

**CHAPTER 16**  
**WILLAMETTE NATIONAL FOREST**  
**SALEM DISTRICT**  
ANALYSIS FOR PENDING LEASE  
APPLICATION:  
OROR 054587

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# SECTION 16.1

## INTRODUCTION

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### 16.1.1 INTRODUCTION

This lease-specific analysis describes the environmental effects of leasing approximately 1,115 acres of National Forest land within the Detroit District of the Willamette National Forest and the BLM Salem Field Office/District to private industry for the development of geothermal resources.

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.

The lease site is within the Detroit Ranger District of the Willamette National Forest, which is the surface management agency for the site. Subsurface mineral rights are managed by the BLM Salem Field Office. The BLM issues leases with the consent of the FS (Regional Forester upon recommendation from the Willamette NF Supervisor) for the lands under application on the Willamette NF.

### 16.1.2 LOCAL REGULATORY CONSIDERATIONS

The pending lease application sites are located within Linn 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.

#### **Willamette National Forest Land and Resources Management Plan (1990)**

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

management standards and guidelines for the Willamette National Forest. It describes resource management practices, levels of resource production and management, and the availability and suitability of lands for resource management.

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

- Minerals and Energy – Facilitate the exploration and development of mineral and energy resources where available on the Forest in a manner compatible with other resource values.
- Economic – Generate revenues from permits, leases, user fees, and product receipts.
- Human and Community – Promote area economic well-being by using Forest resources to generate revenues for local counties and providing direct or indirect employment opportunities.
- Wildlife, Fish, and Plants – Minimize conflicts of human activities and occupancy with wildlife, fish, and plant habitats, including impacts of...road construction...

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

- FW-296 – Leasable minerals shall be administered in accordance with the Minerals Land Leasing Act of 1920 as amended and the Federal Onshore Oil and Gas Leasing Reform Act of 1987.
- FW-297 – Permits for leasable minerals shall provide for protection and rehabilitation of surface resources.
- FW-298 – Applications for permits and leases shall be evaluated in an environmental analysis.
- FW-299 – A “no-surface-occupancy” stipulation on leases should be considered when:
  - Surface occupancy would cause significant resource disturbance which could not be mitigated by any other means;
  - Where resource impacts would be irreversible or irretrievable;  
or
  - The activity is incompatible with surface management objectives.
- FW-300 – Off-lease support facilities and/or activities may be authorized by appropriate NFS land use permits.
- FW-301 – Geothermal resources shall be administered in accordance with the direction established by the final decisions in

the following environmental analysis: Breitenbush Area Final Environmental Impact Statement, 1978; Geothermal Leasing on Nonwilderness Areas Environmental Assessment, 1982; Belknap-Foley Final Environmental Impact Statement, 1981. These documents are on file at the Willamette National Forest Supervisor's Office.

The Forest Plan also includes Standards and Guidelines for rivers determined to be eligible into the National Wild and Scenic River System. The Forest Plan mandates that such rivers, until suitability has been determined, shall be managed within a quarter mile of each side to meet Standards and Guidelines prescribed for Wild and Scenic River Management Area 6c. The Standards and Guidelines mandate that activities shall not preclude the river from potential inclusion into the National Wild and Scenic Rivers System.

### **Salem Resource Management Plan (1995)**

The lease area is within the BLM Salem District. Public lands and geothermal resources within this district are managed by the Salem Resource Management Plan (Salem RMP). The vision of the Salem RMP is to manage land and natural resources under its jurisdiction in western Oregon to maintain healthy, diverse, and productive ecosystems so that present and future generations may continue to benefit from the public lands. There are several basic principles supporting this vision:

- Natural resources can be managed to provide for human use and a healthy environment;
- Resource management must be focused on ecological principles to reduce the need for single resource or single species management;
- Stewardship, the involvement of people working with natural processes, is essential for successful implementation;
- The BLM cannot achieve this vision alone but can, by its management processes and through cooperation with others, be a significant contributor to its achievement; and
- A carefully designed program of monitoring, research and adaptation will be the change mechanism for achieving this vision.

The Energy and Mineral Resource Program within the Salem RMP states the following three objectives:

- Maintain exploration and development opportunities for leasable and locatable energy and mineral resources.

- Provide opportunities for extraction of salable minerals by other government entities, private industry, individuals, and nonprofit organizations.
- Continue to make available mineral resources on the reserved federal mineral estate.

The Program estimates that there are approximately 392,200 acres of leasable mineral resources available for exploration and development within the Salem District. An additional 27,800 acres of private land with reserved federal mineral estate (also referred to as federal subsurface mineral estate) are estimated to be within the Salem District.

The program includes the following Management Actions/Direction regarding leasable minerals:

- Use standard and special stipulations for oil, gas, geothermal, and coal leases to protect fragile areas or critical resource values (Appendix F of the Salem RMP includes a list of mineral restrictions by resource value). Special stipulations may include:
  - Seasonal restrictions to protect resources such as critical wildlife habitat, prevent excessive erosion, etc.;
  - Controlled surface use stipulations to protect valuable resources in small areas; and
  - No surface occupancy stipulations to protect valuable resources scattered over a large area while still providing an opportunity for exploration and development.
- Waive special stipulations if the objective of a stipulation could be met in another way.
- Provide opportunities for coal and geothermal exploration and development in areas with potential for occurrence. Geothermal activities are regulated under 43 Code of Federal Regulations 3200.
- Allow no leasing on lands within incorporated cities. Tracts within the planning area affected by this type of closure are located in Salem and Willamina.

The Bureau of Land Management is currently revising the Salem RMP to align it with the Northwest Forest Plan. The revised plans are to be completed in the fall of 2008.

### **Northwest Forest Plan**

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:

- 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.

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.

### **16.1.3 SCOPE OF ANALYSIS AND APPROACH**

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

This report focuses on specific key resource concerns in the lease area, 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. Willamette National Forest staff members were contacted during the preparation of this lease-specific analysis to help identify local resource concerns.

