
Appendix P

Fluid Minerals

Reasonably Foreseeable Development Scenario

APPENDIX P

FLUID MINERALS REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

This appendix contains reasonably foreseeable development (RFD) scenarios for both geothermal and oil and gas.

GEOHERMAL REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

This RFD scenario serves as a basis for analyzing environmental impacts resulting from future leasing and development of federal geothermal resources within the decision area over the next 20 years. A variety of factors (e.g., economic, social, and political) are beyond the control of the BLM and Forest Service and will influence the demand for geothermal resources. Therefore, the RFD scenario is a best professional estimate of what may occur if public and National Forest System lands are leased. It is not intended to be a “maximum-development” scenario; however, it is biased towards the higher end of expected development and shows where the potential development might occur. If future development eventually exceeds RFD predictions, the BLM and Forest Service will assess the impacts on the resources under the context of the analysis provided in the Programmatic EIS (BLM 2008) or specific land use plans and determine if additional analysis is warranted.

Alternative A

Currently, there are 17 licensed geothermal power plants on federal lands in Nevada with a capacity of 480 MW. This averages out to be 28.8 MW capacity per plant. There are currently 81 producing wells from these 17 plants, which average out to be 5.9 MW capacity per well.

Based on these average figures and current market trends for geothermal energy in Nevada, it is reasonable to assume that over the next 20 years, an additional 336 MW capacity could be added, meaning that total production capacity could reach 816 MW. The addition of 336 MW may translate into 12

new power plants ($336 \text{ MW} \div 28.8 \text{ MW per power plant} = 12 \text{ power plants}$) supported by 56 wells ($332 \text{ MW} \div 5.9 \text{ MW per well} = 56 \text{ new wells}$).

Successful drilling of production wells can be estimated at 60 percent (Shevenell 2012), and thus 94 wells would be drilled (56 successful production wells (60 percent * 94 wells = 56 successful production wells). The unsuccessful wells drilled would be converted into injection wells or plugged and abandoned.

A typical geothermal well pad is approximately 4 acres in size, plus associated access roads, thus accounting for approximately 4 to 7 acres of ground disturbance per well. An average geothermal power plant (28 MW) might typically have 5 production wells and 4 injections wells, 6 miles of access roads (25 feet wide) and pipelines, and a facility footprint of 25 acres, totaling 71 acres of ground disturbance. See **Table P-1**.

Table P-1
Area of Disturbance: Wells, Access Roads, Power Plant, and Ancillary Facilities

Disturbance Type	Temporary Disturbance (approx.)	Permanent Disturbance (approx.)
Production & Injection Wells	36 acres	23 acres
Power Plant & Substation	10 acres	10 acres
Switching Station	7 acres	7 acres
Access Roads & Pipelines	18 acres	18 acres
TOTAL:	71 acres	58 acres

Source: BLM and Forest Service GIS 2015

Location of Development

Development would be distributed across the planning area shown by **Figure P-1** with the highest potential being in the western portions of the planning area. **Figure P-1** and a report for Nevada prepared by the Nevada Bureau of Mines and Geology (2015) is used in this analysis.

Table P-2 displays acreages of moderate and high geothermal potential in the planning area. The low geothermal potential area is not considered, because everything but the moderate and high potential areas in the whole planning area has low potential. That makes it difficult to compare alternatives, and it is most likely that moderate and high geothermal potential areas will be leased, explored, and developed, especially the high geothermal potential areas. These acreages are used in the RFDs.

