Environmental Assessment
Lakeview Geothermal Project

April 2012

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Environmental Assessment
Lakeview Geothermal Project

Lake County, Oregon

Prepared For:

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ACRONYMS

APE	area of potential effect
ARRA	American Recovery and Reinvestment Act of 2009
BLM	Bureau of Land Management
CFR	Code of Federal Regulations
dBA	decibel on an A-weighted scale
DEQ	Department of Environmental Quality (Oregon)
DOE	U.S. Department of Energy
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
FEMA	Federal Emergency Management Agency
GHG	greenhouse gas
H_2S	hydrogen sulfide
KGRA	Known Geothermal Resource Area
MOA	memorandum of agreement
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NRCS	National Resources Conservation Service
NRHP	National Register of Historic Places
ORNHIC	Oregon Natural Heritage Information Center
OSHA	Occupational Safety and Health Administration
OWRD	Oregon Water Resources Department
PM_{10}	particulate matter with an aerodynamic diameter less than or equal to 10 micrometers

$PM_{2.5}$	particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers
PVC	polyvinyl chloride
SCOEDD	South Central Oregon Economic Development District
SEP	State Energy Program
SHPO	State Historic Preservation Office
SPCC	spill prevention, control, and countermeasure
Stat.	United States Statutes at Large
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
WCCF	Warner Creek Correctional Facility

1 INTRODUCTION

1.1 NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act (42 U.S.C. 4341 et seq.; NEPA), Council on Environmental Quality's NEPA regulations [40 Code of Federal Regulations (CFR) Parts 1500 to 1508], require that the U.S. Department of Agriculture (USDA) consider the potential environmental impacts of a proposed action before making a decision. This requirement applies to decisions about whether to provide different types of financial assistance to states and private entities.

1.2 BACKGROUND

The Town of Lakeview is proposing to construct and operate a geothermal direct use district heating system in Lakeview, Oregon. The proposed project would be in Lake County, Oregon (Figure 1.2-1), within the Lakeview Known Geothermal Resources Area (KGRA) (Figure 1.2-2).

The proposed project includes the following elements:

- Drilling, testing, and completion of a new production well and geothermal water injection well
- Construction and operation of a geothermal production fluid pipeline from the well pad to various Town buildings (i.e., local schools, hospital, and Lake County Industrial Park) and back to a geothermal water injection well

1.3 PURPOSE AND NEED

1.3.1 USDA'S PURPOSE AND NEED

USDA Rural Development is the leading advocate for rural America. It supports rural communities and enhances quality of life for rural residents by improving economic opportunities and community infrastructure, and by connecting rural residents to the global economy by facilitating the development of sustainable renewable energy projects. Such investments contribute to long-term national prosperity by ensuring that rural communities are self-sustaining, repopulating, and thriving economically.

USDA Rural Development provides financing for renewable energy project development in rural areas as authorized under the Food, Conservation, and Energy program of 2008. The proposed project would be consistent with the mission of the Rural Development program in providing a source of sustainable renewable energy in a rural area of Oregon.

Figure 1.2-1: Proposed Project Location

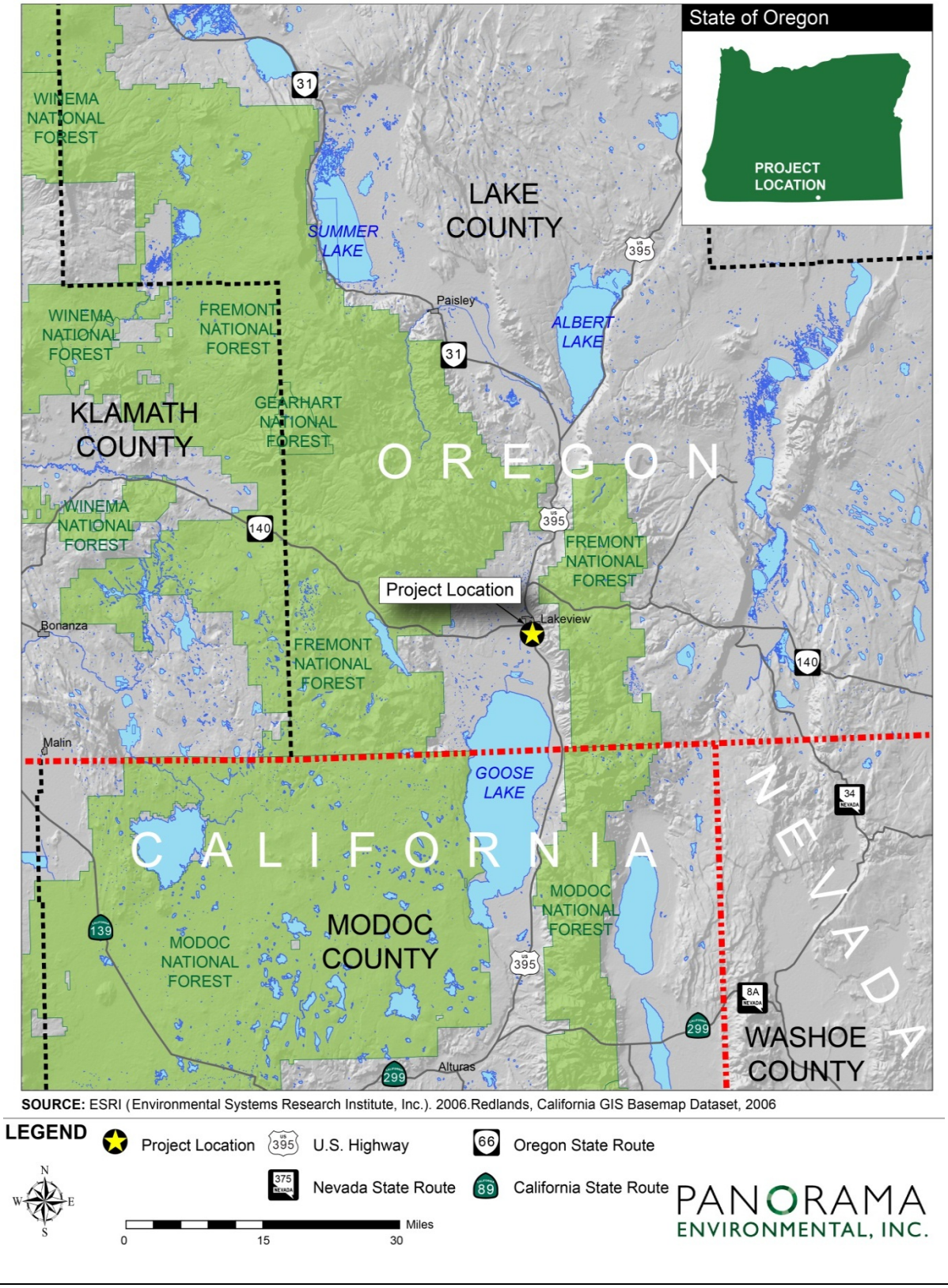
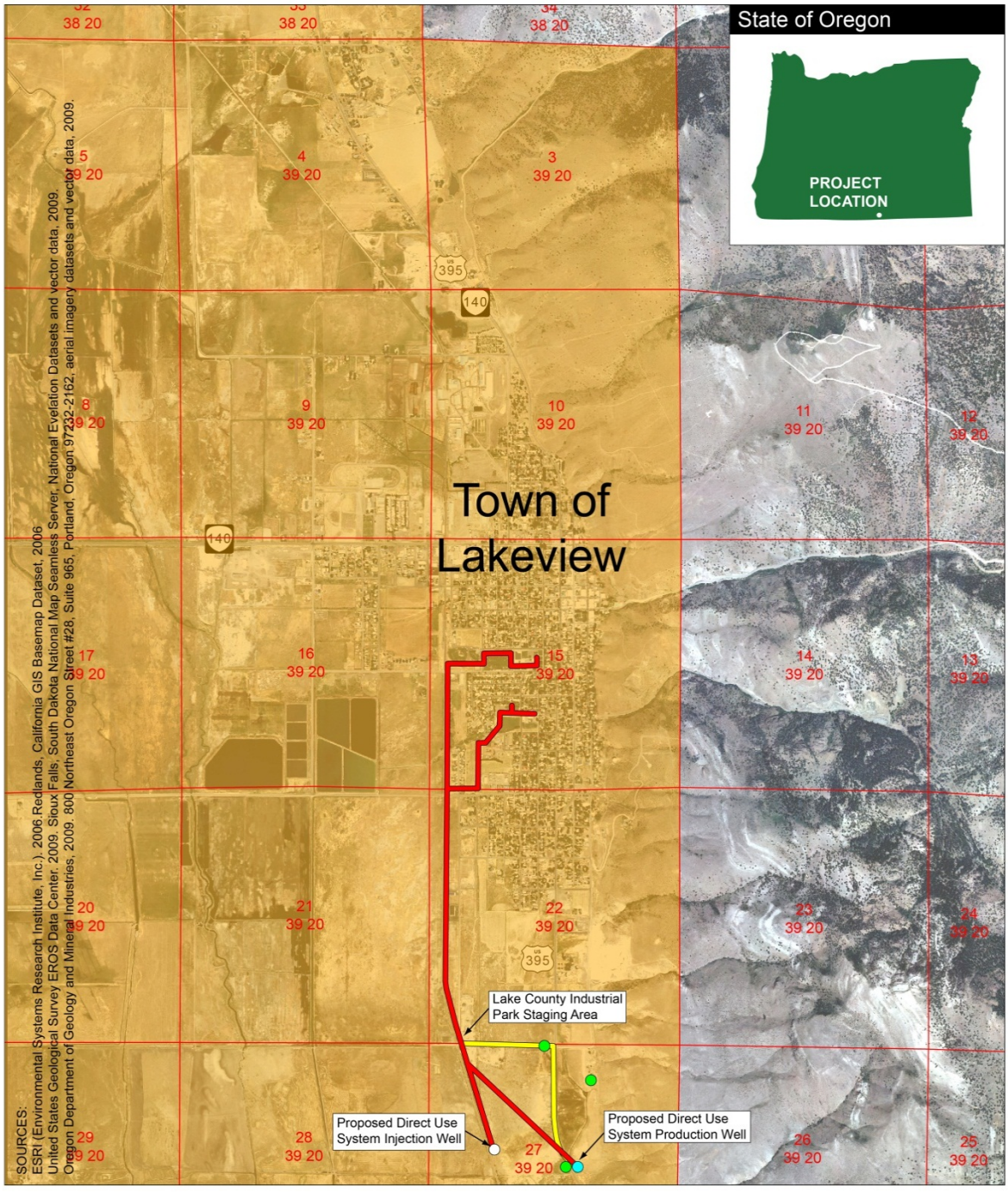


Figure 1.2-2: Lakeview KGRA



1.3.2 OREGON'S PURPOSE AND NEED

Recent events in electricity and gas demands have suggested the need for alternative sources of power. Renewable energy sources, such as geothermal energy, already supply a significant amount of energy in western states. Oregon has passed a renewable portfolio standard that will require the largest utilities in Oregon to provide 25 percent of their retail sales of electricity from clean, renewable sources of energy by 2025. The proposed project would serve as a model to utilities in Oregon by introducing clean, renewable energy into the commercial electrical grid, and also as a model for direct use heating applications, which offset hydrocarbon fuel use.

1.4 PUBLIC AND AGENCY INVOLVEMENT

This EA was initially prepared by the U.S. Department of Energy (DOE) in May 2011, but was not completed due to funding limitations. The Town of Lakeview chose to use available American Recovery and Reinvestment Act funding for geothermal heating system retrofits of school buildings. The geothermal heating system retrofits of school buildings were approved through a NEPA Categorical Exclusion GFO-0000140-014 on June 14, 2011. The EA and NEPA process was substantially completed and, therefore, the public involvement performed by DOE is described here.

On September 28, 2009, DOE sent scoping letters to potentially interested public entities, regulatory agencies, and other interested parties. The scoping letter described DOE's Proposed Action and the Town of Lakeview's proposed project and requested assistance in identifying potential issues to be evaluated in this EA. These letters and the distribution list are included in Appendix A. All comments were considered in preparation of the EA.

DOE contacted the U.S. Fish and Wildlife Service (USFWS) and the Oregon State Historic Preservation Office (SHPO) pursuant to requirements under Section 7 of the Endangered Species Act (16 U.S.C. 1531 et seq.; FESA) and Section 106 of the National Historic Preservation Act (16 U.S.C. 470 et seq.; NHPA). The USFWS sensitive species list includes several fish species. USFWS's letter confirmed DOE's position that the proposed project would not impact streams or rivers where these species are found. The USFWS letter is included in Appendix B. Consultation with SHPO is ongoing and was resumed by USDA, as was consultation with Native American tribes.

2 USDA'S PROPOSED ACTION AND THE PROPOSED PROJECT

2.1 PROPOSED ACTION

2.1.1 PROJECT LOCATION

The proposed project would be in the Town of Lakeview and in unincorporated Lake County, Oregon. Figure 1.2-1 illustrates the project region. The project includes several components that would span from the Town of Lakeview to an area just south of the Town. The components would be located in Range 20 East, Township 39 South of the Willamette Base and Meridian. The total project impacts would encompass approximately 2.5 acres.

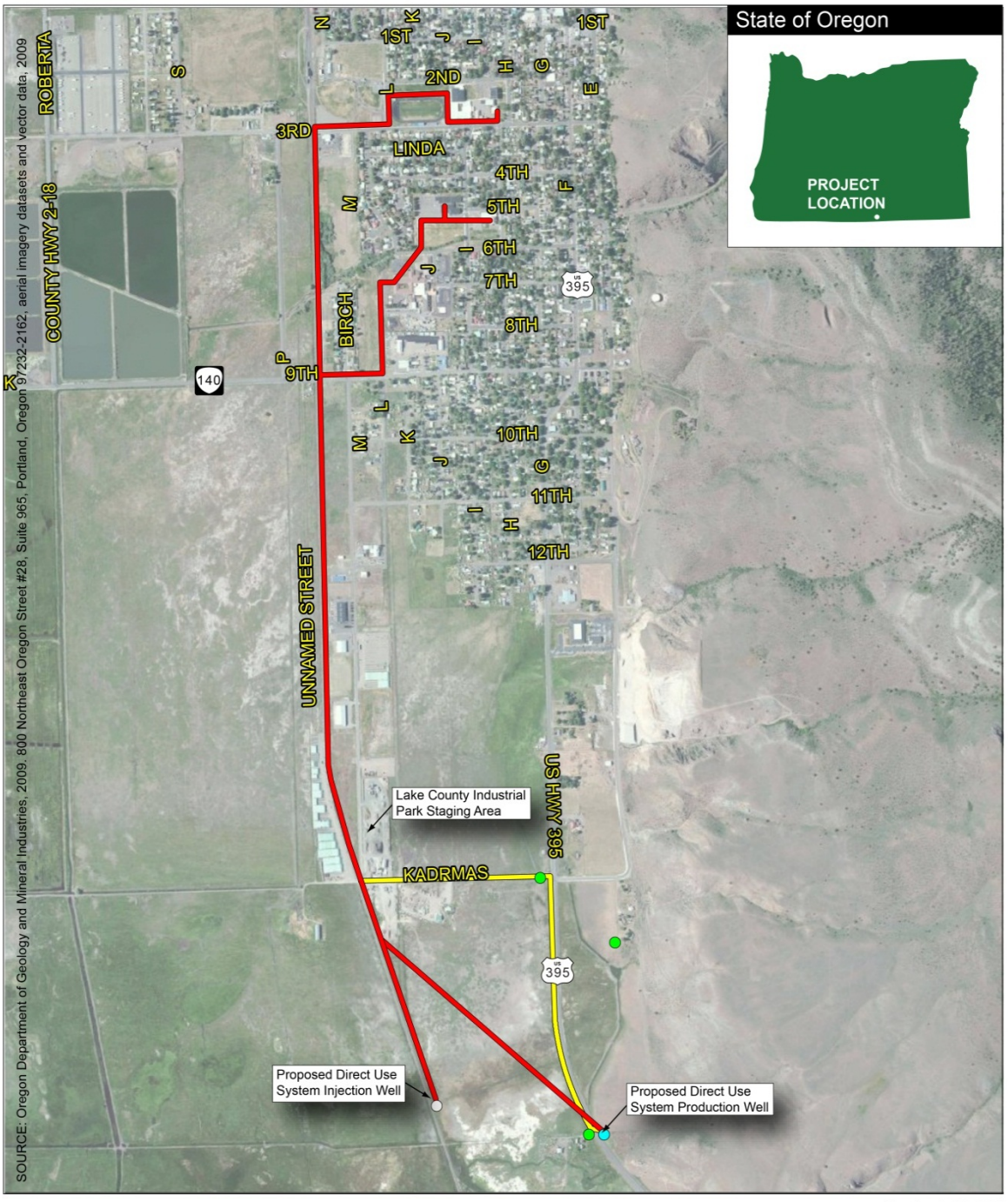
The components of the proposed direct use system are shown in Figure 2.1-1. A proposed production well would be located at an existing well site known as the Barry Well Pad site, approximately 1 mile south of Lakeview and just to the east of U.S. Highway 395. Two additional existing wells are also located at the Barry Well Pad site: Well A and Well B. Well A is located in the northwest corner, and Well B is located in the southern portion of the Barry Well Pad site. The proposed new production well would be located approximately 20 feet west of Well B. The proposed production well location was sited based on recommendations in the Geothermal Heating Feasibility Study prepared for Lakeview in January 2009 by Anderson Engineering and Surveying, Inc. (OECDD 2009), and based on flow results from Well B at the Barry Well Pad site. An injection well is proposed to be located approximately 0.5 mile west of the production well near the existing railroad grade. The railroad grade is owned and operated by Lake County.

The proposed geothermal pipeline would extend from the Barry Well Pad site to several buildings in Lakeview and then to the injection well. It would parallel the railroad tracks northward into Lakeview, as shown in Figure 2.1-1. The pipeline would then extend eastward to the existing Town buildings for delivery of geothermal fluid for heating. The pipeline would then loop southward, within the same trench as the pipeline to the buildings, to the injection well. The approximate length of the proposed pipeline route is 18,000 feet, or 3.4 miles. An alternative spur is also proposed, as shown in Figure 2.1-1 along Highway 395 and then across Kadrmas Road. The alternative segment would be used if an easement cannot be obtained from the landowner for the proposed segment. Permission from Oregon Department of Transportation would be required for construction within the Highway 395 right of way. The total pipeline length with the alternate segment would be 4.1 miles.

2.1.2 EXISTING FACILITIES

The geothermal resources in Lakeview have been known since the early settlement of the area, and records of hot water springs in the area date to the 1900s (Coury and Associates 1980). The earliest plans to utilize the geothermal resources for heating were from the early 1900s. The Hunters Hot Springs area to the north of Lakeview was developed for space heating, home heating, and therapeutic mineral bath use in the 1930s and 1940s (OECDD 2009). Several homes, a lodge, and a greenhouse still utilize the geothermal resources to the

Figure 2.1-1: Location of Components of Geothermal Direct Use System



north of the Town of Lakeview. Private wells used to heat these facilities provide water at temperatures ranging from 170 to 205 degrees Fahrenheit (°F), and with cumulative flows of about 600 gallons per minute (OECDD 2009).Other geothermal use in the vicinity of Lakeview includes the Rockford Ranch and Barry Ranch Hot Springs. The Rockford Ranch, 12 miles south of Lakeview on U.S. Highway 395, irrigates using 170°F water pumped at flows of 400 to 600 gallons per minute. The Barry Ranch Hot Springs, 1 mile south of Lakeview, and adjacent to the proposed project site, has water with a maximum temperature of 193°F; however, it is not currently utilized (Coury and Associates 1980). Cannon Springs are located to the north of the proposed production well and are also not currently used.

Existing well facilities at the Barry Well Pad site consist of Wells A and B, as described previously. Well A, drilled in 1980 to a depth of 235 feet, was constructed with casing to a depth of 220 feet and was completed as an open borehole below the casing. The well derives groundwater from alluvial deposits. Well B is an 8-inch-diameter well that was drilled in 1980 to a depth of 1,355 feet and constructed with casing to a depth of 179 feet. The well was completed as an open borehole below the casing. The borehole penetrated alluvial deposits to a depth of 115 feet; these deposits were underlain or in fault contact with a series of volcanic rocks, which produced the geothermal fluid. Both Wells A and B are currently idle, but were used by Anderson Engineering and Surveying, Inc., to perform hydrologic pump tests for the Geothermal Heating Feasibility Study (OECDD 2009). Wells A and B may be used during the project as monitoring wells; however, no additional work or pumping would be performed at Wells A and B.

2.1.3 PROPOSED ACTION

Summary of System

A summary of project components, their function, and their location is provided in Table 2.1-1. The components are listed in the order in which fluid would flow through the system.

The direct use well and pipeline would be used to heat various Town buildings (Lakeview District Hospital, Lakeview High School, Daly Middle School, Fremont School, and A.D. Hay School). Heating would be accomplished by pumping and piping 180 to 185°F water from the proposed production well to the schools and hospital to supply approximately 5 million British thermal units (BTU) of heat energy per hour. After heating these facilities, the return water, at 80 to 100°F, would be injected into the groundwater aquifer. Buildings in the Industrial Park, located northwest of the Barry Well Pad site, may connect into the pipeline at a later time, but owners would need to build their own infrastructure connection.

Geothermal water would be extracted at the production well site, transferred via the underground pipeline, cycled through the buildings, and then injected into the reservoir at an injection well site. The buildings receiving heating from the system received equipment upgrades in 2011 or earlier. A short spur pipeline would also be constructed to allow heating at the Lakeview Industrial Park in the future.

Table 2.1-1: Summary of Project Components

Component Name	Existing or Proposed?	Size	Location	Function
Direct Use System Production Well	Proposed	Approximately 600 feet deep and 12 inches in diameter, located on a pad about 1.6 acres in size and housed in a 16-foot-by-16-foot building.	On a parcel of land adjacent to and east of U.S. Highway 395.	To produce geothermal fluid at a temperature of approximately 185°F and a rate of approximately 250 gallons per minute for direct use heating.
Well House	Proposed	The house would be 16 feet by 16 feet in size and approximately 12 feet tall.	Over the direct use system production well.	To house the production well.
Distribution Pipeline	Proposed	The 9- to 10-inch-diameter pipeline would be approximately 18,000 feet long (3.4 miles), installed underground.	Extending from the southern production well through Lakeview to several buildings and then back south to the injection well along the railroad grade.	To transport the produced geothermal fluid from the well to the direct use applications and back to the injection well site.
Buildings	Existing	Not applicable	Within Lakeview as shown on Figure 2.1-1.	To receive water from the geothermal direct use system production well.
Geothermal Water Injection Well and housing	Proposed	Approximately 400 to 500 feet deep and 10 inches in diameter, in closed in a 8 X 8 well house on a 0.23 acre well pad	On a small pad adjacent and east of the railroad.	To inject spent geothermal water back into the groundwater reservoir.
Monitoring Wells	Proposed	Hydrologic monitoring wells would be designed by a qualified hydrogeologist.	At various locations in the project area as determined by a qualified hydrogeologist.	To quantify the relationship between geothermal pumping and injection and localized groundwater levels.

Detailed Description of Components

Direct Use System Production Well

Pumping tests have indicated that existing Well B could be used as a production well; however, a new production well would be built at the Barry Well Pad site for the following reasons:

- Well casing can be extended to a deeper depth (Well B well casing is only 170 feet deep)
- Engineered well construction would provide the best mix of the cooler water stratums
- A larger well bore could be installed for better pump options
- A new well would guarantee a longer service life

A 40-horsepower electric motor, installed at the surface, would power the in-line turbine pump, which would have a maximum capacity of 250 gallons per minute at 385 feet of head. The pump would be equipped with a variable frequency drive in order to allow the pump to operate under the needed pumping conditions. Motor and pump speed would be adjustable and controlled based on well flow level and demand requirements. Typical operating speed, however, is expected to be between 125 and 250 gallons per minute. The variable frequency drive would respond to the water need (heat) demand to match pump needs to the demand by controlling the speed of the pump.

When heat is not required, the system pressure would remain at its static setting and the pump would automatically stop; therefore, a minimum pump speed would need to be established so that the variable frequency drive does not slow the pump below its recommended minimum speed. If the minimum speed still produced an "over-pressure" condition, a bypass valve located at one of the heat exchangers would allow water to bypass and go into the return line. This would also prevent pump cycling at low load conditions.

The pump rates were determined using the loads obtained for the hospital heating designs and the evaluation of the heating needs of the schools, as presented in the Geothermal Heating Feasibility Study (OECDD 2009). Well production flows of approximately 227 gallons per minute would provide 91 percent of heating requirements, while 280 gallons per minute would provide 97 percent of heating requirements. Heat requirements would be lower during nights, weekends, vacation periods, and during hotter seasons; therefore, a lower pumping rate would be used during those times. The hospital would not have low-operating periods outside of typical seasonal variations in heating needs.

The water temperature for the new production well is expected to be similar to that encountered in Well B (i.e., approximately 180 to 185°F). The well would operate 24 hours per day.

The well would be housed in a new 16-foot-by-16-foot building. The components inside the building would include the well head, pump motor, variable frequency drive, oil drip system to lubricate the bearings in the line-shaft pump, and a short length of pipe from the

well head for mounting temperature gauges. The pipe would be installed underground where it would connect with the distribution pipeline.

Distribution Pipeline

The distribution pipeline would transport the geothermal water from the production well, to the buildings connected to the heating system, and then to the injection well, as shown in Figure 2.1-1. An alternative spur of the pipeline is proposed as shown in Figure 2.1-1 paralleling Highway 395, crossing Kadrmas Road and then heading north to the Industrial Park. This alternative alignment has been proposed in case the easement from the landowner is not obtainable for the primary route.

The pipeline would consist of an outer and inner pipe. The outer pipe would be 11 inches in diameter and made of polyvinyl chloride (PVC) or ethylene propylene diene monomer. The inner pipeline would be ductile iron and approximately 7 inches in diameter, with approximately 2 inches of foam between the pipes for insulation. An outer jacket would be placed around the pipeline and would consist of high-density polyethylene or PVC. The pipeline would be buried in an approximately 45-inch-deep by 36-inch-wide trench, with at least 20 inches from the top of the pipeline to the ground surface. This type of pipeline, which is also used for the WCCF direct use system, has proven to be efficient for transporting geothermal fluid with negligible heat loss (Anderson Engineering 2009). Heat loss for the direct use system has been estimated to be less than 6°F.

The pipeline comes from the factory in standard 20-foot lengths with bell and spigot fittings. Gaskets at the joints would provide movement ability for minor settlement and thermal changes.

Fluid would flow through the pipeline from the well to the buildings and then from the buildings to the injection well. The only appurtenances associated with the pipeline would be manhole(s) that cover a small excavated area that would hold valves for the pipeline. There would be no routine maintenance on the pipeline. Work would be completed on the pipeline only in the event of a leak, which would be detected through a pressure loss. The valves would be utilized to isolate flow from certain areas of the pipeline in order to stop the flow in a leaking pipeline segment and repair the pipeline segment.

Buildings

The pipeline would connect to Lake District Hospital and five schools in the Lake County School District. The pipeline would connect to Lake District Hospital, delivering a portion of the fluid to the hospital geothermal heating system. The hospital was upgraded and retrofitted to use the geothermal direct use system. The hospital would require approximately 135 gallons per minute of 180°F water for peak loads. The hot water would interconnect to the system on the property. The schools would receive hot water as listed in Table 2.1-2. Upgrades to the existing heating systems at the schools were made in 2011 to accommodate the geothermal heating system.

Table 2.1-2: Peak Geothermal Flow at Buildings

Building	Peak Geothermal Flow (gpm)[a]	Average Fuel Use (BTU/hour)
Lakeview High School	134	212,200
Agricultural Shop	N/A[b]	56,000
Daly Middle School	47	70,300
Fremont Elementary School	18	252,700
A.D. Hay Elementary School	36	145,000
Lakeview Hospital	135	212,200

a. Based on geothermal fluid of 190°F. Geothermal temperatures of 175 to 190°F would not cause a substantial variance in other project operating parameters.

b. Included in Lakeview High School.

BTU = British thermal unit.

gpm = gallons per minute.

Lake County Industrial Park is located northwest of the Barry Well Pad site on South M Street. Current tenants include a concrete plant, a safe manufacturing facility, a sound booth manufacturing building, two small distributor buildings, and a telemarketing facility. The main distribution pipeline would have a tap point at the Lake County Industrial Park, although connections are not currently proposed. Control of the system would be through differential pressure. As heat demand increases at a facility, a valve located near the heat exchanger would open to allow more geothermal water to enter the heat exchanger at the building. An increased amount of water entering the heat exchanger would drop the pressure in the supply line and signal to the pump to produce more flow. The amount of the drop in pressure would signal the variable frequency drive to match the demand with a corresponding pump speed. This would be accomplished by a pressure transducer in the supply pipeline or by a pressure signal at the most distant heat exchanger (most likely at the high school). When no heat is needed, the system pressure would remain at its static setting and the pump would automatically stop.

Geothermal Water Injection Well

A new geothermal water injection well is proposed at the location shown in Figure 2.1-1, and would be located on the same side of the railroad tracks as the southern extent of the pipeline. Geothermal water used in the direct use system would be disposed of by injecting it into the aquifer after use. Injection would be downgradient of the production well. No pump would be needed for injection.

The exact location of the injection well is not known at this time and would require the drilling of a small-diameter test well to a 400-foot depth to evaluate artesian pressure and water chemistry at the location. The test well would allow evaluation of the conditions before a final well is drilled, completed, and tested. The proposed injection well would be a typical injection well. No enhanced geothermal system technology is proposed for this project. Only spent geothermal water would be injected of the same volume as is withdrawn. The well would be housed in a new 8-foot-by-8-foot building.

Construction and Drilling of Components

Production Well Drilling and Testing

The production well would be drilled at the Barry Well Pad site, approximately 20 feet west of existing Well B, as shown in Figure 2.1-2, in order to tap into the geothermal reservoir. The well is expected to be approximately 600 feet deep.

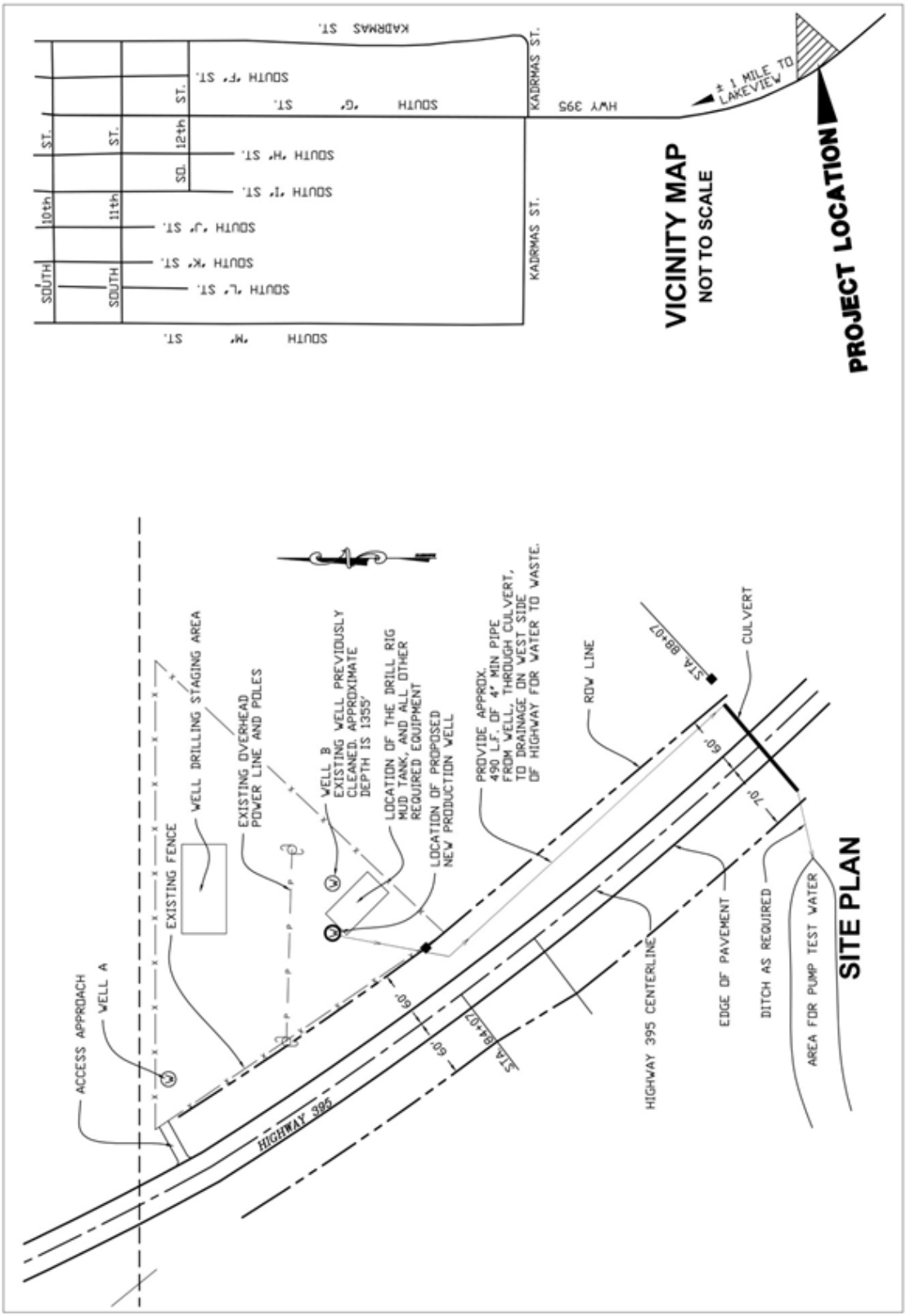
The production well casing would be approximately 12 inches in inside diameter, and would be located in a borehole approximately 20 inches in diameter. Gravel packing would be used between the borehole and the casing. The well would have conductor casing. The conductor casing serves as a support during drilling operations, to flow back returns during drilling and cementing of the surface casing, and to prevent collapse of loose soil near the surface.

Drilling would be performed from a drill pad of approximately 100 feet by 100 feet in size around the proposed production well. Preparation work for the drill pad would consist of laying down gravel, as the site is nearly level. No excavation would be necessary. There is an existing fence around the Barry Well Pad site, which would be used to prevent trespassing in the drilling operations area. The site plan for the Barry Well Pad Site is shown in Figure 2.1-2.

The production well would be drilled using a large mud rotary drill rig, powered by a diesel engine. During drilling, the top of the drill rig mast would be approximately 35 feet above the ground surface. A sample rig is shown in Figure 2.1-3. The rig would be equipped with diesel engines, fuel, drilling mud storage tanks, mud pumps, and other typical ancillary equipment. Metal mixing tanks would be used to mix water and drilling mud. One tank (described below) would be located on site to store the drilling mud. The well would be drilled using air and/or mud to circulate the drill hole cuttings to the surface. The well would be fitted with blowout-prevention equipment, according to the drilling safety plan (Appendix C).

The well bore would be drilled using non-toxic, temperature-stable drilling mud composed of a bentonite clay-water or polymer-water mix for all wells. Variable concentrations of additives would be used. Typical drilling additives include weighting materials such as barite (barium sulfate); corrosion inhibitors such as iron oxide, aluminum bisulfate, and zinc carbonates; and fluid loss reducers including starch and organic polymers. Additional drilling mud would be mixed and added to the mud system as needed to maintain the required quantities.

Figure 2.1-2: Barry Well Pad Site Layout



SOURCE: Anderson Engineering and Surveying, Inc. 2009

Figure 2.1-3: Example Drilling Rig

SOURCE: RMT, Inc. 2009

The production well may need to be worked over or redrilled if mechanical or other problems that prevent proper completion of the well in the targeted geothermal reservoir are encountered while drilling or setting casing. Depending on the circumstances, working over the well may consist of lifting the fluid in the well column with air or gas or stimulation of the formation using dilute acid. Well redrilling may consist of re-entering and redrilling the existing well bore and drilling and casing a new well bore, or relocating the drilling rig a few feet and drilling and casing a new well bore.

The drill rig and all equipment and supplies would be brought to the project site on trucks. Transportation to the project site would be via U.S. Highway 395 and an existing access approach to the Barry Well Pad site, as shown in Figure 2.1-1.

Estimated truck traffic during the approximately 2-month-long drilling process is as follows:

- A total of 11 large trucks for the project (1 truck for the drill rig, 2 trucks for casing, 4 trucks for mud removal, 2 trucks for cement, and 2 miscellaneous trucks)

- Five other vehicles per day (150 total) for pickups and deliveries and to bring workers to and from the site

Short-term hydraulic flow tests would be performed on the new production well after its completion. A line-shaft turbine or submersible pump would be installed in the well bore for the well tests. The tests would consist of pumping the geothermal water from the well through on-site test equipment. The on-site test equipment would include standard flow metering, recording, and sampling apparatus. Pressure, temperature, and spinner production logging equipment would be installed in the wells during the well testing. Well logging equipment would include an e-log, which utilizes radioactive media to determine the geologic material of the well bore.

Step tests would be performed first. The step tests involve pumping the well at approximately 75 gallons per minute for a few hours, and then increasing the pump rate every few hours to approximately 100 gallons per minute, approximately 150 gallons per minute, and finally approximately 250 gallons per minute. Then, a constant flow test would be performed for approximately 24 hours, during which time the well would be flowed at a few hundred gallons per minute (at or above 250 gallons per minute). Geothermal water would be discharged via a temporary pipe into a culvert under U.S. Highway 395 for both tests. The flow would drain into the field across U.S. Highway 395 via a ditch, south of the Barry Ranch Figure 2.1-4). The ditch is an estimated 5 to 10 feet wide and approximately 18 inches deep. The ditch is vegetated and would be able to handle the flows. Sensitive resources are not anticipated to occur in the ditch or the field. Measures would be implemented to ensure that flooding and erosion do not occur during discharge. These measures include the use of flow dissipation devices at the outflow area, if necessary, and timing the discharge so that it does not coincide with heavy rain events that could cause flooding. Discharge would also be coordinated with the Barry Ranch land owner. Surface test equipment and temporary pipelines would be removed at the completion of testing.

An aboveground, prefabricated reserve tank would be located adjacent to the drilling site and would contain drilling mud to be reused in the drilling process. The tank would be 4 feet deep by 8 feet wide by 30 feet long and would be located next to the testing storage tank on the well pad. Fewer than 7,500 gallons of mud would be used for drilling. Shaker screens and mud pumps would be included in the tank unit. The solid contents in the reserve tank would typically consist of non-hazardous, non-toxic drilling mud (bentonite additive and mud). Mud would be reused in the drill until the end of well drilling. Reserve tank waste would be sampled for hazardous contaminants before disposal at an appropriate landfill. Rock and other solid material from the well bore would be separated out by shakers, and the cuttings would be sampled for hazardous waste using the appropriate protocol and disposed at an appropriate landfill.

A diagram of the well is shown in Figure 2.1-5. A slotted liner may be installed in the production zone, or the zone may be unlined, depending on zone characteristics, which would be determined after flow testing.

If the well is not found to be viable for production, the well would be abandoned in conformance with all requirements of the Oregon Water Resources Department (OWRD). Abandonment typically involves plugging the well bore with sufficient cement to ensure that fluids do not move into different aquifers.

Figure 2.1-4: Flow Test Discharge Areas

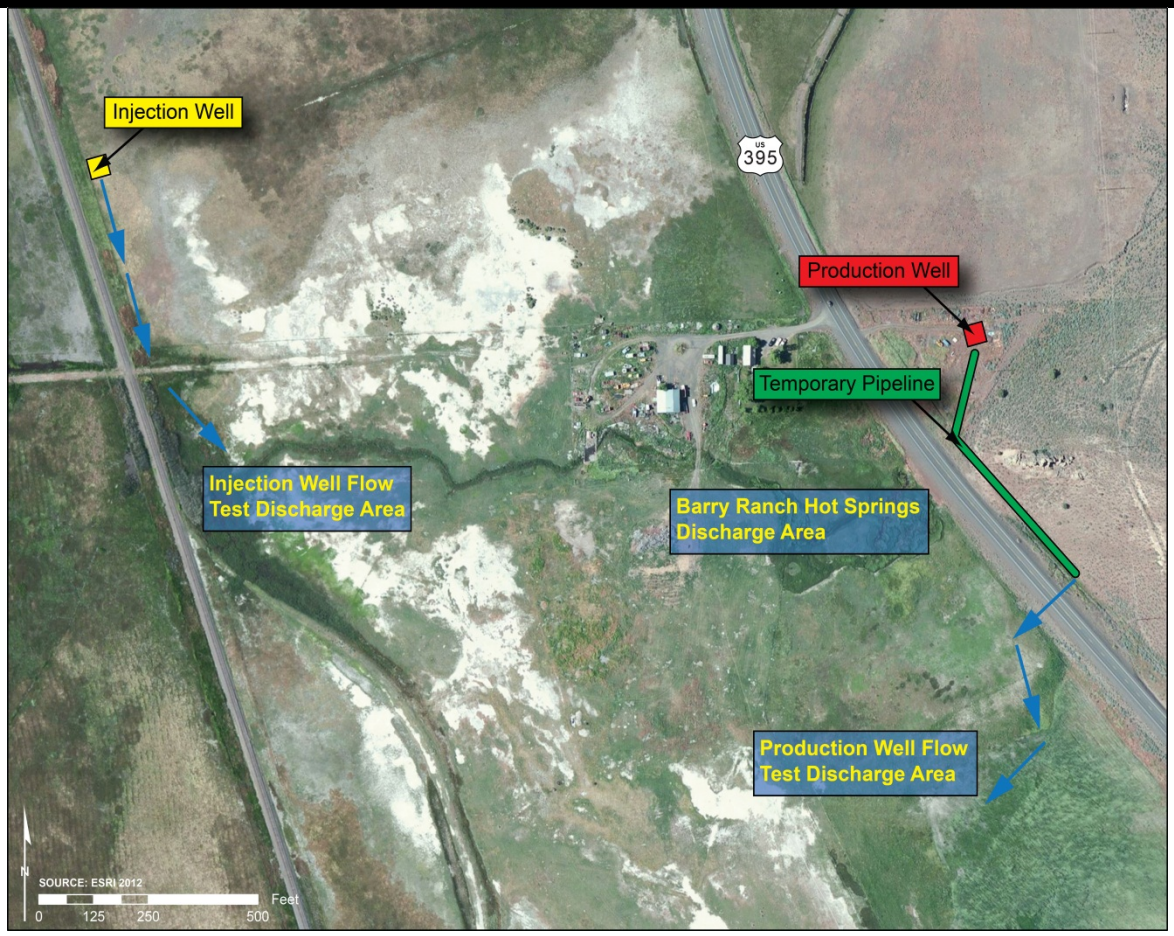
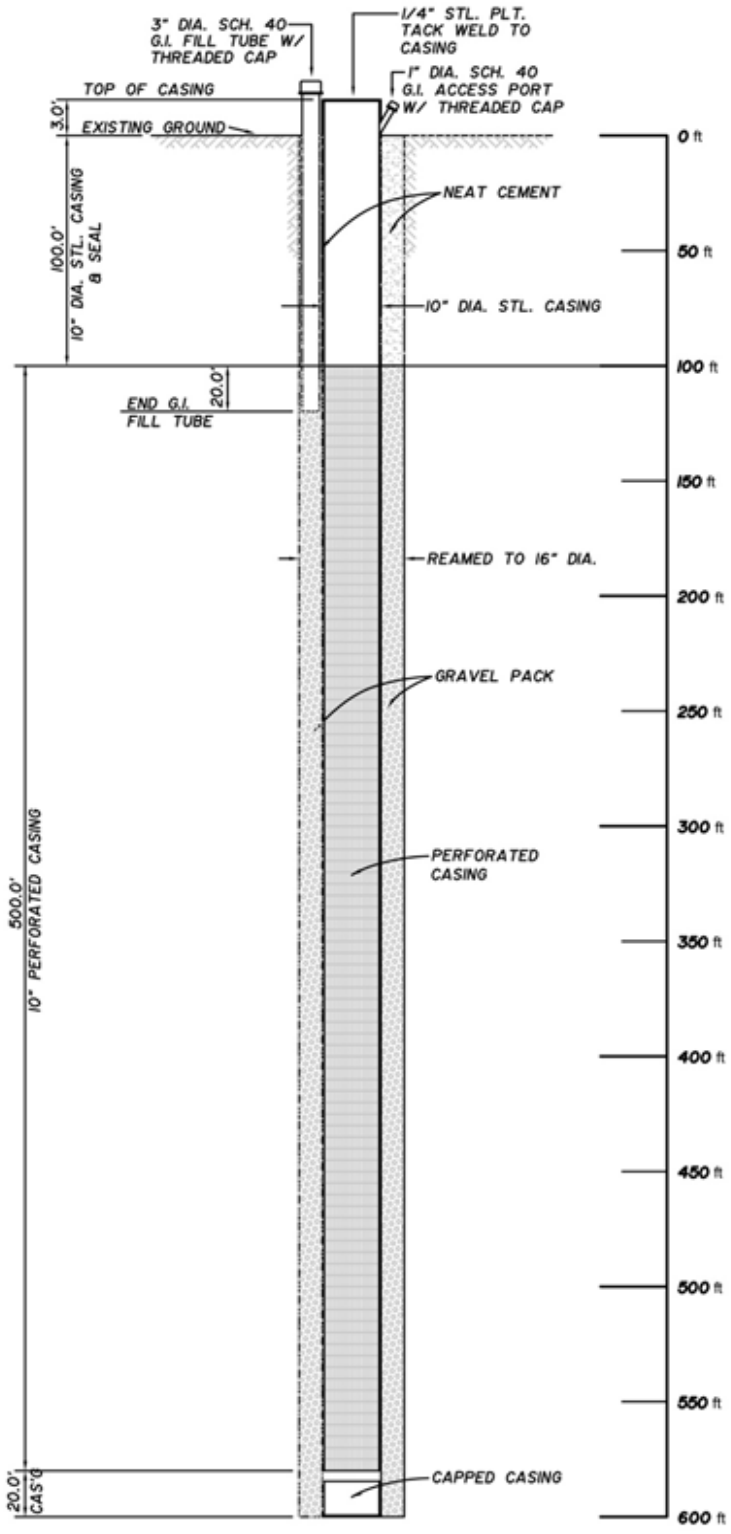


Figure 2.1-5: Direct Use System Production Well Profile



SOURCE: Anderson Engineering and Surveying, Inc. 2009

Distribution Pipeline Construction

The distribution pipeline would follow existing roads or rights-of-way for most of its alignment. In places where there is one pipe, the trench would be 24 inches wide and approximately 45 inches deep. In places where there would be two pipes (a distribution and return pipeline), the trench would be 36 inches wide and 45 inches deep. The depth is based on the requirement that the top of the pipe be at least 30 inches below ground in order to be below the frost line, to prevent pipe damage, and to have the piping at a depth where the soil temperatures would remain relatively constant. The construction right-of-way would be 30 feet wide. Soils would be stockpiled during excavation and would be replaced and recontoured after installation of the pipeline. Excavated material would be stockpiled directly next to the ditch and then used for backfill once the pipeline was installed. Excavated material would be covered with a geotextile to minimize erosion of the soils. The excavated material for road areas would be loaded directly into a truck, stockpiled at the staging areas, and covered to prevent erosion, or would be taken off site. Excess excavated material not required as fill would be disposed of or stockpiled at the discretion of the Town of Lakeview. The pipeline would be installed in a trench. The bottom of the trench would be filled with approximately 4 inches of sand bedding. The pipeline would be placed on this bedding and covered with an additional 6 inches of sand above the top of the pipe. The trench would then be backfilled with the native material originally removed from the trench. Select structural backfill, such as gravel, would be used only under roadways or where a more solid support than soil is needed.

In areas where the pipeline crosses under roadways (U.S. Highway 395, South 6th Street, South 9th Street, and South 3rd Street), boring methods would be employed in an effort to reduce disruption of traffic. The two crossings of Deadman Creek and the associated wetlands and riparian areas would be constructed by hanging the pipeline on the existing trestle of the existing bridge and by jacking and boring under the creek.

Fittings such as tees and bends in the pipeline would be covered with a heavy plastic "shrink wrap" to prevent moisture from entering the insulation. Fittings would also be encased in concrete to provide insulation and protection.

