-Successional Reserve designation for each occupied site has been drafted and proposed, but not finalized to date.

Surveys for potential marbled murrelet nesting trees were completed within all of the Mud Den units following the Residual Habitat Guidelines (USDI USFWS and BLM, 2004). All potential marbled murrelet nest trees and trees adjacent to them, within unit boundaries were marked and tagged for retention. Potential nest trees were located within the proposed boundaries of Calahan Mudaxle Unit 29A, and Mud Slinger units 31A, 32A, and 33A.

Designated Critical Habitat –Critical Habitat for the marbled murrelet was designated in 1996 (61 FR26256-26230). The proposed Mud Den project is not located within designated Critical Habitat for the marbled murrelet.

(2) No Action Alternative

The quality and availability of marbled murrelet habitat would be unaffected under the No Action Alternative. Suitable habitat characteristics would develop more slowly when compared to the proposed action (refer to *Forest Vegetation: No Action Alternative* and *Proposed Action Alternative*, pgs 19-20).

(3) Proposed Action Alternative

Marbled murrelets within the occupied sites would not be disturbed during their nesting season since seasonal restrictions from April 1st through August 5th and Daily Operating Restrictions from August 6th through September 15th (refer to *Additional Project Design Features,* pg. 14) would be applied to harvest operations. Impacts to marbled murrelet habitat would include the modification of approximately 831 acres of mid-seral habitat. Where two years of surveys were completed and no murrelets were detected, micro site conditions around potential nest trees within the unit boundaries and adjacent stands would be modified during thinning. The removal of trees would reduce the cover immediately adjacent to potential nest trees; however, access would be provided to those potential nest trees not accessible during pre-harvest conditions. In addition, reducing tree density adjacent to potential nest trees would reduce competition with surrounding vegetation and in the long term, would create larger trees with larger limbs suitable for nesting marbled murrelets.

There were nine potential nest trees located within the proposed boundaries of Mud Slinger units 31A, 32A, and 33A that would be protected from density management activities under the Residual Habitat Guidelines (USDI USFWS and BLM, 2004). These potential nest trees and trees immediately adjacent to

them (i.e. those trees with interlocking canopies) would be retained to maintain micro-site conditions around the suitable nest trees.

Murrelets were not detected during surveys conducted in 2008 and 2009 within Calahan Mudaxle Unit 29A; therefore the potential nest trees would not require a buffer for treatment. However, these potential nest trees may not be modified or removed during harvest activities. Calahan Mudaxle would not require seasonal or Daily Operating Restrictions.

(4) Sub-Alternative A

Affects would not differ from the proposed action alternative.

(5) Sub-Alternative B

Decommissioning 7,035 feet of road would return approximately three acres into forest habitat production. Edge effects within the stand would decrease as vegetation layers develop on the decommissioned roadbed. Reduction in edge effects would be expected to reduce potential for Corvid species (i.e. ravens and jays) using the stand interior, thus reducing predators to nesting murrelets. In addition, decommissioning the road would minimize or eliminate OHV use in the area, thus reducing noise and visual disturbances to murrelets.

(6) Sub-Alternative C

Decommissioning 7,035 feet of road but not mulching with logging slash or other material would allow OHVs to continue using the road. Continued OHV use would prevent re-establishment of forbs, shrubs, and seedlings. In addition, decommissioning the roads would minimize but not eliminate vehicle use in the area and reduce but not eliminate the noise and visual disturbances to marbled murrelets.

2. Bureau Sensitive Species

Bureau Sensitive species suspected to occur within the project area and that may be affected by the proposed action are discussed briefly in *Appendix A: Bureau Sensitive & Bureau Strategic Species*. Other Bureau Sensitive and Bureau Strategic species suspected to occur on the Roseburg District BLM but not in the project area are also listed in Appendix A.

a) No Action Alternative

Under the No Action Alternative, no suitable habitat or habitat features for BLM Special Status Species would be affected. Species within, or adjacent to the project area, would be expected to persist at their current levels. It is expected that the mid-seral wildlife habitat that is currently present would continue to function in its current capacity. The development of suitable and/or late-successional habitat characteristics such as large trees and a well-developed understory would occur more slowly than compared to the proposed action (refer to *Forest Vegetation*, pgs. 18-20). The assemblage of wildlife species and the wildlife populations currently utilizing the stands in the project area would be expected to continue using those stands.

As the stands mature, structural features (i.e., snow breaks, forked tops, decay) would develop and result in snags, cavities, and a multi-layered canopy. In addition, structural diversity on the forest floor would continue to develop with the growth of the shrub layer and accumulation of down wood. This diversity would benefit many of the Bureau Sensitive and Strategic Species. The effects of the No Action Alternative on individual Bureau Sensitive and Strategic Species are summarized in *Appendix A: Bureau Sensitive & Bureau Strategic Species*.

b) Peregrine Falcon

(1) Affected Environment

A peregrine falcon territory was discovered in May 2010 within 800 yards (0.5 miles) northwest of Devil's Den Unit 21A. The cliff complex is located on private lands. Following management direction, the BLM would comply with disturbance restrictions during the critical breeding period. Falcons will travel several miles from their nesting territory during foraging activities. Thus, falcons would be expected to forage throughout the proposed project area.

(2) Proposed Action Alternative

Treatment by thinning from below the canopy to reduce tree densities is expected to modify habitat for avian species preyed upon by the peregrine falcon. Opening the canopy would create conditions favorable for regeneration of understory vegetation and habitat characteristics that would be expected to increase niches available for avian species. Thus, improving forest habitat conditions would be expected to increase foraging opportunities, by increasing the number and diversity of avian prey species for the peregrine falcon.

(3) Sub-Alternative A

Affects would not differ from the proposed action alternative.

(4) Sub-Alternative B

Decommissioning 7,035 feet of road would return approximately three acres into forest habitat production. Re-establishment of forbs, shrubs, and seedlings would provide additional habitat and micro site conditions for songbirds, increasing diversity of avian prey species for the falcon. In addition, decommissioning the road would minimize or eliminate OHV use in the area, thus reducing noise and visual disturbances to foraging peregrine falcons.

(5) Sub-Alternative C

Decommissioning 7,035 feet of road but not mulching with logging slash or other material would allow OHVs to continue using the road. Continued OHV use would prevent re-establishment of forbs, shrubs, and seedlings, which provide habitat and micro site conditions for songbirds and increase the diversity of avian prey species for the peregrine falcon. In addition, decommissioning the roads would minimize but not eliminate vehicle use in the area and reduce but not eliminate the noise and visual disturbances to foraging peregrine falcons.

3. Northern Goshawk

a) Affected Environment

A northern goshawk nest was discovered in 2007 within the original proposed Calahan Mudaxle boundary. In 2008 an alternate nest tree was located approximately 20 meters north of the 2007 nest tree. Following management direction, a 30 acre buffer of undisturbed habitat around the northern goshawk nest site was established (Appendix F, Figure 7).

The nesting territory would be monitored annually. Northern goshawks typically move, from year to year, among several alternate nests within their territories (Woodbridge and Hargis, 2006). If an active alternate nest tree is not located, then the seasonal restriction would be waived until March 1st of the following year. If an active alternate nest tree is located, seasonal restrictions would apply within 0.25 miles of the nest tree through August 30th.

b) No Action Alternative

The quality and availability of northern goshawk habitat would be unaffected under the No Action Alternative. Suitable habitat characteristics, including large overstory trees, understory vegetation, and canopy gaps, would develop more slowly when compared to the proposed action (see *Forest Vegetation: No Action Alternative* and *Proposed Action Alternative*, pgs. 19-20).

c) Proposed Action Alternative

Mid seral habitat adjacent to the 30 acre buffer would be thinned. Treatment by thinning from below the canopy to reduce tree densities is expected to improve foraging habitat conditions for the northern goshawk. Opening the canopy would create conditions favorable for regeneration of understory vegetation and provide habitat for avian prey species. Open stand conditions would also allow for greater maneuverability by northern goshawks through the thinned stands while in pursuit of prey.

(1) *Sub-Alternative A*

Affects would not differ from the proposed action alternative.

(2) *Sub-Alternative B*

Decommissioning 7,035 feet of road would return approximately three acres into forest habitat production. Re-establishment of forbs, shrubs, and seedlings would provide habitat for prey species (e.g. songbirds) for the northern goshawk. In addition, decommissioning the road would minimize or eliminate OHV use in the area, thus reducing noise and visual disturbances to nesting and foraging northern goshawks.

(3) *Sub-Alternative C*

Decommissioning 7,035 feet of road but not mulching with logging slash or other material would allow OHVs to continue using the road. Decreasing, but not eliminating vehicle use in the area would reduce the noise and visual disturbances to foraging northern goshawks. Continued OHV use would also prevent re-establishment of forbs, shrubs, and seedlings, which provide habitat for prey species (e.g. songbirds) of the northern goshawk. Maintaining the

roads in an open condition would allow for greater maneuverability by northern goshawks through the thinned stands while in pursuit of prey.

C. Fire and Fuels Management

1. Affected Environment

Parts of Mud Slinger (Unit 31B) and Devil's Den (Units 17A, 21A, and 21B) are outside of the Wildland Urban Interface (WUI) boundary as identified in the Roseburg District Fire Management Plan. All of Calahan Mudaxle and the remainder of Mud Den are inside the WUI boundary.

Current fuel conditions in Mud Slinger are best described by photo 2-MC-3 in *Photo Series for Quantifying Natural Forest Residues in Common Vegetation Types of the Pacific Northwest* (Maxwell and Ward, 1980). Based on this photo series, the estimate for downed woody debris in Mud Slinger is 20 tons per acre, although there are some areas that have a lighter fuel load. This area is used recreationally and is not far from homes.

Current fuel conditions for Devil's Den are best described by photo 1-MC-2 (Maxwell and Ward, 1980). Based on this photo series, the estimate for downed woody debris in Devil's Den is 7 tons per acre, although there are some areas of lighter and heavier fuel loads. This area is used recreationally but is not near homes.

Current fuel conditions for Calahan Mudaxle are best described by photo 1-MC-2 and 1-MC-3 (Maxwell and Ward, 1980). Based on these photo series the current estimate of downed woody debris is between 7 and 11 tons per acre. This area is heavily used recreationally but is not near homes.

2. No Action Alternative

Downed fuels would continue to gradually accumulate adding to the existing fuel conditions of 7-20 tons per acre. The risk of wildfire would also gradually increase as fine fuels continue to accumulate.

3. Proposed Action Alternative

After thinning, the down woody debris would increase from 7-20 tons per acre to approximately 15-27 tons per acre as depicted by photos 2-DF-3-PC and 3-DF-3-PC in *Photo Series for Quantifying Forest Residues in the Coastal Douglas-Fir – Hemlock Type* (Maxwell and Ward, 1976). The down woody debris created at landings by the proposed action alternative would be machine piled and burned to reduce concentrated fuel loads. To reduce the likelihood of a roadside ignition, material between three and six inches in diameter within 50 feet of roads would be hand piled and burned in the Calahan Mudaxle units, Devil's Den Unit 21C, and Mud Slinger Units 32A and 33A. The remaining fuels created by the proposed action alternative would be predominately small in size (i.e. less than three inches in diameter) and scattered over the harvest area.

The additional amount of down woody debris would not dramatically increase the fire risk to the area. The primary carrier of fires is the fine fuels that are less than three inches in diameter. These fine fuels generated by timber harvesting would mostly degrade within two years after harvest. Therefore, there would be an increase in fire risk

in the area for approximately two years before these additional fine fuels degrade. However, the homes in the area are not near the harvest units and therefore would not have increased fire risk.

4. Sub-Alternative A

This sub-alternative would not affect the fuels treatment in the area. Helicopter landing piles would be covered and burned similar to landing piles created with other yarding systems.

5. Sub-Alternative B

This sub-alternative would not change the amount of down woody debris. However, mulching the 26-7-29.0 and 26-7-32.0 roads with logging slash or other material to keep OHVs from using these roads would reduce the risk of a roadside ignition from occurring and eliminate the need to hand pile and burn the logging slash along these roads.

6. Sub-Alternative C

This sub-alternative would not change the amount of down woody debris, however, not mulching the 26-7-29.0 and 26-7-32.0 roads with logging slash or other material and allowing OHVs to use these roads would increase the likelihood of a roadside ignition in these areas. To reduce the risk of a roadside ignition occurring, material between three and six inches in diameter within 50 feet of the 26-7-29.0 and 26-7-32.0 roads would be hand piled and burned.

D. Soils

1. Soil Disturbance and Productivity

a) Affected Environment

The terrain varies from near level and gently sloping (0 to 35 percent) to very steep (greater than 70 percent) within the proposed units. The very steep slopes are a moderate component (16 percent) of the proposed sales. The greatest concentration of very steep slopes is in Mud Slinger 33A where ledge rock outcroppings are present.

Approximately 67 percent of the soils in the ground based harvest area have high clay content. The physical and chemical properties of the on-site clay soils mark them as higher risk for compaction using ground based harvesting systems. Under moist soil conditions these soils compact easily and recover very slowly from compaction. Many soil profiles in the proposed units also have very high gravel and cobble content. Very high rock fragment content in the surface soil can lessen the susceptibility to compaction to a moderate degree when the soil moisture level is low. However, once compacted very high rock fragments can prohibit tillage amelioration. With delayed felling of trees until low soil moisture conditions, soil compaction can be avoided.

Ground-based yarding occurred on about 64 percent of the proposed units, primarily on the gentle to moderate slopes, based on 1965 and 1970 aerial photo

interpretation. Substantial soil displacement and compaction resulted. The skid trail density is generally high on gentle slopes. Heavy compaction is still present in some skid trails, decking areas, and landings, even up to 54 years after harvesting occurred. Soil productivity is recovering very slowly where the topsoil had been displaced and the highly compacted subsoil is exposed. Some organic matter incorporation and recovery of soil compaction is occurring on skid trails where native understory vegetation is growing well.

Currently, little in-unit erosion is occurring because vegetation and woody debris dissipate rainfall energy and natural soil structure and porosity outside of roads and old ground-based yarding features (skid trails and log decking areas) allow high water infiltration rates into the soil. However, there are approximately 3.3 miles of trails and natural surfaced roads that have off-highway vehicle traffic and are eroding in these three proposed sales.

b) No Action Alternative

Without timber harvesting or road construction, no additional soil compaction or displacement would occur beyond the current level. Erosion would remain low except for on the 3.3 miles of trails and natural surfaced roads receiving off-highway vehicle traffic. Soils on old skid trails and skid roads compacted by past ground based harvest, especially at depths exceeding six inches, would recover slowly as processes of freezing and thawing, the penetration of plant roots, and burrowing of small animals gradually break up compaction and incorporate organic matter into the soils (Amaranthus, et al. 1996; Powers, et al. 2005). The duff layer and soil organic matter would continue to increase as accumulations of needles, twigs, small branches, and larger woody material decompose, absent a fire of sufficient intensity to consume the material.

c) Proposed Action Alternative

The proposed road construction would create approximately 3.6 acres of new soil disturbance and compaction where soil impacts due to past management are currently light or non-existent (Table 8). Approximately 0.9 acres of new soil disturbance would be subsoiled after use and another 0.4 acres would be fill-slopes associated with road construction. These 1.3 acres of subsoiled roads and fill slopes would allow trees to grow and potentially produce timber in the future. Approximately 2.3 acres would be effectively removed from timber or forest production.

Re-disturbance of existing roads or trails would occur on approximately 4.2 acres, which currently have moderate to heavy residual soil impacts and varying degrees of re-vegetation (Table 8). Of this 1.4 acres would be subsoiled after harvest. The remaining 2.8 acres would be mapped for treatment at a later entry, such as final harvest, if the need is identified.

Compaction is defined, for this analysis, as an increase in soil bulk density of 15 percent or more and an alteration of soil structure that limits tree growth. Restricting ground-based operations to the dry season, as included in the project design (refer to *Timber Yarding: Ground-Based Yarding*, pg. 9), would reduce soil productivity loss.

Up to nine percent of the ground-based harvest area (including skid trails, landings, and log deck ground) would be compacted if tractors or rubber-tired skidders are used. Approximately five percent of the ground-based harvest area would be compacted if harvester-forwarders were used. If a feller-buncher is used on trails spaced 150 feet apart, the total compaction would cover up to approximately 11 percent of the ground-based harvest area.

Table 8. Soil Disturbance from Proposed Road Construction.

Sale	Soil Disturbance (acres)			Subsoiling Amelioration (acres)
	New Disturbance	Re-disturbance of Existing Roads/Trails	Total Soil Disturbance	
Devil's Den	1.4	1.0	2.4	0.7
Mud Slinger	1.6	1.4	3.0	1.6
Calahan Mudaxle	0.6	1.8	2.4	0.0
Total	**3.6**	**4.2**	**7.8**	**2.3**

Cable-yarding corridors would cover about three percent of the cable-yarding area surface (Adams, 2003). Soil disturbance from cable-yarding would vary with topography (e.g. convex vs. concave slope, slope steepness, and the presence or absence of pronounced slope breaks) and by the amount of logs yarded. Compaction would typically be absent or light with little soil displacement in the cable-yarding corridors, partly because intermediate supports would be required where necessary for one-end suspension. Light compaction would be confined to the topsoil and would recover without mitigation. There would be areas with heavier compaction, especially along terrain breaks. Excessive furrowing created by cable yarding would be hand waterbarred and filled with limbs or other organic debris to prevent erosion, sedimentation, and the channeling of water (refer to *Timber Yarding: Cable Yarding*, pg. 8).

Applying the project design features described in Chapter 2 would limit soil erosion to localized areas and any reduction of soil productivity caused by soil erosion would be minor. The effects to soils would be consistent with those identified and considered in the 1994 PRMP/EIS (Chapter 4, pgs. 12-16) due to the project design.

Proposed spurs MS 10, MS 11, MS 12, MS 13, MS 14, MS 15,MS 16, MS 17, DD 2, DD 3, and DD 4 would be subsoiled, mulched or covered with logging slash to discourage use, and waterbarred after thinning operations are completed to help prevent erosion (Tables 3a, 3b, and 3c). Skid and OHV trails not used during the timber harvesting operation would be subsoiled, waterbarred, and covered with slash, where available, if determined to be necessary.

