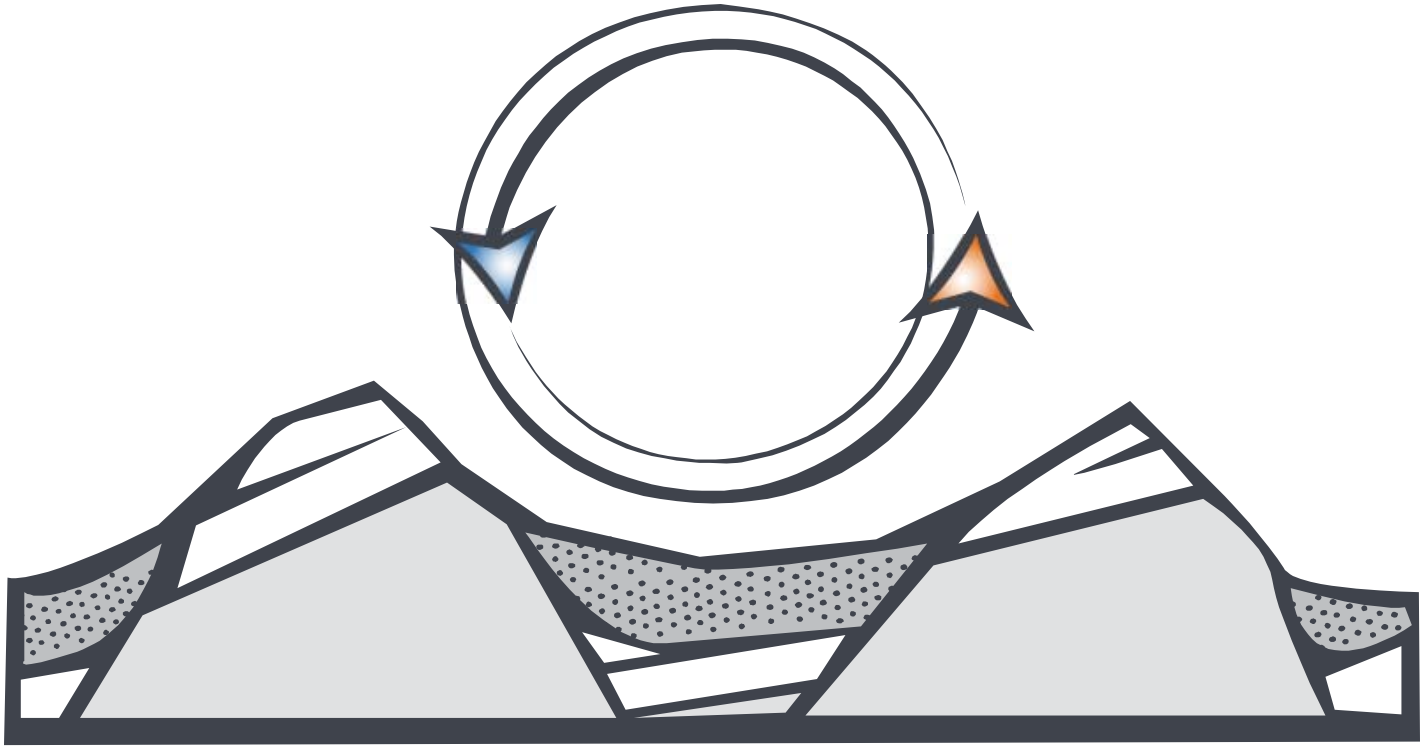

# CHAPTER 15

## MT. HOOD NATIONAL FOREST

## PRINEVILLE FIELD OFFICE

ANALYSIS FOR PENDING LEASE APPLICATIONS:

ORORO 017049, ORORO 017051, ORORO 017052, ORORO 017053, ORORO 017327

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# SECTION 15.1
# INTRODUCTION

## 15.1.1 INTRODUCTION

This lease-specific analysis describes the environmental effects of leasing approximately 9,170 acres of NFS land within the Hood River and Barlow Ranger Districts of the Mount Hood National Forest and the BLM Prineville Field Office to private industry for the development of geothermal resources.

The lease sites are within the Hood River and Barlow Ranger Districts of the Mt. Hood National Forest, the surface management agency for the lease sites. Subsurface mineral rights are managed by the BLM Prineville District. The BLM issues leases with the consent of the Forest Service (Regional Forester upon recommendation from the Mt. Hood National Forest Supervisor) for the lands under application on the Mount Hood NF.

This lease-specific analysis serves as an information resource to aid decision-makers in determining whether these lands are appropriate for leasing under FS and BLM management policies and existing environmental regulations.

## 15.1.2 LOCAL REGULATORY CONSIDERATIONS

The pending lease application sites are located within Hood River County, Oregon and are subject to state and local regulations, as described below.

### State of Oregon Renewable Portfolio Standard Program

The Oregon Renewable Portfolio Standard Program is an Oregon law that requires the largest utilities in Oregon to provide 25 percent of their retail sales of electricity from clean, renewable sources of energy in 2025. Smaller utilities will have similar, but lesser, obligations. Geothermal energy is included in the definition of renewable resources under the program.

### Mount Hood National Forest Land and Resources Management Plan (1990)

The Mount Hood National Forest Land and Resources Management Plan (Forest Plan) guides all natural resource management activities and establishes

management standards and guidelines for the Mount Hood NF. It describes resource management practices, levels of resource production and management, and the availability and suitability of lands for resource management (US Forest Service 1990).

The Forest Plan:

- Establishes Forestwide multiple-use goals and objectives;
- Establishes Forestwide standards and guidelines for future activities;
- Establishes management area direction, including management area prescriptions and standards and guidelines applying to future management activities in that management area;
- Establishes the allowable sale quantity for timber and identifies land suitable for timber management;
- Establishes monitoring and evaluation requirements; and
- Establishes nonwilderness multiple-use allocations for the Olallie/Mount Jefferson roadless area that was reviewed under 36 CFR 219.17 and not recommended for wilderness designation.

The Forest Plan identifies the following resource management goals that apply to geothermal leasing:

- Provide safe, efficient access for the movement of people and materials involved in the use and management of the Forest. Provide for construction and maintenance of roads, at a level that will minimize environmental damage.
- Facilitate the exploration and development of energy and mineral resources on the Forest while maintaining compatibility with other resource values
- Provide for use and occupancy of the Forest by public and private interests when compatible with other resource objectives.
- Integrate the activities of implementing the Forest Plan with activities of local dependent communities to: 1) improve employment opportunities, 2) improve incomes and well being of the nation's rural people, and 3) strengthen the capacity of rural America to compete in the global economy.

The Forest Plan estimates that, within the Forest, there are 4,300 acres available with high potential for geothermal resources, and 123,300 acres with moderate potential for geothermal resources (US Forest Service 1990).

The Forest Plan identifies the following Forest-wide standards and guidelines that apply to geothermal activity:

- FW-386 – Impacts of management activities on mineral resources shall be assessed.
- FW-394, 395, 396 – Mineral and geothermal lease applications should be reviewed within 90 days. Special lease stipulations when necessary to protect surface resources and/or achieve Management Area direction shall be required. Special lease stipulations for surface resource protection shall be provided to the USDI-Bureau of Land Management.
- FW-397 – A "no surface occupancy" stipulation shall be applied to leases only when:
  - Surface occupancy would cause significant other resource disturbance that could not be mitigated by any other means.
  - The activity is incompatible with other resource values and management objectives.
- FW-405 – The Forest shall cooperate with the Bureau of Land Management in analyzing and processing surface use plans of operations for leasable minerals proposals.

**Northwest Forest Plan (1994)**

The Northwest Forest Plan (NWFP) is an overall vision for the Pacific Northwest that would produce timber products while protecting and managing impacted species. The Plan focuses on the following five key principles (US Forest Service 1994):

- Never forget human and economic dimensions of issues;
- Protect long-term health of forests, wildlife, and waterways;
- Focus on scientifically sound, ecologically credible, and legally responsible strategies and implementation;
- Produce a predictable and sustainable level of timber sales and non-timber resources; and
- Ensure that Federal agencies work together.

The mission of the NWFP is to adopt coordinated management direction for the lands administered by the FS and the BLM and to adopt complimentary approaches by other Federal agencies within the range of the northern spotted owl. The management of these public lands must meet dual needs: the need for forest habitat and the need for forest products. With the signing of the Northwest Forest Plan Record of Decision in 1994, a framework and system of

Standards and Guidelines were established, using a new ecosystem approach to address resource management (US Forest Service 1994).

The NWFP includes the following Standards and Guidelines that apply to geothermal development in Late-Successional Reserves:

> Mining - The impacts of ongoing and proposed mining actions will be assessed, and mineral activity permits will include appropriate stipulations (e.g., seasonal or other restrictions) related to all phases of mineral activity. The guiding principle will be to design mitigation measures that minimize detrimental effects to late-successional habitat.

The NWFP includes the following management measures that apply to geothermal development in Riparian Reserves:

MM-1. Require a reclamation plan, approved Plan of Operations, and reclamation bond for all minerals operations that include Riparian Reserves. Such plans and bonds must address the costs of removing facilities, equipment, and materials; recontouring disturbed areas to near pre-mining topography; isolating and neutralizing or removing toxic or potentially toxic materials; salvage and replacement of topsoil; and seedbed preparation and revegetation to meet Aquatic Conservation Strategy objectives.

MM-2. Locate structures, support facilities, and roads outside Riparian Reserves. Where no alternative to siting facilities in Riparian Reserves exists, locate them in a way compatible with Aquatic Conservation Strategy objectives. Road construction will be kept to the minimum necessary for the approved mineral activity. Such roads will be constructed and maintained to meet roads management standards and to minimize damage to resources in the Riparian Reserve. When a road is no longer required for mineral or land management activities, it will be closed, obliterated, and stabilized.

MM-4. For leasable minerals, prohibit surface occupancy within Riparian Reserves for oil, gas, and geothermal exploration and development activities where leases do not already exist. Where possible, adjust the operating plans of existing contracts to eliminate impacts that retard or prevent the attainment of Aquatic Conservation Strategy objectives.

MM-6. Include inspection and monitoring requirements in mineral plans, leases or permits. Evaluate the results of inspection and monitoring to effect the modification of mineral plans, leases and permits as needed to eliminate impacts that retard or prevent attainment of Aquatic Conservation Strategy objectives.

### 15.1.3 SCOPE OF ANALYSIS AND APPROACH

This lease-specific analysis incorporates by reference the programmatic analysis presented in Volume I. This lease-specific analysis examines the cluster of five pending lease application sites, describes the Reasonably Foreseeable Development scenario for this cluster, examines the existing environmental setting, and describes the potential direct and indirect impacts that issuing leases, and the anticipated future actions following leasing, would have on the human and natural environment.

This report focuses on specific key resource concerns in the cluster, and incorporates by reference the impacts described in the PEIS. Decision-makers should consider both the impacts described in this lease-specific analysis, in addition to those described in the main body of the PEIS. The analysis presented here does not reiterate the details of impacts identified in the PEIS, but rather refers to them as they arise in the impact analysis for pending lease application sites addressed here. Mount Hood National Forest staff members were contacted during the preparation of this lease-specific analysis to help identify local resource concerns.

### 15.1.4 CUMULATIVE ACTIONS

Consultation with the Mount Hood National Forest did not identify any projects that would cumulatively contribute to impacts within the project area.

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# SECTION 15.2
# PROPOSED ACTION AND ALTERNATIVES

## 15.2.1 INTRODUCTION

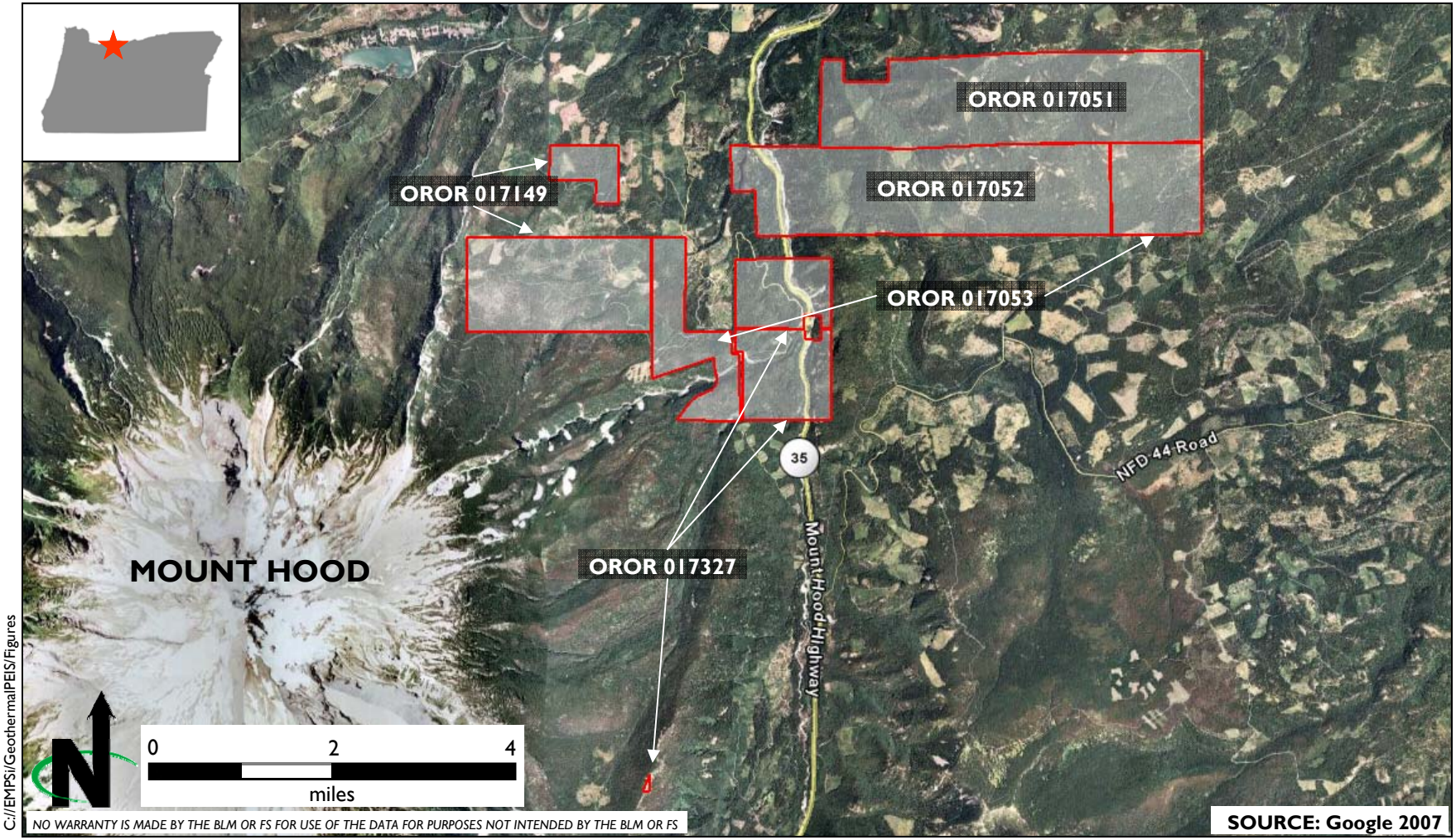
This chapter provides the details of the proposed action, alternatives to the proposed action, and an overview of the reasonably foreseeable develop (Reasonably Foreseeable Development) scenario for pending lease application sites OROR 017049, 017051, 017052, 017053, 017327.

