Application for Amendment of USNRC Source Materials License SUA-1601, Ross ISR Project, for the Kendrick Expansion Area

RAI Question and Answer Responses for the Kendrick Expansion Area Environmental Report Docket #40-09091

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August 2016

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General

RAI – GEN-1 Preconstruction Activities

On September 15, 2011, the NRC published a final rule in the Federal Register (76 FR 56951) to clarify the definitions of commencement of construction and construction with respect to materials licensing actions conducted under the NRC's regulations. This final rule was effective on November 14, 2011. Under the final rule, site preparation activities are separate from the analysis of the construction activities should the amendment be approved. The parts of the final rule that are applicable to the NRC's licensing action for the proposed Kendrick in situ recovery (ISR) project are in 10 CFR 51.45(c), which specifies that an ER must include a description of site preparation activities, a description of the impacts of those activities and an analysis of the cumulative impacts of those activities.

A. *Clarify the description of those Kendrick site preparation (or preconstruction) activities excluded from the definition of construction (i.e., a description separate from that of the description of the proposed construction activities) that have been or will be undertaken, regardless of when those activities may occur in relation to the potential issuance by the NRC of the amendment to the license to construct and operate the proposed ISR facility.*

ER RAI GEN-1(A) Response

Preconstruction activities within the proposed KEA, which are excluded from the definition of construction under 10 CFR § 40.4, are described in Kendrick ER Section 2.3.2.1.1. The following describes the preconstruction activities that have been or will be undertaken within the proposed KEA. Clarification is provided for each activity, including its potential surface disturbance.

- Strata installed 12 regional baseline monitor well clusters for 10 CFR Part 40, Appendix A, Criterion 7 characterization. Each cluster included four monitor wells targeting the SA, SM, OZ, and DM units (except well cluster 5368-43-12, where the SA unit was not encountered). Based on a typical surface disturbance associated with each monitor well or drilling site of approximately 1,250 square feet, the total disturbance associated with construction of the regional baseline monitor well network is 60,000 square feet (1.4 acres). The pits around the wells have since been reclaimed and revegetated in accordance with WDEQ/LQD requirements.

- Strata drilled 1,435 drill holes, primarily in 2011 and 2012, to explore and delineate the uranium ore body and to collect geologic data; these activities occurred after submittal of the Ross ISR Project license application. The total disturbance associated with the drill holes was approximately 41 acres, although the disturbance was phased over several years. Kendrick ER Addendum 3.3-C includes details on the drill holes including the location, type of drill hole, date plugged, and type of plugging (Strata drill hole names begin with "RMR"). The addendum shows that the drill holes were plugged between April 23, 2010 and November 25, 2014.

- Strata conducted baseline characterization surveys including: water resources, soils, vegetation/ecology, wetlands, gamma, and cultural resources. No surface disturbance was associated with these baseline characterization surveys.

- Strata conducted passive measurement and data collection of meteorological, air quality, gamma, radon, and stream flow characteristics. Meteorological data were collected using the previously existing Ross ISR Project met station, located along D Road within the proposed KEA. Air particulate, long-term gamma radiation, and radon measurements were taken at the air particulate monitoring stations, as described in Kendrick ER Section 3.11.4. No surface disturbance was associated with the met station or monitoring stations. As described in Kendrick ER Section 3.11.4.2.4, filters were collected from each air sampling unit on approximately a weekly basis during the baseline monitoring program. Kendrick ER Section 3.4.1.6.2 describes how Strata established five surface water monitoring stations in and around the proposed KEA. No disturbance was associated with these monitoring stations, which were operated from May through October 2013.

- Prior to license amendment approval, Strata may conduct limited delineation drilling under the drilling notification process through WDEQ/LQD. Although Strata has no current plans to conduct additional delineation drilling within the proposed KEA prior to the amendment of the license, it was conservatively assumed that up to 100 additional drill holes would be completed under an existing drilling notification within the proposed KEA. This would result in maximum additional disturbance of up to 3 acres.

