

CHAPTER 17

MT. BAKER-SNOQUALMIE NATIONAL FOREST

SPOKANE DISTRICT

ANALYSIS FOR PENDING LEASE

APPLICATIONS:

WAOR 056025, WAOR 056027, WAOR 056028, WAOR 056029

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SECTION 17.1

INTRODUCTION

17.1.1 INTRODUCTION

This lease-specific analysis describes the environmental effects of leasing approximately 9,450 acres of NFS land within the Mount Baker District of the Mount Baker-Snoqualmie National Forest and the BLM Spokane 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 sites are within the Mount Baker Ranger District of the Mount Baker-Snoqualmie National Forest, which is the surface management agency for the lease sites. Subsurface mineral rights are managed by the BLM Spokane District. The BLM issues leases with the consent of the FS (Regional Forester upon recommendation from the Mt. Baker-Snoqualmie NF Supervisor) for the lands under application on the Mount Baker-Snoqualmie NF.

17.1.2 LOCAL REGULATORY CONSIDERATIONS

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

State of Washington Renewable Portfolio Standard Program

The Washington Renewable Portfolio Standard Program is a Washington law that requires investor-owned utilities to obtain 15 percent of the power supplied to customers to be generated from renewable resources by 2015. Geothermal energy is included in the definition of renewable resources under the program.

Mount Baker-Snoqualmie National Forest Land and Resources Management Plan (1990)

The Mt. Baker-Snoqualmie National Forest Land and Resources Management Plan (Forest Plan) guides all natural resource management activities and establishes management standards and guidelines for the Mt. Baker-Snoqualmie 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 forest-wide standards and guidelines that apply to geothermal activity:

- An appropriate environmental analysis and documentation will be used as a basis for making recommendations in leasing or licensing and in determining necessary stipulations for the protection of other resources. FW-297 – Permits for leasable minerals shall provide for protection and rehabilitation of surface resources.
- Processing and administration of all mineral, oil and gas and geothermal leases, exploration proposals, and development proposals will be in accordance with State and Federal rules, regulations, and standards.
- Mineral exploration and mineral removal are permitted throughout the forest, except withdrawn areas.
- All activities which involve significant disturbance of the surface resources require a notice of intent and/or an operating plan be submitted and processed in accordance with 36 CFR 228.E
- Reclamation standards will be developed to insure land restoration to a productive condition to the extent practicable. Opportunities to enhance other resources will be considered. Concurrent reclamation will be required and bonded.
- Withdrawal of lands from appropriation or entry under the mining or mineral leasing laws will be in accordance with Section 204 of FLMPA. Areas with mineral potential will be recommended for withdrawal from mineral entry when mitigation measures would not adequately protect other resource values which are of greater public benefit.
- For mineral lease applications submitted by BLM, appropriate stipulations will be required for leases as necessary to achieve Management Area prescriptions. "No surface occupancy" stipulations will be incorporated in lease recommendations when: (a) surface occupancy would cause significant resource disturbance which cannot be mitigated by other means; (b) where resource impacts would be irreversible or irretrievable; or (c) the activity proposed is incompatible with the surface management prescription.

Spokane Resource Management Plan (1985)

The lease area is within the BLM Spokane District. The Spokane RMP was developed to provide a comprehensive framework for managing and allocating public land and resources in the Spokane District. It serves as a master plan that

provides a framework within which more site-specific decisions can be made regarding conditional or prohibited uses and activities in some sites. It serves to define the intensity of management of various resources, the development of activity plans such as grazing allotment management plans and habitat management plans, and the issuance of rights-of-way, leases, or permits.

The Leasable Minerals section of the Spokane 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 RMP includes the following Management Actions/Direction regarding leasable minerals:

- All energy leasable minerals (oil, gas, and geothermal) fall under regulations in 43 CFR 3100 and 3200.
- Leasable mineral operations are covered under the District's oil and gas EA which has identified areas of environmental concern
- BLM requires a cultural evaluation prior to entry.
- General stipulations (such as identifying cultural resource potential, endangered, threatened, or sensitive species clearance) are to be established at the time of lease issuance.

Northwest Forest Plan (1994)

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

- 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 (US Forest Service 1994a).

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.

17.1.3 SCOPE OF ANALYSIS AND APPROACH

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

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

17.1.4 CUMULATIVE ACTIONS

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

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SECTION 17.2

PROPOSED ACTION AND ALTERNATIVES

17.2.1 INTRODUCTION

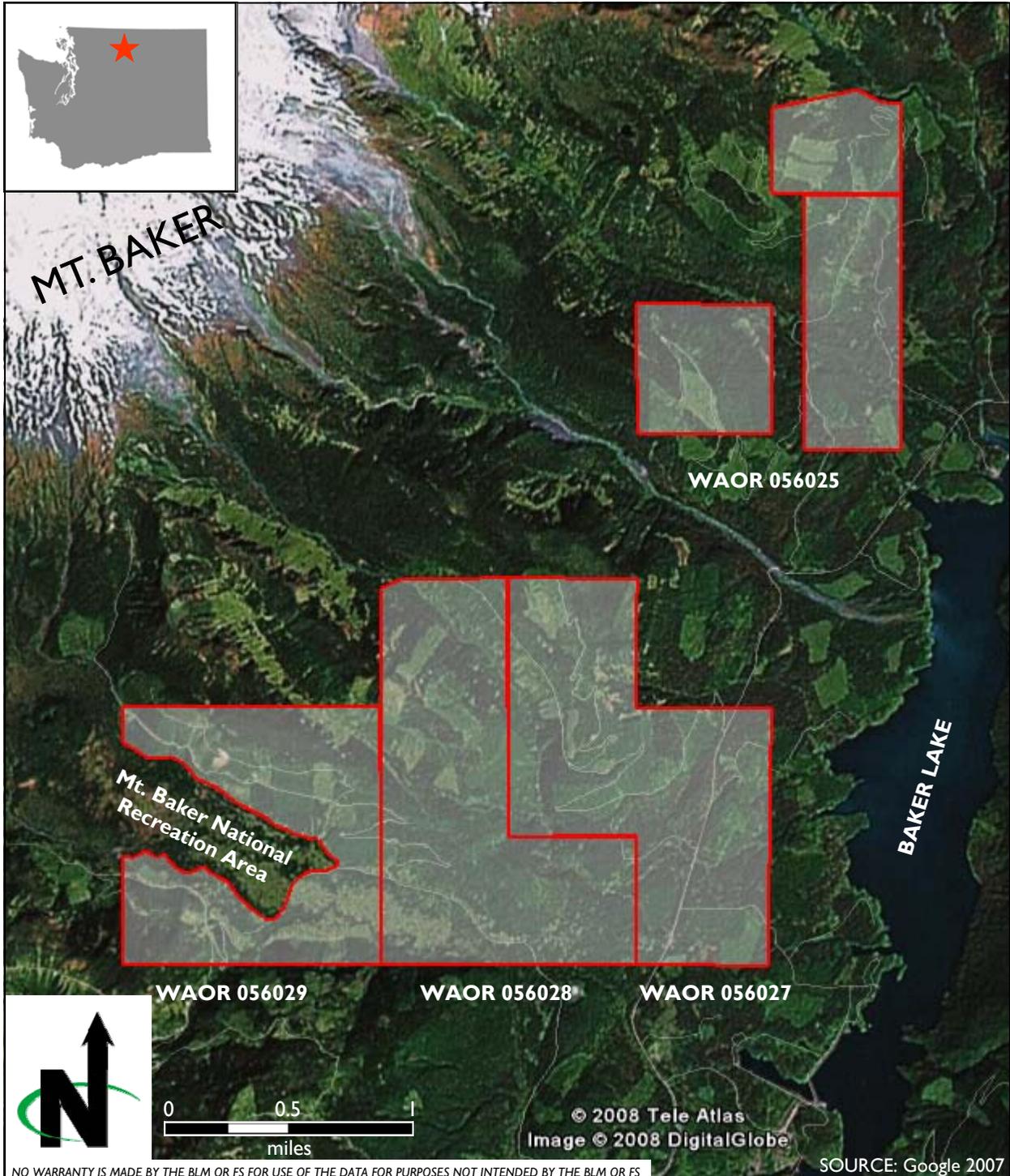
This chapter provides the details of the proposed action, alternatives to the proposed action, and an overview of the reasonably foreseeable develop (Reasonably Foreseeable Development) scenario for pending lease application sites WAOR 056025, 056027, 056028, and 056029.