## 15.2.2 PROPOSED ACTION

The proposed action is for the (1) Forest Service to provide a consent determination to the BLM to issue a lease for two areas within the Mount Hood National Forest and Prineville BLM District; and (2) BLM to issue said leases. The 9,169.98 acres of land are in the foothills to the east and northeast of Mount Hood, in Hood River County, Oregon (see Figure 15-1). Lease boundaries could be adjusted in the decision to avoid unacceptable impacts on sensitive resources.

The lease area comprises five lease sites:

- OROR 017049 – 1,538 acres consisting of two adjacent sections of land and an approximate third of nearby section. The legal description of this land is (1) T2S R9E S1; (2) T2S R9E S2; (3) T1S R9E S36, parts W2NE, N2NW, N2S2NW, NWSE.
- OROR 017051 – 2,480 acres consisting of three contiguous sections of land and an approximate seven-eighths of a fourth adjacent section. The legal description of this land is (1) T1S R10E S25; (2) T1S R10E S26; (3) T1S R10E S27; (4) T1S R10E S28, parts S2, S2N2, NENE, NWNW.
- OROR 017052 – 2,480 acres consisting of three contiguous sections of land and an approximate seven-eighths of a fourth adjacent section. The legal description of this land is (1) T1S R10E S32, parts N2, SE, E2SW; (2) T1S R10E S33; (3) T1S R10E S34; (4) T1S R10E S35.

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*All lease sites are on NFS lands. The East Fork of the Hood River runs alongside the Mount Hood Highway.*

LEGEND:

Lease site boundary

## *Mount Hood Lease Locations*

ORORO 017149, 017051, 017052, 017053, 017327
Mt. Hood NF / Prineville District

Figure 15-1

- OROR 017053 – 1,376.77 acres consisting of one section and parts of two other sections that are contiguous with one another, but approximately 4.3 miles from the first section. The legal description of this land is (1) T1S R10E S36; (2) T2S R10E S6, "all excluding HES 149 & 151;" (3) T2S R10E S7, "M&B outside wilderness".
- OROR 017327 – 1,294.81 acres consisting of portions of two adjacent sections and a small parcel approximately 4 miles from the first two sections. The legal description of this land is (1) T2S R10E S5, parts "S2N2, S2 including part of HES 147 and HES 152, Lots 1-4;" (2) T2S R10E S8, "all including HES 153 and part of HES 152;" (3) T2S R9E S36, "SESE excluding wilderness."

The large grouping of lease sites range in elevation from 3,200 feet to 4,800 feet above mean sea level, with the isolated small parcel of land to the south situated atop a ridge at approximately 5,600 feet above mean sea level. The lease area is largely covered by forest, with substantial portions in various stages of regrowth from past timber harvest. Several creeks cross the lease area, most notably East Fork Hood River. The lease area is traversed by several forest roads and trails, and by the Mount Hood Highway, which runs alongside the East Fork Hood River.

There are no official recreation areas within the lease area. There are two adjacent recreation areas: The Cooper Spur Mountain Resort, which is immediately adjacent to the western edge of section 7 of lease OROR 017053, and a campground, which is adjacent to the southeastern edge of section 36 of the same lease.

There are numerous residences within one mile of lease sites OROR 017049 and 017053.

### 15.2.3 ALTERNATIVES

Two alternatives are considered in this lease-specific analysis: Alternative A, the No Action alternative, and Alternative B, Leasing with Stipulations.

#### Alternative A: No Action

Under Alternative A, the FS would not issue a consent determination for the four pending lease applications.

#### Alternative B: Leasing with Stipulations

Under Alternative B, the FS would provide a consent determination for the lease applications, and the BLM would issue the leases with the stipulations identified in Chapter 2 of the PEIS.

### 15.2.4 REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

All of the lease sites are likely to be developed for electricity generation. The pending noncompetitive lease applications were filed by Portland Electric Corporation in 1976-77, now called Portland General Electric.

Portland General Electric expects to develop two power plants; one 30-megawatt plant to the west of Mount Hood Highway (Hwy 35) and the East Fork Hood River, and one 20-megawatt plant to the east of the highway and river.

The 30-megawatt plant to the west is most likely to be sited in the flat valley of sections 6 and 7 of OROR 017053 or Section 36 of OROR 017049.

The 20-megawatt plant to the east is most likely to be sited in the hilly area of sections 27 and 28 of OROR 017051. This location is within the area proposed to become the Shellrock Mountain National Recreation Area.

It is expected that a 30-megawatt plant would result in 15 acres of land disturbance, and a 20-megawatt plant would result in 10 acres of land disturbance, for a total disturbance of 25 acres. Existing Forest Service roads would be used to access the sites.

Portland General Electric acknowledges that while over 9,000 acres of land are included in the lease area, most of the land is not feasible to develop due to proposed wilderness areas, river riparian setbacks, steep slopes, cliffs, wilderness areas, ski areas, and protected watershed for The Dalles.

Exploration activities for a 20-megawatt plant and a 30-megawatt plant are expected to involve approximately 12 temperature gradient holes, disturbing approximately 0.15 acre each, for a total disturbance of approximately 2 acres. Disturbance would result from the types of activities described under Chapter 2 of the PEIS under *Phase One: Geothermal Resource Exploration*.

Assuming that a commercially viable resource is found within both portions of the lease area identified as being suitable, drilling operations and development of the site would be expected to result in a further approximately 8 acres of land disturbance (roughly 5 acres for the 30-megawatt plant and 3 acres for the 20-megawatt plant) from the types of activities described in the Reasonably Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Two: Drilling Operations*.

Utilization, the third phase of a geothermal project, is expected to result in a further approximately 15 acres of land disturbance (roughly 9 acres for the 30-megawatt plant, and 6 acres for the 20-megawatt plant) from the types of activities described in the Reasonably Foreseeable Development scenario of

Chapter 2 of the PEIS under *Phase Three: Utilization*. The length and alignment of transmission lines are not estimated here since these factors would depend upon the positioning of any power plant and the distance to the nearest electrical tie-in.

Reclamation and abandonment, the fourth phase of a geothermal project, is expected to result in temporary disturbance of all originally disturbed acres, after which, the site would graded and vegetated to pre-disturbance conditions, as described in the Reasonably Foreseeable Development scenario of Chapter 2 of the PEIS under *Phase Four: Reclamation and Abandonment*.

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# SECTION 15.3
# AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

## 15.3.1 INTRODUCTION AND GEOGRAPHIC SETTING

The following resource disciplines are not addressed in this section because they are not found in the leasing areas and are not relevant to the discussion: wild horse or burros, livestock grazing, and historic or scenic trails.

All the pending lease applications are in geologic units that would be expected to have a relatively low potential for containing vertebrate fossils or scientifically significant invertebrate or plant fossils; therefore, paleontological resources are not analyzed in detail. Paleontological mitigative procedures outline in the PEIS would be followed for all ground-distributing activities. Protective measures outlined in the PEIS would be applied.

Future development of the proposed lease sites would also yield the same health and safety impacts as identified in Chapter 4 of Volume I of the PEIS and therefore are not repeated in this lease-specific analysis.

## 15.3.2 LAND USE, RECREATION AND SPECIAL DESIGNATIONS

### Setting

This section is a discussion of the current land ownership and use within the Region of Influence (ROI) for the five lease sites that are part of the proposed action. The ROI is the land area within and adjacent to the potential lease sites.

#### *Policies and Plans*

It is the policy of the Department of the Interior, consistent with Section 2 of the MMPA and Sections 102(a) (7), (8) and (12) of FLPMA, to encourage the development of mineral resources, including geothermal resources, on federal lands. The Geothermal Steam Act of 1970 provides regulatory guidance for geothermal leasing by the BLM. The Mount Hood National Forest LRMP as

amended by the NWFP provides direction for land use in the lease area. Additional details of this plan are discussed in Section 15.3.1.

***Regional Setting***

The pending lease areas are within NFS lands to the east and northeast of Mount Hood, Oregon. Adjacent land is primarily within the NFS, with smaller parcels of private land and public land interspersed. The primary land uses in the area are forestry and recreation.

***Special Designations***

There are no existing wilderness areas, national recreation areas, or wild and scenic rivers within the lease sites. Existing lease boundaries have already been adjusted to avoid overlap with existing wilderness areas; specifically, the lease boundary of ORORO 017053 in Section 7 has been revised to avoid the Mount Hood Wilderness.

A review of FS Geographical Information Systems data shows that the following areas are within an Inventoried Roadless Area:

- ORORO 017327 – Southern one-third of Section 8, west of East Fork Hood River
- ORORO 017049 – Northwest corner of Section 2

According to the Northwest Forest Plan:

- Portions of ORORO 017051, 017052, and 017053 lease areas are in a designated Late-Successional Reserve and a Key Watershed;
- Portions of ORORO 017049 and 017053 are in an Administratively Withdrawn Area; and
- Riparian Reserves form a buffer around all streams and rivers within the lease area. The width of these reserves is based on the presence or absence of fish and if the stream is perennial or intermittent. Riparian Reserves exist within all proposed lease areas.

Section 15.1 of this analysis discusses the standards and guidelines set forth in the NWFP related to geothermal development in Riparian Reserves. NWFP guidance on Late-Successional Reserves does not address geothermal development. NWFP guidance on Key Watersheds includes a description of an Aquatic Conservation Strategy. The applicable portions of this strategy are:

- Reduce existing system and nonsystem road mileage outside roadless areas. If funding is insufficient to implement reductions, there will be no net increase in the amount of roads in Key Watersheds.

- Key Watersheds are highest priority for watershed restoration.
- Watershed analysis is required prior to management activities, except minor activities such as those Categorically Excluded under NEPA (and not including timber harvest).
- Timber harvest cannot occur in Key Watersheds prior to completing a watershed analysis.

Additionally, portions of the lease areas are contained within management areas with special designations for wildlife protection under the Forest Plan. Details for these designations are provided in Section 15.3.9 *Fish and Wildlife*.

On July 25, 2007, the Senate Energy and Natural Resources Committee passed the Lewis and Clark Mount Hood Wilderness Act of 2007. This act requires approval of the Senate. There are several proposed wilderness areas, a national recreational area, and a wild and scenic river overlapping the lease sites. If these areas are given their proposed designations, these areas may be incompatible with mineral leasing.

All of the proposed lease sites would be affected by the proposed designations. Table 15.3-1 lists each of the proposed areas and the sites and sections that would be affected.

**Table 15.3-1**
**Proposed Lewis and Clark Wilderness and Lease Sites Affected**

| Proposed Area | Lease and Section Affected |
|---|---|
| Tilly Jane Wilderness Area | OROR 017049 (Section 2) |
| Cloud Cap Wilderness Area | OROR 017049 (Sections 1, 2)<br>OROR 017053 (Section 7) |
| Blue Grass Ridge Wilderness Area | OROR 017327 (Section 36) |
| East Fork Hood River Wild and Scenic River | OROR 017327 (Sections 5, 8)<br>OROR 017052 (Section 32) |
| Shellrock Mountain National Recreation Area | OROR 017051 (Sections 27, 28) |

***Recreation***

Existing recreational areas in or near the lease sites include the Copper Spur Mountain Resort, which is immediately adjacent to the western edge of Section 7 of lease OROR 017053, a campground, which is adjacent to the southeastern edge of Section 36 of the same lease, and a winter recreation area in portions of Section 4 of leases OROR 017049 and OROR 017053.

***Lease Areas***

*ORORO 017049*

Cloud Cap road traverses sections 1 and section 2 from the SW to the SE. Road NFD 3511 winds through the northwest corner of the Section 2 portion of the lease site and the southeast corner of the Section 36 portion of the lease site. Other unnamed forest roads provide some additional access to section 1 and 36. Portions of the lease site have been clear cut. Evans Creek originates in Section 2 and leaves through the middle portion of the northern edge of that section. Crystal Springs Creek is slightly east of the point of origin of Evans Creek, and runs through the NE quarter section of Section 2, into the NW quarter section of Section 1. A small portion of the SW quarter of the SW quarter of Section 2 is within the Tilly Jane Proposed Wilderness Area. Approximately the southern half of Section 2 is within the Cloud Cap Proposed Wilderness Area, as are most of the SW quarter and about half of the SE quarter of Section 1.