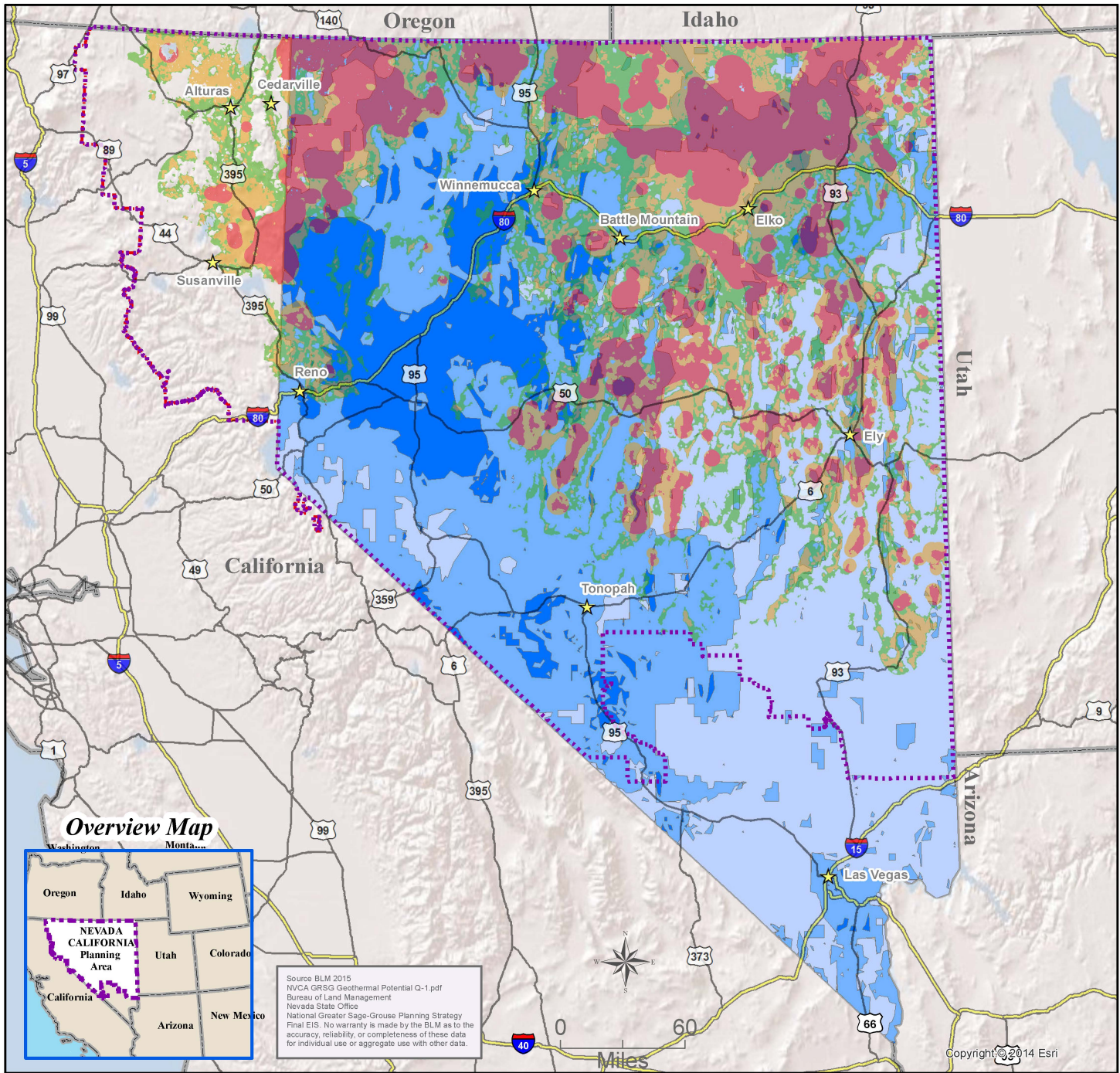
Disturbance from Geothermal Development

This RFD for geothermal resource use involves four sequential phases: (1) exploration, (2) drilling, (3) utilization, and (4) reclamation and abandonment. The success or failure of each phase affects the implementation of subsequent phases, and, therefore, subsequent environmental impacts. The general

Nevada and Northeastern California Greater Sage-Grouse Final EIS



Nevada and Northeastern California Greater Sage-Grouse Geothermal Potential within the Planning Area



Legend

All Land Status

Potential

- High
- Low
- Moderate
- Priority Habitat Management Area (PHMA)
- General Habitat Management Area (GHMA)
- Other Habitat Management Area (OHMA)

- Planning Area
- City/Town
- Interstate
- US Route
- States

Table P-2
Acreages of Moderate and High Geothermal Potential in the
Planning Area

Geothermal Potential	Acres
High	8,226,100
Moderate	33,096,000
Total	41,322,100

Source: BLM and Forest Service GIS 2015

assumptions outlined in the following four phases serve to establish RFD scenarios for analyzing future environmental impacts that may result from development following BLM issuance of leases for geothermal resources within the identified area of geothermal potential. It should be noted that the RFD scenario permits a general evaluation of the types of impacts that may occur but cannot accurately predict the magnitude and extent of these impacts. This is due in part to the uncertainty about the timing, location, distribution of the geothermal resources, and the likely types of development.

Table P-3 provides the estimated acreages of land disturbance for each phase in geothermal development for a typical power plant. The actual area of disturbance varies greatly depending upon site conditions and the type and size of power plant being constructed; therefore, a range is provided. Acreages are not provided for the reclamation and abandonment phase, since this phase involves the return of previously disturbed lands to their existing conditions.

The total potential amount of area disturbed under the utilization phase includes development activities. Much of the land would be reclaimed after the initial exploration, drilling, and construction; therefore, the actual amount of land occupied during operation would be less. A typical development generally requires several leases or the use of private or other adjacent lands.

Alternative B

Under Alternative B, 8,236,400 acres in PHMA would be closed to new geothermal leasing. Existing leases in PHMA would be managed in accordance with the stipulations on their lease. Therefore, no new geothermal leasing, exploration, and development would occur on unleased lands in PHMA; however, GHMA would remain available for leasing under standard stipulations.

Although it is uncertain which future geothermal exploration and development projects would be located within these lands; it is reasonable to assume that development would occur in areas with at least moderate geothermal potential. There are 5,261,300 acres of moderate and high geothermal potential in PHMA, which is 12.7 percent of the total area of moderate and high geothermal potential of 41,322,000 acres. Therefore, geothermal leasing, exploration, and development could be reduced by 12.7 percent (see **Table P-4**).