17.2.2 PROPOSED ACTION

The proposed action is (1) for the Forest Service to issue a consent determination to the BLM to issue leases to the lease applicant for three areas within the Mount Baker National Forest and Spokane/Wenatchee BLM District; and (2) the BLM to issue said leases. The 9,450.2 acres of land are in the southeastern foothills of Mount Baker, in Whatcom County, Washington (see Figure 17-1). Lease boundaries could be adjusted in the decision to avoid unacceptable impacts on sensitive resources.

Four pending lease applications are included within this area:

- WAOR 056025 – 2,403 acres comprise portions of three adjacent sections of land and a full fourth section 0.25 mile to the west. The legal description of this land is (1) T38N R8E S36; (2) T38N R9E S19, “part so of wilderness”; (3) T38N R9E S30, parts E2, E2W2, Lots 1-4; (4) T38N R9E S31, parts E2, E2W2, Lots 1-4.
- WAOR 056027 – 2,560 acres comprised of four contiguous sections of land. The legal description of this land is (1) T37N R8E S11; (2) T1S T37N R8E S13; (3) T37N R8E S14; (4) T37N R8E S24.
- WAOR 056028 – 2,544.970 acres comprised of four contiguous sections of land. The legal description of this land is (1) T37N R8E S10, “pt outside NRA”; (2) T37N R8E S15; (3) T37N R8E S22; (4) T37N R8E S23.



C://EMPS/Geothermal/PEIS/Figures

All 3 lease sites are within the Mt. Baker-Snoqualmie National Forest.

LEGEND:
 Lease site boundary

Mt. Baker Lease Locations
 WAOR 056025, 056027, 056028, 052029
 Mt. Baker-Snoqualmie NF / Spokane District

Figure 17-1

- WAOR 056029 – 1,941.920 acres comprised of four contiguous sections of land with a portion of each excluded due to the excluded land being a National Recreation Area. The legal description of this land is (1) T37N R8E S16, “pt outside NRA”; (2) T37N R8E S17, “pt outside NRA”; (3) T37N R8E S20, “pt outside NRA”; (4) T37N R8E S21, “pt outside NRA”.

The lease sites range in elevation from 800 feet to 3,400 feet above mean sea level and are traversed by several creeks, roads and trails. Other land uses include several gravel pits and quarries. There are no known buildings within the lease sites or within 0.5 mile of any of the lease sites.

17.2.3 ALTERNATIVES

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

Alternative A: No Action

Under Alternative A, the BLM would deny the four pending lease applications.

Alternative B: Leasing with Stipulations

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

17.2.4 REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

All of the lease sites are likely to be developed for electricity generation. The pending noncompetitive lease applications were filed by Vulcan Power Corporation in 2000. It is expected that issuing all of the leases in this area would result in two binary power plants at capacities of 30 and 20 megawatts. 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 17.3

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

17.3.1 INTRODUCTION AND GEOGRAPHIC SETTING

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

17.3.2 LAND USE, RECREATION AND SPECIAL DESIGNATIONS

Setting

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

Policies and Plans

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

geothermal leasing by the BLM. The pending lease application sites are located within the Mount Baker-Snoqualmie National Forest, which is managed under the Mount Baker-Snoqualmie National Forest Land and Resource Management Plan (Forest Plan). The Forest Plan, as amended by the Northwest Forest Plan has the stated goal to, “provide for exploration, development, and production of mineral and energy resources while minimizing effects on the surface resources” (US Forest Service 1994b). Standards and guidelines in the Forest Plan for leasable mineral operations are discussed in Chapter 1.

Regional Setting

The lease area consists of approximately 9,450 acres of NFS land in three areas of the southeastern foothills of Mount Baker. The lease area is within in the Mount Baker District of the Mount Baker-Snoqualmie National Forest, in Whatcom County, Washington. Land within and adjacent to the lease area is primarily NFS land, with some private parcels interspersed.

The lease area and Mount Baker-Snoqualmie NF region is within 70 miles of more than 3 million people in the metropolitan areas of central Puget Sound. Bellingham is approximately 30 miles from the lease sites with a population of 67,000.

One campground occurs near lease site WAOR 056025 and is described below. No other campgrounds occur within 0.5 mile of the lease sites. One trailhead, for Boulder Ridge trail, occurs within the lease sites.

Mount Baker National Recreation Area abuts the center portion of all four sections in lease WAOR 056029 and the NW corner of section 10 in lease WAOR 056028. This National Recreation Area was created to accommodate and preserve the winter snowmobile use of the Mount Baker area. Management of the area focuses on providing snowmobile and cross-country skiing opportunities during the winter and non-motorized recreational uses during the summer season. During the summer months the area is used for hiking, and backcountry camping at designated sites (US Forest Service 2007).

In addition to activities described at the designated recreation areas, dispersed recreation occurs throughout the lease area. Popular forms of recreation in the Forest include hiking, horse-back riding, hunting, and fishing.

At its closest, the North Cascades National Park is approximately 1.9 miles to the northeast from lease site WAOR 056025. The lease site is separated from the National Park by a river and a drop in topography from approximately 1,600 feet above mean sea level (amsl) at the lease site, to approximately 1,300 feet amsl at the river, and back up to approximately 1,800 feet amsl at the National Park boundary.

Lease Areas

According to the Northwest Forest Plan, all sites are in a Late-Successional Reserve, and Sulfur Creek Botanical Area (8C) is present in relatively small parts of sites WAOR 056028 and 056029. Riparian reserves are present throughout the lease areas. None of the lease sites are within Key Watersheds. Riparian Reserves are abundant throughout the lease sites. In addition, some sites are within or adjacent to Inventoried Roadless Areas and the Mt. Baker Wilderness Area, thereby limiting accessibility to the sites.

WAOR 056025

The northern portion of Section 19 lease area borders the Mt. Baker Wilderness Area. Baker Hot Springs is located just to the east of the SE quarter of the same section (the hot springs are not in the lease site). NFD 1130 and 1144 provide access to section 30 and 31. A quarry is found in the NW quarter of Section 30 and a gravel pit in SE quarter of Section 31. The only feature of note in Section 36 is NFD 1131.

The closest campground to the lease sites is approximately 0.3 mile east of Section 31 between NFD 1144 Road and Park Creek. The trailhead for Boulder Ridge trail is within Section 36.

Roughly the southwest half of Section 36, the western half of Section 19, and a small area in the western portion of Section 30 are within Inventoried Roadless Area South Mount Baker #6041. Old growth forest comprises the majority of sections 30 and 31, approximately one third of Section 36, and a small amount of Section 19. Riparian Reserves exist in all sections of this lease site.

WAOR 056027

Numerous roads are found in this lease area. NFD 1127 road crosses the center of section 11 from N to S. NFD 1124 provides access to the SW quarter of Section 11 and the NW of section 13. NFD 1120 crosses Section 13 and the western portion of 24. NFD 1124, 1127, and 1122 cross portions of Section 14. NFD 11/Baker Lake Road crosses through sections 14 and 24 on a NE-SW direction. NFD 118 travels across the SE portion of Section 24. Little Sandy Creek originates in the SE quarter of Section 11. Sandy creek is found in the SW quarter of Section 13, and crosses through the northern half of Section 24.

A small portion along the central northern edge of Section 11 of this lease site is contained within an Inventoried Roadless Area South Mount Baker #6041. Old growth forests comprise approximately two thirds of Section 24, half of sections 13 and 14, and one third of Section 11. Riparian Reserves exist in all sections.

WAOR 056028

Dillard creek crosses Section 15. Sandy Creek crosses through Section 10 and the northern half of Section 23. Sulphur and Rocky creeks pass through Section 22. NFD 13 traverses the western portion of Section 15 and the NW quarter of

Section 22. NFD 12 crosses Section 22 and the SE quarter of Section 23. Additional unnamed roads forest roads are found in sections 15 and 22. A gravel pit is in the SESE of Section 22 and a quarry in the SW of Section 23.

Roughly half of Section 10 and a small portion of on the west side of Section 15 are within Inventoried Roadless Area South Mount Baker #6041. Old growth forests comprise approximately one third of sections 15 and 23, and small portions of sections 10 and 22. Riparian Reserves exist through much of sections 10, 15 and 22, and to a lesser degree in Section 23.