*ORORO 017051*

Alder creek traverses the northern portion of Section 25 and crosses through the NE and SE quarters of Section 26. Crow Creek passes through the NE and NW quarters of Section 26 as well as the eastern half of Section 27. Puppy Creek crosses from the SW corner to the NW corner of Section 28. Surveyors Ridge Road (NFD 17) crosses in a north-south alignment through the center of Section 27. No other developed land uses are found in this lease area. Approximately 50 percent of Section 27 and 50 percent of the Section 28 portion of the lease site are within the proposed Shellrock Mountain National Recreation Area.

Surveyors Ridge Trail #688 is within this lease area (Bambe 2008).

*ORORO 017052*

Dog River Trail #675 and Bluegrass Ridge Trail #647 are within this lease area (Bambe 2008). Mount Hood Highway and the East Fork Hood River traverse the center of Section 32 in a north-south alignment. Dog River crosses from the SE quarter to the NW corner of Section 33. Unnamed forest roads provide some additional access to section 33 and 34. NFD 17 crosses Section 34 through the center in a north-south alignment. South Fork Mill Creek travels through the eastern portion of Section 34, and through the southern half of Section 35. Approximately 75 percent of the Section 32 portion of the lease site is within the proposed East Fork Hood River Wild and Scenic River area. A small portion of the NW quarter of Section 34 is within the proposed Shellrock Mountain National Recreation Area.

*ORORO 017053*

Elk Meadows Trail #645 and Tamanawas Falls Trail #650A are within this lease area (Bambe 2008). The John Mill Trail and Brooks Meadow Road/NFD 1720 travel across the SE quarter of Section 36. The South Fork Mill Creek crosses

through the southern half of Section 36. NFD 1721 loops into the NE and SE quarters of Section 36. Tilly Jane and Doe Creeks traverse Section 6, with Doe Creek also passing through the NW quarter of Section 1. Polallie Creek crosses through the NE quarter of Section 7, and Cold Spring Creek passes through the SE quarter of Section 7. The Section 6 portion of the lease site has an unnamed forest road in its SW quarter. The northern half of Section 7 contains two developed roads: Cloud Cap Road, and Copper Spur Road (NFD 3511). Approximately one-third of the Section 7 portion of the lease site is within the proposed Cloud Cap Wilderness Area.

*OROR 017327*
Four named trails exist in this lease site: East Fork Trail #650, the Tamanawas Falls Trail #650A, Elk Meadows Trail #645 (Bambe 2008) and the Zig Zag Trail. The south fork of Spring Creek transects the section into north and south in the western half of the section. The East Fork Hood River crosses through the eastern halves of sections 5 and 8 in a north-south alignment. Approximately 50 percent of these two sections lie within the proposed East Fork River wild and scenic river area. Polallie Creek traverses the NE quarter of Section 8. Buck Creek passes through Section 6. The Section 36 portion of this lease site lies within the proposed Blue Grass Ridge Wilderness Area.

## Impacts

***Alternative A (No Action)***
The No Action alternative would have no impact on existing land uses, including existing recreational uses and would not conflict with the Mount Hood LRMP or the NWFP.

***Alternative B (Proposed Action)***
The Proposed Action would not have any direct impacts on land use or recreation; however, the anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Portions of the lease areas lie within areas proposed to become Wilderness Areas, National Recreation Areas, and Wild and Scenic Rivers; however, at the time of writing of this analysis, these designations had not been approved. Should these designations be granted to these lands prior to the issuance of leases, the lease boundaries should be revised to exclude these special designations. If leases are issued prior to these designations being granted, the proposed action would be consistent with the Mount Hood LRMP and the NWFP.

Additional discussion of impacts on land use and dispersed recreation from geothermal plant development is provided in Section 4 of the PEIS, under *Land Use, Recreation and Special Designations*.

Anticipated actions following leasing have the potential to conflict with management guidelines and standards set forth by the Northwest Forest Plan

and the Mount Hood Forest Plan for those areas contained within Late Successional Reserves, Riparian Reserves, Key Watersheds and within Inventoried Roadless Areas and management areas with special designations for wildlife protection under the Forest Plan.

*Impacts on Riparian Reserves*

Per the discussion of the Northwest Forest Plan in Chapter 1, no new geothermal development is permitted in Riparian Reserves where leases do not already exist. On federal lands, riparian reserves are designated to protect water quality; timber harvest is prohibited and ground disturbances are not allowed. The reserve's width is based on the presence of fish and whether the stream is permanent or intermittent (see Table 15.3-2 below). Riparian reserve widths are determined by the average maximum height of the tallest trees in the area, "site-potential tree height," or a minimum width requirement. Any development within the Riparian Reserve would have the potential to conflict with the Northwest Forest Plan and the Mount Hood Forest Plan. The issuance of pending noncompetitive lease applications would not conflict with the NWFP with respect to Riparian Reserves if lease stipulations state that no surface-disturbing activities are to occur within the designated riparian buffer zones based on the above criteria.

**Table 15.3-2**
**Federal Riparian Reserve Width Requirements (Each Side of the Stream)**

| Stream Class | Riparian Reserve Width |
|---|---|
| Fish Bearing | Average height of 2 site potential trees or 300 feet |
| Permanent Non-Fish Bearing | Average height of 1 site potential tree or 150 feet |
| Intermittent | Average height of 1 site potential tree or 100 feet |

*Impacts on Key Watersheds*

No new roads are permitted within the project area. The issuance of pending noncompetitive lease applications ORORO 017051, 017052, and 017053 would not conflict with the NWFP with respect to Key Watersheds if lease stipulations state that no new roads shall be constructed.

*Impacts on Late-Successional Reserves*

Anticipated actions following lease issuance have the potential to impact old growth forests in Late-Successional Reserves. The Standards and Guidelines in the NWFP for Late-Successional Reserves require that the Mount Hood NF assess the impacts of proposed mining actions, and that the NF include in mineral activity permits appropriate stipulations (e.g., seasonal or other restrictions) related to all phases of mineral activity. The guiding principle is to design mitigation measures that minimize detrimental effects to late-successional habitat. These mitigation measures would reduce impacts on Late-Successional Reserves.

Potential conflicts with other wildlife management areas are discussed further in Section 15.3.9 *Fish and Wildlife*.

*Impacts on Inventoried Roadless Areas*
Portions of lease sites OROR 017049 and 017327 are within an Inventoried Roadless Area. Development in these areas would be consistent with this designation as long as no new roads were constructed to access the sites.

## 15.3.3 GEOLOGIC RESOURCES AND SEISMICITY

### Setting

The pending lease sites lie within the Pacific Mountain System portion of the Pacific geological province, which extends from southern California through the Kenai Fjords of Alaska. The Pacific province is one of the most geologically young and tectonically active regions in North America. The region straddles the boundaries between several tectonic plates, including the Juan de Fuca and North American plates. Where the Juan de Fuca Plate converges with the North American Plate the Cascade subduction zone occurs as the heavier oceanic plates slide underneath the buoyant North American plate (US Geological Survey 2004).

There are some unusual features at the Cascade subduction zone. Where the Juan de Fuca plate sinks beneath the more buoyant North American Plate there is no deep trench, lower seismic activity than expected, and there is evidence of a decline in volcanic activity over the past few million years. The probable explanation lies in a present slower rate of convergence (three to four centimeters per year) (US Geological Survey 2004).

As subduction occurs, high temperatures and pressures allow water molecules locked in minerals of solid rock to escape. The water vapor rises into the pliable mantle above the subducting plate, causing some of the mantle to melt. This newly formed magma rises toward the Earth's surface to erupt, forming a chain of volcanoes, known as the Cascade Range, above the subduction zone. The Cascade Range extends from British Columbia to Northern California, roughly parallel to the coastline. Within this region 13 major volcanic centers line in sequence. Initially formed 36 million years ago, the range's major peaks date to the Pleistocene. The majority of the Cascades consist of small, short-lived volcanoes built on a platform of lava and volcanic debris. Rising above this platform, a few large volcanoes, including Mt Hood, dominate the landscape (US Geological Survey 2004).

All the lease sites lie within approximately 12 miles of the summit of Mount Hood. Mount Hood is a major active volcano of the Cascade Range; its most recent series of eruptions occurred about 1,500 years ago and in the 1790s, just prior to the Lewis and Clark expedition. A 1997 report by the US Geological

Survey that analyzes potential hazardous geological events at Mount Hood indicates the presence of vents on the east, north and west flanks, as well as on the summit, and labels the area that contains the lease sites as a hazard zone. Areas along the East Fork Hood River, just north of the lease sites, are subject to Lahars (large mudflows of pyroclastic material and water that flow down from volcanoes) generated by eruptions at vents located on the upper east or north flanks of the mountain. The region is also susceptible to debris avalanches and related lahars of about 50 million cubic meters. US Geological Survey places the 30-year probability of a lahar occurring in this area at 1 in 300 (US Geological Survey 1997).

Landslides are the most significant geologic hazard in the lease area. The steep slope areas on all the leases are susceptible to landslides. Many of the steep gradient creeks are susceptible to debris flows.

### Impacts

***Alternative A (No Action)***

The No Action alternative would have no impact on geological resources and would not put any people or structures at risk from seismic-related events.

***Alternative B (Proposed Action)***

The Proposed Action would not have any direct impacts on geological resources or put people or structures at risk from seismic events; however, anticipated actions following leasing could have impacts on these resources and result in risks related to seismicity through development of geothermal resources, which would include increased human presence in the lease area, and construction of facilities, infrastructure and transmission lines. Also, seismic- and non-seismic-related landslides could damage infrastructure and cause injury to humans.

Any development should avoid unstable or potentially unstable areas.

Prior to construction of any facilities or infrastructure, geotechnical investigations would need to be conducted to ensure that any construction can withstand strong seismic events, and that facilities would be placed within safe distances from potential lahar and debris-slide areas.

## 15.3.4 ENERGY AND MINERALS

### Setting

The utility provider for Hood River County is Hood River Electric Cooperative. The Cooperative purchases power from Bonneville Power Administration. Bonneville Power Administration serves the Pacific Northwest through an extensive electricity transmission system and has an average annual generation of approximately 8,848 MW. Bonneville Power Administration markets

wholesale electric power from 31 federal hydro projects (supplying about 80 percent of Bonneville Power Administration's power), one non-federal nuclear plant, and several power plants. Bonneville Power Administration is working toward compliance with state Renewable Energy Standards by marketing wholesale electrical power at cost from federal dams and other nonfederal hydroelectric and wind energy generation facilities (Bonneville Power Administration 2007).

No locatable minerals have been identified in the proposed lease area. In the Mount Hood NF, three mining districts have been identified: the Oak Grove District, the Laurel Hill District, and the North Santiam District (US Forest Service 1990).

There has been significant interest in geothermal resource potential in the region. A total of 26,860 acres have been identified as having high resource potential, although almost 9,000 of these are in a Wilderness Area and therefore withdrawn from mineral leasing. Three geothermal resource potential areas had been identified in the Forest: the summit of Mount Hood, Carey Hot Springs adjacent to the Clackamas River, and Breitenbush in the Southern Portion of the Clackamas District. The three resource potential areas cover a total of 17,920 acres. As of 1990, 127 non-competitive lease applications were filed in areas both within and outside the resource potential areas (US Forest Service 1990). Within the BLM district, additional geothermal resources are being developed. The BLM has recently conducted an environmental analysis on the Newberry Geothermal Area in Deschutes County, with a finding of no significant impact (Bureau of Land Management 2007).

No other leasable minerals have been identified in the lease area (US Forest Service 1990). The 1982 Geothermal Resources of Oregon map noted test wells on the west, south, and northwest sides of Mt. Hood, but none on the east or northeast sides.

## Impacts

### *Alternative A (No Action)*

The No Action alternative would have no impact on energy and mineral resources.

### *Alternative B (Proposed Action)*

The Proposed Action would not have any direct impact on energy or mineral resources; however, anticipated future actions following leasing would potentially result in the development of geothermal resources at the pending lease sites. One 20-megawatt and one 30-megawatt plant are proposed for development in the lease area for a total of 50 megawatts. Details of impacts on energy and minerals are discussed for a standard 50 MW plant in Section 4 of the PEIS, *Energy and Minerals*. Similar impacts are anticipated at the lease site.

This impact would allow existing geothermal resources in the area to be utilized and would contribute a renewable source of energy to the regional power grid.

## 15.3.5 SOILS

### Setting

***ORORO 017149***

Limited soil data are available for ORORO 017049. Given the proximity to other lease sites, Sections 1 and 2 would likely be dominated by soil types seen at nearby lease sites ORORO 017053 and ORORO 017327. No prime or unique farmlands exist at this site (Natural Resource Conservation Service 2008).

***ORORO 017051***

Soils at ORORO 017051 are dominated by Bins-Bindle association, a mixture of soils formed by volcanic ash and loess overlaying colluvium derived from basalt and andesite. Slopes of these soil types are generally 20 to 70 percent, with a depth of 20 to 60 inches to lithic bedrock. The soils are moderately well drained, with no frequency of flooding, and have a low to moderate available water capacity. Gravelly and stony loam formed from volcanic rock, are found at the NW corner of the lease site, with gravelly loam concentrated a slopes ranging from 45 to 75 percent and stony loams concentrated at 8 to 65 percent. No prime or unique farmlands exist at this site (Natural Resource Conservation Service 2008).

***ORORO 017052***

Limited soil data are available for the portions of the lease areas to the east of Section 32. Soil type is likely similar to that of ORORO 017051, with gravelly and sandy loam concentrated in the western area of Section 32 and Bins-Bindle association soil dominating the remaining site area. Farmland of statewide importance exists along the southwest edge of Section 32 but does not fall within the lease area (Natural Resource Conservation Service 2008).

