PRELIMINARY ENVIRONMENTAL ASSESSMENT
DOI-BLM-NV-W010-2012-0057-EA
DOE/EA-1944

Brady Hot Springs
Well 15-12 Hydro-Stimulation

November 2012

Prepared by:

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1.0 INTRODUCTION

1.1 Identifying Information

1.1.1 Title, EA number, and type of project:

Brady Hot Springs Well 15-12 Hydro-Stimulation
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DOE/EA-1944

1.1.2 Location of Proposed Action:

T. 22 N., R. 26 E., sec. 12

1.1.3 Name and Location of Preparing Office:

Lead Office – Humboldt River Field Office (W010)
5100 E. Winnemucca Blvd.
Winnemucca, NV 89445

1.1.4 Identify the subject function code, lease, serial, or case file number:

Subject Function Code: 43 CFR 3200
Case File Number: N-65561

1.1.5 Applicant Name:

Ormat Nevada
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Reno, NV 89511-1163

1.2 Background

This Environmental Assessment (EA) has been prepared to disclose and analyze environmental effects of developing and testing a geothermal reservoir by using enhanced geothermal system (EGS) technologies, as proposed by Brady Power Partners, a subsidiary of Ormat Nevada, Inc. (Ormat). A Geothermal Sundry Notice and "Brady's 15-12 Proposed Stimulation Action Plan" were submitted to the Bureau of Land Management (BLM), Winnemucca District Office, Humboldt River Field Office (WDO/HRFO) on January 5, 2012, and September 24, 2012, respectively.

The proposed project is located north of the Hot Springs Mountains, approximately 50 miles northeast of Reno, in Churchill County, Nevada (**Figure 1**). The project would be located on an existing production well and drill pad (Well 15-12) located on federal geothermal lease NVN 065558 held by Ormat (**Figure 2**). This lease and other federal leases and adjacent private lands comprise lands that are used for the commercial production of geothermal power at the Brady Power Plant.

The BLM is the lead agency for this project because the project activity would occur on leases issued and administered by the BLM. Except for 12 seismic monitoring stations and two water monitoring wells, the proposed project is located on land administered by the Bureau of Reclamation (Reclamation). The Reclamation was extended an invitation to be a cooperating agency in this EA; however, the agency declined formal cooperating agency status. Although the Reclamation declined this status, the BLM has been in close coordination with Reclamation regarding this proposal and the early development of the EA. The Energy Policy Act of 2005 gives the Secretary of Energy the authority to conduct a program of research, development, demonstration, and commercial application for geothermal energy. Further, the Energy Independence and Security Act of 2007 directed the Secretary of Energy to support a program of research, development, demonstration and commercial application for enhanced geothermal systems. The U.S. Department of Energy (DOE) is proposing to authorize the expenditure of federal funding for a portion of the project; therefore, the DOE is a cooperating agency in the development of this EA.

1.3 Purpose and Need for Action

BLM Purpose and Need

The purpose of this federal action is to provide Ormat opportunity to conduct EGS activities on its federal lease at the Brady Hot Springs power plant in order to improve commercial viability of target geothermal well 15-12, and the overall productivity of the well field.

The need for the proposed action is for BLM to respond to a Geothermal Sundry Notice and "Brady's 15-12 Proposed Stimulation Action Plan" submitted by Ormat to implement EGS technologies on public lands. These lands include Reclamation lands with geothermal leases that have been issued and are administered by the BLM. In accordance with The Geothermal Steam Act (Geothermal Steam Act of 1970 (30 U.S.C. 1001-1025) and 43 CFR subpart 3207), the BLM must respond to requests by lessees to explore geothermal resources in accordance to lease stipulations on federal geothermal leases.

BLM Decision to be Made

The BLM would decide to grant, grant with modifications, or deny Ormat's proposal to develop and test a geothermal reservoir in compliance with BLM geothermal leasing regulations, and other applicable Federal laws. The conditions of approval, if any, would be applied to the Geothermal Sundry Notice.

DOE Purpose and Need

The National Environmental Policy Act (42 U.S.C. 4341 *et seq*.; NEPA), the Council on Environmental Quality's NEPA regulations (40 Code of Federal Regulations [CFR] Parts 1500 to 1508), and the DOE's NEPA implementing procedures (10 CFR Part 1021) require that DOE 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 private entities.

As background, in an effort to increase national energy options, reduce vulnerability to disruption and increase the flexibility of the market to meet U.S. needs, DOE's Geothermal Technologies Program (GTP) facilitates research, development, and demonstration to establish geothermal energy as a major contributor for electricity generation. In 2008, pursuant to the Energy Independence and Security Act of 2007 through the GTP, DOE issued a Funding Opportunity Announcement (FOA), DE-PS36-08GO98008 Enhanced Geothermal Systems Research, Development, and Demonstration. In Topic Area 2: System Demonstrations, DOE sought to characterize a geothermal system with low natural productivity, develop a plan to stimulate the productivity of the system, stimulate a well in the system and monitor the productivity or injectivity of the well in relation to other wells available in the system. The proposed project seeks to address this DOE objective at Ormat's Brady Hot Springs geothermal field in Churchill County, Nevada. DOE is proposing to authorize the expenditure of federal funding through the GTP to Ormat for the proposed project. DOE has authorized Ormat to use a percentage of its federal funding for preliminary activities, which include: the seismic monitoring system, surveys, structural modeling, laboratory analyses, and project planning. The activities are associated with the proposed project and do not significantly impact the environment nor represent an irreversible or irretrievable commitment by DOE in advance of the conclusion of the EA.

1.4 Scoping, Public Involvement, and Issues

Based on internal and external scoping, the following issues were identified:

- How would water quality be affected by breakdown of tracer compounds?
- How would water quality be affected by comingling of aquifers?
- How would potential seismicity affect the project site and surrounding area?
- Would the action cause hydraulic connections that would change aquifer characteristics such as water level?
- Are there Native American Religious concerns relative to the implementation of this action?
- How would materials used in the proposed action be handled and stored onsite?

The U.S. Environmental Protection Agency (EPA) submitted comments during the scoping period expressing issues included in the list above. The EPA also stressed certain NEPA requirements such as the development of a reasonable range of alternatives for BLM to pay close attention to during preparation of the EA.

Irreversible and Irretrievable Commitment of Resources

The irreversible commitment of resources is described as the "loss of future options." It applies primarily to non-renewable resources, such as cultural resources, or resources that are renewable after a regeneration period, such as soil productivity. The term may also apply to the loss of an experience as an indirect effect of a "permanent" change in the nature or character of the land. An irretrievable commitment of resources is defined as the loss of production, harvest, or use of natural resources. The amount of production foregone is irretrievable, but the action is not irreversible. No irreversible and irretrievable commitment of resources is expected to result from implementation of the proposed project.