RAI – GEN-1 Preconstruction Activities

On September 15, 2011, the NRC published a final rule in the Federal Register (76 FR 56951) to clarify the definitions of commencement of construction and construction with respect to materials licensing actions conducted under the NRC's regulations. This final rule was effective on November 14, 2011. Under the final rule, site preparation activities are separate from the analysis of the construction activities should the amendment be approved. The parts of the final rule that are applicable to the NRC's licensing action for the proposed Kendrick in situ recovery (ISR) project are in 10 CFR 51.45(c), which specifies that an ER must include a description of site preparation activities, a description of the impacts of those activities and an analysis of the cumulative impacts of those activities.

B. *Provide a description of the environmental impacts from the site preparation activities (including a description of any proposed measures to avoid or reduce adverse effect of the impacts).*

C. *Provide an analysis of the cumulative impacts of the proposed action (i.e., the incremental impact of the proposed action) on the human environment when added to the impact of such excluded site preparation activities and to the impact of other past, present, and reasonably foreseeable future actions (regardless of what agency (Federal or non-Federal) or person undertakes such other actions (see Title 40 of the Code of Federal Regulations (40 CFR) Section 1508.7, "Cumulative Impact")).*

ER RAI GEN-1(B) and (C) Response

The following provides a description of the potential environmental impacts of the preconstruction activities within the proposed KEA by resource. In addition, cumulative impacts of the preconstruction activities are evaluated when coupled with the Proposed Action, as required by 10 CFR § 51.45(c), and the past, present, and reasonably foreseeable future actions (RFFAs).

Land Use

Potential impacts associated with the preconstruction activities are similar to those described for the Proposed Action in Kendrick ER Section 4.1.1.1, but of a much smaller magnitude. These include temporarily changing and disturbing existing land uses, restricting access, and restricting livestock grazing and recreational activities. The potential impacts have been and will continue to be mitigated by phasing activities, restoring and re-seeding disturbed areas promptly, and using existing roads where possible. Figure ER RAI GEN-1-1 depicts some of Strata's drill holes within the proposed KEA on 2012 National Agriculture Imagery Program (NAIP) aerial photography, and the same area on the 2015 NAIP imagery. The figure clearly show that the surface disturbance associated with the delineation drilling has been reclaimed.

Kendrick ER Section 4.1.1 states that approximately 1,050 acres of land or about 13 percent of the proposed KEA are anticipated to be disturbed by the Proposed Action.

By comparison, past disturbance associated with the preconstruction activities is approximately 42 acres, and future delineation drilling may disturb up to 3 acres, for a total of 45 acres, or 0.6 percent of the proposed KEA. Therefore, the preconstruction activities when coupled with the Proposed Action would result in a small incremental effect to land use. The practical impacts would not be additive, since the drill hole development and reclamation are phased such that little residual impacts remain today from preconstruction activities that occurred primarily in 2011-2012. Preconstruction activities would also have a small cumulative impact when added to the moderate cumulative land use impacts from other past, present, and RFFAs, since the disturbance is limited to a relatively small portion of the proposed KEA. This evaluation is consistent with Kendrick ER Section 2.3.4.1.

Transportation

Preconstruction activities have had and may continue to have small potential transportation impacts. Traffic impacts associated with past preconstruction activities included up to 10 vehicles per month for baseline monitoring activities and workers and vehicles associated with delineation drilling. Considering that the operational phase of the Ross ISR Project is estimated to result in up to 3,600 passenger vehicles and 480 trucks per month (based on the information in Ross ER Table 4.2-1), the addition of 20 one-way vehicle trips per month (10 round trips) during past preconstruction activities within the proposed KEA represents about 0.5 percent of an incremental impact. Potential future delineation drilling is anticipated to result in a similarly small incremental impact, with no overlap in the transportation activities between past and future preconstruction activities. Figure ER RAI GEN-1-1 shows that the temporary access roads associated with the 2011-2012 delineation drilling have been reclaimed.

Consistent with the evaluation in Kendrick ER Section 2.3.4.2, the preconstruction activities when added to the Proposed Action would result in a small incremental effect to transportation. Preconstruction activities also would have a small cumulative impact when added to the small to moderate cumulative transportation impacts from other past, present, and RFFAs, due to the few vehicles required to conduct preconstruction activities. Kendrick ER Table 3.2-2 shows that approximately 379 vehicles per day used D Road near Moorcroft in 2014. Approximately 20 one-way vehicle trips per month during past preconstruction activities would have accounted for only about 0.2 percent of this traffic.