### **16.1.4 CUMULATIVE ACTIONS**

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

# SECTION 16.2

## PROPOSED ACTION AND ALTERNATIVES

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### 16.2.1 INTRODUCTION

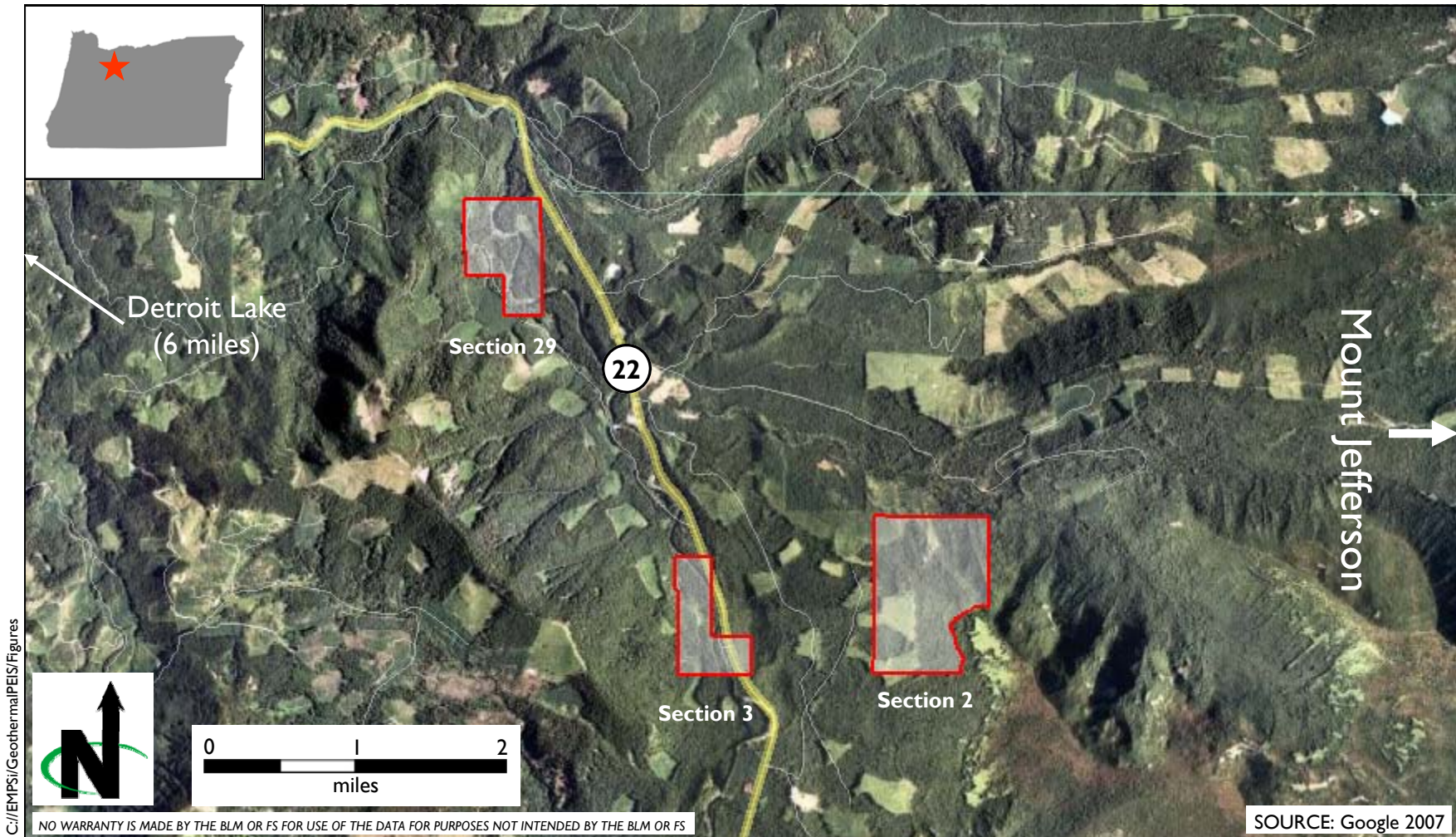
This chapter provides the details of the proposed action, alternatives to the proposed action, and an overview of the reasonably foreseeable develop (Reasonably Foreseeable Development) scenario for pending lease application site OROR 054587.

### 16.2.2 PROPOSED ACTION

The proposed action is for (1) the Forest Service to issue a consent determination to the BLM to issue the lease to the applicant for three areas within the Willamette National Forest and Salem BLM District; and (2) the BLM to issue said lease. The 1,115.280 acres of land are in a river valley centered on the North Santiam River, and are located approximately 5 to 8 miles west of Mount Jefferson, in Linn County, Oregon (see Figure 16-1). Lease boundaries could be adjusted in the decision to avoid unacceptable impacts on sensitive resources.


One pending lease application is included within this area, which is identified on the 1982 Geothermal Resources of Oregon map as being an area likely to be used for direct use heat applications (National Oceanic and Atmospheric Administration 1982). The single pending lease application is OROR 054587, which is comprised of 1,115.280 acres comprised of three non-contiguous sections of land. The legal description of this land is (1) T10S R7E S29, parts NE, NESE; (2) T11S R7E S2, parts S2NE, SENW, E2SW, "SE outside wilderness," Lots 1-3; (3) T11S R7E S3, parts S2NW, S2, Lots 3, 4.

Section 2 contains one forked, unnamed logging road, providing access to some logged areas. Highway 22 (North Santiam Highway) passes through Section 3 and provides access to Riverside Campground. NFD 2242 Road runs through Section 29.



C:/EMPSi/Geothermal/PEIS/Figures

The lease site is on NFS lands. The North Santium River runs generally alongside Highway 22.

**LEGEND:**  
 Lease site boundary

**Willamette Lease Location**  
 OROR 054587  
 Willamette NF / Salem District

Figure 16-1

The lease sites range in elevation from 2,200 feet to 4,400 feet above mean sea level. The lease area is largely covered by forest, with substantial portions of Section 2 and smaller portions of sections 3 and 29 having been clearcut. No other developed uses or buildings have been identified within one mile of the lease sites.

### 16.2.3 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 and the BLM would not issue the pending lease application.

#### **Alternative B: Leasing with Stipulations**

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

### 16.2.4 REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

The pending noncompetitive lease application was filed by the Estate of Max R Millis in 1974 and is expected to be developed for electricity generation. The site is expected to be developed by two powerplants; one 30 megawatt plant in the western half of Section 2 (the eastern half of this section is within an Inventoried Roadless Area), and one 20 megawatt plant in Section 29. 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.

Exploration activities for a 20 megawatt plant and a 30 megawatt plant is 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 be 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*.

# SECTION 16.3

## AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

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### 16.3.1 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: livestock grazing, historic or scenic trails, wild horse and burros, special designations.

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 outlined 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 is not repeated in this lease-specific analysis.

### 16.3.2 LAND USE, RECREATION AND SPECIAL DESIGNATIONS

#### **Setting**

This section is a discussion of the current land ownership and use within the Region of Influence for the three lease sites that are part of the proposed action. The Region of Influence 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. Additional guidelines for geothermal leasing are provided in area Forest Service and Land Management Plans. Once revised, the

Willamette Forest Plan and the Salem RMP will be tiered to the Northwest Forest Plan. Details of the current plans in relation to geothermal leasing are included in Section 16.1.

### **Regional Setting**

The lease area is located in a river valley centered on the North Santiam River in Linn County, Oregon. The total lease area covers approximately 1,115 acres in three non-contiguous sections west of Mt. Jefferson. Lands within and adjacent to potential lease sites are all NFS lands. NFS lands are administered for multiple uses, including some which may be incompatible with energy development.

The nearest population centers are Detroit, approximately 10 miles from the lease sites and Mill City, approximately 25 miles from the lease sites.

In addition to the existing Riverside campground and trail, dispersed recreation occurs throughout the proposed lease area. Some popular recreational activities with the Willamette National Forest and Salem BLM District include hiking, camping, fishing, hunting, off-highway vehicle use, and Nordic skiing (US Forest Service 2006).