Intentional Destructive Acts

In December 2006, the DOE Office of General Counsel issued interim guidance stipulating that NEPA documents completed for DOE actions and projects should explicitly consider intentional destructive acts (i.e., acts of sabotage or terrorism). The proposed project would not involve the transportation, storage, or use of radioactive, explosive, or toxic materials. Consequently, it is highly unlikely that construction or operation of the geothermal project would be viewed as a potential target by saboteurs or terrorists. 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 Action would not offer any targets of opportunity for terrorists or saboteurs to inflict adverse impacts to human life, health, or safety.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 Description of Proposed Action

Enhancing the Geothermal Reservoir

Ormat's well 15-12, located north of the Hot Springs Mountains, approximately 50 miles northeast of Reno, in Churchill County, Nevada; T. 22 N., R. 26 E., sec. 12 (**Figure 1**), was installed in April 2007 to serve as a production well; however, further testing revealed that the well does not have sufficient hydraulic connections with the geothermal reservoir and it has since remained inactive. Ormat proposes to implement a hydro-stimulation program (EGS) to increase energy production by enhancing natural hydraulic connections within the existing hydrothermal system. Hydro-stimulation involves creating better hydraulic connections by injecting cool geothermal water (temperatures ranging from 90-140°F) to further open the existing network of minute cracks in the rocks deep underground, where natural fractures already occur. During the process, geothermal water produced from the geothermal production wells and processed at the geothermal plant would be injected at wellhead pressures less than 1,400 pounds per square inch at depths ranging from approximately 4,245 to 5,096 feet below ground surface. The stimulation plan outlines the injection of cool geothermal water into three vertical intervals at varying pressures over a period of approximately three weeks. The increase in pressure would also accompany a pulsing of the rate of injection. Tracer compounds would be injected at specific times during the stimulation to identify movement of geothermal fluid in real time. Additional details are provided in the Tracer Testing section below.

Based on Ormat's analysis of faults and fractures at the site and experience with similar projects, the estimated extent of the resulting treatment area would measure approximately 1,500 feet in length with its long axis oriented approximately 10 degrees to the northeast as shown on **Figure 3**. The treatment area would have an approximate width of 300 feet and a vertical thickness of approximately 500 feet. The resulting enhanced fracture network would enable increased production of hot geothermal water, thus increasing the power output of the Brady Hot Springs Power Plant up to the plant's designed capacity.

Seismic Monitoring

Stimulating pre-existing fractures by injecting water under varying pressures during the hydro-stimulation process could potentially cause microseismic events which would be mapped and monitored using state-of-the-art equipment and technology. Monitoring and mapping of the micro fractures would be accomplished through an array of microseismic monitoring equipment (microseismometers) installed a few feet below ground (surface stations) and in nearby existing boreholes (borehole stations) at depths up to 300 feet below ground surface. Of the 15 monitoring sites, six locations would be surface stations and nine locations would be borehole stations (**Figure 3**). The equipment would be strategically and carefully located in an array designed to effectively monitor and receive the scientific data.

The nearest population center is Fernley, a town of about 12,000 people, located about 20 miles southwest of the project area. There are no other population centers within 30 miles. A ground motion detector located in Fernley would be monitored as part of the proposed action. Refer to **Geology Section 3.2.1** for details on Induced Seismic Protocol.

Tracer Testing

During the hydro-stimulation process, Ormat proposes to inject tracer compounds into well 15-12 to analyze fluid-flow patterns between well 15-12 and existing geothermal production wells 82A-11 and 47C-1 (**Figure 3**). Well 82A-11 would be selected due to its proximity to well 15-12 while well 47C-1 would be selected as a representative well that is located near the center of the production zone. Target well 15-12 would be injected sequentially with uranine and four naphthalene sulfonate tracers. Following completion of the hydro-stimulation activities, Ormat would collect water samples from wells 82A-11 and 47C-1 on a daily basis for a period of 12 weeks. The samples would periodically be sent to the Energy and Geoscience Institute at the University of Utah (EGI) Tracer Development Laboratory in Salt Lake City for analysis by High Performance Liquid Chromatography.

In the late 1980's, the DOE requested that the EGI initiate a program to develop thermally stable tracers for use in geothermal-reservoir tracing. At the time, several groundwater tracers were available, but no tracers had been characterized for high temperature geothermal applications. Within a few years, EGI had developed a family of fluorescent tracers—the naphthalene sulfonates—that were shown in the laboratory to be both thermally stable and very detectable (Rose et al., 2001). EGI has confirmed these laboratory studies through dozens of tracer tests at geothermal fields in the Western U.S. and at sites around the world. In biological studies, these tracers were shown to be neither carcinogenic nor mutagenic (Greim et al., 1994).

Water Quality and Quantity Monitoring Plan

Ormat proposes to implement a monitoring plan at the site to identify potential effects the project may have on the reservoir chemistry composition and water level and/or well head pressure across the site. A baseline geochemical sampling event would be completed prior to stimulation and would include all production and monitoring wells associated with the Brady Hot Springs power plant, as well as the injectate. Samples would be analyzed for electrical conductivity, pH, temperature, and general chemistry including, but not limited to, chloride, fluoride, sulfate, silica, and various metals. Well head pressure would be monitored in all production and injection wells. Static water level would be measured in non-flowing wells.

During the stimulation and for seven days following the simulation process, geochemical parameters of electrical conductivity, pH, and temperature would be measured each day in wells 82A-11 and 47C-1, as well as the injectate. Well head pressure would also be monitored in wells 82A-11 and 47C-1 during this time. Water samples would be collected from wells 82A-11 and 47C-1 for analysis immediately following the stimulation and then once per week for 30 days and once per month for four months. A field-wide chemical analysis would occur three months following the injection.

The proposed activities would be concentrated around well 15-12 and no new surface disturbance would be created. Ormat estimates that the project would be completed by approximately June 2013.

Management of Health, Safety, and Hazardous Materials

Ormat would use best management practices to address the general and proper management of waste to be used on the project. Hazardous materials and hazardous waste would be transported, handled, utilized, and disposed of properly and according to federal and state requirements for each product. Safety, including the safe and proper handling of waste and hazardous materials, would be an integral part of project implementation. Material Safety Data Sheets for all hazardous chemicals would be kept on site with copies submitted to the BLM WDO/HRFO prior to operations commencing.

Secondary containment structures would be provided for all chemical and petroleum/oil storage areas during operations. Additionally, absorbent pads or sheets would be placed under likely spill sources and spill kits would be maintained onsite during operations to provide prompt response to accidental leaks or spills of chemicals and petroleum products. Any releases above reportable quantities would be reported to the Nevada Division of Environmental Protection and the BLM WDO/HRFO.

Solid wastes generated by the proposed action would be stored onsite until transported offsite to an appropriate landfill facility in accordance with federal, state, and local regulations. Handling, storage, and disposal of hazardous materials, hazardous wastes, and solid wastes would be conducted in conformance with federal and state regulations to prevent soil, groundwater, or surface water contamination and associated adverse effects on the environment or worker health and safety.

Conditions of Approval for Geothermal Drilling Permit for Well 15-12

The proposed action would be subject to the Conditions of Approval (**Appendix A**) of the geothermal drilling permit for well 15-12 approved on December 15, 2004, and other applicable state and local permitting requirements.

2.2 No Action Alternative

Under the No Action Alternative, well 15-12 would likely continue to be used for production on a limited basis or be abandoned and removed from service. Additionally, DOE would not authorize the use of federal funds for the proposed action.