WAOR 056029

NFD 13 road transverses the southern portion of Section 16 and the north east area of Section 17. NFD road 12 crosses the SW quarter of Section 20 and Section 21. Additional unnamed roads provide access to all sections in this lease area. Sulphur Creek cross potions of section 16, 17 and 21.

Roughly the north half of Section 16, the northeast corner of Section 17, and nearly all of sections 20 and 21 are within Inventoried Roadless Area South Mount Baker #6041. Areas not within the roadless area are mostly designated as old growth forest and Riparian Reserves.

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 Mt. Baker Forest Plan or the Northwest 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. It is expected that issuing all of the leases in this area would result in two binary power plants at capacities of 30 and 20 megawatts. A 30 megawatt plant is estimated to result in 15 acres of land disturbance, and a 20 megawatt plant result in 10 acres of land disturbance for a total disturbance of 25 acres. Impacts on land use and dispersed recreation associated with geothermal plant development are further discussed in Section 4 of the PEIS, *Land Use, Recreation, and Special Designations*.

Existing Forest Service roads would be used to access these sites. The Proposed Action would be consistent with the Mt. Baker Forest Plan, the Northwest Forest Plan provided that stipulations for relevant land allocations are followed.

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 Mount Baker-Snoqualmie 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

Portions of lease sites WAOR 056025, 056058, and 052069 are within Inventoried Roadless Area South Mount Baker #6041. Development in these areas would be consistent with this designation as long as no new roads are constructed to access the sites. Lease stipulations would include a prohibition on road construction or reconstruction. Geothermal development in Inventoried Roadless Areas would be limited to areas directly adjacent to existing roads. Impacts on Inventoried Roadless Areas would be limited to areas directly adjacent to existing roads.

Impacts on Riparian Reserves

Riparian Reserves exist throughout all lease sites. Riparian Reserves would have No Surface Occupancy stipulations associated with them in any leases issued that contain such reserves; therefore, Riparian Reserves would not be impacted.

Impacts on Sulphur Creek Botanical Area (8C)

The Forest Plan recommends denial of application for leasable minerals within these the Sulphur Creek Botanical Area (8C), and withdrawal of this area from pending lease applications where they have not been previously withdrawn.

Potential conflicts with other wildlife management areas are discussed further in Section 17.3.9 *Fish and Wildlife*.

17.3.3 GEOLOGIC RESOURCES AND SEISMICITY

Setting

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

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

As subduction occurs, high temperatures and pressures allow water molecules locked in minerals of solid rock to escape. The water vapor rises into the pliable mantle above the subducting plate, causing some of the mantle to melt. This newly formed magma rises toward the Earth's surface to erupt, forming a 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 back to the Pleistocene (US Geological Survey 2004).

The North Cascade Range in Washington State is part of the American Cordillera, a mighty mountain chain stretching more than 12,000 miles from Tierra del Fuego to the Alaskan Peninsula. Although only a small part of the Cordillera, mile for mile, the North Cascade Range is steeper and wetter than most other ranges in the conterminous United States. Rocks of the North Cascades record at least 400 million years of Earth history. The range is a geologic mosaic made up of volcanic island arcs, deep ocean sediments, basaltic ocean floor, parts of old continents, submarine fans, and even pieces of the deep subcrustal mantle of the earth. The disparate pieces of the North Cascade mosaic were born far from one another but subsequently drifted together, carried along by the ever-moving conveyor belt of tectonic plates that make up the Earth's outer shell (US Geological Survey 2004).

All the lease sites lie within approximately ten miles of the summit of Mount Baker. Mount Baker is an isolated stratovolcano. It is the northernmost of the Cascade volcanoes in the United State and second to Mt. Rainier in extent of glaciation. The volcano has been very active over the last ten thousand years, erupting 13 times in recorded history in addition to the occurrence of multiple lava and mud flows (University of North Dakota 2008). Portions of the lease areas lie between the southeastern flank of the volcano and Baker Lake within regions identified in a 1995 US Geological Survey report as areas susceptible to volcano-related hazards, including inundation by cohesive debris flows. Sections closer to the summit fall within a pyroclastic flowage hazard zone, and could be affected by pyroclastic flows and surges, lava flows, and ballistic debris from future eruptions (US Geological Survey 1995).

Impacts

Alternative A (No Action)

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

Alternative B (Proposed Action)

The Proposed Action would not have any direct impacts on geological resources or put people or structures at risk from seismic events; however, anticipated actions following leasing could have impacts on these resources and result in risks related to seismicity through 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 proper evacuation plans would need to be in place in case of a seismic or eruption event.

17.3.4 ENERGY AND MINERALS

Setting

Energy

The electric provider in Whatcom County is Puget Sound Energy. Puget Sound Energy partners with the Public Utility District #1 of Whatcom County, a community-based water and electric utility (Public Utility District of Whatcom County 2005). Approximately one-third of the electricity Puget Sound Energy customers use comes from the utility's own power plants. Together, these plants have more than 2,400 megawatts of power-generating capacity. Puget Sound Energy purchases the rest of its power supply, mostly under long-term contracts, from a variety of other utilities, independent power producers, and energy marketers across the western United States and Canada (Puget Sound Energy 2008).

Low-cost hydropower accounts for the single largest share of Puget Sound Energy's power portfolio. The utility owns and operates three hydropower projects, and purchases additional hydroelectric power from central Washington public utility districts. Additional electricity is generated from four coal and gas fired power plants and two wind farms (Puget Sound Energy 2008).

The Washington Renewable Portfolio Standard Program requires investor-owned utilities to obtain 15 percent of the power supplied to customers to be generated from renewable resources by 2015; Puget Sound Energy is in compliance with this regulation. In addition, a 2002 Washington state law requires all electric utilities in the state to offer their customers the option of purchasing green power. Puget Sound Energy fulfills this measure with the

Green Power Program. Puget Sound Energy's Green Power Program currently has over 19,500 participants, including over 500 businesses (Puget Sound Energy 2008).

Locatable Minerals

The Mt. Baker-Snoqualmie NF has a long history of mining, dating back to the late 1800's. Locatable minerals occurring in the Forest include, but are not limited to, copper, gold, molybdenum, tungsten, olivene, chromite, nickel, zinc, silver, and lead. There are approximately 4,000 mining claims currently in the Forest, the majority of these being located in the Middle Fork Snoqualmie, Sunset-Silver Creek, Vesper Peak, Silverton, Sultan, Darrington, Sauk River, Lone Jack and Twin Sisters areas. A total of 148,187 acres within the Forest have a moderate to high potential for development of locatable minerals (US Forest Service 1990).

Leasable Minerals

Only 18,225 acres in the Forest are classified as prospectively valuable for oil and gas resources. Oil and gas are not thought to exist on the Forest in commercial quantities, but only limited surveys have occurred.

For geothermal resources, a total of 76 geothermal lease applications have been received. Limited exploratory drilling had been conducted, however, the majority of the Forest (1,222,812 acres) has been classified "prospectively valuable" for geothermal energy. NFS land has 14 identified hot or mineral springs identified as having direct utilization potential (Bloomquist 1985). Areas identified as having indirect, electrical generation potential include the Sulphur Creek Hot Springs and Mt. Baker where the current pending lease application sites are located (US Forest Service 1990).

Saleable Minerals

Saleable minerals have been identified in the lease area. Two gravel pits are located in sections 22 and 31, and three quarries are located in sections 14, 23, and 30. The future demand for these materials is likely to reflect the level of road building and maintenance needed in conjunction with timber harvest activities. The demand for county and State highway construction is significant locally, but highly variable in the long term (US Forest Service 1990).

Impacts

Alternative A (No Action)

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

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on energy or mineral resources; however, anticipated future actions following leasing would potentially result in such impacts. One 20 megawatt and one 30 megawatt plant

are proposed for development in the lease area for total of 50 megawatts. Details of impacts on energy and minerals are discussed for a standard 50 MW plant in Section 4 of the PEIS, *Energy and Minerals*. Similar impacts are anticipated at the lease sites. 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 17.1 of this analysis.