### **Lease Areas**

According to the Northwest Forest Plan, all three of the areas are in a designated Late-Successional Reserve and a Key Watershed, areas of sections 2 and 29 that are within the 100-year floodplain of the North Santiam River are within Riparian Reserves, and portions of the lease sites are also contained within management areas with special designations for wildlife protection under the Forest Plan.

The North Santiam River has been determined to be eligible for inclusion into the National Wild and Scenic River System as a Section 5(d) river (Forest Plan) in the Wild and Scenic Rivers Act. Until suitability has been determined, the river shall be managed within a quarter mile of each side to meet Standards and Guidelines prescribed for Wild and Scenic River Management Area 6c. Activities shall not preclude the river from potential inclusion into the National Wild and Scenic Rivers System. This designation would preclude any geothermal activity in sections 3 and 29.

Chapter 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.

Details for these designations are provided in Section 16.3.9, *Fish and Wildlife*.

#### *Section 29*

This lease area contains NFD road 2242, which runs north to south in the western portion of the lease site, and the North Santiam River, which winds in a north-south orientation through the center of the site. No other development exists in the area and land use is primarily limited to forestry and recreational use. Nearly all of the Section 29 portion of the lease site is within a quarter mile of the Santiam River, and is therefore required to be managed under the Wild and Scenic River management guidelines discussed above.

#### *Section 2*

This lease site contains a forked logging road and Forest Service trail number 3448 is found in this lease area. Mt. Jefferson wilderness area lies adjacent to the SE boundary of the lease area. This wilderness area contains 190 miles of trails and is a popular destination for hiking and back-country camping (US Forest Service 2006). The eastern half of this lease site is contained within an Inventoried Roadless Area. No other development exists in the area and land use is primarily limited to forestry and recreational use.

#### *Section 3*

The North Santiam River runs north to south in the southeastern and north portions of the site. Highway 22 lines the river on the east, crossing through the southeastern and north sections of the site. The Riverside campground is found in the SW portion of the site, between the highway and the river. No other development exists in the area and land use is primarily limited to forestry and recreational use. All of the Section 3 portion of the lease site is within a quarter mile of the Santiam River, and is therefore required to be managed under the Wild and Scenic River management guidelines discussed above.

## **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 Salem District RMP, the Northwest Forest Plan or the Forest Plan.

**Alternative B (Proposed Action)**

The Proposed Action would not cause 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. According to the Reasonably Foreseeable Development scenario, two plants are likely to be developed at the lease site; one plant in the western portion of Section 2 resulting in 15 acres of land disturbance, and another in Section 29 with 10 acres of land disturbance. Access to the plant sites would be provided via existing FS roads and should not disturb additional acres.

Geothermal activities could impact all dispersed recreational uses within the lease sites. Through noise, visual impacts of facilities, deforestation, and interruption of previously accessible areas, the quality of dispersed recreational uses would likely decrease.

Anticipated geothermal exploration and development activities likely to follow leasing have the potential to conflict with management guidelines and standards set forth by the Northwest Forest Plan and the Willamette Forest Plan for those areas contained within Late Successional Reserves, Riparian Reserves, Key Watersheds, Wild and Scenic Rivers, and within 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. The reserve's width is based on the presence of fish and whether the stream is permanent or intermittent (see Table 16.3-1 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 Willamette 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.

*Impacts on Key Watershed*

In the Upper North Santiam Watershed, as of 2005 the "tally" for the watershed was (-4.39) miles of road. During the life of the NWFP, 0.41 mile of road has been constructed and 4.8 miles have been decommissioned. Anticipated geothermal exploration and development activities likely to follow leasing would not conflict with the NWFP in terms of Key Watersheds if lease stipulations state that no new roads shall be constructed that would result in a net increase in roads within the watershed over the initial benchmark.

**Table 16.3-1  
Federal Riparian Reserve Width Requirements  
(Each side of the Stream)**

<b>Stream Class</b>	<b>Riparian Reserve Width</b>
Fish Bearing	Average height of 2 site potential trees or 300-344 feet
Permanent Non-Fish Bearing	Average height of 1 site potential tree or 150-172 feet
Intermittent	Average height of 1 site potential tree or 100 feet

*Impacts on Late-Successional Reserves*

Anticipated geothermal exploration and development activities likely to follow leasing 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 Willamette 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.

*Impacts on Inventoried Roadless Areas*

The status of pending lease land as Inventoried Roadless Areas would limit geothermal development the eastern half of Section 2. Development in this area would be consistent with the Inventoried Roadless Area designation as long as no new roads are constructed to access development sites. Since there are no existing roads in or adjacent to the roadless area, no surface occupancy could take place here. There would be no impact in Inventoried Roadless Areas.

*Impacts on Wild and Scenic Rivers*

No geothermal development would be allowed in sections 3 or 29; therefore, there would be no impacts on the “free-flowing character” or “Outstandingly Remarkable Values” of the North Santiam River.

Potential conflicts with other wildlife management areas are discussed further in Section 16.3.9, *Fish and Wildlife*.

### **16.3.3 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 Plate. Where the Juan de Fuca Plate converges with the North America plate the Cascade subduction zone occurs as the heavier oceanic plates slide underneath the buoyant North American plate. There are some unusual features in 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 change 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, dominate the landscape (US Geological Survey 2004).

All the lease sites lie within approximately nine miles of Mt. Jefferson, a stratovolcano composed of andesite and dacite. The formation of Mt. Jefferson occurred in two episodes. The earlier episode constructed a volcano that was likely higher than the present day mountain. Glaciers carved deep canyons into this volcano and deposited sediments across the fertile floor of the Willamette Valley, which extends west of the Cascades. This episode ended with the growth of dacite domes near the summit and collapse of the dome to produce ash flows. The more recent episode of volcanism likely occurred when glaciers were present on Mt. Jefferson, as the lava flow is distributed in an unusual stacked pattern, possibly the result of containment to steep glacier valley (University of North Dakota 2000).

According to a 1999 US Geological Survey report, valleys heading on Mt. Jefferson that lie within the lease area are subject to lahars (mudflows of pyroclastic material and water) with volumes of 20 million cubic meters at the highest probability. The area also subject to debris avalanches as the result of heavy rain on loose soils (US Geological Survey 1999).

## Impacts

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

The No Action alternative would have no direct 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 inducing seismic events from injection into the geothermal reservoir, increased human presence on the site, and construction of facilities, infrastructure and transmission lines.

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.

**16.3.4 ENERGY AND MINERALS****Setting**

The electric utility provider for the region of the lease area is Portland General Electric in coordination with local electric cooperatives. Portland General Electric is Oregon's largest utility and serves over 4,000 square miles and 52 cities in Oregon. Portland General Electric manages company-owned power plants and purchases power supplies on the wholesale market. Their mix of generating resources includes hydropower, coal and gas combustion, and wind. Their 12 power plants have a total combined generating capacity of 1,974 megawatts (Portland General Electric 2006).

Renewable energy is promoted at Portland General Electric through the "Green Power Oregon" program, which allows consumers to purchase wind or biomass off-sets of residential or business use for a supplemental cost (Portland General Electric 2006).

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.