***ORORO 017053***

Limited soil data are available for Section 7 and 36. Soil types in Section 36 are expected to be similar to those at ORORO 017051, given the proximity of the two areas. Soils in Section 6 and likely in Section 7 are dominated by Hudson fine sandy loam, a derivative of volcanic ash and colluvium. Slopes of this soil type range from 0 to 30 percent, with a depth of more than 80 inches. The soil is well drained, with no frequency of flooding, and high water capacity. No prime or unique farmland exists at this site (Natural Resource Conservation Service 2008).

***ORORO 017327***

Limited soil data are available for the portions of the lease areas in Sections 8 and 36. Soil data are not available for Section 36. Soil in Section 5 and likely in

Section 8 is dominated by Hudson fine sandy loam, described under ORORO 017053. Farmlands of statewide importance exist in the SWNW, NWNE, and NENE areas of Section 6 (Natural Resource Conservation Service 2008).

### Impacts

***Alternative A (No Action)***

The No Action alternative would have no impact on soils.

***Alternative B (Proposed Action)***

The Proposed Action would not have any direct impact on soils; however, anticipated ground disturbance from the geothermal exploration and development activities likely to follow leasing would potentially result in impacts on erosion and soil productivity. Prior to construction of any facilities or infrastructure, geotechnical investigations would need to be conducted to ensure that any construction be situated on stable soils and that erosion-prevention measures be implemented in accordance with permitting requirements.

## 15.3.6 WATER RESOURCES

### Setting

***Surface Water***

The lease areas are within the Hood Basin, which drains the northern and eastern slopes of Mount Hood. The lease sites to the west of the East Fork Hood River are within the Western Hood Subbasin, and the lease sites to the east of the East Fork Hood River are within the Middle Columbia-Hood Subbasin (Oregon Department of Environmental Quality 2008a). All sites are within the Middle Columbia-Hood Watershed (US Geological Survey 2008). A Total Maximum Daily Load (TMDL) for the Western Hood Subbasin was approved by the US Environmental Protection Agency on January 30, 2002. A TMDL for the Middle Columbia-Hood Subbasin is in progress as of April 2008 (Oregon Department of Environmental Quality 2008a).

East Fork Hood River runs through the center of the lease area, flowing to the north.

The following surface water features occur within the Western Hood Subbasin portion of the lease sites:

- Evans Creek
- Cold Spring Creek
- Crystal Spring Creek
- Tilly Jane Creek
- Doe Creek

- Polallie Creek
- Buck Creek

The following surface water features occur within the Middle Columbia-Hood Subbasin portion of the lease sites:

- Dog River
- Alder Creek
- Crow Creek
- Puppy Creek
- South Fork Mill Creek

Lands are used primarily for logging and irrigated and non-irrigated agriculture. The Oregon Department of Environmental Quality Laboratory monitored East Fork Hood River in the City of Hood River initially at the Highway 30 Bridge and presently at the footbridge north of Interstate 84, where the East Fork Hood River meets the Columbia River (Oregon Department of Environmental Quality 2008b). This monitoring location is approximately 18 miles downstream of the lease area. Water quality from this monitoring location is expected to be worse than water quality at the portion of the East Fork Hood River crossing through the lease area because substantial urban and agricultural runoff occurs in between the two locations; however, water quality concerns for the river as a whole can indicate which water quality parameters are of greatest concern for the East Fork Hood River, which can guide the impact analysis and management strategies for upstream areas.

Water quality at the terminus of the East Fork Hood River is occasionally impacted by high levels of total phosphates, biochemical oxygen demand, and fecal coliform during heavy precipitation and high flows. This indicates the introduction of inorganic and organic materials to the water by erosion and runoff from fields, ditches, and storm drains. Moderately high temperatures, and high levels of total phosphates, biochemical oxygen demand, and total solids during summer low flow periods have been noted. These concentrations increase as less water is available for dilution. On the average, Oregon Water Quality Index scores for East Fork Hood River are good in the summer and fair during the fall, winter, and spring (Oregon Department of Environmental Quality 2008b).

Section 303(d) of the Federal Clean Water Act requires that a list be developed of all impaired or threatened waters within each state. Table 15.3-3 shows the waterways within the lease sites, their beneficial uses, and the contaminants for which they are in 303(d)-impaired status.

**Table 15.3-3**
**Beneficial Uses and Impairments of Waterways Within Lease Sites**

| Waterway | Beneficial Uses | 303(d) listed | Contaminants |
|---|---|---|---|
| Alder Creek | None defined | No | No data available |
| Buck Creek | None defined | No | No data available |
| Cold Spring Creek | None defined | No | No data available |
| Crow Creek | None defined | No | No data available |
| Crystal Spring Creek | None defined | No | No data available |
| Doe Creek | None defined | No | No data available |
| Dog River | Human health, Aquatic life | Yes | Beryllium, iron |
| Evans Creek | Human health, Aquatic life, Resident fish and aquatic life, Water contact recreation, Cold water aquatic life, Salmonid fish rearing and spawning, Anadramous fish passage, Drinking water | Yes | Beryllium, copper, iron |
| East Fork Hood River | Human health, Aquatic life, Resident fish and aquatic life, Water contact recreation, Cold water aquatic life, Salmonid fish rearing, Anadramous fish passage, Salmon and steelhead spawning, Aesthetics, Fishing, Livestock watering | Yes | Beryllium, copper, iron |
| Polallie Creek | Resident fish and aquatic life, Salmonid fish rearing and spawning | No | None |
| Puppy Creek | None defined | No | No data available |
| South Fork Mill Creek | None defined | No | No data available |
| Tilly Jane Creek | None defined | No | No data available |

Source: Oregon Department of Environmental Quality 2008c.

***Ground Water***

The lease sites lie within the Columbia Plateau regional aquifer system, an extensive set of aquifers and confining units that may locally be discontinuous but function hydrologically as a single aquifer system on a regional scale.

This regional aquifer occupies approximately 50,600 square miles in Idaho, Oregon, and Washington. The section of the aquifer in and around the lease sites is in undifferentiated volcanic and sedimentary rocks from the Pliocene era and younger, including beds of volcanic ash and tuff, silicic volcanic rocks, and semiconsolidated to consolidated sedimentary rock that contain small to large quantities of volcanic material. These rocks are complexly interbedded, and their permeability is extremely variable. The permeability of the various rocks that compose the aquifers is also extremely variable. Interflow zones and faults in basaltic lava flows; fractures in tuffaceous, welded silicic volcanic rocks; and interstices in coarse ash, sand, and gravel mostly yield less than 100 gallons per minute of water to wells. Interbedded almost impermeable rocks may retard the downward movement of groundwater and create perched water table conditions in some areas; however, Grande Ronde Basalt, a thick and extremely permeable volcanic rock, underlies the lease sites. Wells in the area discharge less that 10 to 500 gallons per minute. Discharge from the aquifer occurs via evapotranspiration, leakage to adjacent aquifers, withdrawals from wells, movement of water to surface-water bodies, and discharge from springs. Groundwater levels are highest in the spring as a result of recharge from snowmelt and decline through summer when the evapotranspiration rate causes discharge to exceed recharge. General movement of water in the area of the aquifer system overlain by the lease sites is from recharge areas near the edges of the basalt towards the Columbia River (US Geological Survey 1994).

Ground water quality is generally fresh and chemically suitable for most uses; sparse settlement in the area has prevented much groundwater contamination. Main groundwater uses in the region are for public, domestic and commercial, and agricultural purposes. Groundwater levels have been changed by irrigation practices, causing locally increased recharge and a rise in groundwater levels in some areas and declines (of as much as 300 feet) in others (US Geological Survey 1994).

*Crystal Springs Zone of Contribution*

Lease sites ORORO 017053 (nearly all of Section 6 portion and the northwest corner of the Section 7 portion) and ORORO 017049 (all except northwest half of Section 2 and western half of northwest quarter of Section 36) are within the Crystal Springs Zone of Contribution. The only reported pollutant at Crystal Springs is nitrate. Crystal Springs provides water for the Crystal Springs Water District, which serves a population of 5,000 people in the community of Odell, Oregon (Environmental Working Group 2008).

The Zone of Contribution coincides with the proposed Crystal Springs Management Unit, which is proposed for withdrawal from "*disposition under all laws pertaining to mineral and geothermal leasing or mineral materials*" in the current version of draft legislation (Bambe 2008).

## Impacts

### *Alternative A (No Action)*

The No Action alternative would have no impact on water resources.

### *Alternative B (Proposed Action)*

The Proposed Action would not have any direct impact on water resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts, as described below. Lease stipulations addressing water resources are included in Appendix B of the PEIS and would reduce impacts on surface water quality, as would BMPs in Appendix D and measures required by the permitting process for any site-specific projects.

*Surface Water Quality*

Typical impacts on water quality from geothermal development are described in Chapter 4 of the PEIS under *Water Resources*. The East Fork Hood River, Dog River and Evans Creek are impaired water bodies due to the presence of beryllium, copper, and iron. Geothermal development does not typically produce these contaminants; however, if these elements are naturally occurring in local soils at high levels, ground-disturbing activities could result in stormwater runoff, carrying these contaminants to the impaired water bodies. Impacts on

*Ground Water Quality*

Development of the lease sites could result in the groundwater impacts discussed in Chapter 4 of Volume I of the PEIS. All construction and operation activities are expected to be conducted in compliance with state and local regulations and impacts on ground water quality are expected to be little to none.

The potential for groundwater impacts is of particular concern in lease sites ORORO 017049 and 017053 due to their location in the Crystal Springs Zone of Contribution. Geothermal waters could introduce contaminants into the drinking water aquifer. Subsequent project-specific environmental reviews and permits would ensure that drilling procedures, including the installation of well casings and sealings, are conducted to current Oregon well construction standards.

If the Zone of Contribution area is removed from all existing lease applications through designation of the Crystal Springs Management Area, anticipated future actions following leasing would have no impacts on water quality at Crystal Springs.

*Water Quantity*

Indirect use geothermal projects require large amounts of water during all phases of a project from exploration through reclamation and abandonment;

therefore, anticipated future actions following leasing could result in indirect impacts on the surface water and ground water quantities. Specific geothermal development projects that may occur consistent with the Proposed Action would have a variety of water-sourcing options, including surface water, groundwater, and purchased water.

Project-specific environmental review would include consultation with the Crystal Springs Water District (for any proposed projects within the Crystal Springs Zone of Contribution), environmental groups, and other stakeholders. Additionally, drilling for groundwater would not occur without a ground water permit from the Oregon Water Resources Department, which would ensure sufficiency of the local aquifer to provide for both any approved project and competing users such as the Crystal Springs Water District. The Oregon Water Resources Commission is responsible for managing ground water to prevent depletion of the resource.

If the Zone of Contribution area is removed from all existing lease applications through designation of the Crystal Springs Management Area, anticipated future actions following leasing would have no impacts on water quantity at Crystal Springs.

### 15.3.7 AIR QUALITY AND ATMOSPHERIC VALUES

#### Setting

The lease area is located in Hood River County, an area with air quality status of Unclassified. Due to the remote location of the lease sites, air quality is considered to be good.

The Mount Hood Wilderness Area, adjacent to some of the lease sites, is within a Class I Airshed (Bambe 2008).

The lease site is in the Cascade Mountain Range which is about 75 miles east of the Coast Range. The climate is humid and cool. Air masses from the west rise at the range causing precipitation, though much less than at the Coast Range. The closest weather monitoring station to the lease site is at Parkdale, Oregon approximately five miles north of the lease area. Average maximum temperatures at Parkdale range from 39.0 degrees Fahrenheit in December to 80.9 degrees Fahrenheit in August, with average minimum temperatures ranging from 26.5 degrees Fahrenheit in December to 48.2 degrees Fahrenheit in July. Average annual precipitation at the Parkdale station is 33.2 inches (Western Regional Climate Center 2007).

### Impacts

***Alternative A (No Action)***

The No Action alternative would have no impact on air quality or atmospheric values.

***Alternative B (Proposed Action)***

Neither the Proposed Action nor anticipated future actions following leasing would result in violations of ambient air quality standards given the Unclassified status of the county and the good level of air quality. Anticipated future actions following leasing would have impacts as described in Section 4.8 of this PEIS.

## 15.3.8 VEGETATION

### Setting

The pending lease area is located within the western hemlock (*Tsuga heterophylla*) zone of the Northern Cascades Physiographic Province (Franklin and Dyrness 1988). Mt. Hood (elevation 11,245 feet above mean sea level) rises up from the lease area on the west. Events of both natural and human origin have modified forest stands in the lease area. Natural disturbance events include wind and snow storms, wildfire, and floods. Human disturbance of vegetation has occurred through timber management activities, fire, and recreational use. The lease area is a mosaic of forest stand ages, containing both old growth and second growth coniferous forest. The area is federally managed as NFS lands.

***Late-Successional Reserves***

In 1994 the NWFP designated a network of Late-Successional Reserves with the objective of protecting and enhancing conditions of late-successional and old growth forest ecosystems and the species that depend on this habitat (US Forest Service and Bureau of Land Management 1994). Timber harvest and other development activities are limited in Late-Successional Reserves. Several small areas designated as Late-Successional Reserves are found throughout the areas proposed for leasing (US Forest Service 2008b).

Old growth coniferous forests are characterized by very old and large overstory trees. Old growth forests have multiple structural attributes that make them high-value areas for wildlife, including variations in tree size and spacing, broken and deformed tops, multiple canopy layers, canopy openings, variation and patchiness of understory composition, and large-diameter standing dead and downed trees. This complex habitat supports a large number of plant and animal species, some of which are found only in late seral forests. Mature forests typically exhibit some, but not all, of the components of old growth forests. These forests make up much of the areas proposed for leasing.