2.3 Alternatives Considered but not Analyzed in Detail

Although no unresolved resource conflicts were identified during this impact analysis, alternatives to the proposed action were still considered, but none resulted in a need to analyze the alternative in detail.

Drilling and installation of a new geothermal well in the vicinity of well 15-12 could potentially intercept the geothermal reservoir at the site. However, this is not certain and similar to well 15-12, a new well may not be productive. Additionally, this approach would not meet the purpose and need.

Other well stimulation technologies are currently available and are often used within the geothermal industry. Alternatives considered but not analyzed in detail include a range of technologies such as injection of a hydrochloric acid into the well in order to dissolve rocks and minerals, to the use of traditional rock-fracturing techniques that inject high pressure fluid and proppants (e.g., gel, foam, sand, and ceramic materials) to create new fractures in the rock. The use of radioactive tracers has also been used in traditional rock-fracturing projects. Although these alternatives could potentially meet the purpose and need for the action, they are inherently more impactful and therefore would not be reasonable alternatives to carry through the analysis.

2.4 Conformance

The project area is subject to the BLM, Winnemucca District Office Sonoma-Gerlach Management Framework Plan (MFP), dated July 9, 1982 (BLM 1982). Objective M-5 of the Sonoma-Gerlach MFP states: “Make energy resources available on all public lands and other lands containing federally owned minerals.” The MFP provides for the development of geothermal resources in noncompetitive areas and all Known Geothermal Resource Areas, except those that are areas of significant environmental conflict or have historical and/or cultural significance as defined in the District Manager’s Decision. The proposed action is in conformance with the MFP.

2.5 Relationship to Laws, Regulations, Policies, Other Plans, and Other Environmental Analyses

The alternatives have been reviewed in accordance with the following statutes and implementing regulations, policies and procedures:

- The National Environmental Policy Act (NEPA) of 1969, as amended (Public Law 91-190, 42 USC 4321) (*et seq*.).
- 40 CFR 1500 (*et seq*.). Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act.
- The Council on Environmental Quality's (CEQ) *Considering Cumulative Effects under NEPA* (1997).
- 43 CFR Part 46, Implementation of the National Environmental Policy Act (NEPA of 1969); Final Rule, effective November 14, 2008.
- U.S. Department of the Interior (USDOI) requirements provided in Part 516, Chapters 1 through 15, of the Departmental Manual (USDOI 2004).
- BLM NEPA Handbook (H-1790 1), as updated (BLM 2008a).
- The Geothermal Steam Act of 1970, Title 30, United States Code (USC), Chapter 23, Sections 1001 et seq. (30 USC 1001 et seq.).
- 43 CFR 3200, Geothermal Resources Leasing and Operations; Final Rule, May 2, 2007.
- Energy Independence and Security Act of 2007 (Public Law 110-140).
- The 2005 Energy Policy Act; The National Energy Policy, Executive Order 13212.
- Best Management Practices (BMPs) as defined in *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development, Fourth Edition* (Gold Book) (BLM 2007).

Many of the wells and pipelines associated with the power plant have been constructed on BLM managed public lands. Two previous EAs (NV-020-02-09 and NV-020-02-11) evaluated lands and facilities located in section 12. EA NV-020-05-07 (Decision Record dated December 2004) analyzed well 15-12. The proposed action would be subject to the Conditions of Approval (**Appendix A**) for the geothermal drilling permit for well 15-12 approved on December 15, 2004, and other applicable state and local permitting requirements.

The proposed action would further the purpose of Secretarial Order 3285 (March 11, 2009) that established the development of environmentally responsible renewable energy as a priority for the Department of the Interior.

3.0 THE AFFECTED ENVIRONMENT

3.1 Supplemental Authorities

A variety of laws, regulations, executive orders, and policy directives mandate that the effects of a proposed action and alternatives on certain elements of the human environment be considered. These elements are referred to as supplemental authorities. Not all of the supplemental authorities that require consideration in this EA will be present, or if they are present, may not be affected by the proposed action and alternative (**Table 1**). Only those supplemental authorities that are present and affected are described in this section.

In addition to the supplemental authorities, there are additional resources that would be potentially affected by the implementation of the proposed action and thus require analysis. These are presented in **Section 3.2 Additional Affected Resources**.

Table 1. List of Supplemental Authorities

Supplemental Authorities	**Not Present**	**Present Not Affected**	**Present, Potentially Affected**	**Comments**
Air Quality		X		
Areas of Critical Environmental Concern (ACEC's)	X			
Cultural Resources		X		No new ground disturbance
Environmental Justice	X			
Floodplains	X			
Invasive, Nonnative Species		X		
Migratory Birds		X		
Native American Religious Concerns			X	
Prime or Unique Farmlands	X			
Threatened & Endangered Species	X			
Wastes, Hazardous or Solid		X		Refer to Chapter 2 Description of Proposed Action and Alternatives
Water Quality (Surface and Ground)			X	
Wetlands and Riparian Zones		X		
Wild and Scenic Rivers	X			
Wilderness	X			

3.1.1 Native American Religious Concerns

Numerous laws and regulations require the BLM to consider Native American concerns. These include the NHPA, the American Indian Religious Freedom Act of 1978 (AIRFA), Executive Order 13007 (Indian Sacred Sites), Executive Order 13175 (Consultation and Coordination with Tribal Governments), the Native American Graves Protection and Repatriation Act (NAGPRA), the Archaeological Resources Protection Act (ARPA), as well as NEPA and FLPMA. Order No. 3317, issued in December 2011, updates, expands and clarifies the Department of Interior's policy on consultation with Native American tribes. The BLM also utilizes H-8120-1(General Procedural Guidance for Native American Consultation) and National Register Bulletin 38 (Guidelines for Evaluating and Documenting Traditional Cultural Properties).

The goal of consultation is for the BLM to identify specific traditional/cultural/spiritual sites, activities, and resources important to Native Americans, and limit, reduce, or possibly eliminate any negative impacts. The AIRFA and Executive Order 13007 apply to sites used for religious ceremonies or sacred sites. These authorities do not specify criteria for determining whether a project would affect such places. For purposes of the analysis in this EA, a project effect on sites used for religious ceremonies and sacred sites is considered substantial if it restricts access to such sites; impedes the exercise of ceremonies at such sites in some way or form; or affects the physical integrity of such sites. Traditional Cultural Properties (TCP), which may or may not be sacred sites, have similar substantial project effects thresholds, plus damage to the setting or physical integrity of the TCP.

In general, water is considered to be sacred to the Paiute and Shoshone tribes. Hot springs are considered as sacred and often have medicinal properties associated with them. Ethnographic evidence suggests that springs in general were communally owned at the band level, and many times the use of springs required one to leave offerings at them (Stewart 1941:407, 440).

Brady Hot Springs is approximately 0.30 miles from well 15-12. Hot springs have been identified in the ethnographic literature and past Native American consultations as sacred sites. However, this hot springs is no longer flowing.

Certified letters were sent on September 20, 2012 to the Fallon Paiute Shoshone Tribe, the Lovelock Paiute Tribe and the Pyramid Lake Paiute Tribe. To date, no comments have been received.