No upgrades would be completed at the Lake County Industrial Park. Tenants of the Industrial Park have several options for utilizing the direct use system; however, these upgrades would be the responsibility of the tenants and would not be performed as part of the proposed project.

Geothermal Water Injection Well Drilling

The drilling and testing process and equipment for drilling of the geothermal water injection well would be the same as for the production well. Tests would include water chemistry testing and pumping tests to determine hydraulic characteristics of the well and the reservoir. Geothermal water from testing would be discharged into the wetland/fields near the proposed injection well site (Figure 2.1-4). This area is a season wetland and sensitive species or plants are not anticipated in the area. The water quality from the geothermal fluid is expected to be similar to that of the wetlands in the area, as they are fed by geothermal

springs. Flow dissipation devices would be used if necessary to prevent erosion and timing of discharge would be managed. No houses or structures are in the field area and therefore inundation would not be problematic. The site plan for the geothermal water injection well is shown in Figure 2.1-6.

The injection well would be between 400 and 500 feet deep and have 10-inch-diameter casing. The well would be cased for its entire depth. A diagram of the well is shown in Figure 2.1-7.

Construction Staging

Staging for construction of the direct use system would be at the Lake County Industrial Park on South M Street. The staging area is currently disturbed, but unpaved. The area is unvegetated and is approximately 0.5 acre in size. Gravel and other fill would be placed on the surface prior to using the area for staging. The staging area is shown in Figure 2.1-1. Limited materials would also be stored on the well pad areas for well drilling.

Construction Crew and Schedule

Drilling would occur for 24 hours per day, 7 days per week, by a crew of 2 to 3 workers. Drilling would take approximately 2 months to complete, while testing would take another month to complete. Construction of the direct use system would take approximately 120 to 180 days, depending on the time of year, by a crew of 15 to 25 workers. Construction of the system would likely begin with drilling of the production well, and would then follow with drilling of a test well at the geothermal water injection well site, drilling of the geothermal water injection well, and then construction of the pipeline and upgrades to buildings in Lakeview.

Construction and Drilling Water

Water for construction and drilling would be obtained from the Town of Lakeview municipal system. Stormwater runoff at the drilling pads would be minimized through drainage and collection of runoff in a reserve tank also located on the drilling pads.

2.1.4 MONITORING WELLS

The Town of Lakeview would hire a qualified hydrogeologist to prepare a program for installation of additional monitoring wells and to define and conduct a monitoring program during project operation. Plans for this program will be submitted for approval to the USDA prior to initiation of construction of the geothermal direct use system. Tentative monitoring well locations are shown in Figure 2.1-1.

The number, location, and specifications of monitoring wells would be determined by the qualified hydrogeologist. If existing wells can be used, they will be identified. The program would consist of at least one well. If new wells are needed, the well or wells would not be installed in locations where they are subject to periodic or seasonal inundation by floodwaters (i.e., not in the wetlands). The well or wells would not be drilled in any location of cultural or biological resources, or where the well's integrity could be compromised by soil erosion, soil settlement, shrink-swell soil conditions, frost heaving of soils, damage by vehicles or heavy equipment, or any other hazard. The wellhead would be secured against

Figure 2.1-6: Geothermal Water Injection Well Site Layout

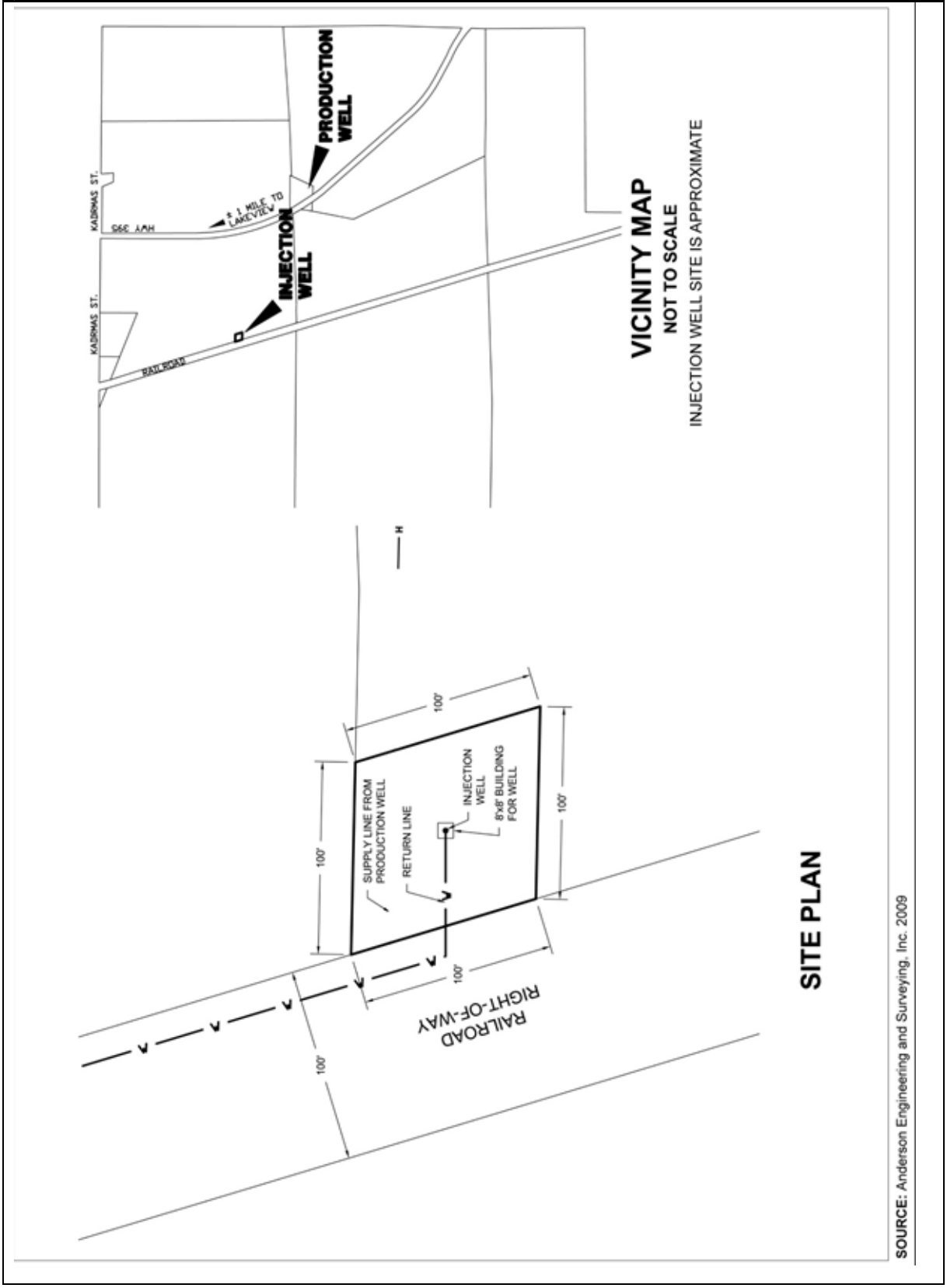
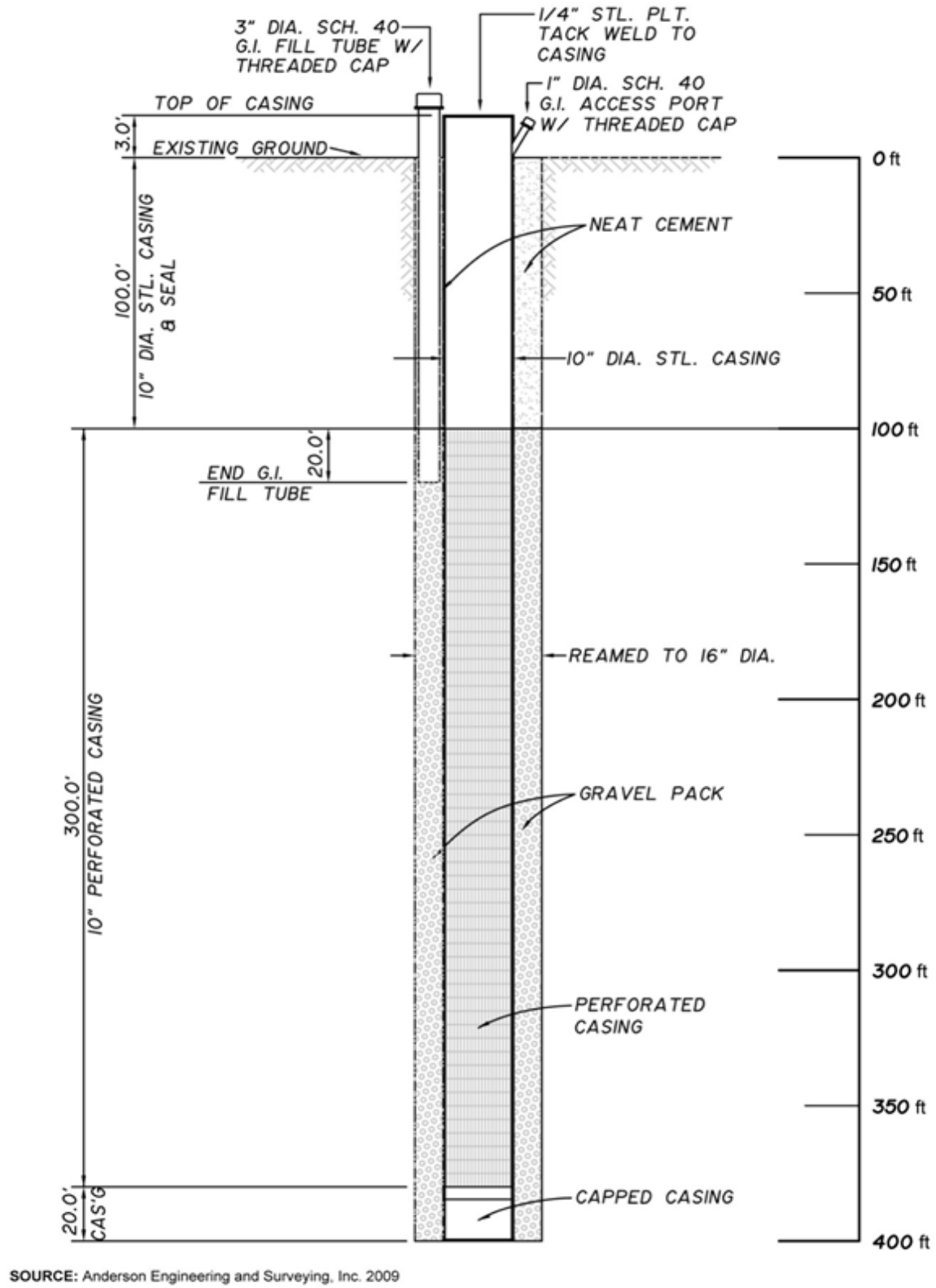


Figure 2.1-7: Geothermal Water Injection Well Profile



SOURCE: Anderson Engineering and Surveying, Inc. 2009

unauthorized entry with an appropriate locking device. A qualified archaeologist and biologist would survey any area proposed for ground disturbance associated with the monitoring wells prior to drilling, if the well is proposed outside of the existing area of potential effect (APE), for any wells to be located in a previously undisturbed area. Each well would disturb an area less than 10 square feet. The groundwater monitoring well or wells would be constructed in compliance with the DEQ's Groundwater Monitoring Well Drilling, Construction, and Decommissioning guidance document (DEQ 1992). A small drill rig would be required to drill the wells. The drilling method would depend upon the site-specific geologic and hydrogeologic conditions. The well bore would likely have a 2- to 4-inch-diameter nominal well casing and an overall diameter of 6 to 8 inches. Groundwater in the project area has varied up to 35 feet below ground surface (OWRD 2010); therefore, it can be expected that the monitoring well would be deeper than 35 feet.

The monitoring data would be used to quantify the relationship between geothermal pumping and injection and localized groundwater levels to ensure that surrounding users are not adversely impacted. Users include:

- Nearby direct use system wells
- Cannon Springs
- Other springs near the direct use system

If a considerable change occurred, then the Town of Lakeview would scale back pumping, re-evaluate the production/injection scenario, or provide supplemental water to users, springs, and/or wetlands to ensure that the project would not have a significant adverse effect on surrounding geothermal users and features. A considerable change would include:

- A reduction in temperature in excess of 5°Fon average, attributable to the proposed project, in geothermal wells or hot springs; and/or
- A loss of water to Cannon Springs or wetlands near the geothermal direct use system.

Due to its location, the production well is expected to capture geothermal fluid flux that discharges as spring flow. The Town of Lakeview, in coordination with the qualified hydrologist, would develop a surface water augmentation plan to discharge an appropriate quantity of the geothermal well water at the spring locations to offset any reduction in natural spring discharge, if necessary. The plan would include the provision of water of similar temperature and water quality, if necessary, and the acquisition of all necessary permits from regulatory agencies. Monitoring results would be provided to the USDA for a period of time, as specified in the monitoring plan, to ensure implementation of the plan.

2.2 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, USDA would not authorize the Town of Lakeview to expend federal funds for the proposed direct use system. As a result, installation of the geothermal direct use system would be delayed while the Town sought out other funding

sources, or abandoned if other funding sources could not be obtained. The existing geothermal direct uses would continue as they currently operate. The use of the geothermal resource would remain the same. Reductions in fossil fuel use and improvements in energy efficiency would not occur.

Although the Town of Lakeview's proposed project might proceed if USDA decided not to provide any form of financial assistance, USDA assumes for purposes of this Final EA that the project would not proceed without this financial assistance. If the project did proceed without USDA's financial assistance, the potential impacts would be essentially identical to those under USDA's Proposed Project (that is, providing assistance that allows the project to proceed). In order to allow a comparison between the potential impacts of a project as implemented and the impacts of not proceeding with a project, USDA assumes that if it decided to withhold assistance from this project, final design and construction of the proposed geothermal direct use system would not proceed.

2.3 SAFETY AND RISK ASSESSMENT

Appendix C provides a detailed description of Lakeview's emergency plans for:

- Injuries
- Well blowouts
- Fire
- Spill or discharge contingencies (for drilling mud, geothermal fluid, lubricants, fuels, etc.)
- Hazardous gas control
- Drilling safety and action plans

The purpose of these plans is to provide guidance to field personnel and management in the event of an uncontrolled well flow (i.e., blowout) or other field-related emergency. The plans are intended to be comprehensive in that they describe the nature of various hazards or problems that might be encountered and specify appropriate preventive or anticipatory actions and equipment, as well as specific responses, notifications, and follow-up procedures that are required in the event of such a field emergency. In addition to blowouts, emergencies such as accidents and injuries are covered, as are fire hazards management and risk assessment.

2.4 PERMITTING

Table 2.4-1 lists the permits, reviews, consultation, and approvals required for the proposed project, as well as the status of the permits and/or timing of acquisition.

Table 2.4-1: Permitting Requirements and Status

Agency	Permit/Approval	Status or Timing
Oregon Water Resources Department (OWRD)	Application to Drill Geothermal Well	An application would be submitted if USDA issues a Finding of No Significant Impact.
	Water Rights	Permit issued #G-16806
Lake County	Conditional Use Permit	Application was submitted in March 2012, but has not yet been approved by the County
Lake County	Building Permit	If USDA issues a Finding of No Significant Impact and the Conditional Use Permit is approved, the Building Permit application would be submitted after the approvals are received.
DEQ	Underground Injection Control	The project is exempt at this time for 750 gallons per minute. A new application would be submitted after the well is completed and the resource characteristics are determined.
	Authority to Construct Permit	The permit would be filed 1 month prior to construction.
	National Pollutant Discharge Elimination System General Construction Permit and Section 401 Certification	These permits would be applied for prior to construction.
Oregon Department of Geology and Mineral Industries	Start card for well drilling	Applied for prior to drilling.
Oregon SHPO	Review of permits for cultural survey and mitigation work pursuant to an MOA	Review and approval must occur prior to construction and is underway.
Oregon Department of Transportation (ODT)	Highway Crossing and Construction within State Right of Way	Applied for prior to construction.
U.S. Army Corps of Engineers (USACE)	Section 404 permit	An application would be submitted before construction. An approved permit must be obtained prior to construction.
U.S. Nuclear Regulatory Commission	License for use of nuclear logging devices	The license would be applied for prior to installation of the wells.

2.5 APPLICANT-COMMITTED MEASURES

The specific environmental protection measures listed by activity or environmental resource area below are incorporated into the proposed project as integral components.

2.5.1 AIR QUALITY

1. Prior to ground disturbance, any dry soils would be watered to reduce fugitive dust emissions. Soils would be monitored and continued to be watered throughout the project if dust begins to generate. Other measures that may be implemented to minimize dust include, but are not limited to:
    a. Application of asphalt, oil, water, or suitable chemicals on dirt roads, material stockpiles, and other surfaces that can give rise to airborne dust
    b. Use of water , venting, or other precautions to prevent particulate matter from becoming airborne in handling dusty materials to open stockpiles and mobile equipment
    c. Maintenance of roadways in a clean condition
2. Hydrogen sulfide (H_2S) concentrations in the air would be monitored at the drill site during drilling and flow testing. H_2S concentrations in the produced geothermal fluid and preliminary flow would be measured during the flow test. If these measurements suggest that the H_2S emissions approach 10 parts per million for an 8- hour day, a chemical abatement (such as sodium hydroxide), standard for the geothermal industry, would be injected into the discharge line to abate the gas. A trailer-mounted abatement skid with a storage tank for sodium hydroxide, a pump, and appropriate monitoring equipment would be kept on site. The discharge line would be appropriately calibrated to provide for abatement at any time if needed. Personnel on site during periods of possible well discharge would be trained in the use of masks and air tanks and would wear H_2S monitors at all times.

2.5.2 BIOLOGICAL RESOURCES

1. Drilling areas would be fenced to prevent wildlife from being injured by drilling equipment.
2. Vegetated areas that are disturbed by trenching for the pipelines would be re-vegetated with species similar to those that currently occur, or other native species.
3. Monitoring and treatment of the project area for invasive, nonnative species would be required for the duration of exploration. Any weeds found along and within the construction right–of-way would be removed completely and discarded in an appropriate manner.
4. All soil where the pipeline trenches cross wetlands would be replaced after construction and would these areas would be re-vegetated with an appropriate seed mix.

5. Erosion control methods would be implemented for all construction work occurring near waterways or wetlands (within 100 feet). Methods can include, but are not limited to, silt fencing and certified weed-free straw waddles or bails.
6. During construction, construction crews would stay within the designated construction areas. All pipelines would be capped at night to ensure that wildlife do not enter stockpiled equipment. Equipment would be checked in the morning for wildlife or other animals. If wildlife is found in equipment, they would be allowed to leave the project area prior to moving equipment.
7. To avoid potential impacts to active nesting birds that may be in the vicinity of the project site, construction would occur outside of the nesting season for these species, which is from mid-March to August 1st of each year. If construction or other ground-disturbing activities is to occur during the nesting season, pre-construction surveys for active nesting birds would be conducted so that impacts to these species can be avoided. Pre-construction surveys would be conducted by a qualified biologist within 48 hours of commencement of construction activities. If an active nesting bird is found, an appropriate buffer, as determined by the qualified biologist, would be implemented around the nest site until all fledglings have left the nest.
8. Preconstruction surveys would be conducted for the 12 federally designated plant Species of Concern that may potentially occur in the project area, including the alternate pipeline route. If any of these plants are identified, they would be avoided to the greatest extent feasible. If the plants cannot be avoided, a plan would be prepared for restoration (as well as an attempt at relocation of the individual plant) and seeds of the plant would be collected. The plan would include at a minimum: (a) the location of where the plant would be seeded or replanted, with preference for on-site replacement such as over the pipeline route; (b) the plant species and seeding rate; (c) a schematic depicting the replanting or seeding area; (d) the planting schedule; (e) a description of the irrigation methodology; (f) measures to control exotic vegetation on site; (g) specific success criteria; (h) a detailed monitoring program; (i) contingency measures should the success criteria not be met; and (j) identification of the party responsible for meeting the success criteria.

2.5.3 WATER RESOURCES

1. Areas temporarily disturbed for excavation or other purposes would be re-vegetated to their original condition.
2. Contamination of stormwater runoff at the drilling pads would be minimized through drainage and collection of runoff in a reserve tank.

3. Erosion control such as erosion control blankets would be used to minimize erosion and scour that could be caused by discharge during pump tests.
4. Contamination along the pipeline corridor would be minimized through containment of any spills before they could be released into stormwater. The contractor would implement an SPCC plan on site to contain incidental drips and/or spills. Containment berms would be constructed around all hazardous material or potentially hazardous material storage for both construction and operation.
5. To ensure that water quality effects are not occurring, the water produced during flow testing from the production and injection wells would be tested for constituents such as arsenic, boron, bicarbonate, and total dissolved solids, and any other constituents as required in permits obtained from the DEQ, prior to overland disposal. If constituent concentrations are significantly higher in the produced water than is naturally occurring at the receiving water (i.e., hot springs and wetlands), an alternative method of disposal would be used. The alternative method could include storage and disposal at a wastewater acceptance facility, or dilution prior to discharge. The temperature of the water would also be measured and would only be discharged when it is no higher than 5°Fabove the existing receiving water's temperature. Detention (such as in a tank) or dilution may be used to adjust water temperature.
6. The Town of Lakeview would hire a qualified hydrogeologist to prepare a detailed program for installation of additional monitoring wells and to define and conduct a monitoring program during project operation.
7. The monitoring data would be used to quantify the relationship between geothermal pumping and injection and localized groundwater levels to ensure that surrounding users are not adversely impacted. Users included:
    - Nearby direct use system wells
    - Cannon Springs
    - Barry Ranch hot springs

    If a considerable change occurred, then the Town of Lakeview would scale back pumping, re-evaluate the production/injection scenario, and/or provide supplemental water to users, springs, and/or wetlands to ensure that the project would not have a significant adverse effect on surrounding geothermal users and features.

    Due to its location, the production well is expected to capture geothermal fluid flux that discharges as spring flow. The Town of Lakeview, in coordination with a qualified hydrologist, would develop a surface water augmentation plan to discharge an appropriate quantity of the geothermal well discharge at the spring locations to offset any reduction in natural spring discharge. The plan would

include the provision of water of similar temperature and water quality, if necessary, and the acquisition of all necessary permits from regulatory agencies.

8. The proposed injection well would be completed with perforations starting no higher than approximately 150 feet below ground surface in the well casing to minimize the potential for injected fluid to migrate to the surface.
9. The number, location, and specifications of monitoring wells would be determined by a qualified hydrogeologist. At least one monitoring well would be required. Wells would not be installed in locations where they are subject to periodic or seasonal inundation by floodwaters (i.e., not in the wetlands). The wells would not be drilled in any location of cultural or biological resources, or where the well's integrity could be compromised by soil erosion, soil settlement, shrink-swell soil conditions, frost heaving of soils, damage by vehicles or heavy equipment, or any other hazard. The wellhead would be secured against unauthorized entry with an appropriate locking device. A qualified archaeologist and biologist would survey any area proposed for ground disturbance associated with the monitoring wells or new injection wells prior to drilling, if the well is proposed outside of the existing area of potential effect (APE), for any wells to be located in a previously undisturbed area. Each well would disturb an area less than 10 square feet.

   The groundwater monitoring wells would be constructed in compliance with the DEQ's Groundwater Monitoring Well Drilling, Construction, and Decommissioning guidance document (DEQ 1992). A small drill rig would be required to drill the wells. The drilling method would depend upon the site-specific geologic and hydrogeologic conditions. The well bore would likely have an overall diameter of 6 to 8 inches and the well would be constructed with 2- to 4-inch-diameter nominal well casing. Groundwater in the project area has varied up to 35 feet below the ground surface (OWRD 2010); therefore, it can be expected that the monitoring well would be deeper than 35 feet.

2.5.4 CULTURAL RESOURCES

1. The Town of Lakeview would perform the following measures:
   - Construction of the pipeline would occur on the west side of the railroad tracks in the area of two potentially historic trash sites in order to avoid these sites or the pipeline would be bored underneath the sites.
   - Prior to project construction, additional subsurface analysis of the one known archaeological site would be completed in order to evaluate the sites' eligibility for the NRHP. An evaluation plan would be prepared and would consist of the methodical excavation of those portions of the sites that would be adversely affected by project activities. Only a qualified archaeologist or

cultural resources consultant would be allowed to collect any prehistoric resources discovered at the site. The work would be accomplished within the context of a detailed research design and in accordance with current professional standards. The plan would result in the extraction of sufficient volumes of non-redundant archaeological data so as to address important regional research consideration; detailed technical reports would be prepared to document the findings.

- If the site is determined eligible for the NRHP, and the eligible areas of the site cannot be avoided, no construction would occur until recovery is implemented. Directional drilling may be used to avoid disturbance of these sites, if necessary. Data recovery would be accomplished in the context of a detailed research design and in accordance with current professional standards. The plan would result in the extraction of sufficient volumes of non-redundant archaeological data so as to address important regional research consideration, detailed technical reports should be prepared to document the findings. The plan and recovery would be approved by the SHPO. Areas to be completely avoided during construction would be identified and marked on maps and with fencing in the field. If one or both sites are determined ineligible, no further mitigation is required.
- A sensitivity assessment would be prepared to identify where potential buried archaeological sites may exist within the project area and an Inadvertent Discovery Plan would be prepared. This assessment would entail review of Quaternary landform mapping, location of artificial fill created during prior construction events, historical reconstructions of habitat distribution, and distribution of known buried archaeological sites in the region. The project would involve excavation that could disturb unknown sites. It is important that vehicles and traffic stay within the clearly delineated and flagged APE during all project operations because undiscovered resources likely exist outside this area. The APE would be clearly flagged and staff would be informed (before project commencement) to stay within the APE and that any effects on, defacement of, removal, and/or disturbance of archaeological, historical, or sacred material is prohibited and subject to disciplinary action.
- Prior to commencement of construction, all construction workers would be trained on critical elements of compliance with the Archaeological Resources Protection Act, Native American Graves Protection and Repatriation Act, and NHPA, along with pertinent

requirements and expectations concerning the protection of natural, cultural, and current approved land uses.

- Due to the high cultural sensitivity at the project site, a trained archaeologist would monitor all ground-disturbing activities. A Native American monitor may also be present during excavation. If prehistoric or historic artifacts are discovered during excavation, the monitor would have the authority to halt all earth-moving activities within and around the immediate discovery area until the find can be assessed.

2. A qualified archaeologist would survey any area proposed for ground disturbance associated with the installation and operation of monitoring wells prior to drilling for any wells to be located in a previously undisturbed area and along the alternate pipeline route. If human remains or artifacts or any other items of cultural significance were encountered during project operations, all work within 300 feet of the remains would cease and the SHPO would be contacted for resolution and further instruction regarding additional studies and/or potential avoidance, minimization, or mitigation measures in accordance with the NHPA.

2.5.5 NOISE

1. Noise screening would be used during drilling to reduce noise heard by sensitive receptors, if noise becomes problematic to sensitive receptors. All equipment used would have the appropriate mufflers and noise abatement equipment necessary. A temporary noise wall may be installed around the drilling pad. The wall would not be greater in height than the base of the drill rig to minimize visual impacts. The wall would be removed after drilling is complete. All neighboring properties would be informed in writing of the proposed drilling and construction schedule and estimated noise levels 30 days prior to commencing drilling operations. The notification would also include the name and number of a contact person who would receive noise complaints and respond to any local complaints about drilling or construction noise.

   In the event of a complaint, the contact would determine the cause of the noise complaint and institute reasonable measures warranted to correct the problem.

2.5.6 VISUAL RESOURCES

1. All buildings and other appropriate structures would be painted a muted color to minimize the visual impact of the new building on the surrounding area.

2.5.7 HUMAN HEALTH AND SAFETY AND RISK ASSESSMENT

1. Temporary safety fencing would be installed during construction or repairs to restrict or prevent public access to active on-site construction materials or chemicals.

2. Safety signage would be placed as appropriate along the construction corridor during construction or repairs to warn of risks associated with on-site construction materials and outline measures to be taken to ensure safe use of facilities near construction areas and avoidance of construction materials.
3. Contamination along the pipeline corridor would be minimized through containment of any spills before they could be released into stormwater. The Town of Lakeview would implement an SPCC plan on site to contain incidental drips and/or spills.
4. All hazardous material storage areas would be surrounded by containment berms that can contain 110 percent of storage contents.
5. The following fire prevention measures would be implemented during construction:
    - Fire extinguishers and shovels would be available on-site.
    - All brush build-up around mufflers, radiators, and other engine parts would be avoided; periodic checks would be conducted to prevent this build-up.
    - Smoking would only be allowed in designated smoking areas; all cigarette butts would be placed in appropriate containers and not thrown on the ground or out windows of vehicles.
    - Cooking, campfires, or fires of any kind would not be allowed.
    - Portable generators used at the project site would be required to have spark arresters.

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3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

This chapter of this EA examines in detail the potential environmental impacts of the proposed project and the No-Action Alternative on the affected environmental resource areas.

3.1 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, USDA would not authorize the use of federal funds for the design, construction, and operation of the proposed project and thus assumes, for purposes of this EA, that the project would not go forward without federal funding. Therefore, there would not be any impacts to the resource areas analyzed in this EA; however, the Town of Lakeview would continue to use fossil fuels to create energy.

3.2 PROPOSED ACTION –CONSIDERATIONS NOT CARRIED FORWARD FOR FURTHER ANALYSIS

Consistent with NEPA implementing regulations and guidance, USDA focuses the analysis in an EA on topics with the greatest potential for significant environmental impact. For the reasons discussed here, the proposed project is not expected to have any measurable effects on certain resources; therefore, these resources were not carried forward for further analysis. Resources that may be measurably affected by the proposed project are discussed in Section 3.3.

3.2.1 GEOLOGY

Soils

Several soil types ranging from well to poorly drained occur in the project area. Construction would have a temporary impact on soils, primarily from grading and trenching. Impacts on soils would not be adverse in areas where soils have been previously disturbed by agricultural practices and construction of the railroad. Standard erosion control protection measures (e.g., use of silt fencing) would be implemented. The Soils category is dismissed as an impact category for analysis.

Mineral Resources

There is an operating perlite mine in the vicinity of Lakeview and former uranium mining operations 17 miles northwest of Lakeview. Under the proposed projsect, there would be no effect on these mineral resources from project activities. There are no known economically viable mineral resources within the project area of impact. The perlite and uranium mines would not be impacted due to their distance from the project site. Therefore, impacts are not expected and Mineral Resources is dismissed as an impact category for analysis.

3.2.2 WATER RESOURCES – FLOODPLAINS

The only permanent structures associated with the proposed project would be the two well houses. The injection well, well house, and part of the pipeline route would be within the

100-year flood hazard zone, as delineated by the Federal Emergency Management Agency (FEMA). FEMA-mapped floodplains are shown in Figure 3.2-1. The project would add approximately 0.0015 acres or 64 square feet of structure to the floodplain. Impacts would be minimal and would not increase flood hazards in the area.

A portion of the pipeline would be installed within the floodplain; however it would be installed underground and would not impact the floodplain.

Aboveground components of the wells would be outfitted with threaded, watertight caps or welded steel plates. All other well components (i.e., pump motor, variable frequency drive, and oil drip system) would consist of industry-standard, waterproofed equipment. Adverse impacts are not expected and Floodplains is dismissed as an impact category for analysis.

3.2.3 LAND USE

Land Usage

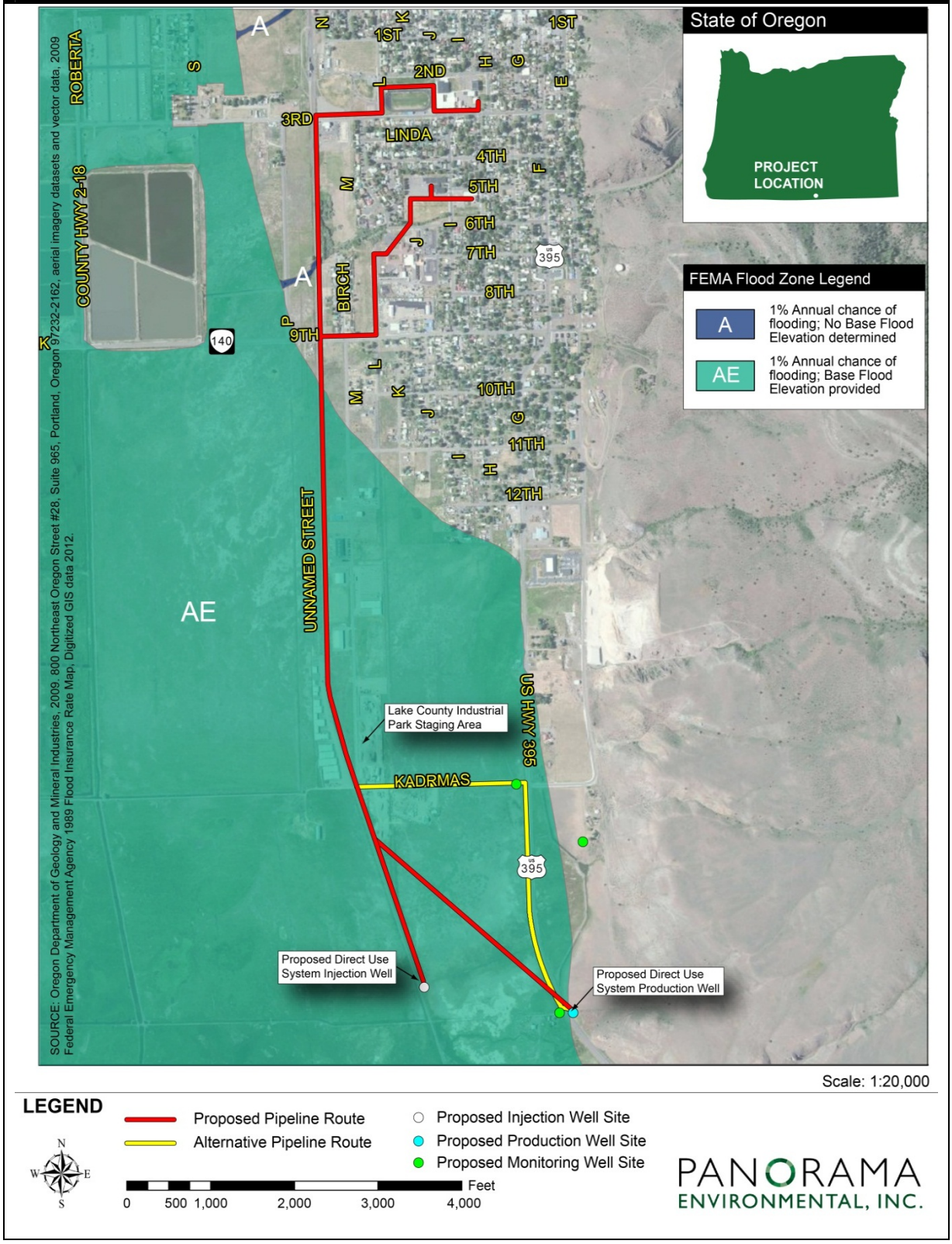
The project area encompasses two separate locations: within the Town of Lakeview limits and just south of the Town of Lakeview, within Lake County. The pipeline would extend from the southern production well in Lake County into Lakeview town limits. The town limits of Lakeview cover approximately 12 square miles from the Town center. An urban growth boundary extends from the Town perimeter and covers a similarly sized area. Land uses outside the Town of Lakeview's established limits, including the urban growth boundary, are managed by Lake County. The majority of lands within the urban growth boundary are currently undeveloped or used for industrial, government, or agricultural purposes (Simms pers. comm. 2009).

The portion of the proposed project that would be within the boundaries of Town of Lakeview would be constructed on lands zoned "residential." Use of the proposed direct use system, including the Lakeview Hospital and several schools, are compatible with the Town of Lakeview's planning objectives. Zoning regulations allow for underground utilities within the "residential" land use areas and the pipeline system within the Town would be compatible and allowable with the existing zoning.

Lake County has jurisdiction over the project sites located to the south of the Town of Lakeview. These areas include the proposed wells, well pads, and portions of the proposed pipelines. These lands are zoned by the County as Exclusive Farm Use (A-1). Geothermal operations are allowed within areas zoned A-1, Exclusive Farm Use with the Conditional Use Permit (Lake County 2009; ORS 522.005). The permit has been prepared, but has not yet been approved by the Lake County Board of Supervisors.

The project would not conflict with any of the permitted land uses or require a change in land use within the Town of Lakeview or Lake County as long as the Conditional Use Permit is obtained. Impacts are not expected and Land Usage is dismissed as an impact category for further analysis.

Figure 3.2-1: FEMA-Mapped Floodplains



Farmlands

The project would not significantly affect agricultural lands or prime or unique farmland soils as defined by the Natural Resources Conservation Service (NRCS). The pipeline from the geothermal production well would be constructed through a pasture grazed by livestock; however, the pipeline would be installed underground and, therefore, would not permanently alter the use of the field for grazing.

The only permanent structures associated with the proposed project would be the two well houses. The injection well house and the production well house would be located on land designated as Agricultural Use/Exclusive Farm Use (tax lots 4900 and 4601, respectively). The permanent footprint of the injection well house would be 8 feet by 8 feet or 0.0015 acre, which constitutes 0.0016 percent of the acreage of tax lot 4900 of 94.62 acres. The permanent footprint of the production well house would be 16 feet by 16 feet or 0.0059 acre, which constitutes 0.25 percent of the acreage of tax lot 4601 of 2.35 acres. However, the production well would be construction on the existing Barry Well Pad site, a previously disturbed site that is currently fenced and contains two existing wells, Well A and Well B.

USDA Farmland Conversion Impact Rating Form AD-1006 has been filled out and submitted to NRCS for review. Due to the minimal acreage of farmland to be converted through construction of the two well houses, it is not anticipated that public notices for farmland conversion would be required. A map of land use zones in the project area is included as Figure 3.2-2. Impacts would be negligible and Farmlands is dismissed as an impact category for analysis.

3.2.4 TRANSPORTATION

The project would not result in an increase in permanent vehicular traffic or require a change in traffic circulation. Small increases in traffic could occur from construction but impacts would be negligible. No new roads would be required. Transportation is dismissed as an impact category for analysis.

3.2.5 INFRASTRUCTURE

The project would have negligible impact on water availability. Roads would experience minimal impacts during construction, and other services such as phone and internet systems would not be impacted. Infrastructure is dismissed as an impact category for analysis. Permits from ODT would be obtained for construction of the alternate pipeline segment and to bore under Highway 395; however, no impacts to traffic are anticipated.

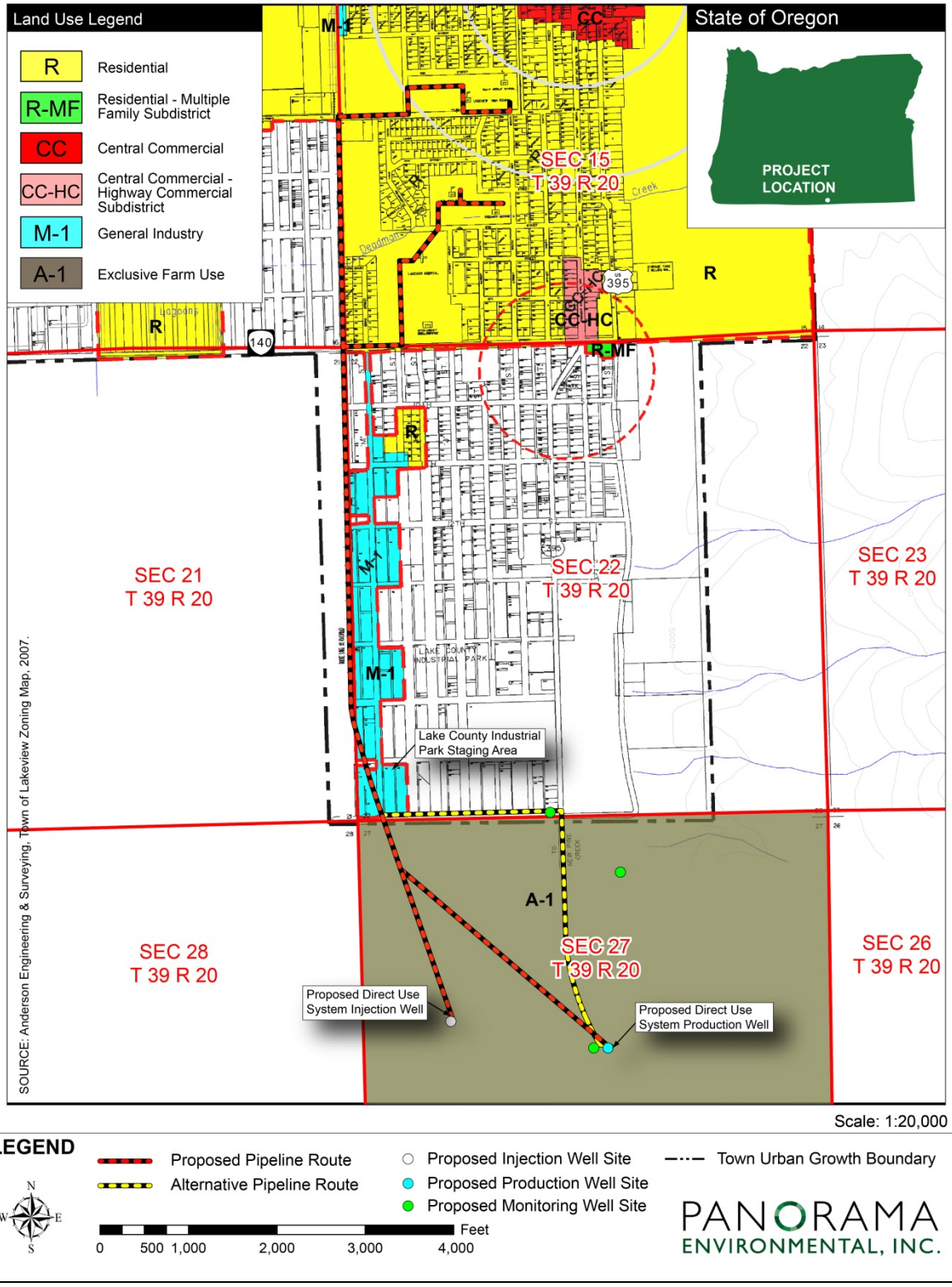
3.2.6 VISUAL RESOURCES – LIGHT EMISSIONS

The project would not require additional lighting. Therefore, impacts would not occur and Light Emissions is dismissed as an impact category for analysis.

3.2.7 WILD AND SCENIC RIVERS

There are no national or state Wild and Scenic Rivers within the project area. Therefore, impacts would not occur and Wild and Scenic Rivers is dismissed as an impact category for analysis.

Figure 3.2-2: Map of Land Use Zones



3.2.8 SOCIOECONOMICS

Construction and operation of the proposed project would not result in any major socioeconomic changes. Construction would be performed by local companies, providing temporary work for drilling and pipeline construction. Socioeconomics is dismissed as an impact category for analysis.

3.2.9 INTENTIONAL DESTRUCTIVE ACTS

The project location is not near any national defense infrastructure or in the immediate vicinity of a major inland port, container terminal, freight trains, or nuclear power plants. The proposed project would not offer any targets of opportunity for terrorists or saboteurs to inflict adverse impacts to human life, health, or safety.

3.3 PROPOSED ACTION - CONSIDERATIONS CARRIED FORWARD FOR FURTHER ANALYSIS

This section of this EA examines in detail the potential environmental impacts of the proposed project on the following resource areas:

- Air Quality
- Geology
- Water Resources
- Biological Resources
- Cultural Resources
- Noise
- Visual Resources
- Hazardous Materials, Human Health and Safety, and Risk Assessment
- Environmental Justice

3.3.1 AIR QUALITY

Affected Environment

Climate

Lake County has a semiarid winter-rainfall climate type characterized by mild summers and cold winters. Lakeview is at an elevation of approximately 4,800 feet. Lake County and Lakeview lie within Climate Division 7 (South Central Oregon), as determined by the National Climatic Data Center (Taylor 2008).

The average annual precipitation for Lakeview from 1971 through 2000 was 14.44 inches (Western Regional Climate Center 2009). The average annual maximum temperature for the same date range was 59.5°F. The average annual minimum temperature was 32.8°F (Taylor 2008).

The Goose Lake Basin is a predominantly flat area containing Goose Lake, a large shallow alkaline lake that overflows into the Pitt River during extreme water years. Interspersed hills and ridges surround the basin and the Lake County area. Lakeview sits at the foot of the Warner Mountains and at the edge of the Southeastern Oregon high desert. Lakeview can experience very strong and shallow nighttime air inversions that break up during the day. In

the winter, frigid arctic air masses frequently move down Goose Lake and invade the Goose Lake Basin (Town of Lakeview 2009a). Winter temperatures can remain well below freezing for several weeks at a time in Lakeview.

Air Quality Regulatory Setting

Air quality in Oregon is regulated by the DEQ. The DEQ implements local programs as well as operates the federal environmental program within the state for implementation of the federal *Clean Air Act*, as delegated by the U.S. Environmental Protection Agency (EPA). The air pollutants of greatest concern in Oregon are:

- Ground-level ozone, commonly known as smog
- Fine particulate matter (mostly from wood smoke or other combustion sources, cars, and dust) known as:
  - PM_{10} (10 microns and smaller in diameter) and
  - $PM_{2.5}$ (2.5 microns and smaller in diameter)
- Hazardous air pollutants (also called air toxics)
  - Carbon monoxide (mostly from motor vehicles)

The DEQ is also concerned about greenhouse gases (GHGs), and, along with the Oregon Department of Energy, is working on strategies to mitigate their release. GHGs cause global warming and according to an Oregon Department of Energy report (DEQ 2001):

> The impacts of such changes on Oregon citizens, businesses, and environmental values are likely to be extensive and destructive. Coastal and river flooding, snow pack declines, lower summer river flows, impacts to farm and forest productivity, energy cost increases, public health effects, and increased pressures on many fish and wildlife species are some of the effects anticipated by scientists at Oregon and Washington universities.

The State of Oregon has adopted the federal air quality standards from the *Clean Air Act*. These standards fall into two general categories: (1) ambient standards that limit air pollution levels in a given area, and (2) emission standards that apply to direct sources.

The National Ambient Air Quality Standards (NAAQS) are defined as levels of specific air pollutants above which detrimental effects on human health and welfare may result. Pollutants for which ambient air quality standards have been established are known as federal "criteria" pollutants. Since the EPA updated the NAAQS in 1997, there are ambient air quality standards for eight criteria pollutants. Ambient standards are listed in Table 3.3-1 for the criteria pollutants that the proposed project could potentially emit. The standards are expressed in terms of different averaging times; for example, annual, 24-hour, and 3-hour (DEQ 2001). An area that is found to be in violation of NAAQS is called a "nonattainment area." Pollution sources contributing to nonattainment areas are subject to stricter restrictions.

The DEQ requires businesses that release air pollutants to obtain permits to operate. Oregon implements the federal Title V Air Operating Permit Program. Under this program, major

sources of air pollutants require a New Source Review. Major sources are defined as projects with the potential to emit:

- 100 tons per year of any criteria pollutant,
- 10 tons per year of any individual hazardous air pollutant, or
- 25 tons per year of any combination of hazardous air pollutants. Hazardous air pollutants are identified in the Clean Air Act (Amendments of 1990, Title III).

The proposed project is not expected to require a New Source Review because emissions would not exceed these thresholds.

Table 3.3-2 lists the emission standards that apply to direct sources of pollutants.

Table 3.3-1: Ambient Air Quality Standards

Pollutant	Averaging Time	Federal Standard	State Standard
PM_{10}	Annual Average	50 µg/m3	50 µg/m3
	3-year average of 99th percentile of 24 hours	150 µg/m3	150 µg/m3
$PM_{2.5}$	Annual Average	15 µg/m3	15 µg/m3
	3-year average of 99th percentile of 24 hours	65 µg/m3	65 µg/m3
Total Suspended Particulate	Annual Geometric Mean	NA	150 µg/m3
	24 hours	NA	0.08 µg/m3
Ozone	3-year average of the yearly 4th highest	0.08 µg/m3	0.08 µg/m3
Carbon Monoxide	8 hours	9 ppm	9 ppm
	1 hour	35 ppm	35 ppm
Sulfur Dioxide	Annual Arithmetic Mean	0.03 ppm	0.02 ppm
	24 hours	0.14 ppm	0.10 ppm
	3 hours	0.5 ppm	0.5 ppm
Nitrogen Dioxide	Annual Arithmetic Mean	0.053 ppm	0.053 ppm
Lead	Calendar Quarter	1.5 µg/m3	1.5 µg/m3

$\mu g/m^3$ = micrograms per cubic meter.
PM_{10} = particulate matter with median aerodynamic diameter of 10 micrometers or less.
$PM_{2.5}$ = particulate matter with median aerodynamic diameter of 2.5 micrometers or less.
ppm = parts per million.