17.3.5 SOILS

Setting

Soils information was provided by the Mount Baker NF through a Geographical Information Systems overlay of soils data with the lease sites. Multiple soil types exist within each of the lease sites, including:

- Ash and cinders;
- Colluvium;
- Colluviated till;
- Eroded glacial materials;
- Glacial till;
- Glacial drift;
- Organics;
- Residium;
- Rock outcrop; and
- Talus slopes (US Forest Service 2008).

There are no prime or unique farmlands within the lease sites.

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.

17.3.6 WATER RESOURCES

Setting

Surface Water

Surface water in Washington State is governed by the Washington State Department of Ecology. The lease sites lie within the Skagit River region and the Upper Skagit Watershed.

The major surface water feature near the lease sites is Baker Lake. Baker Lake lies approximately half a mile east of the lease area and is drained by Baker River. In addition, glacial run-off from Mt. Baker is the source of several creeks that traverse the lease sites and drain to Baker Lake. In addition to several unnamed creeks, the following named creeks are within the lease sites:

- Morovitz (WAOR 056025 - Sections 19, 30, 31)
- Park (WAOR 056025 - Sections 31, 36)
- Little Park (WAOR 056025 - Section 31)
- Sulphur (WAOR 056029 - Section 21; WAOR 056028 - Section 22)
- Rocky (WAOR 056029 - Section 21; WAOR 056028 - Section 22)
- Dillard (WAOR 056027 - Section 13; WAOR 056027 - Section 15; WAOR 056029 - Section 16)
- Sandy (WAOR 056028 - Sections 10, 23; WAOR 056027 – Sections 11, 13, 24)
- Little Sandy (WAOR 056027 - Section 11)

Two small ponds exist in Section 31 of WAOR 056025, one of which is on Morovitz Creek. A third pond is found in Section 24 of WAOR 056027. There are no springs within any of the lease sites, although Baker Hot Spring is located immediately east of the southern portion of Section 19.

None of the above-mentioned creeks were classified as impaired in the 2002-2004 Water Quality Assessment for Washington (Washington Department of Ecology 2004).

Ground Water

The lease site is located to the east of the Puget Sound Lowland 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. In the Puget Sound lowland, unconsolidated-deposit aquifers consist chiefly of glacial deposits that are as much as 3,000 feet thick near Seattle. Sand and gravel that were deposited during the last period of glaciation compose the most productive aquifers in the lowland and generally form the upper 200 to 300 feet of the unconsolidated deposits. At depth, sand and gravel deposits typically are discontinuous lenses that can be present as much as 2,000 feet below the land surface (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).

Although usually much less permeable at depth because of compaction, lenses of sand and gravel can yield large volumes of water to wells. Even though well yields vary greatly, yields from sand and gravel aquifers commonly exceed 2,000 gallons per minute. 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. 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).

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. In the Puget Lowland region most groundwater discharges from springs and seeps to streams that drain the lowland. Large springs discharge from 1,000 to 20,000 gallons per minute from some unconsolidated deposits. 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, and agricultural 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 water quality 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 surface water quality.

Water Quantity

Indirect use geothermal projects require large amounts of water during all phases of a project from exploration through reclamation and abandonment; therefore, anticipated future actions following leasing could result in 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.

The lease sites are separated from the North Cascades National Park by a drop in topography and a distance of 1.9 miles at the closest point, which is the northeast corner of lease site WAOR 056025. The rest of the lease sites (WAOR 056029, 056028, 056027) are separated from the National Park by Baker Lake and a greater distance than 1.9 miles. The nearby National Park does not have any recorded thermal features. A hydrological connection to aquifers and geothermal reservoirs within the National Park is considered to be unlikely. There would be no effect on thermal features within National Parks.

17.3.7 AIR QUALITY AND ATMOSPHERIC VALUES

Setting

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

The lease site is located in the Cascade Mountain range in Washington. Condensation occurs as the air moves inland over the cooler land and rises along the windward slopes of the mountains. This results in a wet season beginning in October, reaching a peak in winter, and gradually decreasing in the spring.

The closest weather monitoring station to the lease site is at the Upper Baker Dam, Washington, approximately two miles south of the lease area. Average maximum temperatures at Upper Baker Dam range from 38.8 degrees Fahrenheit in January, to 74.6 in August, with average minimum temperatures ranging from 28.5 degrees Fahrenheit in January, to 51.3 in August. Average annual precipitation at the Upper Baker Dam station is 99.67 inches (Western Regional Climate Center 2008).

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on air quality and 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 may result in such impacts, the nature of which are discussed in Section 4.8 of this PEIS. Anticipated future actions would not result in violations of ambient air quality standards given the Unclassified status of the county and the good level of air quality.

17.3.8 VEGETATION

Setting

The pending lease sites are located within the western hemlock (*Tsuga heterophylla*) zone of the Northern Cascades Physiographic Province (Franklin and Dyrness 1988). Mt. Baker (elevation 10,778 feet above mean sea level) and other high mountain peaks rise up from the lease area on the north and west. The lease area is on a southeast slope of Mt. Baker. Along these slopes, vegetation transitions to higher elevation assemblages including the Pacific silver fir (*Abies amabilis*), mountain hemlock (*Tsuga mertensiana*), and parkland zones (Forest Service 2002).

Events of both natural and human origin have modified forest stands in the lease area. Natural disturbance events include wind storms, wildfire, and avalanches. Human disturbance of vegetation has occurred through timber management activities, fire, and recreational use. The lease area is a mosaic of forest stand ages, containing both old-growth and second growth coniferous forest. The area is federally managed as NFS lands, and timber harvest is currently restricted.

The forest in the pending lease is predominately of the old-growth and late successional forest types (Federal Energy Regulatory Commission 2006). The forest types include coniferous, mixed, and deciduous forests.

Late-Successional Reserves

In 1994 the NWFP designated a network of Late-Successional Reserves 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 1994b). The Baker Late-Successional Reserve is about 82,100 acres and includes the entire lease area.

Coniferous and Mixed Coniferous/Deciduous Forest

Coniferous forests capable of exhibiting great biomass and longevity dominate the lease area (US Forest Service 2002). 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 lease area are found in areas with relatively recent and/or frequent ground disturbance, such as timber harvest, landslide areas, avalanche chutes, and riparian zones of low to moderate gradient streams and rivers. Red alder (*Alnus rubra*) is the dominant species in areas with 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. Black cottonwood (*Populus balsamifera* spp. *trichocarpa*) is the dominant overstory species along riparian zones with moderately to well-developed floodplains, but is not found in the lease area. Within areas of frequent disturbance, such as avalanche chutes and riparian zones, deciduous shrub communities may persist; these are typically dominated by willows (*Salix* species), vine maple (*Acer circinatum*), and salmonberry (*Rubus spectabilis*) (Federal Energy Regulatory Commission 2006).

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. This habitat is less common in the areas proposed for leasing.

Riparian Habitats

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. Coniferous tree species dominate the overstory along narrow higher gradient streams, which are waterways most common in the lease area. On NFS lands in the lease area, an estimated 10 percent of the riparian area has been disturbed by timber harvest (Federal Energy Regulatory Commission 2006).

Riparian Reserves

On federal lands, riparian reserves are designated to protect water quality; timber harvest is prohibited and ground disturbances are not allowed. The reserve's width is based on the presence of fish and whether the stream is permanent or intermittent (see Table 17.3-1 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.

**Table 17.3-1
Federal Riparian Reserve Width Requirements
(Each side of the Stream)**

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

Wetlands and Open Water Habitats

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 sites themselves (US Fish and Wildlife Service 2008a). The most common tree species associated with forested wetlands are red alder, black cottonwood, and western red cedar. Shrub wetlands in the basin are characterized by various willow species, salmonberry, vine maple, and spiraea (*Spiraea douglasii*). Emergent wetlands in the basin support a variety of sedges, forbs, and grasses, including the common invasive species, such as reed canarygrass (*Phalaris arundinacea*). 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 NWFP (US Forest Service 1994b).

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. Washington Weed Law (Chapter 17.10 RCW) requires that noxious weeds be controlled to limit adverse economic effects on agricultural, natural, and human resources of the state. Noxious weeds are plants that, when established, are highly destructive, competitive, or difficult to control by cultural or chemical practices. The State Noxious Weed Control Board updates its list of noxious weeds annually and categorizes the species into three classes. The State Board coordinates noxious weed control activities throughout the state via County Weed Districts and County Noxious Weed Control Boards. 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 in the Baker Lake area and are expected to occur within the lease area (US Forest Service 2004).