Table P-3
Typical Disturbances by Phase of Geothermal Resource Development

Development Phase	Disturbance Estimate per Plant
<i>Exploration</i>	2 – 7 acres
Geophysical	30 square feet ¹
Seismic surveys	negligible
Road/access construction	1- 6 acres
Temperature gradient wells	1 acre ²
<i>Drilling Operations and Utilization</i>	51 – 350 acres
Drilling and well field development	5 – 50 acres ³
Road improvement/construction	4 – 32 acres ⁴
Power plant construction	15 – 25 acres ⁵
Installing well field equipment, including pipelines	5 – 20 ⁶
Installing transmission lines	24 – 240 ⁷
TOTAL	53 – 367 acres

Source: BLM 2008

¹ Calculated assuming 10 soil gas samples, at a disturbance of less than three square feet each.

² Calculated assuming area of disturbance of 0.05 to 0.25 acre per well and six wells. Estimate is a representative average disturbance of all well sites. Some wells may require a small footprint (e.g., 30x30 feet), while others may require larger rigs and pads (e.g., 150x150 feet).

³ Size of the well pad varies greatly based on the site-specific conditions. Based on a literature review, well pads range from 0.7 acres up to 5 acres (GeothermEx 2007; Forest Service 2005). Generally a 30MW to 50 MW power plant requires about five to 10 well pads to support 10 to 25 production wells and five to 10 injection wells. Multiple wells may be located on a single well pad.

⁴ One-half mile to nine miles; assumes about ¼ mile of road per well. Estimates 30-foot wide surface disturbance for a 18-20 foot road surface, including cut and fill slopes and ditches.

⁵ 30 MW plant disturbs approximately 15 acres; 50 MW plant disturbs approximately 25 acres.

⁶ Pipelines between well pad to plant assumed to be ¼ or less; for a total of 1½ to seven miles of pipeline in length, with a 25-foot-wide corridor

⁷ Five to 50 miles long, 40-foot-wide corridor

Table P-4
Alternatives B through F and Proposed Plan Compared to Alternative A with 41,322,100 acres of Moderate and High Geothermal Potential in Planning Area

Alt.	Moderate and High Geothermal Potential in:			Expected Reduction in Geothermal Leasing, Exploration, and Development (%)	Description of Alternative
	SFA	PHMA	GHMA		
B	N/A	5,261,300	N/A	12.7	PHMA closed to geothermal leasing. Existing leases could be explored.
C	N/A	8,707,300	N/A	21.1	All GRSG habitat considered PHMA and closed to geothermal leasing.

Table P-4
Alternatives B through F and Proposed Plan Compared to Alternative A with 41,322,100
acres of Moderate and High Geothermal Potential in Planning Area

Alt.	Moderate and High Geothermal Potential in:			Expected Reduction in Geothermal Leasing, Exploration, and Development (%)	Description of Alternative
	SFA	PHMA	GHMA		
D	N/A	5,524,000	3,183,200	13.4 - 21.1	PHMA: NSO without WEMs & GHMA: NSO with exceptions.
E	N/A	5,261,300	3,446,000	0 - 21.1	PHMA & GHMA open to geothermal leasing, exploration, and development, but require avoidance, minimization, and mitigation of impacts to GRSG habitat.
F	N/A	5,261,300	3,446,000	21.1	PHMA & GHMA closed to new geothermal leasing. Existing leases could be explored. Impacts and RFD projections would be similar or the same as those described under Alternative C.
Proposed Plan	1,076,300	5,413,000	3,324,600	15.7 - 23.7	PHMA considered SFA: NSO no WEMs. PHMA: NSO with 3 conditions. GHMA: open with TL and CSU stipulations & avoidance, minimization, and application of compensatory mitigation of impacts to GRSG habitat.

Source: BLM and Forest Service GIS 2015

Alternative C

Under Alternative C, all 16,526,600 acres in GRSG habitat would be closed to new geothermal leasing, exploration, and development. Existing leases would be managed in accordance with the lease stipulations on their lease. Therefore, no new geothermal leasing, exploration, and development would occur on unleased lands, and only existing leases could be explored for development.

Although it is uncertain which future geothermal exploration and development projects would be located within these lands, it is reasonable to assume that development would occur in areas with at least moderate geothermal potential.

There are 8,707,300 acres of moderate and high geothermal potential in PHMA, which is 21.1 percent of the total area of moderate and high geothermal potential of 41,322,000 acres. Therefore, geothermal leasing, exploration, and development could be reduced by 21.1 percent (see **Table P-4**).

Alternative D

Under Alternative D, 8,151,600 acres in PHMA would be managed as NSO without any waivers, exceptions, or modifications. In addition, 6,490,700 acres in GHMA would be managed as NSO but would allow exceptions. Existing leases would be under the lease stipulations on the existing lease.

It is difficult to predict the leasing activity in areas with NSO stipulations. In the case of PHMA, this alternative proposes NSO stipulations without any waivers, exceptions, or modifications. Unless there are adjacent lands that are not subject to these restrictions, it would be impossible to explore and develop with current technology. In the case of GHMA with NSO with exceptions, it is still unlikely to be leased because industry would have to lease the land first without knowing if an exception would be granted. This would create a level of uncertainty. Unless there are adjacent lands that are not subject to these restrictions, then it would be unlikely to be leased.

