



Environmental Concerns and Mitigation Associated with Geothermal Resource Confirmation Drilling Activities

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1 Project Overview

2 Environmental Geothermal Experts Interviewed

3 Review of Environmental Concerns/Mitigation by Topic

What is the purpose of this project?

- BLM's Geothermal Program funded NREL to analyze technical and environmental considerations related to geothermal resource confirmation drilling.
- The analysis examines the potential for developing a new classification of wells and/or expediting National Environmental Policy Act (NEPA) compliance for resource confirmation drilling and related activities.

Project Methodology

How did NREL collect information on resource confirmation?

- NREL conducted a series of one-on-one **technical and environmental interviews** with geothermal stakeholders (a “Geothermal Expert Team”) to understand minimum technical requirements and associated environmental impacts.
- NREL **held follow-up monthly calls** with the Geothermal Expert Team to gain consensus on documented technical and environmental feedback collected through one-on-one interviews.

Environmental Expert Team

David Batts

EMPSi

Laurie Hietter

Panorama Environmental, Inc.

Dan Munger

BLM California State Office

Scott Nichols

US Geothermal

Wyndy Rausenberger

DOI Solicitor's Office

Kyle Snyder

Ormat

Casey Strickland

U.S. Department of Energy

Environmental Interview Question Categories

NREL staff asked a series of questions related to the environmental concerns and associated mitigation, best practices, and standard conditions of approval for geothermal resource confirmation well drilling activities.

Categories of Questions included:

- Site Access
- Drill Site (e.g., well pads, sumps/pits, material storage)
- Water Quality, Discharge, and Use
- Safety
- Noise, Light, and Proximity to Population
- Timing for Plugging and Abandoning a Well

Palo Alto Workshop

NREL and the BLM invited stakeholders to attend a workshop co-located with the Stanford Geothermal Workshop in February of 2018.

The workshop provided a venue to verify the previously collected data and seek additional input from an international audience of geothermal professionals.



Photo Credit: Aaron Levine

National Environmental Policy Act of 1969 (NEPA) Analysis

Upon completion of the geothermal stakeholder engagement, NREL reviewed and analyzed NEPA documents - Environmental Assessments (EA) and Findings of No Significant Impact (FONSI) – for geothermal exploration drilling/resource confirmation drilling projects.

Focus on project attributes, environmental concerns and accepted forms of mitigation.



Site Access (access route)

Environmental Concerns

- The presence of cultural, tribal, or paleontological resources; sensitive species and/or critical habitat (including migration corridors), and environmentally sensitive areas (e.g., wetlands, wild and scenic rivers) along the access route.
- The presence of creek crossings, which may impact endangered species and waters of the United States and/or give rise to state water resource issues.
- The spread of noxious weeds and/or invasive species.
- Access routes that include unstable road slopes, which will require extensive cut and fill to stabilize the road.
- The length of road in place and level (quality) of the road, which may require new road construction or upgrades to existing roads.
- Suitable drainage for roads to prevent flash flooding and storm-water runoff.
- Ruts caused by equipment on the roads during rain events, particularly in arid climates, which could last years after the road dries up.
- Fugitive dust emissions from transporting personnel and equipment along the access route.
- Construction of permanent roads, which the public will use for recreational purposes, leading to increased traffic in the area.
- Greenhouse gas emissions from vehicles accessing the site.

Site Access (access route)

Conditions of Approval, Standard Mitigation/Best Practices

- Complete a “desk review” to avoid any known cultural resources, sensitive species and/or critical habitat, and environmentally sensitive areas.
- Complete an on-site review (if necessary) based on findings from a “desk review,” including findings related to the granularity and certainty of existing surveys.
- Lay down temporary mats/pads to protect sagebrush routes or similar environmental concerns along the access route.
- Power-wash all construction equipment prior to arrival at the drill site to prevent transportation of noxious weeds into the project area.
- Inspect and treat employee clothing and shoes to prevent the spread of noxious weeds into the project area.
- Employ standard dust-suppression strategies to prevent fugitive dust emissions, including the use of water and/or magnesium chloride along the access road.
- Reclaim roads constructed to access the drill site.
- Comply with local air-quality requirements for vehicle emissions.

Drill Site (Pads, Sump/Pit, Storage)

Environmental Concerns

- The presence of cultural, tribal, or paleontological resources; sensitive species and/or critical habitat (including migration corridors), and environmentally sensitive areas (e.g., wetlands, wild and scenic rivers) at the drill site and along access routes between individual well pads located at the drill site.
- Terrestrial and avian species getting into a well or sump.
- Avian species (including eagles and other raptors) nesting/perching on drill rig towers, which may create a competitive advantage and threaten existing prey.
- The spread of noxious weeds and/or invasive species.
- The corrosiveness of and/or hazardous constituents in geothermal fluid and the potential for sump overflow to contaminate the surrounding area.
- The length of time the sump will be utilized and how long fluid will remain in the sump.
- Grading of land, which may destroy vegetation and displace species.
- Digging a cellar (e.g., hole) for the blowout preventer.
- Erosion occurring at the drill site.
- New material being brought into the drill site (e.g., road mix gravel).
- Cumulative and connected impacts generally, including ancillary construction activities and pipelines.