Geology and Soils

Potential geology impacts associated with the preconstruction activities are limited due to the minor depth of land disturbance activities. Potential soil impacts are similar to those described for the Proposed Action in Kendrick ER Section 4.3.1, but on a much smaller scale. These include potential soil compaction, loss of soil productivity, and soil contamination. The potential impacts have been and would continue to be mitigated by managing topsoil in accordance with WDEQ/LQD rules and regulations, revegetating disturbed areas, and using existing roads where possible.

During monitor well construction and delineation drilling, the topsoil associated with the mud pits was stripped and temporarily stockpiled. Based on a prior surface disturbance of approximately 42 acres and an estimated average topsoil stripping depth of 1.2 feet (as described in Kendrick ER Section 3.3.5.2 and Table 3.3-1), the total estimated volume of topsoil temporarily stockpiled during past preconstruction activities is estimated to be up to about 81,000 cubic yards, which is only about 4 percent of the estimated volume of topsoil temporarily stockpiled under the Proposed Action (2,000,000 cubic yards, as described in Kendrick ER Section 4.3.1). Potential future delineation drilling may result in stripping and temporarily stockpiling an additional 6,000 cubic yards of topsoil, based on 3 acres of anticipated disturbance and the same estimated topsoil stripping depth of 1.2 feet.

As described in Kendrick ER Section 2.3.4.3, the preconstruction activities when coupled with the Proposed Action would result in a small incremental effect to soils. Potential impacts have been and would continue to be reduced or avoided by implementing the mitigation measures described in Kendrick ER Section 5.3.2, including managing topsoil in accordance with WDEQ/LQD guidelines, separating topsoil from subsoil, revegetating disturbed areas promptly, and implementing storm water management and erosion control best management practices (BMPs). Preconstruction activities also would have a small cumulative impact when added to the small cumulative geology and soils impacts from other past, present, and RFFAs, due to limited disturbance and implementation of mitigation measures.

<u>Surface Water</u>

Potential surface water quality impacts associated with the preconstruction activities are similar to those described for the Proposed Action in Kendrick ER Section 4.4.1.1, but of a much smaller magnitude. Potential impacts include increasing sediment concentrations due to storm water runoff from disturbed areas or increasing other constituent concentrations through accidental spills and leaks or surface water discharges. The potential impacts have been and would continue to be reduced or avoided by implementing the mitigation measures described in Kendrick ER Section 5.4.1, including implementing storm water management and erosion control BMPs, avoiding surface disturbance within incised drainage channels and the 100-year flood inundation area, implementing spill control and cleanup standard operating procedures (SOPs), and adhering to the water quality and quantity limits of the temporary Wyoming Pollutant Discharge Elimination System (WYPDES) permit used for regional baseline aquifer testing. As part of the regional baseline groundwater characterization, Strata conducted three aquifer tests. Groundwater from the aquifer tests was discharged under a temporary WYPDES permit (WYG720359). Table ER RAI GEN-1-1 provides the permit limits and measured results and shows that with the exception of pH, all values were below the permit limits.

As described in Kendrick ER Section 2.3.4.4.1, the preconstruction activities when added to the Proposed Action would result in a small incremental effect to surface water quality, due to the limited disturbance and implementation of mitigation measures. Preconstruction activities also would have a small cumulative impact when added to the small cumulative surface water quality impacts from other past, present, and RFFAs.

Potential surface water quantity impacts associated with preconstruction activities are limited to surface water usage while abandoning exploration and delineation drill holes. Based on the water consumption estimate in the response to ER RAI SW-5 of 500 gallons per abandoned well or drill hole, it is estimated that about 717,500 gallons of surface water were used to plug and abandon 1,435 Strata drill holes within the proposed KEA. This is equal to about 2.2 acre-feet of water, or about 1.3 percent of the annual appropriation amount of the Oshoto Reservoir (172.7 acre-feet per year, as described in the response to ER RAI SW-5). Since this water usage is a small amount compared to the permitted reservoir appropriation and since it would not overlap with surface water usage under the Proposed Action, it would have little or no cumulative impacts on surface water quantity when added to the Proposed Action. Preconstruction activities also would have a small cumulative impact when added to the small cumulative surface water quantity impacts resulting from other past, present, and RFFAs.