Although it is uncertain which future geothermal exploration and development projects would be located within these lands, it is reasonable to assume that development would occur in areas with at least moderate geothermal potential. There are 5,524,000 acres of moderate and high geothermal potential in PHMA, which is 13.4 percent of the total area of moderate and high geothermal potential. Additionally, there are 3,183,200 acres of moderate and high geothermal potential in GHMA, which is 7.7 percent of the total area of moderate and high geothermal potential. It is likely that no geothermal leasing, exploration, and development would occur in PHMA, and little to none would occur in GHMA. Therefore, geothermal leasing, exploration, and development would be reduced by at least the moderate and high geothermal potential in PHMA and, at most, the additional moderate and high geothermal potential in GHMA. Therefore, geothermal leasing, exploration, and development could be reduced by at least 13.4 percent and possibly as much as 21.1 percent (see **Table P-4**).

Alternative E

Under Alternative E, 8,236,400 acres of PHMA and 6,405,900 acres of GHMA would be open to geothermal leasing, exploration, and development but would require avoidance, minimization, and mitigation of impacts on GRS habitat. The impacts under this alternative would be similar to those under Alternative A. However, the additional time and costs associated with the “avoid, minimize, and mitigate” management may discourage leasing and development from occurring.

It is difficult to predict leasing activity in areas with requirements of “avoidance, minimization, and mitigation” of impacts on GRSG habitat. If industry is comfortable with such requirements, then geothermal leasing, exploration, and development would be reduced by zero percent. However, if industry is not comfortable with such requirements, then geothermal leasing, exploration, and development could be reduced by 5,261,300 acres of moderate and high geothermal potential in PHMA and 3,446,000 acres of moderate and high geothermal potential in GHMA for a total of 8,707,300, which is 21.1 percent of the total area of moderate and high geothermal potential. Therefore, geothermal leasing, exploration, and development could be reduced from zero to 21.1 percent (see **Table P-4**).

Alternative F

Under Alternative F, 8,236,400 acres in PHMA and 6,405,900 acres in GHMA would be closed to new geothermal leasing, exploration, and development. Only existing leases could be explored. Impacts and RFD projections would be similar or the same as those described under Alternative C. Existing closures would remain in place on 1,436,900 acres in PHMA and 547,400 acres in GHMA.

There are 5,261,300 acres of moderate and high geothermal potential in PHMA and 3,446,000 acres of moderate and high geothermal potential in GHMA for a total of 8,707,300 acres, which is 21.1 percent of the total area of moderate and high geothermal potential. Therefore, geothermal leasing, exploration, and development could be reduced by 21.1 percent (see **Table P-4**).

Proposed Plan

Under the Proposed Plan, 9,255,400 acres of land in PHMA would be subject to NSO restrictions with only two exceptions. Included in this acreage is 2,797,400 acres of PHMA that is considered SFA and would be managed as NSO without any waivers, exceptions, or modifications. Another 6,037,800 acres of GHMA would be open to leasing, exploration, and development but would be subject to moderate constraints, such as TL and CSU stipulations, and would require avoidance, minimization, and application of compensatory mitigation of impacts on GRSG habitat. There are also 1,984,300 acres that are closed to leasing in WSAs and wilderness areas within PHMA and GHMA.

It is difficult to predict the leasing activity in areas with NSO stipulations. In the case of SFA, this alternative proposes NSO stipulations without any waivers, exceptions, or modifications. Unless there are adjacent lands that are not subject to these restrictions, it would be impossible to explore and develop with current technology. In the case of PHMA with only one exception, it is still unlikely to be leased because industry would have to lease the land first without knowing if an exception would be granted. This would create a level of uncertainty. Unless there are adjacent lands that are not subject to these restrictions, then it would be unlikely to be leased.

Although it is uncertain which future geothermal exploration and development projects would be located within these lands, it is reasonable to assume that development would occur in areas with at least moderate geothermal potential. There are 1,076,300 acres of moderate and high geothermal potential in SFA, which is 2.6 percent of the total area of moderate and high geothermal potential. Additionally, there are 5,413,000 acres of moderate and high geothermal potential in the remaining PHMA, which is 13.1 percent of the total area of moderate and high geothermal potential. It is likely that no geothermal leasing, exploration, and development would occur in SFA and the remaining PHMA. Therefore, geothermal leasing, exploration, and development would be reduced by at least the moderate and high geothermal potential in SFA and in the remaining PHMA, which is 15.7 percent of the total area of moderate and high geothermal potential.

It is difficult to predict leasing activity in areas with requirements of “avoidance, minimization, and application of compensatory mitigation” of impacts on GRSG habitat, as is the case with GHMA for this alternative. If industry is comfortable with such requirements, then geothermal leasing, exploration, and development would be reduced by zero percent in GHMA. However, if industry is not comfortable with such requirements, then geothermal leasing, exploration, and development could be reduced by 3,324,600 acres of moderate and high geothermal potential in GHMA, which is 8 percent of the total area of moderate and high geothermal potential.

Overall, geothermal leasing, exploration, and development could be reduced by at least 15.7 percent and possibly as much as 23.7 percent (see **Table P-4**).