3.1.2 Water Quality

Surface Water

Well 15-12 is located in the rain shadow of the Sierra-Nevada range, and precipitation averages about five inches per year. It is within the hydrographic watershed Fernley Sink and the subwatershed Hot Springs Flat. There are no perennial streams in the immediate vicinity of the project area, although some ephemeral springs occur in the general area.

The part of Hot Springs Flat to the south and west of the project area occasionally is inundated with runoff water. Although Brady's Hot Spring is only 1,500 feet away from well 15-12, historical accounts of surface flow from Brady's Hot Springs date back before geothermal development began in 1959. When present, surface water frequently exhibits alkaline (Sodium Chloride (NaCl)) conditions. Water chemistry is dependent on both the background chemistry of the inflow and the evaporation rate.

The Olam onion drying facility, located one-half mile to the northeast of well 15-12, has discharged excess geothermal fluids to the surface from its onion dehydration plant since operations began in 1978. These waters flow into natural drainages to the southwest, never reaching any permanent surface water.

Groundwater

The Brady Hot Springs area is described by the U.S. Geological Survey (Harrill, 1970) as being composed of two valley segments. The northern segment receives surface inflow from Fireball Valley which is located immediately to the west, and drains through a bedrock constriction to the southern segment which extends south to Fernley. The project area is within the northern segment, the boundary of which is drawn across the approximate center of the Fernley Sink, a shallow, intermittent lake about 10 miles southwest of Brady Hot Springs.

The regional area is a structural depression which has been filled in by sediments eroded from surrounding mountains and volcanic units from several source centers since at least mid-Cenozoic times (i.e., approximately 30 million years ago to today). The project area, with thin, discontinuous alluvial deposits, lies on the gentle western flank of the Hot Springs Mountains from which surface waters and groundwater moves generally westward into the alkali flat of Hot Springs Flat, located immediately west and northwest of the project area. Drainage from Fireball Valley and Hot Springs Flat continues southward to the Fernley Sink.

Harrill (1970) states that essentially all the groundwater is derived from infiltration of precipitation into the bedrock, where it moves through fractures to the zone of saturation. Past drilling along the Brady Hot Spring fault zone has encountered the water table at the top of this zone at depths of 30 to 150 feet. From the project locality, groundwater moves toward the discharge area to the south, but there is evidence for some underflow into the Brady Hot Springs area from the Fernley Area.

Withdrawal of groundwater for all uses in the basin is essentially restricted to geothermal uses at Brady's. All waters sampled by U.S. Geological Survey in the area are high in sodium chloride, and it was determined that "All water samples from the . . . area exceeded limits recommended as drinking water standards by the U.S. Public Health Service (1962) and had high or very high salinity and sodium hazards in regard to irrigation use." Extensive drilling with many analyses of the groundwater along the Brady fault zone has provided ample evidence that no fresh water exists in the project area.

A comparison of four groundwater wells (**Table 2**) in the assessment area provides evidence of the chemical homogeneity of the geothermal reservoir.

- Well MGI-2, installed 443 feet below surface into the shallow portion of the reservoir, is located 0.75 miles to the northeast of well 15-12.
- Well CW-1, installed 466 feet below surface, is located one mile west from well 15-12 in nearby Hot Springs Flat.
- Well 77-1, installed 2,918 feet below surface into the intermediate portion of the reservoir, is located 0.75 miles to the northeast of well 15-12.
- Well 27-1, installed 5,856 feet below surface into the deeper portion of the reservoir, is located 0.6 miles to the north of well 15-12.

There is a close similarity among these waters, which is undoubtedly traceable to their common origin. The groundwater in the Brady Hot Springs area rises along the dominant north-northeasterly trending faults and associated fractures which appear to control the nearer surface thermal anomaly. The western limb of this zone has undergone movement in Holocene times which would allow for expected good transmissivity along the fault plane(s). Geological and geophysical mapping and other evidence strongly suggest that open fractures allow upward movement of thermal waters within this structural zone of weakness to nearer surface horizons. The chemical makeup and concentration of the various chemical constituents is largely a matter of the level of mixing of these waters with other water. Information for the wells was provided by Ormat from their well monitoring data (NV-020-05-07-EA, p. 10 and Ormat Excel file (Brady Chemistry)).

Table 2. Wells MGI-2, CW-1, 77-1 & 27-1 Water Chemistry

Analyte	**PPM (parts per million)**			
Well ID (depth)	MGI-2 (443 ft)	CW-1 (466 ft)	77-1 (2,918 ft)	27-1 (5,856 ft)
Total Dissolved Solids	2150	2100	2950	2750
Calcium	18.5	55	49.6	68
Magnesium	0.5	3.2	<0.20	<5
Sodium	647	650	936	950
Potassium	56	40	58.7	57
Sulfate	298	270	298	500
Chloride	810	400	1350	1250
pH	8.80	8.15	8.74	
Silica	252	120	235	220
Total Inorganic Carbon, as HCO3	50.0	180	34.1	--
Conductivity, umhos/cm	--	--	5100	3984

3.2 Additional Affected Resources

In addition to the supplemental authorities, numerous other important resources are considered when evaluating the potential effects of the proposed action. Those resources that are not present, or present and not affected, are not listed in the EA. However, paleontology and lands with wilderness characteristics are two areas that require some discussion by policy even when they are not affected. There would be no potential for impact on paleontology based on the proposed action and there are no lands with wilderness characteristics present. **Table 3** lists additional affected resources that are present and affected.

Table 3. List of Additional Affected Resources

Additional Affected Resources	Present Affected	Comments
Seismicity	X	Addressed under Geology
Water Quantity	X	

3.2.1 Geology

Well 15-12 is located near the western edge of the Basin and Range province, on the southeast margin of Hot Springs Flat, a small southward draining basin located between the Truckee Range on the west and the Hot Springs Mountains on the east. The project area lies approximately 0.30 mile south of Brady Hot Springs which are associated directly with a fault zone that traverses a pediment and alluvial apron on the western slope of the Hot Springs Mountains.

Crustal extension has resulted in the thinning of the earth's crust beneath the Basin and Range to an average of about 15 miles in thickness in northern Nevada, compared with over 20 miles in thickness beneath the Sierra Nevada. The thinnest crust in the Basin and Range is about 12 miles thick, located in an area of north-central Nevada between Battle Mountain and Brady Hot Springs.

Extension and volcanism have been accompanied by the development of major range-bounding faults along most mountain fronts. Several of these have been active in historic time. These faults in general trend north-south, as do the ranges. Many fault segments of north-south orientation are intersected by segments of northeast-southwest orientation, such as in the Hot Springs Mountains near Brady Hot Springs. Principal movement on these faults has been normal, or dip-slip; with the basins dropped down relative to the mountain ranges.

Rocks occurring in the vicinity of the proposed action are largely Tertiary basalt and andesite lavas and tuffs, sedimentary rocks, and Quaternary Lake Lahontan and alluvial deposits. The basic stratigraphic sequence at the proposed well stimulation location is approximately 25 feet of recent alluvium (soil) overlying an unknown thickness of Chloropagus formation, a Tertiary basalt. Below this, tertiary rhyolitic to dacitic lithic tuffs are present. Basement rocks within the Brady South prospect range from metasediments to metavolcanic rocks.