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 such impacts 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 the following:

- 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 Contaminants** – Vehicle fuel, hydraulic fluid, solvents, cleaners, and geothermal fluids can all be harmful to vegetation and important habitats such as riparian areas. Accidental spills can contaminate soils and water and directly harm vegetation. Licensed herbicide use would likely be employed to control vegetation around geothermal facilities and support structures. Spills of herbicides or acute exposure to herbicides can have adverse effects on non-target vegetation.

Old Growth and Late Successional Reserves

Old growth, including Late-Successional Reserves, is present throughout much of the lease area. The issuance of the pending noncompetitive lease applications has the potential to impact old growth forests in Late-Successional Reserves. Geothermal development of the lease sites would result in the removal of forest, and may include old-growth and late-successional reserves. The Standards and Guidelines in the NWFP for Late-Successional Reserves require

that the Mount Baker-Snoqualmie 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 old growth forests in Late-Successional Reserves. Specific impacts affecting old-growth forest are discussed further in Volume I of the PEIS, Section 4.9 *Vegetation and Important Habitats*.

Riparian and Wetland Habitats

Riparian habitats are found in several locations within the lease area. Riparian habitats are protected as riparian reserves under the NWFP. Stipulations and best management practices exist to limit the level and intensity of potential impacts that may result from development activities within NFS lands, including limitations on surface occupancy and tree and vegetation removal with buffer zones; however, potential impacts on riparian habitats would still exist, including sedimentation, runoff, erosion, and effects to water quality and hydrology. Refer to Section 4.9 *Vegetation and Important Habitats* of Volume I of the PEIS for a more detailed discussion of the potential impacts on riparian habitats resulting from each stage of a geothermal project.

Wetland habitats are not known to occur in the lease area; however, conditions are dynamic and may change over time. 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, Executive Order 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.

17.3.9 FISH AND WILDLIFE

Setting

Fisheries

The following section describes the existing aquatic habitat and fish species occurring in Baker Lake and the lease area. Additional information on federally listed threatened and endangered species is provided in Section 3.11 of Volume I of the PEIS, *Federally Listed Threatened and Endangered Species and Essential Fish Habitat*.

The proposed lease area is within the Baker Lake subbasin which includes Baker Lake and its tributaries. Baker Lake is approximately 9 miles long and covers 4,980 surface acres when full. Several streams run through the lease area, including Sandy and Dillard creeks. Past timber harvest has limited the amount of large woody debris in some of the creeks (Forest Service 2002) in the Baker Lake Basin.

Resident and anadromous fish have access to portions of approximately 30 tributaries to Baker Lake, including those in the lease area; however, steep gradients limit anadromous fish use. The lower reaches of these streams may also be suitable for rainbow and cutthroat trout and resident native char (Federal Energy Regulatory Commission 2006).

Anadromous Fish Species

The following six species of anadromous salmonids occur in Baker Lake and may occur in the lease area: sockeye (*Oncorhynchus nerka*), coho (*O. kisutch*), Chinook (*O. tshawytscha*), steelhead (*O. mykiss*), native char (*Salvelinus* sp.), and coastal cutthroat trout (*O. clarki*). It is unknown whether anadromous native char spawn in the Baker River watershed (Federal Energy Regulatory Commission 2006).

Fish counts conducted by adult trapping from 1926 through 2003 indicate coho and sockeye salmon were the most abundant salmon stocks returning to the Baker Lake area with the remaining species comprising only about 7 percent (Federal Energy Regulatory Commission 2006).

Resident Fish Species

Nine species of resident fish are expected to occur in Baker Lake. These include four species of native game fish and five species of native non-game fish (Table 17.3-2). The abundance of many of these fish is not known.

**Table 17.3-2
Resident Fish Species Confirmed Present in Baker Lake and
Potentially Occurring in the Lease Area**

Common Name	Scientific Name	Status
Native char	<i>Salvelinus</i> spp.	Native, common
Rainbow trout	<i>Oncorhynchus mykiss</i>	Native, common
Coastal cutthroat trout	<i>Oncorhynchus clarki</i>	Native, common
Kokanee (sockeye salmon)	<i>Oncorhynchus nerka</i>	Native, common
Three-spine stickleback	<i>Gasterosteus aculeatus</i>	Native non-game fish, uncommon
Torrent sculpin	<i>Cottus rhotheus</i>	Native non-game fish, common
Prickly sculpin	<i>Cottus asper</i>	Native non-game fish, common
Coastrange sculpin	<i>Cottus aleuticus</i>	Native non-game fish, common
Largescale sucker	<i>Catostomus macrocheilus</i>	Native non-game fish, common

Puget Sound Energy is required to provide upstream and downstream fish passage and operate spawning beaches for sockeye production as part of its existing license to operate hydroelectric facilities on the Baker River. In addition to these programs, Puget Sound Energy also operates the Sulphur Creek hatchery facility, where voluntary production and rearing programs are conducted (Federal Energy Regulatory Commission 2006).

Wildlife

This section describes the occurrence and distribution of wildlife species in the lease area and vicinity. The Baker River basin supports over 164 species of birds, 60 species of mammals, and numerous additional species of amphibians, reptiles, mollusks, and insects (Puget 2002).

Reptiles and Amphibians

Nineteen species of reptiles and amphibians are known or suspected to occur in the project vicinity (Puget 2002). 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*). Surveys of amphibian habitats were conducted in 2001 and 2002 for the Baker River Project (Hamer Environmental 2002). Field survey methods were designed to sample suitable habitats in and near the project area for five species of amphibians with special federal or state management status: Cascades frog (*Rana cascadae*), Oregon spotted frog (*Rana pretiosa*), northern redlegged frog (*Rana aurora*), tailed frog (*Ascaphus truei*), and western toad (*Bufo boreas*). A total of 11 species of amphibians were documented as part of the Baker River Project surveys including Pacific giant salamander (*Dicamptodon tenebrosus*), northwestern salamander (*Ambystoma gracile*), long-toed salamander (*Ambystoma macrodactylum*), northern rough-skinned newt (*Taricha granulosa*), western red-backed salamander (*Plethodon vehiculum*), tailed frog, western toad, Pacific chorus frog (*Pseudacris regilla*), northern red-legged frog, Cascades frog, and the non-native bullfrog (*Rana catesbeiana*).

Birds

Over 164 species of birds are known or are potentially present in the Baker River Watershed (Puget 2002). Species include waterfowl, shorebirds, waterbirds, game birds, raptors, songbirds, and other birds. Bird species closely associated with old-growth and late successional forests found in portions of the lease area include the northern spotted owl (*Strix occidentalis* spp. *caurina*) and marbled murrelet, both federally-listed species.

Species closely associated with deciduous forest and shrub habitats in the lease area include 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*), mountain lion (*Felis concolor*), and mountain goat (*Oreamnos americanus*). Both grizzly bear (*Ursus arctos*) and gray wolves (*Canis lupus*) have been observed in the Baker River basin. Canada lynx (*Lynx canadensis*) are present east of the Cascade crest, but are not known to occur in the Baker River basin. Wolverines (*Gulo gulo luteus*) have been documented in the region and strongly suspected to be resident animals in the Baker River basin and the lease area (Gay 2008).

Furbearer species in the lease area include river otter (*Enhydra lutra*), beaver (*Castor canadensis*), raccoon (*Procyon lotor*), American marten, and coyote (*Canis latrans*). Common small mammals in the project vicinity are Townsend chipmunk (*Eutamias townsendi*), Trowbridge shrew (*Sorex trowbridgei*), deer mouse (*Peromyscus maniculatus*), snowshoe hare (*Lepus americanus*), Douglas squirrel (*Tamiasciurus douglasi*), and northern flying squirrel (*Glaucomys sabrinus*). Bats that may inhabit the vicinity include little brown myotis (*Myotis lucifugus*), long-eared myotis (*Myotis evotis*), silver-haired bat (*Lasionycteris noctivagans*), and Yuma myotis (*Myotis yumanensis*) (Federal Energy Regulatory Commission 2006).