Burning slash in the late-fall to mid-spring (refer to *Fuels Treatment*, pg. 9) would confine burn impacts to the soil underneath the piles and lessen the depth of the impacts (i.e., loss of organic matter, and the change of soil physical properties, ecology and soil nutrients).

d) Sub-Alternative A

Sub-alternative A would use helicopters to yard portions of three units. Soil

displacement and compaction would vary by topography but would be light (generally less than four percent) and confined to the top soil (Megahan, et al. 1995, pg 778). Helicopter landing sites would be within road ways or consist of 150 foot by 200 foot landings constructed along existing roads. These landings would create about 1.4 acres of total soil disturbance. The organic matter and topsoil would be bladed off or displaced to construct the landings, which would reduce long term site productivity.

e) Sub-Alternative B

Sub-alternative B would decommission a section of the 26-7-29.0 road that currently receives concentrated OHV use. The road is compacted and exposed subsoil with no organic matter recruitment because of the amount of traffic using the road. This sub-alternative would also decommission the existing 26-7-32.0 road near Mud Slinger Unit 32A by blocking with a trench barrier, waterbarring where necessary, and adding slash or mulching,. Decommissioning would reduce the amount of erosion and disturbance currently occurring on the road base because it would no longer receive OHV use. If left undisturbed, the decommissioned roads would eventually become vegetated.

f) Sub-Alternative C

Sub-alternative C would renovate and then restore the 26-7-29.0 to its current state with the addition of replacing the stream crossing culvert with an armored dip. The proposed armored dip stream crossing would minimize sedimentation into the intermittent stream. Re-establishing the tank traps and leaving the road surface bare would allow OHV use. Since mulching or slash would not be added to the road surface the potential for erosion would remain, however, waterbars would divert the sediment onto the forest floor.

2. Landslides and Slope Stability

a) Affected Environment

Approximately 322 acres of the proposed units are considered to be fragile due to slope gradient but suitable for forest management with mitigation for surface erosion and shallow-seated landslides (classified as FGR in the Timber Production Capability Classification [TPCC]; Appendix B, Table B-1). No additional tension cracks or fresh scarps (those occurring after tree establishment) were discovered from field investigation, indicating no recent slope movements other than localized soil creep had occurred in the FGR areas.

Three and a half acres in Mud Slinger Unit 33A has the potential for slope failure (the area could be classified as FGR in TPCC). This area is located above a large road cut on the 27-7-4 road. There is a scarp caused by the soil back wasting from the road construction. This area failed numerous times while the 27-7-4 road was being constructed. Due to the potential for slope failure it is recommended that this portion be excluded from the unit.

Interpretation of aerial photographs dating back to 1965 and field investigations identified 58 very small- to medium-sized post-harvest landslides (0.03 to 0.33 acres) within the Mud Den units (including landslides within the stream buffers)

(Appendix B; Table B-2). Most of the landslides likely resulted from previous timber harvest, but 18 were associated with the construction of the 27-7-4 road in Mud Slinger Unit 33A. In addition to the 18 small to medium landslides, three large landslides and two large debris flows resulted from the 27-7-4 road construction.

Devil's Den Unit 21C and Mud Slinger Unit 33A each had a very large debris torrent, which occurred after being clearcut. The very large debris torrent in Devil's Den appears to be in a stable condition. The very large debris torrent in Mud Slinger is located in an area proposed for helicopter yarding. This area contains rock outcroppings and steep inner gorges, which could channel soil and water into streams creating a debris torrent. Three small to medium sized debris torrents were also caused by previous harvest activities throughout the Devil's Den units.

The area proposed for helicopter yarding (under Sub-alternative A) in Mud Slinger Unit 33A contains steep to very steep slopes in inner gorges. There are small waterfalls in the stream channel with no place for the stream to widen out and allow stream velocity to decrease. All of the smaller streams have junction angles less than 70 degrees, which would allow a debris flow starting farther upstream to continue flowing downstream. These factors along with the fact that debris torrents have occurred in this area in the past point to this being a high risk area.

b) No Action Alternative

Landslides on the areas of potentially unstable slopes within the Mud Den units (FGR) would have a low probability of occurring (less than ten percent chance in a given year). If landslides do occur they would likely be less than 0.10 acre in size and few in number. This assessment is based on:

- No in-unit landslides occurring under mid- or late-seral forest conditions were identified by aerial photo interpretation landslide inventory or field observations; (pers. obs.; Barner, 2009).
- No actively failing slopes were discovered in the in-unit FGR areas (pers. obs.; Barner, 2009).
- Approximately 60 percent of historic, post-timber harvest landslides within the project area were 0.03 to 0.10 acres in size (aerial photo landslide inventory; field observations; Barner, 2009; see Table B-2 in Appendix B).
- The Oregon Department of Forestry found that landslide numbers were lowest in mid-and late-seral stands (31 to 100 years old) following the intense 1996 storms (Oregon Department of Forestry Forest Practices Technical Report No. 4, 1999, pg. 64).
- Many of the sites that were most vulnerable to failure probably failed after the units were clear cut in the 1950s and early 1960s and then subjected to an intense rain-on-snow event in 1964 and 1965. This left the FGR slopes in an overall more stable state.

c) Proposed Action Alternative

Where soils are classified as FGR (322 acres; Appendix B, Table B-1), and not in areas recommended to be excluded from the thinning units, the risk of in-unit landslides from occurring would fall between the low risk of the no action and the moderate risk under clearcut conditions (determined from interpretation of 1964,

1965, 1970 and 1978 aerial photos and on-site field investigations). The period of maximum vulnerability would be the ten year period immediately following harvest as root systems and canopies expand. If in-unit landslides do occur during this period of vulnerability, they would likely be few in number and would be less than 0.10 acre in size, for similar reasons as stated previously under the No Action Alternative. The area recommended to be excluded from thinning has a higher risk of landslides.

East of Mud Slinger Unit 33A there are private residences. The area above these residences was evaluated and found to have no debris flow potential (D. Cressy and A. Barner, personal observations).

All new road construction and renovation would be located in stable positions that have: (1) gently sloping benches or ridge top positions and side slopes less than 35 percent and (2) have no apparent signs of potential instability that indicate active slope movement, such as highly curved or pistol-butted conifer boles, tension cracks, scarps, or jack-strawed trees. Based on observations, the proposed road construction and renovation in Mud Den would not create instability (A. Barner, pers. obs.).

Landslide aerial photo inventories within the Swiftwater Resource Area show a declining number of landslides during the past 25 years. The declining number of landslides corresponds with improved management practices. The rate of road-related landslides has declined the most. Fluctuations occur because of variations in weather and levels of management activity. Because of improvements in land management practices, the distribution of landslides in time and space, and their effects, more closely resemble those within relatively unmanaged forests (Skaugset and Reeves, 1998).

d) Sub-Alternative A

Helicopter yarding is associated with a low level of soil disturbance because the logs are lifted off the ground and not yarded along corridors. Low levels of soil disturbance and consistent canopy cover decreases the risk of water channeling into potentially unstable areas. In Mud Slinger Unit 33A, establishing the stream buffer at the slope break and retaining trees in the headwall areas with the potential for debris flow would reduce the risk of slope instability occurring.

e) Sub-Alternative B

Mulching with logging slash or other material would reduce the potential for the 26-7-29.0 and 26-7-32.0 roads to erode and produce sediment that could flow into streams. The removal of stream crossings would eliminate the opportunity for a plugged culvert to wash out the subgrade and cause a debris flow. Constructing waterbars would improve drainage and ripping would ensure proper infiltration on these roads.

f) Sub-Alternative C

The 26-7-29.0 and 26-7-32.0 roads soils would have a greater potential for erosion without mulch. Properly designed waterbars would decrease the potential for sedimentation; however, with OHV use these waterbars may become ineffective over time. Re-establishing the nine trench barriers on the 26-7-29.0 road, after

harvest, would allow OHV use of the road and increase the potential for erosion and sedimentation.

E. Hydrology

1. Water Quality

a) Affected Environment

The Mud Den project area lies within the Camp Creek, Upper Hubbard Creek, and Mill Creek drainages (14 digit Hydrologic Unit Code (HUC)) of the Upper Umpqua River Watershed (10 digit HUC), the Elgarose Creek drainage of the Deer Creek-South Umpqua River Watershed, and the Panther Creek drainage of the South Fork Coos River Watershed. Approximately 63 percent of the project area is within the Upper Umpqua River Watershed and 32 percent is within the Deer Creek-South Umpqua River Watershed.

Approximately 45 acres of Mud Den lie within the South Fork Coos River Watershed. Thinning 45 acres of the 160,000 acre South Fork Coos River Watershed would result in no measurable change to any watershed parameter because less than 0.03 percent of the watershed would be affected. Therefore, hydrologic effects of Mud Den on the South Fork Coos River Watershed will not be analyzed further in this document.

There are approximately 60 first- or second-order headwater streams and two higher order streams (Camp Creek and Hubbard Creek) adjacent to or within the proposed units, totaling 9 miles of stream length. Approximately 20 percent of this stream length is classified as perennial (flows year-round) and 80 percent is classified as intermittent (i.e. stops flowing in the dry season).

Hubbard Creek, which is adjacent to the proposed Calahan Mudaxle units, was previously on the Oregon 303(d) list for excessive summer temperatures and sediment, but has been delisted because there was insufficient data. This stream is included in ODEQ's 2006 Umpqua Basin Total Maximum Daily Load (TMDL) and Water Quality Management Plan (WQMP).

The beneficial uses of water potentially affected within the project area are: resident fish and aquatic life and salmonid spawning and rearing. Beneficial uses of water downstream from the project area include: domestic water supply, fish, recreation, and irrigation. Within one mile downstream of the proposed units there are three surface water rights. One of these surface rights has a point of diversion in a stream located within Mudslinger Unit 33A. Water pipes and storage tanks associated with this diversion are located along the stream course. This stream would receive a "no harvest" buffer of 60 feet. All of the water pipes and structures associated with the water diversion would be located inside the buffer to protect them from harvest activities. The project area lies within the municipal drinking water source area for the community of Elkton, Oregon, however, the water intake is located approximately 50 miles downstream from the proposed thinning units.

The existing roads in the five drainages of the project area total approximately 128 miles. Of these 128 road miles, 33 percent (42 miles) are paved or surfaced with rock and the remaining 67 percent (86 miles) are natural surface. The approximate area in road averages 3.5 percent (ranging from 2.5 to 3.9 percent) for the five drainages that contain the project area.

b) No Action Alternative

There would be no impact to water quality, beneficial uses of water or hydrologic processes under the No Action Alternative. Trees would continue to compete for light, space, and water resulting in overly dense stand conditions and not attain potential growth rates (refer to *Forest Vegetation: No Action Alternative,* pg. 19). Overly dense stands of timber would lead to greater transpiration rates, effectively reducing water availability to the streams themselves. The slower growth rate would result in a smaller size of potential wood for long-term recruitment to streams and slower canopy development to provide shade.

Existing infrastructure (e.g. culverts, ditches, and roads) is subject to ongoing degradation or failure in the event of a storm as these structures age. Most road or culvert failures would result in direct input of sediment to the stream drainage network. The amount of sediment would vary depending on the size of the storm event, the condition and stability of the infrastructure, and the proximity to a stream.

Off-highway vehicle traffic on 3.3 miles of trails and roads has resulted in heavy erosion causing deep ruts and entrenched road surfaces. Drainage from these trails and roads typically finds an outlet at the bottom of slopes and filters out on to the forest floor because the surrounding terrain is generally flat to gently sloping. Evidence of chronic direct sediment delivery from these roads to the stream system has not been observed (Dammann, personal observation, 2010).

Landslides are a natural disturbance mechanism that can provide important ecological functions when they occur at natural rates. As discussed previously (refer to *Soils: Landslides & Slope Stability*, pg. 36-38), landslide rates have been declining over the last 25 years to where they now occur at near natural rates on BLM managed lands.

If a landslide occurs, it would produce a short-term increase in sedimentation until the material is dispersed downstream. Effects of sediment in the stream from small landslides would have a low probability of being detected more than a few hundred feet downstream from the landslide (during normal flow conditions) since small streams have a low capacity for sediment transport due to their small size and low flows.

c) Proposed Action Alternative

Vegetation that provides primary shading for perennial streams would be protected by a 60 foot “no-harvest” buffer and by maintaining a canopy closure of approximately 46 to 81 percent outside of the “no-harvest” buffers (Table 5). Consequently, effective shade for these streams would not be affected by thinning and any measureable increase in water temperature from solar heating during the summer months would be avoided (2008 Final EIS, pgs. 759-760).

Thinning near streams can cause localized soil disturbance and a short term potential for erosion associated with yarding operations. However, "no-harvest" buffers (a minimum of 60 feet on perennial streams and 35 feet on intermittent streams) would be established for all streams adjacent to and within the proposed units and full suspension of timber would be required, where practical, when yarding across streams (refer to *Timber Yarding: Cable Yarding*, pg. 8). These "no-harvest" buffers would prevent disturbance to stream channels and stream banks, as well as, intercept any surface run-off and keep it from reaching the streams.

According to Reid (1981) and Reid and Dunne (1984), forest roads can be a major contributor of fine sediment to streams, through down cutting of ditch lines and erosion of unprotected road surfaces by overland flow. Under the Proposed Action Alternative there would be no new stream crossings, however, the existing 26-7-29.0 road, which would be renovated, does cross an intermittent stream. The proposed addition of rock surfacing and installation of a culvert at the stream crossing would minimize sediment delivery to the stream.

Road construction and renovation would occur during the dry season (refer to *Road Activities*, pgs. 9-13). Timber hauling could occur in both the dry and wet seasons, although during the wet season hauling would be limited to surfaced roads. Hauling and other road related activities during dry season would not deliver road-derived sediment to live stream channels because without precipitation there would be no mechanism for the transport of fine sediment into streams. However, during the first seasonal rains there could be a flush of sediment from the roads near stream crossings. The amount of sediment contributed from these road crossings during the first seasonal rains would be negligible when compared to the amount of sediment from all other intermittent channel beds and stream banks that has accumulated within the stream network during the dry season. Following the first seasonal rains, erosion rates would stabilize and sediment delivery would be indistinguishable from background levels resulting in no measureable change to water quality.

The risk of landslides impacting streams and water quality would be slightly higher than under the No Action Alternative in a given year. If these landslides occur, they would still be occurring at near natural rates and impacts would be similar to the No Action Alternative.

In summary, "no-harvest" stream buffers and the project design features referenced above would prevent changes to the temperature and sediment regimes of the streams and their associated ecosystems. These mitigation measures would also prevent disturbance to stream channels, stream banks and riparian areas. Beneficial uses of water and drinking water sources would not be affected. There would be no cumulative degradation of water quality in the Upper Umpqua River or Deer Creek-South Umpqua River watersheds stemming from the proposed action alternative.

d) Sub-Alternative A

Sub-alternative A would helicopter yard a portion of the Mud Den project area. Helicopter yarding is generally considered to be less impacting in terms of soil

disturbance (Megahan, et al. 1995, pg 778). Less soil disturbance means less potential for erosion and sediment delivery to streams and would not cause greater impacts to water quality than those analyzed under the Proposed Action Alternative.

e) Sub-Alternative B

Sub-alternative B would renovate and then decommission two natural surface roads used by OHV traffic. Renovating and decommissioning these roads would reduce the amount of erosion emanating from these roads because blocking with trench barriers, mulching with logging slash, and installing waterbars would discourage OHV use and provide for better drainage from these roads.

f) Sub-Alternative C

Sub-alternative C would renovate and then decommission two natural surface roads in a way that is compatible with OHV traffic. This would allow continued use of these roads; however, improvements made to the roads would leave these roads more resistant to erosion. The improved drainage would reduce sediment movement by directing it to the forest floor and reduce the potential for concentrated flows to reach streams.

2. Stream Flow

a) Affected Environment

Average annual precipitation in the Mud Den project area ranges from 46 to 64 inches, occurring primarily between October and April. Elevation in all three sale areas is split between a rain dominated hydroregion (i.e. less than 2,000 feet elevation) and a rain-on-snow dominated hydroregion (i.e. more than 2,000 feet elevation) where some snow accumulation is expected to transiently occur throughout the wet season.

Stream flows are dependent upon the capture, storage, and runoff of precipitation. Timber harvest can alter the magnitude and timing of peak flows by changing site-level hydrologic processes. These hydrologic processes include changes in transpiration of forest trees, forest canopy interception of water, snow and snowmelt rates, roads intercepting surface and subsurface flow and changes in soil infiltration rates and soil structure (2008 Final EIS, pg. 352). Based on a compilation of watershed studies in the Northwest, completed in small catchments, a peak flow response is only detected where at least 29 percent of the drainage area is harvested (Grant, *et al.* 2008). There are no peak flow experimental study results in the rain dominated hydroregion showing a peak flow increase where less than 29 percent of a drainage area is harvested (2008 Final EIS, pg. 353).

Research by Poggi, *et al.* (2004) suggests that forest thinning treatments maintains normal patterns of snow accumulation and have little effect on snowmelt rates during rain-on-snow events (2008 Final EIS, pg. 355). Increases in the peak flow of rain-on-snow hydroregions have been found when the roads and other impermeable areas occupy more than 12 percent of a catchment scale watershed (2008 Final EIS, pg. 355). Roads occupy between three and four percent of the respective drainages the project area is in and do not pose a risk to peak flow enhancement.

b) No Action Alternative

Existing roads and landings may modify storm peaks by reducing infiltration, which would allow more rapid surface runoff (Ziemer, 1981, pg. 915). Existing roads may also intercept subsurface flow and surface runoff and channel it more directly into streams (Ziemer, 1981, pg. 915). However, statistically significant increases in peak flows have been shown to occur only when roads occupy at least 12 percent of the watershed (Harr, et al. 1975).

Within the Mud Den project area, roads occupy between three and four percent of each of the five drainages. Therefore, no statistically significant increase in peak flows would be expected to occur due to roads. Also, with no change in the vegetative cover there would be no change in the magnitude or rate of surface water runoff delivery to the stream network.

c) Proposed Action Alternative

Mud Den is a proposed forest thinning treatment. It is presumed that hydrologic impacts, such as peak flow increases, decrease with the intensity of treatment (i.e. regeneration harvest having the greatest impact and thinning treatments having the least impact), although, past experimental studies in the Pacific Northwest did not fully examine the differences (Grant, *et al*. 2008; 2008 Final EIS, pg. 353).

The 2008 Final EIS (pgs.753-759) analyzed the sixth-field subwatersheds that are susceptible to peak flow effects due to regeneration harvests within the rain-on-snow (elevation > 2,000 feet) and rain dominated (elevation < 2,000 feet) areas. The subwatersheds containing the proposed Mud Den project were found to be "not susceptible" to increases in peak flow (2008 Final EIS, pg. 755). In addition, effects to peak flows would not be expected because the streams in the proposed Mud Den project area are high gradient cascade or step-pool stream types, which are most resistant to peak flow effects and channel modification (2008, Final EIS pg. 758).

New road construction (temporary and permanent) in the Mud Den project area would total approximately 3.4 miles (18,070 feet). The new road construction would add approximately 16 acres to the total roaded area, which would temporarily increase the average area in road less than 0.1 percent for the five drainages that comprise the project area. After timber harvest activities are completed, approximately 7,070 feet (1.3 miles) of temporary road construction would be subsoiled. The resulting net gain of approximately 10 acres of roaded area would increase the average area in road less than 0.1 percent. The percent of road surface within the five drainages that comprise the project area would range from three to four percent, which is below the 12 percent threshold where measurable peak flows would be expected (Harr, *et al*. 1975).