The geothermal system at Brady Hot Springs is typical of Basin and Range systems. Faulting and associated fracturing is the principal mechanism for the transport of hot fluids to the surface and to near-surface aquifers. Extensive geological and geophysical analysis, as well as exploration drilling have contributed to the overall knowledge and understanding of the shallow Brady Hot Springs geothermal reservoir, with less information available on the deeper, hotter reservoir.

Geothermal energy is the earth's natural heat captured in fluids trapped in subterranean rock. In the Basin and Range, deep circulation of meteoric waters becomes heated deep in the fractured crust. These super-heated waters of less density than the downward moving meteoric waters move toward the surface. Their movement and presence are defined by the complex geometry of permeable and impermeable rock strata, here and there cut by faults which may act as conduits to bring the hot water to the near-surface where drilling can economically tap this reservoir system.

Steam vents, hot springs, geysers, and fumaroles can occur, as at Brady Hot Springs, where the upper layer of rock has been fractured by seismic activity. These phenomena are often strong evidence that a geothermal reservoir lies below. The flow and interference tests carried out on wells in the project area prove the existence of a convective heat system within the Brady Hot Springs project area.

The thermal waters, along with areas of altered rock, are aligned along the eastern trace of a major fault zone identified as the Brady Fault. The fault is normal and dips steeply westward. A shallow geothermal reservoir approximately 200 to 700 feet in depth at Brady Hot Springs is generally confined to Tertiary volcanic and sedimentary rocks, which overlie volcanic units.

Surface thermal manifestations along the Brady fault zone include weak fumaroles, mud pots, siliceous sinter, calcareous tufa, and hydrothermal alteration in a linear zone over three miles long in the vicinity of Brady Hot Springs. Thermal groundwater is also widespread within an area of about seven square miles centered on this location.

The deeper geologic sections at Brady Hot Springs, including the Desert Peak and older units, contains a thermal reservoir believed to extend from as shallow as 1,500 feet. Temperatures of 360° to over 400°F have been found by exploration and production well drilling at Brady Hot Springs.

Enough stratigraphic data has been collected from wells at Brady Hot Springs to indicate that the displacement on the main Brady Hot Springs Hot fault is 300 to more than 500 feet, although displacement appeared at the surface to be less than 100 feet. The west, or hanging wall, is down-dropped relative to the east, or footwall block.

<u>Seismicity</u>

The project area lies in a region which is part of the most active seismic belt in the Basin and Range province. High angle normal faults are the predominant fault structure present. Major displacement is in a vertical direction with mountain blocks moving upward in relation to the valleys. Activity along many of these faults has continued at a somewhat sporadic rate. Numerous fault scarps are scattered throughout the area. Because of the relative recent history of major faulting (Holocene Age, within the last 12,000 years), some of these faults are considered active (Bell 1984).

Protocol for Induced Seismicity

The DOE introduced an enhanced version of the Protocol for Addressing Induced Seismicity Associated with Enhanced Geothermal Systems (Majer et al., 2012). This protocol's steps are:

- Step 1: Perform Preliminary Screening Evaluation
- Step 2: Implement an outreach and communication program
- Step 3: Review and select criteria for ground vibration and noise
- Step 4: Establish local seismic monitoring
- Step 5: Quantify the hazard from natural and induced seismic events
- Step 6: Characterize the risk of induced seismic events
- Step 7: Develop risk-based mitigation plan

In the last few years (2010 to present) Ormat, in cooperation with the DOE, has performed Steps 1 through 7. These steps will be summarized below but can be found in more detail in Ormat's *Protocol for Induced Seismicity Associated with Enhanced Geothermal Systems* (#DE-FG36-08GO18200).

- ➢ The Preliminary Screening Evaluation (Step 1) has found that microseismicity associated with normal geothermal well field operations occurs at very small magnitudes (all less than two, mostly zeros and ones). Natural earthquakes have also been recorded and located in the vicinity by the University of Nevada-Reno, the largest of which was a magnitude of 3.2 on January 28, 2000. This event caused no damage and was not reported as a concern by any residents in the area.

- ➢ The Outreach and Communication plan (Step 2) includes an open monitoring system for measuring seismicity in real time through a dedicated website http://esd.lbl.gov/research/projects/induced_seismicity/ as well as daily reports to the DOE and BLM during stimulation. The outreach component involves notifying the Churchill County Local Emergency Planning Committee (LEPC) before stimulation.

- ➢ The criteria for ground vibration and noise was identified (Step 3) in comparison with a 2.9 magnitude induced event at Soultz France (Weidler et al., 2002) that had a frequency of 80 Hz. This is a relatively high frequency and is unlikely to cause any structural damage. This may produce a noise which is similar to that of a shot gun or setting of a very small explosive charge.

- Establishment of a seismicity monitoring network (Step 4) was accomplished with nine buried geophones in 300 feet deep boreholes. In addition, there are six stations at the surface. All 15 stations are surrounded with a weather-proof and lightning protected enclosure for the necessary solar panels, batteries for power, and for the digitizer, radio transmitter, and antennas (one for GPS and another for radio transmission).

- The quantification of natural and induced seismic hazards (Step 5) was accomplished by analyzing the results of induced seismic events from a well stimulation project conducted in April 2011, five miles away in a different geothermal reservoir. The results showed low seismicity magnitudes between 0.11 and 0.77.

- The induced seismic risk characterization (Step 6) based on geological and geophysical surveys as well as previous recorded effective distribution of induced seismicity, has shown an effective area with a radius of 500 meters from the stimulated well. The previous observations also show a low probability of seismicity over a magnitude of two in the effective area and much lower to non-existent outside of the effective area. The historical data supports this observation, as there are no recorded natural earthquakes greater than a magnitude of four in the area. This indicates that residual strain energy within this environment is relatively low. Further, the volumes to be injected during the proposed stimulations are unlikely to accommodate large amounts of strain, and thus are unlikely to generate large induced seismic events.

- The risk based mitigation plan (Step 7) consists of halting injection operation activities if one of two thresholds are met; the first being a seismic event of magnitude 2.5 measured by the seismic monitoring array at the Brady well field and the other; a single reading over 0.02g or more than 10 readings per day over 0.002g peak ground acceleration measured at a ground motion sensor located in Fernley, 20 miles to the southwest. The ground motion limits are based on engineering standards. A Trigger report would be produced documenting the occurrence and a determination would then be made by DOE and BLM if the occurrence is natural or operation-induced. Phone calls to key personnel at the DOE, BLM, and Churchill County authorities would be made immediately. Daily stimulation reports would be sent to both the DOE and the BLM.

Mineral Resources

There are no active mining claims located in T. 22 N., R. 26 E., section 12. Historic mining activity has occurred in the vicinity of Brady Hot Springs. Current activity is limited to gravel borrow sites. There are no known overlapping conflicts between mineral exploration and geothermal development.

3.2.2 Water Quantity

Surface Water

Well 15-12 is in the rain shadow of the Sierra-Nevada range, and precipitation averages about five inches per year. There are no perennial streams in the immediate vicinity of the project area, although some ephemeral springs occur in the general area.

Hot Springs Flat to the south and west of the project area occasionally is inundated with runoff water. Historical accounts of surface flow from Brady Hot Springs exist, but they have not flowed since geothermal development began in 1959.