<u>Groundwater</u>

Preconstruction activities have had and would continue to have a small potential to impact groundwater quality and quantity within the proposed KEA. Potential impacts to groundwater quality from past and potential future preconstruction activities include potential leaks and spills to the surficial aquifer from construction equipment and drilling fluids, and the potential to mix groundwater from the various zones. Mitigation measures that have been and would continue to be implemented to reduce or avoid potential groundwater quality impacts include implementing spill control and cleanup SOPs, constructing regional baseline monitor wells in accordance with approved procedures and using on-site engineering and/or geologic supervision, and plugging and abandoning drill holes in accordance with approved procedures.

Potential preconstruction impacts to groundwater quantity are also small. Strata conducted three aquifer tests as part of the regional baseline characterization. During the tests, approximately 20,000 gallons of groundwater were removed, as described in Kendrick ER Addendum 3.4-G. Additionally, small amounts of groundwater were removed to obtain representative samples of the regional baseline monitor wells. Assuming the total volume of groundwater consumed by preconstruction activities was approximately 30,000 gallons, this represents only about 0.06 percent of the annual operational water usage assuming a 1.25 percent bleed at the maximum licensed recovery flow rate of 7,500 gpm.

Due to the limited potential for groundwater quality impacts, implementation of mitigation measures to protect groundwater quality, and very minor impact on groundwater quantity, preconstruction activities would have a small incremental impact on groundwater when coupled with the Proposed Action. As described in Kendrick ER Section 2.3.4.4.2, preconstruction activities are also anticipated to have a small incremental impact when added to the cumulative groundwater impacts from other past, present, and RFFAs.

Ecology

Potential impacts associated with the preconstruction activities are similar to those described for the Proposed Action in Kendrick ER Section 4.5.1, but of a much smaller magnitude. These include short-term loss of vegetation, increased potential for non-native species invasion, changes in vegetative density, and direct and indirect impacts to wildlife. The potential impacts have been and would continue to be mitigated by phasing activities, restoring and re-seeding disturbed areas promptly, and using existing roads where possible. Figure ER RAI GEN-1-1 shows that vegetation impacted from past preconstruction activities within the proposed KEA has been largely reestablished.

As previously stated, past preconstruction activities have disturbed approximately 42 acres, and future delineation drilling may disturb up to 3 acres, for a total of 45 acres, or 0.6 percent of the proposed KEA. When coupled with the Proposed Action, this would result in a small incremental effect to vegetation. The practical impacts would not be additive, since the drill hole development and reclamation are phased such that little residual impacts remain today from preconstruction activities that occurred primarily in 2011-2012. As described in Kendrick ER Section 2.3.4.5, preconstruction activities would have a small cumulative impact when added to the small to moderate cumulative vegetation and wildlife impacts from other past, present, and RFFAs.

Air Quality

Preconstruction activities have had and would continue to have a small potential to impact air quality within the proposed KEA. Potential impacts to air quality from preconstruction activities include fugitive dust and combustion emissions. Regarding fugitive dust, Table ER RAI AIR-1-3 in the response to ER RAI AIR-1 shows that the maximum exposed acreage used to prepare fugitive dust emission rates for the Proposed Action is 705.3 acres. By comparison, preconstruction activities are estimated to have disturbed or have the potential to disturb up to 45 acres over several years. Assuming a maximum of 20 acres would have been disturbed at any one time, the resulting fugitive dust emissions would be less than 3 percent of the maximum emissions estimate for the Proposed Action described in the response to ER RAI AIR-1.