Table 3.3-2: Significant Emission Rates for Pollutants Regulated Under the Clean Air Act

Significant Pollutant	Emission Rate (tons/year)
Carbon Monoxide	100
Nitrogen Oxides	40
Particulate Matter	25
PM_{10}	15
Sulfur Dioxide	40
Volatile Organic Compounds	40
Lead	0.6
Fluorides	3
Sulfuric Acid Mist	7
Hydrogen Sulfide	10
Total Reduced Sulfide	10

Source: DEQ 2001.
PM_{10} = particulate matter with median aerodynamic diameter of 10 micrometers or less.

Air Quality in the Town of Lakeview

High precipitation aids in maintaining relatively good air quality in the Lakeview area during the winter months. Temperature inversions can occur, however, which trap air pollution near the surface and can lead to poor air quality. Natural sources such as wind-blown dust, pollen, and intermittent forest fires can occasionally contribute to increased levels of pollutants in the atmosphere.

The criteria pollutant of greatest concern in the Lakeview area is PM_{10}. Lakeview was designated to be in attainment with the federal NAAQS for PM_{10} in July 2006 and has since maintained its attainment status (EPA 2009a).

The Town of Lakeview has improved overall air quality with the implementation of several annual programs including a public awareness program, restrictions on open burning, a children's education program, and a woodstove replacement program. The Town has also passed ordinances banning the burning of waste and restricting open burning within town's limits (Town of Lakeview 2009a). Wood burning advisories are also in effect from October 15th through March 31st, when thermal inversions are most likely.

Direct and Indirect Impacts

Drilling and Testing

The proposed project includes drilling of a new production well and injection well and drilling small-diameter monitoring wells. One well would be drilled at a time and would take approximately 30 days to drill. The monitoring wells would take a few days to drill. The drill rig would be powered by a large-bore diesel engine. Table 3.3-3 shows a worst-case emissions scenario for a large-bore stationary diesel engine based on estimated maximum daily fuel consumption at the well pad.

Additional generators and pumps may be required for the project, but these small sources would have a negligible impact on emissions. The emissions from diesel generation would be considerably less than standards, especially because most impacts would only occur for 1 month during drilling. Combustion emissions would be minor.

Table 3.3-3: Estimated Emissions from Large-Bore Diesel Engines

Air Pollutant	Emission Factor (lbs/MMBTU)	Maximum Estimated Emissions				
		Hourly (lbs/hour)	24-hour (lbs/day)	1 Month of Drilling Total Emissions (tons)	2 Months of Drilling Total Emissions (tons)	EPA Standard (tons/year)
Carbon Monoxide	0.085	4.83	115.92	1.28	2.56	100
Carbon Dioxide	165.00	942.08	22,609.92	248.7	497.4	--
Total Organic Compounds (as Methane)	0.09	0.51	12.24	0.14	0.28	40 (VOCs)
Oxides of Nitrogen	3.20	18.27	438.48	4.82	9.64	40
PM_{10}	0.0573	0.33	7.92	0.08	0.16	25
Oxides of Sulfur (as Sulfur Dioxide)	0.0202	0.12	2.88	0.04	0.08	40

a. Values based on the assumption that a maximum of 1,000 gallons of low sulfur (0.02 percent) diesel oil fuel would be used, and that the average heating value of the fuel is 19,300 BTU per pound of fuel with a density of 7.1 pounds per gallon.

MMBTU = million British thermal units.

lbs = pounds.

VOCs = volatile organic compounds.

Source: EPA 1996

Well Drilling Emissions

Overview. Production of geothermal fluid during well testing would result in release of water vapor (steam) and non-condensable gases to the atmosphere. The amount and ratio of the non-condensable gas constituents within the geothermal fluid are variable among geothermal resource areas and can be substantially different among individual wells within the same geothermal project area. The non-condensable gas content typically consists of carbon dioxide (usually accounting for about 95 to 98 percent of the total non-condensable gas content) with smaller amounts of methane, H_2S, and trace amounts of ammonia. Trace amounts of elements such as arsenic, mercury, and boron may be present.

Boron and Arsenic Emissions. Water quality testing of the existing geothermal well fluids in 2007 showed arsenic levels of 1.08 milligrams per liter and boron levels of 1.07 milligrams per liter (Appendix D). The national primary drinking water standard for arsenic is 0.010 milligram per liter (EPA 2009b). There are no primary standards for boron, but the World Health Organization suggests drinking water should contain boron at a rate of no more than 0.5 milligram per liter (WHO 2003). The majority of geothermal well water emissions would occur during well testing and logging. Well testing would involve step tests that would incrementally increase the pumping rate until 250 gallons per minute was reached.

A continuous flow test would be performed following step testing, requiring a constant flow of approximately 200 gallons per minute for 24 hours. Fluid would be discharged into a ditch near U.S. Highway 395, which drains into a nearby field. The constituents in the steam would be dispersed in the air; however, most would remain in the geothermal fluid. Geothermal fluids contain trace amounts of arsenic and boron. Geothermal water from a geothermal exploration well identified as GTX-1, located southeast of the geothermal production well north of the Town of Lakeview, was sampled and analyzed in 2002. Arsenic levels were 0.130 milligram per liter and boron levels were 5.36 milligrams per liter, which is representative of groundwater in the area. A small amount of this arsenic and boron could become airborne and be transported and dispersed by wind away from the well pad and would eventually settle onto the ground. The testing would be short-term (a few days). The amount of time that humans would be exposed to any airborne arsenic or boron would be less than that associated with existing emissions that occur naturally from hot springs and from geothermal water that is currently discharged by other users directly into ditches. Some settling of boron and arsenic would not likely impact water quality because groundwater already contains elevated boron and arsenic and the amount attributed to the proposed project would be de minimis. Emissions would be minor.

Emissions from drilling the monitoring wells would be minor, as the monitoring wells would be relatively shallow (tens of feet deep). Flows from monitoring wells would not be expected.

Hydrogen Sulfide Emissions. The principal non-condensable gas emission of concern anticipated from the geothermal fluid is H_2S. H_2S may be released from a well during drilling, and would be vented with the steam and non-condensable gases during flow-testing. H_2S is a colorless, non-condensable gas with a characteristic “rotten egg” odor. H_2S is

toxic at certain levels and can cause negative human and animal health effects. Exposure to H_2S can cause dizziness, headache, and nausea at 50 parts per million and death from respiratory paralysis at 1,000 parts per million. The Occupational Safety and Health Administration (OSHA) indoor workplace standard for H_2S is 10 parts per million for an 8-hour day (Klingberg 2005). Nuisance odor is of primary public concern because this distinctive odor can be easily detected at concentrations far below levels of health concern. Odor is detectable from about 0.008 part per million.

H_2S is typically encountered during the production zone drilling phase. The existing geothermal wells in the project area suggest a low level of H_2S in the system, evidenced by the presence of sulfates identified in 2007 water samples collected from the existing geothermal wells at the Barry Well Pad site at a rate of 0.630 milligram per liter (where the EPA limit is 250 milligrams per liter for drinking water). H_2S emissions from previously drilled wells in the area did not result in substantial effects as odors from the existing wells can only be smelled within a few feet of the wells.

Federal standards for H_2S emissions are 10 tons per year per project. Total emissions from construction would be far less than 10 tons per year; however, given the potential for odoriferous emissions and potential threat to human health from H_2S emissions, protection measures have been built into the project to reduce H_2S emissions as much as possible. H_2S control would be accomplished through the use of properly weighted drilling mud, which is expected to keep the well from flowing during drilling. H_2S gas that may be entrained in the drilling mud and returned with the drilling cuttings to the solids separation process is expected to be neutralized by the high pH of the mud system. Monitoring devices would be installed and operated during all phases of drilling and testing and a H_2S abatement system would be installed if H_2S is being emitted at a rate higher than 10 parts per million within an 8-hour period, such that workers and others in the immediate area would experience minimal effects. The only residence in proximity to the Barry Well pad site is the Barry Ranch, which is approximately 300 feet away, a distance over which odors would dissipate. With monitoring and abatement, H_2S emissions would be minor. H_2S emissions from drilling of monitoring wells would be minimal.

Greenhouse Gas Emissions and Global Warming. The USDA has not yet developed guidance regarding the discussion and analysis of GHGs and global warming in EAs. GHGs are global pollutants, unlike criteria air pollutants and toxic air contaminants, which are pollutants of regional and local concern, respectively. The most prominent GHGs that have been identified as contributing to global warming are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Emissions of GHGs contributing to global climate change are attributable largely to human activities associated with the industrial/ manufacturing, utility, residential, and agricultural sectors. Transportation is also a large contributor of GHGs, particularly carbon dioxide.

The proposed project has the potential to emit GHGs during drilling. Emissions would be primarily from the diesel generator on the drill rigs. Approximately 250 tons of carbon dioxide equivalent emissions are estimated from drilling for each the production well and injection well. Drilling and testing would not emit carbon dioxide from the resource because

the resource is low temperature and would not emit steam. The overall benefits of the project, however, would help to mitigate drilling emissions because the project would provide energy that may replace fossil fuel energy sources. Fossil fuel combustion-related carbon dioxide accounts for 82 percent of the total U.S. human-made GHG emissions (DOE 2007)

Construction

Fugitive Dust. The primary pollutant of concern during construction activities for the proposed project would be emissions of particulates in the form of fugitive dust. Fugitive dust emissions would be generated by ground-disturbing activities related to transport of workers and equipment to the site and well pad and pipeline construction.

Air quality impacts from construction activities for the well pads and pipelines would be localized and temporary. The well pads would be constructed in previously disturbed areas. Construction sites would require the clearing of surrounding vegetation and the laying down of gravel. Each well pad would disturb an area of approximately 100 feet by 100 feet. Installation of the pipeline would require the removal of vegetation and soils. Trenching for the pipelines would require the removal and/or disturbance of native soils within a 3.4-mile-long by 30-foot-wide construction right-of-way. Fill material would include sand and gravel in addition to the original native soils. No additional excavation would be required for the installation of any of the well pads as no grading would be necessary.

Protection measures included in the project description that require watering and/or otherwise entraining dust on de-vegetated areas would be implemented to minimize any adverse impacts from particulate matter emissions during ground disturbance.

Combustion Emissions. Diesel combustion emissions would be emitted from construction equipment and vehicles used to access the project site. Combustion emissions of criteria pollutants and air toxics (e.g., small quantities of diesel particulate matter at approximately 0.12 ton) would be released during well pad and pipeline construction by diesel-powered equipment. Given the small size of the construction areas and the small fleet of vehicles needed for construction (less than 15), emissions would be minimal and would not contribute to or cause the project to exceed air quality standards.

Greenhouse Gas Emissions and Global Warming. Construction of pipelines would result in the emission of some GHGs, mostly from running equipment engines. The overall project would help to mitigate any construction emissions because it would provide energy that would replace fossil fuel energy sources.

Operation

Project operation would consist of operation of the wells. Emissions of criteria pollutants and other air pollutants from the wells would be minimal. The project should have a beneficial effect on reducing GHG emissions on a global scale.

Air Conformity Analysis

The project is not within any current nonattainment areas and would not exceed any conformity requirements as dictated in the EPA rule, "Determining Conformity of General

Federal Actions to State or Federal Implementation Plans" (40 CFR 93, Subpart B). The project would not contribute to any violation of federal ambient air quality standards.

3.3.2 GEOLOGY

Affected Environment

Tectonics and Geology

The project area is located at the northwest end of the Basin and Range Province. Faults in the project area are shown in Figure 3.3-1. The Basin and Range Province contains north-trending fault-block mountains with basins that drain internally. Lakeview is located at the eastern edge of the Goose Lake basin, a large graben system.

The eastern mountains associated with the graben system are located to the immediate east of Lakeview. These mountains are known as the Warner Mountains and contain tuffaceous sandstones and silt, and volcanic and volcaniclastic sedimentary rocks (EPA Office of Environmental Cleanup 2001). The faults associated with the graben system are known as the Goose Lake Faults. These faults are north-trending normal faults and form fault-related ridges along over steepened mountain fronts of volcanic and volcaniclastic sedimentary rocks (USGS 2009). The latest fault movement probably occurred in the middle and late Quaternary on the eastern graben faults near Lakeview (USGS 2009). The faults parallel U.S. Highway 395 near Lakeview.

The Goose Lake basin contains unconsolidated lake and river silt, sand, and gravel deposits (Town of Lakeview 1988). Gravity and well-log data indicate that the Goose Lake basin may be filled with as much as 5,000 feet of unconsolidated sediment.

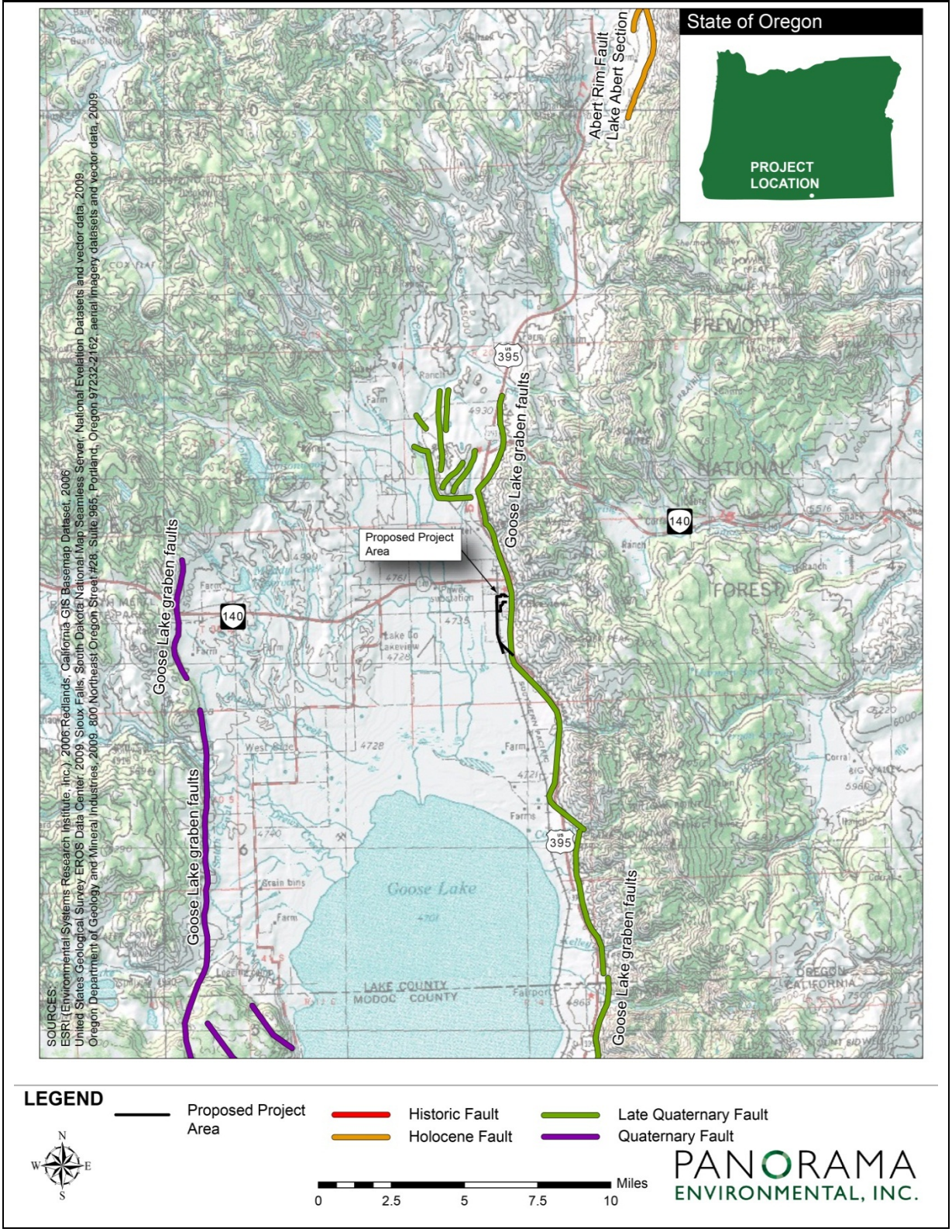
Lakeview, Oregon, was not subject to significant seismicity until 2004. A swarm of earthquakes occurred beginning in June. The first seismic event was detected on June 4, 2004, and six more quakes occurred on June 25. A magnitude 4.4 earthquake occurred on June 30, 2004 (PNSN 2004). Several more earthquakes occurred through December. The earthquakes in the sequence ranged in magnitude from 0.0 (barely detectable by instrumentation) to 4.4 from June to December (UW ESS 2006). These earthquakes were not located on the Goose Lake Fault system. The fault on which these earthquakes occurred either has not yet been mapped, or the fault is not evidenced at the surface (PNSN 2004).

Seismic activity in the area has otherwise been infrequent. The prior largest recorded seismic activity occurred near Adel, Oregon in 1968, approximately 25 miles east of Lakeview. A sequence of earthquakes produced two relatively strong earthquakes (magnitudes of 5.0 and 5.1). It is considered possible and probable that larger earthquakes would occur in the vicinity of Lakeview (PNSN 2004).

Geothermal Resource

The geothermal resource in the Lakeview area is currently used for direct use to the north of the Town for heating in various buildings such as homes in the Goldmohr Terrace and the Warner Creek Correctional Facility (WCCF). The local swimming pool is also heated using geothermal resources as well as greenhouses.

Figure 3.3-1: Fault Systems in the Lakeview Area



The geothermal resource near Lakeview is thought to be associated with the upward migration of hot water along a relatively narrow band of fractures associated with the range-front fault that bounds the Warner Range on the west. Geothermal resources are not found uniformly along the length of the fault trace, but appear to be limited to the intersection of this fault with other geologic structures that combine to form permeable conduits in the bedrock that facilitate upward geothermal fluid migration. At these dispersed areas, the upward-flowing geothermal fluids intersect permeable horizons in the alluvial deposits of the Goose Lake basin and move laterally under the influence of the local hydraulic gradient. The thermal fluids cool with distance from the source fractures as they mix with the cooler groundwater in the alluvial basin and through conductive cooling. The temperature of the resource is estimated to be as high as 300° F based on analysis of water chemistry data using chemical geothermometry techniques, but no wells have achieved these temperatures, nor have they penetrated the geothermal reservoir. The hottest recorded temperatures in the Hunter's Hot Springs area to the north of the Town of Lakeview are in the range of approximately 230°F (Bugenig 2011).

Groundwater is generally being heated along the fault, migrating upward, and then flowing westerly while mixing with colder groundwater in the alluvial deposits of the valley floor. Where the hot water migrates further upward and can be intersected with a well, it provides a good source of hot water for energy needs. Wells 2,000 feet west of the base of the mountains have colder temperatures due to the mixing; hotter water is found directly west or within 1,000 feet of the mountain base (OECDD 2009).

Direct and Indirect Impacts

Drilling and Testing

Tectonics and Geology. Drilling would not impact the tectonics or geology of the area and would not induce seismicity. Induced seismicity in a geothermal system occurs from a process known as effective stress reduction where increased fluid pressure can decrease static friction within the existing rocks and thereby facilitate seismic slip or induced seismicity. Seismicity is triggered on an existing fracture by a pore-pressure increase. In a geothermal field, fluid injection can increase pore pressure locally, if there are local regions of low permeability (Majer 2006); however, drilling a well or using a monitoring well does not change the pore pressure. Monitoring wells are shallow (on the order of tens of feet deep) and would not impact tectonics or geology.

Geothermal Resources. Drilling would occur to depths of 400 to 600 feet to reach the geothermal resource for production and injection. The wells would be cased as they are drilled to prevent contamination. Flow testing may be performed after completion of drilling. The volume of water produced during flow testing would be small in comparison to what is currently drawn from the KGRA for other direct use applications, and would not impact the geothermal resource. The resource is also unconfined and mixes with groundwater. Testing could result in the discharge of approximately 2 million gallons (6 acre-feet) of water, for the production well. The vast majority of the water would percolate back into the groundwater system (90 percent or more). While the volume in gallons of

groundwater in the region has not been calculated, the regional groundwater aquifer is estimated to recharge at 220,000 acre-feet per year. The amount of water withdrawn from testing would be a small fraction of groundwater withdrawn in the area and most would percolate back into the groundwater system with a minimal net loss. Monitoring wells would be much shallower than the geothermal wells and would not require flow testing or use of the geothermal reservoir.

Construction

Tectonics and Geology. Construction of the well pads and pipelines would not affect tectonics or geology in the project region. Construction would require ground disturbance, but is not expected to encounter bedrock. Construction of features such as buildings and pipelines do not induce seismicity because they do not add pressure or change the pressure balance in deep fault systems.

Geothermal Resources. Project construction activities for the well pads and pipelines would occur at the surface and would have no impact on the geothermal resources.

Operation

Tectonics and Geology. The project pipelines and all structures would be constructed to handle the maximum credible earthquake in the project area.

The injection of geothermal fluid back into the geothermal reservoir has the potential to cause microearthquakes[1] due to a pressure buildup at the point of injection. Injection in the Lakeview system would not be under pressure and additional injection wells may be needed to prevent injected water from rising to the ground surface. Induced seismicity has been observed to occur from water behind dams, waste injections, and oil and gas operations. In general, seismicity because of geothermal injection increases as the rate of fluid injection increases. Seismicity is also dependent on the amount of fluid injected into the ground, the increase in pore pressure[2] in relation to the orientation of the stress field, the extensiveness of local faults, and the preexisting excess stress on the local faults (Majer 2006).

Injection would be into the new geothermal water injection well. The injection rate would vary depending on the demand on the direct use system, and would be up to 250 gallons per minute from the proposed project. The new injection well would be designed to handle the maximum flow of the direct use system.

Except for the swarm of earthquake activity in 2004 (prior to the construction of the injection well in 2005), and a swarm in Adel in 1968, seismic activity in the Lakeview region has been minimal. Injection of 250 gallons per minute of additional fluid may slightly increase microseismic activity. The Town of Klamath Falls, located 75 miles west from Lakeview, has an extensive geothermal system, injecting as much as 1,500 gallons per minute with few microseismic events in the last 15 years (see Table 3.3-4).

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[1]. Microearthquakes are earthquakes of magnitude 3 or less.

[2]. Pore pressure is the pressure of fluids in pores of rock, and is exerted on the rock.

Table 3.3-4: Summary of Microseismic Events in Klamath Falls, Oregon

Year	Number of Microseismic Events
1995	1
1997	1
1998	1
1999	2
2002	3
2003	2
2005	1
2007	5

Source: USGS 2008

The likelihood of inducing large or damaging seismic events, however, is low. The proposed injection well would not intercept the Goose Lake Fault, and the injection well would not be deep. It is believed that injection needs to be greater than 3 miles deep to induce significant seismic activity (i.e., earthquakes that cause damage usually of magnitude greater than 4 or 5) (Brommer et al. 2001; Majer 2006). The proposed project is therefore not likely to result in major seismic activity that could cause damage or adverse impacts because the injection for the proposed project would be 500 to 600 feet deep (much less than 3 miles deep) and not near the Goose Lake Fault. Microseismic earthquakes less than 4 or 5 in magnitude do not cause structural damage (Brommer et al. 2001).

Geothermal Resources. The proposed project would tap into the low temperature resource in the Lakeview KGRA. The potential to affect the geothermal resource is minimal due to the small scale of the proposed project.

The heat content at Lakeview is estimated at 6.33 × 1,018 joules (Brown et al. 1981). The direct heating system would utilize 1.21 × 1,013 joules per year, which is approximately 0.00019 percent of the total heat content of the KGRA. It is unlikely that the proposed use of geothermal fluid from the Lakeview KGRA would constitute an adverse impact to the geothermal reservoir in terms of affecting its quality as a geothermal resource for other users.

All spent geothermal water would be returned to the aquifer through injection wells. Injection is not expected to cause an effect on the heat or constituent content of produced water. The proposed injection wells have been sited in order to avoid interference with the heated water at the production wells. The distance required between the wells to prevent interference to the production well is dependent on the hydraulic properties of the geothermal aquifer. Results of pumping tests were used to calculate a spacing of 1,846 feet between the production well and the injection well. This amount represents the required distance to prevent interference. The injection well would also be located downgradient. The

general groundwater gradient is to the west-southwest in the area. Impacts of the additional injection water on water quality in the groundwater aquifer are discussed under 3.3.3. Water Resources.

3.3.3 WATER RESOURCES

Affected Environment

Surface Water Hydrology and Use

Several surface waters in the form of hot springs (which originate as groundwater) and wetlands are found in the project area. Springs and surface waters are shown in Figure 3.3-2. Several springs are located in the direct use system project area, including Cannon Spring, north of the Barry Well Pad site (USGS 1964) and the Barry Ranch hot spring. The closest large body of water to the project site is Goose Lake, located approximately 6 miles south of the direct use system. Several named and unnamed ephemeral streams originate in the mountains to the east of Town and flow westward into the Lakeview area. The pipeline alignment for the direct use system would cross over Deadman Creek, which is one of these ephemeral drainages.

Mean annual precipitation is approximately 16 inches on the valley floor and 32 inches in the Warner Mountains east of Lakeview. Area streams originate from precipitation and

groundwater discharge (e.g., springs), eventually draining into Goose Lake. The lake historically drained to the Pit River, but no longer outflows due to current irrigation practices (ECO:LOGIC 2002). Goose Lake has periodically been dry at several times since the early 1900s (DWR 2003).

Groundwater Hydrology and Use

Lakeview is located in the Goose Lake Valley Groundwater Basin, a down-faulted block that covers an area of approximately 1,100 square miles in Oregon and California. The basin is bounded on the west and east by faults (DWR 2003). The primary water-bearing units in the Oregon portion of the basin are Holocene sedimentary deposits and Pleistocene lava flows. The Holocene sedimentary deposits include lake deposits, alluvium, and alluvial fan deposits with variable water yields. Highly jointed, highly permeable Pleistocene lava flows interfinger with valley sediments, range in thickness from 50 to 200 feet, and generally produce high-yielding groundwater wells (DWR 2003).

Recharge to the groundwater system is estimated at 220,000 acre-feet per year, and originates primarily from precipitation and seasonal cessation of irrigation. Upland recharge areas consist of permeable volcanic rocks (DWR 2003). Regional groundwater flow is likely toward Goose Lake; in the project area, groundwater flow is toward the south-southwest (ECO:LOGIC 2002).

The OWRD maintains a groundwater observation well (LAKE 002424) in Lakeview north of Missouri Avenue. This well was drilled to 800 feet below ground surface (OWRD 2010). Water levels in this well for the past 10 years are listed in Table 3.3-5 below. Groundwater levels have varied by as much as 20 feet seasonally (Morgan 1988).

Figure 3.3-2: Surface Water Features in the Project Area

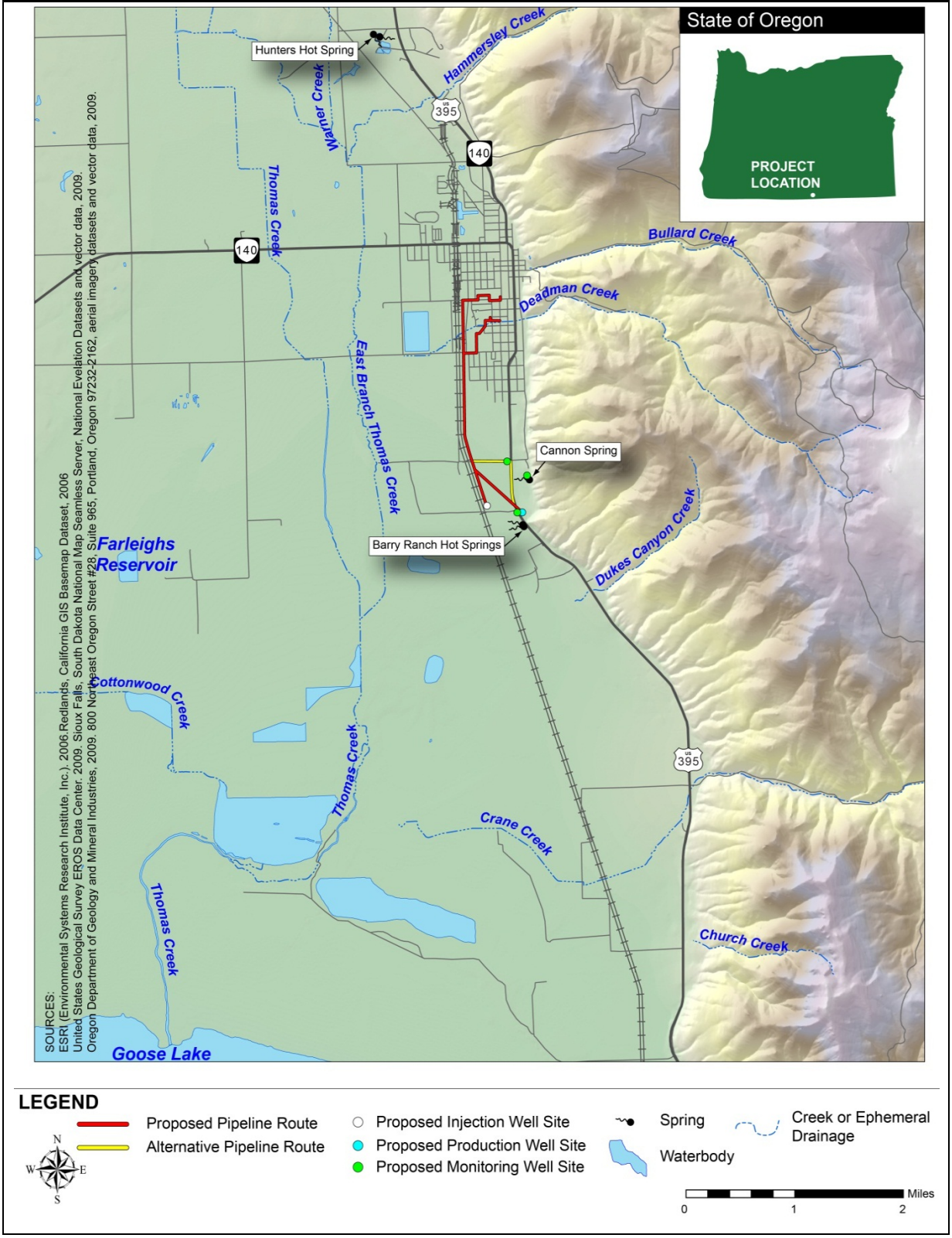


Table 3.3-5: Groundwater Levels in Groundwater Well LAKE 002424	
Date[a]	**Groundwater Level (depth to water in feet below ground surface)**
December 3, 2009	25.92
September 3, 2009	27.62
June 3, 2009	17.92
February 24, 2009	21.71
December 2, 2008	27.28
August 26, 2008	27.18
June 10, 2008	17.92
November 16, 2007	30.78
August 29, 2007	34.02
June 14, 2007	18.6
March 7, 2007	17.3
April 17, 2006	17.8
February 16, 2006	20.58
November 14, 2005	25.75
August 18, 2005	22.65
June 21, 2005	14.2
April 6, 2004	17.62
November 18, 2004	26.04
August 18, 2004	28.8
May 18, 2004	14.83
February 18, 2004	18.57
November 24, 2003	25.81
August 12, 2003	27.55
May 15, 2003	16.73
February 13, 2003	20.67
November 18, 2002	26.63

Table 3.3-5: Groundwater Levels in Groundwater Well LAKE 002424	
Date[a]	**Groundwater Level (depth to water in feet below ground surface)**
August 14, 2002	27.39
May 14, 2002	16.3
February 22, 2002	20.79
November 15, 2001	34.54
August 20, 2001	35.51
May 22, 2001	18.81
February 19, 2001	20.26
November 16, 2000	25.43
August 14, 2000	27.4
May 17, 2000	14.57
February 28, 2000	18.63

Source: OWRD 2010.

a. Dates were chosen from around the same time of year to have comparable seasonal data.

Permitted withdrawals from the basin in 1985 totaled 63,000 acre-feet (ECO:LOGIC 2002). Most well water in the basin is obtained from the top 800 feet of valley fill deposits. Wells in the area have a large range of yields (from a few gallons per minute to 4,000 gallons per minute) (ECO:LOGIC 2002).

The exploited geothermal resource in the project area is relatively shallow and not separated from the groundwater in many places. Use of the geothermal resources is discussed below.

Geothermal Resource Uses

Hot Springs. A shallow (i.e., 38 feet below ground surface) geothermal well drilled in 1923 known as "Old Perpetual" is located at Hunters Hot Springs, located north of the Town. This well erupts as a geyser every 90 seconds on average, but ceases to erupt in summer months when area water levels decrease due to irrigation practices (ECO:LOGIC 2002). Hunters Hot Springs Resort is a private resort that includes a hot mineral water pool that uses water pumped from spring pools. The resort pools were historically supplied with hot water from a well located to the northeast of the greenhouses, and piped to the property until the pipeline failed either due to corrosion or plugging by precipitation.

Cannon Spring is located approximately 0.5 mile north of the Barry Wells Pad site. Cannon Spring supplied hot water to a bath house beginning in the 1920s through the 1940s.

Currently, the spring is not used for recreation, and the spring water flows into and out of a concrete vault and drains into a field down the hillside, feeding the local wetlands.

Local Direct Use Systems. The Bureau of Land Management/U.S. Forest Service (BLM/USFS) inter-agency building operates on a direct use system, which is located less than 1 mile north of the proposed production well. The inter-agency building system discharges effluent to the surface as it does not have an injection well.

The regional geothermal resource is currently used for several heating systems. There are over 17 wells north of the Town of Lakeview, most less than 1,000 feet deep, that use a resource with a temperature less than 250°F (Rafferty 2005). The Town currently has a water rights permit from the OWRD for the Barry Well.

Geothermal uses in the project area are shown in Figure 3.3-3.

Figure 3.3-3: Geothermal Uses Near the Project Area

SOURCE: Eco Logic 2009, U.S. Geological Survey, EROS Data Center, Sioux Falls, SD 2009, and RMT Inc. 2009

Geothermal Aquifer Conditions. The proposed production well for the direct use system is located close to the fault range. The borehole for Well B fully penetrated the alluvial deposits in the area and appears to have intercepted the fractures associated with the range-front fault that likely serves as a conduit for upward movement of the geothermal fluid. The well was constructed with blank well casing and a grout annular seal through the alluvial deposits and is completed so as to derive geothermal fluids directly from the consolidated rocks and not the overlying alluvial aquifer.

Geothermal Use Regulations. The State of Oregon has not enacted many regulations regarding the operation of direct use geothermal systems. Geothermal well drilling and construction is regulated and permitted as normal groundwater use. Drilling a geothermal well that has a temperature of less than 250°F requires a start card and a well completion report that must be submitted to the OWRD. Wells with a temperature greater than 250°F are under the control of the Oregon Department of Geology and Mineral Industries. In both cases, a drilling log must be completed and filed with the OWRD after the well has been drilled.

Water Quality

Surface and Groundwater. Surface water originating in local streams to the east of the project area is of better quality than average due to the lack of industrial and agricultural operations to the east. The Town of Lakeview does not treat its stormwater.

Groundwater quality is generally good in the Lakeview area, as it provides drinking water for most of the residents. Naturally occurring iron and manganese have been known to create problems in drinking water systems. Water analysis for the Town of Lakeview's potable water supply is presented in Table 3.3-6. The groundwater contains H_2S and the Town's drinking water has a distinct "rotten-egg" odor.

Goose Lake Valley Groundwater Basin water is generally classified as calcium bicarbonate type. Geothermal waters associated with fault zones east of Goose Lake contain elevated concentrations of the total dissolved constituents sodium, fluoride, and boron (DWR 2003).

Geothermal Water. The quality of the geothermal water in the immediate project area is unknown. The quality of water from the Town's direct use geothermal system north of the Town of Lakeview contains noticeably raised amounts of some dissolved solids (i.e., arsenic and fluoride) and is not a suitable drinking water source without treatment. Table 3.3-7 lists the concentrations of constituents with primary and secondary maximum contaminant levels in the groundwater sample collected from the geothermal well to the north of the Town. The constituent concentrations are anticipated to be similar in the proposed project area.

Water Quality Regulations

Potable water in Lakeview is regulated by the Oregon Department of Human Health Drinking Water Program (pursuant to the *Oregon Drinking Water Quality Act*) and EPA's *Safe Drinking Water Act*. The State of Oregon has the responsibility for enforcing the *Safe Drinking*

Table 3.3-6: Water Analysis for the Town's Potable Water Supply		
Analyses	**Result**	**EPA Limit**
Alkalinity	144 mg/L	NL
Color	40 color units	15 color units
Specific Conductance	336 μmhos/cm	NL
Chloride	15.8 mg/L	250 mg/L
Fluoride	0.599 mg/L	2 – 4 mg/L
Sulfates	0.630 mg/L	250 mg/L
Hardness	7.43 mg/L	250 mg/L
Aluminum	0.0685 mg/L	0.05 – 0.2 mg/L
Calcium	2.24 mg/L	NL
Copper	0.0370 mg/L	1.3 mg/L
Iron	0.227 mg/L	0.3 mg/L
Manganese	0.0645 mg/L	0.05 mg/L
Nickel	ND	0.1 mg/L
Silver	ND	0.1 mg/L
Zinc	ND	5.0 mg/L
Langelier Index	0 – 0.49	>Negative value
MBAS	ND	0.5 mg/L
Odor	1.6 T.O.N.	3 T.O.N.
pH	8.53	5.5-8.5
Total Dissolved Solids (residue, filterable)	207 mg/L	NL
Total Solids	282 mg/L	500 mg/L

Source: Neilson Research Corporation 2008.

mg/L = milligram(s) per liter; ND = non-detectable; NL = no limit; T.O.N. = threshold odor number.

Table 3.3-7: Constituents in Geothermal Well North of Town of Lakeview

Analysis	Concentration	Primary Drinking Water Standard	Secondary Drinking Water Standard
Total Dissolved Solids	640 mg/L	-	500 mg/L
Arsenic	0.130 mg/L	0.010 mg/L	-
Boron[a]	5.36 mg/L	-	-

Source: ECO:LOGIC 2002; EPA 2008, 2009c.

a. Boron is currently a "Chemical Contaminant Candidate."

Water Act. The EPA and the State of Oregon annually agree on water quality activities to be completed with federal grant money (State of Oregon 2007).National Primary Drinking Water Regulation maximum contaminant levels are enforceable federal standards for public water systems derived from EPA regulations. Secondary maximum contaminant levels are derived from the National Secondary Drinking Water Regulations and are not enforceable, but the EPA recommends adherence to secondary standards. The secondary guidelines help to avoid contaminants that could potentially lead to cosmetic or aesthetic effects.

Direct and Indirect Impacts

Drilling and Testing

Surface Water Hydrology. Drilling would be required for the new direct use system production well at the Barry Well Pad site, for the new injection well, and for monitoring wells. Drilling mud would be contained at the drilling location for each new well, temporarily stored on site, and removed from the site by trucks for off-site disposal. A reserve tank would be located adjacent to the drilling site and would contain drilling mud to be reused in the drilling process. Shaker screens and mud pumps would be included in the tank unit. Reserve tank waste would be sampled for hazardous contaminants before disposal at an appropriate landfill. Rock cuttings and other solid material from the well bore would be separated out by shakers, and the cuttings would be sampled for hazardous waste constituents and disposed of at an appropriate landfill. No discharge of drilling mud to surface waters is anticipated during drilling, and no adverse impacts are expected.

The new production well for the direct use system would require flow testing. During flow testing, water would be discharged into the ditch next to U.S. Highway 395 (shown in Figure 2.1-4), and would eventually drain into the field across U.S. Highway 395. This ditch currently conveys the natural hot spring discharge in the area and has sufficient depth and width to contain the flows from testing. The appropriate permits for this discharge would be obtained from the DEQ. Discharge volume is expected to be about 370 gallons per minute for a duration of 4.25 days (36 hours of developmental pumping, 6 hours of step test pumping, and 24 hours of constant-discharge pumping). Best Management Practices (BMPs) such as erosion control blankets and flow dissipation devices would be used to minimize erosion and scour that could be caused by the discharge during pumping tests. As much as 6 acre

feet gallons of water could be pumped from the production well. The water would ultimately flow to the existing hot spring area just south of the Barry Ranch. If testing is conducted in the winter, it may be necessary to convey the discharge beyond the highway to prevent impairing visibility due to the vapor cloud that would be expected to form in cold air. Appropriate permissions from property owners would be obtained prior to release of fluid directly on private land. The new injection well would also require flow testing, which would also be discharged to a nearby ditch and flow to the same wetlands to the south of the Barry house, ultimately percolating back into the groundwater system. As much as 6 acre feet of water could also be produced from the injection well during testing. No impacts associated with scour or erosion are anticipated as the ditches are vegetated. Flow dissipation devices would be used as necessary. Discharge would be timed so that it does not coincide with rain events to prevent flooding. No water quality impacts are anticipated since the wetlands are naturally fed by geothermal springs with similar temperature and quality water.

Monitoring wells would be relatively shallow and would not be flow-tested.

Groundwater Hydrology and Use. The drilling of new wells for the direct use system and monitoring wells would not adversely impact groundwater hydrology. During drilling, up to 20,000 gallons of fresh water would be needed per day (approximately 14 gallons per minute). A 10,000-gallon water truck would remain on site for storage of water and emergency use. Additional water may also be required to dilute testing water for the 4.25-day testing period. The water would be obtained from the Town of Lakeview municipal system or other groundwater providers with the appropriate entitlements to sell the water. This water is well within the Town's capacity; therefore, minimal impacts are expected.

Water Quality. Drilling and testing are not expected to impact water quality. The production and injection wells would be cased and blowout-prevention equipment would be installed to minimize the potential for blowouts (uncontrolled discharge from the aquifer during drilling) or contamination of the shallow aquifer.

Flow testing would be required for both the production well and new injection well, as previously described. The temperature of the water produced during testing is expected to be from about 187 to 200°F. Water of similar temperature and quality naturally occurs in the area.

The new geothermal injection well would also require testing. About 6.1 acre feet of water would also be produced from the injection well. It is anticipated that the water pumped from the well during development and testing would be discharged to the land surface and would ultimately return to the aquifer through infiltration. The areas where The temperature of the water produced from the injection well would be lower than that discharged from the production well by an estimated 50°F.

To ensure that water quality effects would not occur from well flow testing for any of the tested wells, the water produced would be tested for constituents such as arsenic, boron, bicarbonate, and total dissolved solids. If constituent concentrations are significantly higher in the produced water than is naturally occurring in the receiving water, an alternative

method of disposal would be used. The alternative method could include storage and disposal at a wastewater acceptance facility, or dilution prior to discharge. The temperature of the water would also be tested and would only be discharged when it is no higher than 5°F above the existing hot springs' water temperature. Detention (such as in a tank) or dilution may be used to adjust water temperature. With implementation of these measures, adverse effects to water quality from discharges during flow testing would be minimized.

Construction

Surface Water Hydrology. Construction of the direct use system includes construction of the well pads and pipeline. Construction activities could result in temporary changes to surface water hydrology in areas where fill may be needed and in areas where excavation would be needed for installation of underground components (e.g., pipelines). Material excavated for installation of pipelines would be stockpiled, replaced, and then graded and contoured to its original condition to prevent permanent changes in surface water hydrology. Erosion of loosened soil may also occur as a result of construction of the proposed project. Areas that were vegetated prior to excavation would be re-vegetated and compacted to reduce erosion and siltation such that adverse effects would be minimal.

The two crossings of Deadman Creek and the associated wetlands and riparian areas would be constructed by hanging the pipeline on the existing trestle of the existing bridge and by jacking and boring under the creek, avoiding all direct impacts to surface waters.

Groundwater Hydrology and Use. Construction would occur on the surface and would not impact groundwater hydrology or groundwater use. The construction phase of the project would use the municipal water supply, and, therefore, would not impact groundwater.

Water Quality. The total area of ground disturbance (not including disturbance of pavement in the parking lot) is greater than 1 acre. A general construction National Pollutant Discharge Elimination System (NPDES) permit would be required for this project. Enrollment under this general permit would be applied for immediately prior to construction.

Stormwater runoff could become contaminated with petroleum fuel, oil, or grease from construction vehicles and equipment and from drilling mud and fluids. Contamination of stormwater runoff at the drilling pad would be minimized through drainage and collection of runoff in the reserve tank. Contamination along the pipeline corridor would be minimized through the containment of any spills before mixing occurs with stormwater runoff. The Town of Lakeview would implement an SPCC plan on site to contain incidental drips and/or spills. Containment berms would be constructed around all hazardous material or potentially hazardous material storage for both construction and operation.

Effects to water quality from construction of the proposed project elements would be negligible.

Operation

Surface Water Hydrology. Drainage patterns would be largely unchanged after construction except for a slight increase in surface water runoff due to soil compaction and removal of

vegetation from the well and pipeline locations. Adverse effects to surface water hydrology would be minimal.

Impacts to thermal springs that manifest at the surface and wetlands are discussed below under "Groundwater Hydrology and Use" even though these are surface waters because these originate from the discharge of groundwater.

Groundwater Hydrology and Use. The project has the potential to impact groundwater and surface manifestations of groundwater in the form of thermal springs and wetlands in the project area. The effects are discussed below. Additional support data on groundwater pumping effects is presented in Appendix E.

Operation of the direct use system could impact the groundwater and thermal spring discharges in the area. All geothermal water withdrawn would pass through the direct use system and would be injected back into the aquifer with no net loss of groundwater. Even though all geothermal water would be returned to the aquifer, the proposed project would increase geothermal water pumping in this area. Natural hot springs and other springs occur nearby (see Figure 3.3-3). The following are users of the geothermal resource in the project area:

- Cannon Spring has an average temperature of 154°F and is located approximately 1,800 feet north of Well A, at the base of the range front. The spring flow represents surface discharge of geothermal fluids flowing upward along the range-front fault.
- Diffuse spring discharge also occurs west to southwest of the production well site where the piezometric head (pressure at which water flows) in the aquifer is at or above the land surface (Barry Ranch hot springs).
- The BLM/USFS inter-agency building operates on a direct use system, which is located less than 1 mile north of the proposed direct use system production well. The BLM/USFS system does not include re-injection of the geothermal fluid.

Well B on the Barry Well Pad site was constructed to derive groundwater from fractured rocks and Well A (the well that was used for injection testing) was completed in the basin fill deposits. Likewise, the proposed injection well would be completed in the basin fill deposits. The test of Well B suggests the fractured rocks are less permeable than alluvium at this locale.

The potential changes in water level in the geothermal aquifer in the direct use system area arising from pumping and injection were evaluated using the computer program QTESOLV® Pro for Windows® version 4.50.13[3]. The analytical model (OECDD 2009) invoked for this analysis represents a very simplistic view of the geothermal aquifer. It was derived for porous media, not fractured rocks; however, the observed water-level data collected from the

[3]. Registered by HydroSOLVE, Inc., Reston, Virginia. Protected from 1996 to 2009.

existing wells (Well A and B), in particular, the late-time data, could be simulated reasonably well using the method, suggesting that the aquifer is sufficiently fractured to behave as an equivalent porous medium and that there is good hydraulic communication between the alluvium and the fractured rocks. The monthly pumping and injection rates for the analysis are shown in Table 3.3-8 for the first year of the simulation, followed by continuous pumping at the average rate. Injection rates are assumed to mirror the pumping rates such that none of the geothermal fluid is consumed.

The results of the analytical simulation to predict changes in localized groundwater levels in the geothermal aquifer are depicted in Figure 3.3-4.

The drawdown in the geothermal aquifer at the Barry Well Pad site is expected to be in the range of 60 feet or less, under the influence of pressure support from the injection well. Water levels in the pumped well approach a steady-state condition relatively quickly as the effect of pressure support from injection extends to the fractured rock aquifer near the production well. Drawdown approaching approximately 2.5 feet is anticipated for Cannon Spring during peak pumping periods. During low heat demand periods, drawdown at Cannon Spring can be expected to be less than 1 foot. On average, drawdown at Cannon Spring is expected to be less than 2 feet. For the spring discharge area southwest of the production well, drawdown in the range of 7.5 feet is anticipated during periods of peak demand, decreasing to less than 1 foot during periods of low heat demand.