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 area that would disturb approximately 50 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 area.
- **Fire** – Vehicles, electrical lines, and cigarette smoking can all result in accidental fires. During fires wildlife can be killed or injured. After fires wildlife may be forced to move to other habitats, or may be without suitable habitat for important behavioral activities.
- **Noise** – Construction and operation of geothermal facilities can produce noise far above normal ambient noise levels. Many species are sensitive to increases in noise that may cause disruption of breeding, migration, wintering, foraging, and other behavioral activities.
- **Exposure to Contaminants** – Vehicle fuel, hydraulic fluid, solvents, cleaners, and geothermal fluids can all be harmful to fish and wildlife. Accidental spills can contaminate soils and water and indirectly harm wildlife. Licensed herbicide use would likely be used to control vegetation around geothermal facilities and support structures. Spills of herbicides or acute exposure to herbicides can have adverse effects on wildlife.

Fish

Fish species in the lease area and in Baker Lake 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 coho salmon, cutthroat and rainbow trout, as well as resident fish species found downstream in Baker Lake. 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.

Essential Fish Habitat

The Magnuson-Stevens Fisheries Conservation and Management Act or Magnuson-Stevens Act, as amended by the Sustainable Fisheries Act of 1996 (PL 104-267), established procedures designed to identify, conserve, and enhance Essential Fish Habitat for species regulated under a federal fisheries management plan. The Magnuson-Stevens Act defines Essential Fish Habitat as those waters and substrate necessary for fish use in spawning, breeding, feeding, or growth to maturity. The Magnuson-Stevens Act requires federal agencies to consult with the National Marine Fisheries Service regarding activities that may adversely affect Essential Fish Habitat. Essential Fish Habitat consultations are intended to determine whether proposed projects would adversely affect designated Essential Fish Habitat and to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to Essential Fish Habitat. The implementing regulations for Magnuson-Stevens Act allow for the integration of NEPA or Endangered Species Act Section 7 reviews with the analysis of proposed project effects on Essential Fish Habitat.

Pursuant to the Magnuson-Stevens Act, the Pacific Fisheries Management Council has designated Essential Fish Habitat for Chinook, coho, and Puget Sound pink salmon. Freshwater Essential Fish Habitat for coho and Chinook salmon includes all streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California. Freshwater Essential Fish Habitat for pink salmon includes all currently or historically accessible waters in the Puget Sound region. The four major components of Essential Fish Habitat for these species consist of (1) spawning and incubation habitat, (2) juvenile rearing habitat, (3) juvenile migration corridors, and (4) adult migration corridors and adult holding habitat.

Essential Fish Habitat potentially affected by geothermal activities at the lease areas may occur in the streams that pass through or are immediately adjacent to the lease areas. Additionally, Baker Lake, which is downstream of the lease area, contains Essential Fish Habitat and could be affected by geothermal activities causing erosion, runoff, and changes in hydrology or water quality of the lake.

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 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. The incorporation of stipulations along the lines of the following text, but revised and made more specific by NF wildlife biologists, into any issued leases would reduce the potential for significant impacts on migratory birds:

Prior to any ground-disturbing activities that may disturb nesting, migratory bird surveys would be conducted to assess the presence and use of forest habitats by migratory birds. To avoid disturbing nesting migratory birds, appropriate measures include (1) keeping a distance between the activity and the nest; (2) maintaining preferably forested (or natural) areas between the activity and around nest trees; and (3) avoiding certain activities during the breeding season.

The Nooksack Elk Herd provides recreational, aesthetic, spiritual, and subsistence values to residents of northwestern Washington. The herd is the smallest in Washington and has decreased in size over the past 15 years. The lease area is located on the eastern edge of the Nooksack herd's range. Foraging habitat may not be a limiting factor to the herd at present, but the availability of forage in the future is a concern. Habitat clearing and human activity associated with geothermal projects could disturb elk, displacing them temporarily or permanently from otherwise suitable foraging habitats in and adjacent to the lease area. Geothermal activities associated with development of the lease sites would also result in increased human activity and potentially increase recreational use of the area, which could directly affect elk populations.

17.3.10 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 over several years for the Baker

River Hydroelectric Project (Federal Energy Regulatory Commission 2006) as well as correspondence with NFS biologists regarding the lease area. Federal species are those protected under the Endangered Species Act and those that are candidates or proposed for listing under the Act. State sensitive species are those considered sensitive by the Washington Division of Fish and Wildlife. Federally and state listed species with record of occurrence in the proposed lease area are discussed below.

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.

Coho Salmon

Coho salmon from the Baker River are considered a separate stock from Skagit River coho because of their smaller size at maturity, and because they historically had an earlier adult run timing. These fish are present in Baker Lake. Coho spawning generally occurs from October through January. Spawning and rearing habitat for coho salmon is found in both lease sites WAOR 056025 and 056027 (US Forest Service 2008f). Baker River coho juveniles rear in the stream and lake habitats for one to two years. Coho smolts migrate to the ocean from March to August, with peak migration occurring in May and June (National Marine Fisheries Service 2008). Management of coho fisheries in the Baker River system is under the jurisdiction of Washington Department of Fish and Wildlife and Tribal interests. Coho salmon in the Baker River system are included on the Forest Service Regional Forester's Sensitive Animal list. Impacts on coho salmon

would be analyzed as part of Essential Fish Habitat and Section 7 consultation with NOAA Fisheries.

Marbled Murrelet

The marbled murrelet was designated as federally threatened in Washington, Oregon, and California on October 1, 1992 (57 FR 45328); it is also a Washington State threatened species. Critical habitat was designated for the species in 1996 (61 FR 26255) and a recovery plan was adopted in 1997 (US Fish and Wildlife Service 1997).

The marbled murrelet is a small seabird that feeds at sea and nests in the canopy of old-growth coniferous forests. The bird prefers large stands (500 acres) over smaller ones (100 acres) and avoids forest stands less than 60 acres (US Fish and Wildlife Service 2008a). Large diameter trees with large diameter limbs, broken tops, and other deformities are used for nest platforms. The breeding season extends from April 1 to September 15. Murrelet pairs have a single offspring and adult murrelets carry food from marine waters, typically small fish, to the nest site; this distance can exceed 50 miles (Mack et al. 2004).

Factors contributing to the decline in marbled murrelet populations include over-fishing of its prey species, entanglement in fishing nets, oil spills, and loss of nesting habitat through timber harvest and development (US Fish and Wildlife Service 2008b). Potential threats to marbled murrelet populations include loss of old-growth forest, disturbance during nesting, nest predation, oil spills, entanglement in gill-nets, and disturbance during foraging (Mack et al. 2004).

Critical habitat was designated for the marbled murrelet to provide suitable nesting habitat, located in proximity to marine foraging habitat, on lands not otherwise protected by existing regulations or land use designation. The entire lease area falls within lands designated as critical habitat for marbled murrelet. Murrelets generally use forest stands in the western hemlock and silver fir vegetation zones located below 3,200 feet elevation. Surveys of the Baker River basin have documented marbled murrelets present during the nesting season, and presumably nesting. Forest Service surveys indicate that the northern half of the Mt. Baker-Snoqualmie National Forest accounts for 50 percent of nesting habitat and 85 percent of murrelet detections on the entire forest (US Forest Service 2002).

Surveys have not been conducted in the area in recent years, and the current status of marbled murrelets in the lease area is unknown. Most suitable marbled murrelet habitat in the Baker River basin is protected by designation as critical habitat or as Late-Successional Reserve, within which timber harvest and development is restricted.

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

Critical habitat for spotted owl is found throughout the lease area. The NWFP serves recovery plan functions through specific management requirements, standards, and guidelines. Designated Conservation Area WD-21 was established in 1992 for the protection of northern spotted owls under the Endangered Species Act (US Fish and Wildlife Service 1992). The area encompasses roughly 104,000 acres of NFS lands on the Mt. Baker Ranger District, roughly 29,000 acres not included in the Baker Late-Successional Reserve. The Baker Late-Successional Reserve and Designated Conservation Area WD-21 combined are projected to support 28 pairs of nesting spotted owls (US Forest Service 2002). The Baker Late-Successional Reserve/Designated Conservation Area is expected to be a major contributor to spotted owl recovery as a source of owls dispersing to the north, southeast, south, and east.

The size of old-growth stands is also important to the quality of spotted owl habitat. Throughout the Baker Late-Successional Reserve, most patches of late successional and old-growth forests are greater than 620 acres. Old-growth forest has been fragmented into smaller blocks in the Rocky, Sandy, and Dillard creek drainages passing through the lease area.