Olam has discharged excess geothermal fluids to the surface from its onion dehydration plant since operations began in 1978. These waters flow into natural drainages to the southwest, never reaching any permanent surface water.

Groundwater

The Brady Hot Springs area is described by the U.S. Geological Survey (Harrill, 1970) as being composed of two valley segments. The northern segment receives surface inflow from Fireball Valley which is located immediately to the west, and drains through a bedrock constriction to the southern segment which extends south to Fernley. The project area is within the northern segment, the boundary of which is drawn across the approximate center of the Fernley Sink, a shallow, intermittent lake about 10 miles southwest of Brady Hot Springs.

The area is a structural depression which has been filled in by sediments eroded from surrounding mountains and volcanic units from several source centers since at least mid-Cenozoic times. The project area, with thin, discontinuous alluvial deposits, lies on the gentle western flank of the Hot Springs Mountains from which surface waters and groundwater moves generally westward into the alkali flat of Hot Springs Flat, located immediately west and northwest of the project area. Drainage from Fireball Valley and Hot Springs Flat continues southward to the Fernley Sink.

Harrill (1970) states that essentially all the groundwater is derived from infiltration of precipitation into the bedrock, where it moves through fractures to the zone of saturation. Past drilling along the Brady Hot Spring fault zone has encountered the water table at the top of this zone at depths of 30 to 150 feet. From the project locality, groundwater moves toward the discharge area to the south, but there is evidence for some underflow into the Brady Hot Springs area from the Fernley Area.

Withdrawal of groundwater for all uses in the basin is essentially restricted to geothermal uses at Brady Hot Springs. Extensive drilling with many analyses of the groundwater along the Brady fault zone has provided ample evidence that no fresh water exists in the project area.

The groundwater in the Brady Hot Spring area rises along the dominant north-northeasterly trending faults and associated fractures which appear to control the nearer surface thermal anomaly. The western limb of this zone has undergone movement in Holocene times which would allow for expected good transmissivity along the fault plane(s). Geological and geophysical mapping and other evidence strongly suggest that open fractures allow upward movement of thermal waters within this structural zone of weakness to nearer surface horizons. The chemical makeup and concentration of the various chemical constituents is largely a matter of the level of mixing of these waters with other water.

4.0 ENVIRONMENTAL CONSEQUENCES

Assumptions for Analysis

The impact assessment area for the analysis identified in **Figure 3** includes an area with a radius of two miles from the center of the treatment area. In determining the potential direct and indirect impact assessment area, the hydrographic watershed Hydrographic Unit Code (HUC) 10, Fernley Sink, and subsequently three HUC 12 areas covering the area of interest, these being the smaller Fernley Sink, Hot Springs Flat, and the Eagle Salt Works Spring were first evaluated. Although these areas all intersect with the project, it was determined that evaluating the entire watershed or the three basins in their entirety, would be well beyond the reach of any impacts stemming from the action. Therefore, the assessment area was narrowed to the Brady fault/fracture system which is a down-dropped area on the west flank of the Hot Springs Mountains. Based on the anticipated extent of the stimulation zone (i.e., 1,500 feet in length and 300 feet wide, centered around well 15-12) resulting from the proposed action, a two-mile radial assessment area was identified that extends beyond the geothermal well field, and includes the seismic monitoring stations, and water monitoring wells.

The same assessment area used for the Water Resources and Geology sections will be used for Native American Religious Concerns due to the limited effects of the proposed action and the affected environment.

4.1 Direct and Indirect Impacts

4.1.1 Proposed Action

<u>**Supplemental Authorities**</u>

4.1.1.1. Native American Religious Concerns

<u>Direct and Indirect Impacts</u>

Northern Paiute religious beliefs have been preserved as oral traditions from one generation to the next. As such, it has been poorly documented by anthropologists (Fowler 2002;169). Between bands, common themes ran through religious traditions but there were variations in beliefs. As noted by Hultkrantz (1986:631): "[…] there was no unitary religious system and no world view that provided a dogma of supernatural sanctions. Religious ideas and practices were diffused through the culture but did not constitute a set of defined beliefs, values, and rites."

Common to all Northern Paiute bands is the idea of *puha* (Fowler 2002; Miller 1983). *Puha*, is roughly translated as power, and is a life force that is believed to be in all animate and inanimate objects. With this in mind, the Northern Paiutes consider the Earth, Moon, Sun, Stars, Fire, Water, and Wind as animate living beings. In Northern Paiute theology, the Earth and humans are considered to be the most powerful beings (Fowler 2002:170).

Since all things have *puha*, as a way of showing respect, the Northern Paiutes have songs, dances and ceremonies that must be performed before using, eating, hunting or collecting certain animals, plants and stones. Many places sacred to the Northern Paiutes are where *puha* exists on the landscape. The local landscapes, being part of the Earth, are thus a critical element in traditional Northern Paiute theology.

Brady Hot Springs was impacted by geothermal drilling before there was statutory authority protecting Native American sacred sites. This proposed action is not anticipated to create any new disturbances to the spring. The spring has not flowed since 1959.

<u>Recommended Mitigation and/or Monitoring</u>

None recommended.

4.1.1.2. Water Quality

<u>Direct and Indirect Impacts</u>

Surface Water

Cool geothermal water for the injection would be transferred through a temporary surface pipeline from the Brady geothermal plant, approximately one mile from the northeast, and contained in the existing well 15-12 sump where it would be reused and injected into the well. Based on the absence of surface water in the affected environment and no plans to discharge water onto the surface, no impacts to surface water are anticipated from the proposed hydro-stimulation activities.

Uranine and naphthalene sulfonates are common tracers used in the geothermal field to determine the connectivity of producing wells and injecting wells. Uranine is a fluorescent dye. Naphthalene sulfonates are neither toxic nor carcinogenic since the addition of the sulfonate groups renders the naphthalene molecule environmentally benign (Greim et al., 1994). The tracers would be injected into the subsurface during the hydro-stimulation of well 15-12 and therefore would not impact the surface.

Groundwater

All groundwater sampled in the wells drilled in the vicinity of the Brady Hot Springs Area (Harrill 1970) are high in sodium chloride, arsenic, and boron, which reflects a pervasive natural, high salinity, making it of limited value for domestic or agricultural use. There have been no fresh-water aquifers encountered.

Table 2 lists the water quality for four wells located within the assessment area. Wells MGI-2, CW-1, 77-1 and 27-1, provide representative samples for a range of depths from 433 feet to 5,856 feet. The total dissolved solids generally vary between 2,000 and 3,000 ppm.

It is proposed that cool geothermal water from the Brady geothermal plant, which is produced from the deeper portion of the reservoir, would be reinjected during this hydro-stimulation. The cool geothermal water would be diverted temporarily to a lined sump next to the well before reinjection. It is anticipated that nearly 100 percent of the cool geothermal water would be reinjected into the reservoir from which it is produced. The water not reinjected would be lost to evaporation. The proposed injection pressures would allow for the opening of minute cracks to better connect this well to the existing geothermal reservoir. The geothermal reservoir exists with its own pressure system balanced by the production and the injection wells. The water removed from the reservoir gets reintroduced into the reservoir, thereby creating this closed circuit. Therefore, no change in the groundwater quality in the project area is anticipated. Since the groundwater at all depths is thermally altered and chemically similar, giving evidence to comingled aquifers in the affected environment, the potential to degrade the quality of the aquifers does not exist.