In summary, the thinning treatment is not expected to have any effects on stream flow because of the following reasons:

- The project consists entirely of thinning, which has the least hydrologic effect of active forest management and would not pose any risk to peak flow enhancement,

- The stream types encountered within the project area consist entirely of cascade and step-pool streams, which pose little potential to affect peak stream flows,
- The subwatersheds the project area is in are not susceptible to peak flow enhancement, and
- New road construction would not increase the road density or total roaded area within the project area beyond susceptibility thresholds.

d) Sub-Alternative A

Sub-alternative A would helicopter yard a portion of the Mud Den project area. Helicopter yarding is generally considered to be less impacting in terms of soil disturbance (Megahan, et al. 1995, pg 778). Less soil disturbance means less potential for hydrologic impact and would not cause greater impacts to stream flow than those analyzed under the Proposed Action Alternative.

e) Sub-Alternative B

Sub-alternative B would renovate the 26-7-29.0 road and then decommission the 26-7-29.0 and 26-7-32.0 roads used by OHV traffic. Blocking with trench barriers and mulching with logging slash would discourage OHV use of these roads, which would reduce erosion. The renovation would improve these roads from their current rutted condition, which would reduce the collection of concentrated stormflows and potential delivery to streams

f) Sub-Alternative C

Renovating and decommissioning two natural surface roads in a way that is compatible with OHV traffic would improve the conditions and allow continued use of these roads. The improvements made to the roads would leave these roads more resistant to erosion with improved drainage, which would reduce the collection of concentrated stormflows by directing it to the forest floor and reduce the potential for concentrated flows to reach streams.

F. Aquatic Habitat & Fisheries

1. Affected Environment

There are two fish bearing streams within the Mud Den project area (Hubbard Creek and Camp Creek). The project area for the fisheries analysis includes the proposed thinning units and the haul route to the nearest paved road. Devil's Den units 17A and 21A are the only thinning units adjacent to a fish bearing stream (Camp Creek). There are 4.1 miles of haul route within 800 feet of fish bearing streams in the project area. Timber haul on these roads can be either dry-season (summer) or wet-season (winter) haul. Ditch banks along the haul route are well vegetated and there are no direct connections to fish-bearing streams.

ODFW habitat surveys on Hubbard Creek and Camp Creek indicate an average of 175 pieces of large wood per mile of stream habitat in the project area (Oregon Department of Fish and Wildlife 1999). Streams with greater than 70 pieces of large wood per mile are considered in excellent condition. Field observations have also noted an abundance of small wood in Hubbard Creek and Camp Creek (McEnroe, personal observation, 2009).

On February 4, 2008 NOAA Fisheries listed the Oregon coast coho salmon evolutionary significant unit (ESU) as threatened under the Endangered Species Act. This included the designation of critical habitat. Coho salmon are in the project area in Hubbard Creek. Coho are present along the lower 1.5 miles of haul route adjacent to Hubbard Creek. All of the thinning units are at least 1.7 miles upstream from the nearest coho bearing stream.

The Oregon Coast steelhead (*Oncorhynchus mykiss*) is a Bureau Sensitive fish species. Hubbard Creek and Camp Creek both contain Oregon coast steelhead and cutthroat trout (*Oncorhynchus clarki*). Steelhead and cutthroat trout are present along 1.5 miles of the haul route. Unit 17A in the Devils Den sale is the only thinning unit adjacent to a steelhead and cutthroat trout bearing stream (Camp Creek).

2. No Action Alternative

Without a mechanism to affect either water quality (refer to *Water Quality: No Action Alternative*, pg. 40) or stream flow (refer to *Stream Flow: No Action Alternative*, pg. 43) aquatic habitat in fish-bearing streams within and downstream of the project area would remain unaffected under the No Action Alternative. Without a mechanism to affect aquatic habitat, fish species and populations would remain unaffected under the No Action Alternative.

3. Proposed Action Alternative

Key factors defining the quality of aquatic habitat are water temperature, substrate/sediment quality, large wood, pool quality, and habitat access. Measurable increases in water temperature would be avoided by this project (refer to *Water Quality: Proposed Action Alternative*, pgs. 40-41). Substrate and sediment quality is affected by altering the amount or timing of peak flows or from road derived sediment input. No effects to peak flows are expected as a result of this project (refer to *Stream Flow: Proposed Action Alternative*, pg. 43-44). "No-harvest" stream buffers, a large volume of stream wood, and well-vegetated ditch banks would protect aquatic habitat from road sediment within the project area. Well vegetated ditch banks have been shown to decrease the amount of sediment on forested roads from reaching streams (Luce and Black, 1999; Rashin, *et al.* 2006).

The amount of instream large wood (i.e. trees >20 inches in diameter, and 50 feet in length) and pool habitat are highly correlated with the number and size of trees in the riparian area that have the potential to enter the stream by natural processes. By thinning the area near streams, stand diversity and tree diameter growth rates would increase (refer to *Forest Vegetation: Proposed Action Alternative*, pgs. 19-20) to produce larger wood for recruitment into the stream in the future. Thinning outside the "no-harvest" buffer would temporarily decrease the amount of large wood available to fall into the stream. This short-term decrease in large wood availability would not impact fish habitat because streams in the project area already have a large volume of large wood (ODFW 1999).

Small functional wood also has the potential to affect fish habitat. Smaller trees and logs that enter stream channels provide temporary pool habitat and slow-water refugia, although, pools formed by small functional wood generally are not as deep or complex as those formed by large wood. Small wood also does not persist in streams as long as large wood because it deteriorates quickly and is more likely to be flushed from the

system (Naiman, et al. 2002, Keim, et al. 2002). Thinning outside of the "no-harvest" buffers would temporarily decrease the amount of small functional wood available to fall into the stream. This short-term decrease in small functional wood availability would not impact fish habitat because streams in the project area already have a large volume of small functional wood (McEnroe, personal observation 2009).

Habitat access can be affected by road crossings. There are no new road crossings over fish-bearing streams in the project area, so there would be no change in fish habitat access.

Overall, impacts to water temperature, substrate/sediment quality, pool quality, or habitat access within the project area would be non-existent or immeasurable above background levels. Aquatic habitat in Hubbard Creek, Camp Creek, and their tributaries would be unaffected, except for short-term reductions in the amount of large and small functional wood available to the stream. Fish species and populations in Hubbard Creek, Camp Creek, and downstream would be unaffected because of the high amount of wood currently in the streams, "no-harvest" buffers, and Project Design Features to protect water quality. Coho salmon and their critical habitat would be unaffected by this project.

Over the long term, the quality of large wood in the stream channel would increase and would have a positive effect on aquatic habitat quality and fish populations. Wood recruitment modeling has determined that the potential large wood contribution to fish bearing and non-fish-bearing stream channels would increase over time after thinning harvests (2008 Final EIS, pg. 781).

4. Sub-Alternative A

Changes in the yarding method would not change the effects to Aquatic Habitat and Fisheries. The "no-harvest" buffers and water quality Project Design Features would protect stream habitat and fish populations.

5. Sub-Alternative B

Renovating the 26-7-29.0 road and decommissioning the 26-7-29.0 and 26-7-32.0 roads would improve the hydrologic conditions of the roads proposed in this sub-alternative (refer to *Water Quality: Proposed Action Alternative*, pgs. 40-41). The road renovation and decommissioning proposed for this sub-alternative would not affect stream habitat or fish populations because the 26-7-29.0 road is more than 2,900 feet and the 26-7-32.0 road is more than 2,200 feet from Hubbard Creek, which is the nearest fish-bearing stream to both roads.

6. Sub-Alternative C

Renovating and decommissioning the 26-7-29.0 and 26-7-32.0 roads would improve the hydrologic conditions of the roads proposed in this sub-alternative (refer to *Water Quality: Proposed Action Alternative*, pgs. 40-41). The road renovation and decommissioning proposed for this sub-alternative would not affect stream habitat or fish populations because the 26-7-29.0 road is more than 2,900 feet and the 26-7-32.0 road is more than 2,200 feet from Hubbard Creek, which is the nearest fish-bearing stream to both roads.

7. Essential Fish Habitat

Essential fish habitat is designated for fish species of commercial importance by the Magnuson-Stevens Fishery Conservation and Management Act of 1996. Streams and habitat that are currently or were historically accessible to Chinook and coho salmon are considered essential fish habitat. There is a 4.1 mile segment of essential fish habitat within the project area in Hubbard Creek.

Essential Fish Habitat would be unaffected by the Action Alternatives (refer to Aquatic Habitat and Fisheries, pgs. 44-46). Without any mechanisms for adverse effects to essential fish habitat, no mitigation measures are proposed.

8. Aquatic Conservation Strategy

The Swiftwater Field Office assessed the effect of the proposed project on the Aquatic Conservation Strategy (ACS) objectives at both the site and watershed scale (assessment included in Appendix C). The proposed action would meet and not retard or prevent attainment of ACS objectives at the site or watershed scales. Instead, the proposed action would speed attainment of these objectives. Therefore, this action would be consistent with the ACS, and its objectives at the site and watershed scales.

G. Botany

1. Special Status Species

a) Affected Environment

Field surveys for special status botanical species were conducted in the spring and summer of 2009 to comply with Departmental Manual 6840 directives and the Special Status Plant program.

(1) Federally Listed Species

The project is within the known range of Kincaid's Lupine (*Lupinus sulphureus* ssp. *kincaidii*), a Federally Threatened plant. Habitat for Kincaid's Lupine occurs in the project area. The project area is also within the known range of the Federally Endangered popcorn flower (*Plagiobothrys hirtus*); however, habitat for the popcorn flower is not present.

No Federally listed plant species were detected within the project area during surveys (Appendix D, Botany Summary).

(2) Bureau Sensitive & Strategic Species

No Bureau Sensitive or Strategic Species were found in the project area. (Appendix D, Botany Summary).

b) No Action Alternative

Since there were no sites or populations of special status botanical species found during project surveys, there would be no effect to these species under the No Action Alternative.

c) Proposed Action Alternative

Since there were no sites or populations of special status botanical species found during project surveys, there would be no effect to these species under the Proposed Action Alternative.

d) Sub-Alternatives A, B, and C

There are no special status plants in the project area therefore yarding with a helicopter and renovating and decommissioning roads as proposed in sub-alternatives A, B, and C would have not affect special status plants species.

2. Noxious Weeds

a) Affected Environment

The MudDen project has approximately 1.7 acres of noxious weed infestations of Scotch broom (*Cytisus scoparius*) and Himalayan blackberry (*Rubus armeniacus*) collectively (Table 10). These areas were treated from 2007 through 2009 as part of the ongoing Roseburg District Noxious Weed Program. Other species of noxious weeds present in the project area include: Canada thistle (*Cirsium arvense*), and Meadow knapweed (*Centaurea pratensis*). These other species are not likely to establish invasive populations in forested habitats because they are typically out-competed by the forest canopy. Biocontrols, primarily insects that target specific noxious weed species, are present throughout the range of Scotch broom, Canada thistle, and meadow knapweed.

Table 10. Noxious Weed Infestations in Mud Den

Weed Species	Infested Areas by Proposed Sale (acres)			Total (acres)
	Mud Slinger	Calahan Mudaxle	Devil's Den	
Scotch Broom	0.1	0.1	1.0	**1.2**
Himalayan Blackberry	0.1	0.3	0.1	**0.5**
Canada Thistle	0.1	0.1	0.1	**0.3**
Meadow knapweed	0.2	0.1	0.1	**0.4**
Total	**0.5**	**0.6**	**1.3**	**2.4**

b) No Action Alternative

Noxious weeds within the project area would continue to be managed under the Roseburg District's Noxious Weed Program. Weed populations in this area would be monitored and evaluated for treatment at regular intervals (USDI, BLM 1995). Control of weed populations within the project area is planned for treatment in 2011, contingent on funding and workload priorities, by applying approved herbicides and/or manual removal.

Repeated treatments of existing noxious weed populations, limited opportunities (e.g. disturbed soil) for establishment of new infestations, and ongoing competition from native vegetation would reduce the noxious weed numbers in the project area over time.

c) Proposed Action Alternative

Implementing the *Additional Project Design Features* (pg .13) would limit the spread of weed seed by washing logging and construction equipment prior to entry on BLM lands. Similar to what would occur if the No Action Alternative was implemented, noxious weed populations would be monitored, evaluated, and treated under the Roseburg District's Noxious Weed Program.

Soil disturbance associated with thinning (e.g. ground-based yarding, cable-yarding corridors, spur construction, and slash pile burning) would create areas of exposed mineral soil, which would serve as habitat for noxious weeds. New weed infestations on exposed mineral soil would be expected while there are openings in the canopy. The noxious weeds would decrease in abundance as the conifer canopy closes and native understory species eventually overtop and out-compete weeds for sunlight, soil moisture, and soil nutrients. Therefore, new weed infestations that take advantage of the soil exposed from the proposed action alternative would be short-lived due to competition from the residual forest stand coupled with continued monitoring, evaluation, and treatment under the Roseburg District's Noxious Weed Program.

d) Sub-Alternative A

Sub-alternative A would deter the spread of noxious weeds by reducing ground disturbance in the helicopter yarded portion of the proposed units.

e) Sub-Alternative B

Sub-alternative B would deter the spread of noxious weeds by reducing the amount of bare soil exposure by decommissioning the 26-7-29.0 and 26-7-32.0 roads and mulching with logging slash. Preventing the use of these roads by OHVs by mulching with logging slash would also reduce the potential to spread noxious weeds in these areas.

f) Sub-Alternative C

Sub-alternative C would deter the spread of noxious weeds by blocking the 26-7-29.0 and 26-7-32.0 roads with trench barriers and limiting vehicle traffic to OHVs.

H. Recreation

1. Affected Environment

Portions of the proposed Mud Den project area, mainly Calahan Mudaxle, were burned during the Hubbard Creek Fire in the 1950s. Fire lines and roads constructed to contain the fire were not decommissioned afterwards and as a consequence Off-Highway Vehicles (OHVs) have been using these roads and trails in the Mud Den area. New unauthorized trails have been developed by OHV users during the past 55 years.

The Hubbard Creek Area was designated in the 1995 ROD/RMP (p.58) to be managed as an OHV recreation use area under the limited category where 11,681 acres would be managed for motorized use, limited to existing roads and trails. In this area, registered vehicles, such as all terrain vehicles and motorcycles, would be allowed to travel on

BLM maintained (graveled) roads as well as other natural surfaced roads and trails on public lands.

The RMP directs that cooperation and partnerships be sought with adjoining private landowners, state agencies, and organized clubs for program development. In 1994 the Roseburg BLM District met with these groups to propose developing and managing the Hubbard Creek Area as an OHV trail system, utilizing public as well as private lands. The private landowners did not agree with managing their lands for OHV use.

In 1996, the Roseburg BLM District tried to block OHV use of the 26-7-29.0 road by constructing 39 trench barriers (about two to three feet deep encompassing the entire road width). These trench barriers have provided a challenge to OHV users (mainly four wheel drive) and are considered by some users as the best mudding opportunity in the west.

The OHV trails in the Hubbard Creek Area were inventoried in 2003 and 2004. This survey provided information about the condition of the ground, the impacts to the streams, the GPS length of each type of OHV trail, and a baseline photo inventory.

The results of the OHV trail inventory were as follows:

- 11.6 miles of all terrain vehicle trails were identified
- 22 miles of four wheel drive trails were identified
- 9.1 miles of motorcycle trails were identified
- 8 miles of miscellaneous trails were identified
- A total of 50.7 miles of OHV trails were identified in the Hubbard Creek Area.

Much of the inventoried trail system remains the same as it was in 2003; however, approximately seven miles of native surface roads and OHV trails were rocked in 2005 and 2006. When the trench barriers were constructed in 1996, many were created with a vertical drop creating a safety hazard for four wheel drive vehicles that attempt to use the 26-7-29.0 road. Other users have gone around these barriers, creating new unauthorized trails and additional impacts.

In 2006, a local four wheel drive club proposed developing a four wheel drive loop in the Hubbard Creek OHV Area. The four wheel drive loop would have included the 26-7-29.0 road with 39 trench barriers and other roads on BLM Administered and private lands.

To qualify for Oregon State Parks OHV trail development and management funding, the private land owners had to agree to an exclusive easement with the BLM to allow the public to cross the private lands. This easement would provide public access, but allow the private land owners to retain all other ownership rights. The private land owners declined to sign such an agreement. The loop proposal has not been re-visited since that time.

2. No Action Alternative

The roads and OHV trails used for recreation would be unaffected under the No Action Alternative. With this alternative OHV use would continue on existing roads and trails and the safety issues with the trench barriers on the 26-7-29.0 road would remain.

3. Proposed Action Alternative

Under this alternative all of the new temporary roads constructed and approximately 8,135 feet of renovated roads would be decommissioned by placing logging slash on the road, which would eliminate OHV use on these roads. Approximately 26,170 feet of renovated native surface and 54,975 feet of rocked roads would remain open and usable by OHVs. In Devil's Den the construction and decommissioning of Spurs DD6 and DD7 would eliminate approximately 1,100 feet of existing OHV trails. In Calahan Mudaxle the renovated 26-7-29.0 road would be decommissioned and not restored to its current condition consisting of nine trench barriers used by OHVs.

4. Sub-Alternative A

This sub-alternative would have the same effects to recreation as the proposed action alternative because helicopter yarding portions of Mud Den would not change which roads would be decommissioned or remain open.

5. Sub-Alternative B

This sub-alternative would eliminate approximately 9,100 feet of roads and trails currently used by OHVs.

6. Sub-Alternative C

This sub-alternative would have the same effects to recreation as the proposed action alternative except that because decommissioning the 26-7-29.0 and 26-7-32.0 roads would not include subsoiling/ripping and mulching with logging slash approximately 9,100 feet of roads would remain usable by OHVs. In addition re-establishing (with the sides being less steep for safer conditions) the nine trench barriers on the 26-7-29.0 road would retain the current OHV opportunities in the project area.

I. Carbon Storage

Climate change and greenhouse gas emissions have been identified as an emerging resource concern by the Secretary of the Interior (Secretarial Order No. 3226; January 16, 2009), the OR/WA BLM State Director (IM-OR-2010-012; January 13, 2010), and by the general public through comments on previous, recent analyses.

Forster et al. 2007 (pgs. 129-234), incorporated here by reference, reviewed scientific information on greenhouse gas emissions and climate change and concluded that human-caused increases in greenhouse gas emissions are extremely likely to have exerted a substantial warming effect on global climate. Literature, however, has not yet defined any specifics on the nature or magnitude of any cause and effect relationship between greenhouse gases and climate change.

The U.S. Geological Survey, in a May 14, 2008 memorandum (USDI USGS, 2008) to the U.S. Fish and Wildlife Service, summarized the latest science on greenhouse gas emissions and concluded that it is currently beyond the scope of existing science to identify a specific source of greenhouse gas emissions or sequestration and designate it as the cause of specific climate impacts at a specific location. Given this uncertainty, this analysis is focused on calculating greenhouse gas emissions and carbon storage, in the context of carbon release and sequestration.

Forests store carbon through photosynthesis, and release carbon through respiration and decay, affecting atmospheric concentrations of carbon dioxide, and thereby affecting global climate. Forest management can be a source of carbon emissions through deforestation and conversion of lands to non-forest condition, or store carbon through forest growth or afforestation (2008 Final EIS, pg. 220).