There are currently no data from which to develop head-discharge relationships for either Cannon Spring or the Barry Ranch hot springs south of the production well site. These data cannot be collected until the well is drilled and pumped. Over the long term, it is expected that the spring discharge would diminish. Due to its location, the production well would be expected to capture geothermal fluid flux that discharges as spring flow. The project includes installation of additional monitoring wells, as determined in coordination with a qualified hydrogeologist, and development of a surface water augmentation plan to discharge an appropriate quantity of the geothermal well discharge at the spring locations to offset any reduction in natural spring discharge. The plan includes providing water of similar temperature and water quality, if necessary, and acquisition of all necessary permits. With implementation of these measures, effects would be minimized. Preparation of the groundwater monitoring and mitigation program is underway. Plans for this program will be submitted for USDA approval prior to initiation of construction of the geothermal direct use system.

One geothermal well user has been identified near the direct use system. The BLM/USFS inter-agency office uses a direct use geothermal system, with a well located 4,700 feet north of the proposed production well. The effects to the BLM/USFS well were modeled (Appendix E). The potential for the project to impact water levels in the BLM/USFS well was examined using the same analytical model used to assess the potential effects on the springs. The results of the analysis indicate that the BLM/USFS well may experience approximately 0.3 foot or less of interference drawdown due to the project, but it is unlikely the effect would be measureable and, therefore, would not be considered adverse.

Table 3.3-8: Predicted Monthly Well Discharge for the Direct Use System	
Month	**Monthly Projected Well Discharge (million gallons)**
January	11.00
February	9.00
March	7.80
April	5.20
May	3.00
June	0.50
July	0.50
August	0.70
September	4.00
October	7.00
November	8.60
December	11.00
Annual Total (million gallons)	68.30
Average (gallons per minute)	129.95

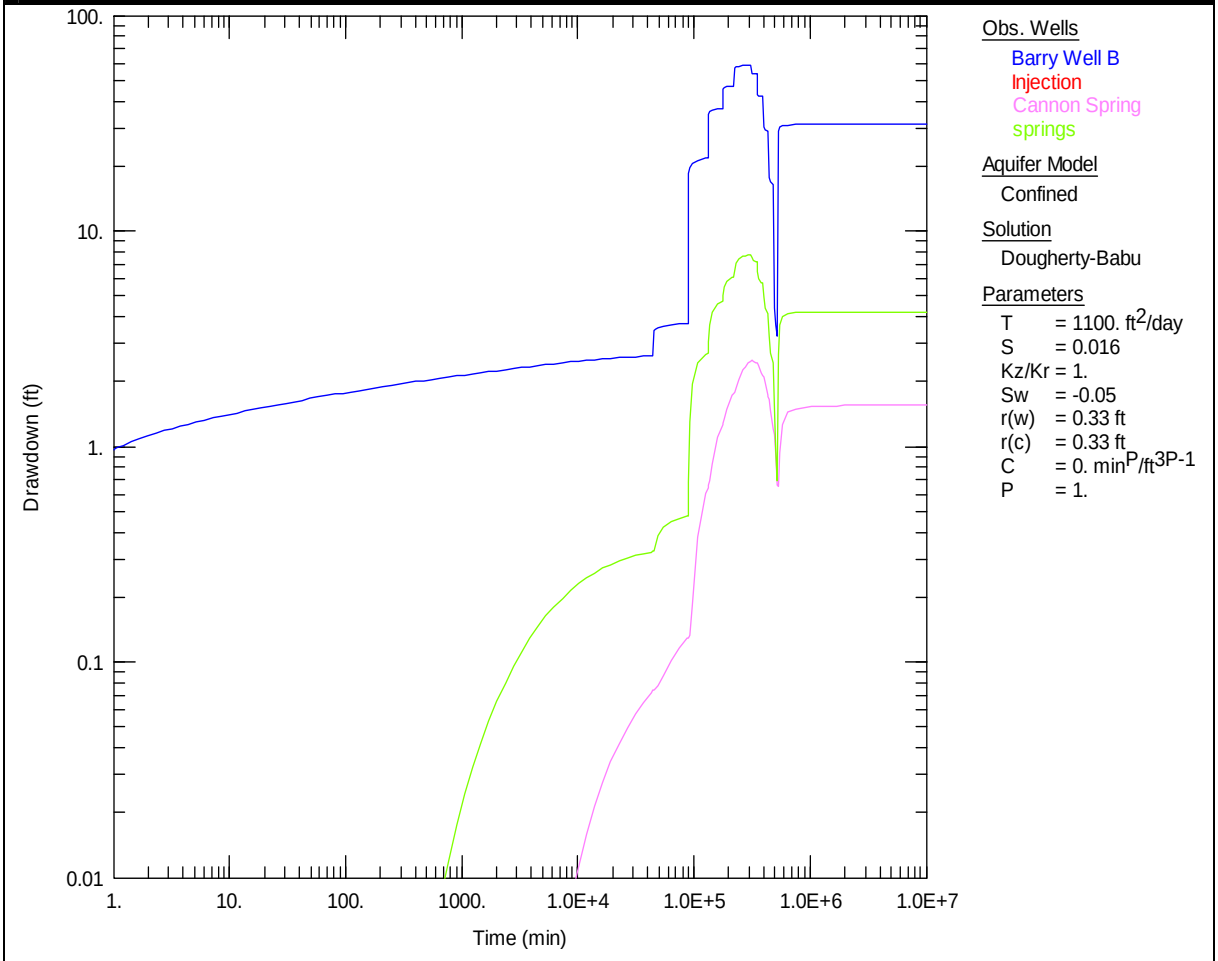
Source: OECDD 2009.

Note: Monthly injection rates are equal to the pumping rates.

Water Quality. Injection would be designed such that the chemistry of injectate would be similar to that in the groundwater/geothermal aquifer so as not to foul the system or affect groundwater quality in the area.

There is a potential for surface water quality to be affected by injection through changes in water chemistry. There are no well-defined impermeable layers in the area that would prevent the injected fluid from reaching the land surface. Fine-grained sediments in the aquifer slow, but do not prevent, vertical movement of groundwater. The proposed injection well for the direct use system, therefore, would need to be completed with perforations starting no higher than approximately 150 feet below ground surface in the well casing to minimize the potential for injected fluid to migrate to the surface and to minimize effects.

Figure 3.3-4: Predicted Water-Level Changes in the Geothermal Aquifer for the Proposed Project



Definition of Parameters:

T – aquifer transmissivity

S – aquifer coefficient of storage

Kz/Kr – ratio of aquifer vertical hydraulic conductivity to horizontal hydraulic conductivity

Sw – wellbore skin

r(w) – well radius

r(c) – casing radius

C – well loss coefficient

P - well loss exponent

Source: Eco:Logic 2009

3.3.4 BIOLOGICAL RESOURCES

Affected Environment

Federal Regulations

Endangered Species Act. Federal law requires that all federal departments and agencies shall use their authority to conserve endangered and threatened species as defined in FESA. FESA defines as "endangered" any species that is in danger of extinction throughout all or a significant portion of its range, and as "threatened" any species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Two other special-status categories are recognized under FESA: (1) proposed for listing as threatened or endangered and (2) species of concern. Proposed endangered and threatened species are those species for which a proposed regulation has been published in the Federal Register, but not a final rule. "Species of Concern" is the current designation of species formerly identified as "candidate" for listing in the Federal Register.

Section 9 of FESA prohibits the "taking" of listed species. Under Section 7 of FESA, federal agencies are directed to consult with the USFWS to ensure that no agency actions would jeopardize the continued existence of any listed species or result in the destruction of critical habitat. FESA requires formal consultation only for those species currently listed as threatened or endangered, USFWS recommends that adverse impacts on species proposed for listing and species of concern also be considered because they may become listed during the design and construction phases of a project.

The Bald Eagle Protection Act. The *Bald Eagle Protection Act* provides federal-protection to the bald eagle, and through amendments, to the golden eagle. The act prohibits the direct or indirect take of an eagle, eagle part or product, and nests.

Migratory Bird Treaty Act. The *Migratory Bird Treaty Act* prohibits the killing of any migratory bird without a permit. With a few exceptions, most birds are considered migratory under the *Migratory Bird Treaty Act*. The act protects migratory birds and their nests.

Clean Water Act. The federal *Clean Water Act* regulates fill in all wetlands, streams, lakes, and other waters of the United States. Jurisdictional determinations and permitting are handled by USACE under Section 404. Wetlands and waters of the United States often provide habitat for sensitive biological species.

State Regulations

The State of Oregon Division of State Lands regulates fill and removal permits for stream crossings, which are coordinated with USACE. The DEQ regulates potential water quality impacts from projects in the state under section 401 of the *Clean Water Act*. Streams often provide habitat for sensitive biological species.

The *Oregon Endangered Species Act* provides protection for species that are state listed. Species listed as "endangered" are at risk of extinction from all or some of their current range in the foreseeable future. Species listed as "threatened" are at risk of becoming endangered in the foreseeable future. Species with "critical" status are species that would be listed as threatened or endangered if immediate actions of conservation are not taken. Species with

"vulnerable" status do not require conservation efforts to prevent from becoming endangered; however, they could gain a "critical," "threatened," or "endangered" status if there are changes in habitat, threats, or populations. Species with "undetermined" status are species for which a status is unclear. Additional information would be needed to make a determination. Species that are "not listed" do not have special-status under the *Oregon Endangered Species Act*.

Town of Lakeview Regulations

The Town of Lakeview regulates high-quality wetlands found within the town limits (Foster pers. comm. 2009). Wetlands that are prioritized under Town guidelines are those that have unique features, such as hot springs, and those that perform important functions, such as high quality habitat. The wetlands in the project area have unique functions as hot springs.

Methods

Background information on biological resources in the vicinity was reviewed before surveying the site. Background informational resources include:

- Adolphson Associates, Town of Lakeview Local Wetlands Inventory (Adolphson 2003).
- Franklin, Jerry F. and C. T. Dyrness, Natural Vegetation of Washington and Oregon (Franklin and Dyrnes 1988).
- California Natural Diversity Database (http://www.dfg.ca.gov/biogeodata/cnddb/) June 2009.
- Oregon Natural Heritage Information Center (ORNHIC). Data search for rare, threatened, and endangered species (ORNHIC 2009).
- USFWS. Federally listed, proposed, candidate species and species of concern for Lake County Oregon (USFWS 2009 and USFWS 2012).
- Proposed geothermal line location maps, Lakeview, Oregon.

The site was visited by an RMT, Inc., biologist from June 24 to 26, 2009. The project area was traversed on foot and observations were made of flora, fauna, and habitat features. Observations of indicators of surface water hydrology and of the presence of hydric soils were recorded and the project site was photographed. The locations of potential waters of the United States were mapped with a Trimble Geo XT GPS unit and by mapping features on aerial photographs; however, a formal wetland delineation was not prepared. Results of these field observations are presented in the following sections.

Protected and sensitive species that could occur in the project area were identified through literature searches. Ground surveys were conducted to characterize the vegetation communities and habitats and to map the wetlands. The alternate pipeline segment route has not been surveyed; however, the habitats and type of species are anticipated to be the same along this route as the rest of the project.

Vegetation

General Vegetative Communities. The proposed project area is located within the Sagebrush (*Artemisia tridentata)* region of the Basin and Range physiographic province of southeastern Oregon (Franklin and Dyrness 1988). This project area is within both an urbanized area and the surrounding rural landscape. The general vegetative communities are shrub steppe, emergent wetland, scrub-shrub wetlands and riparian areas, and urbanized landscapes.

The general region includes extensive wetlands and numerous creeks. The wetlands are fed by both runoff from nearby mountains and the hot and cold springs that are found in the area. The project area is bisected by Deadman Creek and a tributary of Warner Creek.

A summary of the dominant vegetation in each plant community is presented below:

- **Shrub steppe community:** sagebrush(*Artemisia tridentata*), bitterbrush (*Purshia tridentata*), gray rabbitbrush (*Chrysothamnus naseosus*), and grasses and forbs such as crested wheatgrass (*Agropyron desertorum*), basin wildrye (*Elymus cinereus*), and creeping thistle (*Cirsium arvense*).
- **Emergent wetlands**: creeping spikerush (*Eleocharis palustris*), inland saltgrass (*Distichlis spicata*), fox-tail barley (*Hordeum jubatum*), reed canary grass (*Phalaris arundinacea*), soft rush (*Juncus effusus*), and western dock (*Rumex occidentalis*).
- **Scrub-shrub wetlands and riparian areas:** Pacific willow (Salix lasiandra) and coyote willow (*Salix exigua*).
- **Urbanized landscapes**: nonnative ornamental vegetation, including blue spruce (*Picea pungens*), poplar (*Populus sp.*), Oregon apple (*Malus fusca*), and pine (*Pinus sp.*), areas of lawn and ruderal vegetation, parking lots, school yards, the railroad bed, and both paved and unpaved roads.

Invasive Vegetative Species. The Oregon Department of Agriculture leads statewide efforts to control state-listed noxious weeds. Noxious weeds were not observed in the area near the hospital and schools or in the large wetland areas. Noxious weeds may occur along the railroad bed, roadside ditches, and other disturbed areas.

Wetlands and Other Waters of the United States

Numerous palustrine emergent (shallow freshwater) wetlands and Deadman Creek are found on the project site. These wetlands total approximately 7 acres in size. The most extensive palustrine emergent wetlands are in the vicinity of the proposed geothermal water injection well. These wetlands are fed by surface water runoff and groundwater discharge from the numerous springs and seeps in the area. Additional palustrine emergent wetlands are found along the railroad bed; these typically form in borrow areas that were created during construction of the railroad bed.

Riverine scrub-shrub wetlands were observed along Deadman Creek. These wetlands are supported by the flows in this seasonal creek and are dominated by willow shrubs.

Deadman Creek was historically a tributary of Thomas Creek and it has the potential to support fish species.

Wildlife

The Goose Lake basin, in which Lakeview is located, is home to a wide variety of fish, birds, mammals, and herptile species.

The basin has eight native fish species, five of which are expected to occur in Warner and Deadman Creeks (Hurn pers. comm. 2009). These are the redband trout (*Oncorhynchus mykiss* pop. 6), two species of lamprey (*Lampetra sps.),* Tui chub (Gila bicolor thalassina), and the Pit roach (*Lavinia symmetricus mitrulus*).

The Goose Lake basin is also an important location for bird breeding and migration. A variety of waterfowl, shorebirds, and other avian species dependent upon wetlands were observed in the vicinity, including red-winged blackbird (*Agelaius phoeniceus*), common snipe (*Gallinago gallinago*), Canada goose (*Branta canadensis*), glossy ibis (*Plegadis falcinellus*), black-necked stilt (*Himantopus himantopus*), willet (*Tringa semipalmata*), and sandhill crane (*Grus canadensis*). Upland birds observed were mourning dove (*Zenaida macroura*), raven (*Corvus corax*), western meadowlark (*Sturnella neglecta*), California quail (*Callipepla californica*), American robin (*Turdus migratorius*), American crow (*Corvus brachyrhynchos*), and killdeer (*Charadrius vociferus*).

Mammals observed in the area include Belding's ground squirrel (*Spermophilus beldingi*), desert cottontail (*Sylvilagus audubonii*), pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), and coyote (*Canis latrans*). Ground squirrels are burrowing mammals that may provide burrows for use by burrowing owls, and are also potentially important prey species for hawks and other raptors.

The proposed project area may support herptiles, although none were observed during surveys. Species that may occur in the vicinity are the western toad (*Bufo boreas*), western fence lizard (*Sceloporus occidentalis*), and gopher snake (*Pituophis melanoleucus*). Generally, herptiles would not be found in the immediate project area due to the level of disturbance in the area and lack of habitat and cover.

Protected and Sensitive Species

Several protected and sensitive species were identified for the project area. These species were compiled from two sources. USFWS maintains a list of endangered, threatened, and candidate species as determined under FESA. A query under Section 7 of FESA was made to determine what species could occur in the project area in 2009 and then again in 2012. The ORNHIC maintains a list of rare, threatened, and endangered species as determined by the State of Oregon under the Oregon Endangered Species Act. The ORNHIC list was also queried. Potential for occurrence was determined based on an evaluation of the type of habitat (or lack of habitat) at the project site. Only one federally threatened or endangered species would occur in the project area, the Modoc sucker in Deadman Creek. The project would not impact the creek and therefore would not impact the species. A letter was provided to the USFWS on October 1, 2010 identifying the results of the Section 7 query and

requesting concurrence that no threaten or endangered species would be impacted by the project. A concurrence finding of No Effects to threatened and endangered species was received on October 22, 2010. The correspondence and concurrence letter are provided in Appendix B. Since 2010, two new species have been added to the candidate list, Greater sage grouse and North American wolverine (in addition to Columbia spotted frog). None of these species are anticipated to be found in the project area due to a lack of habitat. Sage grouse may fly over the area; however, known sage grouse core areas are found approximately 10 to 12 miles to the east of the project area within the Warner Basin (ODFW 2011). The Warner Basin is separated from the Goose Lake basin by the Werner Mountains. The project site also does not include abundant open sagebrush habitat required for sage grouse. A new letter to requesting a concurrence of No Effects has been provided to USFWS.

ORNHIC List One includes species that are threatened with extinction or presumed extinct from all previously known habitats. List Two includes species that are threatened with extinction or presumed extinct from the state of Oregon. List Three contains species that may be endangered or threatened; more information is needed to make a definite finding. List Four contains species that are not endangered or threatened, but are a conservation concern.

Table 3.3-9 lists all of the species with potential to occur on site.

Direct and Indirect Impacts

Drilling and Testing

Vegetation and Wetlands. The geothermal production and injection wells would be located on previously disturbed areas of pasture grasses and forbs. Any new monitoring wells would also be sited on previously disturbed areas. Table 3.3-10 summarizes the acreage of impacts to wetlands and other vegetated habitats from the proposed project. Monitoring well disturbance is currently unknown; however, it would not result in any disturbance to wetlands. The number of monitoring wells would be determined by a qualified hydrologist. Areas of permanent disturbance for monitoring wells would be minimal (a few square feet per well).

Well testing would include discharge of geothermal fluid for 4.25 days into the ditch near U.S. Highway 395. Discharge would eventually flow to the surrounding wetlands. The geothermal water in the Lakeview area is mixed with the groundwater and has similar constituents. The project includes measures to ensure that constituent levels in discharged water would be similar to that of the receiving water. All permits and permission from the private property owner or owners in the area would be secured before discharge. Temperature would also be modified and water would only be released when it is within 5°F of the receiving water temperatures (see Section 3.3.3 of this EA for additional description of water quality and temperature effects).

Appropriate waste discharge permits from the DEQ would be acquired and all conditions implemented.

Table 3.3-9: Special Status Species			
Common Name Scientific Name	**Listing Status**	**Habitat Remarks**	**Potential to Occur on Site**
Plants			
Crenulate grape fern (*Botrychium crenulatum*)	Federal Status: Species of Concern State Status: Candidate ORNHIC List: 1	Meadows, freshwater marsh, bogs and fens.	Very Low
Crosby's buckwheat (*Eriogonum crosbyae*)	Federal Status: Species of Concern State Status: Threatened ORNHIC List: 1	Sagebrush scrub, pinyon and juniper woodland.	Very Low
Howell's thelypody (*Thelypodium howellii ssp. howellii*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: 2-extirpated from Oregon	Sagebrush scrub	Very Low
Cusick's buckwheat (*Eriogonum cusickii*)	Federal Status: Species of Concern State Status: Candidate ORNHIC List: 1	Very little is known about this species.	Very Low
Prostrate buckwheat (*Eriogonum prociduum*)	Federal Status: Species of Concern State Status: Candidate ORNHIC List: 1	Sagebrush scrub, lodgepole forest, red fir forest, northern juniper woodland.	Very Low
Warner Mountain bedstraw (*Galium serpenticum ssp. warnerense*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: 1	Meadows.	Very Low
Boggs Lake hedge-hyssop (*Gratiola heterosepala*)	Federal Status: Species of Concern State Status: Threatened ORNHIC List: 1	Lake margins and vernal pools.	None
Cooper's goldflower (*Hymenoxys lemmonii*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: 2	Sagebrush scrub, yellow pine forest.	Very Low
Grimy ivesia (*Ivesia rhypara var.*	Federal Status: Species of Concern State Status: Endangered	Dry, relatively barren areas of light-colored ash-tuff and areas with	Very Low

Table 3.3-9: Special Status Species

Common Name Scientific Name	Listing Status	Habitat Remarks	Potential to Occur on Site
rhypara)	ORNHIC List: 1	volcanic ash deposited with riverbed gravel.	
Shelly's ivesia (*Ivesia rhypara var. shellyi*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: 1	Very little is known about this species.	Very Low
Disappearing monkeyflower (*Mimulus evanescens*)	Federal Status: Species of Concern State Status: Candidate ORNHIC List: 1	Sagebrush scrub, lower montane coniferous forest, pinyon and juniper woodland.	Very Low
Blue-leaved penstemon (*Penstemon glaucinus*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: 1	Very little is known about this species.	Very Low
Desert allocarya (*Plagiobothrys salsus*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: 2	Playas.	Very Low
Reptiles			
Northern sagebrush lizard (*Sceloporus graciosus graciosus*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Sagebrush, mountainous shrublands.	Very Low
Amphibians			
Columbia spotted frog (*Rana luteiventris*)	Federal Status: Candidate State Status: Undetermined Status ORNHIC List: 2	Found in Parsnip Creek in Warner Basin in isolated population.	None
Birds			
Northern goshawk (*Accipiter gentilis*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Nests in wide variety of forest types. Typically nests in mature forests with high canopy cover. Hunts in heavily forested and open habitats.	May forage or fly over site; no nesting habitat on site

Table 3.3-9: Special Status Species

Common Name Scientific Name	Listing Status	Habitat Remarks	Potential to Occur on Site
Bald eagle (*Haliaeetus leucocephalus*)	Federal Status: Delisted State Status: Threatened ORNHIC List: 4	Prefers large, accessible trees. Breeding habitat is within 4 km of bodies of water	May fly over site; no nesting habitat on site
Purple martin (*Progne subis*)	Federal Status: Species of Concern State Status: Critical ORNHIC List: 2	Frequently nests in snags in coniferous forests, may nest in buildings or near cities and water.	May forage or fly over site; nesting habitat is adjacent to site
Tricolored blackbird (*Agelaius tricolor*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Nests in large stands of cattails; may also nest in shrub thickets near water	May forage or fly over site; nesting habitat is adjacent to site
Western burrowing owl (*Athene cunicularia hypugaea*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Open areas of friable soils; typically nests in burrows constructed by small mammals	May occur; many small mammal burrows are located near the site
Upland sandpiper (*Bartramia longicauda*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Open upland grasslands and fields, generally with low cover.	May forage or fly over site; nesting habitat is adjacent to site
Ferruginous hawk (*Buteo regalis*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Hunts open grasslands and sagebrush flats; nests on cliffs, buttes, or other elevated structures.	May forage or fly over site; no nesting habitat on site
Greater sage-grouse (*Centrocercus urophasianus*)	Federal Status: Candidate State Status: Vulnerable ORNHIC List: 4	Breeds on bare ground surrounded by sagebrush; forages in sagebrush	May fly over site; no breeding habitat on site
Black tern	Federal Status: Species of	Nests and feeds in	May forage or

Table 3.3-9: Special Status Species

Common Name Scientific Name	Listing Status	Habitat Remarks	Potential to Occur on Site
(*Chlidonias niger*)	Concern State Status: Not listed ORNHIC List: None	freshwater emergent wetlands, wet meadows, and ponds.	fly over site; nesting habitat is adjacent to site
Olive-sided flycatcher (*Contopus cooperi*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Requires large trees, usually conifers, for nesting and roosting.	May forage or fly over site; no nesting habitat on site
Yellow rail (*Coturnicops noveboracensis*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Sedge marshes, hayfields.	Very Low
Willow flycatcher (*Empidonax traillii adastus*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Dense stands of willows.	May forage or fly over site; nesting habitat is adjacent to site
Yellow-breasted chat (*Icteria virens*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Riparian willow and other shrubs.	May forage or fly over site; nesting habitat is adjacent to site
Lewis' woodpecker (*Melanerpes lewis*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Open habitats with scattered trees and snags with cavities.	May forage or fly over site; nesting habitat is in the region
Mountain quail (*Oreortyx pictus*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Montane habitats, open forest, and chaparral.	May forage or fly over site; no nesting habitat on site
White-faced ibis (*Plegadis chihi*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Nests in extensive marshes, feeds in shallow water.	May forage or fly over site; nesting habitat is

Table 3.3-9: Special Status Species

Common Name Scientific Name	Listing Status	Habitat Remarks	Potential to Occur on Site
			adjacent to site
Greater sandhill crane (*Grus canadensis tabida*)	Federal Status: None State Status: Sensitive/vulnerable ORNHIC List: 4	Open wetlands, dry plains.	Yes, observed nearby
Mammals			
Pallid bat (*Antrozous pallidus*)	Federal Status: Species of Concern State Status: Vulnerable ORNHIC List: 2	Dry grasslands near rock outcrops. Roosts in buildings, rock crevices, or under bridges.	Not roosting, only foraging
Townsend's western big-eared bat (*Corynorhinus townsendii townsendii*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Caves, crevices, buildings, and mines used for maternity roosts. Feeds in riparian and forested habitats.	Not roosting, only foraging
Silver-haired bat (*Lasionycteris noctivagans*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Caves, crevices, snags, and trees used for maternity roosts. Primarily found in forested habitats.	Not roosting, only foraging
Small-footed myotis bat (*Myotis ciliolabrum*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Caves, crevices, snags, and trees used for maternity roosts. Feeds in arid and upland habitats.	Not roosting, only foraging
Long-eared myotis bat (*Myotis evotis*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Caves, crevices, snags, and trees used for maternity roosts. Feeds in riparian and forested habitats.	Not roosting, only foraging
Fringed myotis bat (*Myotis thysanodes*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Caves, crevices, and mines used for maternity roosts. Feeds in riparian and forested habitats.	Not roosting, only foraging
Long-legged myotis bat	Federal Status: Species of	Caves, crevices, snags,	Not roosting,

Table 3.3-9: Special Status Species

Common Name Scientific Name	Listing Status	Habitat Remarks	Potential to Occur on Site
(*Myotis volans*)	Concern State Status: Not listed ORNHIC List: None	and trees used for maternity roosts. Feeds in riparian and forested habitats.	only foraging
Yuma myotis bat (*Myotis yumanensis*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Caves, crevices, snags, buildings, and mines used for maternity roosts. Feeds in riparian and forested habitats.	Not roosting, only foraging
Preble's shrew (***Sorex preblei***)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: None	Poorly understood; primarily sagebrush and grasslands.	Very Low
White-tailed jackrabbit (*Lepus townsendii*)	Federal Status: None State Status: Sensitive/vulnerable ORNHIC List: 3	Fairly common in upland habitats further north.	Very Low
North American wolverine (*Gulo gulo luscus*)	Federal: Candidate State Status: Listed Threatened ORNHIC List:4	Found in areas that re cold and receive enough winter precipitation to reliably maintain deep persistent snow late into the warm season.	Very Low
Fish			
Modoc sucker (*Catostomus microps*)	Federal Status: Endangered State Status: SC ORNHIC List: 1	Shallow mud-bottomed pools of cool creeks.	Possibly Deadman Creek
Goose Lake sucker (*Catostomus occidentalis lacusanserinus*)	Federal Status: Species of Concern State Status: Sensitive/vulnerable ORNHIC List: 1	Streams and rivers tributary to Goose Lake.	Possibly Deadman Creek
Goose Lake lamprey (*Lampetra tridentate ssp.*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: 1	Creeks, rivers, lakes.	Possibly Deadman Creek

Table 3.3-9: Special Status Species

Common Name Scientific Name	Listing Status	Habitat Remarks	Potential to Occur on Site
Pit roach (*Lavinia symmetricus mitrulus*)	Federal Status: Species of Concern State Status: Not listed ORNHIC List: 2	Creeks, rivers, lakes.	Possibly Deadman Creek
Great Basin redband trout (*Oncorhynchus mykiss gibbsi*)	Federal Status: Species of Concern State Status: ORNHIC List:	Creeks, rivers, lakes.	Possibly Deadman Creek
Goose Lake tui chub (*Gila bicolor thalassina*)	Federal Status: Species of Concern State Status: not listed ORNHIC List: 1	Creeks, rivers, lakes.	Possibly Deadman Creek
Goose Lake redband trout (*Oncorhynchus mykiss* pop. 6)	Federal Status: Species of Concern State Status: Sensitive/Critical ORNHIC List: 1	Creeks, rivers, lakes.	Possibly Deadman Creek

Sources: ORNHIC 2009; USFWS 2009; USFWS 2012; Pearl et al. 2009
ORNHIC = Oregon National Heritage Information Center.

Table 3.3-10: Summary of Project Impacts to Vegetated Habitats

Component Name	Total Footprint	Area of Vegetation	Area of Wetlands
Drilling and Testing	0.01-acre permanent impact	0.01-acre permanent impact	0.0-acre impact
Construction	10.5-acre temporary impact	9.5-acre temporary impact (proposed pipeline route) or 13.1 acres (for the alternate pipeline route)	0.23-acre temporary impact
Operations	N/A	1.83-acre permanent impact	0.08-acre permanent impact

Wildlife. Noise from drilling and testing may cause minor impacts to common birds and mammals. Existing noise from vehicle traffic and other sources keep sensitive wildlife to a minimum in the project area. Increased noise levels could deter common small mammalian species from occupying the site; however, there is abundant land and habitat nearby for these animals and impacts would be minor. The drilling areas would be fenced to prevent animals from injury by drilling equipment or getting into the drill rigs. The project is located at the fringe of the developed are of Town and, therefore, would not block or inhibit migration as animals generally do not migrate through the developed area. The surrounding undeveloped habitat, similar to the project area, encompasses approximately 115,000 acres.

Sensitive and Protected Species. Special-status fish and wildlife species would only be minimally affected by the proposed drilling and testing of wells. Water discharged to ditches during the testing operations would be of similar quality to surface waters in the area with implementation of protection measures previously described. Noise from operating drill rigs would be above ambient levels [up to 10 A-weighted decibels (dBA)] in the immediate vicinity of drilling (i.e., up to 100 feet away), which may deter wildlife from the immediate vicinity of the drill rigs; however, ample habitats for birds, mammals, and herptiles exist in the surrounding areas. Wildlife would be able to avoid these disturbances. Wildlife fencing would prevent special-status wildlife species from being injured by drilling equipment or being injured by drill rigs. The fencing would be limited to the area surrounding the well pads, which are away from roads. USFWS has stated that no federally listed species are located within or near the proposed project area. A copy of USFWS's letter is included in Appendix B.

Construction

General Vegetative Communities. Construction includes creation of two new well pads and placement of approximately 3.4 to 4.1 miles (depending on whether the proposed or alternate route is used) of new pipeline. The construction would take place in previously disturbed areas, as feasible, including areas that have been paved. The construction footprint for the well pads would be approximately 1.6 acres for the Barry well and 0.08 acres for the injection well. Construction would include removal of existing vegetation in those areas that are currently vegetated.

Construction would disturb some landscaped turf, an equipment yard, a pasture grazed by livestock, and other similar low-quality habitats. Vegetated areas that are disturbed by trenching for the pipelines would be re-vegetated with species similar to those that currently occur, or other native species. Project construction would require temporary impacts to 9.73 to 13.3 acres of vegetation and permanent impacts to 1.83 acres of vegetation (see Table 3.3-10). Impacts would be minimal.

Invasive Species. Project activities could contribute to the spread of invasive, nonnative plant species within the project area through surface disturbing activities and construction and drilling vehicles. The amount of land that would be vegetated and/or undisturbed is approximately 9.73 to 13.3 acres. Weeds found during construction would be removed.

Adverse impacts would be minimized by cleaning equipment to avoid the spread of noxious weeds.

Wetlands. The project has been designed to minimize direct impacts to wetlands. Wetlands occurring in the project area are likely considered jurisdictional by USACE. Jurisdictional determinations are made on a case-by-case basis by USACE and a submittal of a formal analysis of the significant nexus is required for USACE to make this determination (Hanson pers. comm. 2009). The Town of Lakeview currently is in the process of conducting a USACE jurisdictional wetlands delineation. Results of the delineation will be submitted to the USACE as part of the permitting process for this project prior to construction.

Construction of the direct use system, including the pipeline into Lakeview, would result in temporary placement of fill in approximately 0.23 acre of potentially USACE jurisdictional wetlands and 0.08 acre of wetland would be permanently impacted for the creation of the well pad for the injection well (see Table 3.3-10). The proposed pipelines would be constructed along roadways and the railroad grade. The two crossings of Deadman Creek and the associated wetlands and riparian areas would be constructed by hanging the pipeline on the trestle of the existing bridge and by jacking and boring under the creek; therefore, only minimal direct impacts to those wetland and riparian areas are expected.

The wetlands to be permanently and temporarily filled are palustrine emergent wetlands found along roadways and the railroad or otherwise previously impacted by agricultural activities. These wetlands are along the perimeters of extensive wetland systems, and only a very small portion of those wetland systems would be lost.

Due to the nature of these project components, including limited permanent footprints, and the area of wetlands to be permanently filled (approximately 0.08 acre), the project would have an adverse, minor impact to wetlands. Direct impacts to waters of the United States would likely be permitted by USACE under one of the Nationwide Permit processes because of the lower quality of the wetlands affected, the abundance of wetlands in the area, and the limited permanent effects from the project construction (Hanson pers. comm. 2009). Compensatory mitigation would not likely be required to mitigate for loss of less than 0.10 acre of wetland.

In order to further minimize effects to existing wetlands, the Town of Lakeview would replace all soil where the pipeline trenches cross wetlands after construction and would re-vegetate these areas with an appropriate seed mix. The potential for water quality impacts to wetlands and other sensitive habitats would be minimized and avoided by implementing BMPs for water quality control during construction of the project, including erosion control.

Wildlife. Removal of vegetation for the pipeline would likely displace common small mammals and reptiles; however, the surrounding habitat is plentiful and adequate with approximately 115,000 acres of similar (and often better as it is away from the urban areas) habitat in the surrounding area to support these animals such that impacts would be negligible.

Several large pieces of equipment, as well as trucks and worker vehicles, would access the project site during construction. Vehicles could crush or injure terrestrial wildlife. Keeping vehicles at low speeds would reduce the potential for wildlife mortality. Some mortality of common species, such as lizards and voles, would only minimally affect overall populations due to the abundance of these species.

Noise from construction may cause minor impacts to common birds and mammals. Existing noise from vehicle traffic and other sources keep noise sensitive wildlife to a minimum in the project area. Increased noise levels could deter common small mammalian species from occupying the site; however, there is abundant land and habitat nearby for these animals. This impact would be negligible.

Protected and Sensitive Plant Species. There are 12 federally designated plant Species of Concern that may potentially be affected by the construction of the project. The likelihood of any of these species occurring in the project area is quite low because the areas of impact have been previously disturbed and the habitats are degraded. Pre-construction surveys for these species would be conducted so that any occurrence of these special-status plant species would be avoided including along the alternate pipeline route. The project would have minimal impacts on sensitive plant species.

Sensitive habitats in the project area include designated critical habitats, wetlands, streams, and riparian areas. The one known designated critical habitat in the area is critical winter range for mule deer located east of proposed south production well (Foster pers. comm. 2009). This area would be avoided, and only minimal impacts to the critical winter habitat for mule deer are anticipated.

Protected and Sensitive Invertebrates and Herptiles. There are no known listed invertebrate or herptile species that might occur in the area. The northern sagebrush lizard is not known to occur in the area and is unlikely to occur in disturbed habitats. No impacts to invertebrates and herptiles would occur from project construction activities.

Protected and Sensitive Avian Species. There are 16 federally listed avian Species of Special Concern that are known to occur in Lake County. In addition, the bald eagle is federally delisted and state threatened and the sandhill crane is state-listed as Sensitive-Vulnerable. Both the bald eagle and the sandhill crane are on the ORNHIC List 4.

All of these special-status avian species may occur in the area, with the exception of the white-headed woodpecker (*Picoides albolarvatus*); however, none of these species would nest in the project area due to a lack of appropriate nesting habitat and, in some areas, frequent disturbances from vehicle traffic. To avoid potential impacts to nesting birds that may be in the vicinity of the project site, construction would occur outside of the nesting season for these species, which is from mid-March to August 1st of each year. If construction or other ground-disturbing activities occur during the nesting season, pre-construction surveys for nesting birds would be conducted so that impacts to these species can be avoided. Pre-construction surveys would be conducted by a qualified biologist within 48 hours of commencement of construction activities. If a nesting bird is found, an appropriate buffer as

determined by the qualified biologist would be implemented around the nest site until all fledglings have left the nest. Project construction would only have a minimal impact on special-status avian species.

Protected and Sensitive Mammalian Species. Eight species of bats that are Species of Special Concern may forage in the area. There is no roosting habitat for any of these species in the area, and they are crepuscular species that are unlikely to be in the area when construction occurs (e.g., during daylight hours). The white-tailed jackrabbit is state Sensitive-Vulnerable and is unlikely to occur in the project area or be impacted by the project. Project construction would not have adverse effects on special-status mammals.

Protected and Sensitive Fish Species. Of the native fish species that occur in Lake County, two are federally listed as endangered, four as threatened, and 13 are Species of Special Concern. The only fish habitat in the project area is Deadman Creek. Construction through this creek would be avoided. The two crossings of Deadman Creek and the associated wetlands and riparian areas would be constructed by hanging the pipeline on the existing trestle and by jacking and boring under the creek from an appropriate distance away from the riparian corridor, avoiding all direct impacts to vegetation and other biological resources in these areas. The project would have minimal on sensitive fish species.

USFWS has stated that no federally listed species are located within or near the proposed project area. A copy of USFWS's letter is included in Appendix B.

Operation

Vegetation. Operation of the geothermal wells and pipelines would not have an adverse effect on general vegetative communities. Operation would not require removal of vegetation; access to and from the wells would be on existing roads. Operation of the geothermal wells would not cause the spread of invasive species, as access to the wells would be on existing roads.

Wetlands. Operation of the project may alter the hydroperiod of the wetlands in the project vicinity, which is discussed in Section 3.3.3 of this EA. No net loss of water is expected because withdrawn geothermal water would be re-injected to replenish the groundwater reservoir. Localized effects to wetlands could occur due to pumping. Refer to Section 3.3.3 of this EA for a discussion of indirect impacts to wetlands. The project includes preparation of a detailed program for installation of additional monitoring wells and to define and conduct a monitoring program during project operation. The monitoring data would be used to quantify the relationship between geothermal pumping and injection and localized groundwater levels to ensure that surrounding users were not adversely impacted. If a substantial change occurred, as determined by the methods and criteria established in the monitoring program by the qualified hydrogeologist, then the Town of Lakeview would take actions such as scaling back pumping, re-evaluating the production/injection scenario, or providing supplemental water to users, springs, and/or wetlands to ensure that the project is not having a substantial adverse effect on surrounding geothermal users and features. A substantial change (as related to wetlands) would include:

- Loss of water to natural hot springs and ponds attributable to the proposed project;
- A reduction in temperature in excess of 5° F on average in hot springs attributable to the proposed project; and/or
- A loss of water to Cannon Springs, or wetlands near the direct use geothermal system.

Due to its location, the direct use system production well would capture geothermal fluid flux that discharges as spring flow. The Town of Lakeview would hire a qualified hydrogeologist who would develop a surface water augmentation plan to discharge an appropriate quantity of the geothermal well discharge at the spring locations to offset any reduction in natural spring discharge. The plan would include providing water of similar temperature and water quality, if necessary, and acquisition of all necessary permits from regulatory agencies. With implementation of these measures the project would have only minimal indirect effects on wetlands during project operation.

Wildlife. Impacts from operation of the direct use system would be minimal and negligible. Periodic maintenance would not disturb wildlife. No new ground disturbance would be required during operation of the system. Noise impacts would be minimal.

Protected and Sensitive Species. There would be no threat to protected and sensitive species in the proposed project area during project operation. Operation would occur on the existing well pads; therefore, sensitive species and their habitat would not be adversely impacted.

3.3.5 CULTURAL RESOURCES

Affected Environment

Cultural and Historic Resources

Cultural resources include landscapes and places, and archaeological sites and objects. Examples of cultural resources include, but are not limited to, the following:

- Mountain tops
- Rock art
- Refuse deposits
- Houses
- Railroads
- Lithic scatters
- Quarry sites
- Foundations
- Tailings
- Rails

A cultural resource must be more than 50 years old or have special significance to culture and history (e.g., Mount Rushmore) to be eligible for listing in the NRHP.

Prehistoric Period

The Lakeview area was used and/or semi-permanently occupied by native people as long ago as the late Pleistocene Epoch. Semi-permanent use of the area was nearly continuous over the past 14,000 years. The Lakeview area was within territory that was eventually ceded by the Klamath, Modoc, and Yahooskin (or Yahuskin), per terms of the 1864 *Treaty of Klamath Lake, Oregon with the Klamath, Modoc, and Yahooskin Band of Snake*.

The Goose Lake region marked the eastern edge of Modoc territory with the Modoc village of Lu'kmtsis on the lake's western shoreline in the protohistoric and historic periods (Ray 1963). Northern Paiute bands, likely the Kidütükadü and/or Yahuskin, occupied the northwestern part of Goose Lake and the valley to the north of the lake, including the Lakeview area. Allison (1994) documented the Klamath Tribes' use of Lakeview as a yearly gathering place, and the use of springs (not named in the source) north and south of the Town for preparing animals after slaughter. Allison also documented the use of thermal springs by people of the Klamath Tribe in the 20th century, yet this does not negate the fact that tribes speaking Northern Pauite claimed the Lakeview area.

Historic Period

The earliest nonnative people to visit Lake County, Oregon, were probably trappers from the Hudson's Bay Company. The earliest description of the region appears to be written by Ogden in 1826-1827, and refers to Goose Lake as Pit Lake. There were trappers and cartographers in the region before Oregon became a state. The Applegate Trail, part of the Oregon Trail Complex, crossed through Goose Lake Valley at the lake's southern end (Lake County Historical Society 2008).

Settlement of Goose Lake Valley, north of Goose Lake, began in the 1870s, but the Town of Lakeview was established in 1869. Population growth was slow and the principle economic activities were ranching and other agricultural pursuits. Mining was an early economic activity but the gold boom only lasted for a few years.

In the early 20th century lumber activity was prominent on USFS land east and west of Lakeview but the economic boom was short-lived and it ended when old-growth timber had been cut down. For a time, dairying was an important activity but that too was short-lived and it essentially ended when the State of Oregon terminated its milk control law in the early 1950s (Bartlett 1954) as a result of a statewide referendum. Discovery of uranium north of Lakeview in the 1950s created a short-lived boom (Lake County Historical Society 2008).

Regulatory Requirements

Cultural resources are protected primarily through the NHPA and the regulations implementing Section 106 of NHPA (36 CFR Part 800), the *Archaeological and Historic Preservation Act of 1974*, and the *Archaeological Resources Protection Act of 1979*. Section 106 of the NHPA requires federal agencies to consider the effects of undertakings on cultural resources that meet the criteria and are considered eligible for inclusion in the NRHP. These cultural resources are known as "historic properties." The Section 106 process must only be administered if the federal undertaking has an adverse effect on a historic property.

Criteria for inclusion within the NRHP, as provided in 36 CFR 60.4. Section 101(d)(6)(A) of the NHPA, allows properties of traditional religious and cultural importance to a tribe to be determined eligible for inclusion within the NRHP.

The American Indian Religious Freedom Act (42 U.S.C. 1996 et seq.) also allows for access to sites of religious importance to Native Americans. The *Native American Graves Protection and*

Repatriation Act provides for the repatriation of human remains and funerary items to identified Native American descendants.

Native American Consultation

The Native American Heritage Commission was contacted to conduct a search of the Sacred Lands File to identify any Traditional Cultural Properties or areas of Native American heritage significance; none were identified.

Informal consultation was initiated by ASI, through distribution of an initial letter to ten tribes, which described the proposed project and solicited comments. Each letter was followed up with a phone call. Additional tribal consultation was then conducted by DOE in September 2009. The letters further described the proposed Project and requested comments and concerns be submitted to DOE within 30 days of receipt of letter. A copy of the distribution list is provided in Appendix A. Additional consultation is being conducted by the USDA.

Field Survey

Study Area of Potential Effect. Roger Werner of ASI defined the APE for the project in coordination with the Oregon SHPO and the Town of Lakeview. The APE included all project elements, plus a 50-foot buffer around the element (i.e., 25 feet on either side of the pipeline routes for a total corridor of 50 feet and 50 feet from the edge of the well pads).

Survey. ASI conducted a records search at the Oregon SHPO followed by an archaeological field survey of the project area during the week of July 20, 2009.

One previously recorded archaeological resources were re-identified during the field survey, as were two potentially historic buildings. Several previously unrecorded cultural resources were also discovered in the process of the field survey. These previously recorded and unrecorded resources are described in Table 3.3-11 as well as their potential eligibility and overlap with the project APE.

Several of the buildings that would be connected to the direct use system are more than 50 years old but were found to be ineligible for listing in the NRHP. The alternate pipeline route has not yet been surveyed but will be surveyed in prior to project construction (refer to next section).

Direct and Indirect Impacts

Historic Properties

Several potentially eligible historic resources would be avoided. These include the Barry Ranchstead, the Barry Ranch Pasture Site, and the historical trash dumps. The proposed project would not have any effect on these resources because they would be avoided. No railroad track would be disturbed and any impacts to the appearance of the railroad would be temporary as the pipeline would be buried. The railroad is likely eligible under criterion (a) and/or (b) under the National Register Eligibility Criteria. The construction of the pipeline would have a negligible effect on the railroad because it would not permanently alter the appearance or function of the railroad. After construction, the pipeline would not be visible.

Table 3.3-11: Summary of Cultural Resources Within the Project Area

Site	Type of Site/Eligibility	Overlap with APE
Prehistoric archaeological site	Archaeological/ Potentially eligible	Within APE
Barry Ranchstead	Historic/Potentially eligible	Site avoided/not in APE
Barry Ranch Pasture Site	Historic/Potentially eligible	Site avoided/not in APE
Lake County Railroad	Historic/Potentially eligible	Within APE for pipeline
Two historical trash deposits	Historic/Potentially eligible	Sites avoided/not in APE
Isolates in the southern portion of the project area	Archaeological/Not eligible	Not applicable

Source: ASI 2009

One archaeological resources has been discovered in the project vicinity that is potentially eligible for listing in the NRHP. The limits, depth, and eligibility of the prehistoric archaeological site within the APE have not yet been determined. Construction of the pipeline and drilling of the well could damage the resource in a way that may be considered adverse. Additional subsurface analysis of the archaeological site would be completed to evaluate its eligibility to the NRHP. A test plan would be prepared, consisting of methodical hand-excavation of those portions of the site(s) that would be adversely affected by project activities. Only a qualified archaeologist or cultural resources consultant would be allowed to collect any prehistoric resources discovered at the site after consultation with Indian tribes and SHPO. The work would be accomplished within the context of the research design and in accordance with current professional standards. The plan would result in the extraction of sufficient volumes of non-redundant archaeological data so as to address important regional research consideration; detailed technical reports would be prepared to document the findings.

If the site is determined ineligible, no further Section 106 process would be required. If the site is determined eligible for the NRHP, and the eligible areas of the sites could not be avoided, no construction would occur until data recovery is implemented. Data recovery would be accomplished in the context of the Secretary of the Interior's Guidelines for Treatment of Historic Properties and in accordance with current professional standards. The plan would result in the extraction of sufficient volumes of non-redundant archaeological data so as to address important regional research consideration; detailed technical reports would be prepared to document the findings. The test plan and data recovery would be approved by the SHPO; a permit from the SHPO would be obtained prior to

implementation. Certain portions of the site(s) to be completely avoided during construction would be identified as environmentally sensitive areas and marked on maps and construction plans, and fenced with orange mesh in the field, as described in an environmentally sensitive area plan. A qualified archaeologist would survey any area proposed for ground disturbance associated with the installation and operation of monitoring wells and the alternate pipeline route prior to drilling for any wells to be located in a previously undisturbed area or construction of the alternate pipeline. Resources would be avoided, or the aforementioned protocol would be implemented to minimize impacts.

Any adverse effects to historic properties found through the Section 106 process will be properly mitigated.