OIL AND GAS REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

This RFD scenario serves as a basis for analyzing environmental impacts resulting from future leasing and development of federal oil and gas resources within the decision area over the next 20 years. A variety of factors (e.g., economic, social, and political) are beyond the control of the BLM and Forest Service and will influence the demand for oil and gas resources. Therefore, the RFD scenario is a best professional estimate of what may occur if public lands are leased. It is not intended to be a “maximum-development” scenario; however, it is biased towards the higher end of expected development and shows where the potential development might occur. If future development eventually exceeds RFD predictions, then the BLM and Forest Service will assess the impacts on the resources under the context of the analysis provided in this EIS or specific LUPs and determine if additional analysis is warranted.

The decision area produces approximately 367,000 barrels of oil per year. Based on production data within the planning area, production wells produce on average 14 barrels per day per well. The success rate for drilling production wells can be estimated at 20 percent within the decision area. However, production within Elko-Noble project areas is estimated to be as high as 55

percent because of new completion technologies. If a total of 100 wells were to be drilled in the decision area, including 60 wells projected for the Elko-Noble project, up to 41 could be successful production wells, as shown in Table P-5.

Table P-5
Oil and Gas Wells (Exploration & Production) Projections for the Decision Area (DA) and Elko-Noble Area (Elko)

Alternative	Oil Wells Expected to be Drilled					Oil Wells Expected to be Producing				
	On Existing Leases		On New Leases		Total	On Existing Leases		On New Leases		Total
	DA	Elko	DA	Elko		DA	Elko	DA	Elko	
A	15	60	25	0	100	3	33	5	0	41
B	12	40	20	0	72	2	22	4	0	28
C	10	20	18	0	48	2	11	3	0	16
D	11	24	19	0	54	2	13	4	0	19
E	13	51	21	0	85	2	28	4	0	34
F	10	20	18	0	48	2	11	3	0	16
PP	14	45	19	0	78	3	9	4	0	16

Source: BLM and Forest Service GIS 2015

LOCATION OF DEVELOPMENT

Development would be distributed across the area shown by **Figure P-2**. The majority of the resources are located within the eastern portion of the decision area with high potential areas occurring within the Battle Mountain, Elko, and Ely BLM districts around Railroad and Pine Valleys.

Typical Phases in Oil and Gas Development

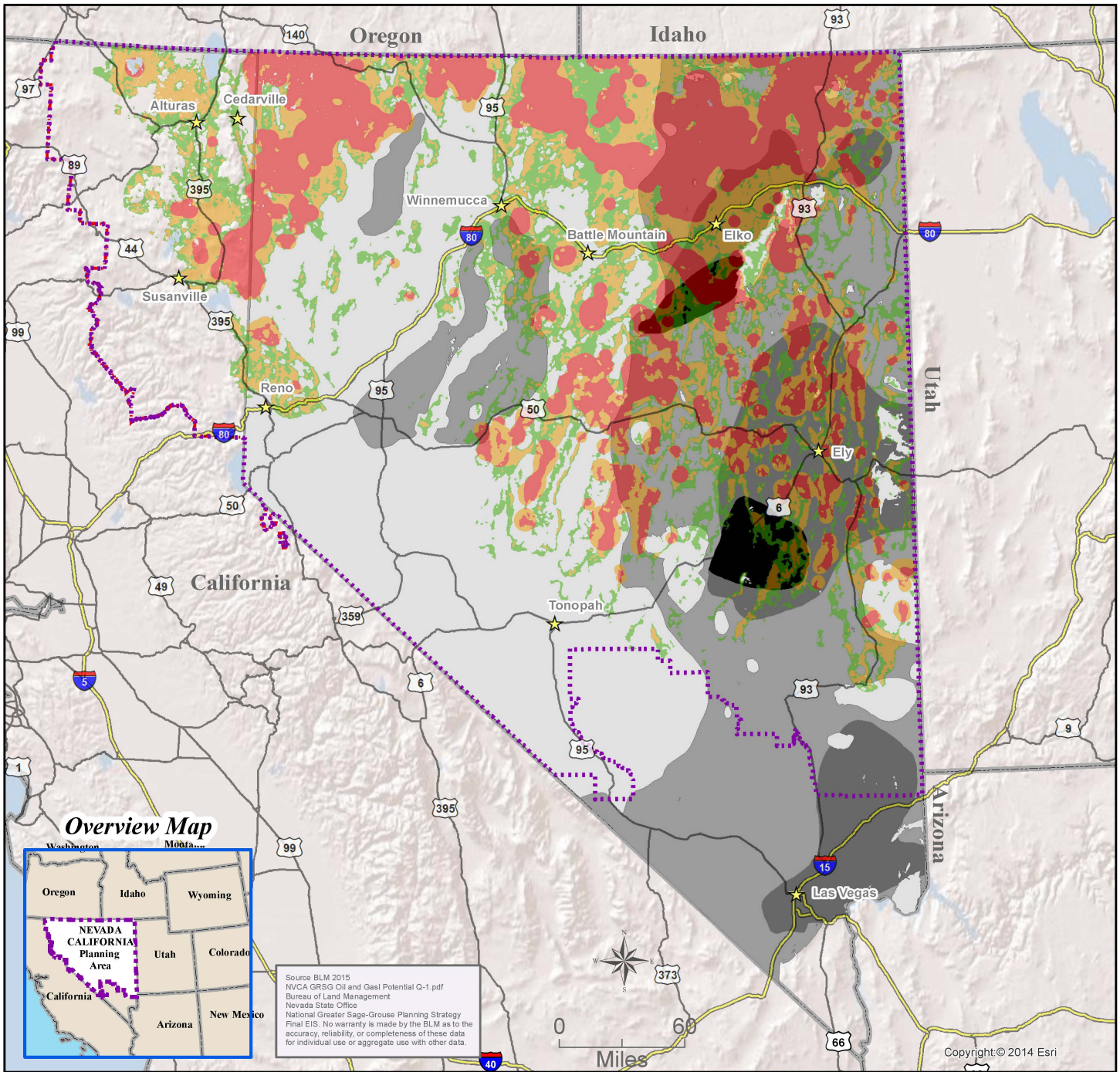
This RFD for oil and gas resource use involves four sequential phases: (1) exploration, (2) drilling, (3) utilization, and (4) reclamation and abandonment. The success or failure of each phase affects the implementation of subsequent phases, and, therefore, subsequent environmental impacts. The general assumptions outlined in the following four phases serve to establish RFD scenarios for analyzing future environmental impacts that may result from development following BLM issuance of leases for oil and gas resources within the identified area of oil and gas potential. It should be noted that the RFD scenario permits a general evaluation of the types of impacts that may occur but cannot accurately predict the magnitude and extent of these impacts. This is due in part to the uncertainty about the timing, location, distribution of the oil and gas resources, and the likely types of development.