No mineral extraction sites are located within the lease sites. Gold and silver deposits have been found in a 25-30 mile wide, north-south belt in the Western Cascades of Oregon. In the vicinity of the lease area, 2 major mineral mining districts have been identified; the North Santiam district in Marion and Clackamas counties and the quartzville district in Linn County on the Middle Fork of the Santiam River (US Forest Service 1990). The North Santiam District was active primarily in the 1920s to 1930s with copper, zinc, and lead being the primary metals extracted (Callaghan and Buddington 1938).

The region is generally not considered to have high potential for oil and gas leasing. In the 1970s an increased interest in the areas resulted in 200,000 leases, but most of these have now been withdrawn (US Forest Service 1990). Within the Salem District, the only developed oil or gases are is at Mist Gas Field, far from the lease area (Bureau of Land Management 2007).

In the Forest as a whole there has been considerable interest in geothermal development; over 55 exploratory temperature gradient holes were drilled in the early 1980's. In addition, three hot springs within the Willamette NF at Breitenbush, Belknap-Foley, and McCredie-Kitson had been identified as having high geothermal resource potential by the US Geological Survey (US Forest Service 1990).

### **Impacts**

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

The No Action alternative would have no direct 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 such impacts. Based on the Reasonably Foreseeable Development scenario, the site is expected to be developed by one 30 megawatt plant in Section 2, and one 20 megawatt plant in Section 29. Details of impacts on energy and minerals are discussed for a standard 50 megawatt plant in Section 4 of the PEIS. 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 local and regional power grid. The Proposed Action could potentially contribute to State efforts to meet the RPS as discussed in Section 16.1 of this analysis.

## **16.3.5 SOILS**

### **Setting**

This lease site is dominated by soils of alluvial, colluvial, volcanic, and glacial origin. Soil types are a combination of flat lying alluvial floodplains, gently sloping alluvial terraces, moderate to steep sloping (40 to 80% slope) soils of glacial origin on various bedrock types, and steep (50 to 90% slope), rocky, colluvial derived soils with depths of one to eight feet on volcanic tufts, breccias, and basaltic and andesitic bedrock mixed with glacial soils. A small area of older, stabilized slump/earthflow terrain is found in Section 29 (Shank 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 future actions following leasing would potentially result in impacts on erosion and compaction associated with ground disturbance from the geothermal exploration and development process.

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.

**16.3.6 WATER RESOURCES****Setting****Surface Water**

The North Santiam River traverses sections 3 and 29. All three sections contain unnamed streams: four in Section 2, one in Section 3, and two in Section 29. Section two contains a coldwater spring, and Section 3 contains the Riverside Campground.

The major surface water features in the lease site is the North Santiam River. At Detroit Dam, this river has a flow rate ranging from an average of 434 cubic feet per second in September, to 1,400 in May (US Geological Survey 2008a). The river flows to the north through the lease area, then turns west through Detroit Lake, Mehama, and on to Salem. The City of Salem water-treatment facility withdraws water from the North Santiam River.

The project area is within the North Santiam subbasin of the North Santiam River Basin, within the Willamette Valley. In 1998, a monitoring program was initiated to better understand the sources and transport of sediment that causes high turbidity within the North Santiam River Basin. The project is a cooperative effort of the City of Salem, the U.S. Geological Survey (USGS), the U.S. Forest Service, and the U.S. Army Corps of Engineers. The nearest water quality monitoring station to the lease area is near Detroit, and monitoring there began in October 1998 (US Geological Survey 2008b).

Turbidity is a major water quality concern in the North Santiam River, which becomes exacerbated during heavy rain events and flood conditions as soils are transported into the river system (US Geological Survey 2008b). No other water quality concerns are reported for the North Santiam River in the lease area.

A Total Maximum Daily Load (TMDL) for the Willamette Basin was approved by the US Environmental Protection Agency on September 29, 2006. The North Santiam subbasin has stream segments listed under Section 303(d) of the federal

Clean Water Act that are exceeding water quality criteria for temperature and dissolved oxygen (Oregon Department of Environmental Quality 2008). Temperature is a greater concern than turbidity in the North Santiam River (Halemeier 2008).

### **Ground Water**

The lease site is located to the east of the Willamette River Valley portion of the Puget-Willamette Trough regional aquifer system, an extensive system of aquifers and confining units that may locally be discontinuous but function hydrologically as a single aquifer system on a regional scale. The Trough extends southward from near the Canadian border to central Oregon (US Geological Survey 1994).

The principal aquifers that compose the Willamette River Valley are unconsolidated-deposit and Miocene basaltic rock aquifers of a thickness of approximately 200 feet near Salem, which thin rapidly southward and toward the margins of the valley; these deposits are generally less than 100 feet thick. Miocene basaltic-rock aquifers consist primarily of thick basaltic lava flows that were extruded from major fissures. Some of the open spaces initially formed during cooling or subsequently formed during folding have been filled with secondary clay minerals, calcite, silica, or unconsolidated alluvial deposits emplaced by streams or in lakes. Except where such fill materials are coarse grained, these secondary deposits tend to markedly decrease the permeability of Miocene basaltic-rock aquifers (US Geological Survey 1994).

Miocene basaltic rock aquifer permeability is extremely variable. Maximum specific-capacity values are approximately 3,000 gallons per minute per foot of drawdown. Some interbeds of unconsolidated deposits that contain water under unconfined and confined conditions can yield as much as 100 gallons per minute (US Geological Survey 1994).

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 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 (US Geological Survey 1994).

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 evapotranspiration rate cause discharge to exceed recharge. Ground water quality is generally fresh and chemically suitable for most uses; sparse settlement in the area has prevented much groundwater contamination. Public, domestic and commercial, agricultural, and industrial uses are the main uses of ground water in this area (US Geological Survey 1994).

## 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 future actions would potentially result in such impacts, as described below.

#### *Water Quality*

Typical impacts on the quality of surface water and ground water from geothermal development are described in Chapter 4 of the PEIS under Water Resources. 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. Lease stipulations and best management practices addressing stormwater are included in Chapter 2 and Appendix D, respectively, of the PEIS and would reduce impacts on water quality.

A watershed analysis would not be required because the watershed analysis for this watershed has been completed and was revised/updated in 2007. Since anticipated future actions following leasing would not result in impacts that have the potential to have impacts at the watershed scale, there would not be any need to do any further revision or updating. The watershed analysis and recent update should be sufficient to provide information necessary for from the watershed scale for the individual geothermal activities described in the Reasonably Foreseeable Development scenario.

#### *Water Quantity*

Indirect use geothermal projects require large amounts of water during all phases of a project from exploration through reclamation and abandonment; therefore, the anticipated future actions following leasing could result in impacts on the surface water and ground water quantities. Both groundwater and surface waters are abundant in the lease area, and no impacts on existing water resources are expected.

Section 2 contains a surface spring, which could be affected by any drawdown of the local water table. The potential for impacts on springs depends upon the proximity of the pumping, the hydraulic characteristics of the aquifer, and the magnitude and duration of pumping. Due to the abundance of groundwater in the area and few to no competing groundwater users, impacts on this spring are not expected; however, lease stipulations should include a requirement to maintain a buffer from this spring to protect its flow rate and its attractiveness to both wildlife and recreationalists.