Undiscovered Resources

A sensitivity assessment would be prepared to identify where potential buried archaeological sites may exist within the project area. This assessment would entail review of Quaternary landform mapping, location of artificial fill created during prior construction events, historical reconstructions of habitat distribution, and distribution of known buried archaeological sites in the region. The project would involve excavation that could disturb unknown sites. It is important that vehicles and traffic stay within the clearly delineated and flagged APE during all project operations, because undiscovered resources likely exist outside this area. The APE would be clearly flagged and staff would be informed (before project commencement) to stay within the APE and that any effects on, defacement of, or removal and/or disturbance of archaeological, historical, or sacred material is prohibited and subject to disciplinary action.

An Inadvertent Discovery Plan would be prepared. If a subsurface cultural resource were found during project operations, all work in the vicinity of the resource would cease until the resources were evaluated by a qualified archaeologist or cultural resources specialist. The Town of Lakeview would implement those appropriate measures requested by the SHPO to protect the resource until it could be adequately evaluated by a permitted archaeologist, as necessary. The project includes requiring a professional archaeologist and a Native American monitor for all ground-disturbing activities. If prehistoric or historic artifacts were discovered during excavation, the monitor would have the authority to halt all earth-moving activities within and around the immediate discovery area until the find could be assessed.

Measures would be implemented to avoid adverse effects to Native American burials including cease of all work within 300 feet of the remains, and protecting the remains from further exposure or damage. The USDA, the Tribal Historic Preservation Office, and the SHPO would be notified immediately. Adverse effects would be mitigated with implementation of these procedures.

Native American Values

Native American tribes throughout the west express interest in any areas of hot springs, which were often sites of aboriginal medicine and ceremonial rituals (e.g., Coso Hot Springs in southeastern California). The Northern Paiute have expressed concern for any impacts to cultural resources and hot springs in the Lakeview area, particularly to the north of the

Town, and requested that a Native American monitor be present during construction. The project includes mitigation to avoid adverse impacts to cultural resources or human burials. No direct impacts to the regional hot springs (e.g., Hunter's Hot Springs) are expected.

3.3.6 NOISE

Affected Environment

Noise Definitions

Noise is defined as unwanted sound. Sound becomes "noise" when it interferes with sleep or conversation and when it causes physical harm. Human perception of noise is subjective and varies considerably. Decibels and other technical terms are defined in Table 3.2-12.

Noise Standards and Practices

Several federal government agencies and states have developed guidelines regarding the types of land uses that are acceptable within noise-impacted areas. Where local governments lack specific noise criteria, they may rely on state or federal standards.

The Town of Lakeview requires compliance with DEQ noise standards for industrial noise, as described below (Simms pers. comm. 2009).

The DEQ has standards regarding new industrial or commercial noise sources located on previous industrial or commercial sites. The proposed project areas are not located on industrial sites throughout the entire project, but the project components would be considered an "industrial noise source," which is defined as any noise source that generates industrial-type noises (DEQ 2008). DEQ regulations provide that:

No person owning or controlling a new industrial or commercial noise source located on a previously used industrial or commercial site shall cause or permit the operation of that noise source if the statistical noise levels generated by that new source and measured at an appropriate measurement point, specified in subsection (3)(b)4 of this rule, exceed the levels specified in [Table 3.3-13.]

Construction sites and equipment are exempt from these rules.

Lake County does not have specific noise ordinances pertaining to construction or operation of geothermal facilities. The Lake County zoning ordinance permits the construction and operation of geothermal facilities within all the identified Lake County land use zones for this project, pending the submission and approval of a Conditional Use Permit. Upon

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[4]. (3) Measurements

(b) Unless otherwise specified, the appropriate measurement point shall be that point on the noise sensitive property, described below, which is further from the noise source:

- 25 feet (7.6 meters) toward the noise source from that point on the noise sensitive building nearest the noise source.
- That point on the noise sensitive property line nearest the noise source.

Table 3.3-12: Definition of Acoustical Terms

Terms	Definitions
Decibel	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20.
Sound Pressure Level	Sound pressure is the sound force per unit area, usually expressed in micropascals (or 20 micro Newtons per square meter), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure (e.g., 20 micropascals). Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency, hertz	The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 and 20,000 hertz. Infrasonic sound is below 20 hertz and ultrasonic sounds are above 20,000 hertz.
A-Weighted Sound Level	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
Equivalent Noise Level	The average A-weighted noise level during the measurement period.
Community Noise Equivalent Level	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels in the evening from 7:00 pm to 10:00 pm and after addition of 10 decibels to sound levels in the night between 10:00 pm and 7:00 am.
Day/Night Noise Level	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 pm and 7:00 am.
L01, L10, L50, L90	The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content, as well as the prevailing ambient noise level.

Source: Caltrans 2009.

Table 3.3-13: New Industrial and Commercial Noise Source Standards	
Allowable Statistical Noise Levels in Any One Hour	
7 am – 10 pm	**10 pm – 7 am**
L50 – 55 dBA	L50 – 50 dBA
L10 – 60 dBA	L10 – 55 dBA
L1 – 75 dBA	L1 – 60 dBA

Source: DEQ 2008.

approval of the Conditional Use Permit, all neighboring residents and businesses would be notified of the project.

The Town of Lakeview does not have defined numerical noise standards for construction (Simms pers. comm. 2009).

Noise Sources in the Project Area

Noise sources in the project area are typical to both urban and rural landscapes, since components of the project exist within the Town of Lakeview as well as outside the Town's limits to the south. These areas are mostly rural, but the ambient noise level is influenced by vehicle traffic from nearby roads as well as natural noises such as wind and birds. Noise sources within Lakeview would be more urban in nature and include vehicle traffic, as well as human-generated noises.Noise exposure goals for different types of land uses reflect the varying noise sensitivities associated with those uses. Hospitals, schools, and libraries would be examples of receptors more sensitive to noise intrusion and, therefore, require greater levels of protection from noise.

Sensitive receptors within Lakeview would include:

- Patients of the Lake District Hospital
- Students of the Lake County School District (including Lakeview High School, A.D. Hay School, and Fremont School)
- Residents at the J & J Adult Foster Home

Sensitive receptors located closest to the project area would include nearby or adjacent residences. The nearest receptor to the project area, outside of the Town, is the Barry Ranch, located 300 feet to the west of the Barry Well Pad site and a home along Kadrmas Road located 150 feet north of the alternate pipeline route. There are no other residences in proximity to the project construction areas outside of the Town.

Direct and Indirect Impacts

Drilling and Testing

Noise from geothermal well drilling would have the most effect, as drilling must occur 24 hours per day; however, noise impacts from drilling would be temporary. Table 3.3-14 presents the typical noise from various drilling activities at varying distances. Monitoring

Table 3.3-14: Typical Noise from Geothermal Drilling Activities (dBA)

Activity	100 feet	200 feet	500 feet	1,000 feet	2,000 feet	5,000 feet
Site preparation and construction	78	73	66	58	50	38
Well drilling	75	68	60	53	44	30
Well clean-out	75	68	58	50	41	25
Flow testing	78	73	66	59	52	42

Source: CEGC 1994.

Notes: Identified noise levels are given for various distances from a proposed noise-generating source. These noise levels do not account for the topographical barriers throughout the project vicinity, which may absorb or deflect sound waves, thereby reducing noise levels.

dBA = A-weighted decibel.

well drilling would generate less noise than drilling of geothermal wells because smaller rigs can be used and the wells would be shallower and smaller in diameter.

The closest sensitive receptor to the proposed drilling site is the Barry Ranch. The edge of the Barry Ranch property is approximately 300 feet from the proposed drill pad. Noise heard by this sensitive receptor would be comparable to a gas lawn mower at 30 meters (about 98 feet). Despite the temporary nature of the drilling, it could generate exterior noise from 37 to 69 dBA, noticeable to some sensitive receptors during night hours. Standard building construction typically provides about 15 dBA of noise reduction between exterior and interior noise levels, with the windows partially open. The interior noise levels would therefore be about 22 to 54 dBA, which is slightly above the acceptable level of 50 dBA for noise-sensitive receptors between the hours of 10 pm and 7am.

Adverse effects from drilling noise would be reduced through installation of temporary noise screening equipment around the well pad sites. The screening equipment would be no taller than the top of the base of the drill rig (about 12 feet high) to minimize visual impacts associated with the well. Screening would provide a 5 to 15 dBA reduction in noise (US DOT 2000). Project sites would experience a range in noise from 17 to 49 dBA with the implementation of noise screening equipment.

All neighbors would be contacted prior to construction regarding the timeframe and estimated noise levels from the proposed project and provided a hotline for answering noise complaints. Screening would not be required for drilling of monitoring wells and the injection well, unless complaints are received. Noise effects are expected to be minor with implementation of these measures.

Construction

Construction noise levels, by their nature, can be difficult to quantify. The amount of construction noise is directly proportional to the amount of activity occurring and the level of sound energy produced by the equipment involved. On a construction project, the level of

activity and type of equipment can be varying and difficult to predict. For these reasons, the ranges of noise levels of construction equipment are usually listed and typically, no effort is made to predict the specific level of construction noise. Identification of land use activities that may be affected by construction noise can aid in consideration of construction noise abatement strategies.

General construction noise would result from the use of heavy equipment for construction of the pipeline. Maximum noise levels generated by construction activities typically range from about 85 to 90 dBA at a distance of 50 feet. Typical hourly average construction noise levels are about 10 dBA less during busy construction periods (e.g., while earth-moving equipment is operating). The construction of a linear element such as a distribution pipeline expands the area of noise impact over a considerable distance. Pipeline construction noise would be the worst when construction would be closest to the individual receptor. This distance would range from 50 to 600 feet for individual sensitive receptors.

Construction of the well pads and pipeline would only occur during typical working hours. Maximum noise would range from about 66 to 90 dBA. Noise generation would be in the acceptable range for daytime hours for most of the project, but may fall outside the accepted noise limits during pipeline construction at several sensitive receptor sites. Standard building construction typically provides about 15 dBA of noise reduction between exterior and interior noise levels with the windows partially open. Interior noise levels would range from 52 to 75 dBA, an acceptable noise range for daytime (Table 3.3-13). Construction would not occur during the night time. Impacts from construction noise would be minor with implementation of standard noise reduction measures that require mufflers and noise abatement equipment on construction

Operation

Project operation noise would be negligible during project operation. The direct use system would not generate substantial audible noise.

3.3.7 VISUAL RESOURCES

Affected Environment

Regional Visual Setting

The project would be located in Lake County, Oregon, at multiple locations situated to the south of Lakeview, as well as within the Lakeview town limits.

The geography, geology, and climate of the area produce a diversity of shapes and colors in Lakeview, which is centrally located between Bend, Oregon, and Reno, Nevada. Two major highways pass through Lakeview, and the area is a popular route between the Willamette Valley and Central Oregon (Town of Lakeview 2009b). There are several natural and scenic vantage points within Lakeview, each offering views of the urban area, the Goose Lake Basin, and adjacent mountains. Views from the project vicinity include:

- Warner Mountains
- Fremont National Forest
- Mt. Shasta

The Lakeview area is located at the foot of the Warner Mountains to the east and surrounded by the Goose Lake Basin from all other directions. Local topography within the adjacent Warner Mountains includes Crane Mountain, Cougar Peak, Grizzly Peak, and Black Cap. Black Cap is a conspicuous sight from Lakeview, as it is covered with multiple cell towers and telecommunication equipment. The flatlands of the Goose Lake basin are covered with grassy groundcover, with areas of wetlands and riparian vegetation. Visibility in the region is good, although snow, precipitation, and localized topography can all reduce regional visibility.

Local Visual Setting

Project Area. Lakeview is located at an elevation of approximately 4,800 feet, at the foot of the Warner Mountains, which obscures the Town from the east. The primary influence from humans on the visual landscape in the vicinity of the proposed project has been through ranching, cattle grazing, and geothermal activities. Geothermal activities in the immediate vicinity include several existing wells and Hunters Hot Springs, a resort and hotel for recreationalists. Buildings within the Town are built along street grids, are generally a few stories in height or less, and do not greatly obstruct the skyline.

The surrounding landscape is largely undeveloped agricultural lands and is made up of open space, commercial buildings, and isolated residences.

Viewsheds. A viewshed is an area that can be seen from a given vantage point and viewing direction. A viewshed is composed of foreground items (items closer to the viewer) that are seen in detail and background items (items at some distance from the viewer) that frame the view. The area in between is the mid-ground. The viewshed changes as a person moves along a roadway (a view corridor), with the foreground items changing rapidly and the background items remaining fairly consistent for a long period of time.

The viewshed at the proposed project site is shaped by the regional features in the background and local land uses in the foreground. The viewshed at the proposed project site includes the mountain ranges and in the background and the road, parking lots, existing construction, and other built features in the foreground and mid-ground. The background of the viewshed is more aesthetically pleasing than the foreground and mid-ground in the project area. Figure 3.3-5 depicts the view from the southern edge of the project at Barry Ranch. The viewshed is from the northwest adjacent to the proposed production well.

Sensitive Visual Receptors

Sensitive visual receptors in the proposed project area include neighboring residents, schools, churches, hospitals and healthcare facilities, and employees of commercial enterprises. The proposed production well site would not be readily visible from within the Lakeview town limits, as the viewshed is obstructed by overall distance, buildings, and existing vegetation.

Figure 3.3-5: Viewshed from the Barry Ranch

Direct and Indirect Impacts

Drilling and Testing

Visual impacts from the proposed project would result from:

- Views of drilling equipment and facilities on the well pad
- View of the 50- foot- tall drill rigs for approximately 60 days
- View of steam plumes during well drilling and testing

Materials required for well drilling would be staged in the existing Lake County Industrial Park where foreground views do not have any scenic value (bare ground and buildings). Drilling at the project sites would be visible, but due to its temporary nature, impacts would be considered minor. The drill rigs would be the most visible from elevated vantage points such as multi-story buildings in Town and from hill slopes to the east. As seen from these locations, the drill rigs would temporarily interrupt scenic background views. The drill rig would be on site for up to 60 days (30 days per well); however, and the impact would be considered minor. Steam plumes from drilling may also be visible, but would not be large enough to block or obstruct background views. The remainder of the construction equipment would blend into the foreground and would not obstruct background views. Drill rigs for drilling of monitoring wells would be smaller and would be visible for shorter timeframes. Impacts on visual resources from drilling of the proposed wells would be minor.

Construction

Visual impacts from construction would result from:

- Views of construction equipment and facilities
- Views of disturbed ground during construction of the pipeline

Construction of the pipeline and upgrades for the direct use system would be visible to many receptors living and working within Lakeview. Construction of the direct use system would be temporary (approximately 4 to 6 months); however, construction would have a low profile and would be near existing roads or rights-of-ways. The existing buildings in Lakeview would largely shield views of construction equipment from the retirement center, hospital, and schools during construction of the proposed pipeline for the direct use system. Impacts from construction would be minor.

Construction at the southern project site would occur adjacent to the existing geothermal facilities. Construction on the southern project site would be limited to well pads and the pipeline corridor. A 16-foot-by-16-foot building would be constructed to enclose the well head of the direct use system production well and an 8-foot-by-8-foot building would be constructed to enclose the injection well for the direct use system. Construction profiles would be low and short in duration, lasting only a few months. Construction effects would be temporary and, therefore, would be considered minor.

Operation

Visual impacts from project operation would include views of the cleared well pads and well heads and views of the well buildings. The proposed production and injection wells would be located in an isolated rural setting near the intersection of U.S. Highway 395 and Kadrmas Road. Once the wells have been drilled, a 16-foot--by--16--foot building containing the production well head, an 8-foot-by-8-foot building containing the direct use system injection well, and the cleared well pad would be visible. The building housing the well pad would be no more than 10 feet in height and would be similar in appearance to nearby existing buildings. All buildings would be painted a muted color to minimize the visual impact of the new building on the surrounding area. These features would easily blend into the surrounding viewshed and would not be discernable from a distance greater than 200 feet.

3.3.8 HAZARDOUS MATERIALS, HUMAN HEALTH AND SAFETY, AND RISK ASSESSMENT

Affected Environment

Environmental Risk Assessment for Lake County

In November 2007, Lake County Emergency Management requested the preparation of a Multi-Jurisdictional Natural Hazards Mitigation Plan for the purpose of creating a "disaster resilient Lake County" (ONHW 2007). The analysis contained a list of hazards and determined the risk for each hazard based on Lake County's vulnerability to the hazard and likelihood of the event occurring in the future. The plan was developed in an effort to reduce future loss of life and property resulting from natural disasters.

Table 3.3-15: Relative Risk of Hazards for Lake County		
Hazard	**Probability of Future Event**	**Vulnerability to Future Event**
Wildfire	High	Moderate
Earthquake	Moderate	High
Flood	High	Moderate
Drought	High	Moderate
Wind Storm	High	Moderate
Winter Storm	High	High

Source: ONHW 2007

The risk of each hazard is listed in Table 3.3-15. The *Multi-Jurisdictional Natural Hazards Mitigation Plan* prepared by the County (ONHW 2007) addresses relative risk of hazards for Lake County. The analysis in the report explains how hazard risk was determined.

Hazardous Substances

There is one National Priorities List (Superfund) site in Lake County. The Fremont National Forest/White King and Lucky Lass Uranium Mines site is located approximately 18 miles northwest of the Town of Lakeview, within the Lakeview Ranger District Fremont National Forest, Lake County, Oregon. The mine is situated on both National Forest and private lands.

Approximately 140 acres were affected by uranium mining. The site was proposed as a Superfund site in 1993. Remedial design was completed in 2005 and cleanup was completed in 2007 (EPA Superfund Information System 2009). There are no sites in the Oregon State Environmental Health Assessment Program for Lake County (ODHS 2009).

Fire Hazards

Potential for fire is greatest near the Barry Well Pad, where naturally vegetated areas dominate the landscape. Fire potential in the area is moderate to high due to the low rainfall. The project area is serviced by the Lakeview Fire Department. The fire district is made up of three divisions: the Lakeview Fire Department, the Volunteer Fire Department, and the Lakeview Rural Fire Department. The main station is located in Lakeview, within minutes of each project site. The Lakeview Fire Department in Town staffs six 911 dispatchers/firefighter-engineers and two trucks. Two firefighters are on duty 24 hours per day (Firehouse.com 2009).

The Fire Department provides firefighting services, hazardous material response, and vehicle rescue.

Direct and Indirect Impacts

Exposure to Fuels and Lubricants

Drilling would involve hazardous material use. These materials would include, but would not be limited to, drilling additives and mud, diesel fuel, lubricants, solvents, oil, equipment/vehicle emissions, and geothermal fluids.

Hazardous materials that may be used include fuels and lubricants. This project would be in compliance with all local, state, and federal regulations regarding the use, transport, storage, and disposal of hazardous materials and wastes. The Town of Lakeview or its contractor would prepare an SPCC plan to minimize adverse impacts to the environment from hazardous materials.

Drilling mud and fluid would be directed to the reserve tank. The contents would be tested, removed, and disposed of off-site in a facility authorized to receive such wastes. Adverse impacts would be minimal.

The drill sites would be fenced or walled to prevent unauthorized access, which would minimize risks to the general public.

Exposure to Well Blowouts and Geothermal Fluid

Well blowouts and pipeline failures are rare occurrences during well drilling and can result in the release of drilling additives and fluids, as well as H_2S gas from the geothermal resource. Blowouts may also result in the surface release of geothermal fluids and steam containing heavy metals, acids, mineral deposits, and other pollutants.

The Town of Lakeview has an existing detailed blowout prevention plan (Appendix C). Measures include:

- Performing regular maintenance of wellheads, including corrosion control and inspection, pressure monitoring, and use of blowout prevention equipment such as shutoff valves;
- Preparing an emergency response plan for well blowout, including measures for containment of geothermal fluid spills;
- Preparing a contingency plan for H_2S release events, including all necessary aspects from evacuation to resumption of normal operations; and
- Providing workers with a fact sheet about the potential human health and safety impacts from exposure to liquids and gases from the production well during a blowout.

With implementation of these plans and standard safety precautions, adverse impacts would be minimized.

Exposure to Hydrogen Sulfide

Steam encountered during drilling and testing would likely contain H_2S. The concentration of H_2S encountered is not known at this time.

H_2S may be released from a well during drilling and would be vented with the steam and non-condensable gases during flow testing. H_2S is a colorless, non-condensable gas with a characteristic "rotten egg" odor. H_2S is toxic at certain levels and can cause negative human and animal health effects. Exposure to H_2S can cause dizziness, headache, and nausea at 50 parts per million and death from respiratory paralysis at 1,000 parts per million. The OSHA indoor workplace standard for H_2S is 10 parts per million for an 8-hour day (Klingberg 2005). Nuisance odor is of primary public concern because this distinctive odor can be easily detected at concentrations far below levels of health concern. Odor is detectable from about 0.008 part per million.

H_2S is typically encountered during the production zone drilling phase. The existing geothermal wells in the area suggest some level of H_2S in the system, evidenced by a faint odor of "rotten eggs" smelled when standing within a few feet of the source. Sulfates were also identified in water samples from the existing geothermal wells (Barry Well Pad site). No records have been found indicating H_2S emissions from previously drilled wells in the area caused adverse effects such as odor. H_2S levels at the Glass Mountain Known Geothermal Resource Area in Siskiyou County, California (southwest of the project site), were approximately 2.8 pounds per hour (USFS and BLM 1998), well below state standards in California. Effects from exposure to H_2S would be minimal.

Exposure to Noise

Drilling could generate considerable noise. Workers would be required to wear hearing protection and other personal protection equipment as required by OSHA to prevent injuries.

Exposure to Radiation from Well Logging Equipment

Radioactive well logging tools would be used during the well drilling process. Licenses and radiation safety requirements for well logging is described in U.S. Nuclear Regulatory Commission Regulations and 10 CFR Part 39. The Town of Lakeview would apply for the appropriate license for the use of licensed material in logging or require this of contract providers. The Town would follow all regulations, including:

- Development of a program for training logging supervisors and logging assistants including initial training, on-the-job training, annual safety review, and the means to demonstrate understanding of and ability to comply with operating and emergency procedures;
- Operating and emergency procedures or an outline or summary of the procedures that includes the important radiation safety aspects of the procedures;
- Development of job performance criteria for logging supervisors; and
- A description of overall organizational structure as it applies to radiation safety responsibilities in well logging, including delegations of authority and responsibility.

With safety precautions and proper licensing in accordance with 10 CFR Part 39, impacts associated with human exposure to radioactive logging equipment would be minor.

Exposure to Hazardous Materials

Some hazardous materials from project-related activities (i.e., fuels, oils) would be present on site during construction activities. The likelihood of substantial spills and discharges in this area would be low. Hazardous chemicals to be transported include fuels, oils, industrial solvents, and lubricants used during construction. Discharge of oils or petroleum products could occur from equipment leakage and would involve a very small volume.

Contamination of stormwater runoff at the drilling pad would be minimized through drainage and collection of runoff in a reserve tank. Contamination along the pipeline would be minimized through containment of any spills before they could be released into stormwater. The Town of Lakeview would implement an SPCC plan on site to contain incidental drips and/or spills. All hazardous material storage would be surrounded by containment berms.

Construction would also introduce potentially dangerous equipment. Should people gain access to the construction area, there would be a potential for accidents. The construction sites would be fenced and locked. Other protective measures include alerting the public to the risks of on-site construction materials.

Exposure to Noise

Construction could generate considerable noise. Workers would be required to wear hearing protection and other personal protective equipment as required by OSHA to prevent injuries.

Fire Hazards

The potential for fire is moderate to high because some construction locations are adjacent to undeveloped hillsides and fields dominated by dry vegetation. Fire hazards would be minimized through the maintenance of an on-site water tank to put out any potential fires. Other measures include:

- Fire extinguishers and shovels would be available on site.
- All brush build-up around mufflers, radiators, and other engine parts would be avoided; periodic checks conducted to prevent this build-up.
- Smoking would only be allowed in designated smoking areas; all cigarette butts would be placed in appropriate containers and not thrown on the ground or out windows of vehicles.
- Cooking, campfires, or fires of any kind would not be allowed.
- Portable generators used onsiteon site would be required to have spark arresters.

3.3.9 ENVIRONMENTAL JUSTICE

Affected Environment

Overview

President Bill Clinton issued Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations*, on February 11, 1994. It calls for federal agencies to recognize and attend to minority and low-income groups that may be

disproportionately affected by federal policies and programs. Consequences to consider when adhering to Executive Order 12898 include negative effects on health and environment.

Population and Demographic Characteristics

Lakeview is a town within Lake County, Oregon. The population of Lakeview was 2,474 in the 2000 Census, with a 2008 estimate of 2,750 (Portland State University 2009).

The demographic makeup of Lakeview is similar to that of the State of Oregon. The Town of Lakeview, however, has a nearly 2 times greater population concentration of Native Americans and Alaska Natives, and has less than one-third the population concentration of Asians than the state as a whole (USCB 2000). Population and demographic statistics are shown in Table 3.3-16. Approximately 13 percent of the Town consists of minority populations.

Table 3.3-16: Population and Demographic Statistics for Lakeveiw, Oregon (2000)

Population Group	Lakeview, Oregon	Oregon	United States
Total Population	2,474	3,421,399	281,421,906
White	91.5%	86.6%	75.1%
Black or African American[a]	0.0%	1.6%	12.3%
Native American and Alaska Native[a]	2.5%	1.3%	0.9%
Asian[a]	0.9%	3.0%	3.6%
Native Hawaiian or Other Pacific Islander[a]	0.2%	0.2%	0.1%
Other Race[a]	3.1%	4.2%	5.5%
Two or More Races	1.9%	3.1%	2.4%
Total	100.0%	100.0%	100.0%
Hispanic/Latino Origin (of any race)[a,b]	5.9%	8.0%	12.5%

Source: USCB 2000.

[a.] Considered minority population

[b.] The federal government treats Hispanic origin and race as separate and distinct concepts. In surveys and censuses, separate questions are asked on Hispanic origin and race. The question on Hispanic origin asks respondents if they are Spanish, Hispanic, or Latino. Starting with Census 2000, the question on race asks respondents to report the race or races they consider themselves to be. Thus, Hispanics may be of any race.

Economic Characteristics

The economic conditions in Lakeview, Oregon, are considerably different from state and national economic conditions. The unemployment rate in 2007 was higher than state and national unemployment rates.

The industries that provide the greatest number of jobs in Lake County include (OED 2008):

- Government (local, state, and federal)
- Leisure and hospitality
- Retail
- Trade, transportation, and utilities
- Wood product manufacturing
- Agriculture/Farming

In Lake County, Oregon, the median household income was $37,129 in 2007 and the percentage of residents living in poverty was 15.6 percent (USCB 2009). The median household income of Lake County was less than that of the average Oregon household and the average U.S. household. The percentage of individuals living in poverty was also higher than the percentage of individuals living in poverty in Oregon or the United States. The poverty rate for children was much higher than the rate for all ages: 23.2 percent of children were classified as living below poverty standards in 2006 (USCB 2008).

Direct and Indirect Impacts

Environmental justice impacts occur if there is any disproportionately high and adverse human health or environmental effects on minority or low-income populations.

Public scoping included distribution of a scoping notice to Native American tribes in the area because the project could have impacts to cultural resources as well as calls to tribes to solicit comments and interest.

The proposed project includes incorporation of environmental protection measures in the project description to minimize any physical effects from the project related to health and safety and air quality, among other resource areas. No disproportionately high and adverse human health or environmental effects would be anticipated to affect minority or low-income populations in the project area, despite a higher rate of these populations. Mitigation has been included to address any impacts to cultural resources including archaeological sites potentially eligible for the National Register of Historic Places and that may be important to Native American tribes. This EA includes a detailed discussion of effects to cultural resources.

The environmental impacts have been presented throughout the EA in compliance with NEPA and other laws such as the *Clean Air Act*. The project would not have disproportionately adverse effects on minority populations, low-income populations, or Indian tribes, including human health, social, and economic effects, because all adverse effects can be minimized and/or mitigated.

3.4 IRREVERSITLBE AND IRRETREIVABLE COMMITMENT OF RESOURCES

This section describes the major irreversible and irretrievable commitments of resources that can be identified at the level of analysis conducted for this EA. A commitment of resources is irreversible when its primary or secondary impacts limit the future options for a resource or limits those factors that are renewable only over long periods of time. Examples of nonrenewable resources are minerals, including petroleum, and cultural resources.

An irretrievable commitment of resources refers to the use or consumption of a resource that is neither renewable nor recoverable for use by future generations. Examples of irretrievable resources are the loss of production, harvest, or recreational use of an area. While an action may result in the loss of a resource that is irretrievable, the action may be reversible. For instance, paving over farmland results in the irretrievable loss of harvests from that land; however, the parking lot could be removed and crops could be grown again. This action would be reversible.

The construction and operation of the production and injection wells would require the irreversible and irretrievable commitment of building materials. The project would also result in the irretrievable loss of 0.08 acre of wetland and 1.83 acres of vegetation for construction of the well pads.

The use of geothermal water and heat represents a larger irretrievable impact to the geothermal resource. However, the same amount of geothermal fluid used would be injected and the resource's heat production potential likely exceeds the proposed use. Both the geothermal fluid and heat would likely recover soon after the proposed use.

3.5 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts associated with the proposed project include:

- Minor increases in combustion emissions, GHGs, and H_2S from drilling and testing, and minor increases in fugitive dust emissions from construction;
- Minor long-term effects on thermal spring discharges and groundwater levels from pumping operations;
- Long-term loss of approximately 1.83 acres of vegetation resulting from the construction of project components, and minor indirect effects to wetlands from pumping operations; and
- A minor increase in noise levels during construction.

Some of these impacts are temporary in the case of construction activities, and potentially long-term in regard to the loss of vegetation, reduction in spring flows, and visual impacts. Overall, impacts of the proposed project on the environment and human health would be considered minor. Water monitoring wells will serve to further understand the groundwater conditions in the area and help minimize potential impacts in the future.

3.6 THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE HUMAN ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Short-term use of the environment, as the term is used in this document, is that used during the life of the project, whereas long-term productivity refers to the period of time after the project has been decommissioned, the equipment removed, and the land reclaimed and stabilized. The short-term use of the project area for the proposed project would not affect the long-term productivity of the area. If it is decided at some time in the future that the

project has reached its useful life, components of the geothermal direct use system could be decommissioned and the site reclaimed and revegetated to resemble the pre-disturbance conditions. The installation of project components at this site would not preclude using the land for purposes that were suitable prior to this project.

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4 CUMULATIVE IMPACTS

Cumulative impacts are those potential environmental impacts that result "from the incremental impact of the action when added to other past, present, or reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions" (40 CFR 1508.7). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

This cumulative impact analysis considers impacts of the proposed project and other projects that have been proposed, or are reasonably foreseeable to take place in the vicinity of the proposed project. The primary activities considered in the analysis of cumulative impacts are other geothermal projects and other activities in the project vicinity that could occur at the same time as the proposed project.

The geographic area considered for cumulative impacts is generally considered to be a 10-mile radius from the proposed project area, although boundaries of analysis are dependent upon the type of impact to be assessed and the extent of the proposed project's impacts. The anticipated start date for construction of the proposed project would be in 2011 (summer or fall).

The effects of geothermal projects vary with the type of activity (i.e., exploration, development, well drilling, or power plant operation) and the temperature of the geothermal resource. High-temperature resources usually result in the development of power production facilities. Low-temperature resources usually support direct use projects, such as district heating, aquaculture, or food drying.

The effects of construction- and operation-related activities of the proposed project are described in Chapter 3 of this document.

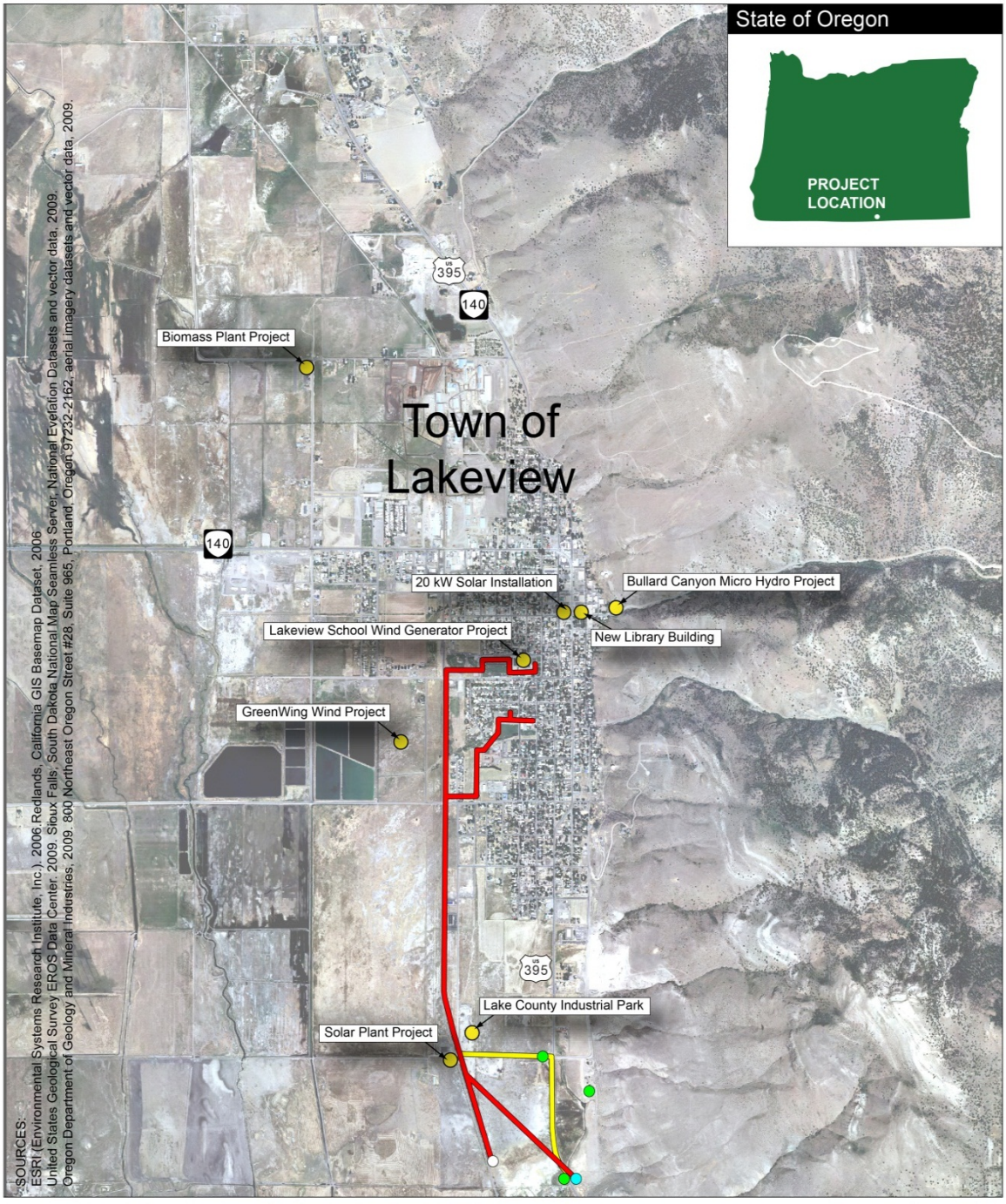
4.1 REASONABLY FORESEEABLE PROJECTS

This section provides a brief discussion of projects near the proposed project that could have some potential to lead to cumulative impacts. Past and present projects are addressed as part of the project baseline, in Chapter 3. Agencies contacted or queried for information regarding cumulative projects include:

- BLM, Lakeview District (no projects within 10 miles)
- Town of Lakeview
- USFS, Lakeview Ranger District (no projects within 10 miles)
- Lake County

Several upcoming renewable energy projects, pending approval and funding, have been identified within 10 miles of Lakeview. Each of these projects is summarized below. Other projects include the ongoing construction of the new library within Lakeview. The regional projects considered in the cumulative analysis are shown in Figure 4.1-1.

Figure 4.1-1: Regional Projects



4.1.1 BULLARD CANYON MICRO HYDRO PROJECT

The Town of Lakeview is proposing to install a micro-hydropower system using a turbine generator with spring water from Bullard Canyon. The system would be installed near the Town's pool for the purposes of energy generation. Project implementation is expected to occur within 1 to 5 years.

4.1.2 20-KILOWATT SOLAR INSTALLATION

The Town of Lakeview currently applied for a Pacific Power Blue Sky grant to install a 20-kilowatt solar panel system on the roof of the Town's Emergency Service Building. The panels would be used to offset the energy used in building operations. An informational kiosk and meter would be displayed in the lobby for the purpose of educating residents and visitors about renewable energy. Matching funding is available for the project from the Town pending the receipt of the Blue Sky grant.

4.1.3 LAKEVIEW SCHOOL -WIND GENERATOR PROJECT

The Lakeview School District currently applied for a Pacific Power Blue Sky grant for the installation of a small wind generator at one of the schools in Lakeview. The school would use the wind generator to introduce an alternative energy component to the educational curriculum.

4.1.4 BIOMASS PLANT PROJECT

The biomass energy facility would be located near the Fremont Sawmill in Lakeview. This area falls within a Fremont-Winema National Forest Stewardship Unit. DG Energy is working with The Collins Company's (sawmill owner) to pursue the development of a 10- to 15-megawatt biomass cogeneration plant. Construction of the project is slated to begin in 2011.

4.1.5 SOLAR PLANT PROJECT

The Obsidian Finance group has begun acquiring properties for development of a solar farm. The potential site for the solar farm is still unknown, but may be located near the southern end of the proposed project, near the Lake County Industrial Park.

4.1.6 GREENWING WIND PROJECT

GreenWing Energy Management, Ltd., a privately owned company, is gathering data for the development of a wind farm outside Lakeview. To date, two test towers have been installed and over the next year will be used to gather data on the viability of the resource.

4.1.7 NEW LIBRARY BUILDING

Construction of a new library building in Lakeview has begun on behalf of the Oregon Library District. The Town of Lakeview is not involved in this project, as the funding is from the local tax base.

4.1.8 LAKE COUNTY INDUSTRIAL PARK

Lake County owns a business incubator/startup facility on the Town of Lakeview proposed project site. The Industrial Park could be served in the future by geothermal water that had already circulated through the other buildings. The water would be approximately 80°F to 100°F once it reached the Industrial Park, which is hot enough for space heating for industrial use. Connections would be made to the main distribution pipeline on a case-by-case basis. Connection at this point is unknown.

4.2 SUMMARY OF CUMULATIVE IMPACTS

4.2.1 AIR QUALITY

The proposed project would have some emissions during construction, including particulate matter and precursors to ozone. The region is in attainment for particulate matter (PM_{10}); however, the proposed project would generate some PM_{10} and $PM_{2.5}$. Cumulative impacts could occur if projects occurring simultaneously also produced enough particulate matter to exceed ambient air quality standards. Projects that would involve ground disturbance include the construction of the wind generator and solar panels on buildings in the Town; however, these projects are not scheduled for at least a year. None of these projects would be expected to generate significant amounts of particulate matter and it is likely that measures would be enforced to reduce fugitive dust levels. Fugitive dust would also be controlled at the proposed project site through proposed environmental protection measures. Cumulative impacts would be minor.

The proposed project is not expected to generate major air emissions during operation. Well venting may generate some H_2S emissions; however, no other projects in the vicinity of the proposed project would generate large quantities of H_2S. Cumulative H_2S emissions are negligible.

4.2.2 GEOLOGY AND SOILS

The proposed project would involve disturbance of soils, leading to a small potential for erosion. Cumulative impacts would occur if other projects involved large amounts of ground disturbance that could, in conjunction with the proposed project, lead to severe erosion and cause siltation of a waterway or water body or slope instability.

Some of the other construction projects would involve ground disturbance and could lead to erosion and slope instability depending on where the project takes place. Impacts from erosion are minimal and would only occur for a short period of time. All disturbed areas would be reclaimed to prevent future erosion at the project site. The proposed project would have negligible effects on soils and cumulative effects would be minimal.

The project would utilize the geothermal resource in the area. No other proposed projects in the region would also utilize the geothermal resource; however, this could change in the future. Existing facilities may choose to connect to the direct use system for their heating needs; however, this would represent a small percentage of energy provided by the geothermal resource. Geothermal water from the project would be injected back into the

geothermal reservoir. The proposed project in conjunction with other projects would have minimal cumulative impacts on the geothermal resource.

4.2.3 BIOLOGICAL RESOURCES

The proposed project includes protection measures to avoid or reduce the impacts associated with special-status species, wetlands, and invasive species. Cumulative impacts would occur if the project, in relation to another project, led to a massive spread of invasive species, threatened the existence of a special-status species or its habitat, or resulted in additional impacts to wetlands. The construction of the commercial wind and solar projects and the biomass plant would cause the removal of vegetation if they are sited in vegetated areas. Depending on the location of the facilities, the construction could affect special-status species, wetlands, and aid in the spread of invasive species. Measures would likely be defined for the project to reduce potential impacts.

The proposed project would only disturb 11.5 acres of vegetated lands and 0.08 acre of wetlands. With implementation of measures to minimize impacts to sensitive species and prevent the spread of invasive plants, the project would have a minimal contribution to any cumulative impacts. The project could indirectly impact wetlands and springs. Other projects that could also withdraw water in the future could have a cumulative effect on wetlands and springs. There are no proposed projects that would withdraw water from the same aquifer in the vicinity of the proposed projects such that cumulative effects could occur. The existing water users (i.e., the WCCF, the greenhouse, the BLM/USFS interagency building) were considered in the baseline analysis for this document.

4.2.4 WATER RESOURCES

The proposed project would present a risk to water quality because of the use of hazardous materials; however, construction plans include measures to reduce the risk of a hazardous material spill or other potential contamination.

Cumulative impacts would occur if water quality was seriously degraded due to a hazardous materials spill. The proposed project would be confined to a specific area and all spills during construction and/or operation would be contained and cleaned. The chance of a hazardous materials spill being compounded by any of the other projects in the area is unlikely. Cumulative impacts to water quality would be minimal.

The project could impact groundwater use that could compound with other proposed projects. No other proposed projects are anticipated to use the existing geothermal wells and system; however, this could change in the distant future. The project has been analyzed for the effects of groundwater drawdown with the existing uses.

Existing facilities may choose to connect to the direct use system for their heating needs; however, this use would consume only a small percentage of energy provided by the geothermal resource.

4.2.5 NOISE

The proposed project would have adverse noise impacts from drilling. Proposed strategies, including notifying neighboring properties of noise effects and installing a sound barrier

attached to the drill rig, would prevent adverse impacts. Cumulative impacts could occur if other noise is generated in the same area as the proposed project.

The construction of several anticipated projects could occur at the same time as the proposed project. General construction noise from the building of the biomass plant, solar project, or GreenWing wind project could compound with the drilling noise; however, construction would only occur during daytime hours. The measures proposed to minimize noise from the drilling and construction site would prevent the proposed project from having a large incremental contribution to overall noise effects. Impacts from drilling would be temporary and response to noise complaints would minimize impacts of the proposed project in conjunction with other projects.

The operations phase of the project would have limited noise generation. Residences and businesses would be far enough away from the proposed project areas that noise generated from the geothermal well sites would not compound with any of these projects to generate a cumulatively considerable noise impact. Cumulative noise impacts would be minimal.

4.2.6 VISUAL RESOURCES

The proposed project would have temporary impacts on visual resources during construction; however, most construction would occur in foreground views and would not impact the more scenic background views. The existing construction, including construction of the library building and potential construction of a new wind generator at the school or solar panels at the Emergency Services building would result in additional construction in foreground views in Lakeview. Because these views are not considered scenic, major cumulative effects on visual resources are not expected.

Project operation would have limited visual impacts. New developments, such as the development of a wind farm, would have some impact on visual resources in the area, but the contribution of the proposed project to an overall adverse impact is expected to be negligible.

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6 AGENCIES AND PERSONS CONSULTED

Name	Organization/Title
Tribes	
Melinda Dollarhide	Cedarville Rancheria of Paiute Indians
John Vass	Fort Bidwell Indian Community
Environmental Coordinator	Pitt River Tribe Environmental Office
Theresa Peck	Burns Paiute Tribe
Dale Barr	Fort McDermitt Reservation
Sally Bird	Confederate Tribes of Warm Springs Reservation
Perry Chocktoot	Klamath Tribes
Ron Eagleye Johnny	Summit Lake Paiute Council
Floyd Buckskin	Pitt River NAGPRA
Philip Del Rosa	Alturas Rancheria of Pitt River Indians
Bureau of Land Management, Lakeview Office	
Paul Whitman	NEPA Coordinator
U.S. Army Corps of Engineers, Eugene Field Office	
Shelly Hanson	Specialist
Oregon State Historic Preservation Office	
Dennis Griffin	State Archaeologist
Oregon State Department of Environmental Quality	
Steve Kirk	Goose and Summer Lakes Basin Coordinator
Frank Messina	Air Quality Inspector
Oregon State Department of Fish and Wildlife	
Craig Foster	Biologist
U.S. Fish and Wildlife Service	
Alan Mauer	Biologist

Name	Organization/Title
Oregon Natural Heritage Information Center	
Lindsey Koepke	Assistant Information Manager
Town of Lakeview	
Ray Sims	Town Manager
U.S. Forest Service	
Karen Zamudio	Forest Ecologist, Fremont-Winema National Forest
Lake County	
Jennifer Stephens	Planning Department

APPENDIX A: SCOPING MATERIALS

Scoping Notice and Mailing List

Department of Energy
Golden Field Office
1617 Cole Boulevard
Golden, Colorado 80401-3393

September 28, 2008

TO: Distribution List

SUBJECT: Notice of Scoping – South Central Oregon Economic Development District Lakeview Geothermal Project

The U.S. Department of Energy (DOE) is proposing to provide Congressionally Directed Federal Funding to the South Central Oregon Economic Development District (SCOEDD) to fund a geothermal direct use and small scale power generation project in Lakeview, Oregon. Pursuant to the requirements of the National Environmental Policy Act (NEPA), the Council on Environmental Quality regulations for implementing the procedural provisions of NEPA (40 CFR Parts 1500-1508), and DOE's implementing procedures for compliance with NEPA (10 CFR Part 1021), DOE is preparing a draft Environmental Assessment (EA) to:

- Identify any adverse environmental effects that cannot be avoided should this proposed action be implemented.
- Evaluate viable alternatives to the proposed action, including a no action alternative.
- Describe the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity.
- Characterize any irreversible and irretrievable commitments of resources that would be involved should this proposed action be implemented.

Project Description

Direct Use System

The direct use well and pipeline would be used to heat various town buildings (Lakeview District Hospital, Lakeview High School, Daly Middle School, Fremont School, A.D. Hay School). Geothermal water would be extracted at the production well site, transferred via an underground pipeline, cycled through the buildings, and then reinjected into the reservoir at a reinjection well site. All buildings receiving heating from the system would require some form of equipment upgrade, except for the hospital. A short spur pipeline would also be constructed to allow heating at the Lakeview Industrial Park in the future.

The direct use system would require drilling a production well (approximately 600 feet deep) at the Barry Well site near US Highway 395 and drilling an injection well (approximately 400 to 500 feet deep) 0.5 miles west of the Barry Well site near an existing railroad right of way. The proposed pipeline would extend from the production well to the reinjection well, and then follow the railroad right of way north to the Town. This pipeline would extend further north along the railroad tracks before heading east to Lakeview High School and Daly Middle School. Another spur would be located at a point just south of Deadman's Creek. This spur would extend eastward

from the railroad tracks to Lakeview District Hospital, A.D. Hay School, and Fremont School. The total length of the pipeline would be approximately 3.4 miles

Power Generation System

A small, 200-kW geothermal power plant is proposed just south of Geyser View Road. The power plant would be constructed at the location of an existing geothermal production well (North production well). The North production well is currently used to provide heat to the Warner Creek Correctional Facility. The power plant would utilize geothermal fluid from the existing production well. Work would be completed on another production well (the Utley well) such that the Utley well could be used to augment the geothermal fluid flow to the power plant. Geothermal fluid from the system would continue to be injected at the existing hot water reinjection well off of McDonalds Road. Water for use in the proposed cooling tower would be obtained from the Lakeview municipal water system.

The power generation system would require the drilling of a new cold water injection well to the east of the power plant at the intersection of Geyser View Lane and McDonalds Road for injection of cold water used for the proposed cooling tower. New pipelines would have to be constructed from the Utley well to the power plant and from the cold water injection well to the cooling tower. Several small connector pipelines would need to be installed to connect existing facilities to the power plant.