Table P-6 provides the estimated acreages of land disturbance for each phase in oil and gas development for an oil and gas field. The actual area of disturbance varies greatly depending upon site conditions and the type and size of field being constructed; therefore, a range is provided. Acreages are not provided for the reclamation and abandonment phase since this phase involves the return of previously disturbed lands to their existing conditions.

Nevada and Northeastern California Greater Sage-Grouse Final EIS



Nevada and Northeastern California Greater Sage-Grouse
Oil and Gas Potential within the Planning Area



Overview Map



Source: BLM 2015
NVCA GRS/G Oil and Gas Potential Q-1.pdf
Bureau of Land Management
Nevada State Office
National Greater Sage-Grouse Planning Strategy
Final EIS. No warranty is made by the BLM as to the
accuracy, reliability, or completeness of these data
for individual use or aggregate use with other data.

All Land Status

- High Potential
- Low Potential
- Moderate Potential
- Very Low Potential
- Priority Habitat Management Area (PHMA)
- General Habitat Management Area (GHMA)
- Other Habitat Management Area (OHMA)

Legend

- Planning Area
- City/Town
- Interstate
- US Route
- States

Table P-6
Disturbance from Reasonably Foreseeable Development

Activity	Disturbance (acres)	Reclamation (acres)	Total Disturbance at the End of the RFD Period (acres)
Seismic Surveys	606	606	0
Roads	480	384	96
Drilling	160	128	32
Total	1246	1118	128

Source: BLM and Forest Service 2015

The total potential amount of area disturbed under the utilization phase includes development activities. Much of the land would be reclaimed after the initial exploration, drilling, and construction; therefore, the actual amount of land occupied during operation, would be less than the figure outlined in the development section. A typical development generally requires several leases or the use of private or other adjacent lands. The details of each phase of development are described below.

ASSUMPTIONS FOR REASONABLY FORESEEABLE DEVELOPMENT SCENARIO – OIL AND GAS WITHIN THE DECISION AREA

Alternative A

Assumptions for Exploration

1. Exploration and development will occur over 20 years.
2. There would be approximately 25 miles of seismic line at a width of 10 feet surveyed per year for an anticipated overall total of 606 acres of disturbance over the life of the RFD. Each year, 100 percent of the disturbance would be reclaimed. Other geophysical surveys would be completed; however, the surveys would be minimal, with little to no surface disturbance.
3. The majority of the decision area is considered to be a high risk (wild cat) exploration region. This means that there is low to moderate potential for oil and gas discoveries.
4. Approximately 450 wells have been drilled within the decision area to date, and 71 of those wells are producing. This is a success rate of approximately 16 percent. On average two wells per year are drilled, which amounts to 40 wells over the life of the RFD (this does not include the following RFD for the Noble project in the Elko District). It is projected that the success rate would increase to 20 percent because of new completion technologies. Approximately 8 out of the 40 wells drilled would be potentially viable for production.

5. An estimated 32 wells would be reclaimed over the 20-year timespan.
6. The majority of successful wells drilled are located in the high potential regions within the eastern portion of the planning area. From this we can assume the continued success of these locations.
7. The average size for a well pad is 4 acres. Forty new wells over the next 20 years would then amount to 160 acres of disturbance for new wells drilled. Since it is projected that 8 wells would be producing, the amount remaining unreclaimed would be 32 acres.
8. The average access road would be 20 feet wide and 5 miles long (average width accounting for turnouts) the total disturbance due to road construction would then be approximately:
 - 5 miles by 5,280 feet/mile by 20 feet = 528,000 square feet.
 - 528,000 feet by 1 acre/43560 feet = approximately 12 acres per successful well.
 - 12 acres by 8 (successful wells) = 96 acres remaining unreclaimed over the course of 20 years. Over the 20 year period, the total amount of disturbed area due to access roads is expected to be no more than 480 acres, with 384 acres being reclaimed.