Water needs of a powerplant could alternatively be sourced from the North Santiam River. Water rights would have to be applied for from the Oregon Water Resources Department by the project proponent. This permitting process would determine whether the proposed usage of the river's waters would be in line with the river's beneficial uses.

### 16.3.7 AIR QUALITY AND ATMOSPHERIC VALUES

#### Setting

The lease area is located in Linn County, an area with unclassified air quality standards. Due to the remote location of the lease sites, air quality is considered to be good.

The lease site is within the Willamette Valley, on the western foothills of Mount Jefferson, which is part of the Cascade Mountains. Air masses from the west are forced to ascend causing them to give up moisture, resulting in high levels of precipitation in the area. Climate in the Willamette Valley is relatively free of extremes in temperatures, with abundant rainfall most of the year.

The closest weather monitoring station to the lease site is at Detroit Dam, Oregon, approximately 10 miles northwest of the lease area. Average maximum temperatures at Detroit Dam range from 43.3 degrees Fahrenheit in January, to 79.0 in August, with average minimum temperatures ranging from 33.2 degrees Fahrenheit in January, to 53.7 in August (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)**

The Proposed Action alternative would not have any direct impacts on air quality or atmospheric values; however, anticipated future actions following leasing could result in such impacts. Future actions following leasing would not result in violations of ambient air quality standards given the unclassified status

of the county and the good level of air quality. The nature of impacts on air quality and atmospheric values are discussed in Section 4.8 of this PEIS.

### 16.3.8 VEGETATION

#### Setting

The pending lease area located within the western hemlock (*Tsuga heterophylla*) zone of the Northern Cascades Physiographic Province (Franklin and Dyrness, 1988). Mt. Jefferson (elevation 10,497 feet above mean sea level) rises up from the lease area on the east side. There are three portions of the lease site. Two straddle the North Santiam River (sections 3 and 29), while one area (Section 2) is on an upland slope on the east side of the river.

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 National Forest System lands, and timber harvest is currently restricted as the entire area is part of the Jefferson Late-Successional Reserve. The forest types include coniferous and mixed riparian forests.

#### **Late-Successional Reserves**

In 1994 the Northwest Forest Plan (NWFP) designated a network of Late-Successional Reserves (LSR) with the object of protecting and enhancing conditions of late-successional and old-growth forest ecosystems, and the species that depend on this habitat (US Forest Service 1994). Timber harvest and other development activities are limited in LSRs. All three of the proposed lease sites are within the Jefferson LSR.

#### **Coniferous and Mixed Coniferous/Deciduous Forest**

Coniferous forests capable of exhibiting great biomass and longevity dominate the lease area (US Forest Service, 2008a). 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 variation 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 North Santiam River. Red alder (*Alnus rubra*) is the dominant species 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. Locally unique 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 on the north and west sides of the lease area, leading to stands of mixed coniferous and deciduous species. Along narrow higher gradient streams, as are most common in the lease area, coniferous tree species dominate the overstory. On Forest Service lands in the lease area, an estimated 10 percent of the riparian area has been disturbed by timber harvest.

Wetlands in the vicinity of the lease area include forested, scrub, emergent, and open water habitats of small ponds, however, there are no documented wetlands within the lease area itself (US Fish and Wildlife Service 2008). The most common tree species associated with forested wetlands are red alder, black cottonwood, and western redcedar. Shrub wetlands in the basin are characterized by various willow species, salmonberry, vine maple, and spiraea (*Spiraea douglasii*). Freshwater forested scrub wetlands exist along the North Santiam River in several locations, including within the lease sites straddling the river. These wetlands support a variety of sedges, forbs, and grasses (US Fish and Wildlife Service 2008). Wetlands provide valuable plant, fish, and wildlife habitat, and are also valued for their hydrologic functions. The Forest Service manages the land adjacent to streams, lakes, reservoirs, and wetlands as Riparian Reserves, per the direction of the Northwest Forest Plan (US Forest Service 1994).

**Riparian Reserves**

On federal lands, riparian reserves are designated to protect water quality; timber harvest is prohibited and ground disturbance is not allowed. Under the Northwest Forest Plan riparian reserve areas are associated with flowing streams, as well as intermittent and ephemeral streams. The guidance given under the NWFP is to designate riparian reserves if an area or feature shows

annual scour or deposition. The width of a riparian reserve is based on the presence of fish and whether the stream is permanent or intermittent, and by the average maximum height of the tallest trees in the area or a minimum width requirement. The riparian reserve that borders the North Santiam River is 344 feet on either side of the river's ordinary high water mark (Halemeier 2008).

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

Invasive and non-native plant species are known to occur in the lease area and vicinity. These species can be aggressive, out-competing native plant species, reducing the value of wildlife habitat, and affecting waterways and aquatic habitats. Management goals for noxious weed species may range from complete eradication to containment of the species within a currently infested area. Multiple invasive plant species are documented along the Highway 22 corridor and are expected to occur in the lease sites. Potential species include tansy ragwort, St. John's-wort, and Scotch Broom (US Forest Service 2007).

#### **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; however, anticipated future actions following leasing would potentially result in impacts on vegetation through an estimated disturbance of approximately 25 acres. 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, as well as maintenance and

operational activities would disturb timber and scrub habitat, increase risk of invasive species, and alter water and seed dispersion, as well as 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, deposition of dust and. 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 affects to riparian vegetation and riparian habitats).
- **Exposure to Contaminant** – 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 affects on non-target vegetation.

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

Old growth forests, including Late-Successional Reserves, are present throughout much of the lease area. These forests are protected under the provisions of the Northwest Forest Plan (US Forest Service 1994); these

protections are expected to remain in place in the future. Geothermal development of the lease sites 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 the PEIS, Section 4.9 Vegetation and Important Habitats.

#### **Riparian and Wetland Habitats**

Riparian habitats are found along North Santiam River and Grizzly Creek, as well as throughout the forest as riparian swells, drainages, and intermittent unnamed streams. These habitats are protected as part of the Northwest Forest Plan and would be protected through best management practices if the lease sites were 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 of the PEIS for a more detailed discussion of the potential impacts on riparian habitats resulting from each stage of a geothermal project.

Wetland habitats have been documented within both lease sites straddling the North Santiam River. 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. Impacts that could occur to 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 U.S. 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. A more complete discussion of the potential impacts on wetlands resulting from geothermal activities is can be found in Section 4.9 of the PEIS.

### **16.3.9 FISH AND WILDLIFE**

#### **Setting**

##### **Fisheries**

The following section describes the existing aquatic habitat and fish species occurring in North Santiam River and Grizzly Creek, which is a tributary to the North Santiam River and runs just north of Section 2. The proposed lease sections 3 and 29 straddle the North Santiam River. The two waterways provide habitat for Chinook salmon (*Oncorhynchus tshawytscha*), rainbow trout (*O. mykiss*), cutthroat trout (*O. clarki*), naturalized sockeye salmon (commonly referred to as kokanee salmon (*O. nerka*)), long-nosed (*Rhinichthys cataractae*)

and black sided dace (*Phoxinus cumberlandensis*), and sculpins (US Forest Service 2007).