Values presented in this analysis, in terms of carbon stored and carbon released, are expressed as tonnes (metric tons). This is the unit of measure that is most commonly used in scientific literature to express carbon storage and release. One tonne of carbon is equivalent to 3.67 tons of carbon dioxide (U.S. EPA, 2005).

The 2008 Final EIS (pgs. 488-490), incorporated by reference, described current information on predicted changes in regional climate. That description concluded the regional climate has become warmer and wetter with reduced snowpack and continued change is likely. The description also concluded that changes in resource impacts as a result of climate change would be highly sensitive to specific changes in the amount and timing of precipitation, but those changes are too uncertain to predict at this time. Because of this uncertainty, it is not possible to predict changes in vegetation types and condition, wildfire frequency and intensity, streamflow, or wildlife habitat in the project area.

Even though a causal link between a specific project, such as Mud Den, and specific climate change effects cannot be made, the amount of carbon released or stored can be estimated for this project. Site specific data from stands exams was input into the ORGANON Growth Model (Hann et al., 2005) and the output from that model was used to calculate the amount of carbon that would be released or sequestered and the resulting net carbon balance that would result under the alternatives. The values presented in this analysis are estimates based on modeled outputs and should be considered approximations.

This analysis was modeled out to 100 years as was done for carbon analysis in the 2008 Final EIS. The net carbon balance for Mud Den was analyzed by calculating: the amount of carbon held in live trees and other components of the forest stands, the amount of carbon held in wood products and logging slash that gradually releases that carbon over time, and the amount of carbon released by the burning of fossil fuels and slash burning by the proposed action alternative. The methodology used in the calculations to estimate the net carbon balance is described in *Appendix E: Carbon Storage Analytical Methodology*.

1. Affected Environment

Current global emissions of carbon dioxide total 6.8 billion tonnes of carbon (based on Denman et al. 2007) and current U.S. emissions of carbon dioxide total 1.7 billion tonnes (based on EPA, 2010; Table 2-3). In 2008, forest management in the United States resulted in the net carbon sequestration of 196 million tonnes of (based on EPA, 2010; Table 2-9), which represents an offset of approximately 11 percent of total U.S. carbon dioxide emissions.

On lands managed by the Salem, Eugene, Roseburg, Coos Bay, and Medford districts of western Oregon and on the Klamath Falls Resource Area of the Lakeview District there are 222 million tonnes of carbon currently stored in live trees (2008 Final EIS, pg. 221). For this same area, the amount of carbon stored in other than live trees (includes shrubs, brush, snags, woody debris, and organic carbon in the soil) is calculated at 195 million tonnes (2008 Final EIS, pg. 222).

Currently, there are 126,070 tonnes of carbon held within the stands that comprise the Mud Den project. This carbon is held in either the pool of "standing, live trees" (67,651 tonnes) or in the pool of "other than live trees" (58,419 tonnes) (refer to *Current Condition* in Tables 11 or 12). The amount of carbon currently held in Mud Den (126,070 tonnes) represents approximately 0.03 percent of the total carbon stored on BLM administered lands in western Oregon (417 million tonnes) as described previously.

In the 2008 Final EIS (pg. 538), the No Action Alternative (Northwest Forest Plan) would result in 596 million tonnes of carbon stored on BLM administered lands in western Oregon in the year 2106. The No Action Alternative described in the 2008 Final EIS (pg. 22) would be continued management under the six District resource management plans that were approved in 1995 and subsequently amended.

2. No Action Alternative

Under the No Action Alternative, the stands in the proposed units would continue to develop and grow as described under *Forest Vegetation* (pg. 19). Carbon would be released through the decay of snags, woody debris, and dead vegetation but it would also be sequestered as living, growing trees and other vegetation pull carbon dioxide from the atmosphere. The proposed units in Mud Den would, on average over 100 years, sequester 2,654 tonnes of carbon per year and the net carbon balance would steadily increase over time. In 100 years, it is estimated, the total amount of carbon stored on-site would more than triple from 126,070 tonnes to 411,829 tonnes (Table 11).

In addition, wood products would not be produced, fossil fuels would not be consumed for the purposes of timber harvest, and there would be no burning of slash since none would be generated under the No Action Alternative. Consequently, there would be no carbon release from these sources or carbon storage in wood products.

Table 11. Carbon Storage in Mud Den Commercial Thinning under the No Action Alternative.

Time Step	Carbon Storage						
	Standing, Live Trees (tonnes)	Other Than Live Trees (tonnes)	Logging Slash (tonnes)	Wood Products (tonnes)	Fossil Fuels (tonnes)	Slash Burning (tonnes)	Net Carbon Balance (tonnes)
Current Condition	67,651	58,419	0	0	0	0	126,070
+10 years	101,475	58,419	0	0	0	0	159,894
+20 years	136,066	58,419	0	0	0	0	194,485
+50 years	230,267	73,294	0	0	0	0	305,562
+100 years	333,050	78,779	0	0	0	0	411,829

Under the No Action Alternative, Mud Den would sequester an average of 2,654 tonnes of carbon annually. Therefore, Mud Den would represent an offset of 0.00004 percent of current global emissions (2,654 tonnes out of 6.8 billion tonnes) and 0.0002 percent of current U.S. emissions (2,654 tonnes out of 1.7 billion tonnes). Mud Den would constitute 0.001 percent of the net sequestration represented by forest management in the United States (2,654 tonnes out of 196 million tonnes). In roughly

100 years (ca. 2106), Mud Den would represent 0.07 percent of the carbon stored on BLM administered lands in western Oregon (411,829 tonnes out of 596 million tonnes).

3. Proposed Action Alternative

Under the proposed action alternative, thinning would be prescribed with an average of 120 square feet of basal area retained in GFMA and an average of 70 to 80 square feet of basal area retained in C/D, Riparian Reserves, and LSR (*Treatment Prescription*, pgs. 6-7). Consequently, carbon would consequently be released from harvest-related sources. Based on ORGANON modeling 15.3 million board feet (15.3 MMBF) would be harvested from Mud Den. Consequently, 37,857 tonnes of carbon would be moved from the standing, live tree pool into:

- *the "logging slash" pool (16,234 tonnes; Table 12),*
- *the "wood products" pool as pulpwood and saw logs (18,417 tonnes; Table 12),*
- *the "slash burning" pool which would release carbon into the atmosphere (316 tonnes; Table 12),*
- *or would be immediately released into the atmosphere following harvest (2,890 tonnes).*

Based on (Smith et al., 2006), 13.5 percent of the gross saw log carbon and 14.8 percent of the gross pulpwood carbon would be immediately released into the atmosphere following harvest (for Mud Den this would be 2,890 tonnes of carbon). In addition, it is estimated that the consumption of 85,032 gallons of fossil fuels would release another 232 tonnes of carbon as a direct consequence of harvest operations (Table 12).

Logging slash that would not be burned and wood products would store less carbon over time as these sources decay and expel carbon into the atmosphere. Logging slash and wood products would decay and expel carbon at rates from Smith et al. (2006) and DOE (2007) as presented in the 2008 Final EIS (Appendix C, Tables C-3 and C-4). Over the course of 100 years following harvest, a total of 17,572 tonnes of carbon would be emitted from logging slash and wood products or an average of 176 tonnes of carbon per year.

While logging slash and wood products are emitting carbon, the standing live trees would simultaneously continue to grow; removing carbon from the atmosphere and sequestering it within additional standing volume on-site. The amount of carbon stored in "other than live trees" would also increase over time (Table 12). The "standing live trees" and "other than live trees" pools in Mud Den combined would, on average, sequester 2,330 tonnes of carbon per year from the atmosphere under the Proposed Action Alternative over the 100 years following harvest. The net carbon balance would nearly triple from 126,070 tonnes currently to 338,577 tonnes in 100 years after harvest (Table 12).

Direct carbon emissions resulting from the proposed action would total 3,438 tonnes of carbon. Therefore, the emissions from the proposed action would constitute 0.00005 percent of current global emissions (3,438 tonnes out of 6.8

billion tonnes) and 0.0002 percent of current U.S. emissions (3,438 tonnes out of 1.7 billion tonnes). The emissions from the proposed action would represent an offset of 0.002 percent of the net sequestration by forest management in the United States (3,438 tonnes out of 196 million tonnes). In roughly 100 years (ca. 2106), Mud Den would represent 0.06 percent of the carbon stored on BLM administered lands in western Oregon (338,577 tonnes out of 596 million tonnes).

Overall, the Proposed Action Alternative would result in the direct release 3,438 tonnes of carbon through the burning of fossil fuels (232 tonnes), slash burning (316 tonnes), and immediate release of carbon at time of harvest (2,890 tonnes). It would take approximately two years for the residual stands (i.e. "standing live trees" and "other than live trees" pools) in Mud Den to recover or sequester carbon (at an average rate of 2,330 tonnes per year) equivalent to that released directly by the proposed action. After two years, Mud Den would begin to have a net increase in carbon sequestration since the average rate at which logging slash and wood products would emit carbon (i.e. 176 tonnes per year) would be less than the average rate at which the residual stands sequester carbon (i.e. 2,330 tonnes per year).

Table 12. Carbon Storage in Mud Den Commercial Thinning under the Proposed Action Alternative.

Time Step	Carbon Storage						
	Standing, Live Trees (tonnes)	Other Than Live Trees (tonnes)	Logging Slash (tonnes)	Wood Products (tonnes)	Fossil Fuels (tonnes)	Slash Burning (tonnes)	Net Carbon Balance (tonnes)
Current Condition	67,651	58,419	0	0	0	0	126,070
Harvest Time (0 years)	30,111	58,419	16,234	18,417	-232	-316	122,633
+10 years	51,038	58,419	13,562	16,893	0	0	139,912
+20 years	73,241	58,419	11,556	16,143	0	0	159,360
+50 years	143,816	73,294	7,147	14,909	0	0	239,166
+100 years	242,719	78,779	3,215	13,864	0	0	338,577

4. Sub-Alternatives A, B, and C

As stated previously under Forest Vegetation (pg. 20), sub-alternatives A, B, and C would have the same effects to the vegetation in the proposed units as the Proposed Action and therefore the post-treatment stand conditions would be the same. Consequently, there would be no difference in the effects to carbon storage between the sub-alternatives and the Proposed Action Alternative due to stand development. Sub-alternatives B and C would have the same effects as described under the Proposed Action Alternative since there are no differences in yarding methods. However, there would be a difference in carbon storage between sub-alternative A and the Proposed Action Alternative due to differences in yarding methods.

The Proposed Action Alternative includes 831 acres of cable and/or ground-based yarding (Table 2, pg. 7) whereas sub-alternative A would replace 85 acres of cable yarding with aerial, helicopter yarding (pg. 15). The effects to carbon storage would essentially be the same as described previously under the Proposed Action Alternative

(Table 12) except for differences in fossil fuel consumption. By yarding 85 acres with a helicopter, an additional 20,706 gallons of fuel would be consumed and 50 more tonnes of carbon would be released by the helicopter (Appendix E, Tables E-5 and E-6).

Chapter 4. Contacts, Consultations, and Preparers

A. Agencies, Organizations, and Persons Consulted

The Agency is required by law to consult with certain federal and state agencies (40 CFR 1502.25).

1. Threatened and Endangered (T&E) Species Section 7 Consultation

The Endangered Species Act of 1973 (ESA) requires consultation to ensure that any action that an Agency authorizes, funds or carries out is not likely to jeopardize the existence of any listed species or destroy or adversely modify critical habitat.

a) U.S. Fish & Wildlife Service

Consultation with the U.S. Fish and Wildlife Service has been completed for the Calahan Mudaxle and Devil's Den timbersales for the northern spotted owl, marbled murrelet, and their respective designated Critical Habitat.

(1) A Letter of Concurrence was received from the U.S. Fish and Wildlife Service (Tails#: 13420-2009-I-0109; pgs. 34-35) dated June 9, 2009, which concurred with the District's conclusion in the Biological Assessment for Commercial Thinning and Programmatic Actions Proposed by the Roseburg District BLM in Fiscal Years 2009 and 2010 (pgs. 71-73) that the commercial thinning activities described for the Calahan Mudaxle timbersale may affect, but is not likely to adversely affect the northern spotted owl, marbled murrelet, or their respective designated Critical Habitat.

(2) A Biological Opinion was received from the USFWS (Roseburg District BLM Fiscal Year 2009-2010 Program of Activities [Tails#: 13420-2009-F-0125]) dated July 31, 2009. The biological opinion stated (pgs. 64-65) that thinning of dispersal habitat as described for the Devil's Den timbersale is likely to adversely affect spotted owls by negatively affecting forage species (e.g. flying squirrels) that the owls may feed upon. However, the USFWS concluded in their biological opinion (pg. 75, Ref. No. 13420-2009-F-0125) that the Roseburg District's program of commercial thinning (which included the Devil's Den project) are not likely to jeopardize the continued existence of the spotted owl because thinning is not likely to completely eliminate mammalian prey species and the network of reserved land use allocations would maintain a sufficient amount of dispersal habitat.

Consultation with the U.S. Fish and Wildlife Service for the Mud Slinger commercial thinning project has not been completed, but is expected to be completed by September 2010. The Project Design Features described in the EA (pgs. 6-15) are consistent with those found in the current 2009-2010 Consultation. Project Design Features developed for this project through the consultation process are not anticipated to change from those in the 2009-2010 Consultation. In addition, the District would adhere to the *Terms and Conditions* stipulated in the consultation package for the Mud Slinger project. When consultation for Mud Slinger has been completed, the results would be disclosed in the decision document.

b) NOAA Fisheries Service

The Swiftwater fisheries staff has determined that any impacts from the proposed action to water temperature, substrate/sediment quality, large wood, pool quality, or habitat access within the project area would be non-existent or immeasurable above background levels (refer to *Aquatic Habitat & Fisheries: Proposed Action Alternative*, pgs. 45-46). Aquatic

habitat in Hubbard Creek, Camp Creek, and their tributaries would be unaffected, except for short-term reductions in the amount of large and small functional wood available to the stream. Due to the high volume of wood already in the stream, "no-harvest" buffers, and lack of harvest units adjacent to fish-bearing streams, fish species and populations in Hubbard Creek, Camp Creek, and downstream would be unaffected. Coho salmon and their critical habitat would be unaffected by this project. Therefore, the proposed project would not have an effect on Oregon Coast coho salmon or its habitat and further consultation with the NOAA Fisheries Service is not required.

2. Cultural Resources Section 106 Compliance

Compliance with Section 106 of the National Historic Preservation Act under the guidance of the 1997 National Programmatic Agreement and the 1998 Oregon Protocol has been documented with Project Tracking Forms for Calahan Mudaxle and Devil's Den. It was determined that there would be no effect to any cultural resources since none would be included within the Calahan Mudaxle and Devil's Den units.

The proposed Mud Slinger units are scheduled to be inventoried in 2010. If any cultural resources are discovered they would be excluded from the harvest unit. There would be no effect to any cultural resources since none would be included within the Mud Slinger units.

B. Public Notification

1. Notification of Landowners

A letter was sent (March 29, 2010) to **adjacent landowners**, **landowners along the proposed haul route**, **registered water-rights users**, and **tribal governments** (Confederated Tribes of Grand Ronde, Confederated Tribes of Siletz, Cow Creek Band of Umpqua Tribe of Indians, and the Komemma Cultural Protection Association).

2. Roseburg District Planning Updates

The **general public** was notified via the *Roseburg District Planning Updates* (i.e. Winter 2008, Spring 2009, Fall 2009, Winter 2009, and Spring 2010), which was published on the Roseburg District BLM Internet website. Electronic notification of the availability of the Roseburg District Planning was sent to approximately 40 addressees. These addressees consist of members of the public that have expressed interest in Roseburg District BLM projects.

3. State, County, and Local Government Agencies

This EA, and its associated documents, would be provided to certain **State, County, and local government** offices including: U.S. Fish & Wildlife Service, NOAA Fisheries Service, Oregon Department of Environmental Quality, and the Oregon Department of Fish and Wildlife. If the decision is made to implement this project, the Decision Document and FONSI would be sent to the aforementioned State, County, and local government offices.

4. Public Comment Period

A 30-day **public comment period** would be established for review of this EA. A Notice of Availability would be published in *The News-Review*. The public comment period would begin with publication of the notice published in *The News-Review* on June 8, 2010 and end close of business July 8, 2010. Comments must be received by close of business July 8, 2010 to be considered for the subsequent decision. If the decision is made to implement this project, a notice will be published in *The News-Review* and notification sent to all parties who request it.

C. List of Preparers

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Layout	Bruce Baumann (Calahan Mudaxle)
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Rights-of-Way	Chuck White
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Soils	Allie Barner
Recreation/Visual Resources	Ron Murphy
Timber Cruising	Doug Snider (Calahan Mudaxle)
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Appendix A. Bureau Sensitive & Bureau Strategic Wildlife Species

Project: Mud Den Density Management
Prepared By: Elizabeth Gayner
Date: January 12, 2010
SSSP List Date: July 26, 2007 (IM-OR-2007-072)

The following tables include those species which are documented or suspected to occur within the Roseburg District BLM. Those Bureau Sensitive or Bureau Strategic species which are suspected or documented to occur within the project area are detailed below.

Bureau Sensitive Species. BLM districts are responsible to assess and review the effects of a proposed action on *Bureau Sensitive* species. To comply with Bureau policy, Districts may use one or more of the following techniques:

a. Evaluation of species-habitat associations and presence of potential habitat.
b. Application of conservation strategies, plans, and other formalized conservation mechanisms.
c. Review of existing survey records, inventories, and spatial data.
d. Utilization of professional research and literature and other technology transfer methods.
e. Use of expertise, both internal and external, that is based on documented, substantiated professional rationale.
f. Complete pre-project survey, monitoring, and inventory for species that are based on technically sound and logistically feasible methods while considering staffing and funding constraints.

When Districts determine that additional conservation measures are necessary, options for conservation include, but are not limited to: modifying a project (e.g. timing, placement, and intensity), using buffers to protect sites, or implementing habitat restoration activities (IM-OR-2003-054).

Strategic Species. If sites are located, collect occurrence data and record in corporate database.

Table A-1. Bureau Sensitive & Strategic Wildlife Species.