***Deciduous Forest and Shrub Habitats***

Deciduous forest stands in the vicinity are found in sites with relatively recent ground disturbance, such as timber harvest and riparian zones along the East Fork Hood River and its tributaries. Red alder (*Alnus rubra*) is the dominant species in areas of disturbed soils within the western hemlock zone; it is also common within riparian zones. Big-leaf maple (*Acer macrophyllum*) is common in riparian zones and in openings in coniferous forest. Deciduous shrub communities may persist along the riparian corridors; these are typically dominated by willows (*Salix species*) and vine maple (*Acer circinatum*) (Franklin and Dyrness 1988). Deciduous forest stands along riparian zones can provide locally unique wildlife habitat when certain structural features are present. Such features can include variation and patchiness of understory vegetation, snags and downed logs, seasonal canopy cover, and stream shading.

***Riparian Habitats and Wetlands***

Riparian habitats are located at the interface between terrestrial habitats and aquatic environments. Deciduous forest and shrub habitats are characteristic along active channels of low-gradient waterways with well-developed floodplains. Riparian zones narrow with increasing stream gradient at the higher elevations within the proposed lease areas, leading to stands of mixed coniferous and deciduous species. Along narrow, higher-gradient streams, as are common in the lease area, coniferous tree species dominate the overstory.

Wetlands in the vicinity of the lease area include small areas of forested scrub and emergent wetlands (US Fish and Wildlife Service 2008a) along the floodplain of the East Fork Hood River. The most common tree species associated with forested wetlands are red alder, black cottonwood, and western redcedar. Freshwater forested scrub wetlands support a variety of sedges, forbs, and grasses (US Fish and Wildlife Service 2008a). Wetlands provide valuable plant, fish, and wildlife habitat and are also valued for their hydrologic functions. The US Forest Service manages the land adjacent to streams, lakes, reservoirs, and wetlands as Riparian Reserves, per the direction of the NWFP (US Forest Service and Bureau of Land Management 1994).

***Riparian Reserves***

On Federal lands, riparian reserves are designated to protect water quality; timber harvest is prohibited and ground disturbance is not allowed. The width of a riparian reserve is based on the presence of fish and whether the stream is permanent or intermittent. Riparian reserve widths are determined by the average maximum height of the tallest trees in the area or a minimum width requirement. Riparian reserves are found throughout the lease area, bordering all of the East Fork Hood River and its tributaries, as well as headwater streams of The Dalles watershed that is within the eastern portion of OROR 017053 (US Forest Service 2008b).

***Invasive and Non-Native Plant Species***

Invasive and non-native plant species (often called noxious weeds) are known to occur in the lease area and vicinity. The Oregon State Weed Board defines them as "*exotic, non-indigenous, species that are injurious to public health, agriculture, recreation, wildlife or any public or private property*" (Oregon Department of Agriculture 1999). The Oregon weed policy and classification system has been developed by the state of Oregon to provide a way to prioritize control programs for these species and to restrict their spread and effect on the environment. Treatment protocol of noxious weeds within the lease areas is outlined in the Forest-wide (Mt. Hood) Site-Specific Invasive Plant Treatment Environmental Impact Statement (US Forest Service 2008a). Table 15.3-4 shows invasive plant species expected to occur within the lease areas.

**Table 15.3-4**
**Invasive Plant Species Expected in the Lease Area**

| Common Name | Scientific Name |
|---|---|
| Diffuse knapweed | *Centaurea diffusa* |
| Spotted knapweed | *Centaurea maculosa* |
| Canada thistle | *Cirsium arvense* |
| St. Johns-wort | *Hypericum perforatum* |
| Meadow knapweed | *Centaurea pratensis* |
| Tansy ragwort | *Sencio jacobaea* |
| Butter and eggs | *Linaria vulgaris* |

SOURCE: US Forest Service 2005, 2008f

## Impacts

Potential impacts on vegetation and important habitats could occur if reasonably foreseeable future actions were to:

- Affect a plant species, habitat, or natural community recognized for ecological, scientific, recreational, or commercial importance;
- Affect a species, habitat, or natural community that is specifically recognized as biologically significant in local, state, or federal policies, statutes, or regulations;
- Establish or increase noxious weed populations;
- Destroy or extensively alter habitats or vegetation communities in such a way that would render them unfavorable to native species; or
- Conflict with FS management strategies.

***Alternative A (No Action)***

The No Action alternative would have no impact on vegetation and important habitats.

***Alternative B (Proposed Action)***

The Proposed Action would not have any direct impact on vegetation or important habitats or communities; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in impacts associated with the elimination and degradation of approximately 25 acres of habitat. Potential impacts associated with future exploration, drilling operations and development, utilization, and reclamation and abandonment would include:

- Habitat disturbance – Site clearing, well drilling, construction of access roads and geothermal facilities, and maintenance and operational activities would disturb timber and scrub habitat, increase risk of invasive species, and alter water and seed dispersion and wildlife use, which can further affect vegetation communities.
- Direct Removal and Injury – Trees and other vegetation would be cleared for roadways, vehicle staging, buildings, pipelines, and transmission lines. Activities could result in loss of soil, loss of seed bank in soil and deposition of dust. Maintenance around project components, such as drill pads, buildings, pipelines, or other facilities would involve mowing, herbicide treatment, and other mechanical or chemical means of removal and control. This would result in a net loss of important habitats and communities in the lease area.
- Invasive Vegetation – Disturbance and access by vehicles and human foot traffic may expose areas to colonization by invasive and non-native species, making it more difficult for endemic species to reestablish in disturbed areas and threatening the continued existence of endemic species (Bureau of Land Management 2007).
- Fire – Increased vehicular and human traffic, operation of equipment, the use of drilling muds, and the extraction of geothermal fluids can increase the risk of fires. Vehicles, electrical lines, and cigarette smoking can all result in accidental fires. Fires destroy valuable timber and forest vegetation and can aid in the establishment of invasive species.
- Erosion – Site clearing, grading, construction of access roads, containment basins, site runoff and vehicle and human foot traffic cause erosion. The effects of erosion include the removal of top soil, loss of seed bank, loss of native vegetation, the establishment of invasive species, the sedimentation of streams, and flooding (which can directly result in effects on riparian vegetation and riparian habitats).
- Exposure to Contaminants – Vehicle fuel, hydraulic fluid, solvents, cleaners, and geothermal fluids can all be harmful to vegetation and important habitats such as riparian areas. Accidental spills can

contaminate soils and water and directly harm vegetation. Licensed herbicide use would likely be used to control vegetation around geothermal facilities and support structures. Spills of herbicides or acute exposure to herbicides can have adverse effects on non-target vegetation.

***Old Growth and Late Successional Reserves***

Old growth, including Late-Successional Reserves, are scattered throughout the areas proposed for leasing. These forests are protected under the provisions of the NWFP (US Forest Service 1994); these protections are expected to remain in place in the future. Geothermal development of the lease areas would result in the removal of forest, and may include old growth and Late-Successional Reserves. Specific impacts affecting old growth forest are discussed further in Volume I of the PEIS, in Section 4.9, *Vegetation and Important Habitats*.

***Riparian and Wetland Habitats***

Riparian habitats are found along the East Fork Hood River and its tributaries, as well as headwater streams in The Dalles watershed. These habitats are protected as part of the NWFP and would be protected through best management practices if the lease sites are developed. Development is not allowed within riparian reserves; however, potential impacts on riparian habitats would still exist. They would include sedimentation, runoff, erosion, and effects to water quality and hydrology. Refer to Section 4.9 in Volume I of the PEIS for a more detailed discussion of the potential impacts on riparian habitats resulting from each stage of a geothermal project.

Impacts that could occur on wetlands include dewatering, changes in hydrology, disturbance, and removal. Impacts on wetlands are regulated under the River and Harbors Act and Section 404 of the Clean Water Act. Permitting from the US Army Corps of Engineers (Corp) will be required if future development at the site will have any impact on wetlands under Corps' jurisdiction. In addition, EO 11990, "Protection of Wetlands," requires all federal agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. Wetland habitats exist along the East Fork Hood River, which traverses north-south through much of the area proposed for leasing (US Forest Service 2008a). Other wetlands may exist within the lease area but have not been recorded; however, conditions are dynamic and may change over time. Wetland delineations would be conducted prior to activities that may disturb wetlands as the result of geothermal activities at the pending lease sites. A more complete discussion of the potential impacts on wetlands resulting from geothermal activities can be found in Section 4.9 in Volume I of the PEIS.

## 15.3.9 FISH AND WILDLIFE

### Setting

#### *Fisheries*

The following section describes the existing aquatic habitat and fish species occurring in East Fork Hood River and its tributaries, as well as fish that may occur in the headwater streams of The Dalles watershed. The waterways provide habitat for rainbow trout (*O. mykiss*), cutthroat trout (*O. clarki*), long-nosed (*Rhinichthys cataractae*) and black sided dace (*Phoxinus cumberlandensis*), and sculpins (US Forest Service 2008). Steelhead trout (*O. Mykiss*) are also present or expected to occur in both the East Fork Hood River and its tributaries, and waters of The Dalles watershed (US Forest Service 2008).

#### *Wildlife*

*Reptiles and Amphibians*

Reptiles likely to inhabit the area include the western terrestrial garter snake (*Thamnophis elegans*), common garter snake (*Thamnophis sirtalis*), and northern alligator lizard (*Elgaria coerulea*). Amphibians potentially present in the riparian habitat occurring in the lease sites include Pacific giant salamander (*Dicamptodon tenebrosus*), northwestern salamander (*Ambystoma gracile*), long-toed salamander (*Ambystoma macrodactylum*), northern rough-skinned newt (*Taricha granulosa*), Pacific chorus frog (*Pseudacris regilla*), northern red-legged frog, and the non-native bullfrog (*Rana catesbeiana*) (US Forest Service 2005). Larch mountain salamander *(Plethodon larselli*) may be found in higher elevations where there are talus slopes. There is also potential for Oregon slender salamander (*Batrachoseps wrightii*) in the lower elevations of lease areas (Dyck 2008).

*Birds*

Forested habitats in the lease area may contain game birds, raptors, songbirds, and other birds. Bird species closely associated with old growth and late successional forests found in the lease area include the northern spotted owl (*Strix occidentalis* spp. *caurina*), a federally listed species (see Section 3.11 below for further discussion). Species closely associated with deciduous forest and shrub habitats in the lease area include willow flycatcher (*Empidonax trailii*), yellow warbler (*Dendroica petechia*), MacGillivray's warbler (*Oporornis tolmiei*), black-capped chickadee (*Parus atricapillus*), red-eyed vireo (*Vireo olivaceous*), olive-sided flycatcher (*Contopus cooperi*), and ruffed grouse (*Bonasa umbellatus*).

*Mammals*

Large mammals in the lease area and surrounding vicinity include blacktailed deer (*Odocoileus hemionus columbianus*), elk (*Cervus elaphus*), black bear (*Euarctos americanus*), and mountain lion (*Felis concolor*). Furbearer species in the lease area include river otter (*Enhydra lutra*), beaver (*Castor canadensis*), raccoon (*Procyon lotor*), and coyote (*Canis latrans*). Common small mammals in the project vicinity are Townsend chipmunk (*Eutamias townsendi*), Trowbridge shrew (*Sorex*

*trowbridgei*), deer mouse (*Peromyscus maniculatus*), snowshoe hare (*Lepus americanus*), Douglas squirrel (*Tamiasciurus douglasi*), and northern flying squirrel (*Glaucomys sabrinus*). Bats that may inhabit the vicinity include little brown myotis (*Myotis lucifugus*), long-eared myotis (*Myotis evotis*), silver-haired bat (*Lasionycteris noctivagans*), and Yuma myotis (*Myotis yumanensis*).

## Impacts

Potential impacts on fish and wildlife could occur if reasonably foreseeable future actions were to:

- Adversely affect a population by substantially reducing its numbers, causing a fish or wildlife population to drop below self-sustaining levels or causing a substantial loss or disturbance to habitat; such effects could include vehicle impacts and crushing, increased predation, habitat fragmentation, or loss of seasonal habitat;
- Have a substantial adverse impact on nesting migratory birds, including raptors, as protected under the Migratory Bird Treaty Act;
- Interfere with the movement of any resident or migratory fish or wildlife species, or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites; or
- Conflict with the wildlife management strategies of the FS.

### *Alternative A (No Action)*

The No Action alternative would have no impact on fish and wildlife.

### *Alternative B (Proposed Action)*

The Proposed Action would not have any direct impact on fish and wildlife; however, anticipated future actions following leasing would potentially result in impacts on fish and wildlife within the lease areas from an estimated disturbance of approximately 25 acres. Potential impacts that would affect all wildlife would result from:

- Habitat disturbance – The fragmentation of wildlife habitat for species requiring large contiguous tracts, such as elk, mountain lion, and black bear, can be affected by site clearing, well drilling, construction of access roads and geothermal facilities, and maintenance and operational activities. These activities could cause disruption of breeding, foraging and migration, as well as mortality and injury of wildlife.
- Invasive Vegetation – Invasive species can affect wildlife by reducing habitat quality and species diversity and can affect foraging and breeding behavior.

- Injury or Mortality – Wildlife could be injured or killed during the clearing of roadways, vehicle staging, building construction, and other activities. Small mammals, reptiles and amphibians are most likely to be affected.
- Erosion and runoff – The effects of erosion include the loss of habitat for terrestrial species and increased turbidity which can directly affect the resident salmonid species found in the lease area.
- Fire – Vehicles, electrical lines, and cigarette smoking can all result in accidental fires. During fires wildlife can be killed or injured. After fires wildlife may be forced to move to other habitats or may be without suitable habitat for important behavioral activities.
- Noise – Construction and operation of geothermal facilities can produce noise far above normal ambient noise levels. Many species are sensitive to increases in noise that may cause disruption of breeding, migration, wintering, foraging, and other behavioral activities.
- Exposure to Contaminants – Vehicle fuel, hydraulic fluid, solvents, cleaners, and geothermal fluids can all be harmful to fish and wildlife. Accidental spills can contaminate soils and water and indirectly harm wildlife. Licensed herbicide use would likely be used to control vegetation around geothermal facilities and support structures. Spills of herbicides or acute exposure to herbicides can have adverse effects on wildlife.