#### *Anadromous Fish Species*

Resident and hatchery fish Spring Chinook salmon and steelhead historically utilized North Santiam River. Access to this habitat was eliminated in 1953 with the construction of Detroit dam, which does not provide upstream passage. Spring Chinook salmon, of hatchery origin, have been reintroduced above the dam, starting in the year 2000. These fish are released in the North Santiam River and area expected in the lease area. Steelhead have not been transported and released above Big Cliff Dam (US Forest Service 2007).

The National Marine Fisheries Service (NMFS) recently completed their final listing determinations for 16 evolutionarily significant units (ESUs) of West Coast Salmon (70 FR 37160; effective August 29, 2005). They listed the Upper Willamette River Chinook salmon ESU as threatened under the Endangered Species Act, confirming their earlier determination (64 FR 14308; effective May 24, 1999). This includes Chinook in the Santiam River. The NMFS has designated critical habitat for 12 ESUs of West Coast Salmon and Steelhead in Washington, Oregon, and Idaho (70 FR 52630; effective January 2, 2006). Designated critical habitat for Chinook salmon does not extend above Big Cliff dam, and would not be affected by activities in the lease area (US Forest Service 2007).

Similarly, the Magnuson-Stevens Fishery Conservation and Management Act lead to the designation of Essential Fish Habitat (EFH) for commercially harvested fish, which includes Chinook salmon on the Willamette National Forest. Their designation of EFH did not include any streams above Big Cliff dam, and therefore EFH would not be affected by geothermal activities occurring in the lease area.

#### **Wildlife**

This section describes the occurrence and distribution of wildlife species in the lease area and vicinity.

#### *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 wetland and 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*).

### 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 includes the northern spotted owl (*Strix occidentalis* spp. *caurina*), a federally listed species (see Section 16.3.10 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 olivaceus*), 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*). The lease sites fall within several big game emphasis area (Table 16.3-2).

**Table 16.3-2  
Big Game Emphasis Areas with the Proposed Lease Areas**

Lease	Big Game Emphasis Area
OR 054587 S29	Whitewater, Mt Bruno
OR 054587 S3	Mt Bruno, Minto
OR 054587 S2	Minto, Red Grizzly

Furbearer species in the lease area include river otter (*Enhydra lutra*), beaver (*Castor canadensis*), raccoon (*Procyon lotor*), and coyote (*Canis latrans*). Wolverines (*Gulo gulo luteus*) have been documented in the region and may be occasional visitors to the lease area. Small mammals in the project vicinity are red tree vole (*Arborimus longicaudus*), 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 from future development of geothermal power plants within the lease sites that would disturb 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, as well as 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 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 are.
- 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 maybe 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 North Santiam River 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, such as Chinook salmon; and cutthroat and rainbow trout, as well as 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 would result in direct mortality for amphibians and reptiles that would be crushed by equipment or entrapped in underground burrows.

The habitats within the lease area provides habitat for a variety of migratory birds. The FS is required to analyze the impacts of any action on migratory birds, under the Migratory Bird Treaty Act. 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 area. 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 sites are located within several Big Game Emphasis Areas (Table 16.3-2). The lease sites provide foraging and wintering habitat for elk and deer. Habitat clearing and human activity associated geothermal projects could disturb elk, displacing them temporarily or permanently from otherwise suitable foraging habitats in and adjacent to the lease area. 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.

### 16.3.10 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 Blowout Thin Project located approximately five miles west of the proposed lease sites, (US Forest Service 2007) 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 Endangered Species 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 (Table 16.3-3).

#### ***Harlequin Duck***

Harlequin ducks use rivers, streams, and creeks as feeding habitat and commonly nest on banks. Shrubby riparian vegetation, lack of human disturbance, and loafing sites are important factors for harlequin ducks (Cassirer and Groves 1989). The North Santiam River that passes through the lease area provides nesting habitat for harlequin ducks during the breeding season. Grizzly Creek may also contain suitable habitat.

#### ***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

**Table 16.3-3  
Federally Listed Species with Record of Occurrence  
and Potential to Occur in Lease Area**

Species	Habitat Present in the Lease Sites?	Status		
		Federal	USFS – R6	State
<b>Birds</b>				
Harlequin duck	Yes	Candidate	Sensitive	N/A
Northern spotted owl	Yes	Threatened	N/A	Threatened
Northern bald eagle	Yes	Sensitive	N/A	Threatened
Yellow rail	No	N/A	Sensitive	N/A
<b>Mammals</b>				
California wolverine	Yes	Candidate	Sensitive	Threatened
Baird's shrew	Yes	N/A	Sensitive	N/A
Pacific Shrew	Yes	N/A	Sensitive	N/A
Pallid bat	Yes	N/A	Sensitive	N/A
Townsend's big eared bat	Yes	N/A	Sensitive	N/A
<b>Reptiles and Amphibians</b>				
Oregon slender salamander	Yes	N/A	Sensitive	N/A
Western pond turtle	Yes	N/A	Sensitive	Critical
<b>Invertebrates</b>				
Mardon skipper	No	Candidate	Sensitive	N/A

Source: US Forest Service 2007, 2008

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).

The lease sites are entirely within northern spotted owl critical habitat. The Northwest Forest Plan (US Forest Service 1994) serves recovery plan functions through specific management requirements, standards, and guidelines. The Jefferson LSR is expected to be a major contributor to spotted owl recovery as a source of owls dispersing to the north, southeast, south, and east.

Old growth is found throughout the lease area, and all lease sites are entirely within the Jefferson LSR. The lease site in section 29 is in Willamette Land and Resource Management Plan Management Area 7, Old Growth Grove. Direction from the management plan may prohibit any geothermal development within an old growth grove (Whitmore 2008). A spotted owl activity center is located in the center of the area on the west side of the river (US Forest Service 2008a). The lease area in Section 2 is also spotted owl critical habitat, and a spotted owl

activity center is also located in the lease area located in Section 2 at the base of Minto Mountain.

### ***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 which are snowbound with very limited human activity. Wolverines do not make much use of forests that are young and densely vegetated, nor do they make much use of clear-cut areas (Hornocker and Hash 1981).

Wolverines appear to be extremely wide-ranging, and unaffected by geographic barriers such as mountain ranges, rivers, reservoirs, highways, or valleys. For these reasons, Hornocker and Hash (1981) concluded that wolverine populations should be treated as regional rather than local.

Wolverine surveys were conducted on the Detroit Ranger District in a cooperative aerial survey effort with Oregon Department of Fish and Wildlife during the winters of 1997-98, 1998- 99, 1999-2000 and 2000-2001. Camera bait sets were used in 2002, 2003 and 2004 with no wolverines detected. Wolverine dens or tracks have not been located on the district (US Forest Service 2007).

### ***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 containing physical or biological features essential to conservation, and those features require special management considerations or protection; as well as those areas outside the geographical area occupied by the species 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.

### **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 U.S. 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 BEPA, MBTA, 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 special status species; however, anticipated future actions would potentially result in impacts on special status species. 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 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.