Species	General Habitat Requirements	Present in Project Area?	Impacts to Species	
			No Action	Proposed Action
BUREAU SENSITIVE				
American Peregrine Falcon *Falco peregrinus anatum*	Cliffs, rock outcrops; and open habitats for hunting birds. Known site in T26S, R7W, Section 16, northeast of Devil's Den. Additional suitable nesting habitat is present in T26S, R7W, Section 28, east of Calahan Mudaxle ; it is unknown if peregrines are nesting within this cliff complex. There is a known nest site 1.9 miles south of the project area. Peregrine falcons probably forage within the proposed project area.	Documented	No Effects	No effects to nesting habitat. Improve forest habitat conditions for avian species, thus increasing foraging opportunities and prey species diversity.
Bald Eagle *Haleaeetus leucocephalus*	Late successional forests with multi-canopies, generally within two miles of a major water source; 3.8 miles (northeast) to nearest known site.	No Known Nest/ Roost Sites	No Effects	No effects to nesting or foraging habitat
Chace Sideband *Monadenia chaceana*	Rocky, talus habitats in the Klamath Province and southwards.	Out of Range	No Effects	
Columbian White Tailed Deer *Odocoileus virginianus leucurus*	Bottomlands, oak/hardwood forests; cover for fawning.	No Habitat	No Effects	
Crater Lake Tightcoil *Pristiloma arcticum crateris*	Perennially wet areas in late seral forests above 2000ft elevation and east of Interstate-5; seeps, springs, riparian areas.	Out of Range	No Effects	

Species	General Habitat Requirements	Present in Project Area?	Impacts to Species	
			No Action	Proposed Action
Fisher *Martes pennanti*	Natal and foraging habitat consists of structurally complex forests; mature open forests with large live trees, snags, and down wood. Nearest sighting documented 7.6 miles northwest in 2000 (ORNHIC, 2010).	Suspected	No Effect	No effects to suitable natal and foraging habitat.
Foothill Yellow-legged Frog *Rana boylii*	Low gradient streams/ponds; gravel/cobble, bedrock pools.	No Habitat	No Effects	
Fringed Myotis *Myotis thysanodes*	Late-successional forest features (e.g. snags or trees with deeply furrowed bark, loose bark, cavities), caves, mines, bridges, rock crevices.	Suspected	No Effect	Snags retained in Riparian Reserve and LSR; potential loss of roosting snags in GFMA & C/D.
Green Sideband *Monadenia fidelis beryllica*	Coast Range, riparian forests at low elevations; deciduous trees & shrubs in wet, undisturbed forest.	No Habitat	No Effects	
Harlequin Duck *Histrionicus histrionicus*	Mountain Streams in forested areas on west slope of the Cascade Mountains.	Out of Range	No Effects	
Lewis' Woodpecker *Melanerpes lewis*	Open woodland habitat near water; open woodland canopy and large diameter dead/dying trees, snag cavities.	No Habitat	No Effects	
Northwestern Pond Turtle *Clemmys marmorata marmorata*	Ponds, low gradient rivers; upland over-wintering habitat, CWD.	No Habitat	No Effects	
Oregon Shoulderband *Helminthoglypta hertleini*	Talus and rocky substrates, grasslands or other open areas with low-lying vegetation.	Out of Range	No Effects	
Oregon Vesper Sparrow *Pooecetes gramineus affinis*	Open habitats such as grasslands, meadows, farmlands.	No Habitat	No Effects	
Pallid Bat *Antrozous pallidus*	Usually rocky outcroppings near dry open areas; occasionally near evergreen forests; cliffs south of Craven Raven 13D.	Suspected	No Effect	No effect to roosting sites in cliff area
Purple Martin *Progne subis*	Snags cavities in open habitats (e.g. grasslands, brush lands, open woodlands); foraging habitat in units.	Suspected	No Effect	No measurable effect to foraging habitat.
Rotund Lanx *Lanx subrotundata*	Major rivers and large tributaries with cold, well-aerated water and rocky substrate.	Out of Range	No Effects	
Scott's Apatanian Caddisfly *Allomyia scotti*	High-elevation (>4,000ft), cold streams in the mountainous regions of Oregon.	Out of Range	No Effects	
Spotted Tail-dropper *Prophysaon vannattae pardalis*	Mature conifer forests in the Coast Range; associated with significant deciduous tree/shrub component.	Suspected	No Effect	
Townsend's Big-eared Bat *Corynorhinus townsendii*	Late-successional forest features (e.g. snags or trees with deeply furrowed bark, loose bark, cavities), caves, mines, buildings, bridges, tunnels.	Suspected	No Effect	Snags retained in Riparian Reserve and LSR; potential loss of roosting snags in GFMA & C/D.
Western Ridgemussel *Gonidea angulata*	Creeks, rivers, coarse substrates; Umpqua R. and possibly major tributaries.	Out of Range	No Effects	
White-Tailed Kite *Elanus leucurus*	Open grasslands, meadows, emergent wetlands, farmlands, lightly, wooded areas; wooded riparian habitats close to open hunting; tall trees and shrubs.	No Habitat	No Effects	
BUREAU STRATEGIC				
Broadwhorl Tightcoil *Pristiloma johnsoni*	Moist forest sites, typically with deciduous component; Coast/Cascades in WA, Coast Range in OR, as far south as Lane County.	Out of Range	No Effects	

Species	General Habitat Requirements	Present in Project Area?	Impacts to Species	
			No Action	Proposed Action
Klamath Tail-Dropper *Prophysaon sp. nov.*	Moist, open areas along streams or springs in Ponderosa Pine forests; as far North as Crater Lake.	Out of Range	No Effects	
Merlin *Falco columbarius*	Coniferous forests adjacent to open habitats, along forest edges; units within winter range.	Suspected	No Effect	No measurable effect to foraging habitat.
Pristine Springsnail *Pristinicola hemphilli*	Shallow, cold, clear springs/seeps; strongly spring-influenced streams, slow-moderate flow; Umpqua River drainage.	Out of Range	No Effects	
Oregon Giant Earthworm *Driloleirus macelfreshi*	Deep, moist, undisturbed soils of riparian forests.	Out of Range	No Effects	

Appendix B. Soils

Project: Mud Den Commercial Thinning
Prepared By: Allie Barner
Date: April 29, 2010

Table B-1. Timber Production Capability Classification (TPCC).

Unit	FGR[1] (acres)	FPR[2] (acres)	FSR[3] (acres)	FGNW[4] (acres)	FPNW[5] (acres)	Category 1[6] (acres)
Devils Den 17A	9	0	NA	0	0	NA
Devils Den 21A	23	0	NA	0	0	NA
Devils Den 21B	0	0	NA	0	0	NA
Devils Den 21C	108	0	NA	0	0	NA
Devils Den-Total	140	0	NA	0	0	NA
Mud Slinger 29A	6	0	NA	0	0	NA
Mud Slinger 31A	0	0	NA	0	0	NA
Mud Slinger 31B	0	0	NA	0	0	NA
Mud Slinger 31C	0	0	NA	0	0	NA
Mud Slinger 31D	0	0	NA	0	0	NA
Mud Slinger 32A	0	0	NA	0	0	NA
Mud Slinger 33A	146	0	NA	0	0	NA
Mud Slinger-Total	152	0	NA	0	0	NA
Calahan Mudaxle	30	0	NA	0	0	NA
Calahan Mudaxle-Total	30	0	NA	0	0	NA
Mud Den Total	322	0	NA	0	0	**NA**

[1] **FGR** = fragile soils that are subject to unacceptable soil and organic matter losses from surface erosion or mass soil movements as a result of forest management activities, unless mitigating measures are used to protect the soil.
[2] **FPR** = fragile soils that may contain tension cracks and/or sag ponds; because of the slow rate of movement, forest management is feasible.
[3] **FSR** = fragile soils that typically have loamy fine sands and sandy loam textures with high amounts of coarse fragments (i.e. rock); they generally have between one and ½ inch of available water holding capacity in the top 12 inches (i.e. water deficiency).
[4] **FGNW** = fragile soils where unacceptable soil and organic matter losses could occur from surface erosion or mass soil movements as a result of forest management activities; these losses cannot be mitigated even using best management practices.
[5] **FPNW** = fragile soils that have active, deep-seated slump earth flow types of mass movement; because of the rapid rate of movement, forest management is not feasible on these sites.
[6] **Category 1** = soils that are highly sensitive to broadcast burning due to shallow soil depths, have A horizons less than 4 inches in depth, and/or are on slopes over 70 percent.

Table B-2. Mass Wasting & Landslides Inside Units. An analysis of mass wasting events initiating inside the proposed thinning units was done using aerial photo interpretation covering 1960 to 2004 and field reconnaissance. Documented are landslides that occurred after clear-cut harvest.

Sale Name	# Debris Torrents			# Landslides[1]			
	Small (< 0.1 acre)	Medium (0.1-0.5 acre)	Large (>0.5 acre)	Small (< 0.1 acre)	Medium (0.1-0.5 acre)	Large (> 0.5 acre)	All
Devil's Den	2	1	1	28	7	0	39
Mud Slinger	0	0	1	6	12	3	24
Calahan Mudaxle	0	0	0	2	0	0	2
Total	2	1	2	36	19	3	63
Probability of occurrence expected within units:							
No Action Alternative	low	low	low	low	low	low	low
Action Sub-Alternatives	low	low	low	low	low	low	low
Cumulative Effects	Unchanged[2]	Unchanged[2]	Unchanged[2]	Unchanged[2]	Unchanged[2]	Unchanged[2]	Unchanged[2]

[1]Twenty-three of the identified landslides and debris torrents were road related and 40 were harvest related.
[2]Unchanged" indicates that the current conditions and current probabilities of mass wasting or landslide events are expected to be essentially the same at the 6th field watershed scale.

Appendix C. Aquatic Conservation Strategy

Project: Mud Den Commercial Thinning
Prepared By: Dan Dammann and Jeff McEnroe
Date: January 29, 2010

The Aquatic Conservation Strategy (ACS) was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands. The ACS must strive to maintain and restore ecosystem health at watershed and landscape scales to protect habitat for fish and other riparian-dependent species and resources and restore currently degraded habitats. This approach seeks to prevent further degradation and restore habitat over broad landscapes as opposed to individual projects or small watersheds. (Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl, page B-9).

ACS Components:

Riparian Reserves (ACS Component #1)

Riparian Reserves were established. The 1995 ROD/RMP (pg. 24) specifies Riparian Reserve widths equal to the height of two site potential trees on each side of fish-bearing streams and one site-potential tree on each side of perennial or intermittent non-fish bearing streams, wetlands greater than an acre, and constructed ponds and reservoirs. The height of a site-potential tree in the Lower South Umpqua and Upper Umpqua watersheds has been determined to be 180 feet based on average tree heights of the respective watershed. One of the objectives of this project (pg. 3) is to accelerate the development of late seral characteristics in the Riparian Reserves.

Key Watersheds (ACS Component #2)

Key Watersheds were established "as refugia . . . for maintaining and recovering habitat for at-risk stocks of anadromous salmonids and resident fish species [ROD/RMP, pg. 20]." There are no key watersheds within the Deer Creek-South Umpqua River or Upper Umpqua River fifth-field watersheds.

Watershed Analysis (ACS Component #3) and other pertinent information:

In developing the project, the *Lower South Umpqua Watershed Analysis* (USDI, BLM 2000) and *Upper Umpqua Watershed Analysis* (USDI, BLM 2002) prepared by the Roseburg BLM District was used to evaluate existing conditions, establish desired future conditions, and assist in the formulation of appropriate alternatives. Existing watershed conditions are described in the above documents and also in the *Hydrology* and *Aquatic Habitat & Fisheries* sections of this EA (pgs. 39-47). The short and long term effects to aquatic resources are also described in these sections of the EA.

Watershed Restoration (ACS Component #4)

One of the purposes of this project is to accelerate tree growth in Riparian Reserves and the attainment of late seral stand conditions. Therefore, the treatments within the Riparian Reserve are considered to be a watershed restoration project.

Additionally, since 1994, numerous stream enhancement projects have been implemented in the Upper Umpqua River and Deer Creek-South Umpqua River Watershed. This includes placing instream structures (e.g. logs, boulders, root wads, etc.) to improve aquatic habitat on over 10 miles of stream, replacing over 15 culverts identified as barriers to fish passage to open up access to additional habitat, or improving or decommissioning over two miles of road to reduce road sediment impacts to aquatic systems. This work has been collaboration collaborative effort with private timber companies, the Partnership for Umpqua Rivers watershed council, Douglas Soil and Water Conservation District, and Oregon Department of Fish and Wildlife. Future opportunities for restoration are discussed in the respective Watershed Analyses. This work would be implemented as budgets allow.

Range of Natural Variability within the Watersheds:

Based on the dynamic, disturbance-based nature of aquatic systems in the Pacific Northwest, the range of natural variability at the site scale would range from 0-100 percent of potential for any given aquatic habitat parameter over time. Therefore, a more meaningful measure of natural variability is assessed at scales equal to or greater than the fifth-field watershed scale. At this scale, spatial and temporal trends in aquatic habitat condition can be observed and evaluated over larger areas, and important cause/effect relationships can be more accurately determined.

Natural disturbance events to aquatic systems in the Pacific Northwest include wildfires, floods, and landslides. Average fire return intervals at the drainage scale were calculated between 50 and 75 years (prior to the advent of fire suppression). The more destructive stand replacement fires occurred irregularly at intervals up to 350 years (USDI, BLM 2000 & 2002). Most of the Upper Umpqua River and Deer Creek-South Umpqua River Watersheds is dominated by Tyee Formations of sandstones and siltstones, which have a relatively high frequency of debris avalanches on slopes steeper than 65 percent and debris flows on slopes steeper than 35 percent.

Timber harvesting and road construction over the past 50 years have substantially increased the frequency and distribution of landslides above natural levels in the Upper Umpqua River and Deer Creek-South Umpqua River Watersheds. However, there is a downward trend in landslide incidence over the last 50 years that is associated with improved management practices (USDI, BLM 2002). On BLM land, future landslides, mostly during large storm events, are expected to deliver large wood and rock fragments to lower-gradient streams because of BLM Riparian Reserves. These events would more closely resemble landslides within relatively unmanaged forests. These disturbance events are the major natural sources of sediment and wood to a stream system and are very episodic in nature.

Due to the dynamic nature of these disturbance events, stream channel conditions vary based on the time since the last disturbance event. This results in a wide range of aquatic habitat conditions at the site level. Site level habitat conditions can be summarized by using Oregon Department of Fish and Wildlife (ODFW) habitat surveys. Surveys have been conducted throughout the Upper Umpqua River and Deer Creek-South Umpqua River Watersheds mostly in the third through sixth-order streams. Approximately 20 stream reference reaches in the Coast Range of the Umpqua Basin were used to compare against all surveyed streams. These relatively unmanaged reaches represent the variability of conditions within natural stream systems as well as characteristics desirable for a variety of fish species (including salmonid habitat). When compared to these “reference streams”, aquatic habitat survey data from the Upper Umpqua River and Deer Creek-South Umpqua River Watersheds indicates that most of the tributaries are lacking large woody debris. While this condition is considered typical at any given site scale, it is considered atypical for most streams to be devoid of wood at the larger fifth-field scale. Therefore, at this larger scale, aquatic habitat conditions are considered to be outside the range of natural variability.

Because of its dynamic nature, sediment effects to streams can only be described in general terms. It is important to remember that ODFW instream habitat data is a snapshot in time. When compared to reference reaches, sediment conditions in many of the tributaries of the Upper Umpqua River and Deer Creek-South Umpqua River Watersheds appear to be lacking gravel substrate when compared to the reference reaches (Personal Observation, McEnroe).

Stream temperatures vary naturally in these watersheds as a result of variation in geographic location, elevation, climate, precipitation, and distance from the source water (USDI, BLM 2000 & 2002). Stream temperatures also naturally vary as a response to the natural disturbance events mentioned in the previous paragraphs, as well as current practices on private forest, agricultural, and residential properties. Due to the large amount of riparian clearing that has occurred over the last 150 years (converting forest into farmland), coupled with management-induced channel widening, irrigation withdrawals, and loss of gravels, it is likely that stream temperature increases have been greater over larger spatial and temporal scales than observed naturally. One of BLM’s objectives for managing Riparian Reserves is to maintain and enhance shade providing vegetation along streams.

Changes in stream flow can result from consumptive withdrawals and effects of land use activities on storm water runoff, infiltration, storage, and delivery. Commercial and domestic withdrawals are common along the Upper Umpqua River, Deer Creek-South Umpqua River, and their tributaries. There is evidence that previous management has heavily influenced stream channels throughout the Upper Umpqua River and Deer Creek-South Umpqua River Watersheds (USDI, BLM 2002). Over the last 150 years, much of the lower elevation forest land has been

converted to farmland. Many tributaries within the Upper Umpqua River and Deer Creek-South Umpqua River Watersheds have also been cleaned (had large wood removed) or salvage logged. BLM forest management in the watersheds would be designed to reduce or prevent watershed impacts. BLM's objectives for managing Riparian Reserves is to provide for riparian and aquatic conditions that supply stream channels with shade, sediment filtering, leaf litter, large wood, and streambank stability.

Table C-1. Individual Aquatic Conservation Strategy Objective Assessment.

ACS Objective	Site/Project Scale Assessment	Fifth-Field Watershed Scale Assessment
	Scale Description: Units identified in this project are located in four separate seventh-field drainages (detailed below*) distributed throughout the watersheds totaling 21,643 acres in size. The BLM manages 3,907 acres in these drainages (18%). Units proposed for treatment (831 acres) represent 4% of the total drainage area, and 21% of the BLM-managed lands in these drainages.	Scale Description: This project is located in the Upper Umpqua River and Deer Creek-South Umpqua River fifth-field watersheds. These watersheds are 169,470 and 110,419 acres in size respectively. The BLM manages approximately 58,700 acres in the Upper Umpqua River Watershed (35%) and 4,155 acres in the Deer Creek-South Umpqua River Watershed (4%). Units proposed for treatment represent less than 0.1% of the total watershed areas, and less than 2% of the BLM-managed lands in the watersheds. Approximately 45 acres of this project is within the South Fork Coos River watershed (0.03% of the watershed). No measureable changes to any watershed parameter would be detected from this project, so this portion will not be discussed further *(see Hydrology: Affected Environment, pgs. 39-40).*
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.	Trees within the treated riparian stands would attain larger heights and diameters in a shorter amount of time than if left untreated. Design features, such as "no-harvest" buffers established along streams (*Stream Buffers*, pgs. 7-8), would retain shading, and therefore maintain water temperature. "No-harvest" buffers established on perennial streams in or adjacent to proposed units would prevent disturbance to stream channels and stream banks and intercept surface run-off allowing sediment transported by overland flow to be filtered out before reaching active waterways (*Water Quality: Proposed Action Alternative*, pgs. 40-41) and would prevent impacts to aquatic resources. This treatment would speed attainment of this objective.	This treatment would also speed attainment of this objective at the watershed scale.
2. Maintain and restore spatial and temporal connectivity within and between watersheds	Within the drainages, the proposed project would have no influence on aquatic connectivity. Therefore this treatment would maintain the existing connectivity condition at the site scale.	Within the watersheds, the proposed project would have no influence on aquatic connectivity. Therefore this treatment would maintain the existing connectivity condition at the watershed scale.