Uranine and naphthalene sulfonates are common tracers used in the geothermal field to determine the connectivity of producing wells and injecting wells. Uranine is a fluorescent dye. Naphthalene sulfonates are neither toxic nor carcinogenic since the addition of the sulfonate groups

renders the naphthalene molecule environmentally benign (Greim et al., 1994). Naphthalene sulfonates have been shown to be undetectable after two years in multiple field trials such as at Dixie Valley, Steamboat Springs, Desert Peak and Soda Lake projects (Rose et al., 2001).

The goal of the proposed project is to improve the connection from well 15-12 to the existing geothermal reservoir. The tracer compounds would be injected over a period of weeks during the stimulation activities. These compounds would travel through the enhanced fracture network with the intention of being detected in water samples collected from existing monitoring wells, 82A-11 and 47C-1. Because of the pressure system created from the pumping and injection of fluids in the geothermal reservoir, it is expected that the tracers would remain part of the system. It is anticipated that the compounds would eventually degrade through the natural processes of dilution or dispersion until reaching non-detectable levels.

Recommended Mitigation and/or Monitoring

No recommended mitigation or monitoring.

Additional Affected Resources

4.1.1.3. Geology

Direct and Indirect Impacts

No known impacts would occur to the surface geology of the area. Hydro-stimulation activities should not impact the geothermal reservoir except for increasing connectivity of the wells by increasing the size of minute cracks in a portion of the rock 500 feet thick at a depth of 4,245 feet. No other mineral resources would be affected by the proposed action.

It is reasonable to assume that impacts to geology may occur due to microseismic events resulting from the hydro-stimulation of well 15-12. This is due to the physical shifting of the minute cracks in the rock at this depth. Based on what is known about the affected environment and Ormat's Protocol for Induced Seismicity (See Protocol Steps 1 and 5 in **Geology Section 3.2.1**), it is estimated that the potential induced seismicity would be low, in the realm of a magnitude of zero to two.

Recommended Mitigation and/or Monitoring

No recommended mitigation or monitoring.

4.1.1.4. Water Quantity

<u>Direct and Indirect Impacts</u>

Surface Water

No impacts to surface water quantity are anticipated from hydro-stimulation of well 15-12. Water from the geothermal plant used in the activities would be contained in the lined sump adjacent to the well.

Groundwater

The water used for the hydro-stimulation would not be derived from any surface groundwater sources. Although geothermal water could be utilized from the surface without interfering with any fresh water aquifers (because none have been encountered in this watershed), the proposal is to use geothermal water from the existing Brady plant.

It is proposed that cool geothermal water from the Brady geothermal plant, which is produced from the deeper portion of the reservoir, would be reinjected during this hydro-stimulation. The cool geothermal water would be diverted temporarily to a lined sump next to the well before reinjection. It is anticipated that nearly 100 percent of the cool geothermal water would be reinjected into the reservoir from which it is produced. The water not reinjected would be lost to evaporation. The proposed injection pressures would allow for the opening of minute cracks to better connect this well to the existing geothermal reservoir. The geothermal reservoir exists with its own pressure system balanced by the production and the injection wells. The water removed from the reservoir gets reintroduced into the reservoir, thereby creating this closed circuit. Therefore, no change in the groundwater quantity in the project area is anticipated. Since the groundwater at all depths is thermally altered, giving evidence to comingled aquifers in the affected environment, the potential to create a comingling of aquifers does not exist.

<u>Recommended Mitigation and/or Monitoring</u>

No recommended mitigation or monitoring.

4.1.2 No Action Alternative

<u>Supplemental Authorities</u>

4.1.2.1. Native American Religious Concerns

Continued use on a limited basis or abandonment of well 15-12 would not impact Native American religious concerns.

4.1.2.2. Water Quality

Continued use on a limited basis or abandonment of well 15-12 would not have an impact on water quality for the same reason it would not under the proposed action (i.e., the well field is a closed-circuit system).

Additional Affected Resources

4.1.2.3. Geology

Continued use on a limited basis or abandonment of well 15-12 would not have an impact on geology, including induced seismicity, as no action would be taken to modify the rock permeability.

4.1.2.4. Water Quantity

Continued use on a limited basis or abandonment of well 15-12 would not have an impact on water quantity for the same reason it would not under the proposed action (i.e., the well field is a closed-circuit system).

4.2 Irreversible and Irretrievable Commitment of Resources

No irreversible and irretrievable commitment of resources is expected to result from implementation of the alternatives.

4.3 Cumulative Impacts

The Council on Environmental Quality (CEQ) regulations that implement NEPA define a cumulative impact as: "The impact on the environment which results from the incremental impact of the action when added to other past, present, or reasonably foreseeable future actions." Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

4.3.1 Assumptions for Cumulative Analysis

Impacts associated with past, present, and reasonably foreseeable future actions are generally created by ground or vegetation-disturbing activities that affect natural and cultural resources in various ways. Of particular concern is the *accumulation* of these impacts over time. This section of the EA considers the nature of the cumulative effect and analyzes the degree to which the proposed action and alternatives contribute to the collective impact.

For the purposes of this analysis, the cumulative impact assessment area (**Figure 3**) includes an area with a radius two miles from the center of the treatment area. The cumulative assessment area consists of 8,038 acres of which about 4,019 acres are public lands, and 4,019 acres are private lands.

Temporal: The last cumulative assessment of this project area covering the same affected resources was made in 2004 in EA NV-020-05-07. Based on this, a review of past actions was made for this action from 2004 to present. Reasonable Foreseeable Future Actions were considered out to summer 2013, the completion of this action.

Geographic: Due to the localized expression of the geothermal resource and based on the direct and indirect impacts disclosed earlier in this chapter, the same assessment area was utilized for the evaluation of cumulative impacts as for the direct and indirect impacts.

4.3.2 Past and Present Action

On the basis of aerial photographic data, BLM Legacy Rehost 2000 database (which records lands and mineral actions; reports ran in October 2012) agency records and current agency GIS records and analysis, the following past and present actions since 2004, which have impacted the assessment area to varying degrees, have been identified: Gravel pit (surface mineral extraction).

4.3.3 Reasonable Foreseeable Future Actions

There are no reasonable foreseeable future actions identified within the cumulative impact assessment area. Should implementation of the action succeed then Ormat would pursue plans to add infrastructure that would include piping from the plant to the well. Although it is important to mention that this would be the next logical step, it is not currently proposed and would be outside the temporal assessment for this cumulative analysis.

4.3.4 Cumulative Impacts

4.3.4.1 Proposed Action

Past, present and reasonable foreseeable future actions have no measurable impacts on the affected resources in this analysis.

Based on potential impacts from past, present, proposed and reasonable foreseeable future actions within the cumulative impact assessment area, no cumulative impacts to the affected resources are anticipated from implementation of the proposed action.

4.3.4.2 No Action

Past, present and reasonable foreseeable future actions have no measurable impacts on the affected resources in this analysis.