*Fish*

Fish species in the East Fork Hood River and its tributaries, as well as headwater streams of The Dalles watershed could be affected by several activities. Impacts on fish and aquatic biota from development to the lease area would be linked to impacts on riparian habitats and immediately adjacent upland habitat. Ground disturbance, vegetation removal, ground water withdrawal, road construction and excavation, installation of structures and other facilities, such as transmission towers or pipelines, and release of water contaminants could affect fish species residing in streams in the project area, including cutthroat and rainbow trout and resident sculpin and dace species. Changes in hydrology, increased turbidity, changes in water quality (temperature, dissolved oxygen, pollutants, etc.), loss of riparian vegetation (an indirect aquatic food source), restriction of fish movement and migration, and changes in predator and human use of the aquatic habitat are all potential impacts associated with development of the lease area. The PEIS provides a more complete analysis of the potential impacts on fish resulting from geothermal activities, as well as impacts on riparian and wetland habitat that could affect fish and other aquatic biota.

*Wildlife*

Amphibians present in the lease area could be affected by any impacts that affect riparian habitat or water quality. Additionally, activities could result in direct mortality for amphibians and reptiles that are crushed by equipment or entrapped in underground burrows.

The lease sites provide habitat for a variety of migratory birds. Under the Migratory Bird Treaty Act, the FS is required to analyze the impacts of any action on migratory birds. The likelihood of disturbing nests of such birds is limited primarily to breeding and nesting seasons (spring and summer). Waterfowl, raptors, and small birds that depend on a particular forest types as a source of food or cover could be vulnerable to loss of habitat within the lease sites. Removing timber and other vegetative cover affects foraging and nesting behavior. Lease stipulations to avoid disturbance during the migratory bird nesting season, so as not to violate the Migratory Bird Treaty Act, would reduce the potential for significant impacts on migratory birds.

The lease areas provide foraging and wintering habitat for elk and deer. Habitat clearing and human activity associated with geothermal projects could disturb elk, displacing them temporarily or permanently from otherwise suitable foraging habitats in and adjacent to the areas proposed for leasing. Geothermal activities associated with development of the lease site would also result in increased human activity and potentially increase recreational use of the area, which could directly affect big game populations.

## 15.3.10 THREATENED AND ENDANGERED SPECIES AND SPECIAL STATUS SPECIES

### Setting

This section provides an overview of threatened, endangered, and special status species and their habitats in the proposed lease area. Special status species are those identified by federal, state, or local agencies as needing additional management considerations or protection. The discussion of special status species is based primarily on analysis conducted for the Long Prairie Grazing Allotment Project located immediately adjacent to the areas proposed for leasing (US Forest Service 2005), as well as correspondence with NFS biologists regarding the lease area. Federal species are those protected under the Endangered Species Act and those that are candidates or proposed for listing under the act. State sensitive species are those considered sensitive by the Oregon Department of Fish and Wildlife. Federally listed species with record of occurrence in the proposed lease area are discussed below and listed in Table 15.3-5. Table 15.3-6 provides a record of FS sensitive species and management indicator species that may be present in the lease sites.

**Table 15.3-5**
**Federally Listed Wildlife Species with Record of Occurrence and Potential to Occur in the Lease Area**

| Species | Habitat Present in Lease Areas? | Status | | |
|---|---|---|---|---|
| | | Federal | USFS – R6 | State |
| Lower Columbia River Steelhead Trout | Immediately adjacent | Threatened | Sensitive | N/A |
| Middle Columbia River Steelhead Trout | Immediately adjacent | Threatened | Sensitive | N/A |
| Northern Spotted Owl | Yes | Threatened | N/A | Threatened |
| California Wolverine | Yes | Candidate | Sensitive | Threatened |

Source: US Forest 2005, 2008f

*Lower and Middle Columbia River Steelhead Trout*

Lower and Middle Columbia River Steelhead Trout are the only anadramous fish known or expected to occur within the areas that may be affected by proposed leasing (US Forest Service 2008f). The presence of Lower Columbia River Steelhead has been recorded within the East Fork Hood River, and Middle Columbia River Steelhead Trout are found in the headwater of The Dalles watershed (US Forest Service 2008f). Both fish were listed under the Endangered Species Act threatened species on March 19, 1998. The threatened status of both of these species was reaffirmed on January 5, 2006 (National Marine Fisheries Service 2008).

*Northern Spotted Owl*

The northern spotted owl was federally listed as threatened in Washington, Oregon, and California in July 1990 (55 FR 26114); it is an Oregon State endangered species. Factors that contributed to the federal listing were the declining population trends, the loss of suitable forested habitats throughout the species range, and the lack of adequate regulatory mechanisms to protect existing habitat for the species. Critical habitat was designated for the northern spotted owl in 1992 (57 FR 1796). Spotted owls are strongly associated with mature and old growth forests for nesting, foraging, and roosting. Nesting and roosting occur in a variety of coniferous forest types characterized by moderate to high levels of canopy closure; high density of standing snags; large diameter overstory trees with deformities, such as broken tops and witches' brooms; and abundant coarse woody debris on the forest floor (Courtney et al. 2004). Old growth and Late-Successional Reserves are found throughout the lease sites and

**Table 15.3-6**
**FS Sensitive Species and Management Indicator Species that May Occur in the Lease Sites**

| Common Name | Scientific Name | Potential Occurrence |
|---|---|---|
| Oregon Slender salamander | *Batrachoseps wrighti* | Y |
| Larch Mountain salamander | *Plethodon larselii* | Y |
| Cascade torrent salamander | *Rhyocotriton cascadae* | N |
| Pacific fisher | *Martes pennanti* | Y |
| Horned grebe | *Podiceps auritus* | Y |
| Bufflehead | *Bucephala albeola* | Y |
| Harlequin duck | *Histrionicus histrionicus* | Y |
| Peregrine falcon | *Falco peregrinus anatum* | N |
| Gray flycatcher | *Empidonax righti* | N |
| Puget oregonium | *Cryptomastix devia* | Y |
| Columbia oregonium | *Cryptomastix hendersoni* | Y |
| Dalles sideband | *Monadenia fidelis minor* | Y |
| Crater Lake tightcoil | *Pristiloma arcticum crateris* | Y |
| Evening fieldslug | *Deroceras hesperium* | Y |
| **Mt Hood NF Management Indicator Species and Neotropical Birds** | | |
| Mule/Blacktailed Deer | *Odocoileus hemionus* | Y |
| Rocky Mountain Elk | *Cervus elaphus* | Y |
| Pine Martin | *Martes Americana* | Y |
| Pileated Woodpecker | *Dryocopus pileatus* | Y |
| Western Gray Squirrel | *Sciurus griseus* | Y |
| Wild Turkey | *Meleagris gallopavo* | Y |
| Snag and Down Log Associated Species | -- | Y |
| Neotropical Migratory Birds | -- | Y |

SOURCE: US Forest Service 2005

provide suitable habitat for northern spotted owl; thus, their presence is assumed to occur in the sites proposed for leasing where suitable habitat occurs.

*California Wolverine (Gulo Gulo)*
Wilderness or remote country where human activity is limited appears essential to the maintenance of viable wolverine populations. High-elevation wilderness areas appear to be preferred in summer, which tends to effectively separate wolverines and humans. In winter, wolverines move to lower elevation areas that are snowbound with very limited human activity (Hornocker and Hash 1981). The last confirmed sighting of a wolverine in the Hood River Ranger

District was in 1990. The north side of Mount Hood is considered the most likely area for wolverines to den, if present within the area. The closest recent and confirmed wolverine sighting was two years ago on the Willamette National Forest by a USFS biologist (Dyke 2008). Because of the level of human activity present in the area and lack of confirmed presence, wolverines are not likely to be found in the lease area; however, their presence/absence from the lease sites on the north side of the Mt Hood can not be confirmed.

*Critical Habitat*

The Endangered Species Act requires the federal government to designate critical habitat for any species listed under the Act. Critical habitat is any specific area within the geographical area occupied by the species at the time of listing under the act that contains physical or biological features essential to conservation, and those features requiring special management considerations or protection; it also includes areas outside the geographical area occupied by the species that are determined essential to conservation.

Critical habitat designations must be based on the best scientific information available, in an open public process, within specific timeframes. Before designating critical habitat, careful consideration must be given to the economic impacts, impacts on national security, and other relevant impacts of specifying any particular area as critical habitat. The Secretary of Commerce may exclude an area from critical habitat if the benefits of exclusion outweigh the benefits of designation, unless excluding the area will result in the extinction of the species concerned.

The Endangered Species Act protects threatened and endangered species in several ways. Under Section 7, all federal agencies must ensure that any actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species, or destroy or adversely modify its designated critical habitat.

*Plants*

Two FS sensitive plant species are found in the lease area. They are elegant rockcress (*Arabis sparsiflora* var. *atrorubens*) and violet suksdorfia (*Suksdorfia violacea*).

## Impacts

Title 16, United States Code, section 1531 *et seq.,* and Title 50, Code of Federal Regulations, part 17.1 *et seq.*, designate and provide for protection of threatened and endangered plant and animal species and their critical habitat. The administering agencies are the US Fish and Wildlife Service and the National Marine Fisheries Service. Consultation pursuant to Section 7 of the Endangered Species Act would be performed prior to any ground-disturbing activity.

Potential impacts on threatened and endangered and special status species could occur if reasonably foreseeable future actions were to:

- Violate the Endangered Species Act, the Migratory Bird Treaty Act, or applicable state laws; or
- Decrease a plant or wildlife species population to below self-sustaining levels.

***Alternative A (No Action)***
The No Action alternative would have no impact on special status species.

***Alternative B (Proposed Action)***
The Proposed Action would not have any direct impact on threatened and endangered and special status species; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Threatened and endangered species (including federal and state-listed species and FS and BLM special status species) could be affected as a result of 1) habitat disturbance, 2) the introduction of invasive vegetation, 3) injury or mortality, 4) erosion and runoff, 5) fugitive dust, 6) noise, 7) exposure to contaminants, and 8) interference with behavioral activities.

Because of the regulatory requirements of the Endangered Species Act and various state regulations, and the requirements specified in BLM Manual 6840 Special Status Species Management, FS sensitive species and management indicator species guidelines, and other resource-specific regulations and guidelines, appropriate survey, avoidance, and mitigation measures would be identified and implemented prior to any geothermal activities to avoid adversely affecting any sensitive species or the habitats on which they rely.

## 15.3.11 HISTORIC AND SCENIC TRAILS

### Setting

The Oregon section of the Pacific Crest National Scenic Trail traverses an area approximately five miles from the SWSW corner of Section 2 of OROR 017049. The Pacific Crest Trail spans 2,650 miles from Mexico to Canada, crossing through California, Oregon, and Washington. The trail passes through many historic and scenic areas and is mainly contained within National Forests and protected wilderness. The Mount Hood area is the chief attraction for the Oregon section of this trail, with 200 people annually attempting to complete the entire trail (US Forest Service 2008).

### Impacts

***Alternative A (No Action)***
The No Action alternative would have no impact on historic or scenic trails.

***Alternative B (Proposed Action)***

The Proposed Action would have no direct impact on historic or scenic trails. Anticipated future actions following leasing are not expected to result in any impacts on the Pacific Crest Trail due to the lease sites being farther than the required one-mile buffer that is described in the PEIS to avoid impacts.

## 15.3.12 CULTURAL RESOURCES

### Setting

Cultural resources are past and present expressions of human culture and history in the physical environment and include prehistoric and historic archaeological sites, structures, natural features, and biota that are considered important to a culture, subculture, or community. Cultural resources also include aspects of the physical environment that are a part of traditional lifeways and practices and are associated with community values and institutions.

As in the PEIS, discussions relevant to cultural resources in this document are found in three sections. Traditional cultural resources and traditional cultural properties are addressed in Section 15.3.13, *Tribal Interests and Traditional Cultural Resources*. Section 15.3.11 addresses *Historic and Scenic Trails*. Cultural resources in this section include the physical remains of prehistoric and historic cultures and activities.

Ceded Lands of The Confederated Tribes of Warm Springs (Dryden 2008a) in the Molala extended-family groups wintered west of the Cascades summit in low elevations. Winter villages included semi-excavated wood plank houses. At other times of the year, individuals and families ranged to a variety of harvest localities from low-elevation prairies to collecting and hunting grounds in the High Cascades. Summer houses were constructed of bark or thatched-rush and resembled winter houses but were not excavated. Large and small terrestrial mammals were hunted for subsistence, primarily deer and elk. The bow and arrow, snares, deadfalls, pitfalls, stalking, and tracking by dog were all used for hunting. Fish were hunted with harpoon, basketry traps, and weirs in the rivers, while vegetal subsistence resources were collected in the prairies, savannas, and high elevations (Zenk and Rigsby 1998).

A variety of historic-era activities have been documented within the region of the pending lease application sites. These included fur trapping and trade, mining, agriculture, fishing, emigration and settlement by Euro-Americans, missionization, and establishment of trails and railroads. Lewis and Clark may have been the first Euro-Americans to contact the Molalas; however, there is sufficient documentation to confirm that contact had been made by the 1840s when Euro-Americans began to settle in the Willamette Valley, resulting in occasional conflicts between settlers and Molala people. The Dayton and Molala treaties of 1855 provided for the removal of Molalas to the Grand Ronde

Reservation east of the project area. Primarily Northern Molalas moved to the reservation, but many others moved to other reservations in Oregon or maintained their own residences (Zenk and Rigsby 1998). The Warm Springs and Wasco bands were relocated to the Confederated Tribes of Warm Springs Reservation. As noted in Section 15.3.11, the Oregon Trail passes through the region. Associated with this trail is the National Register of Historic Places (NRHP)-listed Barlow Road National Historic District also within the region (Dryden 2008b).