The combustion emissions from preconstruction activities also would be significantly less than the maximum emission estimates for the Proposed Action presented in response to ER RAI AIR-1, as summarized in Table ER RAI AIR-1-1. The emissions inventory for the Proposed Action assumes 12 drill rigs operating 8 hours per day for

139 days per year during construction, for a total of 13,376 operating hours per year. As part of the preconstruction activities, Strata estimates that each of the 1,435 exploration and delineation drill holes required one drill rig operating 8 hours. Since most of the past preconstruction drilling activities were completed over a 2-year period, up to 718 drill holes are estimated to have been completed each year, for a total of 5,744 operating hours per year. This is approximately 43 percent of the hours used for the emissions inventory. The maximum operating hours for future preconstruction activities would be about 800 hours per year, or approximately 6 percent of the hours used for the emissions inventory.

Consistent with Kendrick ER Section 2.3.4.6, the preconstruction activities when coupled with the Proposed Action would result in a small incremental effect to air quality. Preconstruction activities also would have a small cumulative impact when added to the small cumulative air quality impacts from other past, present, and RFFAs.

Noise

Potential noise impacts associated with the preconstruction activities are similar to those described for the Proposed Action in Kendrick ER Section 4.7.1 and include short-term impacts to nearby residences. The potential impacts have been and would continue to be mitigated by implementing a speed limit policy for Strata employees and contractors and restricting drilling activities to daytime hours (6 a.m. to 8 p.m.).

Most preconstruction drilling activities have taken place well inside the proposed KEA boundary, and the noise levels from drilling activities have seldom exceeded the annoyance noise threshold of 55 dBA. Figure ER RAI GEN-1-2 shows the drill holes and regional baseline monitor wells completed by Strata within the proposed KEA. The nearest drill hole to a residence is 1,231 feet away, which is estimated to have resulted in a drill rig noise level of 24-46 dBA, based on the equation in Kendrick ER Section 4.7.1.1.1. Recognizing that backhoes and other equipment could result in higher short-term noise levels at the drill site, as described in the response to ER RAI NOI-1, the maximum noise level at the nearest residence resulting from drilling activities at the nearest drill site may have been above the annoyance noise threshold. However, this equipment would not have operated for more than a short duration, and only a few of the preconstruction drill holes were within even half a mile of a residence. Future preconstruction activities would likely be confined to areas along the ore trends that have been delineated previously and would be expected to result in similarly small potential noise impacts. Consistent with Kendrick ER Section 2.3.4.8, the preconstruction activities would have a small potential noise impact that would not generally overlap with the Proposed Action. Preconstruction activities also would have a small cumulative impact when added to the small cumulative noise impacts from other past, present, and RFFAs, since noise would be localized and short term.

Historic and Cultural Resources

The potential impacts to historic and cultural resources from preconstruction activities are similar to those described in Kendrick ER Section 4.8.1.1 and include both direct (disturbing an historic property) and indirect (visual and audible intrusions) impacts. Potential direct impacts have been and would continue to be mitigated by adhering to Strata's Unanticipated Discovery Plan (UDP). The UDP was provided to the NRC as part of the Environmental Management Program (EMP) that was reviewed during the preoperational inspection. The UDP ensures that any cultural resource materials such as artifacts, sites, human remains, or any other cultural resources eligible, or potentially eligible, for listing on the National Register of Historic Places (NRHP) that are discovered by Strata in the course of activities are properly identified and protected. Potential indirect impacts would be short lived due to the temporary nature of preconstruction disturbance and lack of any resulting surface facilities. As stated in Kendrick ER Section 4.8.1.1, the opportunities for potential adverse effects to historic and cultural resources in the proposed KEA are less than in the current Ross license area due to decreased overlap between the mineralization and stream drainages that host the majority of potentially eligible historic resources.

As described in Kendrick ER Section 2.3.4.9, preconstruction activities would have a small incremental effect on the Proposed Action, since Strata would adhere to the UDP and LC 9.8 of SUA-1601, which includes a stop-work provision. The preconstruction activities also would have a small cumulative impact when added to the historic and cultural resources impacts from other past, present, and RFFAs.