ACS Objective	Site/Project Scale Assessment	Fifth-Field Watershed Scale Assessment
3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	Treatments would not reduce canopy closure to an extent that could potentially influence in-stream flows. In addition, "no-harvest" buffers established on all streams in or adjacent to proposed units would prevent disturbance to stream channels and stream banks (*Water Quality: Proposed Action Alternative*, pgs. 40-41). Therefore, these treatments would maintain the physical integrity of the aquatic system at the site scale.	This treatment would also maintain the physical integrity of the aquatic system at the watershed scale.
4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Project design features (PDF) would ensure that water quality would not be adversely impacted by the proposed action. PDF's, such as variable width "no-harvest" buffers established along streams, would maintain shade and water temperature (*Water Quality: Proposed Action Alternative*, pgs. 40-41). "No-harvest" buffers established on streams in or adjacent to proposed units would prevent disturbance to stream channels and stream banks and intercept surface run-off allowing sediment transported by overland flow to be filtered out before reaching active waterways (*Water Quality: Proposed Action Alternative*, pgs. 40-41). Therefore, this treatment would maintain the existing water quality at the site scale.	Based on the information discussed at the site scale, this project would also maintain water quality at the watershed scale.
5. Maintain and restore the sediment regime under which aquatic ecosystems evolved.	"No-harvest" buffers established on streams in or adjacent to proposed units would prevent disturbance to stream channels and stream banks and intercept surface run-off allowing sediment transported by overland flow to settle out before reaching active waterways (*Water Quality: Proposed Action Alternative*, pgs. 40-41). Therefore, this project would maintain the existing sediment regime.	This project would maintain the existing sediment regime at the watershed scale as well.
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.	Treatments would not reduce canopy closure to an extent that could potentially influence in-stream flows. The project would involve partial removal of vegetation on areas constituting less than ten percent in the affected drainages. In addition, new road construction would not extend the drainage network or contribute to a potential increase in peak flow because new roads would be located on ridge tops or stable side slopes with adequate cross drain structures.. Therefore, this treatment would maintain stream flows within the range of natural variability at the site.	As discussed at the site scale, thinning would not reduce canopy closure to an extent that could potentially influence in-stream flows. Therefore, at the larger watershed scale, this treatment would also maintain stream flows within the range of natural variability.

ACS Objective	Site/Project Scale Assessment	Fifth-Field Watershed Scale Assessment
7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and woodlands.	As discussed in Objective #6, this project would maintain stream flows within the range of natural variability at the site scale. Therefore, it would also maintain stream interactions with the floodplain and respective water tables at the site scale.	At the watershed scale, this project would also maintain stream interactions with the floodplain and respective water tables within the range of natural variability.
8. Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.	The proposed treatment is designed to return riparian stands to a more natural density and growth trajectory. Therefore, this treatment would serve to restore plant species composition and structural diversity at the site scale.	The proposed treatment is designed to return riparian stands to a more natural density and growth trajectory. Therefore, this treatment would serve to restore plant species composition and structural diversity at the larger watershed scale as well.
9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	As mentioned previously, one of the objectives of this project is to restore riparian stand conditions in the proposed treatment areas. Implementation of riparian restoration projects would help restore adequate habitat to support riparian-dependent species at the site and watershed scales.	As mentioned previously, one of the objectives of this project is to restore riparian stand conditions in the proposed treatment areas. Implementation of riparian restoration projects would help restore adequate habitat to support riparian-dependent species at the site and watershed scales.

*Detailed scale description of the four, seventh-field drainages:

1) The **Camp Creek** drainage is about 1,383 acres in size. The BLM manages approximately 732 acres in this drainage (53%). Units proposed for treatment represent 6% of the total drainage area and 12% of the BLM-managed lands in the drainage.
2) The **Upper Hubbard Creek** drainage is about 5,604 acres in size. The BLM manages approximately 2,544 acres in this drainage (45%). Units proposed for treatment represent 5% of the total drainage area and 12% of the BLM-managed lands in the drainage.
3) The **Mill Creek** drainage is about 8,640 acres in size. The BLM manages approximately 229 acres in this drainage (2%). Units proposed for treatment represent 0.5% of the total drainage area and 38% of the BLM-managed lands in the drainage.
4) The **Elgarose Creek** drainage is about 6,016 acres in size. The BLM manages approximately 402 acres in this drainage (7%). Units proposed for treatment represent 4% of the total drainage area and 66% of the BLM managed lands in the drainage.

Aquatic Conservation Strategy Summary:

Based upon the information presented in Table C-1, the proposed action would meet ACS objectives at the site and watershed scale. In addition, based upon the restorative nature of the action, this project would not retard or prevent attainment of ACS objectives; it would actually speed attainment of these objectives. Therefore, this action is consistent with the ACS and its objectives at both the site and watershed scales.

Appendix D. Botany Summary

Project: MudDen Commercial Thinning
Prepared By: R. S. Wickline
Date: January 8, 2010
SSSP List Date: February 8, 2008 (IM-OR-2008-038)

Those Bureau Sensitive or Bureau Strategic species which are suspected or documented to occur within the Roseburg District BLM area are detailed below.

Bureau Sensitive Species. BLM districts are responsible to assess and review the effects of a proposed action on *Bureau Sensitive* species. To comply with Bureau policy, Districts may use the following techniques:

a. Evaluation of species-habitat associations and presence of potential habitat.
b. Application of conservation strategies, plans, and other formalized conservation mechanisms.
c. Review of existing survey records, inventories, and spatial data.
d. Utilization of professional research and literature and other technology transfer methods.
e. Use of expertise, both internal and external, that is based on documented, substantiated professional rationale.
f. Complete pre-project survey, monitoring, and inventory for species that are based on technically sound and logistically feasible methods while considering staffing and funding constraints.

When Districts determine that additional conservation measures are necessary, options for conservation include, but are not limited to: modifying a project (e.g. timing, placement, and intensity), using buffers to protect sites, or implementing habitat restoration activities (IM-OR-2003-054).

Strategic Species. If sites are located, collect occurrence data and record in the corporate database.

Table D-1. Federally Listed & Bureau Sensitive Botanical Species.

Species	Within species range?	Habitat Present?	Species Present?	Reason for concern or no concern	Surveys Completed	Mitigation Measures
Threatened & Endangered Species						
Lupinus sulphureus ssp. *kincaidii* Kincaid's lupine (T)	**Yes**	**Yes**	No	Surveys performed, not detected.	May/June 2009	N/A
Plagiobothrys hirtus Rough popcorn flower (E)	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Sensitive Species						
Chiloscyphus gemmiparus Liverwort	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Diplophyllum plicatum Liverwort	**Yes**	No	No	No habitat present	May/June 2009	N/A
Entosthodon fascicularis Moss	**Yes**	No	No	No habitat present	May/June 2009	N/A
Gymnomitrion concinnatum Liverwort	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Helodium blandowii Moss	**Yes**	No	No	No habitat present	May/June 2009	N/A
Meesia uliginosa Moss	**Yes**	No	No	No habitat present	May/June 2009	N/A
Schistostega pennata Moss	**Yes**	No	No	No habitat present	May/June 2009	N/A
Tayloria serrata Moss	**Yes**	**Yes**	No	Surveys performed, not detected.	May/June 2009	N/A

Species	Within species range?	Habitat Present?	Species Present?	Reason for concern or no concern	Surveys Completed	Mitigation Measures
Tetraphis geniculata Moss	**Yes**	No	No	No habitat present	May/June 2009	N/A
Tetraplodon mnioides Moss	**Yes**	**No**	No	No habitat present	N/A	N/A
Tomentypnum nitens Moss	**Yes**	No	No	No habitat present	N/A	N/A
Tortula mucronifolia Moss	**Yes**	**No**	No	No habitat present	N/A	N/A
Trematodon boasii Moss	**Yes**	No	No	No habitat present.	N/A	N/A
Bridgeoporus nobilissimus Giant polypore fungus	**Yes**	No	No	No habitat present.	N/A	N/A
Cudonia monticola *Fungi*	**Yes**	No	N/A	Surveys Not Practical. [1]	N/A	N/A
Dermocybe humboldtensis Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Gomphus kauffmanii Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Helvella crassitunicata Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Leucogaster citrinus Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Otidea smithii Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Phaeocollybia californica Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Phaeocollybia dissiliens Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Phaeocollybia gregaria Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Phaeocollybia olivacea Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Phaeocollybia oregonensis Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Phaeocollybia pseudofestiva Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Phaeocollybia scatesiae Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Phaeocollybia sipei Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Phaeocollybia spacidea Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Pseudorhizina californica Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Ramaria amyloidea Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Ramaria gelatiniaurantia Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Ramaria largentii Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Ramaria rubella var. blanda Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A

Species	Within species range?	Habitat Present?	Species Present?	Reason for concern or no concern	Surveys Completed	Mitigation Measures
Ramaria spinulosa var. *diminutiva* Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Rhizopogon chamalelotinus Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Rhizopogon exiguus Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Sowerbyella rhenana Fungus	**Yes**	**No**	N/A	Surveys Not Practical. [1]	N/A	N/A
Bryoria subcana Lichen	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Calicium adspersum Lichen	**Yes**	No	No	No habitat present	May/June 2009	N/A
Chaenotheca subroscida Lichen	**Yes**	**No**	No	No habitat present.	May/June 2009	N/A
Dermatocarpon meiophyllizum Lichen	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Hypogymnia duplicata Lichen	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Lobaria linita Lichen	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Pannaria rubiginosa Lichen	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Pilophorus nigricaulis Lichen	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Stereocaulon spathuliferum Lichen	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Adiantum jordanii California maiden-hair	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Arabis koehleri var. *koehleri* Koehler's rockcress	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Arctostaphylos hispidula Hairy manzanita	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Asplenium septentrionale Grass-fern	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Bensoniella oregana Bensonia	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Botrychium minganense Gray moonwort	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Calochortus coxii Crinite mariposa-lily	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Calochortus umpquaensis Umpqua mariposa-lily	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Camassia howellii Howell’s camas	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Carex comosa Bristly sedge	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Carex gynodynama Hairy sedge	**Yes**	**No**	No	No habitat present	May/June 2009	N/A
Carex serratodens Saw-tooth sedge	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Cicendia quadrangularis Timwort	**Yes**	No	No	No habitat present	May/June 2009	N/A

Species	Within species range?	Habitat Present?	Species Present?	Reason for concern or no concern	Surveys Completed	Mitigation Measures
Cimicifuga elata var. elata Tall bugbane1	**Yes**	**Yes**	No	Surveys performed, not detected.	May/June 2009	N/A
Cypripedium fasciculatum Clustered lady slipper	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Delphinium nudicaule Red larkspur	**Yes**	No	No	No habitat present.	May/June 2009	**N/A**
Epilobium oreganum Oregon willow-herb	**Yes**	No	No	No habitat present	May/June 2009	**N/A**
Eschscholzia caespitosa Gold poppy	**Yes**	No	No	No habitat present.	May/June 2009	**N/A**
Eucephalus vialis Wayside aster	**Yes**	No	No	No habitat present	May/June 2009	**N/A**
Horkelia congesta ssp. *congesta* Shaggy horkelia	**Yes**	No	No	No habitat present	May/June 2009	**N/A**
Horkelia tridentata ssp. *tridentate* Three-toothed horkelia	**Yes**	No	No	No habitat present	May/June 2009	N/A
Iliamna latibracteata California globe-mallow	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Kalmiopsis fragrans Fragrant kalmiopsis	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Lathyrus holochlorus Thin-leaved peavine	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Lewisia leana Lee's lewisia	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Limnanthes gracilis var. *gracilis* Slender meadow-foam	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Lotus stipularis *Stipuled trefoil*	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Meconella oregana *White fairypoppy*	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Pellaea andromedifolia Coffee fern	**Yes**	**No**	No	No habitat present	May/June 2009	N/A
Perideridia erythrorhiza Red-rooted yampah	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Polystichum californicum California sword-fern	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Romanzoffia thompsonii Thompson's mistmaiden	**Yes**	**No**	**No**	No habitat present	May/June 2009	N/A
Schoenoplectus subterminalis Water clubrush	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Scirpus pendulus *Drooping rush*	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Sisyrinchium hitchcockii Hitchcock's blue-eyed grass	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Utricularia gibba Humped bladderwort	**Yes**	No	No	No habitat present	May/June 2009	N/A
Utricularia minor Lesser bladderwort	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Wolffia borealis Dotted water-meal	**Yes**	No	No	No habitat present.	May/June 2009	N/A
Wolffia columbiana Columbia water-meal	**Yes**	No	No	No habitat present.	May/June 2009	N/A

[1] Surveys are considered not practical for these species based on the 2001 Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guideline (Standards and Guidelines, pg. 9)..

Table D-2. Bureau Strategic Botanical Species.

Scientific Name	Roseburg Occurrence	Occurrence in the Project Area
Bryophytes		
Cephaloziella spinigera	Suspected	None Observed
Grimmia anomala	Suspected	None Observed
Scouleria marginata	Suspected	None Observed
Fungi		
Cazia flexiascus	Suspected	Surveys Not Practical. [1]
Choiromyces alveolatus	Suspected	Surveys Not Practical. [1]
Clavariadelphus subfastigiatus	Documented	Surveys Not Practical. [1]
Endogone oregonensis	Documented	Surveys Not Practical. [1]
Glomus pubescens	Suspected	Surveys Not Practical. [1]
Gymnomyces monosporus	Documented	Surveys Not Practical. [1]
Helvella elastica	Documented	Surveys Not Practical. [1]
Hygrophorus albicarneus	Suspected	Surveys Not Practical. [1]
Mycena quinaultensis	Suspected	Surveys Not Practical. [1]
Nolanea verna var. *isodiametrica*	Suspected	Surveys Not Practical. [1]
Plectania milleri	Suspected	Surveys Not Practical. [1]
Psathyrella quercicola	Suspected	Surveys Not Practical. [1]
Ramaria abietina	Documented	Surveys Not Practical. [1]
Ramaria bothryis var. aurantiiramosa	Suspected	Surveys Not Practical. [1]
Ramaria concolor f. tsugina	Suspected	Surveys Not Practical. [1]
Ramaria conjunctipes var. sparsiramosa	Suspected	Surveys Not Practical. [1]
Ramaria coulterae	Suspected	Surveys Not Practical. [1]
Ramaria rubribrunnescens	Suspected	Surveys Not Practical. [1]
Ramaria suecica	Documented	Surveys Not Practical. [1]
Ramaria thiersii	Suspected	Surveys Not Practical. [1]
Rhizopogon brunneiniger	Suspected	Surveys Not Practical. [1]
Rhizopogon clavitisporus	Suspected	Surveys Not Practical. [1]
Rhizopogon flavofibrillosus	Documented	Surveys Not Practical. [1]
Rhizopogon variabilisporus	Suspected	Surveys Not Practical. [1]
Sarcodon fuscoindicus	Documented	Surveys Not Practical. [1]
Lichens		
Buellia oidalea	Suspected	None Observed
Lecanora pringlei	Suspected	None Observed
Lecidea dolodes	Suspected	None Observed
Leptogium rivale	Documented	None Observed
Leptogium teretiusculum	Documented	None Observed
Peltula euploca	Suspected	None Observed
Vezdaea stipitata	Documented	None Observed
Vascular Plants		
Camissonia ovata	Suspected	None Observed
Frasera umpquaensis	Suspected	None Observed

[1] Surveys are considered not practical for these species based on the 2001 Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guideline (Standards and Guidelines, pg. 9).

Appendix E. Carbon Storage/Release Analytical Methodology

Project: Mud Den Commercial Thinning
Prepared By: Rex McGraw, Ryan Johnson, Abe Wheeler
Date: May 19, 2010

Analysis of Carbon Storage

It is recognized that there is considerable variety available in the scientific literature regarding the quantitative measures and additional factors that may be used in calculating carbon storage that can influence the outcome of this analysis. However, the methodology described here provides a consistent means to compare the relative effects of the alternatives considered in Mud Den Commercial Thinning and not necessarily the absolute amount of carbon that would be stored or released under the alternatives.

The analysis of carbon storage modeled the amount of carbon stored in the forest and harvested wood products, and the amount of carbon released into the atmosphere to harvest those wood products. The analysis divided carbon storage/release into six pools:

- Standing, Live Trees
- Other Than Live Trees
- Wood Products
- Slash Burning
- Logging Slash
- Fossil Fuels

The carbon in these six pools was summed at each time step to calculate the Net Carbon Balance by alternative.

Carbon Storage in Standing, Live Trees

The carbon pool of "Standing, Live Trees" represents the live trees that are developing currently and would develop in the future within the proposed units.

1. Standing, live tree carbon was derived in this analysis using the outputs from the ORGANON model (Hann et al., 2005) for standing tree volume in the proposed units over time for each alternative.

2. Standing tree volumes measured in board feet per acre were converted to cubic feet using a conversion factor of 6.00 board feet/cubic foot (2008 Final EIS, Appendices-28).

3. The cubic foot tree volumes per acre were converted to pounds of biomass using a conversion factor of 35 pounds of biomass/cubic foot (2008 Final EIS, Appendices-28, Table C-1). Biomass was assumed to be Douglas-fir in this analysis.

4. The pounds of biomass per acre derived from tree volumes were expanded to a total biomass for entire trees (including branches, bark, roots, etc…) per acre by multiplying by 1.85 (2008 Final EIS, Appendices-28).

5. The expanded biomass for entire trees per acre was converted to pounds of carbon per acre by multiplying by 0.50 (2008 Final EIS, Appendices-28).

6. Pounds of carbon in whole trees per acre were converted to tonnes of carbon in whole trees per acre by dividing by 2200 (2008 Final EIS, Appendices-28).

7. The tonnes of carbon in whole trees per acre were converted to tonnes of carbon in whole trees within each proposed unit by multiplying by the size of the unit in acres.

8. The tonnes of carbon in whole trees within the project were derived by summing the tonnes of carbon in whole trees within each unit. It is this summation that is shown in Tables 11 and 12 as "Standing, Live Trees".

Carbon Storage in Forests Other than Live Trees

The carbon pool of "Other than Live Trees" represents shrubs, brush, snags, woody debris, and organic carbon in the soil within the proposed units.

1. Carbon in other than live trees for each unit was derived by multiplying the unit acreage by the tonnes of carbon per acre shown in Table E-1 (which was adapted from Table C-2 in the 2008 Final EIS, Appendices-29). The stands in Mud Den were aged based on the time steps used in the analysis (i.e. 10, 20, 50, and 100 years after the current condition) and the corresponding tonnes of carbon per acre was used in the calculations of other than live tree carbon. Under the "current condition", stands in Mud Den were 37-54 years old. At 50 years after current condition, Mud Den was assumed to be "mature" for the purposes of this calculation since a majority of the acreage (686 acres out of 831 acres) would be at least 95 years old.

2. The tonnes of carbon within the project were derived by summing the tonnes of carbon within each unit. It is this summation that is presented in Tables 11 and 12 as "Other Than Live Trees".

Table E-1. Forest Ecosystem Carbon (Excluding Live Trees) By Structural Stage*.

Age of Stand(s)	Structural Stage	Tonnes of Carbon per Acre
5-34 years	Stand Establishment	67.8
35-94 years	Young	70.3
95-124 years	Mature	88.2
$\geq$ 125 years	Developed Structurally Complex	94.8

* adapted from 2008 Final EIS, Appendices-29.

Carbon Storage in Wood Products

The carbon pool of "Wood Products" represents the amount of carbon that would be converted from standing, live trees into either saw logs or pulpwood, collectively referred to as wood products under the proposed action. There would be no carbon pool of wood products under the No Action Alternative since wood products would not be generated.