Drill Site (Pads, Sump/Pit, Storage)

Conditions of Approval, Standard Mitigation/Best Practices

- Complete a “desk review” to avoid any known cultural resources, sensitive species and/or critical habitat, and environmentally sensitive areas.
- Complete an on-site review (if necessary) based on findings from a “desk review,” including findings related to the granularity and certainty of existing surveys.
- Establish seasonal restraints for breeding and migration.
- Place fencing around sump and grate over wellbore to protect humans/species.
- Place netting over or rubber balls in sump to prevent avian species from entering.
- Place escape ladders in sump for humans/species to exit and/or make the sump shallower in one end to allow for easier exit for species (i.e., “beach approach”).
- Place mats for vegetation at the drill site, particularly in wet climates to help avoid need for a Clean Water Act Section 404 permit.
- Power-wash all construction equipment prior to arrival at project site to prevent transportation of noxious weeds into drill site/project area.
- Inspect and treat employee clothing and shoes to prevent the spread of noxious weeds into the drill site/project area.
- Limit/prevent new material being brought into the drill site without specific environmental analysis.

Water Quality, Discharge, and Use

Environmental Concerns

- Effects to plant and animal species from briny, salty, corrosive, or scalding (hot) geothermal fluids.
- Source of water use (e.g., Where does the water come from? Is the withdrawal sustainable? Does the water require pipelines to the well pad? Is the water hauled to the site in tanker trucks?).
- Sump overflow and potential contaminants in the sump fluids.
- Leaching of sump fluid into the soil, potentially impacting the shallow drinking water table (if one exists).
- Creation of unstable slopes.
- Safe water discharge to natural drainages while avoiding erosion.
- Leaking or spilling tanks (if tank storage is utilized), particularly due to disconnecting hoses from storage tank.
- Spills associated with the drill rig that are not noticed until taking the drill rig off of the drill pad.
- Use of toxic drilling muds.

Water Quality, Discharge, and Use

Conditions of Approval, Standard Mitigation/Best Practices

- Use of liners for sumps/pits (clay or ethylene propylene diene monomer rubber [EPDM]) if shallow groundwater is present.
- Use of separate pits for geothermal brine (large pit) and drill cuttings (small pit).
- Maintain 2 feet of freeboard to prevent sump overflow (freeboard height potentially changes based on sump dimensions, particularly depth).
- Case well to beneath the potable-water-quality aquifer (if one exists).
- Place impermeable (removable) protection under the rig to facilitate clean-up.
- Use water-based and non-toxic geothermal drilling fluids.
- Revegetate slopes to stabilize slopes.
- Reinject geothermal fluids or use storage tanks (as opposed to long-term storing on surface in sumps).
 - A small sump for drilling mud, drill cuttings, etc., may always be necessary, but this can avoid the need for a larger sump.

Safety

Environmental Concerns

- Improper storage of fuels or hazardous materials.
- Release of H₂S (where applicable).
- Fires.
- Well blowout.
- Dangers (e.g., human contact) resulting from very high-temperature geothermal fluids.



Desert Peak exploration project – Nevada
NREL picture number: 13081

Safety

Conditions of Approval, Standard Mitigation/Best Practices

- Add containment around stored fuels and hazardous materials.
- Use H₂S monitoring devices at drill site and potentially on drilling personnel.
- Place danger signs to warn about fluid temperature and H₂S.
- Ensure adequate well design to control well and prevent blowout.
- Store fire safety equipment at the drill site.
- Plan an emergency escape/evacuation route.
- Use a blowout preventer.
- Wear protective clothing.

Noise, Light, Proximity to Population

Environmental Concerns

- Generally, limited concerns due to the temporary activity that is associated with the drill rig, which is only at the drill site for a couple of weeks.
- Noise and light impacts for specific species.
- Noise related to transporting equipment and personnel to the site, 24-hour drilling, and well testing may impact species or nearby populations.
- Small levels of induced seismicity that may impact nearby populations.

Conditions of Approval, Standard Mitigation/Best Practices

- Use sound barriers or blankets.
- Shield light downward.
- Place time and seasonal restrictions on drilling to protect species and nearby populations.

Timing for Plugging and Abandoning Well

Environmental Concerns

- The site stays un-reclaimed for an extended period of time.
- Liner degradation may cause water quality impacts.
- Impacts to groundwater quality.
- Could cause more environmental impacts by plugging and abandoning a well than leaving it in place on an active project site, particularly if the developer plans to revisit and continue work.

Timing for Plugging and Abandoning Well

Conditions of Approval, Standard Mitigation/Best Practices

- Provide sufficient bonding amount to cover the cost of reclamation.
- Ensure conditions of approval aimed at limiting the time period and well safety during that time period.

Thank You!

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