Based on the above assumptions, disturbance from geophysical surveys are estimated at 606 acres, access roads are estimated at 480 acres, and well pads are estimated at 160 acres for a total surface disturbance of approximately 1,246 acres. The surface disturbance from oil and gas exploration well pads and access roads combined is estimated to be 640 acres, of which 512 acres for roads and well pads of unsuccessful wells would be reclaimed within the 20-year period, leaving a total of approximately 128 acres of surface disturbance.

Assumptions for Production

We have estimated that over the next 20 years 8 new producing wells will be discovered.

The following assumptions are based on estimated mineral potential, ground conditions within the decision area, road availability, and existing development for the decision area.

1. There would be 40 wells drilled within the RFD; 32 of those wells would be reclaimed, leaving a total of 8 successful production wells totaling 32 acres of disturbance due to well pads.
2. A tank battery would be placed on the existing drill pad of the producing well, and no additional surface disturbance would be required.

3. The access roads to the unsuccessful wells total 384 acres. This acreage would be reclaimed.
4. Based on the above assumption, the total surface disturbance from the 8 production well pads is estimated at 32 acres, and the surface disturbance from the construction of roads is estimated to be approximately 96 acres. Surface disturbance from oil and gas production over the 20-year period could total a maximum of approximately 128 acres after reclamation.

The above assumptions for both exploration and production are summarized below in **Table P-7**, Reasonably Foreseeable Disturbance from Exploration and Production.

Table P-7
Reasonably Foreseeable Disturbance from Exploration and Production

Activity	Disturbance (acres)	Reclamation (acres)	Total Disturbance at the end of the RFD period (acres)
Seismic Surveys	606	606	0
Roads	480	384	96
Well Pads	160	128	32
Total	1246	1118	128

Source: BLM and Forest Service 2015

Assumptions for Reasonably Foreseeable Development Scenario (Noble – Elko Areas Only)

1. Exploration and development will occur over 20 years.
2. The majority of the decision area is considered to be a high risk (wildcat) exploration region. This means that there is low to moderate potential for oil and gas discoveries.
3. Extensive seismic surveys have been completed within this portion of the planning area; therefore, additional seismic survey disturbance would be minimal.
4. Although no wells have been drilled within this portion of the decision area, it is anticipated that Noble would drill 60 wells within the decision area and that 33 of those wells would be productive. This is a success rate of approximately 55 percent.
5. Multi-well directional and horizontal pads would be implemented; therefore, four wells would be drilled on each pad. The average size of a well pad is four acres. This would result in a total of 15 pads being required to drill a total of 60 wells, amounting to 60 acres of disturbance.
6. Wells within this portion of the decision area would be drilled using new completion technologies. These technologies could include hydraulic fracturing and horizontal drilling.

7. The majority of successful wells drilled are located in the moderate potential regions within the northeastern portion (Elko District) of the decision area.
8. The average access road would be 20 feet wide and 5 miles long (average width accounting for turnouts). The total disturbance due to road construction would then be:
 - 5 miles by 5,280 feet/mile by 20 feet by 1 acre/43,560 square feet = approximately 12 acres.
 - 12 acres by 0.75 well pads per year = approximately 9 acres/year. Over the course of 20 years, this amounts to an expected maximum of approximately 180 acres.

The above assumptions for Noble – Elko are summarized below in **Table P-8**, Disturbance from Reasonably Foreseeable Development in Noble – Elko.

Table P-8
Disturbance from Reasonably Foreseeable
Development in Noble – Elko

Activity	Disturbance (acres)
Roads	180
Well Pads	60
Total	240

Source: BLM and Forest Service GIS 2015

Alternative B

Under Alternative B, 8,236,000 acres in PHMA (plus acreage already closed within WAs and WSAs under Alternative A) would be closed to new oil and gas leasing, exploration, and development. Of the 8,236,000 acres, there are approximately 6,591,100 acres with low, moderate, and high oil and gas potential in PHMA that would be closed to leasing, exploration, and development. Approximately 41 percent of PHMA habitat (15,343,900 acres) would be closed under Alternative B. Existing leases in PHMA would be subject to the existing lease stipulations. Out of the total 6.9 million acres of GHMA, 3.5 million acres with low, moderate, and high oil and gas potential would remain open to existing and new oil and gas leasing and development.

Although it is uncertain which future oil and gas exploration and development projects would be located within these lands, it is reasonable to conclude that oil and gas exploration and development could be reduced by 35 to 50 percent in the northern area and southwest area in the Elko District. Instead of drilling 60 wells, as projected in the RFD for Elko, closures in PHMA could decrease the well count to less than 40 wells. Development in the rest of the planning area could be decreased by as much as 20 percent under Alternative B. This could result in the reduction of drilled wells, as projected in the RFD, from 40 wells to 32 wells (see **Table P-9**).