1. The tonnes of carbon in whole trees were derived previously in Steps 1-7 under "Standing, Live Trees" for the time steps used in this analysis. The difference between the tonnes of carbon in whole trees at "current condition" and at "harvest time" would be the tonnes of carbon in whole trees that would be harvested.

2. The tonnes of carbon in whole trees that would be harvested per unit were summed to provide the total for the project.

3. The tonnes of carbon in whole trees that would be harvested were converted to tonnes of carbon in saw logs by dividing by 1.85 (2008 Final EIS, Appendices-28). *Note:* this reversed the calculation that expanded biomass of harvested logs into the biomass of whole trees performed previously (derived in Step 4 of "Standing, Live Trees").

4. At harvest time, 13.5 percent of the saw log's carbon would immediately be released Smith et al. (2006); but afterwards the carbon in saw logs would be gradually released over time. The tonnes of carbon held in saw logs were then decayed over time by multiplying the tonnes of carbon in saw logs harvested by the values shown in Table E-2 which were adapted from the 2008 Final EIS, Appendices-30 and Smith et al. (2006).

5. Additional tonnes of carbon held in pulpwood (e.g. chips) were derived by multiplying the tonnes of carbon in saw logs (derived in Step 3 above) by five percent (2008 Final EIS, Appendices-30). *Note*: Pulpwood tonnage is five percent *in addition to* the saw logs not five percent *of* the saw logs.

6. At harvest time, 14.8 percent of the pulpwood's carbon would immediately be released Smith et al. (2006); but afterwards the carbon in pulpwood would be gradually released over time. The tonnes of carbon held in pulpwood were then decayed over time by multiplying the tonnes of carbon in pulpwood by the values shown in Table E-2 which were adapted from the 2008 Final EIS, Appendices-30 and Smith et al. (2006).

7. The sum total of the tonnes of carbon immediately released from saw logs (derived in Step 4 above) and from pulpwood (derived in Step 6 above) represent the total amount of carbon released by "Wood Products" at harvest time. The sum total of the tonnes of carbon held in saw logs (derived in Step 4 above) and held in pulpwood (derived in Step 6 above) at each time step represent the amount of carbon stored in "Wood Products" as shown in Table 12.

Table E-2. Fraction of Carbon Remaining or Captured as an Alternative Energy Source*.

Timestep	Saw Logs	Pulpwood
Harvest Time (0 years)	0.865	0.852
+10 years	0.796	0.730
+20 years	0.761	0.691
+50 years	0.702	0.655
+100 years	0.651	0.645

* These fractions include; wood products in use, wood products in the landfill, and wood products emitted as energy in lieu of fossil fuels (adapted from 2008 Final EIS, Appendices-30 and Smith et al., 2006).

Carbon Release in Slash Burning

The carbon pool of "Slash Burning" represents the amount of slash generated by the proposed timber harvest that is consumed through prescribed pile burning. There would be no carbon pool of slash burning under the No Action Alternative since logging slash would not be generated and therefore not burned.

1. The reported amount of slash, in tons of biomass per acre, which was scheduled for prescribed burning in 42 commercial thinning and/or density management units within the Swiftwater Resource Area was available for this analysis (K. Kosel, pers. comm., 2009). The tons of slash biomass per acre were converted to tonnes of biomass per acre by using a conversion factor of 0.909 tons/tonne.

2. It was assumed that prescribed fire would consume 90 percent of the slash scheduled for burning (K. Kosel, pers. comm., 2009); thereby releasing carbon. The tonnes of slash biomass per acre consumed were derived by multiplying the tonnes of slash biomass per acre by 0.90.

3. The tonnes of slash biomass consumed per acre were converted to tonnes of carbon released per acre by using a conversion factor of 0.50 tonnes of biomass/tonne of carbon.

4. Within the Swiftwater Resource Area, it was calculated that an average of 0.382 tonnes of carbon would be released per acre of commercial thinning and/or density management unit scheduled for piling and burning using prescribed fire.

5. The tonnes of carbon that would be released under the proposed action were derived by multiplying the acreage of the project by 0.382 tonnes per acre (derived in Step 4 above) and are shown in Table 12 as "Slash Burning" at harvest time.

Carbon Storage in Logging Slash

The carbon pool of "Logging Slash" represents the limbs, fine branches, leaves/needles, stumps, and roots of trees that are left on-site in the proposed units after harvest operations that are not consumed during slash burning. There would be no carbon pool of logging slash under the No Action Alternative since logging slash would not be generated.

1. The tonnes of logging slash remaining on-site was calculated by subtracting the following three amounts of carbon from the total tonnes of carbon in whole trees that would be harvested from the project (derived in Step 2 under "Wood Products"):
    - the tonnes of carbon immediately released from wood products (derived in Step 7 of "Wood Products"),
    - the tonnes of carbon stored in wood products at harvest time (derived in Step 7 of "Wood Products"), and
    - the tonnes of carbon released from slash burning (derived in Step 5 under "Slash Burning").

2. The tonnes of logging slash on-site were then multiplied by the fraction of Douglas-fir slash remaining at each time step as shown in Table E-3 (based on Janisch et al. 2005). This represents the amount of carbon stored in "Logging Slash" as it decayed and released carbon over time as shown in Table 12.

Table E-3. Decay Rates of Carbon from Douglas-fir Slash*.

Timestep	Fraction of Carbon Remaining in Douglas-fir Slash
Harvest Time (0 years)	1.000
+10 years	0.852
+20 years	0.726
+50 years	0.449
+100 years	0.202

* based on Janisch et al. 2005.

Carbon Release in Fossil Fuels

The carbon pool of "Fossil Fuels" represents the amount of carbon that would be released through the consumption of gasoline and diesel fuel by various harvest-related activities under the proposed action such as: timber falling, timber yarding, log hauling, and road construction and renovation. There would be no carbon pool of fossil fuels under the No Action Alternative since no harvest-related activities would occur.

1. The gallons of fuel that would be consumed during harvest operations (i.e. timber felling and yarding) were estimated based on the production rates and fuel efficiencies shown in Table E-4. For the fossil fuels portion of the analysis, it was assumed that the 831 acre project would be cable-yarded and a loader would handle logs at the landings under the Proposed Action Alternative. Under sub-alternative A, it was assumed that 85 acres would be aerially yarded by helicopter, 746 acres would be cable-yarded, and a loader would handle logs at the landings.

Table E-4. Fossil Fuel Consumption during Harvest Operations.

Equipment	Production Rate[a]	Fuel Efficiency[b,c]		Fuel Consumed (gallons)	
		(gallons/hour)	(gallons/day)	*Proposed Action Alternative*	*Sub-Alternative A*
Chainsaw (gasoline)	0.4 acres/day	-	1	2,078	2,078
Motorized Carriage (gasoline)	1 acre/day	-	3	2,493	2,238
Cable/Skyline Yarder (diesel)	1 acre/day	2.3	19.55	16,246	14,584
Loader (diesel)	1 acre/day	4.5	38.25	31,786	31,786
Helicopter (jet fuel[a,c])	100 MBF/day	170	1,445	0	22,623
Total	-	-	-	52,603	73,309

[a] based on experience of BLM Contract Administrators and Cruiser/Appraisers.

[b] Chainsaw, motorized carriage, yarder, and loader fuel efficiency based on World Forestry Institute (1997).

[c] Fossil fuel consumption for helicopters was considered only for sub-alternative A.

2. For the hauling of logs, this analysis assumed an average log-truck load of 4,000 BF (based on experience of BLM Contract Administrators and Cruiser/Appraisers) and a fuel efficiency of 6.0 miles per gallon. It was also assumed that the total timber volume in Mud Den was 15.3 MMBF (based on ORGANON modeling) and the length of haul (round-trip) was 46 miles. It was estimated that 29,336 gallons of diesel would be consumed during log hauling for this project.

3. For road construction it was assumed that 588 gallons of diesel would be consumed per mile (5,280 feet) of road constructed and 73 gallons per mile of road renovated (Loeffler et al., 2009). In Mud Den, there would be 17,190 feet of road construction (Table 1) corresponding to 1,940 gallons of diesel consumed and 83,565 feet of road renovation (Table 1) corresponding to 1,153 gallons of diesel consumed.

4. The gallons of fuel that would be consumed by harvest operations (derived in Step 1), log hauling (derived in Step 2), and road construction and renovation (derived in Step 3) were summed to provide the total fuel consumption for the project under the Proposed Action Alternative (Table E-5). The total gallons of fuel that would be consumed were converted to tonnes of carbon that would be released using the conversion factors shown in Table E-5. The total amount of carbon that would be released by the proposed action is shown in as "Fossil Fuels" in Table 12.

Table E-5. Total Fossil Fuel Consumption and Associated Carbon Release under the Proposed Action Alternative.

Fuel Use	Fuel Consumption (gallons)	Pounds CO_2 per Gallon[a]	CO_2 Released[b] (tonnes)	Carbon Released[c] (tonnes)
Harvest Operations (gasoline)	4,571	19.4	40	11
Harvest Operations (diesel)	48,032	22.2	485	132
Log Hauling (diesel)	29,336	22.2	296	81
Road Construction & Renovation (diesel)	3,093	22.2	31	9
Total	**85,032**	**-**	**852**	**232**

[a] based on U.S. EPA, 2005.

[b] conversion rate of 2,200 pounds per tonne (2008 Final EIS, Appendices-28).

[c] One tonne of carbon is equivalent to 3.67 tons of carbon dioxide (U.S. EPA, 2005).

5. The gallons of fuel that would be consumed by harvest operations (derived in Step 1), log hauling (derived in Step 2), and road construction and renovation (derived in Step 3) were summed to provide the total fuel consumption for the project under sub-alternative A (Table E-6). The total gallons of fuel that would be consumed were converted to tonnes of carbon that would be released using the conversion factors shown in Table E-6. The difference between the total amount of carbon that would be released by sub-alternative A is discussed in the EA under "*Sub-Alternatives A, B, and C*".

Table E-6. Total Fossil Fuel Consumption and Associated Carbon Release under Sub-Alternative A.

Fuel Use	Fuel Consumption (gallons)	Pounds CO_2 per Gallon[a]	CO_2 Released[b] (tonnes)	Carbon Released[c] (tonnes)
Harvest Operations (gasoline)[d]	26,939	19.4	237	65
Harvest Operations (diesel)	46,370	22.2	468	127
Log Hauling (diesel)	29,336	22.2	296	81
Road Construction & Renovation (diesel)	3,093	22.2	31	9
Total	**105,738**	**-**	**1,032**	**282**

[a] based on U.S. EPA, 2005.

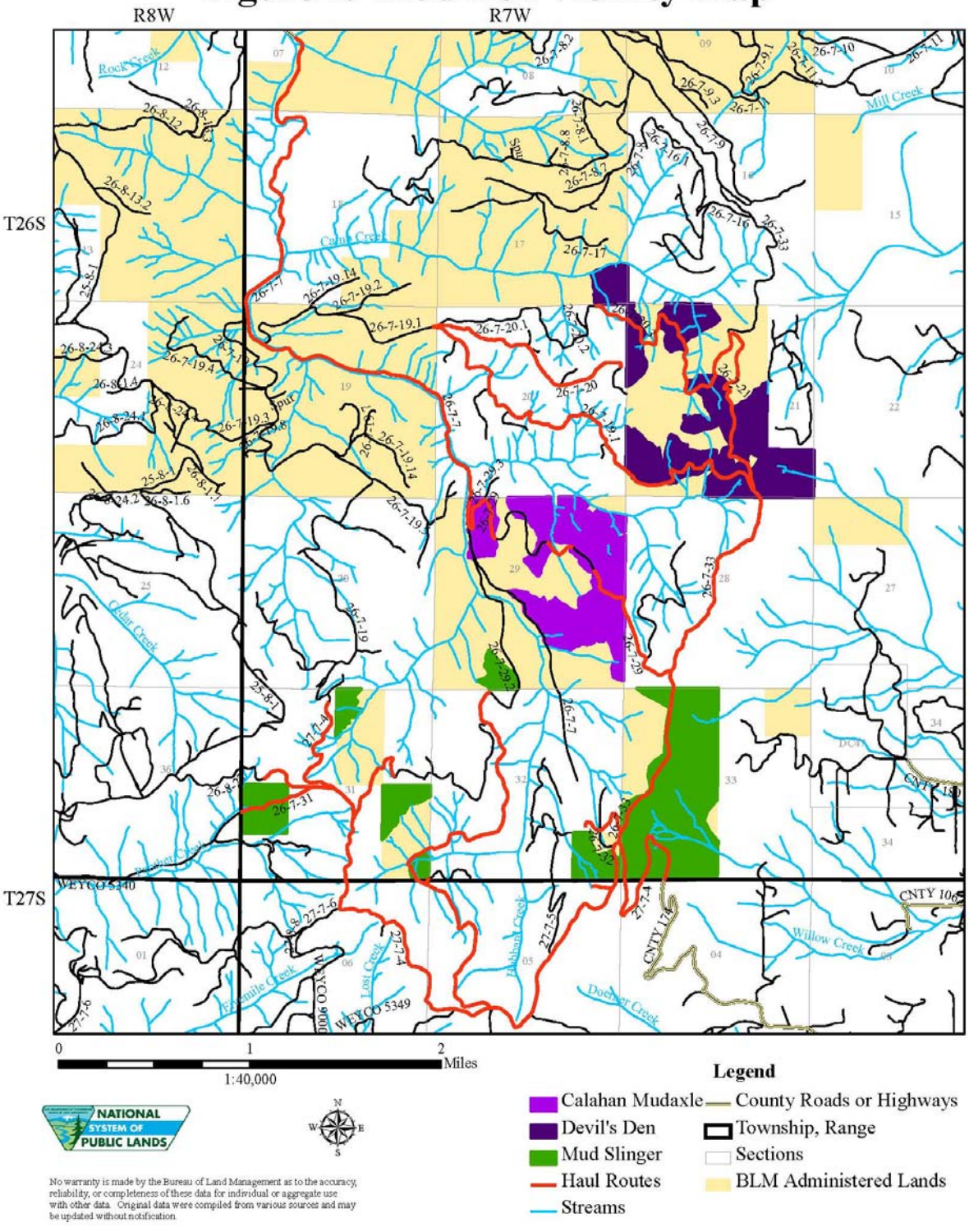
[b] conversion rate of 2,200 pounds per tonne (2008 Final EIS, Appendices-28).

[c] One tonne of carbon is equivalent to 3.67 tons of carbon dioxide (U.S. EPA, 2005).

[d] Jet fuel for the helicopter was assumed to be equivalent to gasoline for the purposes of this analysis.

Appendix F. Map Packet Table of Contents

Figure 1. Mud Den Vicinity Map



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.