The power generated by the system would be sold to PacifiCorp. A power line from the geothermal power plant to the existing power line on the south side of Geyser View Lane would be connected underground or above ground, determined in coordination with PacifiCorp.

Project Location

The proposed project area would be located in and around Lakeview, Oregon. The components would be located in Range 20 East, and Townships 38 South and 39 South, of the Willamette Base and Meridian. The proposed geothermal direct use system would originate approximately 1 mile south of Lakeview at the Barry well site, located just east of US Highway 395. The pipeline from this site would extend west, then north into Lakeview. The proposed power generation system would be located approximately 1 mile north of Lakeview off of Geyser View Lane. The project location is shown in Figures 1 and 2.

Probable Environmental Effects/Issues Scoped for the Environmental Assessment (EA)

The EA will describe all potential impacts on the environment caused by the project and will identify possible mitigation measures to reduce or eliminate those impacts. The EA will describe the potentially affected environment and the impacts that may result to:

- Meteorology/Air Quality
- Geology/Soils
- Mineral Resources (including geothermal)
- Biological Resources
- Water Resources
- Cultural Resources

- Land Use
- Noise
- Infrastructure
- Aesthetics
- Socioeconomics (including Mineral Rights)

Development of a Reasonable Range of Alternatives

DOE is required to consider a reasonable range of alternatives to the proposed action during the environmental review. The definition of alternatives is governed by the "rule of reason." An EA must consider a reasonable range of options that could accomplish the agency's purpose and need and reduce environmental effects. Reasonable alternatives are those that may be feasibly carried out based on environmental, technical, and economic factors.

The No Action alternative will be addressed. The need for project redesign, or a project alternative, will be determined during the course of environmental review.

Public Scoping

This letter will be available to all interested state, local, and federal agencies to supply input on issues to be discussed in the EA. Agencies should identify the issues, within their statutory responsibilities, that should be considered in the EA. The general public is also invited to submit comments on the scope of the EA on or before October 28, 2009. No formal public scoping meeting is currently planned for this project. Please send your comments regarding the scope and content of the EA, along with the name and address of an appropriate contact person to:

Tania Treis
c/o RMT, Inc.
4 West Fourth Avenue, Suite 303, San Mateo, CA 94402
tania.treis@rmtinc.com

This letter and the draft EA, when available, will be posted to the Golden Field Office electronic reading room: http://www.eere.energy.gov/golden/reading_room.aspx.

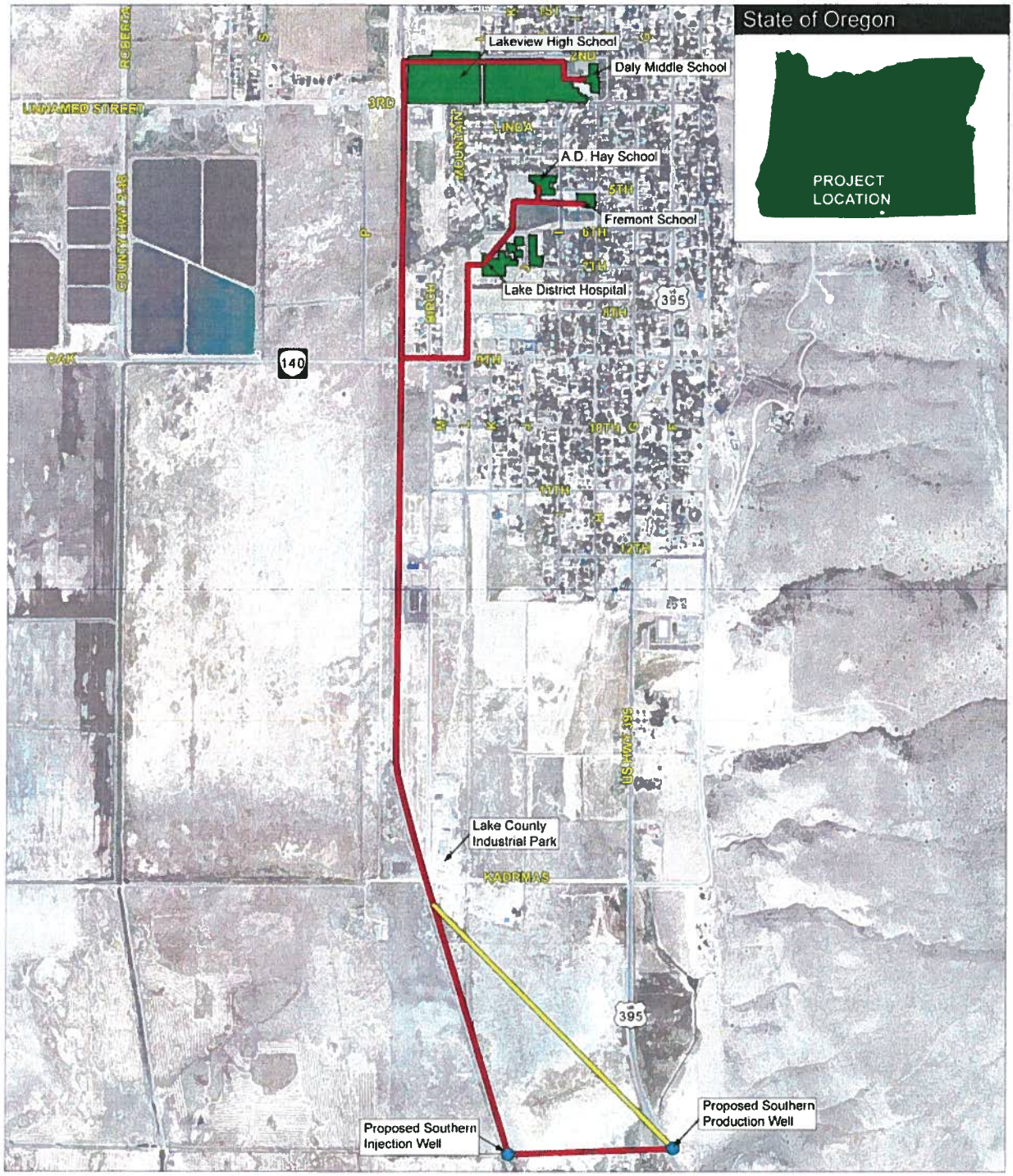
Thank you for your participation in the environmental review process.

Sincerely,

Steve Blazek

NEPA Compliance Officer

Figure 1: Proposed Project Elements - Direct Use System



SOURCE: www.OregonExplorer.info 2009, and RMT Inc. 2009

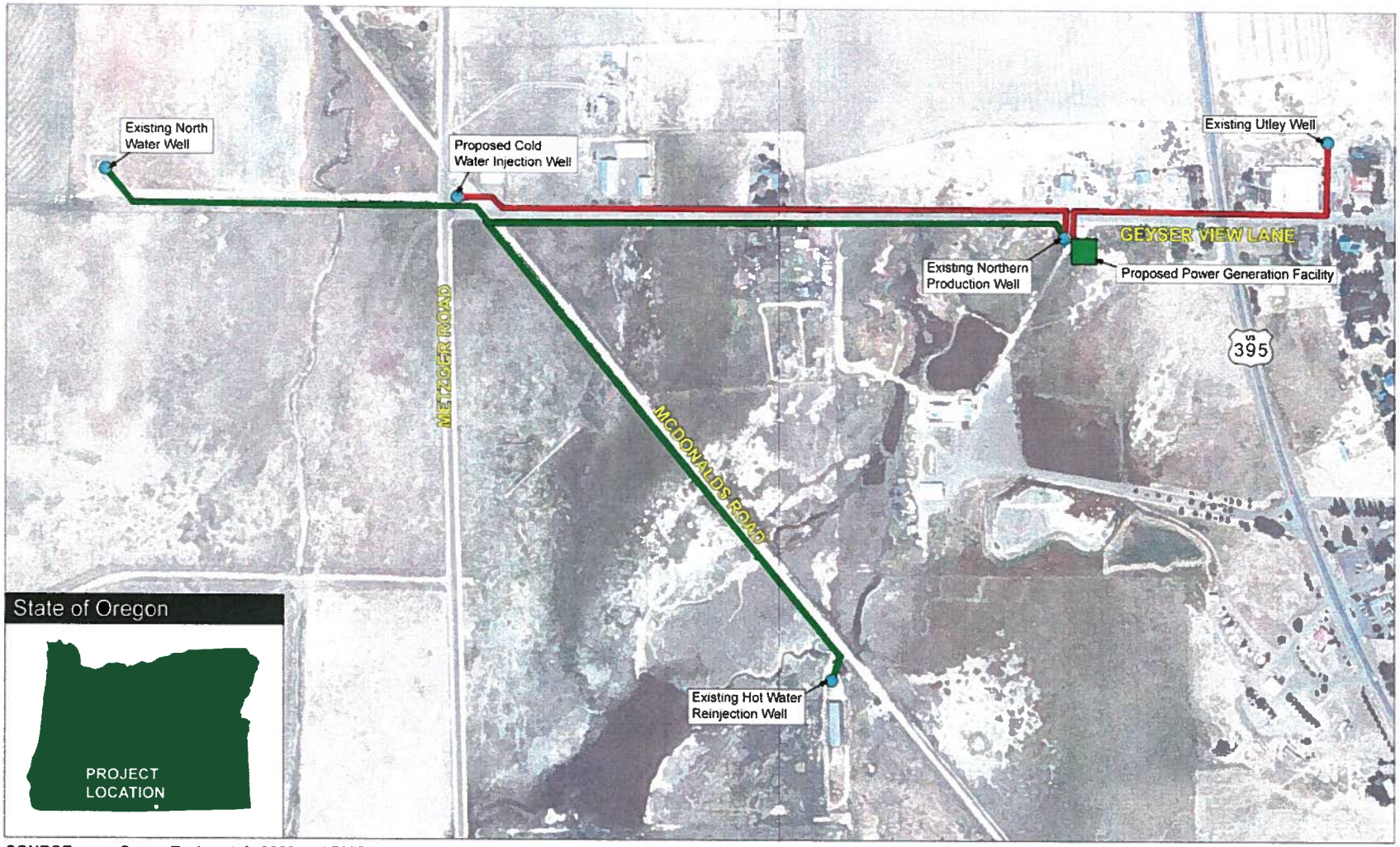
LEGEND

- Proposed Pipeline Route
- Alternative Pipeline Route
- Well Site
- Project Building
- 395 U.S. Highway
- 66 Oregon State Route

N W E S

0 0.5 1 Mile

Figure 2: Proposed Project Elements - Power Generation



SOURCE: www.OregonExplorer.info 2009 and RMT Inc. 2009

LEGEND

N W E S

Proposed Pipeline Route

Existing Pipeline Route

Well Site

Power Generation Facility

395 U.S. Highway

0 500 1,000 Feet

RMT

ENVIRONMENT • ENERGY • ENGINEERING

Scoping Letter Contact List

Oregon Water Resources Department

Brian Mayer, District 12 Watermaster
513 Center Street
Lakeview, OR 97630
541-947-6038

Kyle Gorman, Region Manager
South Central Region
1128 NW Harriman Street
Bend, Oregon 97701
541 388-6669

Tim Wallin, Water Rights Manager
725 Summer Street, NE Suite A
Salem, OR 97301
503-986-0891

Bureau of Land Management

Carol Benkosky
BLM Lakeview District
1301 South G Street
Lakeview, OR 97630
541-947-2177

US Forest Service

Fremont-Winema National Forests
1301 South G Street
Lakeview, OR 97630
541-947-2151

Oregon Department of Geology and Mineral Industries

Vickie McConnell
Oregon Department of Geology and Mineral Industries
800 NE Oregon St. #28, suite 965
Portland OR, 97232
971-673-1555

Bob Brinkmann, RG, Hydrogeologist
Mineral Land Regulation & Reclamation Program
229 Broadalbin Street SW
Albany, OR 97321
541-967-2068

Oregon Department of Energy

Tom Stoops
625 Marion St. NE
Salem, OR 97301-3737

Department of Environmental Quality

811 SW 6th Avenue
Portland, OR 97204-1390
503-229-5696

Underground Injection Control
811 SW 6th Avenue
Portland, OR 97204-1390
503-229-5945

US Fish and Wildlife Service

Alan Mauer
Bend Field Office, USFWS
20310 Empire Avenue, Suite A-100
Bend, OR 97701
541-383-7146

Oregon Department of Fish and Wildlife

Lakeview Field Office
Craig Foster
PO Box 1214
Lakeview, OR 97630

Lakeview Field Office
Shannon Hurn
PO Box 1214
Lakeview, OR 97630

US Army Corps of Engineers

Michele Hanson
1600 Executive Parkway, Suite 210
Eugene, OR 97401-2156
541-465-6878

Planning

Ken Gerschler
Lake County Planning Department
513 Center Street
Lakeview, OR 97630
541-947-6032

Town of Lakeview Planning Commission
525 North 1st Street
Lakeview, OR 97630
541-947-2029

Native American Contacts

Melinda Dollarhide, Environmental Coordinator
Cedarville Rancheria of Paiute Indians
200 South Howard Street
Alturas, CA 96101

John Vass, Cultural Resources Coordinator
Fort Bidwell Indian Community
PO Box 129
Ft. Bidwell, CA 96112

Cultural Resources Coordinator
Pitt River Tribe Environmental Office
37118 State Highway 299
Burney, CA 96013

Theresa Peck, Cultural Resources Coordinator
Burns Paiute Tribe
100 Pasigo Street
Burns, OR 97720

Dale Barr
Fort McDermitt Reservation
PO Box 457
Ft. McDermitt, NV 89421

Sally Bird
Confederate Tribes of Warm Springs Reservation - Natural Resources Dept
1233 Veterans St.
Warm Springs, OR 97761

Perry Chocktoot, Cultural Resources Coordinator
Klamath Tribes
PO Box 436
Chiloquin, OR 97624

Ron Eagleye Johnny, J.D.
Summit Lake Paiute Council
1708 H Street
Sparks, NV 89431

Floyd Buckskin, Cultural Resources Coordinator
Pitt River NAGRPA
40538 McArthur Road
Fall River Mills, CA 96028

Philip Del Rosa, Chair Person
Alturas Rancheria of Pitt River Indians
PO Box 340
Alturas, CA 96101

Comment Letters
Received During Scoping

From: Paul_Whitman@blm.gov [mailto:Paul_Whitman@blm.gov]
Sent: Tuesday, October 06, 2009 6:02 PM
To: Carusona, Christopher; tania.treis@rmtinc.com
Cc: Steven_Flock@blm.gov; Tom_Rasmussen@blm.gov; Barbara_Benz@blm.gov
Subject: Fw: Lakeview geothermal scoping

Chris - thanks for sending this notice to our office. I would like to formally request that you add our office to the mailing list for the EA.
Bureau of Land Management
Lakeview District
1301 N. G Street
Lakeview, OR 97630
ATTN: Paul Whitman

In addition, the EA should address the potential impacts of this new use of geothermal energy on other existing geothermal users in the vicinity of Lakeview, including private homes and the BLM/Forest Service. As you may recall, our inter-agency office is located about a mile north of the proposed production well and uses a geothermal heating system. The proposed project has the potential to negatively affect the amount and/or temperature of the water available to heat our office building.

I assume the EA will also address who has the mineral rights to the geothermal resource in Goose Lake Valley.

Paul Whitman
Planning and Environmental Coordinator
Lakeview District

Lake County Board of Commissioners
513 Center Street
Lakeview, Oregon 97630
(541) 947-6003
Fax (541) 947-5775

Bradley J. Winters, Chairman
Dan Shoun, Vice-Chairman
Ken Kestner, Commissioner

October 21, 2009

Tania Treis
c/o RMT, Inc.
4 West Fourth Avenue, Suite 303
San Mateo, CA 94402

RE: Lake County, Oregon, Public Comment on South Central Oregon Economic Development District (SCOEDD) Lakeview Geothermal Project.

Dear Ms Treis;

This Board of Lake County Commissioners wishes to express our full support of DOE's proposed funding to SCOEDD to fund the Lakeview Geothermal Project.

Lake County is an economically-depressed, remote, rural county in the State of Oregon. The County, the public schools and hospital, and the affected communities are not financially able to fund the Lakeview Geothermal Project.

The Town of Lakeview lies in a valley basin which incurs stagnant air conditions, resulting in poor air quality that is currently of concern by EPA. Emissions from use of fossil fuel for heating and cooling our public schools, hospital, and other public facilities contribute to the poor air quality.

Fossil fuel for our current, conventional heating and cooling systems is a substantial budget cost associated with public institutions and facilities, and the costs will only increase in the future as world demands outpace the supply. Additionally, fossil fuel must be trucked into Lake County from roughly a hundred miles away, adding a substantial increase in costs. Meanwhile, geothermal resource, a 'green energy', is proven less costly over time, less environmentally damaging, and is locally accessible if the infrastructure is developed.

The County's land mass is 78% publicly owned, predominately of federal lands, resulting in both a low tax base and a low population level. Both of these factors further place a constraint on available financial resources to support our public schools, hospital, other public services, and communities in general, including the Town of Lakeview.

This Board does not foresee any adverse effects associated with the proposed project which cannot be adequately mitigated.

This Board does foresee substantial environmental and social-economical beneficial effects that could be realized by the proposed project. The beneficial effects that could be realized from this proposed project are:

1. Contribute locally to reduction in trade import of foreign petroleum.

2. Contribute locally to reduction in fossil fuel emissions to atmosphere, thus contribute to reduction in global warming caused by air pollution.

3. Contribute locally to reduction in fossil fuel emissions to the atmosphere, thus contribute locally to enhancing air quality for the citizens of the Town of Lakeview and citizens of the surrounding basin.

4. Contribute locally to reductions in highway truck traffic, which in turn contribute to highway safety, especially during dangerous winter driving conditions, and contribute to reduction of damages to highway infrastructure caused by wear-and-tear from truck traffic.

5. Contribute locally to increase percentages of available, marginal financial resources to be spent on primary focuses of public institutions and facilities, as education in schools, health care in the hospital, and initial start-up funds for businesses to utilize the Lakeview Industrial Park.

6. Number 5 above further contributes locally to better education, better health care, and increased success potential in establishment of new businesses, all which contribute to enhancing social and economical health of rural America.

Respectfully submitted,

Bradley J. Winters

Dan Shoun

Ken Kestner

Cc: Honorable US Senator Jeff Merkley
Honorable US Senator Ron Wyden
Honorable US Representative Greg Walden
Honorable Governor Ted Kulongoski, State of Oregon

October 28, 2009

Tania Treis
c/o RMT, Inc.
4 West Fourth Avenue
Suite 303
San Mateo, Cailfornia 94402
tania.treis@rmtinc.com

RE: Addendum to My Public Scoping Comments for South Central Oregon Economic Development District - Lakeview Geothermal Project

Dear Ms. Treis:

I would like to add the following to the public scoping comments I forwarded to you on October 25, 2009.

Thank you!

Sincerely,

Chris Zinda
P.O. Box 574
Lakeview, Oregon 97630
541/219-0347

Under **NEPA**:

Exemptions

It is my understanding that the Warner Creek Correctional Facility had quite a bit of controversy surrounding its location in Lakeview. Part of that controversy was Oregon Public Initiative Measure 11 and exemptions from environmental impact compliance for construction of new facilities, of which Warner Creek was one. There was some question of the legality of this process, particularly since federal dollars were utilized and, it was argued (notably by the Western Prison Project), the prison project should have required application of NEPA. That issue never saw a legal proceeding.

It is unclear the level and extent of environmental compliance and impact analysis that has been performed either by the State of Oregon, Oregon Department of Corrections or the Town of Lakeview for their use of geothermal resources at City Well site as part of prison operations.

Therefore, I ask that the spirit of NEPA be applied to the environmental, socioeconomic, and cultural impacts of the water drawn by the Town of Lakeview for the Warner Creek Correctional Facility and be applied separately and in relation to the additional/cumulative water drawn from the well as proposed for the PGS. This is particularly relevant in conjunction with a water agreement the Town of Lakeview has in place with the Department of Corrections in relation to priority water delivery (see Socioeconomics – Agreements, below).

Segmenting

The development of the City Well and its application to the Warner Creek Correctional Facility was in large paid for by the State of Oregon in conjunction with construction of the prison. The Town of Lakeview supplemented the capital costs to oversize the system to enable expansion. (See http://dspace.mit.edu/bitstream/handle/1721.1/42932/251518357.pdf)

Had NEPA been appropriately applied to the construction impacts of the Warner Creek Correctional Facility and had the City stated its intent to propose a PGS at that same time, an analysis of the environmental, socioeconomic and cultural impacts of BOTH projects would have been applied. As it stands, it is unclear the level of environmental impact analysis that was performed on either the Warner Creek Correctional Facility OR the City Well.

Therefore, because of the segmenting that has occurred with the totality of the water development project, I ask that the spirit of NEPA be applied retroactively to the development of the City Well, its current water allocation to the Warner Creek Correctional Facility and the intended expanded draw for the PGS.

Under **SOCIOECONOMICS**:

Agreements

It is my understanding that the Town of Lakeview and the Oregon Department of Corrections have a water agreement in place that stipulates that in the event of water shortages, the prison has priority to delivery.

Given there were documented surface water recharge issues at Hunters Hot Springs during the summer of 2009, it is quite possible that during drought years the PGS would not be able to operate and during the wet season would also not be able to operate due to the greater demands of the Warner Creek Correctional Facility.

Since surface water rights are priority, I ask that the economic impacts of this agreement in relation to the proposed PGS and its effects on surface and subsurface water availability need to be reflected in that analysis. No doubt, PacificCorp, the Town of Lakeview, the Utley well owner (or others if a bidding process, as suggested) have much to lose - as do the taxpayers who provide funding via various governmental agencies.

--- On **Sun, 10/25/09, C Z <zinwhit@yahoo.com>** wrote:

From: C Z <zinwhit@yahoo.com>
Subject: Hunters Hot Springs and Geothermal Power System Scoping Comments
To: lakeviewtownmanager@yahoo.com
Date: Sunday, October 25, 2009, 7:29 PM

Dear Mr. Simms:

Rather than work through other individuals to voice our opinions regarding the Geothermal Power System proposal on which you have been working for the last 4 or so years, I thought that I'd open a dialog with you as to where I am coming from regarding the project. I'm doing this as a courtesy so that we may work with one another in the future as the EA for the project progresses.

Depending on one's point of view, fortunately we are staying at Hunters' while we are purchasing a home. My background includes a Master of Public Administration with an emphasis on environmental planning and 10 or so years with the National Park Service, most in management or planning related roles. I am well versed with the NEPA process, environmental laws, and their application to public projects.

Unfortunately for some, we just moved to the area and never intended to be the "newcomer" who creates "problems" for the local community. The proposed power generation facility and its siting, along with my interest and area of expertise, were serendipitous.

I have recently provided my scoping comments for the project. I believe I forwarded them to you and your peers via email, but include them once again, below, if for some reason you didn't receive it. I have also forwarded them to various public agencies and environmental interest groups to bring awareness to this important high desert, wetlands issue.

In short, because I care about the hot springs and associated wetlands, and because we are purchasing a home affected by the proposed project, my concerns are as follows:

* Federal law requires no net loss of wetlands. The Cone of Depression from the current draw from the city well is not monitored and, I believe, has already negatively affected surface hot water recharge at Hunter's Hot Springs that feed the wetlands. Additional draw as proposed as part of the project may/will only make matters far worse. Therefore, monitoring wells need to be installed and measurements correlated with current city use.
* There is the possibility of a rare, endemic, T&E fish species being present on the site. Oregon Fish and Wildlife has already collected a specimen.
* Nearby geothermal wells on Goldmor Terrace could be negatively affected by a increase in draw from the Utley well. Additionally, I would like to see an open bidding process for other interested well owners.
* Noise from the generation facility will be heard 24/7 by north valley residents and negatively impact migratory wildlife (including waterfowl).

* The geyser and Hunter's Hot Springs (including the resort) are important cultural resources to the residents of Lakeview and Lake County and because DOE has done the minimum public notice (a public notice in the newspaper), fewer interested residents are informed of potential negative affects associated with the project. Therefore, a formal public meeting is in order.

Regarding the geyser the your comments I received from Ken Kestner (whom I will soon be a next-door neighbor), I am currently in the process of obtaining the original EA for the Warner Creek Correctional Facility via their PIO. It is my bet that not much work was performed on the ground at the private lands of Hunters Hot Springs and no longitudinal data collection performed to establish long term effects (i.e. monitoring wells).

Nonetheless, Old Perpetual is a side issue, in my opinion. A symbol. The real deal are the vents that feed the hot springs and pots on the surface that no doubt extend to the same depth (most likely beyond) that of the city well. These vents (and wells) no doubt interact with one another through the highly fractured and fissured volcanic rock. Without monitoring wells in place, your own, the former contractors doing the EA for the Warner Creek Correctional Facility, and my opinion are worth the same weight when it comes to the effects of the city well draw to surface waters and wetlands at Hunters.

In a perfect world, the Town/County would purchase Hunters and turn it into a public park. Resource restoration projects could ensue to improve the wetlands, local people would have a great place to recreate and learn, and the land would become a tourist destination asset rather than its current run down reality. I know the owner is looking to sell, and this could be one way the town/county could better control the project outcome. Playing devil's advocate here, of course :-)

That said, I'd still be opposed for the reasons described, above and below.

Since the DOE is not proposing to have a formal public meeting at this time, I have been thinking of holding my own here at Hunters in their banquet room, including a petition drive. I have also been thinking of creating a 501(3)c with the name "Friends of Hunters Hot Springs" to get people involved and informed not only in this particular project but also to generate interest in restoring the wetlands area after the fate of this project is decided. While this area is in private hands, resources such as these particular hot spring wetlands are uniquely public and important wildlife assets.

Thank you again for your time spent on what I believe is a very important issue. I look forward to meeting with you again in the future and am available to speak or meet with you at any time.

Chris Zinda

October 23, 2009

Tania Treis

c/o RMT, Inc.

4 West Fourth Avenue

Suite 303

San Mateo , Cailfornia 94402

tania.treis@rmtinc.com

RE: Public Scoping Comments for South Central Oregon Economic Development

District - Lakeview Geothermal Project

Dear Ms. Treis:

As an interested citizen, I am writing to provide public comments regarding the Environmental Assessment being developed for the South Central Oregon Economic Development District – Lakeview Project. My comments relate to the proposed Power Generation System.

Thank you for the opportunity to comment. Should you have any questions, please feel free to contact me at the number, below.

Sincerely,

Chris Zinda

P.O. Box 574

Lakeview , Oregon 97630

541/219-0347

Cc: Lake County Supervisors

Lake County Chamber of Commerce

Oregon Wild

Oregon Natural Desert Association

Oregon Audubon Society

Oregon Ducks Unlimited

Hunter's Hot Springs Resort

Oregon Department of Fish and Wildlife

Area Landowners

NEPA PROCEDURES

- **Two EAs for Two Projects**

I have concern that the Environment Assessment (EA) is too broad, meaning there are two dissimilar projects being evaluated by the same assessment. One is the Direct Use System (DUS) and the other the Power Generation System (PGS). I believe each should receive their own EAs.

They are not only dissimilar in scope but dissimilar in geography and natural environment. Hunters Hot Springs , nearest to the proposed PGS, contains extensive wetlands and currently utilized historic surface water resources at a historic hot springs resort while the location of the DUS does not. The surface waters at Hunters Hot Springs that may be affected by geothermal groundwater pumping at the City Well could also result in the extirpation of a fish species that may be endemic and rare. Hunter's Hot Springs and its pools/ponds are used by migratory birds while the DUS is not.

The economic differences are also quite dissimilar, as additional geothermal groundwater use at the proposed PGS could render surface waters inadequate for the owners of Hunter's Hot Springs Resort and the recharge inadequate for the hot water geyser – Old Perpetual – that is highly touted by the Lake County Chamber of Commerce and area tourism related businesses as a "must see" destination.

Therefore, I propose that two, separate, Environmental Assessments be prepared.

- **Formal Public Scoping Meeting**

The hot water geyser, historic Hunter's Hot Springs and the associated wetlands are important cultural resources for area residents. A simple NEPA scoping announcement in the public notice section of the local newspaper does not give this local importance justice.

Therefore, I propose that a formal Public Scoping Meeting be held in Lakeview , Oregon before

the DRAFT EA is prepared.

- **Project Partners**

It is proposed that part of the PGS is a hot springs known as the Utley Well. Why was this well/partner chosen? There are other hot wells in the area owned by individuals that could also benefit by the economic gain the project presents.

Therefore, I ask for the EA to include a discussion of how and why the Utley Well was chosen, including a possible public bidding process to allow other interested individuals access to the project.

WATER RESOURCES

- **Surface Water**

Hunter's Hot Springs Resort has historic surface water rights in the proposed area. During the late summer and early fall of 2009, the surface water in the geothermal hot pools that supply the historic resort would not recharge at a sufficient rate to allow even a proper heating of the therapeutic hot pool in the complex.

Additionally, the Old Perpetual geyser stopped erupting earlier than in normal years – and as of October 23, 2009 has not yet returned. A local man has kept eruption records for the last decade that illustrate a drastic change in the geyser's behavior.

Finally, all but one of the surface water ponds surrounding Hunter's Hot Springs dried up in 2009 – a first in the last 70 years say many old timers. These ponds are supplied water by the geothermal hot pots near the proposed project.

I believe a combination of variables are involved, including the Cone of Depression created by the city well that supplies the Warner Creek Correctional Facility and that is proposed to be used for the PGS (see Ground Water comments, below). This well is not more than 100 yards from the geyser and not 150 yards from the hot pots that are supposed to bubble their hot water to the surface and supply the wetlands with much needed water.

Surface water is vital to the fragile environment surrounding Hunter's Hot Springs . Migratory waterfowl, shorebirds, scientifically important bacteria, possibly rare and endangered plants, a variety of macro and micro invertebrates, and other vertebrates – including a possibly endemic remnant species of dace that Oregon Fish and Wildlife is attempting to identify – depend on the availability of surface water supplied by these hot springs .

Therefore, I ask that a comprehensive investigation of the flora and fauna that depend on the surface water at Hunter's Hot Springs be undertaken, including an evaluation of the consequences and mitigation measures should too much water be drawn from the nearby city well that results in a loss of spring surface water recharge. I have been assured that the land owner has/will give permission.

- **Ground Water**

It is my contention that current geothermal groundwater resource use by the City of Lakeview in their sale of water to the Warner Creek Correctional Facility has already impacted ground and surface water resources of Hunter's Hot Springs (see Surface Water, above). The City well is not 100 yards from the geyser and not 150 yards from the majority of the surface water geothermal springs that supply area wetlands. The well's Cone of Depression, in my view, is within those limits and will only grow larger with additional groundwater pumping.

Therefore, I ask that a study be undertaken, including a series of monitoring wells established, to determine the width and depth of the Cone of Depression under current use, and that those stay in place if the PGS project is approved for the provision of longitudinal data collection when additional pumping is undertaken. No results from such an evaluation should occur until data is collected during the late summer / early fall "drought" period of the year, the earliest next date being late summer/fall 2010.

One possible mitigation measure of the depletion of groundwater around Hunters Hot Springs could be injection of used geothermal water right at the current City Well site rather than using the Utley injection site. It is my contention that the Utley site is down gradient, a mistake in the first place when the Warner Creek Facility was built and is lost to the Hunter's Hot Springs wetlands. Perhaps this could be corrected as part of the PGS proposal. Reinjection UP gradient of Hunters *may* alleviate groundwater recharge issues that were present in 2009.

Furthermore, the proposed pumping of geothermal water at the Utley Well could have a negative impact on area home owners who currently utilize geothermal water resources for their heating purposes. Depending on the volume of the draw, the water table could drop significantly, leaving area landowners dry.

Therefore, I ask that area landowners that could be affected by the draw of geothermal water from the Utley Well be contacted and specifically solicited for public comment regarding the PGS project and that groundwater monitoring wells around the Utley well be established. Longitudinal landowner surveys should also be undertaken to ensure that landowners are not negatively affected. Finally, I ask that a discussion of what mitigation measures would be undertaken should area landowner geothermal wells be negatively affected, including monetary compensation and/or new wells drilled for those affected landowners.

- **Water Rights**

It is my understanding that historic surface water rights supercede ground water rights. Given that it is suspected that the pumping of geothermal groundwater for the Warner Creek Correctional Facility at the City Well is currently effecting surface water resources, it is possible that the owners of Hunter's Hot Springs Resort could stop the PGS project once completed if it is determined that their rights to surface water have been infringed upon by too much water being drawn and not enough water recharging in their geothermal hot springs.

Therefore, in addition to undertaking the ground water monitoring and evaluation of the current well Cone of Depression (described in Ground Water, above), I ask that a discussion ensue in the EA regarding area land owner surface water rights and how they relate to the PGS project, and include a discussion of the financial loss that could be incurred through litigation and the loss of revenue to the City should such a suit be undertaken and won by the owners of Hunter's Hot

Springs.

BIOLOGICAL RESOURCES

- **Possible Rare Endemic Fish Species**

As mentioned earlier (see Surface Water, above), a single pond remained with water at Hunter's Hot Springs during the late summer / early fall of 2009. A friend (with the owners' permission) investigated this pond and noted that it contained many small fish in a warm water environment. It is my contention that these fish once inhabited all the wetlands that were once in this area.

This fish has the potential to be an endemic, rare fish, a remnant population from thousands of years ago that now only live at Hunter's Hot Springs . On October 22, 2009, an Oregon Fish and Wildlife Fish Biologist was contacted and she obtained several specimens for identification. We are awaiting those results and I suspect that the Oregon Fish and Wildlife agency will provide comments as part of this NEPA process as well.

Therefore, I ask the EA include an evaluation of this species of fish and its dependence on area geothermal surface water resources. If found to be rare and endemic, I also ask for sufficient mitigation measures to ensure for this fish population's survival should geothermal ground water pumping as proposed in the PGS result in a loss of surface water recharge.

- **Migratory Wildlife**

Area ponds are a vital stop over habitat for migratory birds along the Pacific Flyway. Open water – especially during the early winter due to the hot surface water – is critical to the dozens of species of water fowl that use this area. Additional geothermal groundwater usage for the PGS – in conjunction with the pumping already underway for the Warner Creek Facility at the City Well – has the potential to result in a loss of the surface water on which these migratory birds have come to depend.

Therefore, I request a comprehensive evaluation be undertaken of the effects of the proposed PGS and the possible loss of wetland habitat for migratory birds. Mitigation measures should be developed to ensure the surface water continues to be available.

- **Wetlands/Riparian Environment**

Wetlands and riparian environments are rare – more so every day as we slice the loaf of bologna. They are important ecosystems that not only provide home for hundreds of species of flora and fauna, but help clean and filter our surface water resources. Hot water wetlands are even more rare and their flora and fauna more significant and oftentimes dependent on those specialized environmental conditions.

Since the proposed PGS could negatively impact geothermal surface water resources and, therefore, adjacent wetlands (as described, above, under Surface and Ground Water Resources), I ask for a discussion of the importance of area wetlands in the broad scheme of the Gooselake basin and South Central Oregon.

CULTURAL RESOURCES

- **Local Importance**

Hunter's Hot Springs and the sanatorium/resort complex have always been important to residents of Lakeview , Oregon . In 1924, a sanatorium was developed at the site, utilizing the geothermal water for therapeutic purposes. Local people and area visitors continue to use the hot springs pool at the now historic – and possible National Register eligible - Hunter's Hot Springs Resort for those purposes.

During development of the sanatorium in the 1920s, three wells were drilled to increase water flow to the sanatorium and these wells turned into geysers. One continued to erupt on a regular basis until June of 2009. Named "Old Perpetual," this geyser is prominently featured to this day

as a tourist attraction promoted by area businesses and the Lake County Chamber of Commerce.

As described earlier (see Surface and Ground Water, above), the geyser no longer functions and during the late summer and early fall of 2009 the springs supplying the therapeutic hot pool were recharging at an insufficient rate to keep even the pool warm – much less the motel complex with geothermal heat. It is contended that the Cone of Depression from the City Well that is currently drawn for the Warner Creek Correctional Facility is the primary reason.

With the additional proposed draw from this City well for the PGS, it is quite possible that the geyser would never again erupt and that the hot springs that supply the historic therapeutic pool and heating system at Hunter's Hot Springs Resort will no long recharge sufficiently to keep the possible National Register eligible property in operation.

Therefore, I reiterate the need for a formal public scoping meeting for the PGS. Local people who have a generational connection to the historic hot springs resort and the "Old Perpetual" geyser should be given the opportunity to express their views in a public forum.

Furthermore, I ask for an evaluation of the effects on the National Register eligibility of Hunter's Hot Springs Resort should the hot springs no longer recharge at a sufficient rate to keep the property operational due to the proposed additional geothermal groundwater use by the project.

NOISE

There are a number of residents adjacent to the proposed PGS facility that would be subjected to noise from the generators and injection wells. These include residential areas and the motel complex at the historic hot springs .

Additionally, the noise associated with the generators would likely effect migratory birds and other wildlife that depend on the surface water in the direct vicinity, possibly keeping them away from this important resource, negatively affecting populations.

Therefore, I ask that a study be undertaken to determine the effects of the noise/dB levels by the generators and associated machinery on area residents and a variety of wildlife including but not limited to migratory birds and fowl. I also ask that affected landowners be directly contacted and solicited for public comment on the proposed project.

SOCIOECONOMICS

As stated earlier (See Cultural Resources, above), the geyser "Old Perpetual" and the therapeutic hot springs at Hunter's Hot Springs Resort are important to the local tourism industry. The Lake County Chamber of Commerce features the geyser on its promotional materials and people come from all over the world to view it and soak in the therapeutic hot springs . The loss of these resources would put an end to that important economic input.

Therefore, I ask that a study be undertaken to determine the economic loss to the community should tourists no longer visit the area if the geyser and therapeutic hot springs were lost due to inadequate water recharge because of the increased geothermal water draw from the City Well as part of the PGS proposal.

To: Tania Treis

c/o RMT, Inc

4 West Fourth Avenue

Suite 303

San Mateo, California 94401

tania.treis@rmtinc.com

October 28, 2009

From Margot (Margaret) W. Dodds

PO Box 1346

Lakeview, OR 97630

Re: Direct Use System and Power Generation System

I am writing this at the last minute and hope that email is accepted as a form of public scoping comment.

I tend to read the legals pretty carefully to see what might be being proposed, but I didn't understand from the legal notice that the town planned to use any well north of town for anything more than current use. I am assuming that the Utley well is not the one that the County

Commissioners granted a variance for at a meeting last spring, since that variance had only to do with certifying that such well could be on

a small lot in an area zoned agricultural. That well, we were assured, was not going to be used for anything other that what it was being

used for at that time.

The geyser and hot springs pool water flow have been steadily declining as the Prison slowly reached full capacity over a 2 year period. I know the whole Great Basin is drying up, but can't help feeling that taking water out of a geothermal pot, then reinjecting it quite far away and significantly lower than the original well defies the law of gravity. (In the old days, when people had wells and barns, the people who were the sickest were the ones who placed their animals/barns uphill from the well. Gradient is important).

My concern with the Direct Use System is the same one I have with the current water use by the Prison. Please return the water as close as possible to and upgrade from the pumping well. I don't know much about surface water vs ground water, nor about how water moves through

the layers of earth, but taking water from depths seems to have an adverse affect on the surface wateer.

I understand that heating schools and hospital with geothermal will save the taxpayer money -- hurray. I gather that at least some of the energy from a geothermal power generating station would be returned to the town/county as cheap electricity. What are the safeguards for Lake County that ensure these electricity benefits? Will those savings be passed along to the taxpayer? Why can't the taxpayers get cheaper

electricity also? It seems that often "solutions" generate more problems that have to be fixed later. I am a fan of local generation as much as possible, seeing what resources each locale has that can be used to create its own electricity instead of our current system which involves sending it over hundreds and thousands of miles.

I love Lakeview and want to see it thrive, in a small town sort of way. But if we are going to "go green," let's do it in as conscious a way as possible, with as few "side effects" as possible and serious research into what effects there might be (In medicine a "side effect" is most of the time a bad effect. Only occasionally is it beneficial). Also, so much of the "development" we have been doing does not truly bring jobs to

town. Most of the construction is so highly regulated that the crews come from a long way away (witness the Ruby Pipeline). There may be a few local contractors who gain, but I can't believe that most of the work doesn't have to be done by specially-trained experts from the power company and its energy contractors. The only local benefit is temporary while crews are staying in town. Then we are potentially left with noisy and/or ugly and/or resource-depleting systems that do nothing for Lake County.

TOWN OF LAKEVIEW
525 North First St. • Lakeview, OR 97630

October 26, 2009

Tania Treis
Sr. Environmental Scientist/Project Manager
RMT, Inc.
4 West Fourth Avenue
Suite 303
San Mateo, Oregon 94402

RE: North Well Water Issues

Dear Tania;

In response to the concerns on the north geothermal project I have prepared information that we compiled during the exploration and test pumping of the north geothermal well. As you know there were several public concerns when we drilled the well which we addressed at the time.

During the test pumping of the test well and the final production well, the surrounding shallow wells were monitored including the small hot pools on the Hunter's Lodge property and the geyser. With the exception of the greenhouse well approximately 800 feet to the East all of the wells including the geyser are shallow, less than 100 feet deep.

Our impact during pumping was minimal, if any, on the surrounding wells. The geyser was monitored in late February and early March of 2002 prior to our test pumping program, and the time between geyser eruptions varied from 22 to 48 seconds. For early April when the well was test pumped, the time between eruptions ranged between 35 and 43 seconds. During the constant-discharge testing, the cycle was relatively constant, varying by one or two seconds. During the recovery portion of the test, the interval varied between 41 and 43 seconds. These observations were made visually and the intervals recorded with a stop watch. Weather conditions seemed to affect it more as air pressures influence how fast the artesian flow flashes to steam.

Our production well is drawing water below the 150 foot level, well below the depth of the surrounding shallow wells and the geyser. The aquifer is confined with a vertical hydraulic conductivity of 0.001 foot per day, which retards vertical movement of groundwater and inhibits communication between the production zones tapped by the production well and the shallow wells/geyser. For this reason the production well construction is sealed above the 150 foot level not to interfere with the shallow wells (the geyser well is less than 50 deep). Sealing the well to this depth along with the very low vertical hydraulic conductivity keeps the impact to the shallow water resource very minimal.

The geyser has been going dormant in the summer to early fall since the irrigation wells to the west were drilled in the late 1970's. The irrigation wells have shallow seals and draw water from the shallow aquifer. Once pumping starts the artesian head pressure that causes the geyser begins to decline and goes to a point that there is not enough pressure to bring the artesian flow above ground. The irrigation pumping lowers the shallow groundwater depth by 20 feet or more during the irrigation season. Currently as of October 23, 2009 the water level at the production well site is 9.7 feet below land surface. Once the pumping stops the water levels in the aquifer begin to recover and the geyser begins to flow again. This varies from year to year but generally the geyser resumes again in late October or November.

Also, all the water which the Town pumps is re-injected back into the aquifer approximately 1200 feet south west of our production well. Some distance south west was required to ensure the cooler water being re-injected does not begin to cool the production well or the hot water around the area. Putting the water back insures the Town's use is non consumptive and contributes to maintaining the artesian head in the aquifer.

The production geothermal well is permitted for 300 gallons per minute. The winter pumping rates, which are higher than summer rates, average 120 gallons per minute. The irrigation well permits just west of Rabbit Hills Road to the west allow 5,500 gallons per minute. All of the water pumped from the geothermal well is and will be returned to the aquifer to provide pressure support to the aquifer. The irrigation use west of Rabbit Hills Road uses approximately 945 million gallons annually that is pumped out of the aquifer.

Our impacts to the groundwater for heat and the proposed power generation are minor in comparison to the overall use of our aquifer within the North Goose Lake Basin. Also we are not using water we are using only the heat, as opposed to many of the other geothermal resource users who discharge the water to waste and do not contribute to maintaining the water levels in the aquifer.

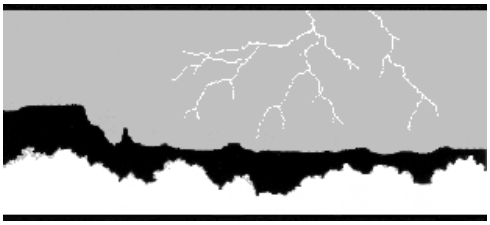
The large irrigation users to the west are permitted and the Town will keep that in mind on upcoming projects, however the small amount of use for heating and power generation do not contribute to the geysers non-function in the summer months.

Please give me a call if there are any questions or if you need any additional information on the North Well issue.

Sincerely;

Ray Simms

Ray Simms, Manager



Oregon Natural Desert Association

VIA E-mail to tania.treis@rmtinc.com

November 6, 2009

Ms. Tania Treis
RMT, Inc.
4 West Fourth Avenue
Suite 303
San Mateo , Cailfornia 94402

Re: Public Scoping Comments for South Central Oregon Economic Development District—Lakeview Geothermal

Dear Ms. Treis,

I write on behalf of the Oregon Natural Desert Association ("ONDA")[1] regarding the Environmental Assessment ("EA") being developed for the South Central Economic Development District—Lakeview Project. Although the comment period has expired, I hope you will take our comments into consideration.

We were informed of this project through a concerned citizen. To our knowledge, notice of the EA was not provided to any public interest organizations in Oregon that are concerned with potential environmental impacts of geothermal development, which includes ONDA, Oregon Wild, and WaterWatch of Oregon. ONDA commented on the development of the federal Geothermal Leasing Programmatic Environmental Impact Statement during 2008 and 2009, and has been actively participating in commenting on issues involving Oregon's high desert since 1989. Notice of the preparation of an EA also was not published in the Federal Register. ONDA requests that the US Department of Energy ("DOE") extend the scoping period by 30 days, until November 27, 2009, because the Department neglected to contact interested parties or provide adequate notice of this project. We would like time to evaluate how the proposed actions might affect public lands, native wildlife, and local water resources. The extension of the comment period would also provide the opportunity to other interested organizations and agencies to

[1] ONDA is a non-profit public interest organization dedicated to preserving and protecting the public lands of eastern Oregon. ONDA's mission is to protect, defend, and restore forever the health of Oregon's native deserts.

provide comments. We also encourage the DOE to open scoping to a public meeting. We feel a formal public meeting should be included in this review process before the draft EA is prepared.

ONDA recognizes the potential importance of geothermal energy and other alternative sources of low-carbon-emission energy for reducing this country's reliance on fossil fuels and beginning to reverse the effects of global climate change. ONDA supports the development of geothermal energy projects on lands where the projects will not have an unacceptable impact to other resources, and where the potential impacts have been studied sufficiently and carefully mitigated.

Our initial concerns of the proposed project are in regards to the wildlife habitat that might be adversely impacted due to development of geothermal resources through the proposed power generation area. This region is home to many resident and migratory birds, which make up an important part of our natural heritage and know no boundaries between public and private lands. Understanding how the development of geothermal resources might affect the wetlands and riparian areas in close proximity to the power generation area is vital. In addition, it appears that significant surface and underground water resources would be affected by the proposed development, including a spring that may contain endemic fish. We encourage the DOE to complete an environmental impact statement so that these impacts will be understood and proper mitigation can be undertaken, and to consult with the Oregon Department of Fish & Wildlife and US Fish & Wildlife Service to ensure that effects on wildlife and fish are properly evaluated in the environmental review.

Thank you for your time and consideration. Please contact me with any questions about our comments. I would like to be informed by the DOE in the future of any proposed renewable energy projects in eastern Oregon.

Sincerely,

Liz Nysson

Climate Change Coordinator
liznysson@onda.org

APPENDIX B: USFWS CONSULTATION

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Klamath Falls Fish and Wildlife Office
1936 California Avenue
Klamath Falls, Oregon 97601
(541) 885-8481 FAX (541)885-7837

In Reply Refer To:
81450-2011-TA-0001

OCT 22 2010

Tania Treis, Sr. Project Manager
RMT, Inc.
4 West Fourth Avenue
San Mateo, California 94402

Subject: Town of Lakeview Geothermal Project

Dear Ms. Treis:

The U.S. Fish and Wildlife Service (Service) appreciates the opportunity to comment on the potential effects of the proposed project on federally-listed species. The Service has reviewed the information in our files as well as that which was provided in your October 1, 2010, letter and determined that no federally-listed species occur within or near the project areas. Therefore, the Service does not anticipate any impacts to occur as a result of your proposed project. Should the proposed project plans change, if additional information on the distribution of listed or proposed species in the proposed project area becomes available, or a new species is listed or critical habitat designated that may be affected by the proposed project, then please contact Tia Adams of my staff at (541) 885-2520.