Table P-9
Reasonably Foreseeable Disturbance from Oil & Gas Exploration within the Decision Area (DA) and Elko-Noble

	Alt A		Alt B		Alt C		Alt D		Alt E		Alt F		Proposed Plan	
RFD Areas	Elko	DA	Elko	DA	Elko	DA	Elko	DA	Elko	DA	Elko	DA	Elko	DA
# of new wells	60	40	40	32	20	28	24	30	51	34	20	28	45	33
Seismic Surveys (acres)	-	606	-	485	-	436	-	455	-	515	-	436	-	497
Roads (acres)	180	480	120	384	60	346	72	360	153	408	59	346	135	394
Well Pads (acres)	60	160	48	128	20	115	24	120	51	136	20	115	45	131
Total Acres:	240	1,246	168	997	80	897	96	935	204	1,059	79	897	180	1,022

(DA = Decision Area minus Elko-Noble Areas)

Source: BLM and Forest Service GIS 2015

Alternative C

Under Alternative C, all 16,526,600 acres in GRGS habitat would be closed to new oil and gas leasing, exploration, and development, affecting almost 13.5 million acres of lands with low, moderate, and high oil and gas potential. Existing leases would be managed as NSO with exceptions.

Alternative D

Under Alternative D, 8,236,400 acres in PHMA would be managed as NSO without any exceptions, modifications, or waivers. In addition, 6,405,900 acres in GHMA would also be managed as NSO but would allow exceptions. Existing closures would remain in place on 1,436,900 acres in PHMA and 547,400 acres in GHMA. The maximum lateral extent of oil wells with current drilling technologies is typically between 3,000 and 4,000 feet but can be as much as 10,000 feet lateral extent. However, the cost of the project is determined by several factors, such as the length and size of the installed product, the lithology, and the ongoing operation. If the expected lithology is bedrock, or other hard-to-drill conditions, horizontal/directional drilling may be cost prohibitive for an operator; therefore, as much as 75 percent of oil and gas resources within the NSO interior within PHMA may not be accessible.

It is estimated that oil and gas exploration and development in the Elko District could be reduced by 55 to 65 percent by applying the NSO restriction to GRSG habitat and by 25 percent throughout the rest of the planning area. Applying an NSO restriction to leasing, exploration, and development within PHMA and GHMA lands could decrease the projected well counts in the RFD from 60 in the Elko District to 24 wells, and from 40 wells to 30 wells for the rest of the planning area.

Alternative E

Under Alternative E, 8,236,400 acres of PHMA and 6,405,900 acres of GHMA would be open to oil and gas leasing, exploration, and development but would require avoidance, minimization, and mitigation of impacts on GRSG habitat. The impacts under this alternative would be similar to those under Alternative A. However, the additional time and costs associated with the “avoid, minimize, and mitigate” management may discourage leasing and development from occurring. Existing closures would remain in place on 1,436,900 acres in PHMA and 547,400 acres in GHMA.

Areas with the most GRSG habitat would be the most affected, especially Elko and the areas with moderate to high potential. Therefore, it is estimated that oil and gas drilling and exploration could be reduced by more than 10 to 20 percent under this alternative. This could decrease the projected well counts in the RFD from 60 in the Elko District to 51 wells, and from 40 wells to 34 wells for the rest of the planning area (See Table P-9).

Alternative F

Under Alternative F, 8,236,400 acres in PHMA and 6,405,900 acres in GHMA would be closed to new oil and gas leasing, exploration, and development. Only existing leases could be explored. This would remove over 10 million acres of land with oil and gas potential from leasing, exploration, and development. Impacts and RFD projections would be similar or the same as those described under Alternative C (See **Table P-9**).

Proposed Plan

Under the Proposed Plan, approximately 7,498,700 acres of land in PHMA would be subject to NSO restrictions with only two exceptions. An additional 2,797,400 acres of PHMA is considered SFA and would be managed as NSO with no exceptions. Another 6,516,800 acres of GHMA would be open to leasing, exploration, and development but would be subject to moderate constraints, such as TL and CSU stipulations, and would require avoidance, minimization, and mitigation of impacts to GRSG habitat. However, the additional time and costs associated with the “avoid, minimize, and application of compensatory mitigation” management may discourage leasing and development from occurring.

Areas managed as NSO would only be accessible by directional drilling, and the maximum lateral extent of oil wells with current drilling technologies is typically between 3,000 and 4,000 feet but can be as much as 10,000 feet lateral extent. However, the cost of the project is determined by several factors, such as the length and size of the installed product, the lithology, and the ongoing operation. If the expected lithology is bedrock, or other hard-to-drill conditions, horizontal directional drilling may be cost prohibitive.

Areas with the most PHMA habitat would be the most affected, especially Elko and the areas with moderate to high potential. Therefore, it is estimated that oil and gas exploration and development in the Elko District could be reduced by 20 to 30 percent by applying the NSO restriction to PHMA habitat and by 18 percent throughout the rest of the planning area. Applying an NSO restriction to leasing, exploration and development would decrease the projected well counts in the RFD from 60 in the Elko District to 45 wells, and from 40 wells to 33 wells for the rest of the planning area (see **Table P-9**).