Based on potential impacts from past, present, no action and reasonable foreseeable future actions within the cumulative impact assessment area, no cumulative impacts to the affected resources are anticipated from implementation of the no action alternative.

4.4 Mitigation Measures, Monitoring, and Residual Impacts

4.4.1 Mitigation Measures

No recommended mitigation.

4.4.2 Monitoring

No recommended monitoring.

4.4.3 Residual Impacts

No residual impacts anticipated under either alternative.

5.0 TRIBES, INDIVIDUALS, ORGANIZATIONS, OR AGENCIES CONSULTED

5.1 Government to Government Consultation

Table 4. Native American Consultation

Tribe	**Method of Communication**	**Dates of Communication**
Fallon Paiute & Shoshone Tribe		
Chair: Alvin Moyle	Letter	September 20, 2012
Lovelock Paiute Tribe		
Chair: Victor Mann	Letter	September 20, 2012
Pyramid Lake Paiute Tribe		
Chair: Wayne Burke	Letter	September 20, 2012

5.2 Individuals and Organizations Consulted

Ormat Nevada, Inc.

5.3 Public Outreach

Public scoping of the proposed action was conducted for thirty days beginning September 20, 2012. Letters were sent to potentially interested parties, including governments, organizations, and individuals. Information about the proposed action and BLM's intention to initiate an environmental assessment was also posted on the Winnemucca District Office website. Refer to **Section 1.4** for results of public scoping.

6.0 LIST OF PREPARERS (Assigned Interdisciplinary Team)

Table 5. The following staff participated in the writing and review of this EA:

BLM Interdisciplinary Team Member &Title	EA Area(s) of Responsibility	Degree and Years of Experience
BLM Winnemucca Field Office		
Doug Rowles Project Manager, Geologist	Project Manager; Overall Document	B.S. Geology 15 years of experience
Phil D'Amo Geologist	Hydrology	M.S. Geology M.S. Wildlife Ecology and Conservation B.S. Geology 12 years of experience
Mark Hall Archaeologist Native American Coordinator	Native American Religious Concerns	Ph.D., Anthropology M.A., Anthropology M.S.E. Metallurgy and Mining B.S.E. Metallurgy and Mining Registered Professional Archaeologist 19 years of experience
John Callan Environmental Protection Specialist	Waste (Hazardous or Solid)	B.A. Geography 20 years of experience
John Menghini Petroleum Engineer	Engineering Petroleum	B.S. Petroleum Engineering B.S. Business Administration 25 years of experience
Robert Bunkall GIS Specialist	GIS	B.S. Geography 10 years of experience
Lynn Ricci Planning and Environmental Coordinator	NEPA Compliance	B.S. Biology 23 years of experience

Table 6. Cooperating Agencies

Name	EA Area(s) of Responsibility	Title
United States Department of Energy		
Casey Strickland	Full document	Physical Scientist/NEPA Specialist

7.0 REFERENCES

Bell, J.W., 1984, Quaternary fault map of Nevada-Reno sheet: Nevada Bureau of Mines and Geology Map 79, scale 1:250,000.

BLM. EA/FONSI/DR for Installation of Brady Well 15-12 (#NV-020-05-07-EA). Dated January 6, 2005.

BLM. EA for Newberry Volcano Enhanced Geothermal System (EGS) Demonstration Project (#DOI-BLM-OR-P000-2011-003-EA). Dated December 2011.

BLM Legacy Rehost 2000 database, October 2012 Report.

BLM. Sonoma-Gerlach Management Framework Plan III. Winnemucca District Office, Winnemucca, Nevada. Dated July 1982.

Brady Power Partners. Brady 15-12 Stimulation Plan (#N20-12-009GS). Sundry Notice. Dated January 4, 2012.

Brady Power Partners. Brady 15-12 Liner Change (#N20-12-024GS). Sundry Notice. Dated July 26, 2012.

Brady Power Partners. Brady's Well 15-12 Baseline Flow Test (#N20-11-056GS). Sundry Notice. Dated September 22, 2011.

Geomechanics International. Geomechanical Modeling and Contribution to Fluid Flow from Natural Fractures at the Brady's EGS Site. Dated August 2011. Revised October 2011.

Greim et al., (1994) Toxicity and Ecotoxicity of Sulfonic Acids: Structure-Activity Relationship: Chemosphere, 28(12), 2203-2236.

Harrill, J. R., 1970, Water-resources appraisal of the Granite Springs Valley area, Pershing, Churchill, and Lyon Counties, Nevada: Nevada 'U Dept. Conservation and Natural Resources, Water Resources-Reconnaissance Ser. Rept. 55, 36 p.

Hultkrantz, A., 1986, Mythology and Religions Concepts. In: Handbook of North American Indians,Vol. 11, Great Basin, Warren L. d'Azevedo, ed., pp. 630-640. Washington D. C.: Smithsonian Institution.

Majer, E., Nelson, J.T., Robertson-Tait, A., Savy, J., and Wong, I., 2012, Protocol for addressing induced seismicity associated with Enhanced Geothermal Systems, DOE/EE-0662, 45 p.

Ormat Nevada, Inc. Bradys EGS Project – Water Quality and Quantity.

Ormat Nevada, Inc. Memorandum. Brady's EGS Demonstration Project - DE-FG36-08GO18200: Forward Modeling for Prediction of EGS Stimulation Volume. Dated October 8, 2012.

Ormat Nevada, Inc. Phase I: Studies and Engineering Summary Report (#DE-FG36-08GO18200).

Ormat Nevada, Inc. Phase I: Studies and Engineering Summary Report – Supporting Figures (#DE-FG36-08GO18200).

Ormat Nevada, Inc. Brady's 15-12 Proposed Stimulation Action Plan (#DE-GO-18200).

Ormat Nevada, Inc. Protocol for Induced Seismicity Associated with Enhanced Geothermal Systems (#DE-FG36-08GO18200).

Ormat Nevada, Inc. Bradys EGS Project. Dated September 28, 2012.

Rose, P.E., Benoit, W.R., and Kilbourn, P.M., (2001), The Application of the Polyaromatic Sulfonates as Tracers in Geothermal Reservoirs: Geothermics, 30(6), pp. 617-640.

Stewart, Omer. 1941. Culture Element Distributions: XIV Northern Paiute. Anthropological Records 4(3):361-446.

The University of Utah, EGI. Peter Rose, Ph.D. Justification for the Use of Naphthalene Sulfonates as Tracers During the EGS Experiments at Brady's Hot Springs Geothermal Reservoir.

The University of Utah, EGI. Peter Rose, Ph.D. Proposal for Tracer Testing at the Brady's Geothermal Field EGS Demonstration Project. Dated October 2012.

U.S. DOE. Protocol for Addressing Induced Seismicity Associated with Enhanced Geothermal Systems. Dated January 2012.

Weidler, R., Gerard, A., Baria, R., Baumgärtner, J. and Jung, R., 2002. Hydraulic and Micro-Seismic Results of a Massive Stimulation Test at 5 km Depth at the European Hot-Dry-Rock Test Site Soultz, France. Proceedings of the 27th Workshop on Geothermal Reservoir Engineering, Stanford University, California

Appendix A – Conditions of Approval to Drill Production Well 15-12