Data on cultural resources of the proposed lease area were provided in May 2008 by Michael Dryden, East Zone Archaeologist for the Mount Hood NF. The basic records search conducted revealed there are ten previously recorded cultural resource sites within lease application site OROR 017053, four within OROR 017327, five within OROR 017052, two within OROR 017051, and four within OROR 017049, including a NRHP-listed historic district and its contributing elements. Sites OROR 017327, 017052, and 017053 have been almost entirely surveyed while the remaining two leases application sites have had only minimal, scattered coverage by previous surveys.

Resources within OROR 017053 are all historic-era sites. Seven of these are buildings and building remains: FS Site Nos. 666EA0179 (Don's Cabin), 666EA0161 (Cooper Spur Warming Hut), 666EA0199 (collapsed cabin), 666EA0200 (collapsed cabin), 666EA0083 (Homestead Inn), 666EA0085 (cabin remains), and 666EA0081 (cabin remains). Two of the Euro-American sites are ditches: FS Site Nos. 666EA0050 (Glacier Ditch) and 666EA0079 (portion of Glacier Ditch). The final site is a hunter's campsite, FS Site No. 666EA0180. Of the sites within Lease OROR 017053 only FS Site Nos. 666EA0161 and 666EA0180 have been evaluated for NRHP eligibility; the former has been determined eligible for the NRHP and the latter ineligible. All other sites within the lease area are unevaluated for NRHP eligibility and are therefore treated as eligible. Almost the entire lease area has been previously surveyed with current survey methods.

Two of the recorded resources within Lease OROR 017327 are pre-contact-era and two are Euro-American. These include the pre-contact sites FS Site Nos. 666NA0080 and 666NA0063, both locations of peeled cedar trees. The former has not been evaluated for NRHP eligibility and is therefore treated as eligible. FS Site No. 666NA0063 has been evaluated and was determined ineligible for the NRHP. The two Euro-American resources within Lease OROR 017327 are FS Site Nos. 666EA0087 and 666EA0088, both cabin remains. Neither has been evaluated for NRHP eligibility. Almost the entire lease area has been previously surveyed with current survey methods.

Lease OROR 017052 includes three Euro-American sites and two pre-contact sites. The Euro-American sites include FS Site Nos. 666EA0115, a sheepherder's grave, 666EA0058, Mill Creek Buttes Lookout, and 66EA0001, Glade rock piles.

The pre-contact sites include FS Site Nos. 666NA0301, a quarry and lithic scatter, and 666NA0303, a lithic isolate. None of the sites within this lease have been evaluated for NRHP eligibility and are therefore treated as eligible. Almost the entire lease area has been previously surveyed with current survey methods.

The two resources within ORORO 017051 are both pre-contact sites. These include FS Site Nos. 666NA0078, a spring ditch, and 666NA0068, a stripped cedar tree. Neither site has been evaluated for NRHP eligibility. Less than ten percent of the lease area has been previously surveyed with current survey methods.

Recorded resources within Lease ORORO 017049 are all Euro-American. Most of the lease is within the boundaries of the Cloud Cap-Tilly Jane National Historic District and includes various unrecorded contributing resources to the district. Additionally, FS Site Nos. 666EA0184, 666EA0100, and 666EA0029 are within the lease. FS Site No. 666EA0184 is a dispersed can dump site and FS Site No. 666EA0100 is the Cloud Cap Wagon Road. Both have been determined eligible for the NRHP. FS Site No. 666EA0029 is the location of a 1959 jet airplane crash that has been determined ineligible for the NRHP. Very little (less than ten percent) of the lease area has been previously surveyed.

Consultation with federally recognized tribes that are affiliated with the lease area, including the Warm Springs Reservation, was initiated on September 12, 2007 to identify and assess historic properties that may be affected by the undertaking. No responses from local tribes have been received as of the date of publication; however consultation is considered on-going.

Until consultation with local Native Americans has been completed, it is unknown if there are Native American sites or sacred sites within or adjacent to the lease areas. The presence of cultural resources within portions of the leases not previously surveyed is also possible. Table 15.3-7 summarizes available data on the cultural resources of the proposed lease areas.

**Table 15.3-7**
**Recorded Cultural Resources in the Proposed Lease Areas**

| Lease ORORO | Surveys (Percent) | NRHP-listed sites | NRHP-eligible sites | NRHP-ineligible sites | Unevaluated sites (Treated as NRHP-Eligible) |
|---|---|---|---|---|---|
| 017049 | 8 | 1 | 2 | 1 | N/A |
| 017051 | 1 | N/A | N/A | N/A | 2 |
| 017052 | 99 | N/A | N/A | N/A | 5 |
| 017053 | 96 | N/A | 1 | 1 | 8 |
| 017327 | 98 | N/A | N/A | 1 | 3 |

## Impacts

### *Alternative A (No Action)*

The No Action alternative would have no impact on cultural resources.

### *Alternative B (Proposed Action)*

The Proposed Action would not have any direct impact on cultural resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Completion of the Section 106 process of the National Historic Preservation Act requires the FS to consult with the State Historic Preservation Office, tribes and other parties to identify and assess historic properties affected by the undertaking and to develop measures to avoid, minimize, or mitigate any adverse effects of the undertaking on historic properties.

Given the density of sites within the lease areas and the presence of NRHP-listed and –eligible resources within the Mt. Hood area leases, impacts on cultural resources could occur from subsequent permitted geothermal exploration, drilling operations and development, utilization and reclamation and abandonment through ground-disturbing activities, unauthorized actions and alterations to setting and cultural landscapes. The nature of these impacts is described in Chapter 4 of Volume I of the PEIS. Additionally, as described in Chapter 2 of Volume I of the PEIS, various areas of cultural resources would have No Surface Occupancy stipulations: National Landmarks, National Register Districts, NRHP-listed and –eligible sites and their associated landscapes, traditional cultural properties, Native American sacred sites, and areas with important cultural and archaeological resources. Areas of potential effect would include access roads, well pads, power plant footprints, pipeline and transmission line routes, and construction staging areas as well as the boundaries of cultural resources those facilities cross and the aspects of setting that contribute to significance. These areas of potential effect would be developed at the project-specific level and would require inventories, evaluations, and appropriate treatments as outlined in the best management practices of Appendix D in Volume III of the PEIS. Under these cultural resources best management practices, the FS would also conduct Section 106 consultations with the State Historic Preservation Office, Native American tribes with ties to the project area, and local historic preservation groups to identify the presence and significance of cultural resources within or adjacent to the lease area and assess the level of impact of geothermal leasing and development on those resources. Project-specific impacts after leasing would be reduced by implementing these best management practices.

## 15.3.13 TRIBAL INTERESTS AND TRADITIONAL CULTURAL RESOURCES

### Setting

Tribal interests include economic rights such as Indian trust assets, and resource uses and access guaranteed by treaty rights. Traditional cultural resources or properties include areas of cultural importance to contemporary communities, such as sacred sites or resource gathering areas. While most commonly considered in the context of Native Americans and Native Alaskans, there are traditional cultural resources associated with other ethnic or socially linked groups.

The lease area is within the Ceded Lands of The Confederated Tribes of Warm Springs (Dryden 2008a) in the Plateau culture region, as described in the Appendix I of the PEIS. Zenk and Rigsby (1998) provide an ethnographic overview of the project area within the larger Plateau culture region. The leases are considered to be within the traditional territory of the Warm Springs and Wasco bands (Dryden 2008b), Molala-speaking groups. Within the traditional territory, the project area is in an area where the Northern Molala dialect was spoken but is immediately adjacent to the northern boundary of the Molala territory. Traditional collecting and hunting grounds were typically located in the High Cascades.

The Dayton and Molala treaties of 1855 provided for the removal of Molalas to the Grand Ronde Reservation east of the project area. Primarily Northern Molalas moved to the reservation, but many others moved to other reservations in Oregon or maintained their own residences (Zenk and Rigsby 1998). The Warm Springs and Wasco bands were relocated to the Confederated Tribes of Warm Springs Reservation (Dryden 2008b).

The lease areas are entirely within the Ceded Lands of the Confederated Tribes of the Warm Springs Reservation. Although there are no known traditional cultural properties within the lease areas (Dryden 2008a), this location makes the likelihood for such resources high. Additionally, there are known huckleberry fields within OROR 017049 and 017327 that have not been defined or mapped. Huckleberry fields are considered to be Native American resource sites by local Native Americans. These fields therefore have the potential to be cultural properties.

Tribes with ties to the lease area include the Confederated Tribes of Warm Springs Reservation of Oregon. Consultation with federally recognized tribes that are affiliated with the lease area, including the Warm Spring Reservation, was initiated on September 12, 2007 to identify and assess tribal concerns and traditional resources that may be affected by the undertaking. No responses from the tribes have been received as of the date of publication; however, the consultation process is considered on-going. While many traditional cultural

resources are well known, some locations or resources may be privileged information that is restricted to specific practitioners or clans. For tribes, maintaining confidentiality and customs regarding traditional knowledge may take precedence over identifying and evaluating these resources, unless they are in imminent danger of damage or destruction.

## Impacts

### *Alternative A (No Action)*

The No Action alternative would have no impact on tribal interests and traditional cultural resources.

### *Alternative B (Proposed Action)*

The Proposed Action would not have any direct impact on tribal interests and traditional cultural resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Impacts on tribal interests and traditional cultural resources are assessed using the criteria found in Chapter 4 of Volume I of the PEIS. Because issuing geothermal leases confers on the lessee a right to future exploration and development of geothermal resources within the lease area, it is a commitment or granting of a right that may interfere with other uses or interests. Although no tribal interests or concerns have been identified by the consultation process, the presence of huckleberry fields within the lease areas and the location of the leases within the Ceded Lands of the Confederated Tribes of Warm Springs Reservation make the likelihood of Native American resources or areas of concern high. The process of Native American consultation is considered on-going and such resources may be identified in the future by tribes. Impacts on tribal interests would be minimized or avoided by implementing best management practices included in Appendix D of Volume III of the PEIS for each phases of the Reasonably Foreseeable Development scenario, as described in Chapter 2 of Volume I of the PEIS.

For traditional cultural resources, completion of the Section 106 process of the National Historic Preservation Act requires the FS to consult with the State Historic Preservation Office, tribes and other parties to identify and assess historic properties affected by the undertaking and develop measures to avoid, minimize, or mitigate any adverse effects of the undertaking on historic properties, which include traditional cultural properties. No traditional cultural resources have been identified by consulted tribes thus far, but consultation is considered on-going. Additionally, archaeological resources such as those discussed in Section 15.3.12 *Cultural Resources* are often considered traditional resources by tribes.

Impacts on traditional cultural resources could occur from subsequent geothermal exploration, drilling operations and development, utilization, and reclamation and abandonment through ground-disturbing activities, unauthorized actions and alterations to setting and cultural landscapes. The

nature of these impacts and mitigations are described in Chapter 4 of Volume I of the PEIS. Areas of potential effect would include access roads, well pads, power plant footprints, pipeline and transmission line routes, and construction staging areas as well as the aspects of setting that contribute to significance. These areas of potential effect would be developed at the project-specific level and would require inventories, evaluations, and appropriate treatments as outlined in the best management practices of Appendix D in Volume III of the PEIS. Under these cultural resources best management practices, the FS would also conduct Section 106 consultations with the State Historic Preservation Office, Native American tribes with ties to the project area, and local historic preservation groups to identify the presence and significance of cultural resources within or adjacent to the lease area and assess the level of impact of geothermal leasing and development on those resources. Project-specific impacts after leasing would be reduced by implementing these best management practices.

## 15.3.14 VISUAL RESOURCES

### Setting

This section describes the visual resources in the region of influence, which is defined as the areas within and immediately surrounding the proposed lease areas. Described below is the method for managing scenic resources and the visual landscape of the lease areas.

The scenery of the Forest is managed through the application of the Visual Management System (Agricultural Handbook- 462, National Forest Landscape Management, Volume 2, Chapter 1, The Visual Management System). The Visual Management System was adopted by the Forest Service in 1974. The key component of the Visual Management System is the establishment of Visual Quality Objectives within the Land and Resource Management Plan.

There are five differing levels of Visual Quality Objectives: Preservation, Retention, Partial Retention, Modification, and Maximum Modification.

The following is a brief description of the five Visual Quality Objectives:

- Preservation – Allows ecological change only. Management activities are prohibited except for very low visually impacting recreation facilities.
- Retention – Management activities may not be visually evident. Contrasts in form, line, color and texture must be reduced during or immediately after the management activity.
- Partial Retention – Management activities must remain visually subordinate to the characteristic landscape. Associated visual

impacts in form, line, color and texture must be reduced as soon after project completion as possible but within the first year.

- Modification – Management activities may visually dominate the characteristic landscape. However, landform and vegetative alterations must borrow from naturally established form, line, color or texture so as to blend in with the surrounding landscape character. The objective should be met within one year of project completion.
- Maximum Modification – Management activities including vegetative and landform alterations may dominate the characteristic landscape. However, when viewed as background they must visually appear as natural occurrences within the surrounding landscapes or character type. When viewed as foreground or middle ground, they may not appear to completely borrow from naturally established form, line, color, or texture. Alterations may also be out-of-scale or contain detail which is incongruent with natural occurrences as seen in foreground or middle ground. Reduction of contrast should be accomplished within five years.

Some of the lease areas have Partial Retention and Retention Visual Quality Objectives. The southwestern areas are adjacent to the Mount Hood Wilderness area. The lease areas contain scenic viewsheds, a special interest area (in the westernmost lease areas), winter recreation areas (around Cooper Spur Mountain Resort), and special emphasis watersheds (in the easternmost lease areas).

According to the Forest Plan, the Forest offers a number of scenic vistas, a snowcapped mountain, waterfalls, crystal clear streams, blue lakes, and meadows of many-colored flowers (US Forest Service 1990). These visual resources attract tourists from near and far, as well as nearby residents.