Visual Resources

Potential impacts to visual resources from preconstruction activities are similar to those described in Kendrick ER Section 4.9.1.1 and include visible construction equipment at drill sites (drill rigs, water trucks, backhoes, supply trailers, and passenger vehicles) and dust generated from construction equipment. As stated in Kendrick ER Section 4.9.1.1, a typical truck-mounted drill rig is about 30-40 feet tall. To reduce potential visual impacts, Strata limits drilling to daytime hours in the vicinity of residences and promptly revegetates disturbed areas. Figure ER RAI GEN-1-2 depicts the location of preconstruction drilling in relation to nearby residences. The figure shows that the vast majority of drilling occurred more than a mile from the nearest residence. Due to distance and topography, most of this drilling was not likely visible from any nearby residence.

Consistent with the evaluation in Kendrick ER Section 2.3.4.10, the potential visual resource impacts from past and potential future preconstruction activities when coupled with the Proposed Action would have a small incremental effect, since drilling and other baseline characterization activities were phased, distributed throughout the proposed KEA, and distant from residences. Preconstruction activities also would have a small cumulative impact when added to the small cumulative visual resource impacts from other past, present, and RFFAs.

Socioeconomics

As described in Kendrick ER Section 2.3.4.11, preconstruction activities within the proposed KEA have resulted in and would continue to result in small potential socioeconomic impacts due to the limited number of contractors and materials required for monitor well installation, exploration/delineation drilling, and other baseline characterization activities. Preconstruction activities also would have a small impact to socioeconomics within the proposed KEA and a small incremental effect on regional cumulative socioeconomic impacts.

Public and Occupational Health

Potential impacts to public and occupational health from preconstruction activities are similar to those described in Kendrick ER Section 4.12.1.1 and include those from fugitive dust, combustion emissions, noise, and occupational hazards associated with drilling. Based on the low levels of radionuclides in soil, fugitive dust would not contribute a significant dose. Refer to the response to ER RAI GEO-4, which describes a study at the Lost Creek ISR Project showing that direct gamma readings produced from drill cuttings and mud pits were indistinguishable from background. Potential impacts from fugitive dust have been and would continue to be mitigated by limiting the area of disturbance and reclaiming and re-seeding disturbed areas. Potential noise impacts have been and would continue to be mitigated by adhering to Strata's hearing conservation program. Potential occupational injuries have been and would continue to be reduced or avoided by implementing worker safety procedures and training.

Consistent with the evaluation in Kendrick ER Section 2.3.4.13, the potential public and occupational health impacts from past and future preconstruction activities when coupled with the Proposed Action would have a small incremental effect. Preconstruction activities also would have a small cumulative impact when added to the potential impacts from other past, present, and RFFAs.

Waste Management

Preconstruction activities have had and would continue to have a small potential to impact waste management within the proposed KEA. Wastes generated from preconstruction activities include non-AEA-regulated solid waste and TENORM comprised of drilling fluids, drill cuttings, and regional baseline aquifer testing water. Non-AEA-regulated solid waste typically included up to 5 cubic yards per week of construction debris and less than 1 cubic yard per week of petroleum contaminated soil, which are consistent with the quantities shown in Kendrick ER Table 4.13-1. Solid waste was and would continue to be removed from the proposed KEA by the drilling contractor and disposed at an appropriately permitted landfill. Due to the small quantities of solid waste generated and the fact that all solid waste from past preconstruction activities has already been disposed, the potential cumulative impacts of solid waste management when coupled with the Proposed Action are small. TENORM generated from each well or drill hole includes approximately 6,000 gallons of drilling fluid and 15 cubic yards of drill cuttings. Therefore, past preconstruction activities generated about 8.9 million gallons of drilling wastewater and approximately 22,000 cubic yards of drill cuttings. As described previously in this response, the regional baseline aquifer tests within the proposed KEA also generated approximately 20,000 gallons of water that was discharged under a temporary WYPDES permit. Future preconstruction activities may generate up to 0.6 million gallons of drilling wastewater and 1,500 cubic yards of drill cuttings. Drilling fluids and drill cuttings have been and would continue to be disposed in mud pits excavated at each drill hole or monitor well. Refer to the response to ER RAI GEO-4 for additional information on potential impacts related to these disposal methods.