Sincerely,

Laurie R. Sada
Field Supervisor

RMT

• ENVIRONMENT • ENERGY • ENGINEERING

October 1, 2010

Ms. Laurie Sada
Field Supervisor
United States Fish and Wildlife Service
1936 California Avenue
Klamath Falls, OR 97601

Subject: Town of Lakeview Geothermal Project

Dear Ms. Sada:

RMT, on behalf of the U.S. Department of Energy (DOE), is preparing an Environmental Assessment (EA) to address the potential environmental effects of the Town of Lakeview's proposed geothermal direct use and power generation system located in Lakeview, OR.

The DOE is requesting concurrence from the USFWS that the project will have no effects on threatened or endangered or proposed threatened or endangered species in accordance with the Endangered Species Act (ESA) and that a formal consultation under Section 7 of the ESA is not necessary.

Project Description

The proposed geothermal project would include a direct use system and a small power generation system. Each system is described here.

Direct Use System

The proposed geothermal direct use system would include the following elements:

- Drilling, testing, and completing a new direct use system production well and geothermal water injection well for the direct use project;
- Construction and operation of a geothermal production fluid pipeline from the well pad to various town buildings (e.g., local schools, hospital, and Lake County Industrial Park) and back to the geothermal water injection well; and
- Retrofit of various school and possibly other buildings for geothermal use.

The direct use system would require drilling a production well (approximately 600 feet deep and 10 inches in diameter,) at the Barry Well site near US Highway 395 and drilling an injection well (approximately 400 to 500 feet deep and 10 inches in diameter) 0.5 miles west of the Barry Well site near an existing railroad right-of-way. The production well would be housed in a newly constructed 16-foot-by-16-foot building. The proposed pipeline would be 9-10 inches in diameter and would be approximately 3.4 miles long, extending from the well to Town.

Geothermal water would be extracted at the production well site, transferred via the underground pipeline, cycled through the buildings, and then injected into the reservoir at the injection well site. All buildings receiving heating from the system would require some form of equipment upgrade, except for the hospital. A short spur pipeline would also be constructed to allow heating at the Lakeview Industrial Park in the future.

Figure 1 shows the direct use system project elements.

Power Generation System

The power generation system would include the following elements:

- Construction and operation of a 200-kilowatt (kW) geothermal power plant and associated facilities (e.g., supply lines);
- Work on an existing production well (the Utley Well);
- Drilling, testing, and completing a cold water injection well; and
- Construction of various pipelines to connect new and existing wells within the system.

A small, 200 kilowatt geothermal power plant is proposed on an approximate 0.19 acre site just south of Geyser View Road. The power plant would be constructed at the location of an existing geothermal production well (North production well). The North production well is currently used to provide heat to the Warner Creek Correctional Facility. The power plant would utilize geothermal fluid from the existing production well. Work would be completed on another production well (Utley well) such that the Utley well (450 feet deep and 10 inches in diameter) could be used to augment the geothermal fluid flow to the power plant. Geothermal fluid from the system would continue to be injected at the existing hot water injection well off of McDonalds Road. Water for use in the proposed cooling tower would be obtained from the Lakeview municipal water system.

The power generation system would require the drilling of a new cold water injection well (approximately 400 feet deep and 10 inches in diameter) to the east of the power plant at the intersection Geyser View Lane and McDonalds Road for injection of cold water used for the proposed cooling tower. New pipelines would have to be constructed from the Utley well to the power plant

and from the cold water injection well to the cooling tower. Several small connector pipelines would need to be installed to connect existing facilities to the power plant.

The power generated by the system would be sold to PacifiCorp. A 50 foot-long power line from the geothermal power plant to the existing power line on the south side of Geyser View Lane would be connected underground or above ground, determined in coordination with PacifiCorp.

The project elements of the power generation system are shown in Figure 2.

Effects to Listed Species

RMT initially contacted the USFWS in June 2009 for a list of federal species that could occur in the project area. RMT also contacted the Oregon Natural Heritage Information Center (ONHIC). The ONHIC maintains a list of rare, threatened, and endangered species as determined by the state of Oregon under the Oregon ESA. The Modoc sucker (*Catostomus microps*) was the only threatened or endangered species with the potential to occur in the project area that resulted from the USFWS and ONHIC queries.

The only fish habitat in the project area is Deadman Creek. Construction through this creek would be avoided. The two crossings of Deadman Creek and the associated wetlands and riparian areas would be constructed by hanging the pipeline on the existing trestle and by jacking and boring under the creek from an appropriate distance away from the riparian corridor, avoiding all direct impacts to vegetation and other biological resources in these areas. The project would have no impact on sensitive fish species.

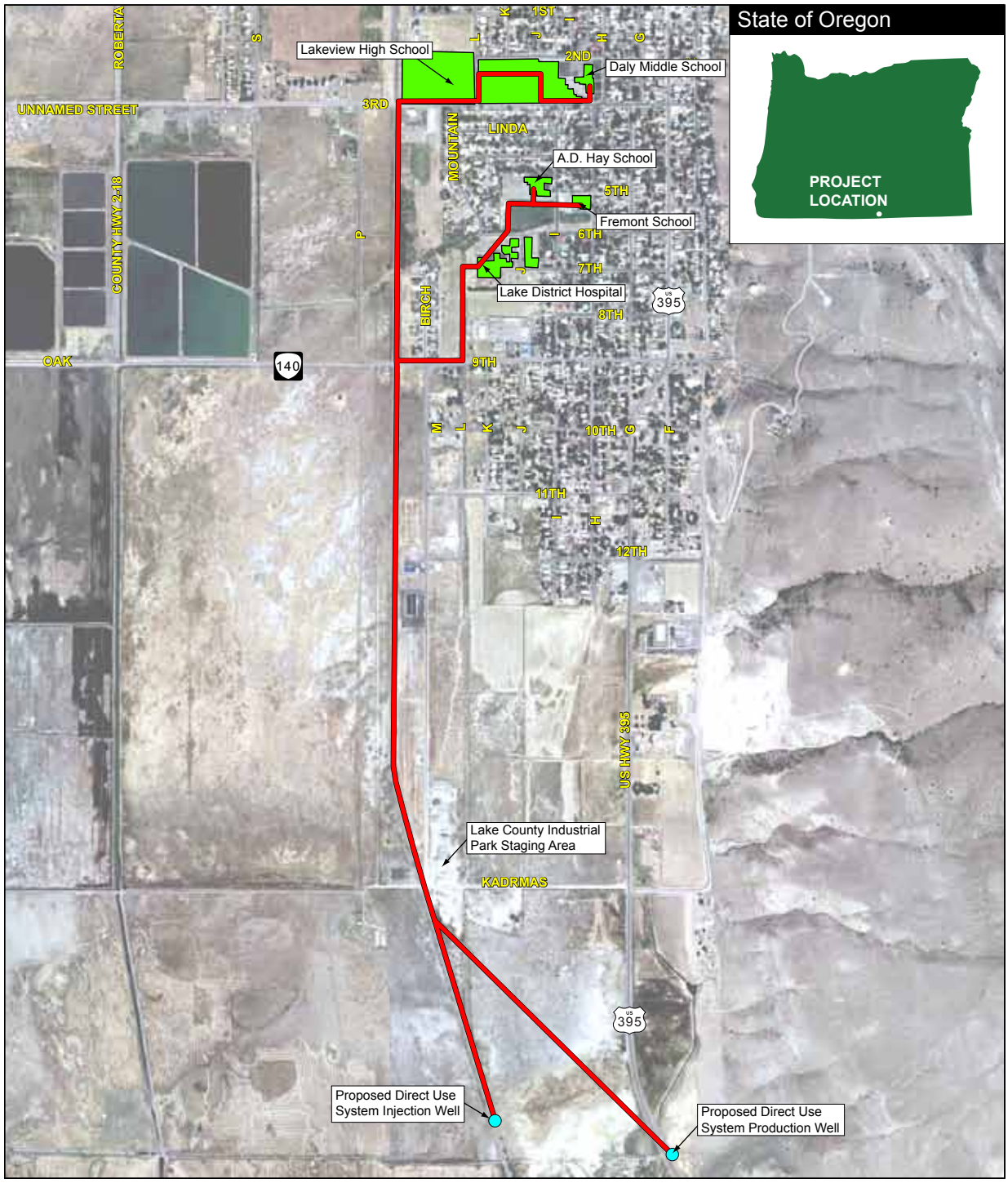
The DOE is seeking concurrence that the project would have no effects on federally listed threatened or endangered or candidate species in accordance with the Endangered Species Act and that no formal consultation is required. Please feel free to contact me at (650) 373-1200 if you have any questions.

Sincerely,

Tania Treis
Sr. Project Manager
RMT, Inc.

Cc: Trisha Roninger, Klamath Falls Fish and Wildlife Office
Laura Margasson, DOE
Darryl Anderson, AES

Figure 1: Location of Components of Geothermal Direct Use System



SOURCE: www.OregonExplorer.info 2009 and RMT Inc. 2009

LEGEND

Proposed Pipeline Route

Well Site

U.S. Highway

Project Building

Oregon State Route

N W E S

0 0.5 1 Mile

RMT
ENVIRONMENT • ENERGY • ENGINEERING

Figure 2: Location of Components of Geothermal Power Generation System

SOURCE: www.OregonExplorer.info 2009 and RMT Inc. 2009

LEGEND

N W E S

Proposed Pipeline Route

Existing Pipeline Route

Well Site

Power Generation Facility

US 395 U.S. Highway

0 500 1,000 Feet

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APPENDIX C: EMERGENCY PLANS

EMERGENCY PLANS

1. Injury Contingency Plan

In the event injuries occur in connection with the Town of Lakeview Geothermal Heating Project, specific and immediate attention will be given to proper transportation to a medical facility.

Ambulance
911

Lake District Hospital
700 South J Street
Lakeview, OR 97630
541-947-2114

2. Blowout Contingency Plan (Also see Blowout Action Plan)

Blowout prevention equipment will be kept in operating condition and tested in compliance with Oregon Department of Geology and Mineral Industries (DOGAMI) regulations and industry standards.

In addition, cold water and barite will be stored at the wellsite for use in killing the well in case of an emergency.

In the event of an emergency, such as a blowout, immediate efforts will be taken to shut surface valves and blowout preventer system.

If the means to shut-in or control the flow from the well is lost, the Drilling Supervisor is to:

1. Initiate appropriate control procedures.

    1. Arrange for any injured persons to be taken by the fastest transportation available to the nearest medical facility, as shown in the Injury Contingency Plan.

    2. If there is a threat to any local residents, the Lake County Sheriff's Office will be notified as soon as possible.

        Lake County Sheriff's Office
        513 Center Street
        911 or (541) 947-6027

2. Secure and maintain control of access roads to the area to eliminate entry of unauthorized personnel.

3. Contact the Project Manager and advise of the situation. The Drilling Supervisor will follow the same procedures stated in the Spill or Discharge Plan.

4. Initiate any further or supplemental steps that may be necessary or advisable, based on consultation with the Project Manager.

5. Be certain that all safety practices and procedures are being followed and that all members of the drilling crew are performing their assigned duties correctly.

6. Attempt to control the well at the rig site with rig personnel and supervisors.

7. If fluid flow is of an uncontained nature, attempt containment with required equipment by constructing sumps and/or dikes as rapidly as possible and as needed.

8. Attempt to construct and/or fabricate and install any wellhead facilities require to contain fluid flow at the well or casing head.

9. Maintain a continuing inspection of the pad area immediately around the well site subject to erosion that may cause failure to the drilling rig structure. Take necessary steps to avert areas of possible erosion by excavation and rebuilding of the area as necessary.

10. Following complete containment of the well, initiate steps to return the area to its normal state prior to the blowout or fluid flow, such as reseeding with similar and approved vegetation.

C. Fire Contingency Plan

1. Any small fires which occur around the well pad during drilling and/or testing operations should be able to be controlled by rig personnel utilizing on-site fire fighting equipment.

2. The Lakeview Rural Fire Protection District (911) will be notified of any fire, even if the available personnel can handle the situation or the fire poses no threat to the surrounding area.

3. A roster of emergency phone numbers will be available on-site so that the appropriate fire fighting agency can be contacted in case of a fire.

D. Spill or Discharge Contingency Plan

1. Potential Sources of Accidental Spills or Discharges

   a. Geothermal Fluid

Accidental geothermal fluid spills or discharges are very unlikely because the hole will be cased and blowout prevention equipment will be utilized. However, accidental discharges or spills could result from any of the following:

i. Loss of well control (blowout)

b. Drilling Muds

Muds are a mixture of water, non-toxic chemicals and solid particles used in the drilling operations to lubricate and cool the bit in the hole, to carry cuttings out of the hole, to maintain the hole condition and to control formation pressure. Drilling muds are prepared and stored in metal tanks at the drilling site. Waste drilling mud and cuttings are discharged into the reserve pit, which is open and is adequately sized to hold the volume necessary for the operation. Accidental discharges of drilling mud are unlikely, but could occur by:

1) overflow of the reserve pit

2) reserve pit wall seepage or wall failure.

3) discharge from equipment failure on location.

4) shallow lost circulation channeling to the surface.

3. Lubricating or Fuel Oils and Petroleum Products

A discharge of this type would probably be very small and be from equipment used in the field. Potential locations for accidental spills are:

(1) drilling equipment and machinery at and around the drilling location.

(2) other miscellaneous equipment and machinery at well site and roads.

4. Construction/Maintenance Debris

Typically a minor consideration, one which is usually able to be cleaned up on the job. Potential locations are the same as for lubricating or oils listed in Item 3, above.

2. Plan for Cleanup and Abatement

In the event of discharge of formation fluids, drilling muds, petroleum products or construction debris, the person responsible for the operation will make an immediate investigation, then contact the Drilling Supervisor and advise him of the spill. The

Drilling Supervisor will in turn call out equipment, regulate field operations, or do other work as applicable for control and clean up of the spill, as follows:

1. Action - Small, Containable Spill

   If the spill is small (i.e., less than 250 gallons) and easily containable without endangering the watershed, the Drilling Supervisor will direct and supervise complete cleanup and return to normal operations.

2. Action - Large or Uncontainable Spill

   If the spill is larger than 250 gallons, or is not easily contained, or endangers, or has entered the watershed, the Drilling Supervisor will proceed to take necessary action to curtail, contain and cleanup the spill, as above, and notify personnel as listed below.

3. Notification

   (1) The Drilling Supervisor will, as quickly as practicable:

   - Call out contractor(s), as required.
   - Notify the Project Manager.
   - Notify the local law enforcement agencies if the public safety is threatened.

   (2) The Project Manager will notify the following as soon as practical and work closely with them in all phases of the curtailment, containment and cleanup operations:

   Robert Houston
   Oregon Department of
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   475 NE Bellevue, Suite 110
   Bend, OR 97701
   (541) 388-6146

The Drilling Supervisor will also advise local population and affected property owners if spill affects residents or property.

1. Specific Procedures

(1) For geothermal fluid spills:

- Contain spillage with dikes if possible and haul to disposal site by vacuum or water trucks or dispose of in a manner acceptable to the Oregon Water Resources Department or DOGAMI.

(2) For drilling mud:

- Repair sump or contain with dikes. Haul liquid to another sump, available tanks or approved disposal site.

(3) For petroleum products:

- Contain spill with available manpower. Use absorbents and dispose of same in approved disposal area.

For (1) through (3) above, Town of Lakeview will have the source of spill repaired at the earliest practical time, and continue working crews and equipment on cleanup until all concerned agencies are satisfied.

5. Confirm telephone notification to agencies and regulatory bodies. Telephone notification shall be confirmed by the Project Manager in writing within two weeks of telephone notification.

Written confirmation will contain:

Reason for the discharge or spillage.

Duration and volume of discharge or spillage.

Steps taken to correct problem.

Steps taken to prevent recurrence of problem.

Town of Lakeview Geothermal Heating Project
EMERGENCY PLANS

BLOWOUT ACTION PLAN
WAIT AND WEIGHT METHOD

To Be Posted at Well Pad Site

1. The hole is to be kept full of drilling or completion fluids at all times unless this becomes impossible due to lost circulation.

2. Before starting out of hole with drillpipe or tubing, circulate off bottom until mud is properly conditioned.

3. Close and open pipe rams once per day and log on tour sheet. Pressure test BOPE prior to drilling out of casing shoes and coincident with casing test. Log results on blowout preventer check list.

4. Close blind rams when out of hole and log on tour sheet.

5. Fill hole at five (5) stand intervals or less while pulling drillpipe out of hole. Count pump strokes or use chart attached to the pit volume indicator to determine the volume required to fill the hole.

6. Watch pit flow or pit level indicator when running in the hole to insure that the volume of mud displaced by the drillpipe is not exceeded.

7. The drillpipe will be run in the hole to the shoe of the casing and a TIW valve installed to perform any of the following operations:
   a. Slip or cut drilling line.
   b. Repair equipment (if possible).
   c. Any foreseen delay.

8. Record reduced circulating pressure at 30 strokes per minute (SPM) or other suitable kick control SPM daily and after each bit change.

9. An approved inside blowout preventer and full opening safety valve with wrench must be immediately available on the rig floor.

10. A blowout prevention drill will be conducted by the rig tool pusher under the supervision of the Drilling Supervisor for each drilling crew to ensure that each person is properly trained to carry out emergency procedures. Assign kick control duties in advance: i.e. mud mixing assigned to floorman, operating pumps assigned to derrickman, etc.

11. At first indication of gain in pit level (or other sign of possible blowout), the driller will immediately do what is necessary to control the well. In most cases this action should be:

While Drilling:

a. Pull kelly up out of rotary table and stop pumps.
b. Open valve(s) on choke line.
c. Close the blowout preventer and gradually reclose choke line.
d. Record shut-in drillpipe (Pdp) and casing (Pcg) pressure. Maximum allowable casing pressure to be dependent on casing depth and burst rating. Allowable pressure for each string to be posted and noted in driller's instructions and on well control data sheet.

Inform the Drilling Supervisor and/or proceed with appropriate kick control measures as follows in Step 12.

While Tripping:

a. Install full opening safety valve.
b. Open valve on choke(s) line.
c. Close safety valve.
d. Close blowout preventer and gradually reclose choke valve(s).
e. Record shut-in drillpipe and casing pressure. Maximum allowable casing pressure to be dependent on casing depth, mud weight and burst rating.
f. Inform the Drilling Supervisor. Run drillstring in hole as far as practical after first installing inside BOP and reopening safety valve, and/or proceed with appropriate kick control measures as follows in Step 12.

12. Calculate and mix mud of weight necessary to keep well under control using the well control worksheet and attached monograph.

Mud weight increase in lb/gallon =

$$\frac{\text{Pdp}}{\text{Drillstring depth in feet} \times 0.052} + 0.4 \text{ lb/gallon}$$

Where Pdp = shut-in drillpipe pressure in psig.

13. When sufficient volume of proper weight mud has been prepared, start pumping increased weight mud down drillpipe at constant kick control SPM which will reduce circulating pressure downward gradually from Pi (initial drillpipe circulating pressure) as calculated on the well control worksheet to Pf (final drillpipe circulating pressure)

when drillpipe is filled with weighted mud. Therefore hold drillpipe pressure constant at Pf by adjusting choke until proper weight mud returns to surface.

14. When proper weight mud returns to surface, stop pumps, release any remaining pressure on casing, and check for additional kick before returning to normal operations.

15. Drill new directional hole as a last resort to kill well.

Town of Lakeview Geothermal Heating Project
EMERGENCY PLANS

BLOWOUT ACTION PLAN
DRILLERS METHOD

To Be Posted at Well Pad Site

1) The hole is to be kept full of drilling or completion fluids at all times unless this becomes impossible due to lost circulation.

2) Before starting out of hole with drill pipe or tubing, circulate off bottom until mud is properly conditioned.

3) Close and open pipe rams once per day and log on tour sheet. Pressure test BOPE prior to drilling out of casing shoes and coincident with casing test. Log results on tour sheet.

4) Close blind rams when out of hole and log on tour sheet.

5) Fill hole at five (5) stand intervals or less while pulling drill pipe out of hole. Count pump strokes or use chart attached to the pit volume indicator to determine the volume required to fill the hole.

6) Watch pit flow or pit level indicator when running in the hole to insure that the volume of mud displaced by the drill string is not exceeded.

7) The drill pipe will be run in the hole to the shoe of the casing and a full opening safety valve installed to perform any of the following operations:

   a) Slip or cut drilling line.

   b) Repair equipment (if possible).

   c) Any foreseen delay.

8) Record on the tour sheet the reduced circulating pressure at 30 strokes per minute (SPM) or other suitable kick control pump rate daily and after each bit change.

9) An approved inside blowout preventer and full opening safety valve with wrench must be immediately available on the rig floor.

10) A blowout prevention drill will be conducted by the rig tool pusher and observed by the Drilling Supervisor for each drilling crew to ensure that each person is properly trained to carry out emergency procedures. Assign kick control duties in advance: i.e. mud mixing assigned to floorman, operating pumps assigned to derrickman, etc.

11) At first indication of gain in pit level (or other sign of possible blowout), the driller will immediately do what is necessary to control the well. In most cases this action should be:

Shut-In Procedure While Drilling:

12) Pull kelly above the rotary table and stop pumps.

13) Check the well for flow.

14) Close the blowout preventer and shut the well in completely.

15) Record pit level, shut-in drill pipe (P_{sidp}) and shut-in casing pressure (P_{sicg}).

16) Inform the Drilling Supervisor and/or proceed with appropriate kick control measures as follows.

Shut-in Procedure While Tripping:

17) Set slips with tool joint in rotary table.

18) Install full opening safety valve.

19) Close safety valve.

20) Close blowout preventer.

21) Install the kelly.

22) Record shut-in drill pipe and casing pressure.

23) Inform the Drilling Supervisor.

24) Run drill string in hole as far as practical after first installing inside BOP and reopening safety valve, and/or proceed with appropriate kick control measures as follows.

Kick Control Measures for Driller's Method

First Circulation

25) Select a pump speed for the kill operation. This will usually be the previously recorded slow pump rate. It is important to maintain a constant speed throughout the kill operation.

26) Start the pump and open the choke to maintain the casing pressure ($P_{cg)}$ constant as the pump is brought up to the desired kill speed. Once the kill speed is reached, observe the new drill pipe pressure (P_{dp}). Record the drill pipe pressure.

27) Pump one full circulating volume at constant pump speed while operating the choke to maintain the drill pipe pressure constant.

28) Stop the pump and shut the choke. At this point the new shut-in casing pressure and the shut-in drill pipe pressure should be equal. Record these pressures. If a drill pipe float is making it difficult to obtain drill pipe pressure readings, the new shut in casing pressure may be used in the calculation below.

Second Circulation

29) Calculate the kill-weight mud density.

$$\text{New Mud Weight} = \text{Current Mud Weight} + \frac{\text{Drill Pipe Pressure}}{0.052 * \text{TVD}}$$

A trip margin may be added if desired, but management approval is required for a trip margin in excess of
0.2 ppg.

30) Start the pump, bringing it up to the kill speed, and operate the choke as necessary to maintain the casing pressure constant. Continue operating the choke to keep the casing pressure constant until one drill string volume of kill weight mud has been pumped.

31) After pumping one drill string volume of the kill weight mud, maintain the pump speed constant and record the circulating drill pipe pressure.

32) Maintain the pump speed constant and operate the choke so as to maintain the drill pipe pressure constant until kill weight mud returns are measured at the surface.

33) Stop the pump and check for flow.

APPENDIX D: ANALYTICAL QUALITY CONTROL SUMMARY REPORT

Neilson Research Corporation

Date: 12-Sep-07

CLIENT: Anderson Engineering & Surveying, Inc
Work Order: 0708836
Project: Geothermal Well B Proj 2006-152

ANALYTICAL QC SUMMARY REPORT

TestCode: ALKALINITY_W

Sample ID: MBLK	SampType: MBLK	TestCode: ALKALINITY_	Units: mg/L	Prep Date:	RunNo: 35896
Client ID: ZZZZZ	Batch ID: R35896	TestNo: SM 2320B		Analysis Date: 09/06/07	SeqNo: 541176

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	ND	10.0									
Alkalinity, Carbonate (As CaCO3)	ND	10.0									
Alkalinity, Hydroxide (As CaCO3)	ND	10.0									
Alkalinity, Total (As CaCO3)	ND	10.0									

Sample ID: LCS	SampType: LCS	TestCode: ALKALINITY_	Units: mg/L	Prep Date:	RunNo: 35896
Client ID: ZZZZZ	Batch ID: R35896	TestNo: SM 2320B		Analysis Date: 09/06/07	SeqNo: 541177

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	30.00	10.0	29.6	2	94.6	80	120				
Alkalinity, Total (As CaCO3)	30.00	10.0	29.6	2	94.6	80	120				

Sample ID: 0709107-01ADUP	SampType: DUP	TestCode: ALKALINITY_	Units: mg/L	Prep Date:	RunNo: 35896
Client ID: ZZZZZ	Batch ID: R35896	TestNo: SM 2320B		Analysis Date: 09/06/07	SeqNo: 541179

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Total (As CaCO3)	142.0	10.0						141	0.707	10	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Minimum Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

CLIENT: Anderson Engineering & Surveying, Inc
Work Order: 0708836
Project: Geothermal Well B Proj 2006-152

ANALYTICAL QC SUMMARY REPORT

TestCode: EPA300_W

Sample ID: **MB** SampType: **MBLK** TestCode: **EPA300_W** Units: **mg/L** Prep Date: RunNo: **35833**
Client ID: **ZZZZZ** Batch ID: **R35833** TestNo: **EPA 300.0** Analysis Date: **08/31/07** SeqNo: **539969**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	ND	1.00									
Fluoride	ND	0.200									
Nitrate Nitrogen	ND	0.200									
Nitrite Nitrogen	ND	0.0500									
Sulfate	ND	0.500									
Nitrogen, Nitrate-Nitrite	ND	0.0500									

Sample ID: **MB** SampType: **MBLK** TestCode: **EPA300_W** Units: **mg/L** Prep Date: RunNo: **35833**
Client ID: **ZZZZZ** Batch ID: **R35833** TestNo: **EPA 300.0** Analysis Date: **08/31/07** SeqNo: **539980**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	ND	1.00									
Fluoride	ND	0.200									
Nitrate Nitrogen	ND	0.200									
Nitrite Nitrogen	ND	0.0500									
Sulfate	ND	0.500									
Nitrogen, Nitrate-Nitrite	ND	0.0500									

Sample ID: **LCS** SampType: **LCS** TestCode: **EPA300_W** Units: **mg/L** Prep Date: RunNo: **35833**
Client ID: **ZZZZZ** Batch ID: **R35833** TestNo: **EPA 300.0** Analysis Date: **08/31/07** SeqNo: **539970**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	7.007	1.00	7.5	0	93.4	90	110				
Fluoride	3.626	0.200	3.75	0	96.7	90	110				
Nitrate Nitrogen	1.918	0.200	2.032	0	94.3	90	110				
Nitrite Nitrogen	0.9779	0.0500	1.028	0	95.2	90	110				
Sulfate	22.60	0.500	22.5	0	100	90	110				
Nitrogen, Nitrate-Nitrite	2.896	0.0500	3.06	0	94.6	90	110				

Qualifiers:
E Value above quantitation range
H Holding times for preparation or analysis exceeded
J Analyte detected below quantitation limits
ND Not Detected at the Minimum Reporting Limit
R RPD outside accepted recovery limits
S Spike Recovery outside accepted recovery limits

CLIENT: Anderson Engineering & Surveying, Inc
Work Order: 0708836
Project: Geothermal Well B Proj 2006-152

ANALYTICAL QC SUMMARY REPORT

TestCode: EPA300_W

Sample ID: **LCS**	SampType: **LCS**	TestCode: **EPA300_W**	Units: **mg/L**	Prep Date:	RunNo: **35833**
Client ID: **ZZZZZ**	Batch ID: **R35833**	TestNo: **EPA 300.0**		Analysis Date: **08/31/07**	SeqNo: **539981**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	6.943	1.00	7.5	0	92.6	90	110				
Fluoride	3.728	0.200	3.75	0	99.4	90	110				
Nitrate Nitrogen	1.921	0.200	2.032	0	94.5	90	110				
Nitrite Nitrogen	0.9488	0.0500	1.028	0	92.3	90	110				
Sulfate	22.71	0.500	22.5	0	101	90	110				
Nitrogen, Nitrate-Nitrite	2.870	0.0500	3.06	0	93.8	90	110				

Sample ID: **0708836-01AMS**	SampType: **MS**	TestCode: **EPA300_W**	Units: **mg/L**	Prep Date:	RunNo: **35833**
Client ID: **Geothermal Well**	Batch ID: **R35833**	TestNo: **EPA 300.0**		Analysis Date: **08/31/07**	SeqNo: **539973**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	189.0	1.00	7.5	182.8	82.7	80	120				R3
Fluoride	8.386	0.200	3.75	4.607	101	80	120				R3
Nitrate Nitrogen	1.859	0.200	2.032	0	91.5	80	120				
Nitrite Nitrogen	1.785	0.0500	1.028	0	174	80	120				MI
Sulfate	243.1	0.500	22.5	214	129	80	120				R3
Nitrogen, Nitrate-Nitrite	3.644	0.0500	3.06	0	119	80	120				

Sample ID: **0708844-02AMS**	SampType: **MS**	TestCode: **EPA300_W**	Units: **mg/L**	Prep Date:	RunNo: **35833**
Client ID: **ZZZZZ**	Batch ID: **R35833**	TestNo: **EPA 300.0**		Analysis Date: **08/31/07**	SeqNo: **539988**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	59.31	1.00	7.5	51.39	106	80	120				R3
Fluoride	3.508	0.200	3.75	0	93.5	80	120				
Nitrate Nitrogen	1.885	0.200	2.032	0	92.7	80	120				
Nitrite Nitrogen	1.249	0.0500	1.028	0	122	80	120				MI
Sulfate	29.11	0.500	22.5	5.571	105	80	120				
Nitrogen, Nitrate-Nitrite	3.134	0.0500	3.06	0	102	80	120				

Qualifiers:
E Value above quantitation range
H Holding times for preparation or analysis exceeded
J Analyte detected below quantitation limits
ND Not Detected at the Minimum Reporting Limit
R RPD outside accepted recovery limits
S Spike Recovery outside accepted recovery limits

CLIENT: Anderson Engineering & Surveying, Inc
Work Order: 0708836
Project: Geothermal Well B Proj 2006-152

ANALYTICAL QC SUMMARY REPORT

TestCode: EPA300_W

Sample ID: **0708836-01AMSD** SampType: **MSD** TestCode: **EPA300_W** Units: **mg/L** Prep Date: RunNo: **35833**
Client ID: **Geothermal Well** Batch ID: **R35833** TestNo: **EPA 300.0** Analysis Date: **08/31/07** SeqNo: **539974**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	188.1	1.00	7.5	182.8	71.4	80	120	189	0.452	20	R3
Fluoride	8.236	0.200	3.75	4.607	96.8	80	120	8.386	1.80	20	R3
Nitrate Nitrogen	1.872	0.200	2.032	0	92.1	80	120	1.859	0.672	20	
Nitrite Nitrogen	1.775	0.0500	1.028	0	173	80	120	1.785	0.562	20	MI
Sulfate	244.0	0.500	22.5	214	133	80	120	243.1	0.355	20	R3
Nitrogen, Nitrate-Nitrite	3.646	0.0500	3.06	0	119	80	120	0	0	20	

Sample ID: **0708844-02AMSD** SampType: **MSD** TestCode: **EPA300_W** Units: **mg/L** Prep Date: RunNo: **35833**
Client ID: **ZZZZZ** Batch ID: **R35833** TestNo: **EPA 300.0** Analysis Date: **08/31/07** SeqNo: **539989**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	59.28	1.00	7.5	51.39	105	80	120	59.31	0.0506	20	R3
Fluoride	3.486	0.200	3.75	0	93.0	80	120	3.508	0.640	20	
Nitrate Nitrogen	1.886	0.200	2.032	0	92.8	80	120	1.885	0.0653	20	
Nitrite Nitrogen	1.251	0.0500	1.028	0	122	80	120	1.249	0.165	20	MI
Sulfate	29.16	0.500	22.5	5.571	105	80	120	29.11	0.186	20	
Nitrogen, Nitrate-Nitrite	3.137	0.0500	3.06	0	103	80	120	0	0	20	

Qualifiers:
E Value above quantitation range
H Holding times for preparation or analysis exceeded
J Analyte detected below quantitation limits
ND Not Detected at the Minimum Reporting Limit
R RPD outside accepted recovery limits
S Spike Recovery outside accepted recovery limits

CLIENT: Anderson Engineering & Surveying, Inc
Work Order: 0708836
Project: Geothermal Well B Proj 2006-152

ANALYTICAL QC SUMMARY REPORT

TestCode: HG_W

Sample ID: **MB-13765**	SampType: **MBLK**	TestCode: **HG_W**	Units: **mg/L**	Prep Date: **08/31/07**	RunNo: **35836**
Client ID: **ZZZZZ**	Batch ID: **13765**	TestNo: **EPA 245.1**	**(EPA 245.1/74**	Analysis Date: **09/01/07**	SeqNo: **540049**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	ND	0.000100									

Sample ID: **LCS-13765**	SampType: **LCS**	TestCode: **HG_W**	Units: **mg/L**	Prep Date: **08/31/07**	RunNo: **35836**
Client ID: **ZZZZZ**	Batch ID: **13765**	TestNo: **EPA 245.1**	**(EPA 245.1/74**	Analysis Date: **09/01/07**	SeqNo: **540050**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	0.005060	0.000100	0.005	0	101	80	120				

Sample ID: **0708821-01BMS**	SampType: **MS**	TestCode: **HG_W**	Units: **mg/L**	Prep Date: **08/31/07**	RunNo: **35836**
Client ID: **ZZZZZ**	Batch ID: **13765**	TestNo: **EPA 245.1**	**(EPA 245.1/74**	Analysis Date: **09/01/07**	SeqNo: **540058**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	0.005192	0.000100	0.005	0.000296	97.9	75	125				

Sample ID: **0708821-01BMSD**	SampType: **MSD**	TestCode: **HG_W**	Units: **mg/L**	Prep Date: **08/31/07**	RunNo: **35836**
Client ID: **ZZZZZ**	Batch ID: **13765**	TestNo: **EPA 245.1**	**(EPA 245.1/74**	Analysis Date: **09/01/07**	SeqNo: **540059**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	0.005327	0.000100	0.005	0.000296	101	75	125	0.005192	0	20	

Qualifiers:
E Value above quantitation range
H Holding times for preparation or analysis exceeded
J Analyte detected below quantitation limits
ND Not Detected at the Minimum Reporting Limit
R RPD outside accepted recovery limits
S Spike Recovery outside accepted recovery limits

CLIENT: Anderson Engineering & Surveying, Inc
Work Order: 0708836
Project: Geothermal Well B Proj 2006-152

ANALYTICAL QC SUMMARY REPORT

TestCode: ICP_200.7_W

Sample ID: **MB-13782**	SampType: **MBLK**	TestCode: **ICP_200.7_W**	Units: **mg/L**	Prep Date: **09/04/07**	RunNo: **35901**
Client ID: **ZZZZZ**	Batch ID: **13782**	TestNo: **EPA 200.7**	**(EPA 200.7)**	Analysis Date: **09/07/07**	SeqNo: **541850**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	ND	0.00500									
Antimony	ND	0.0500									
Arsenic	ND	0.0500									
Barium	ND	0.00500									
Beryllium	ND	0.00100									
Boron	ND	0.0500									
Cadmium	ND	0.00100									
Calcium	ND	1.00									
Chromium	ND	0.00500									
Cobalt	ND	0.0100									
Copper	ND	0.0100									
Hardness	ND	3.80									
Iron	ND	0.0150									
Lead	ND	0.0500									
Lithium	ND	0.0100									
Magnesium	ND	1.00									
Manganese	ND	0.0200									
Nickel	ND	0.00500									
Potassium	ND	1.00									
Selenium	ND	0.0500									
Silver	ND	0.00100									
Sodium	ND	1.00									
Thallium	ND	0.0100									
Zinc	ND	0.0500									

Sample ID: **MB-13819**	SampType: **MBLK**	TestCode: **ICP_200.7_W**	Units: **mg/L**	Prep Date: **09/10/07**	RunNo: **35942**
Client ID: **ZZZZZ**	Batch ID: **13819**	TestNo: **EPA 200.7**	**(EPA 200.7)**	Analysis Date: **09/11/07**	SeqNo: **542018**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Qualifiers:
E Value above quantitation range
H Holding times for preparation or analysis exceeded
J Analyte detected below quantitation limits
ND Not Detected at the Minimum Reporting Limit
R RPD outside accepted recovery limits
S Spike Recovery outside accepted recovery limits

CLIENT: Anderson Engineering & Surveying, Inc
Work Order: 0708836
Project: Geothermal Well B Proj 2006-152

ANALYTICAL QC SUMMARY REPORT

TestCode: ICP_200.7_W

Sample ID: MB-13819	SampType: MBLK	TestCode: ICP_200.7_W	Units: mg/L	Prep Date: 09/10/07	RunNo: 35942
Client ID: ZZZZZ	Batch ID: 13819	TestNo: EPA 200.7	(EPA 200.7)	Analysis Date: 09/11/07	SeqNo: 542018

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Potassium	ND	1.00									
Silica	ND	0.700									
Sodium	ND	1.00									

Sample ID: LCS-13782	SampType: LCS	TestCode: ICP_200.7_W	Units: mg/L	Prep Date: 09/04/07	RunNo: 35901
Client ID: ZZZZZ	Batch ID: 13782	TestNo: EPA 200.7	(EPA 200.7)	Analysis Date: 09/07/07	SeqNo: 541851

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	1.066	0.00500	1	0	107	85	115				
Antimony	1.037	0.0500	1	0	104	85	115				
Arsenic	1.072	0.0500	1	0	107	85	115				
Barium	1.080	0.00500	1	0	108	85	115				
Beryllium	1.057	0.00100	1	0	106	85	115				
Boron	1.057	0.0500	1	0	106	85	115				
Cadmium	1.078	0.00100	1	0	108	85	115				
Calcium	1.068	1.00	1	0	107	85	115				
Chromium	1.054	0.00500	1	0	105	85	115				
Cobalt	1.058	0.0100	1	0.0015	106	85	115				
Copper	1.088	0.0100	1	0	109	85	115				
Hardness	7.061	3.80	6.615	0	107	85	115				
Iron	1.057	0.0150	1	0	106	85	115				
Lead	1.056	0.0500	1	0.0022	105	85	115				
Lithium	1.069	0.0100	1	0	107	85	115				
Magnesium	1.067	1.00	1	0	107	85	115				
Manganese	1.077	0.0200	1	0	108	85	115				
Nickel	1.076	0.00500	1	0	108	85	115				
Potassium	1.082	1.00	1	0	108	85	115				
Selenium	1.054	0.0500	1	0.0343	102	85	115				
Silver	0.9491	0.00100	1	0	94.9	85	115				

Qualifiers:
E Value above quantitation range
H Holding times for preparation or analysis exceeded
J Analyte detected below quantitation limits
ND Not Detected at the Minimum Reporting Limit
R RPD outside accepted recovery limits
S Spike Recovery outside accepted recovery limits

CLIENT: Anderson Engineering & Surveying, Inc
Work Order: 0708836
Project: Geothermal Well B Proj 2006-152

ANALYTICAL QC SUMMARY REPORT

TestCode: ICP_200.7_W

Sample ID: LCS-13782	SampType: LCS	TestCode: ICP_200.7_W	Units: mg/L	Prep Date: 09/04/07	RunNo: 35901
Client ID: ZZZZZ	Batch ID: 13782	TestNo: EPA 200.7	(EPA 200.7)	Analysis Date: 09/07/07	SeqNo: 541851

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sodium	1.057	1.00	1	0	106	85	115				
Thallium	1.028	0.0100	1	0	103	85	115				
Zinc	1.024	0.0500	1	0	102	85	115				

Sample ID: LCS-13819	SampType: LCS	TestCode: ICP_200.7_W	Units: mg/L	Prep Date: 09/10/07	RunNo: 35942
Client ID: ZZZZZ	Batch ID: 13819	TestNo: EPA 200.7	(EPA 200.7)	Analysis Date: 09/11/07	SeqNo: 542019

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Potassium	ND	1.00	1	0	90.1	85	115				
Silica	2.063	0.700	2.143	0	96.3	85	115				
Sodium	ND	1.00	1	0	97.8	85	115				

Sample ID: 0708836-01AMS	SampType: MS	TestCode: ICP_200.7_W	Units: mg/L	Prep Date: 09/04/07	RunNo: 35901
Client ID: Geothermal Well	Batch ID: 13782	TestNo: EPA 200.7	(EPA 200.7)	Analysis Date: 09/07/07	SeqNo: 541853

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	22.44	0.00500	21	0.0691	107	70	130				
Antimony	1.070	0.0500	1	0	107	70	130				
Arsenic	1.132	0.0500	1	0.0252	111	70	130				
Barium	1.081	0.00500	1	0.015	107	70	130				
Beryllium	1.065	0.00100	1	0	106	70	130				
Boron	12.26	0.0500	1	11.03	123	70	130				
Cadmium	1.061	0.00100	1	0	106	70	130				
Calcium	29.76	1.00	21	7.488	106	70	130				
Chromium	1.034	0.00500	1	0	103	70	130				
Cobalt	1.019	0.0100	1	0.0018	102	70	130				
Copper	1.079	0.0100	1	0.0012	108	70	130				
Hardness	164.2	3.80	138.8	18.84	105	70	130				
Iron	21.92	0.0150	21	0.0348	104	70	130				

Qualifiers:
E Value above quantitation range
H Holding times for preparation or analysis exceeded
J Analyte detected below quantitation limits
ND Not Detected at the Minimum Reporting Limit
R RPD outside accepted recovery limits
S Spike Recovery outside accepted recovery limits

CLIENT: Anderson Engineering & Surveying, Inc
Work Order: 0708836
Project: Geothermal Well B Proj 2006-152

ANALYTICAL QC SUMMARY REPORT

TestCode: ICP_200.7_W

Sample ID: **0708836-01AMS** SampType: **MS** TestCode: **ICP_200.7_W** Units: **mg/L** Prep Date: **09/04/07** RunNo: **35901**
Client ID: **Geothermal Well** Batch ID: **13782** TestNo: **EPA 200.7** **(EPA 200.7)** Analysis Date: **09/07/07** SeqNo: **541853**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	0.9956	0.0500	1	0.0034	99.2	70	130				
Lithium	1.233	0.0100	1	0.1604	107	70	130				
Magnesium	21.83	1.00	21	0.035	104	70	130				
Manganese	1.038	0.0200	1	0.0041	103	70	130				
Nickel	1.032	0.00500	1	0	103	70	130				
Selenium	1.081	0.0500	1	0.0307	105	70	130				
Silver	0.9398	0.00100	1	0	94.0	70	130				
Thallium	0.9590	0.0100	1	0.0064	95.3	70	130				
Zinc	1.056	0.0500	1	0.0027	105	70	130				

Sample ID: **0709107-01BMS** SampType: **MS** TestCode: **ICP_200.7_W** Units: **mg/L** Prep Date: **09/10/07** RunNo: **35901**
Client ID: **ZZZZZ** Batch ID: **13819** TestNo: **EPA 200.7** **(EPA 200.7)** Analysis Date: **09/07/07** SeqNo: **541878**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	22.58	0.00500	21	0.0213	107	70	130				
Antimony	1.080	0.0500	1	0	108	70	130				
Arsenic	1.132	0.0500	1	0.0129	112	70	130				
Barium	1.082	0.00500	1	0	108	70	130				
Beryllium	1.085	0.00100	1	0	108	70	130				
Boron	10.05	0.0500	1	8.808	124	70	130				
Cadmium	1.080	0.00100	1	0	108	70	130				
Calcium	24.60	1.00	21	2.423	106	70	130				
Chromium	1.052	0.00500	1	0	105	70	130				
Copper	1.099	0.0100	1	0.0013	110	70	130				
Hardness	152.6	3.80	138.8	6.387	105	70	130				
Iron	22.27	0.0150	21	0.0955	106	70	130				
Lead	1.015	0.0500	1	0.0032	101	70	130				
Manganese	1.059	0.0200	1	0.0062	105	70	130				
Nickel	1.048	0.00500	1	0	105	70	130				

Qualifiers:
E Value above quantitation range
H Holding times for preparation or analysis exceeded
J Analyte detected below quantitation limits
ND Not Detected at the Minimum Reporting Limit
R RPD outside accepted recovery limits
S Spike Recovery outside accepted recovery limits

CLIENT: Anderson Engineering & Surveying, Inc
Work Order: 0708836
Project: Geothermal Well B Proj 2006-152

ANALYTICAL QC SUMMARY REPORT

TestCode: ICP_200.7_W

Sample ID: 0709107-01BMS	SampType: MS	TestCode: ICP_200.7_W	Units: mg/L	Prep Date: 09/10/07	RunNo: 35901
Client ID: ZZZZZ	Batch ID: 13819	TestNo: EPA 200.7	(EPA 200.7)	Analysis Date: 09/07/07	SeqNo: 541878

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Potassium	29.48	1.00	21	6.939	107	70	130				
Selenium	1.090	0.0500	1	0.0312	106	70	130				
Silver	0.9407	0.00100	1	0	94.1	70	130				
Thallium	0.9975	0.0100	1	0.0056	99.2	70	130				
Zinc	1.132	0.0500	1	0.0671	106	70	130				

Sample ID: 0709107-01BMS	SampType: MS	TestCode: ICP_200.7_W	Units: mg/L	Prep Date: 09/10/07	RunNo: 35942
Client ID: ZZZZZ	Batch ID: 13819	TestNo: EPA 200.7	(EPA 200.7)	Analysis Date: 09/11/07	SeqNo: 542022

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Potassium	27.34	10.0	21	6.51	99.2	70	130				
Silica	169.0	7.00	45	109.4	133	70	130				MI
Sodium	199.3	10.0	21	177.2	105	70	130				

Sample ID: 0708836-01AMSD	SampType: MSD	TestCode: ICP_200.7_W	Units: mg/L	Prep Date: 09/04/07	RunNo: 35901
Client ID: Geothermal Well	Batch ID: 13782	TestNo: EPA 200.7	(EPA 200.7)	Analysis Date: 09/07/07	SeqNo: 541854

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	22.42	0.00500	21	0.0691	106	70	130	22.44	0.0892	20	
Antimony	1.068	0.0500	1	0	107	70	130	1.07	0.187	20	
Arsenic	1.132	0.0500	1	0.0252	111	70	130	1.132	0	20	
Barium	1.080	0.00500	1	0.015	106	70	130	1.081	0.0925	20	
Beryllium	1.062	0.00100	1	0	106	70	130	1.065	0.282	20	
Boron	12.38	0.0500	1	11.03	135	70	130	12.26	0.974	20	S
Cadmium	1.059	0.00100	1	0	106	70	130	1.061	0.189	20	
Calcium	29.85	1.00	21	7.488	106	70	130	29.76	0.302	20	
Chromium	1.031	0.00500	1	0	103	70	130	1.034	0.291	20	
Cobalt	1.012	0.0100	1	0.0018	101	70	130	1.019	0.689	20	
Copper	1.077	0.0100	1	0.0012	108	70	130	1.079	0.186	20	

Qualifiers:
E Value above quantitation range
H Holding times for preparation or analysis exceeded
J Analyte detected below quantitation limits
ND Not Detected at the Minimum Reporting Limit
R RPD outside accepted recovery limits
S Spike Recovery outside accepted recovery limits

CLIENT: Anderson Engineering & Surveying, Inc
Work Order: 0708836
Project: Geothermal Well B Proj 2006-152