## **16.3.11 HISTORIC AND SCENIC TRAILS**

### **Setting**

The Oregon section of the Pacific Crest National Scenic Trail traverses an area approximately two miles from the southeast corner of the SESE corner of T11S R7E S2. 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 Mt. 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 2008b).

### Impacts

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

The No Action alternative would have no impact on historic or scenic trails.

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

Neither the Proposed Action nor anticipated future actions following leasing would have any impact on historic or scenic trails. No effects are expected to occur on the Pacific Crest Trail due to the lease sites being greater than the required one-mile buffer that is described in the PEIS to avoid impacts.

## 16.3.12 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 16.3.13, *Tribal Interests and Traditional Cultural Resources*. Section 16.3.11 addresses *Historic and Scenic Trails*. Cultural resources in this section include the physical remains of prehistoric and historic cultures and activities.

The pending lease application site is within the Plateau culture region, as described in the Appendix I of the PEIS. Zenk and Rigsby (1998) provides an ethnographic overview of the project area within the larger Plateau culture region. The following discussion is based primarily on that overview. The pending lease application site is considered to be within the traditional territory of Molala-speaking groups. Within the traditional territory, the project area is in an area where the Northern Molala dialect was spoken. Human occupation of the Plateau culture region began around 12,000 years ago although there is little archaeological evidence for very early human occupation compared to later time periods.

Molala extended-family groups wintered west of the Cascades summit in low elevations. Winter villages included semiexcavated 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. 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-American 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).

Data on cultural resources of the proposed lease area were provided in May 2008 by Cara Kelly, Zone Archaeologist for the Detroit and McKenzie River Ranger Districts of the Willamette National Forest. Collected data was recovered via a basic records search. No additional archaeological research or review of historic maps was done due to time constraints. Very little (less than 10-percent) of the lease sites have been previously surveyed. The single cultural resources survey that covers a small portion of the lease was conducted in 1990. Eleven cultural resources have been recorded within OROR 054587. All are unevaluated for National Register of Historic Places (NRHP)-eligibility and are therefore treated as NRHP-eligible until assessments show they are ineligible.

The majority of sites in the lease area are prehistoric lithic scatters. Site numbers for these resources are included in Table 16.3-4.

Two of the sites, the Newport Drive Historic Trail and FS Site No. 06180400389, are historic linear resources associated with pre-contact and historic trails. One additional resource, FS Site No. 06180400108 (Smithsonian Site No. 35 LIN 580), is an area of culturally modified trees.

**Table 16.3-4  
Lithic Scatters in the Proposed Lease Area**

FS Site Number	Smithsonian Site Number
06180400076	35 LIN 633
06180400002	35 LIN 63
06180400003	35 LIN 64
06180400443	None
06180400058	None
06180400116	None
06180400057	35 LIN 374
06180400004	35 LIN 65

Consultation with federally recognized tribes that are affiliated with the lease area was initiated on September 12, 2007 to identify and assess historic properties that may be affected by the undertaking. No responses from the 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 sites. The presence of cultural resources within portions of the sites not previously surveyed is also possible. Table 16.3-5 summarizes available data on the cultural resources of the proposed lease sites.

**Table 16.3-5  
Recorded Cultural Resources in the Proposed Lease Area**

Lease OROR	Surveys (Percent)	NRHP- listed sites	NRHP- eligible sites	NRHP- ineligible sites	Unevaluated sites (Treated as NRHP-Eligible)
054587	<10%	N/A	N/A	N/A	11

## 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

develop measures to avoid, minimize, or mitigate any adverse effects of the undertaking on historic properties.

Given the density of unevaluated cultural resources and the lack of previous survey within the Willamette area leases, impacts on cultural resources could occur from subsequent permitted geothermal exploration, development, production and closeout 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.

### **16.3.13 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 pending lease application site is within 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 pending lease application site is considered to be within the traditional territory of Molala-speaking groups. Within the traditional territory,

the pending lease application site area is in an area where the Northern Molala dialect was spoken. 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).

Tribes with ties to the lease area include the Confederated Tribes of Grand Ronde Community of Oregon, the Confederated Tribes of Siletz Indians, the Confederated Tribes of Warm Springs Reservation of Oregon, and the Klamath Tribe. Consultation with federally recognized tribes that are affiliated with the lease area 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 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 process 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 in Appendix D of Volume III of the PEIS for each of the 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 BLM and 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 includes 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 16.3.12, *Cultural Resources*, are often considered traditional resources by tribes.

Impacts on traditional cultural resources could occur from subsequent geothermal exploration, development, production and closeout 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.

#### 16.3.14 VISUAL RESOURCES

##### Setting

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

The Forest Service's Scenery Management System is the current method for inventorying and managing scenic resources in National Forests. It is described in Chapter 3 of Volume I of the PEIS under *Visual Resources*. The scenery of the Forest, however, is managed through the application of the older Visual Management System (Agricultural Handbook - 462, National Forest Landscape Management, Volume 2, Chapter I, The Visual Management System). The Visual Management System (VMS) was adopted by the Forest Service in 1974. The key

component of the VMS is the establishment of Visual Quality Objectives (VQOs) within the Land and Resource Management Plan.

There are five differing levels of VQOs: Preservation, Retention, Partial Retention, Modification, and Maximum Modification. The following is a brief description of the five VQOs:

- 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.

Additionally, Agricultural Handbook - 478, National Forest Landscape Management, Volume 2, Chapter 2: "Utilities" (1975) also contains guidelines for managing visual resources with respect to utilities.

The northern lease sites have mostly Modification and Retention VQOs. There is also a portion with a Preservation VQO. The southern lease sites have mostly Modification and Retention VQOs. There is also a portion with a Partial Retention VQO.

According to the Land and Resource Management Plan Final Environmental Impact Statement for the Willamette National Forest, the landscape of the Forest is composed of dense coniferous vegetation, varied terrain, an abundance of geologic features, lakes and rivers, wildlife, and snow-capped mountain peaks (US Forest Service 1990). This resource provides a broad range of natural and managed scenic experiences for both local and distant visitors. The scenery of the Forest is an important asset to the local communities.

The western Cascades landscape type is oriented in a north-south direction and occupies the western two-thirds of the Forest (US Forest Service 1990). It is characterized by a general conformity in ridge crests separated by deep valleys with moderately steep, highly dissected, side slopes. In the southern portion of this landscape type, the major valleys are V-shaped. Some rock cliffs and rock outcrops exist. Vegetation is characterized by dense stands of large trees including western hemlock, Douglas-fir, and true fir. Most areas have a continuous cover of overstory and understory vegetation. Deciduous species such as alder and maple are often intermixed along drainages. Some meadows are found in both lower and upper elevations.

A wide variety of rock formations exist in the area but most are hidden by the dense vegetative cover (US Forest Service 1990). Some extensive bare rock ridges and volcanic plugs stand out above the vegetation, and old volcanic lava flows are sparsely vegetated. Water bodies, particularly lakes, ponds, and marshes are scarce within this landscape character type. Other waterforms consist of streams and major rivers, all of which drain in to the Willamette Basin.