As described in Kendrick ER Section 2.3.4.14, preconstruction activities would have a small incremental effect on waste management when coupled with the Proposed Action, since wastes would be disposed appropriately. The preconstruction activities also would have a small cumulative impact when coupled with other past, present, and RFFAs, due to the relatively small quantity of waste generated and use of approved disposal methods.

Table ER RAI GEN-1-1. Temporary WYPDES Permit Effluent Limits and Reported Concentrations during Regional Baseline Aquifer Testing

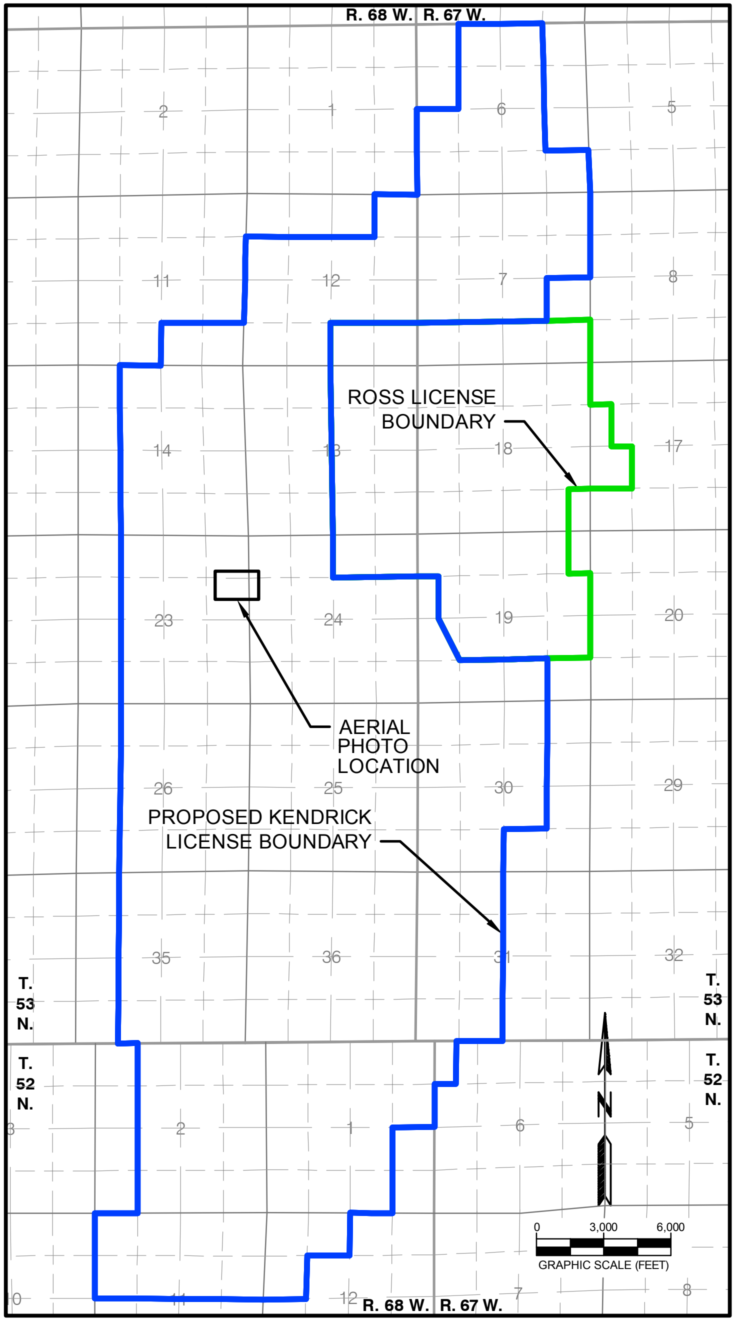
Parameter	***Limit***	**Outfall 003**	**Outfall 008**	**Outfall 011**
Duration of Discharge (days)	*31*	2	2	4
pH (s.u.)	*6.5-9.0*	8.8-9.2	8.9	9.1-9.2
Total Suspended Solids (mg/L)	*90*	ND	ND	16
Total Dissolved Solids (mg/L)	*5,000*	1,210	1,000	860
Total Uranium (mg/L)	*4.0*	0.0096	0.0107	0.0341
Total Recoverable Radium-226 (pCi/L)	*60*	ND	ND	2.3