Grizzly Bear

The grizzly bear is a federally threatened species. The species is also classified as endangered by the State of Washington. The grizzly bear was listed as federally threatened under the Endangered Species Act in the 48 contiguous states in 1975 (40 FR 31734). The primary causes of population decline are hunting, human disturbance, and habitat alteration.

Grizzlies are omnivores that use a wide range of habitat types across a large home range. Home ranges of males can be 200 to 500 square miles, while those of females are in the range of 50 to 300 square miles (US Fish and Wildlife Service 2008b). Habitat use varies with season, with lower elevation, snow-free areas used in early spring, mid-elevation habitats during summer, and mid- to high-elevation habitats during late summer and fall (US Fish and Wildlife Service

2008b). Presence of roads and humans are negatively correlated with grizzly bear presence.

The most recent grizzly sightings in the project vicinity include an observation of one adult and one young in the Baker River headwaters in 1991 (Federal Energy Regulatory Commission 2006) and a grizzly bear track was recorded in 1989 on the southeast side of Baker Lake, approximately eight miles from the lease sites (Federal Energy Regulatory Commission 2006).

Impacts

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

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

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

Alternative A (No Action)

The No Action alternative would have no impact on special status species.

Alternative B (Proposed Action)

The Proposed Action would not have any direct impact on special status species; however, anticipated future actions following leasing 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, stipulations to perform 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.

17.3.11 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 two sections. Traditional cultural resources and traditional cultural properties are addressed in Section 17.3.12, *Tribal Interests and Traditional Cultural Resources*. Cultural resources in this section include the physical remains of prehistoric and historic cultures and activities.

All four leases in Washington are within the Northwest Coast culture region, as described broadly in the Appendix I of the PEIS, near the region's eastern boundary with the Great Plains culture region. Cultural aspects of both regions likely existed within the lease areas. Suttles and Lane (1990) provide an ethnographic overview of the project area within the larger Northwest Coast culture region. The following discussion is based primarily on that overview. Given that the Washington leases are in a more inland portion of the area, cultural aspects specific to that setting are focused upon.

The Washington leases are considered to be within an area attributed to Southern Coast Salish-speaking groups. That area is further broken down into two linguistic groups: Lushootseed (northern and southern dialects) and Twana. The lease areas are within the Northern Lushootseed dialect area. They are also just south of the Central Coast Salish linguistic group and likely experienced influences from this area and the Plateau culture region (Suttles and Lane 1990). The areas are just east of the historic villages of Miskaiwhu, Sauk, and Suiattle (Suttles and Lane 1990). As outlined in Appendix I, the earliest people to inhabit this area are referred to as Paleoindian, though there is little archaeological evidence that has been attributed to these populations. However, this may be due to the effects of sea level rise. The earliest definitive evidence for such early populations in the region is found in the Plateau culture region which is within a few miles of the lease areas (Neusius and Gross 2007).

Southern Coast Salish groups were initially small, mobile populations with large territories. Later as populations increased these groups became more sedentary with cyclical rounds of permanent village sites. Ethnographic accounts documented Southern Coast Salish tribes as organized based on village, household, and family groupings. Within this a hierarchy of members was developed. Additionally, villages established ties through marriages of high-

ranking families. The Southern Coast Salish likely relied upon a variety of vegetal foods and terrestrial game than their neighbors. However fish, notably salmon, were also very important in the diet. When acquired in rivers, salmon were caught by weirs, traps, nets, gaff hooks, harpoons, and leisters. Shellfish and waterfowl were also collected and hunted in the region's rivers. Blacktail deer and elk were the primary targets for hunting using bow and arrow. Hunting was usually done individually with dogs to assist. In addition to the bow and arrow, hunters also used pitfalls, snares, and drives to get their prey. Woodworking was a principal craft of men in Southern Coast Salish tribes who constructed plank houses, household utensils, boxes, water containers, and canoes. Women used cedarbark to make cordage, mats, baskets, and blankets. Many of these perishable wood items are found in waterlogged archaeological sites of the region. Several types of canoes were the mode of transportation for people along the region's rivers (Suttles and Lane 1990).

A variety of historic-era activities have been documented within the region of the Washington leases. These included fur trapping during an initial period of Euro-American exploration, emigration and settlement by Euro-Americans and Canadians, trade between Native Americans and Euro-Americans, and missionization. By the 1850s many Southern Coast Salish were participating in Euro-American economies, selling a variety of items including furs, natural resources, and labor to non Salish. Agriculture, sawmills, and commercial fishing provided income and employment for others. The state became a territory in 1853 and treaties were made with the area's tribes. The Southern Coast Salish were party to the Treaties of Medicine Creek, Point Elliott, and Point No Point. These treaties reserved seven tracts of land for the Southern Coast Salish which eventually became reservations (Squaxin, Nisqually, Puyallup, Port Madison, Tulalip, Swinomish, and Skokomish). Many did not move on to these reservations however (Suttles and Lane 1990).

Data on cultural resources of the proposed were unavailable. As such, it is assumed that National Register of Historic Places (NRHP)-eligible resources are within the lease areas. It is also assumed that none of the leases have been previously surveyed. Until consultation with local Native Americans has been concluded, it is unknown if there are Native American sites or sacred sites within or adjacent to the lease areas.

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 future actions following 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 assumptions of NRHP-eligible resources and lack of survey within the Mt. Baker-Snoqualmie lease sites, impacts on cultural resources could occur from subsequent permitted geothermal exploration, drilling operations and development, utilization, and reclamation and abandonment through ground-disturbing activities, unauthorized actions and alterations to setting and cultural landscapes. The nature of these impacts is described in Chapter 4 of Volume I of the PEIS. Additionally, as described in Chapter 2 of Volume I of the PEIS, various areas of cultural resources would have No Surface Occupancy stipulations: National Landmarks, National Register Districts, NRHP-listed and -eligible sites and their associated landscapes, traditional cultural properties, Native American sacred sites, and areas with important cultural and archaeological resources. Areas of potential effect would include access roads, well pads, power plant footprints, pipeline and transmission line routes, and construction staging areas as well as the boundaries of cultural resources those facilities cross and the aspects of setting that contribute to significance. These areas of potential effect would be developed at the project-specific level, and would require inventories, evaluations, and appropriate treatments as outlined in the best management practices of Appendix D in Volume III of the PEIS. Under these cultural resources best management practices, the BLM 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.

17.3.12 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 Washington leases are considered to be within an area attributed to Southern Coast Salish-speaking groups, specifically the Northern Lushootseed dialect. They are also just south of the Central Coast Salish linguistic group and

likely experienced influences from this area and the Plateau culture region (Suttles and Lane 1990). The areas are just east of the historic villages of Miskaiwhu, Sauk, and Suiattle (Suttles and Lane 1990).

By the 1850s many Southern Coast Salish were participating in Euro-American economies, selling a variety of items including furs, natural resources, and labor to non Salish. The Southern Coast Salish were party to the Treaties of Medicine Creek, Point Elliott, and Point No Point. These treaties reserved seven tracts of land for the Southern Coast Salish which eventually became reservations (Squaxin, Nisqually, Puyallup, Port Madison, Tulalip, Swinomish, and Skokomish); however, many did not move on to these reservations (Suttles and Lane 1990).

Data on Tribal Interests and Traditional Cultural Resources of the proposed lease areas were unavailable. 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 future actions following 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 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.

17.3.13 VISUAL RESOURCES

Setting

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

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

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

- Preservation – Allows ecological change only. Management activities are prohibited except for very low visually impacting recreation facilities.
- Retention – Management activities may not be visually evident. Contrasts in form, line, color and texture must be reduced during or immediately after the management activity.
- Partial Retention – Management activities must remain visually subordinate to the characteristic landscape. Associated visual impacts in form, line, color and texture must be reduced as soon after project completion as possible but within the first year.
- Modification – Management activities may visually dominate the characteristic landscape. However, landform and vegetative alterations must borrow from naturally established form, line, color or texture so as to blend in with the surrounding landscape character. The objective should be met within one year of project completion.
- Maximum Modification – Management activities including vegetative and landform alterations may dominate the characteristic landscape. However, when viewed as background they must visually appear as natural occurrences within the surrounding landscapes or character type. When viewed as foreground or middle ground, they may not appear to completely borrow from naturally established form, line, color, or texture. Alterations may also be out of scale or contain detail which is incongruent with natural occurrences as seen in foreground or middle ground. Reduction of contrast should be accomplished within five years.