ANALYTICAL QC SUMMARY REPORT

TestCode: ICP_200.7_W

Sample ID: **0708836-01AMSD** SampType: **MSD** TestCode: **ICP_200.7_W** Units: **mg/L** Prep Date: **09/04/07** RunNo: **35901**
Client ID: **Geothermal Well** Batch ID: **13782** TestNo: **EPA 200.7** **(EPA 200.7)** Analysis Date: **09/07/07** SeqNo: **541854**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Hardness	164.4	3.80	138.8	18.84	105	70	130	164.2	0.112	20	
Iron	21.90	0.0150	21	0.0348	104	70	130	21.92	0.0913	20	
Lead	0.9916	0.0500	1	0.0034	98.8	70	130	0.9956	0.403	20	
Lithium	1.231	0.0100	1	0.1604	107	70	130	1.233	0.162	20	
Magnesium	21.82	1.00	21	0.035	104	70	130	21.83	0.0458	20	
Manganese	1.036	0.0200	1	0.0041	103	70	130	1.038	0.193	20	
Nickel	1.032	0.00500	1	0	103	70	130	1.032	0	20	
Selenium	1.083	0.0500	1	0.0307	105	70	130	1.081	0.185	20	
Silver	0.9250	0.00100	1	0	92.5	70	130	0.9398	1.59	20	
Thallium	0.9566	0.0100	1	0.0064	95.0	70	130	0.959	0.251	20	
Zinc	1.051	0.0500	1	0.0027	105	70	130	1.056	0.475	20	

Sample ID: **0709107-01BMSD** SampType: **MSD** TestCode: **ICP_200.7_W** Units: **mg/L** Prep Date: **09/10/07** RunNo: **35901**
Client ID: **ZZZZZ** Batch ID: **13819** TestNo: **EPA 200.7** **(EPA 200.7)** Analysis Date: **09/07/07** SeqNo: **541879**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	22.60	0.00500	21	0.0213	108	70	130	22.58	0.0885	20	
Antimony	1.087	0.0500	1	0	109	70	130	1.08	0.646	20	
Arsenic	1.132	0.0500	1	0.0129	112	70	130	1.132	0	20	
Barium	1.083	0.00500	1	0	108	70	130	1.082	0.0924	20	
Beryllium	1.083	0.00100	1	0	108	70	130	1.085	0.185	20	
Boron	9.954	0.0500	1	8.808	115	70	130	10.05	0.960	20	
Cadmium	1.081	0.00100	1	0	108	70	130	1.08	0.0925	20	
Calcium	24.63	1.00	21	2.423	106	70	130	24.6	0.122	20	
Chromium	1.052	0.00500	1	0	105	70	130	1.052	0	20	
Copper	1.100	0.0100	1	0.0013	110	70	130	1.099	0.0910	20	
Hardness	152.8	3.80	138.8	6.387	106	70	130	152.6	0.157	20	
Iron	22.32	0.0150	21	0.0955	106	70	130	22.27	0.224	20	
Lead	1.014	0.0500	1	0.0032	101	70	130	1.015	0.0986	20	

Qualifiers:
E Value above quantitation range
H Holding times for preparation or analysis exceeded
J Analyte detected below quantitation limits
ND Not Detected at the Minimum Reporting Limit
R RPD outside accepted recovery limits
S Spike Recovery outside accepted recovery limits

CLIENT: Anderson Engineering & Surveying, Inc
Work Order: 0708836
Project: Geothermal Well B Proj 2006-152

ANALYTICAL QC SUMMARY REPORT

TestCode: ICP_200.7_W

Sample ID: **0709107-01BMSD** SampType: **MSD** TestCode: **ICP_200.7_W** Units: **mg/L** Prep Date: **09/10/07** RunNo: **35901**
Client ID: **ZZZZZ** Batch ID: **13819** TestNo: **EPA 200.7** **(EPA 200.7)** Analysis Date: **09/07/07** SeqNo: **541879**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Manganese	1.060	0.0200	1	0.0062	105	70	130	1.059	0.0944	20	
Nickel	1.049	0.00500	1	0	105	70	130	1.048	0.0954	20	
Potassium	29.61	1.00	21	6.939	108	70	130	29.48	0.440	20	
Selenium	1.094	0.0500	1	0.0312	106	70	130	1.09	0.366	20	
Silver	0.9496	0.00100	1	0	95.0	70	130	0.9407	0.942	20	
Thallium	0.9983	0.0100	1	0.0056	99.3	70	130	0.9975	0.0802	20	
Zinc	1.130	0.0500	1	0.0671	106	70	130	1.132	0.177	20	

Sample ID: **0709107-01BMSD** SampType: **MSD** TestCode: **ICP_200.7_W** Units: **mg/L** Prep Date: **09/10/07** RunNo: **35942**
Client ID: **ZZZZZ** Batch ID: **13819** TestNo: **EPA 200.7** **(EPA 200.7)** Analysis Date: **09/11/07** SeqNo: **542023**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Potassium	27.67	10.0	21	6.51	101	70	130	27.34	1.20	20	
Silica	170.4	7.00	45	109.4	136	70	130	169	0.819	20	MI
Sodium	200.8	10.0	21	177.2	112	70	130	199.3	0.750	20	

Qualifiers:
E Value above quantitation range
H Holding times for preparation or analysis exceeded
J Analyte detected below quantitation limits
ND Not Detected at the Minimum Reporting Limit
R RPD outside accepted recovery limits
S Spike Recovery outside accepted recovery limits

CLIENT: Anderson Engineering & Surveying, Inc
Work Order: 0708836
Project: Geothermal Well B Proj 2006-152

ANALYTICAL QC SUMMARY REPORT

TestCode: SOLIDS_TDS_W

Sample ID: **MB**	SampType: **MBLK**	TestCode: **SOLIDS_TDS**	Units: **mg/L**	Prep Date: **09/05/07**	RunNo: **35876**
Client ID: **ZZZZZ**	Batch ID: **R35876**	TestNo: **SM 2540-C**		Analysis Date: **09/06/07**	SeqNo: **540647**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	ND	10.0									

Sample ID: **LCS**	SampType: **LCS**	TestCode: **SOLIDS_TDS**	Units: **mg/L**	Prep Date: **09/05/07**	RunNo: **35876**
Client ID: **ZZZZZ**	Batch ID: **R35876**	TestNo: **SM 2540-C**		Analysis Date: **09/06/07**	SeqNo: **540648**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	131.0	10.0	134	0	97.8	80	120				

Sample ID: **0709054-02ADUP**	SampType: **DUP**	TestCode: **SOLIDS_TDS**	Units: **mg/L**	Prep Date: **09/05/07**	RunNo: **35876**
Client ID: **ZZZZZ**	Batch ID: **R35876**	TestNo: **SM 2540-C**		Analysis Date: **09/06/07**	SeqNo: **540653**

Analyte	Result	MRL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	114.0	10.0						110	3.57	10	

Qualifiers:

E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Minimum Reporting Limit	R	RPD outside accepted recovery limits	S	Spike Recovery outside accepted recovery limits

NEILSON RESEARCH CORPORATION

245 S. GRAPE ST. * MEDFORD, OR 97501-3123 * (541) 770-5678 * FAX (541) 770-2901

Environmental Testing Laboratory

Chain of Custody Record

Date 8/30/07 Page 1 of 1

Attention:

Results and Invoice to: Anderson Engineering

Address:

Phone: Sampled By:

Fax #: P.O. #:

REPORTING REQUEST

Preliminary: Fax ☒ Verbal ☐

Final: Written ☒ Fax ☐

RUSH REQUEST: ☐ 24–48 hrs. (100% sur)

☐ 5 days (50% sur) ☒ Standard 10–14 days

Other

PROJECT INFORMATION

Project Number: 2006-152

Project Name: Town Geothermal

Attention: Darryl Anderson

Address: Anderson Engineering & Surveying

Phone: 541-947-4407

SPECIAL INSTRUCTIONS:

10 Amber received - limited sample

17.5°C/I

☐ 4°C

☐ EPA JARS/VIALS WITH TEFLON LIDS

FIELD BLANK INCLUDED: ☐ YES ☐ NO

ANALYSIS REQUEST

NO. OF CONTAINERS

LAB ID	SAMPLE ID	DATE	TIME	SOIL/WATER OTHER	Alkalinity	TDS	Cl, F, NO2-N, NO3-N, SO4	Metals 200.7	Ba, B, Ca, Cr, Fe, Mg, Mn, Na, Si, Sr, Zn	Hg 245.1	DEPTH	REMARKS/SAMPLE CONDITION
					✓	✓	✓✓	✓	✓✓✓✓✓✓	✓		
	Deep Well	8/30/07	8:00AM	Water	X	X	Inorganic					Analysis
					TRACE		Metals					
	Temperature at				Gate		190° F					

RELINQUISHED BY (Sign and Print)	DATE/TIME	RECEIVED BY (Sign)	DATE/TIME
	8/30 - 9:00 Am		
		REC'D. BY (LABORATORY)	8/31/07 10:00

SAMPLE DISPOSAL

☐ NRC disposal of non-contaminated

☐ Return ☐ Pick up

CHAIN OF CUSTODY SEALS Y/N/NA

SHIPPED VIA: UPS Fed-Ex Bus Hand

Note: See Standard Terms & Conditions on reverse side of this form.

Neilson Research Corporation

245 South Grape Street, Medford, Oregon 97601 541-770-5678 Fax 541-770-2901

Analysis Report

Anderson Engineering & Surveying, Inc
PO Box 28
Lakeview, OR 97630

Lab Order: 0805188
NRC Sample ID: 0805188-01B
Collection Date: 05/08/08 7:15:00 AM
Received Date: 05/09/08 10:15:00 AM
Reported Date: 05/23/08 2:23:42 PM

Sample Information

Proj 2007-111 Well #4

Client Sample ID: 2007-111 Well #4
Collectors Name: Ryan Conn
Sample Location:
Source: Well #4

ANALYTICAL RESULTS

Analyses	Method	NELAC Accredited	Result	Qual	MRL	Units	EPA Limit	Date Analyzed	Analyst
Alkalinity, Total (As CaCO3)	SM 2320B	A	144		10	mg/L	N.L.	05/20/08	BJF
Color	SM 2120B	A	40		5	Color Units	15	05/09/08	BJF
Specific Conductance	SM 2510B	A	336		1	µmhos/cm	N.L.	05/09/08	BJF
Chloride	EPA 300.0	A	15.8		1	mg/L	250	05/14/08	TJK
Fluoride	EPA 300.0	A	0.599		0.2	mg/L	2 - 4	05/14/08	TJK
Sulfate	EPA 300.0	A	0.630		0.5	mg/L	250	05/14/08	TJK
Hardness	SM 2340B	A	7.43		3.8	mg/L	250	05/13/08	BAR
Aluminum	EPA 200.7	A	0.0685		0.005	mg/L	0.05 - 0.2	05/13/08	BAR
Calcium	EPA 200.7	A	2.24		1	mg/L	N.L.	05/13/08	BAR
Copper	EPA 200.7	A	0.0370		0.01	mg/L	1.3 AL	05/13/08	BAR
Iron	EPA 200.7	A	0.227		0.015	mg/L	0.3	05/13/08	BAR
Manganese	EPA 200.7	A	0.0646	*	0.02	mg/L	0.05	05/13/08	BAR
Nickel	EPA 200.7	A	ND		0.005	mg/L	0.1	05/13/08	BAR
Silver	EPA 200.7	A	ND		0.001	mg/L	0.1	05/13/08	BAR
Zinc	EPA 200.7	A	ND		0.05	mg/L	5.0	05/13/08	BAR
Langelier Index	SM 203		-0.49		0	Index	> Neg Valu	05/20/08	BJF
MBAS	SM 5540C	A	ND	N	0.1	mg/L	0.5	05/09/08	BJF
Odor	SM 2150 B	A	1.6		1	T.O.N.	3	05/09/08	BJF
pH	SM 4500 H-B	A	8.53	HR	0.1	pH Units	6.5 - 8.5	05/09/08	BJF
Total Dissolved Solids (Residue, Filtereble)	SM 2540-C	A	207		10	mg/L		05/12/08	BJF
Total Solids	SM 2540B	A	262		4	mg/L	500	05/08/08	BJF

Notes: ND - Not Detected at the MRL N.L. - No Limit MRL - Minimum Reporting Limit

2

KLAMATH ENVIRONMENTAL SERVICES
200 E. Main • Klamath Falls, OR 97601

ENVIRONMENTAL CONSULTING, HAZARDOUS WASTE
MANAGEMENT, WATER ANALYSIS, GROUND WATER MONITORING
200 EAST MAIN - KLAMATH FALLS, OR 97601 - 503 / 882-6577
FAX 503 / 882-7867 TOLL FREE 800/262-6973
OREGON STATE CERTIFIED LABORATORY #17
STATE OF CALIFORNIA CERTIFIED
EPA APPROVED

LABORATORY RESULTS
Irrigation Water Parameters
August 12, 1994

Greenhouse well

Attn: Andy Parker
The Greenhouse
P O Box 709
Lakeview OR 97630

Sample Matrix : water
Date Sampled: 7/28/94
Date Received: 7/28/94
Date Analyzed: 8/12/94
Analysis Units: mg/L, ppm
Collected by: Andy

Primary Elements

June
Desert Farm
Leach Mt. Spring

Elements:	# 1 Home:	# 2 Greenhouse:	# 3 Hunter's:
Boron	0.20	4.64	0.19
Chloride	32.8	100	16.7
Conductivity	572	993	382
Nitrate	5.60	2.86	2.30
pH	7.9 s.u.	8.0 s.u.	8.0 s.u.
SAR	0.56	7.76	0.68

Recommended less than 0.5 ppm

Miscellaneous Elements

Elements:	# 1 Home:	# 2 Greenhouse:	# 3 Hunter's:
Aluminum	0.54	0.17	0.27
Antimony	<.02	<.02	<.02
Arsenic	0.02	0.03	<0.02
Barium	0.021	0.024	0.014
Beryllium	<.001	<.001	<.001
Bismuth	<.05	<.05	<.05
Cadmium	0.002	<0.002	0.002
Calcium	75.9	34.9	50.5
Chromium	<.005	<.005	<.005

Elements:	# 1 Home:	# 2 Greenhouse:	# 3 Hunter's:
Cobalt	<.005	<.005	<.005
Copper	0.002	<.002	<.002
Gold	<.005	<.005	<.005
Iron	<.01	<.01	<.01
Lanthanum	<.005	<.005	<.005
Lead	<.02	<.02	<.02
Magnesium	13.1	3.1	5.4
Manganese	<.01	<.01	<.01
Mercury	<.02	<.02	<.02
Molybdenum	0.008	0.021	0.006
Nickel	0.006	<.005	<.005
Phosphorus	0.16	<.04	0.10
Potassium	3.2	5.9	2.7
Silicon	8.04	14.73	7.56
Silver	< .003	<.003	<.003
Sodium	20	178	19 less than 50 ppm
Strontium	0.408	0.235	0.358
Titanium	<.005	<.005	<.005
Tungsten	0.05	<.02	<.02
Vanadium	0.005	0.023	0.016
Zinc	0.03	0.02	0.01

Reviewed and Approved by:

Lee Halbert

Laboratory Supervisor

APPENDIX E: POTENTIAL IMPACTS TO THE GEOTHERMAL AQUIFER ARISING FROM INCREASED UTILIZATION

ECO:LOGIC
ENGINEERS · CONSULTANTS

Memorandum

To: Tania Treis

From: Dale Bugenig

CC: Darryl Anderson

Date: September 3, 2009

RE: Lakeview, Oregon – Potential impacts to the geothermal aquifer arising from increased utilization

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This memorandum addresses changes in the geothermal aquifer located near Lakeview, Oregon that might be anticipated as a result of increased use of the resource by the Town. Two project areas are considered. The first area is located north of Lakeview where the Town has developed the resource to provide heat to the Warner Corrections Facility (referred to herein as the North Area). The second area is located south of Town where it proposes to develop the geothermal resource to provide heat to community facilities including schools and the hospital (the South Area).

The following brief description of the geothermal resource is extracted from the reports that were prepared to document the Town's geothermal resource exploration and development (ECO:LOGIC, 2002 & 2005).

> "The details of the geothermal system are not known with any level of confidence. A moderate-temperature resource (up to 300º F) is believed to originate at depth in the volcanic rocks [that comprise the Warner Range to the east and likely underlie the alluvial deposits in Goose Lake Valley]. The geothermal fluids probably ascend along a relatively narrow band of fractures associated with the range-front fault. The occurrence of hot springs and other near-surface thermal expressions of the resource appear to be related to the intersection of this fault with other geologic structures (faults, fractures, or joints). The rising thermal waters presumably intersect permeable horizons in the alluvial deposits and migrate laterally in the direction of the local hydraulic gradient."

The geothermal aquifer north of Lakeview is clearly part of a hydrologic continuum with the basin-fill deposits of Goose Lake Valley farther to the west. Pumping from agricultural and other wells that derive groundwater from the alluvial deposits in Goose Lake Valley causes seasonal

water-level declines in wells throughout the groundwater basin including the area where geothermal development has occurred.

Both geothermal projects incorporate re-injection of the heat-spent thermal effluent to the aquifer. Consequently, no geothermal fluids are consumed and water-level changes would be expected to be limited to the area close to wells.

NORTH AREA

Background

The North Area is located approximately one-half mile west of the range front. The Town's current geothermal production well was completed to a depth of 601 feet below land surface (bls). The well is completed with well screen selectively placed from 180 to 601 feet bls. The vast majority of geothermal fluid production is believed to originate from permeable strata between 270 and 510 feet bls, although some water is probably produced from a permeable horizon 180 to 190 feet bls. Nearby residential geothermal wells and the "geyser" (a former well that flows uncontrollably) exploit comparatively shallow permeable strata in the aquifer. At this locale the Town well's production horizon is separated from the shallower permeable strata by an aquitard comprising at least 70 feet of clay and clayey gravel. The locations of the wells are illustrated in Figure 1.

Figure 1. Lakeview, Oregon North Project Area.

Testing of the Town's geothermal exploration and production wells yielded estimates of the transmissivity of the geothermal aquifer in the range of 3,000 to 5,000 feet^2/day (at 200º F). Assuming an aquifer thickness of 600 feet, the average horizontal hydraulic conductivity of the geothermal aquifer is approximately 8.3 feet/day. Because the geologic materials in this area contain a significant aggregate thickness of clay lenses or strata, the hydraulic conductivity of the permeable horizons is higher. The coefficient of storage for the aquifer is approximately 0.0002, indicating confined conditions in the aquifer at this locale. This conclusion is consistent with the presence of an aggregate thickness of as much as 200 feet or more of clay overlying the primary production zones. The vertical hydraulic conductivity of these low permeability deposits is estimated from stress test results to be 0.001 feet/day, a value consistent with clay.

The Town's geothermal production well has been test pumped at rates as high as 220 gpm. It is equipped to pump at a peak rate of 125 gpm, although the average pumping rate over three years of operation is less than 90 gpm. The heat-spent thermal effluent is re-injected via the Town's injection well, located approximately 1,800 feet to the south-southwest. As presently operated, only a small build up of pressure has been observed in the injection well. To date, the operation of the Town's geothermal well has resulted in no discernible impact on the nearby residential wells or the geyser (Darryl Anderson, personal communication).

Analysis of potential water-level impacts

The proposed project entails generating electrical power, which will significantly increase geothermal well pumping in this area. The projected monthly well discharge to meet the heating requirements for the Prison and to generate electricity is tabulated in Table 1.

Table 1.
Monthly Well Discharge for North Area Project
(Source: Anderson Engineering & Surveying, 2009)

	Monthly Well Discharge for Prison Heat (Million Gallons)	Monthly Projected Well Discharge for Power Generation (Million Gallons)
July	2.50	13.00
August	3.00	13.00
September	3.00	13.00
October	3.30	13.00
November	3.70	13.00
December	4.50	13.00
January	5.30	13.00
February	4.50	13.00
March	4.90	13.00
April	4.70	13.00
May	4.10	13.00
June	3.50	13.00
Annual total (Million Gallons)	47.00	156.00
Average (gpm)	89.42	296.80

Note: Monthly injection rates are equal to the sum of the pumping rates.

The potential changes in water level in the geothermal aquifer at the North Area arising from pumping and re-injection were evaluated using the forward modeling capabilities of the computer program AQTESOLV® Pro for Windows® version 4.50.13 (HydroSOLVE, Inc., 1996-2009). The specific analytical model that was employed is that of Dougherty and Babu (1984). Dougherty and Babu derived an analytical solution for unsteady flow to a fully or partially penetrating, finite-diameter well with wellbore storage and wellbore skin in a homogeneous, isotropic confined aquifer. Moench (1988) extended the method to include anisotropy. AQTESOLV uses the principle of superposition in time to simulate variable-rate tests including recovery with the Dougherty-Babu solution.

Analysis of water-level (piezometric head) changes in the geothermal aquifer employed the following assumptions, which incorporate the results of formal testing of wells:

- *Pumping and re-injection rates:* The combined monthly pumping rates for the Prison and electrical generation shown in Table 1 for the first year of operation, followed by continuous pumping at the average rate.
- *Pumped well casing diameter:* 10 inches
- *Pumped well borehole diameter:* 15 inches.
- *Transmissivity:* 5,000 ft^2/day (at 200º F).
- *Coefficient of storage:* 0.0002 (dimensionless).
- *Vertical hydraulic conductivity: 0.001 ft/day*
- *Aquifer thickness:* 600 feet.
- *Partial penetration of the aquifer by the production well:* screened interval 180 to 601 feet bls.
- *Partial penetration of the aquifer by nearby wells and geyser:* screened intervals above 70 feet bls for the wells and above 38 feet bls for the Geyser.
- *Partial penetration of the aquifer by the injection well:* screened below 180 feet bls.

The results of the simulation to predict changes in water-levels are depicted below Figure 2. As with any attempt to predict the response of a natural system to a stress, the predicted changes in water level should be viewed as approximate.

From Figure 2, the maximum drawdown in the geothermal aquifer tapped by the Town's existing geothermal production well during peak demand periods is expected to be in the range of 30 feet and less than 30 feet during periods of lower demand. Figure 2 also indicates water levels in the pumped well approach a steady-state condition after a few days as the effect of pressure support from re-injection is propagated away from the injection well. Pressure support from re-injection also accounts for the small projected drawdown in the nearby shallow wells such as the Geyser, the McDonald well, and the Parker well.

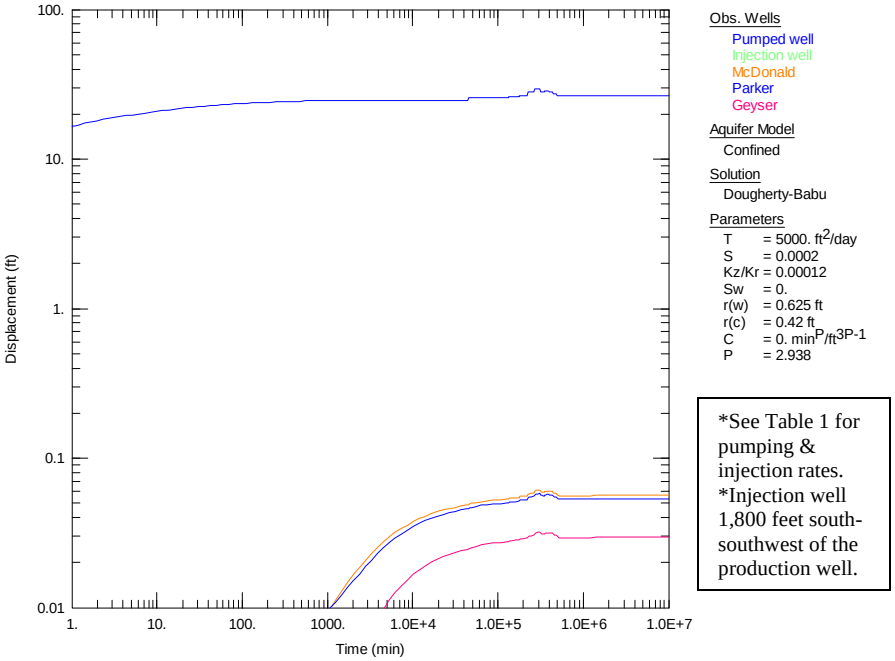


Figure 2. Simulated water-level changes in the geothermal aquifer, pumping from the Town's production well, re-injecting at the Town's injection well – Lakeview, Oregon North Project Area.

The drawdown in the existing production well will be greater than the predicted drawdown in the aquifer because of linear and non-linear well losses. The maximum rate at which the well has been pumped to date is 220 gallons per minute during the aquifer stress test conducted soon after the well was constructed. At this rate, the maximum observed drawdown was measured at approximately 38 feet. The combined power generation and Prison heating demand will require a supply as high as 410 gallons per minute during peak heating periods. Incorporating linear and non-linear well losses into the analysis of drawdown in the production well (as opposed to the drawdown in the aquifer at the production well) suggests the drawdown in the well may be expected to exceed 200 feet. As a result, an additional production well may be required for power production. Likewise, the re-injection well has not been tested at 410 gpm and an additional injection well may be necessary.

The Town of Lakeview has acquired the right to utilize a nearby geothermal well to supplement their existing production well or provide redundant capacity. This 450-feet deep well, referred to as the Utley Well, is located approximately 1,100 feet east-northeast from the Town's geothermal production well (see Figure 1). Constructed in 1959, it currently provides a source of heat to a commercial greenhouse operation. A comprehensive aquifer-stress test involving this well was completed for Northwest Geothermal Corporation in 1980. The results of the testing program suggested the Utley Well could be rated to yield 384 gpm on a sustained basis (Hydrosciences, Inc., 1981).

The potential changes in water levels in the aquifer arising from using the Utley Well as a source of supply was also investigated. The assumptions for the analysis of the effect of pumping the Town's production well were used for this analysis of the effects of pumping only the Utley Well. The results are illustrated below in Figure 3. Comparison with Figure 2 indicates that using the Utley well as the sole source of supply can be expected to have a larger affect on water levels in the nearby domestic wells and geyser (approximately 5 to 9 feet of drawdown), primarily because the Utley well is assumed to fully penetrate the aquifer, in the absence of a well-completion log.

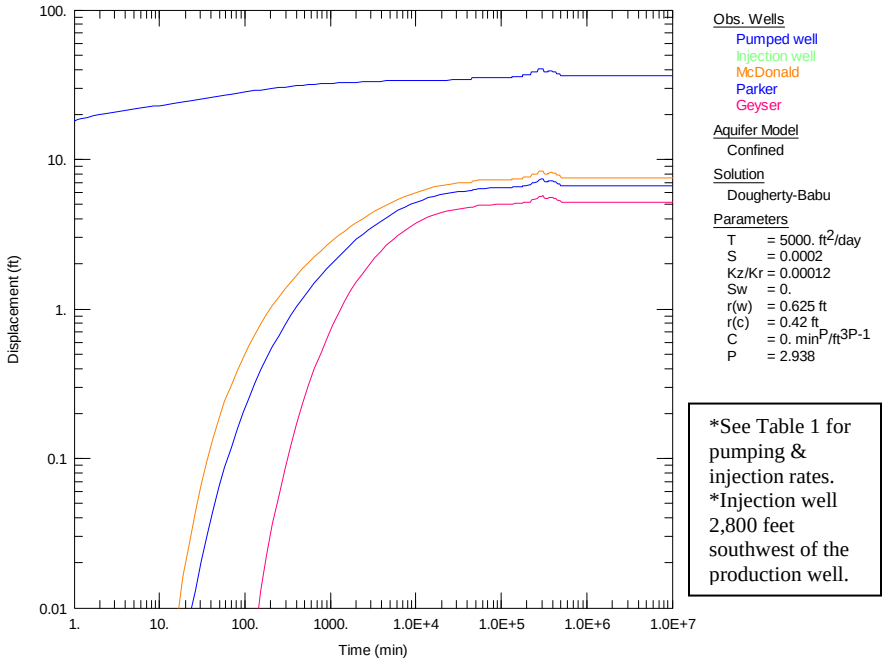


Figure 3. Predicted water-level changes in the geothermal aquifer, pumping from the Utley well, re-injecting at the Town's injection well – Lakeview, Oregon North Project Area.

A third simulation was performed that assumed that production would be shared equally between the Town's current production well and the Utley Well (total combined discharge per Table 1). The results of these calculations are shown in Figure 4. Under this simulation, the drawdown in the nearby wells and the geyser are less than the case where the Utley Well provides the sole source of supply. Maximum drawdown in the domestic wells is estimated to range between approximately 3 and 3.5 feet and drawdown at the Geyser is estimated to be three feet or less. Note also that the estimated drawdown in the aquifer at the Utley well is more than at the Town's production well because it is farther from the injection well site, therefore receives less pressure support from re-injection.

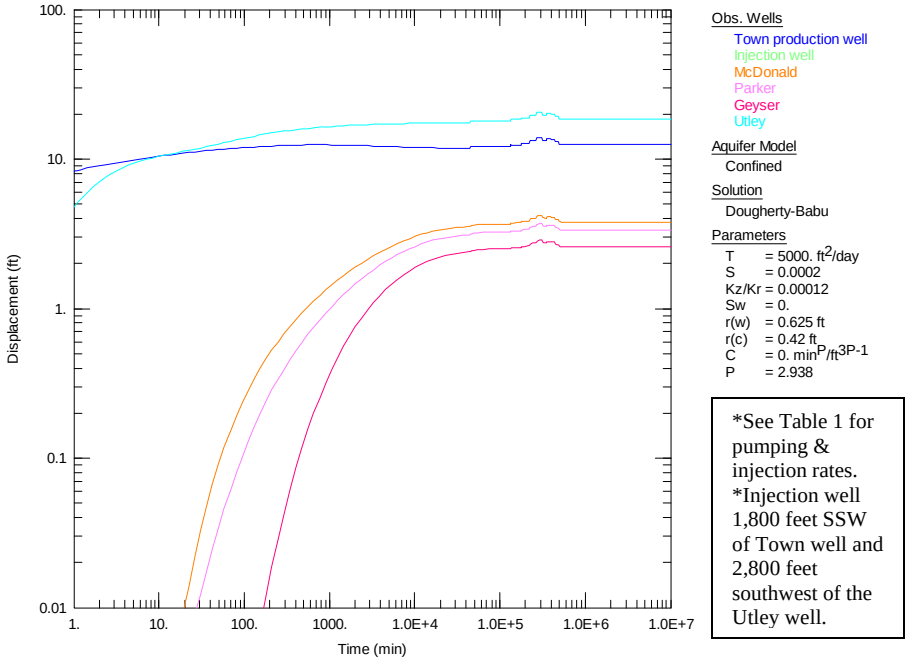


Figure 4. Predicted water-level changes in the geothermal aquifer, pumping from the Town's production well and the Utley well, re-injecting at the Town's injection well – Lakeview, Oregon North Project Area.

Recommendations

Because of its age, the condition of the Utley well and its performance should be evaluated prior to integrating it into the Town's proposed geothermal project. This work might include, as a minimum:

- Removing accumulated fill to the bottom of the well.
- Performing a short pumping test to determine whether or not well performance has deteriorated.
- Re-evaluating the long-term reliable yield.
- Evaluating the concentration of the suspended solids in the discharge.
- Upgrading the surface completion of the well.

Given the well was constructed 50 years ago, it almost certainly will need to be replaced during the life of the project.

SOUTH AREA

Background

The conditions in the geothermal aquifer at South Project Area (Figure 5) are generally similar to the North Project Area, but there are some differences. The primary difference is the proposed production well (Barry Well B) is located much closer to the range front than the wells north of Lakeview. The borehole for Barry Well B fully penetrated the alluvial deposits and appears to have intercepted the fractures associated with the range-front fault that likely serves as a conduit for upward movement of the geothermal fluid. The well was constructed with blank well casing and a grout annular seal through the alluvial deposits and is completed so as to derive geothermal fluids from the consolidated rocks.

Figure 5. Lakeview, Oregon South Project Area

An existing well (Barry Well A, located approximately 265 feet northwest of Barry Well B) was used to test the injection potential at the site. The results of a coupled pumping and re-injection test showed that the re-injection will result in pressure support in the aquifer at the production well. However, Barry Well A is too close to the production well to prevent breakthrough of the heat-spent thermal effluent to the production well. The project calls for a new injection well to

be located approximately 1,900 feet west (down-gradient to cross-gradient) of the production well to reduce the potential for breakthrough to the production well.

The aquifer conditions in the South Area are more complex than the portion of the geothermal aquifer exploited by the North Area wells. In the North Area, both the production and injection wells are completed in basin-fill deposits more than one-half mile west of the range front. The hydraulic properties of the geothermal aquifer there are relatively uniform over a large area and the vertical hydraulic conductivity is several orders of magnitude less than the horizontal hydraulic conductivity, leading to a high degree of vertical anisotropy. In contrast, at the South Area, Barry Well B was constructed to derive groundwater from fractured rocks and Barry Well A (the well used for injection testing) was completed in the basin-fill deposits. Likewise, the injection well that is proposed to be constructed for the project will be completed in the basin-fill deposits.

The test of Barry Well B suggests the fractured rocks are less permeable than the alluvium at this locale. The calculated transmissivity of the fractured rocks is in the neighborhood of 180 to 220 $feet^2$/day. Comparatively, the transmissivity of the alluvium was calculated to be in the range of 900 to 1,100 $feet^2$/day. In the vicinity of the existing wells, the geothermal aquifer does not appear to be vertically anisotropic to a large degree. The calculated coefficient of storage was 0.001 to 0.03, suggesting semi-confined to unconfined conditions prevail at this locale.

The South Project Area is located in a thermal spring discharge area. Cannon Spring (154º F) is located approximately 1,800 feet north of Barry Well A, at the base of the range front. The spring flow is hypothesized to represent surface discharge of geothermal fluids flowing upward along the range-front fault. Diffuse spring discharge also occurs west to southwest of the production well site where the piezometric head in the aquifer is at or above the land surface.

Analysis of potential water-level impacts

The projected monthly well discharges that are required to meet the heating requirements for the South Project are tabulated in Table 2, below.

Table 2.
Monthly Well Discharge for North Area Project
(Source: Anderson Engineering & Surveying, 2009)

	Monthly Projected Well Discharge (Million Gallons)
January	11.00
February	9.00
March	7.80
April	5.20
May	3.00
June	0.50
July	0.50
August	0.70
September	4.00
October	7.00
November	8.60
December	11.00
Annual Total (Million Gallons)	68.30
Average (GPM)	129.95

Note: Monthly injection rates are equal to the pumping rates.

Similar to the North Project Area, the potential changes in water level in the geothermal aquifer at Barry Well B in the South Area arising from pumping and re-injection were evaluated using the forward modeling capabilities of the computer program AQTESOLV® Pro for Windows® version 4.50.13 (HydroSOLVE, Inc., 1996-2009). The analytical model (Dougherty and Babu, 1984) invoked for this analysis represents a very simplistic view of the geothermal aquifer. It was derived for porous media, not fractured rocks. However, the observed water-level data collected from the well, in particular, the late-time data, could be simulated reasonably well using the method, suggesting that the aquifer is sufficiently fractured to behave as an equivalent porous medium and that there is good hydraulic communication between the alluvium and the fractured rocks.

Assumed well and aquifer characteristics include:

- *Pumped well casing diameter:* 8 inches.
- *Pumped well borehole diameter:* 8 inches.
- *Transmissivity:* 1,100 ft^2/day (at 187º F).
- *Coefficient of storage:* 0.016 (dimensionless).
- *Ratio of vertical to horizontal hydraulic conductivity:* 1 (dimensionless).
- A*quifer thickness:* 600 feet.
- *All wells fully penetrate the aquifer.*

The monthly pumping and injection rates for the analysis are shown in Table 2 for the first year of the simulation, followed by continuous pumping at the average rate. Reinjection rates are assumed to mirror the pumping rates.

The results of the analytical simulation to predict changes in water-levels in the geothermal aquifer south of Lakeview are depicted below Figure 6, below. From Figure 6, the drawdown in the geothermal aquifer at the Barry Well B site is expected to be in the range of 60 feet or less, under the influence of pressure support from the injection well. Figure 6 also indicates water levels in the pumped well approach a steady-state condition relatively quickly as the effect of pressure support from re-injection extends to the fractured-rock aquifer near the production well. Drawdown approaching approximately 2.5 feet is anticipated for Cannon Spring during peak pumping periods. During low heat-demand periods, drawdown at Cannon Spring can be expected to be less than one foot. On average, drawdown at Cannon Spring is expected to be less than two feet. For the spring discharge area southwest of the production well, drawdown in the range of 7.5 feet is anticipated during periods of peak demand, decreasing to less than one foot during periods of low heat demand.

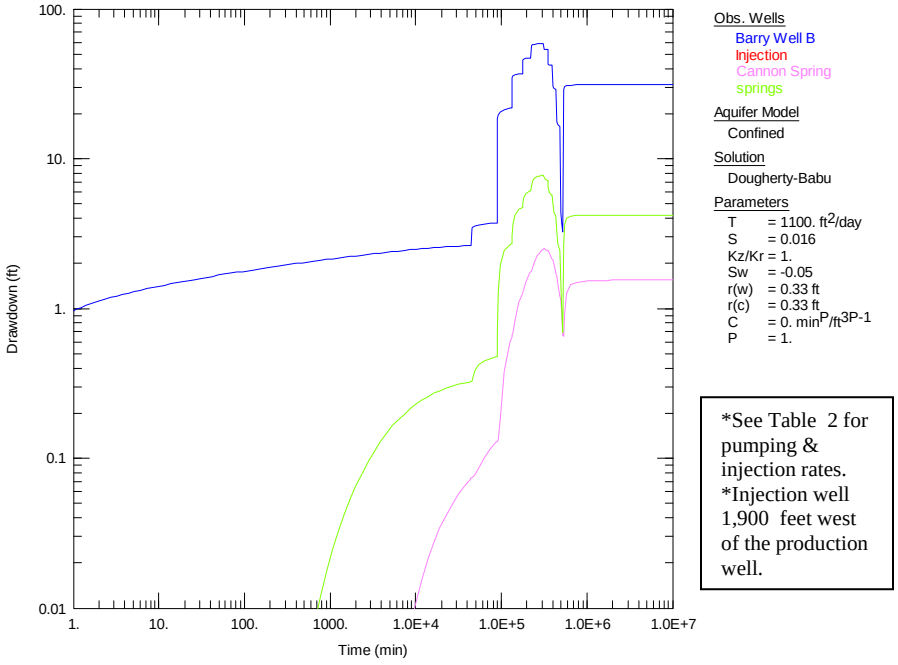


Figure 6. Predicted water-level changes in the geothermal aquifer – Lakeview, Oregon South Project Area.

The drawdown in the production well will be greater than the predicted drawdown in the aquifer because of linear and non-linear well losses. The maximum rate at which the well has been pumped to date is 160 gallons per minute during the aquifer stress test. At this rate, the maximum observed drawdown was measured at approximately 90 feet. The peak heating demand for the project requires a flow of 370 gpm. The available data indicate that Barry Well B

cannot yield 370 gpm. However, 96% of the time, the heating demand for the project can be met by a flow of approximately 250 gpm or less and the annual average pumping rate is expected to be approximately 130 gpm (Darryl Anderson, personal communication).

The available data suggest Barry Well B can yield 250 gpm for short periods of time; however, it should be test pumped at this rate to confirm its performance at this rate. Likewise, the well appears capable of sustained pumping at the average rate of 130 gpm under the influence of pressure support from re-injection.

Because the conditions in the aquifer at the South Project Area are fairly complex and not as well documented as the conditions at the North Project Area, predicting changes in water level in the aquifer has a greater degree of uncertainty than for the North Area. Furthermore, the injection well has not yet been constructed and the degree of the hydraulic connection between the aquifer at the production well and the proposed injection well location has not been documented. Further testing and analysis is recommended as the project moves forward.

The yield rating of the Well B is influenced by a recommended maximum pumping level, which, in this case, is influenced by the depth to the major water-producing fractures. In the absence of a fluid-entry survey, it has been hypothesized that the bulk of the thermal water derived from the well enters at a relatively shallow depth of approximately, perhaps less than 200 feet bls (a short distance below the bottom of the well casing at 179 feet bls) based on comparisons of the Well B temperature log and the discharge temperature. These fractures are further inferred to be associated with the range-front fault. A new well located farther from the range-front fault than Well B would be expected to encounter the fault-influenced fractures at a greater depth. If, in fact, the permeable horizons associated with the fault are intercepted at a greater depth, an increase in well performance should be anticipated.

Recommendations

A new production well is planned for the South Area project. The intention is to place the well farther from the range front in an attempt to intersect the water-yielding fractures deeper than they were intercepted in Well B. A possible, yet unproven benefit of a well that penetrates the permeable fractures at a depth greater than encountered in Barry Well B is that there may be a lesser potential for cooler water to migrate to the well bore. To facilitate peak pumping at rates approaching 370 to 400 gpm, the pumping level in the well may need to be as deep as 400 feet below land surface. To accommodate a pump capable of discharging 370 to 400 gpm, nominal 12-inch diameter production casing is recommended. A suggested well design, drilling program and testing program are outlined below.

Production well

- *Surface conductor casing:* Nominal 18-inch diameter from the land surface to a depth of 50 feet. The casing will be installed in a nominal 22-inch diameter borehole and the annular space sealed with cement grout.

- *Production casing:* 12 ¾-inch outside diameter casing from land surface to a target depth of 450 feet bls (or the depth to the first major fracture zone). The casing will be installed within a nominal 18-inch diameter borehole and the annulus sealed with cement grout. Below the casing, the borehole in the consolidated rocks can be completed as an open borehole (without casing and well screen) if it is competent.
- *Drilling program:* Drill the borehole for the conductor casing and the production casing by the mud-rotary method. Drill below the production casing by the air-rotary method. Air-rotary drilling will enable an assessment of well yield as the borehole is advanced.
- *Testing program:* Conduct a battery of pumping tests that includes step and constant-discharge test pumping. A fluid-entry survey is recommended to be performed in conjunction with the step test. Once the injection well is constructed, conduct a coupled pumping / re-injection test.

Injection well

- *Surface conductor casing:* Nominal 16-inch diameter from the land surface to a depth of 50 feet. The casing will be installed in a nominal 20-inch diameter borehole and the annular space sealed with cement grout.
- *Injection casing and screen:* 10 ¾-inch outside diameter casing from land surface to a target depth of 450 feet bls. The casing and screen will be installed within a nominal 18-inch diameter borehole. The annulus surrounding the well screen will be filled with an engineered filter pack / formation stabilizer. The annulus sealed above the formation stabilizer will be sealed with cement grout. A mechanical integrity test will be performed.
- *Drilling program:* Drilling will be accomplished by the mud-rotary method. After the conductor casing has been drilled and grouted, a pilot hole will be drilled to acquire the information and data necessary to finalize the design of the injection well. Once the design has been finalized, the pilot hole will be reamed by the mud-rotary method.
- *Testing program:* Conduct a battery of pumping tests that includes step and constant-discharge test pumping. The pumping tests will be followed by a coupled pumping / re-injection test.

ECO:LOGIC
ENGINEERS · CONSULTANTS

Memorandum

To: Tania Treis

From: Dale Bugenig

CC: Darryl Anderson

Date: November 10, 2009

RE: Response to questions

This memorandum addresses questions regarding potential impacts to the geothermal aquifer south of Lakeview arising from the project. I have provided the questions either as direct quotes; or I have paraphrased them to help clarify the question.

What is the volume of water that will be discharged from wells south of Lakeview during the testing program? What is the temperature of the discharge? Where will water be discharged during testing?

Developmental pumping and test pumping of the production and re-injection wells will take place after the wells are constructed. At this stage in the process I can only estimate the pumping rates, the volume of water pumped, and the temperature. For the production well, if we assume that the well will be pumped as high as 370 gallons per minute (the peak pumping rate) and a total of 4.25 days (36 hours of developmental pumping, 6 hours of step test pumping and 24 hours of constant-discharge pumping) perhaps as much as 20,000,000 gallons of water will be pumped from the production well and a similar amount of water pumped from an injection well.

The temperature of the discharge of a new production well is unknown until such time as it is constructed. It is expected to be between 187º F (temperature of water discharge from Barry Well B) and could be as high as 200º F if the new well is constructed such that it is influenced less by the cooler groundwater in the alluvium. The temperature of water from the injection well will be significantly lower due to its location, approximately 1,900 feet west of the production well.

I anticipate that the water from the production well will be discharged to the existing ditch that currently conveys the natural hot springs discharge in this area, depending on the time of year. If testing is conducted in the winter, it may be necessary to convey the discharge beyond the highway to prevent impairing visibility due to the vapor cloud that can be expect to form in cold air.

Pumping the south well would draw down Cannon Spring by up to 2.5 feet. Would this stop the flow of the spring? If so, this could be a significant impact. Is there a use of Cannon springs right now? It looks like it feeds a large wetland area as well.

Would the drawdown of 7.5 for the springs south of the well cause a cessation of flow to the surface and would it dry up the wetland? If so, that also would be a significant impact.

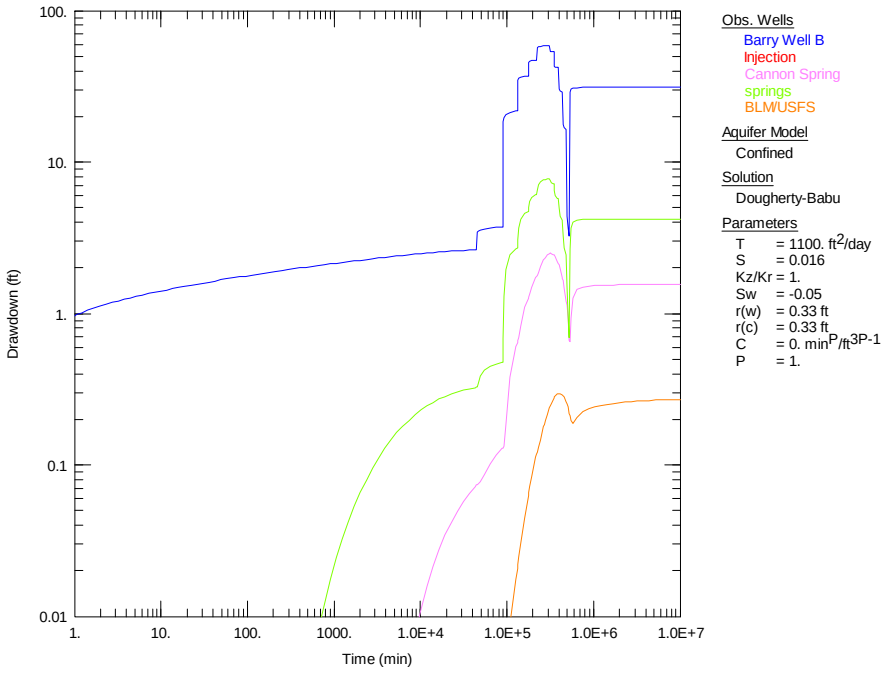
There are no data with which to develop head-discharge relationships for either Cannon Spring or the unnamed springs south of the proposed well site. However, over the long term we would expect that the spring discharge will be diminished because the production well for the project is located in a spring-discharge area. Due to its location, it is expected to capture geothermal fluid flux that discharges as spring flow. If a significant reduction in spring flow occurs, it can be mitigated by discharging an appropriate quantity of the geothermal well discharge at the spring locations to offset any reduction in natural spring discharge.

What is the potential impact on nearby wells?

Based on the analysis of spring impacts, nearby wells are expected to experience less than 10 feet of water-level decline due to the project. The State of Oregon recognizes that development of a groundwater resource can result in a decline in water levels. Furthermore, the State allows for water level declines, so long as the existing users continue to have their customary use of the groundwater resource. Because the aquifer thickness is large compared to the predicted drawdown, nearby well owners' customary use of the groundwater resource is not expected to be affected.

What is the anticipated impact to the geothermal well at the BLM/USFS offices located less than a mile north of the project's production well.

The BLM/USFS offices' geothermal well is located approximately 4,700 feet to the north of the proposed production well for the project. The potential for the project to impact water levels in the BLM/USFS well was examined using the same analytical model used to assess the potential effects on the springs. The results of the analysis, illustrated in the following figure, indicate that the BLM/USFS well may experience approximately 0.3 foot of interference drawdown, or less, due to the project, but it is unlikely the affect will be measureable.


100.
10.
1.
0.1
0.01
Drawdown (ft)
1.
10.
100.
1000.
1.0E+4
1.0E+5
1.0E+6
1.0E+7
Time (min)
Obs. Wells
Barry Well B
Injection
Cannon Spring
springs
BLM/USFS
Aquifer Model
Confined
Solution
Dougherty-Babu
Parameters
T = 1100. ft2/day
S = 0.016
Kz/Kr = 1.
Sw = -0.05
r(w) = 0.33 ft
r(c) = 0.33 ft
C = 0. minP/ft3P-1
P = 1.