The proposed lease areas are approximately 4 to 12 miles northeast of the summit of Mount Hood (approximately 11,200 feet above mean sea level), just south of Upper Hood River Valley, and straddle Highway 35 and East Fork Hood River. Other watercourses in the lease areas are Crystal Spring Creek, Tilly Jane Creek, Doe Creek, Cold Spring Creek with Tamanawas Falls (approximately 100 feet tall), Ash Creek, Polallie Creek, Puppy Creek, Dog River, Crow Creek, Alder Creek, and South Fork Mill Creek. Prominent peaks near the lease areas are Shellrock Mountain (approximately 4,400 feet), Mill Creek Buttes (approximately 4,800 feet), and Bluegrass Ridge (approximately 5,600 feet).

The foothills and canyons of the lease areas are mostly covered with a coniferous forest of varying heights and maturity, except where a patchwork of clear cuts occurs. A web of dirt roads for logging covers the lease areas.

Human-made modifications to the visual landscape are limited to roads of various conditions and recreation areas. Hiking and backpacking activities occur in the lease areas. Cooper Spur Mountain Resort is adjacent to lease ORORO 017053. In addition to downhill skiing, the resort and surrounding areas are also used for cross country skiing and snowshoeing. Sherwood Campground is also adjacent to the same lease. With the exception of Highway 35, there are no sources of light in the lease areas.

Highway 35 is a National Scenic Byway and an Oregon State Scenic Byway (US Department of Transportation 2008a). It is 105 miles long and offers views of deep gorges, unique geology, waterfalls, temperate rain forests, wild rivers, pastoral valleys, and the last leg of the Oregon Trail, the Barlow Road (US Department of Transportation 2008b). The visual corridor along Highway 35 has a Visual Quality Objective of Retention.

Portions of the area northeast of the summit of Mount Hood are proposed for special designations. The remarkable visual resources in these areas attract tourists and residents. The following lists the special designations, which involve scenic resource protection:

- Tilly Jane Wilderness Area;
- Cloud Cap Wilderness Area;
- Bluegrass Ridge Wilderness Area;
- Shellrock Mountain National Recreation Area; and
- East Fork Hood River Wild and Scenic River.

## Impacts

Mount Hood National Forest was not able to provide Visual Quality Objective data for this analysis. For the purpose of this analysis, it is assumed that all of the lease areas on Forest Service land have either Partial Retention or Retention Visual Quality Objectives.

### *Alternative A (No Action)*

The No Action alternative would have no impacts on visual resources. There would be no changes to visual resources.

### *Alternative B (Proposed Action)*

The Proposed Action would not have any direct impact on visual resources; however, anticipated geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. The potential risk of changes affecting visual resources is assessed for five significance criteria, which are described in the PEIS. Future actions based on the Reasonably Foreseeable Development scenario could result in changes that impact visual resources.

Future geothermal development activities could involve new structures, roads, and operations that are described in the Reasonably Foreseeable Development scenario. The new structures, roads, and operations would alter the characteristic landscape and be sources of light and glare. Depending on their exact location, they could also diminish scenic views afforded individuals participating in recreation activities or traveling through the area. These impacts would be noticeable, because they would be in areas that are relatively undeveloped and would be near areas where various recreation activities occur year-round. The impacts would also be near a scenic byway and the Mount Hood Wilderness Area. Although stipulations outlined in Appendix B of the PEIS would minimize these impacts, geothermal resource development activities would be visually evident. Changes to visual resources based on the Reasonably Foreseeable Development scenario would result in impacts on visual resources that would not be consistent with Retention Visual Quality Objectives.

It is assumed the stipulations would result in positioning new structures, roads, and operations in the landscape so they would remain visually subordinate to the characteristic landscape. It is also assumed geothermal development activities do not occur in areas proposed for special designation due to the outstanding scenery associated with the proposed designations and would comply with scenic byway standards. As a result, changes to visual resources based on the Reasonably Foreseeable Development scenario would result in impacts on visual resources that would be consistent with Partial Retention Visual Quality Objectives.

## 15.3.15 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

### Setting

The lease area covers approximately 9,200 acres within Hood River County, Oregon. The county was selected as the ROI for socioeconomic analysis as the impacts of leasing are likely to occur within this region. A summary of the population, housing, employment, local school data and low-income and minority populations for the county is provided based primarily on data from Census 1990 and 2000 population, demographic and housing information (US Census Bureau 1990, 2000).

#### *Population*

The 2006 estimates for county population are 21,533 (US Census Bureau 2008), which is a 5.5 percent increase over 2000 census levels. From 1990 to 2000, the population increased 17 percent (US Census Bureau 1990, 2000).

#### *Housing*

In 1990 approximately 7,589 housing units existed, of which 6,425 were occupied and 3,990 were owner-occupied with a homeowner vacancy rate of 1.5 percent and a rental vacancy rate of 9.7 percent. In 2000 total housing units

were 7,818, of which 7,248 were occupied and 4,702 were owner-occupied with a homeowner vacancy rate of 1.4 percent and a rental vacancy rate of 3.7 percent (US Census Bureau 1990, 2000).

***Employment***

In 1990 the total work force was 8,461, with 728 (or 8.6 percent) of those people being unemployed. Unemployment fell by 2000, with a total workforce of 10,196 an unemployment rate of 4.4 percent. Median household income was $38,326 in 2000 and $29,009 in 1990 (US Census Bureau 1990, 2000).

In 1999, the industries employing the largest percentage of the population were education, health and human services (18.5 percent); agriculture, forestry and mining (14.0 percent); retail trade (11.5 percent); and arts, entertainment, recreation, accommodation and food services (10.3 percent) (US Census Bureau 2000).

While farming and forestry have historically been the dominant industries, recreational development and the sale of land for construction of second homes have become increasingly important in the local economy (US Forest Service 1990).

***Schools and Public Infrastructure***

In 2000, 4,269 students were enrolled in K-12 education in Hood River County. This is an increase from 1990, when 3,020 students were enrolled. Future enrollment is expected to follow general population trends (US Census Bureau 1990, 2000).

***Environmental Justice***

In Hood River County, 70.7 percent of the population identified themselves as White of non-Hispanic descent. The largest minority population represented in the county is the Hispanic /Latino population, which makes up approximately 25 percent of the population (US Census Bureau 2000). Additional details for the racial and ethnic groups represented in the county are provided in Table 15.3-8.

In 2000, 14.2 percent of the population surveyed was below the poverty level. This is a slight decrease from 1990, when 15.6 percent of individuals were below the poverty level. The unemployment numbers in Hood River County are approximately the same as those seen at the State level (US Census Bureau 1990, 2000).

**Table 15.3-8**
**Race/Ethnicity in Hood River County**

| | 1990 | 2000 | Percent Change |
|---|---|---|---|
| Total Population | 16,903 | 20,411 | 20.7 |
| White | 15,346 | 16,099 | 4.9 |
| Black/African American | 46 | 117 | 154 |
| American Indian/ Alaskan Native | 201 | 229 | 13.9 |
| Asian | 305 | 301 | -1 |
| Pacific Islander* | N/A | 25 | N/A |
| Other | 1005 | 3137 | 212 |
| Two or more* | N/A | 503 | N/A |
| Hispanic or Latino** | 2,752 | 5107 | 85.5 |

Source: US Census Bureau 1990, 2000.

* Not reported on1990 census: Asian and Pacific Islanders were one group and more than one race was not an option.

** In combination with other race. Totals may add to more than 100 percent as individuals can report more than one race.

## Impacts

### *Alternative A (No Action)*

The No Action alternative would have no impact on existing socioeconomics in Hood River County. No impacts would occur to minority or low-income populations.

### *Alternative B (Proposed Action)*

The Proposed Action would not have any direct impact on socioeconomics or environmental justice; however, geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. Impacts include a potential increase in jobs and decrease in unemployment in Hood River County due to construction and operations and maintenance jobs at newly developed geothermal plants. Geothermal development would also be a positive stimulus to the local economy through tax revenues for Hood River County and the State of Oregon.

A general discussion of the impacts of geothermal leasing for a 50-MW plant is provided in Section 4 of the PEIS under *Socioeconomics and Environmental Justice*. Similar impacts to those discussed in the PEIS are likely for this lease area.

Due to the lack of residential areas in the vicinity of the lease area, there would be no disproportionate impacts on minority or low-income populations.

## 15.3.16 NOISE

### Setting

Current sources of noise in the lease areas are limited to wind, dispersed recreational use, traffic from roads within the leasing site boundaries, and wildlife. Sources of noise originating outside of the lease areas but affecting the lease areas include traffic from adjacent roads, air traffic, and activity from an adjacent recreational facility. Sensitive noise receptors are generally considered to be homes, hospitals, schools, and libraries. One resort lies within one mile of the lease site. No other buildings or developments are present within one mile of the lease site.

### Impacts

***Alternative A (No Action)***

The No Action alternative would have no impact on noise.

***Alternative B (Proposed Action)***

The Proposed Action would not have any direct impact on noise; however, geothermal exploration and development activities likely to follow leasing would potentially result in such impacts. No sensitive receptors have been identified within or immediately adjacent to the lease areas, so noise impacts are expected to be minimal.

# SECTION 15.4
# REFERENCES


Bambe, Daina. 2008. Mount Hood National Forest. Comments on Preliminary Draft PEIS for Geothermal Leasing in the Western United States.

Bonneville Power Administration, 2007. Internet Web site: http://www.bpa.gov/corporate/. Accessed April 2008. Updated August 2007.

Dryden. 2008a. Personal communication between Michael Dryden, East Zone Archaeologist, Mount Hood National Forest and Erin King, Archaeologist, Tetra Tech, Inc. E-mail, May 7, 2008.

Dryden. 2008b. Comments provided on the Preliminary Draft PEIS for Geothermal Leasing in the Western US. May 2008.

Dyck. 2008. Alan Dyck, Wildlife Biologist, Hood River Ranger District. Email to Ty Brookhart of EMPSi. May 2, 2008.

Environmental Working Group. 2008. National Tap Water Quality Database. Local System Water Report for Crystal Springs Water District, Odell, OR.

Natural Resource Conservation Service. 2008. Web Soil Survey. National Resource Conservation Service. Internet Web site: http://websoilsurvey.nrcs.usda.gov/app/. Accessed on April 8, 2008.

Oregon Department of Environmental Quality. 2008a. Total Maximum Daily Loads (TMDLs) Program. Internet Web site: http://www.deq.state.or.us/wq/TMDLs/hood.htm. Accessed on April 18, 2008.

Oregon Department of Environmental Quality. 2008b. Oregon Water Quality Index Report for Deschutes and Hood Basins. Internet Website: http://www.deq.state.or.us/wq/TMDLs/hood.htm. Accessed on April 18, 2008.

Oregon Department of Environmental Quality. 2008c. Water Quality Assessment Database. Online database: http://www.deq.state.or.us/wq/assessment/rpt0406/search.asp#db. Accessed on April 18, 2008.

US Bureau of Land Management, 2007. Environmental Impact Statement, Newberry Geothermal Exploration Project. Deschutes County, Oregon. August 2007.

US Census Bureau. 2008. State and County QuickFacts. Internet Web site: http://quickfacts.census.gov/qfd/states/41/41027.html accessed April, 2008. Last Revised: January 2, 2008.

US Census Bureau, 2000. Census 2000 Summary Files 1,3. Geographic Area: Hood River County, Oregon. http://quickfacts.census.gov/qfd/states/41/41027.html

US Census Bureau, 1990. Census 1990 Summary Files 1,3. Geographic Area: Hood River County, Oregon. http://quickfacts.census.gov/qfd/states/41/41027.html

US Forest Service. 1990. Final Environmental Impact Statement, Land and Resource Management Plan, Mount Hood National Forest. Forest Service. Pacific Northwest Region. October 1990.

US Department of Transportation. 2008a. Mt Hood Scenic Byway Official Designations. Internet Web Site: http://www.byways.org/explore/byways/61400/designation.html. Accessed April 1, 2008.

US Department of Transportation. 2008b. Mount Hood Scenic Byway. Internet Web Site: http://www.byways.org/explore/byways/61400/. Accessed April 1, 2008.

US Forest Service. 1994. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl.

US Forest Service. 2005. Long Prairie Grazing Allotment Environmental Assessment. September 14, 2005.

US Forest Service 2008a. Final Environmental Impact Statement: Site-Specific Invasive Plant Treatments for Mt. Hood National Forest and Columbia River Gorge National Scenic Area in Oregon, including Forest Plan Amendment #16.

US Forest Service 2008b. GIS data provided by the Hood River Ranger District. Mount Hood National Forest. April 15, 2008.

US Forest Service. 2008c. Pacific Crest National Scenic Trail. Internet Web site: www.fs.fed.us/pct. Accessed on March 31, 2008.

US Geological Survey. 1997. Volcanic Hazards in the Mount Hood Region, Oregon. 1997. US Geological Service. Internet Web site: http://vulcan.wr.usgs.gov/Volcanoes/Hood/Hazards/OFR97-89/framework.html/. Accessed on April 16, 2008.

US Geological Survey. 1994. Water Atlas of the United States, Idaho, Oregon, Washington.

US Geological Survey. 2004. Geological Provinces of the United States. US Geological Service. Internet Web site: http://geology.wr.usgs.gov/parks/province/basinrange.html. Accessed on April 16, 2008.

US Geological Survey. 2008. Science in Your Watershed. Internet Web site: http://water.usgs.gov/wsc/map_index.html. Accessed on April 18, 2008.

Western Regional Climate Center. 2007. Monthly Climate Summary for Parkdale 2 NNE, Oregon, from 8/1/1981 to 6/30/2007. Internet Web site: http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?or6466. Accessed on April 1, 2008.

Zenk, Henry B. and Bruce Rigsby. 1998. "Molala." In *Handbook of North American Indians*, Volume 12 – Plateau. Deward E. Walker, Jr., Volume Editor. William C. Sturtevant, General Editor. Smithsonian Institution, Washington, D.C.

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