Most of the NFS land in the vicinity of Baker Lake is assigned the Visual Quality Objectives of retention, partial retention, and modification (Federal Energy Regulatory Commission 2006). All forest lands around Baker Lake are designated as partial retention. Areas where timber has been harvested on ridges surrounding the lake have been assigned a Visual Quality Objective of modification. The mountains to the east and west are designated retention.

According to the Final Environmental Impact Statement for the Mount Baker-Snoqualmie National Forest Land and Resource Management Plan, the Mount Baker-Snoqualmie National Forest contains some of the nation's most scenic forest landscapes and a wide variety of visual settings or scenes (US Forest Service 1990). Lush, low-elevation forests contrast sharply with the glaciated peaks and ridges of the North Cascade Mountains. Major mountain peaks

located within the Forest are dominant focal points for the forest visitors. Contrasting with this natural landscape are human modifications, including roads, rockpits, utility corridors, ski areas, and the activities associated with timber harvesting. Clearcut patterns resulting from past timber harvest are the most visually evident. However, natural appearing environments exist on much of the Forest, even where extensive timber harvest and other activities are occurring.

The proposed lease areas are on the southeastern slopes of Mt Baker (approximately 10,700 feet) between the summit and both Baker Lake Highway and Baker Lake. The closest lease area to the lake is approximately a half a mile away, and the furthest is approximately six miles away.

The Baker River watershed is generally very steep, with slopes from 20 to 40 percent over most of its area, with the exception of the valley bottom along the Baker River channel and some of its major tributary streams (Federal Energy Regulatory Commission 2006). The middle portion of the basin, the site of Baker Lake, is a more confined valley where glacial and stream sediments have been covered by mudflows and recent alluvial deposits. At the upper reaches of the watershed, Mount Baker, Mt. Shuksan, and their adjacent ridges and pinnacles form a spectacular alpine topography that dominates the landscape.

Baker Lake is a narrow 4,800-acre, 9-mile-long reservoir in the center of the Baker River watershed (Federal Energy Regulatory Commission 2006). It is set in dramatic terrain, surrounded by forested ridges rising to about elevation 4,100 feet on the west side. The western ridges are the foothills of Mount Baker.

The sloped terrain found in the lease areas are mostly covered with a coniferous forest of varying heights and maturity, except where a patchwork of clear cuts occurs. Ridges, canyons, and strings of dirt roads for logging cross the lease areas.

Human-made modifications to the visual landscape are limited to roads of various conditions and recreation areas. Hiking, backpacking, cross country skiing, and snowshoeing activities occur in all of the lease areas.

Impacts

For the purpose of this analysis, it is assumed the lease areas on FS land are designated with a Retention or Partial Retention Visual Quality Objective.

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 future actions following leasing would potentially result in such impacts. The potential risk of changes affecting visual resources is assessed for five significance criteria, which are described in the PEIS. Future actions based on the Reasonably Foreseeable Development scenario could result in changes that impact visual resources.

Future geothermal development activities could involve new structures, roads, and operations that are described in the Reasonably Foreseeable Development scenario. The new structures, roads, and operations would alter the characteristic landscape and be sources of light and glare. Depending on their exact location, they could also diminish scenic views afforded individuals participating in recreation activities. These impacts would be noticeable, because they would be in areas that are relatively undeveloped and would be near areas where various recreation activities occur year-round. It is assumed the stipulations outlined in Chapter 2 of the PEIS would result in positioning new structures, roads, and operations in the landscape so they would remain visually subordinate to the characteristic landscape. As a result, changes to visual resources based on the Reasonably Foreseeable Development scenario would result in impacts on visual resources that would be consistent with the Partial Retention Visual Quality Objectives.

The Forest Plan requires foreground retention for primary road corridors. Primary road corridors exist in the southern three lease areas. If sited within areas of *Scenic Viewshed: Foreground*, developments would not likely meet the Retention Visual Quality Objective.

17.3.14 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE**Setting**

The leasing area covers approximately 9,450 acres within Whatcom County, Washington. Whatcom County was selected as the ROI for socioeconomic analysis as the impacts of leasing are likely to occur within this region. A summary of the population, housing, employment, local school data and low-income and minority populations for the County is provided based primarily on data from Census 1990 and 2000 population, demographic and housing information (US Census Bureau 1990, 2000).

Population

Most recent population data estimates Whatcom county population at 185,953 in 2006, (US Census Bureau 2008), representing an 11.5 percent increase from 2000. From 1990 to 2000, there was an approximate 23 percent increase in population (US Census Bureau 1990, 2000).

Housing

In 1990, a total of 55,742 housing units were in the county; of these approximately 87 percent were occupied and 56 percent occupied by owner. In 2000, the total number of housing units increased to 73,893. The percent of total occupied units and owner occupied units has remained constant at 87 percent and 55 percent respectively. Homeownership rates are approximately the same as for the state of Washington as a whole (US Census Bureau 1990, 2000).

Employment

In 1999 the workforce consisted of 87,365 total people of which 4.9 percent were unemployed. In 1990 the labor force was 64,773 and unemployment was 4.8 percent. Median household income in the County was \$40,405 in 2000, which was below the state average of \$45,776 at that time (US Census Bureau 1990, 2000).

The industries employing the largest percent of the population in 1999 were education, health and human services (20.9 percent); retail trade (14.4 percent); manufacturing (12.1 percent); and arts, entertainment, recreation, accommodation and food services (9.6 percent) (US Census Bureau 2000).

Schools and Public Infrastructure

Total K-12 school enrollment in Whatcom County in 2000 was approximately 29,602. In 1990 enrollment was 21,174. Based on current population trends, enrollment is likely to continue to increase (US Census Bureau 1990, 2000).

Environmental Justice

In Whatcom County 88.4 percent of the population identified themselves as White of non-Hispanic descent in the 2000 census. The percent of population representing minority racial or ethnic groups has dramatically increased over the past two decades; the Hispanic/Latino population increased 134 percent between 1990 and 2000 and as of 2006 comprised 6.2 percent of the population, while the Asian American population increased by 94 percent for the same period and made up 3.5 percent of the population in 2006 (US Census Bureau 1990, 2000, 2008). Additional details are provided in Table 17.3-3.

2006 poverty status estimates indicate that 13.2 percent of individuals were living below the poverty line in Whatcom County. This is slightly higher than the state average of 11.6 percent. Census data indicates that 14.2 percent of individuals were below the poverty level in 2000 and 12.2 percent in 1990 (US Census Bureau 1990, 2000).

**Table 17.3-3
Race/Ethnicity in Whatcom County**

	1990	2000	Percent Change
Total Population	127,780	166,814	30.5
White	119,229	147,485	23.6
Black/African American	650	1,150	43.5
American Indian/Alaskan Native	4,014	4,709	17.3
Asian	2,363	4,637	96.2
Pacific Islander*	N/A	235	N/A
Other	1,524	4,159	173
Two or more*	N/A	4,439	N/A
Hispanic or Latino**	3,718	8,687	134

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 Whatcom County. No impacts would occur to minority or low income populations.

Alternative B (Proposed Action)

The Proposed Action would have no direct impacts on socioeconomics or environmental justice; however, anticipated future actions following leasing would potentially result in such impacts. Potential impacts include an increase in jobs and decrease in unemployment in Whatcom County due to construction and operations and maintenance jobs at newly developed geothermal plants.

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

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

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

17.3.15 NOISE

Setting

Current sources of noise in the lease sites are limited to wind, dispersed recreational use, traffic from roads within the lease site boundaries, and wildlife. Sources of noise originating outside of the lease sites but affecting the lease sites include road and air traffic, and recreational use. Sensitive noise receptors are generally considered to be homes, hospitals, schools, and libraries. No buildings or developments exist in or within half a mile of the lease area.

Impacts

Alternative A (No Action)

The No Action alternative would have no impact on noise.

Alternative B (Proposed Action)

Neither the Proposed Action, nor anticipated future actions following leasing, would have any direct impact on noise since no sensitive receptors have been identified within or adjacent to the lease sites.

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SECTION 17.4

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