Figure 2. Calahan Mudaxle Commercial Thinning

Proposed Units and Roads

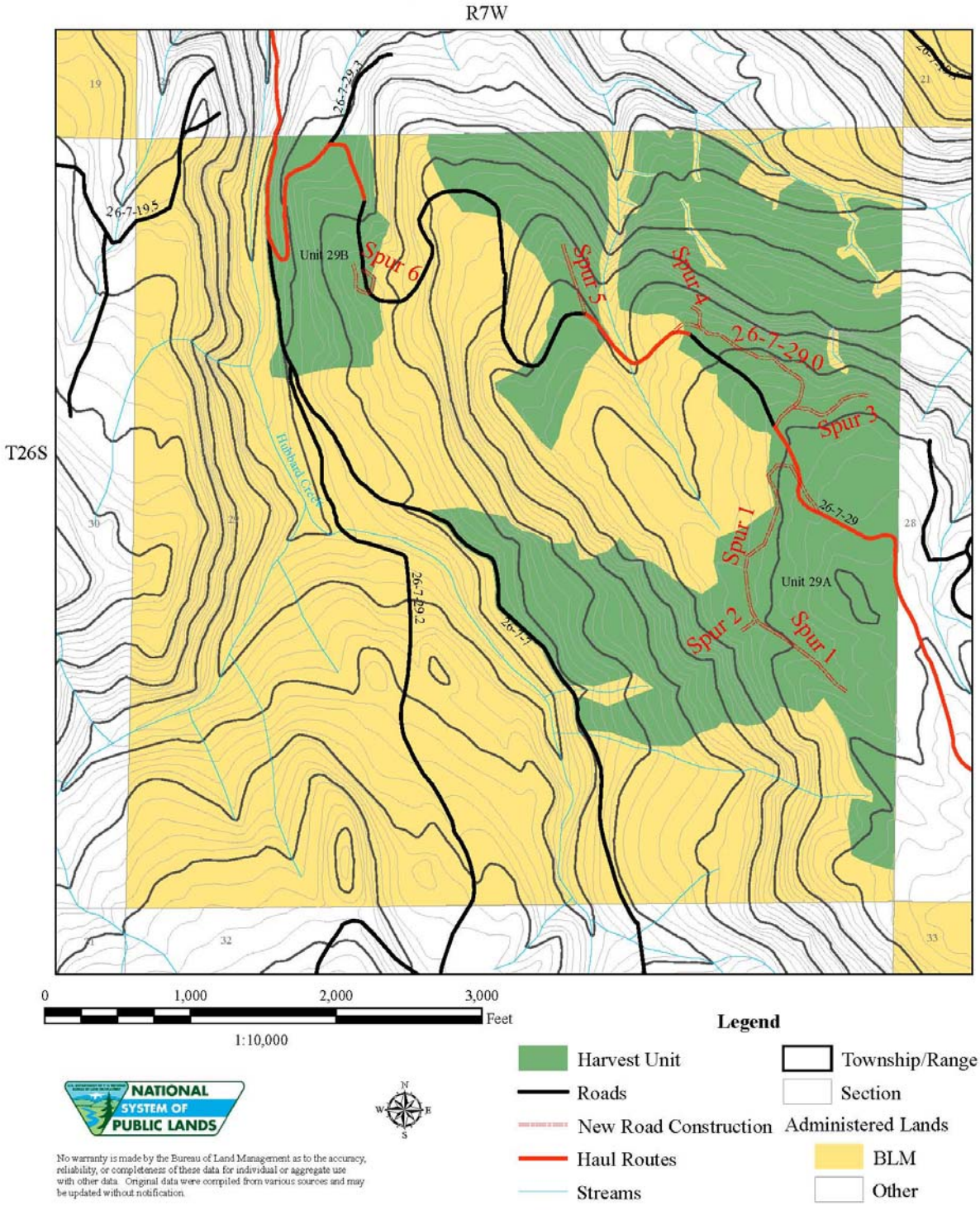


Figure 3. Devil's Den Commercial Thinning

Proposed Units & Roads

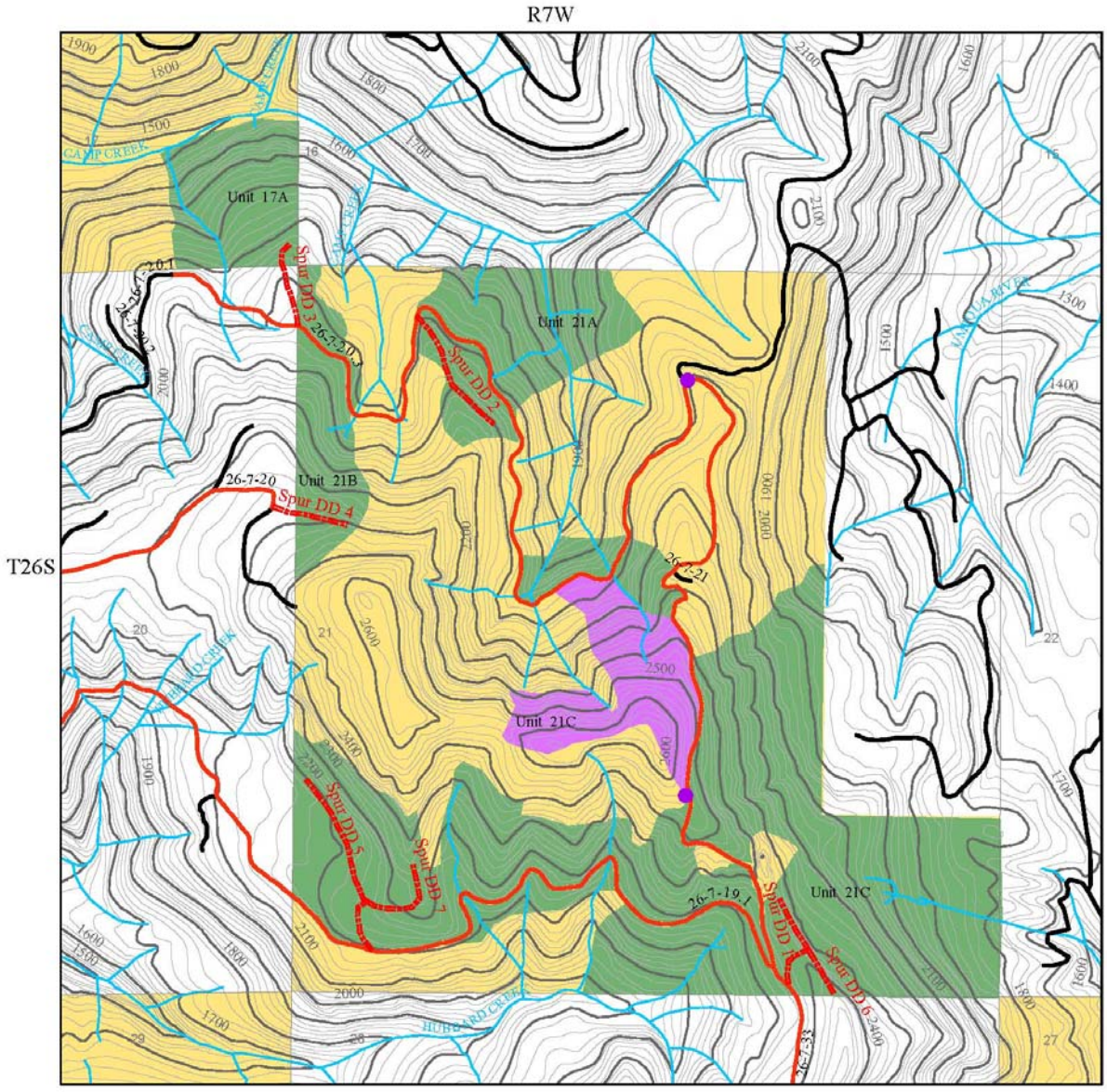
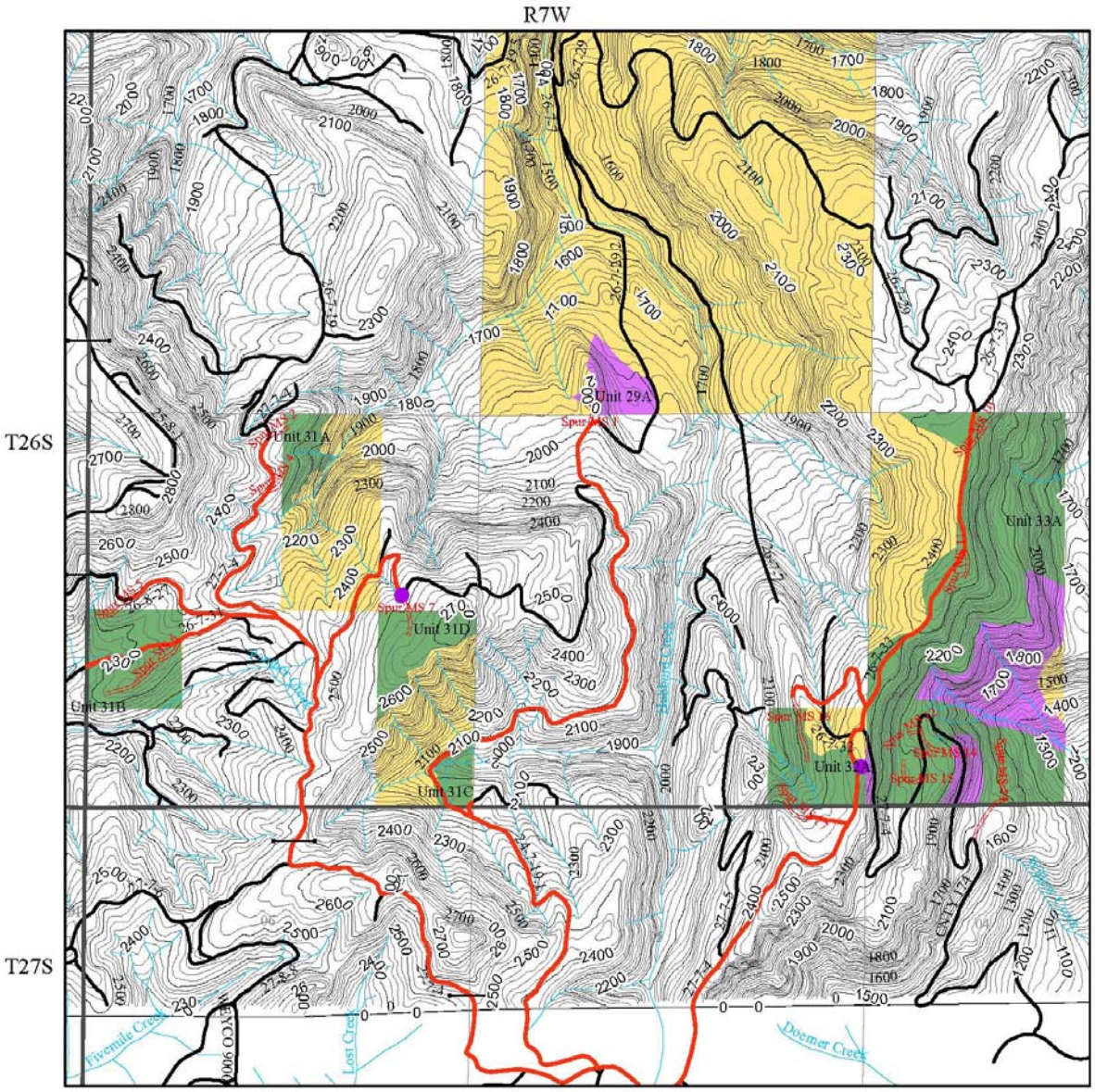


Figure 4. Mud Slinger Commercial Thinning

Proposed Units and Roads



0 1,000 2,000 3,000 4,000 5,000 6,000 Feet

1:22,000

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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.

Legend

- Mud Slinger
- Helicopter Yarding Area
- Roads
- New Road Construction
- Haul Routes
- Gates
- Potential Helicopter Landings
- Streams
- Township and Range
- Section Lines

Administered Lands

- BLM
- Other

Figure 5. Mud Den Commercial Thinning

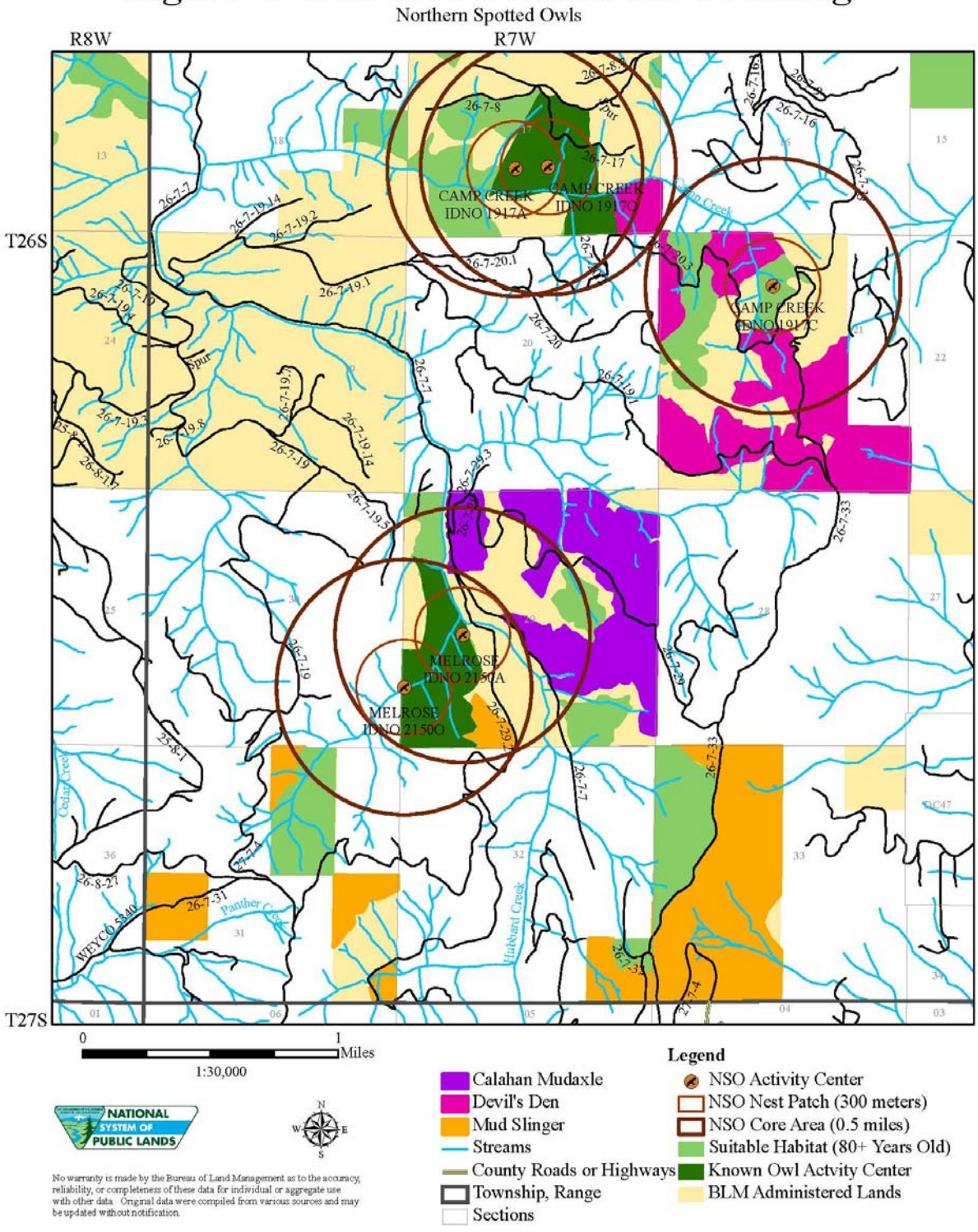

Figure 6. Mud Den Commercial Thinning

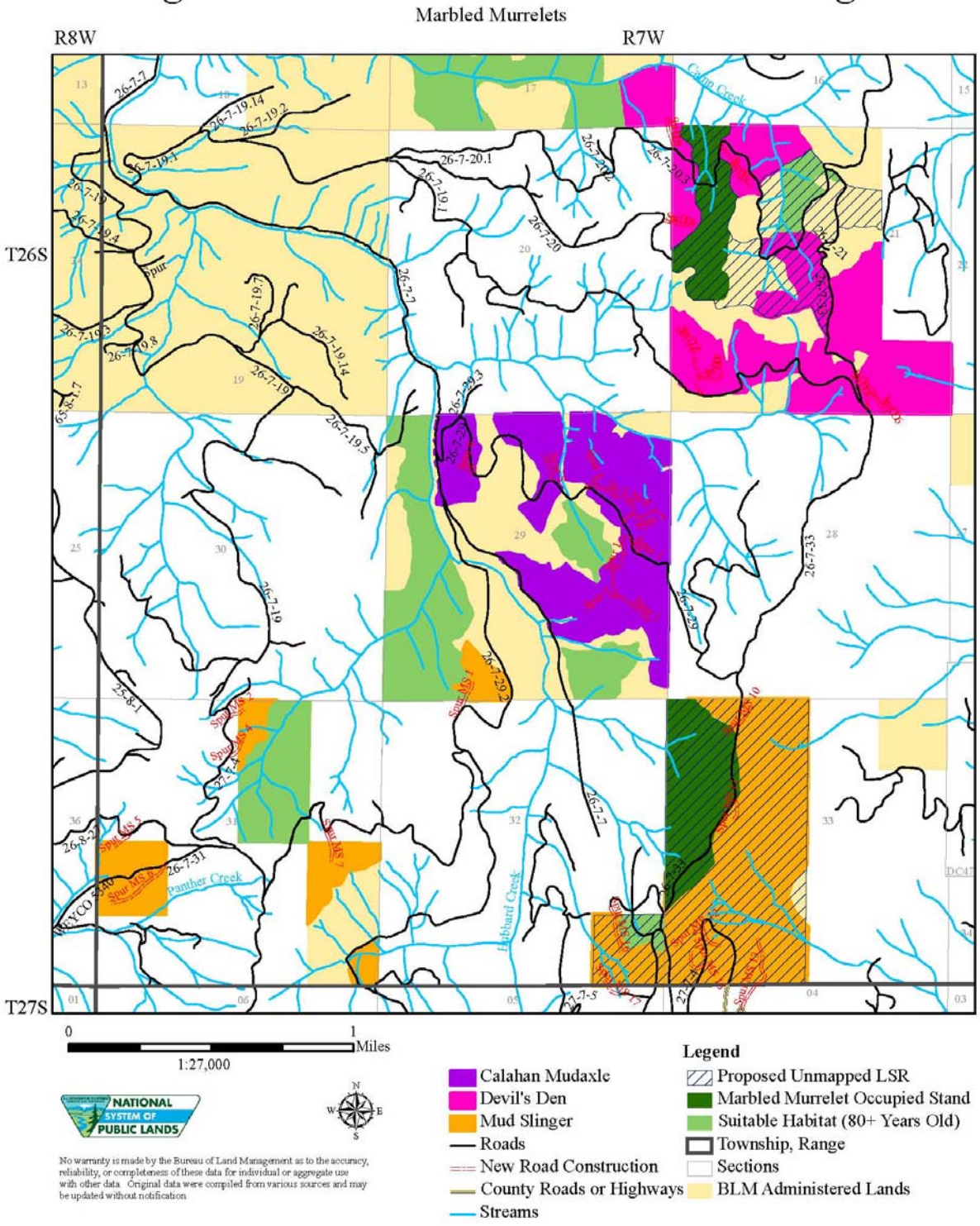

Figure 7. Calahan Mudaxle Commercial Thinning

Northern Goshawk

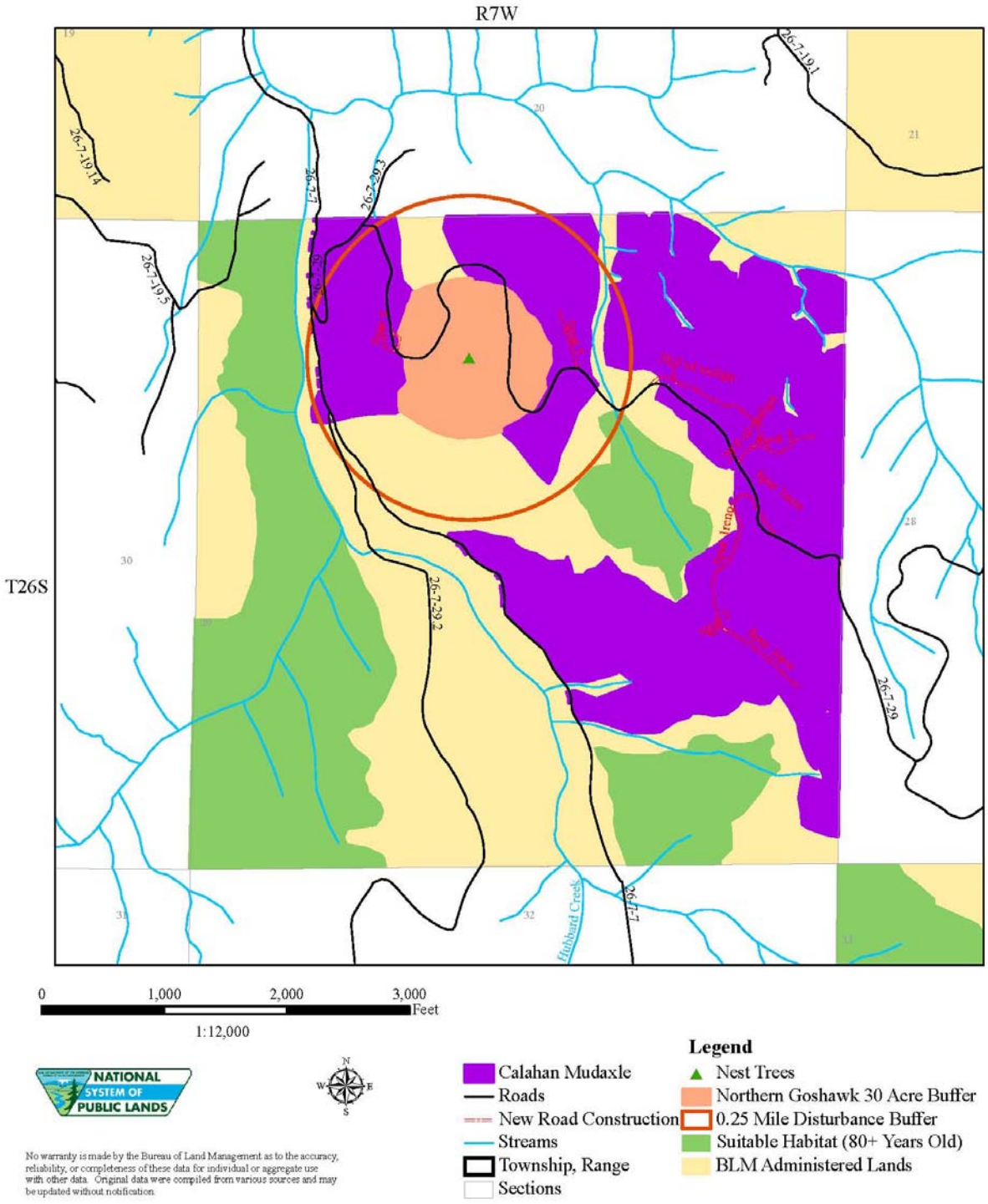

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Figure 8. Mud Den Commercial Thinning