The visual experience of Forest visitors in this landscape type is characterized by views that are focused or directed at points or features in the landscape by road and trail side vegetation or landform structure (US Forest Service 1990). To a lesser extent, visitors will also experience landscape spaces enclosed by a continuous physical barrier of trees, hills, or mountains.

The proposed lease sites are approximately 5 to 8 miles west of the summit of Mt. Jefferson (approximately 10,500 feet), approximately 8 to 10 miles southeast of the town of Detroit, and straddle Highway 22 and Santiam River. Tributaries of the Santiam River also cross the lease area. Prominent peaks near the lease sites are Mount Bruno (approximately 5,300 feet), Woodpecker Hill (approximately 5,000 feet), Minto Mountain (approximately 5,100 feet), and Lizard Ridge (approximately 5,600 feet).

The sloped terrain found in the lease sites are mostly covered with a coniferous forest of varying heights and maturity, except where a patchwork of clear cuts occurs. Strings of dirt roads for logging cover the lease sites.

Human-made modifications to the visual landscape are limited to roads of various conditions and recreation areas. Hiking, backpacking, and snowshoeing activities occur in all of the lease sites. There is a trail (#3448) in the most eastern parcel proposed for geothermal leasing. Riverside Campground is next to Highway 22 and is also in a lease area. With the exception of Highway 22, there are no sources of light in the lease sites.

Highway 22 is a National Scenic Byway (US Department of Transportation 2008a). It is 220 miles long and offers views of waterfalls, ancient forests, rushing whitewater, placid lakes, and snowcapped volcanic peaks (US Department of Transportation 2008b).

## Impacts

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

There would be no impacts on, or 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. These impacts would be noticeable, because they would be near areas where recreation takes place and near areas where minimal nearby development exists. The impacts would also be near a scenic byway. 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 reasonable development scenario would result in impacts on visual resources that would not be consistent with Retention and Preservation VQOs.

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 and would result in landform and vegetative alterations that blend in with the surrounding landscape character. As a result, changes to visual resources based on the reasonable development scenario would result in impacts on visual resources that would be consistent with Partial Retention and Modification VQOs.

### 16.3.15 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

#### **Setting**

The leasing area covers approximately 1,115 acres within Linn County, Oregon. Linn County was selected as the Region of Influence 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**

In 2006, population in Linn County was estimated at 111,489 (US Census Bureau 2008). This represents an 8.2 percent increase in population from 2000, when the total population within the county was approximately 103,069. Between 1990 and 2000 population increased by approximately 7.5 percent. Current population trends are expected to continue (US Census Bureau 1990, 2000).

#### **Housing**

In 2000, there were 42,521 total housing units; 39,541 of these were occupied and 26,854 owner occupied, with a homeowner vacancy rate of 2.2 percent and a rental vacancy rate of 9.2 percent. In 1990, there were 36,482 total housing units, of which 34,716 units were occupied and 22,757 owner occupied. In 1990 the homeowner occupancy rate was 1.2 percent and the rental vacancy rate was 4.3 percent (US Census Bureau 1990, 2000).

#### **Employment**

In 2000 the workforce consisted of 50,105 individuals, of which 3,931 people, or 7.8 percent were unemployed. This is consistent with 1990 data, when the workforce consisted of 42,851 people, of which 3,354 or 7.8 percent were unemployed. Median household income was \$37,518. In 1990 median family income was \$29,421.

Based on 2000 data, the industries employing the greatest percent of the population include manufacturing (21.6 percent), educational, health and social services (19 percent); retail trade (11.7 percent); and construction (7.7 percent) (US Census Bureau 1990, 2000).

#### **Schools and Public Infrastructure**

In 1990, 15,646 students were enrolled in K-12 education in Linn County. In 2000 this number increased to 19,774 students (US Census Bureau, 1990, 2000). School Districts within Linn County include Central Linn, Greater Albany Harrisburg, Santiam Canyon, Sweet Home, and Linn Benton.

**Environmental Justice**

Whites of non-Hispanic origin account for approximately 94.9 percent of the population of Linn County based on the most current data available (US Census Bureau 2008). The minorities with the largest presence in the local population are people of Hispanic/Latino descent (5.6 percent) and American Indian or Alaskan Natives (1.2 percent) (US Census Bureau 2008). Additional details are provided in Table 16.3-6, below.

In 1999, 11,618 people, or 11.4 percent of the population were living below the poverty level in Linn County. This was a slight decrease from 1990, during which survey approximately 12,178 individuals or 13.5 percent of the population was living below poverty level (US Census Bureau 1990, 2000).

**Table 16.3-6  
Race/Ethnicity in Linn County**

	1990	2000	Percent Change (%)
Total Population	91,227	103,069	7.5 %
White	88,364	96,059	87 %
Black/African American	182	327	79 %
American Indian/Alaskan Native	1056	1313	24 %
Asian	799	799	0 %
Pacific Islander*	N/A	151	N/A
Other	826	1855	125 %
Two or more*	N/A	2,565	N/A
Hispanic or Latino**	2,177	4,514	107 %

Source: US Census Bureau 1990, 2000.

\* Not reported on 1990 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 Linn County, Oregon. 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 Linn County due to construction and operations and maintenance jobs at a newly

developed geothermal plant. Given the reported unemployment rate of 11.4 percent in 2000, and the small size of the proposed plants, it is not likely that jobs created by the proposed action would require a large population influx. As a result, impacts on local schools or other public infrastructure would be minimal.

Geothermal development would also be a positive stimulus to the local economy through tax revenues for Linn County and the State of Oregon.

The Reasonably Foreseeable Development scenario predicts one 20 MW plant and one 30 MW plant will be developed in the lease area for electricity generation. Impacts of a standard 50 MW plant are discussed in Chapter 4 of the PEIS, *Socioeconomics and Environmental Justice*. Similar impacts to those discussed in the PEIS are likely for this lease area; however, impacts would be reduced according to the smaller MW capacity of the plants in the lease area.

Due to the absence of residences in and around the lease area, impacts on low income or minority populations would be minimal.

### 16.3.16 NOISE

#### Setting

Current sources of noise in the lease site are limited to wind, dispersed recreational use, traffic from Highway 22, logging roads, camping at the Riverside campground, and wildlife. Sources of noise originating outside of the lease sites but affecting the lease sites include traffic from logging roads and air traffic. Sensitive noise receptors are generally considered to be homes, hospitals, schools, and libraries, but can also include recreational facilities, where a quiet environment is vital to the natural setting and recreational experience. Aside from the Riverside campground located at the south end of Section 3, no other buildings or developments are within one mile of the site. The Riverside campground is the only identified sensitive noise receptor.

#### 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. Geothermal activities in the south portion of Section 3 could adversely impact the quality of recreational experience currently possible at the Riverside campground. The prohibition of geothermal activities within a quarter mile of the Santiam River due to its eligibility as a Wild and Scenic River would eliminate any noise impacts on the campground.

Geothermal activities in sections 3 and 29 could impact the Outstanding Remarkable Values for the North Santiam River, as a river that is eligible for designation as a Wild and Scenic River. The prohibition of geothermal activities within a quarter mile of the river would reduce such noise impacts.

## SECTION 16.4

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