ND – Not measured above detection limits

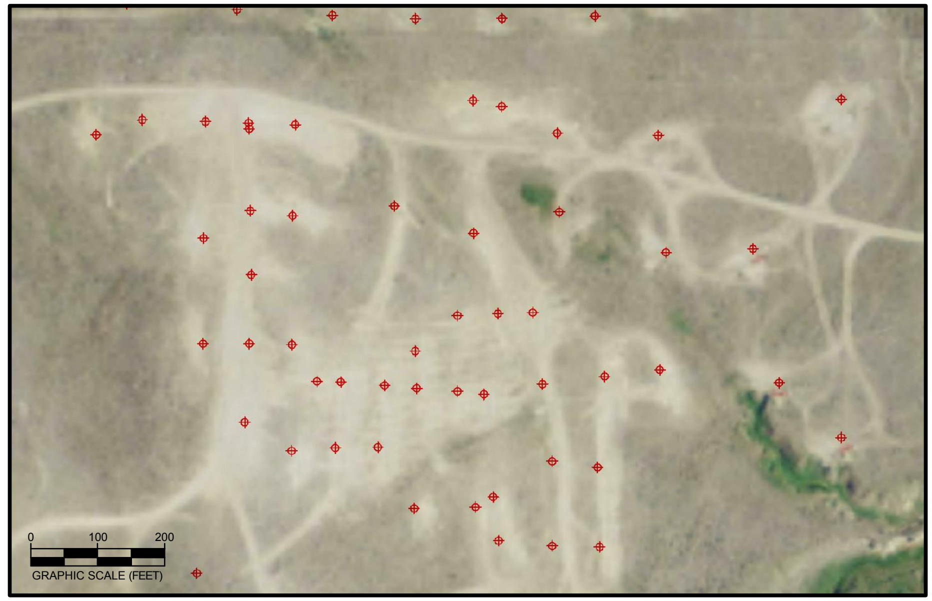
Figure ER RAI GEN-1-1. Strata Drill Holes on NAIP Aerial Photography

Kendrick Expansion Area

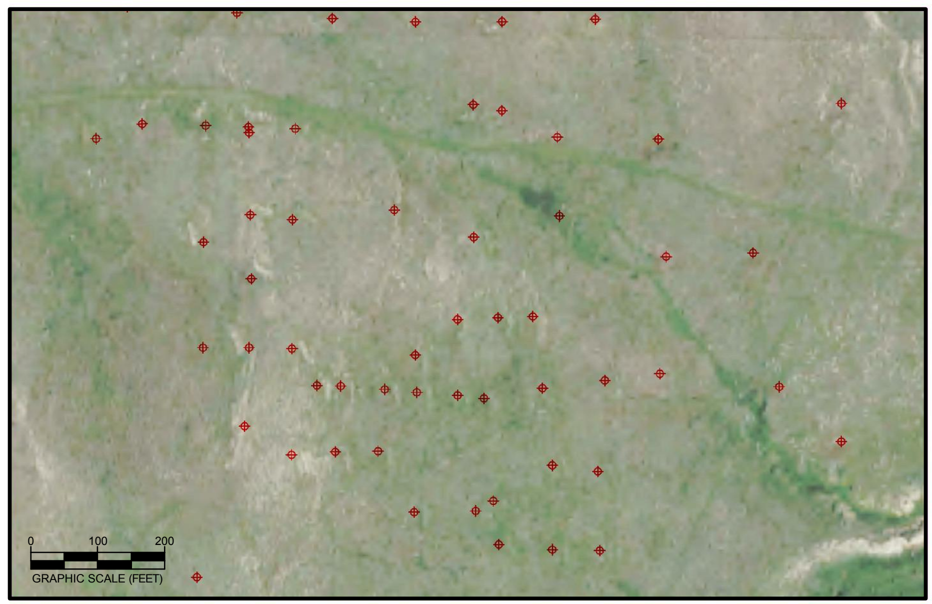
SUA-1601 Amendment Application



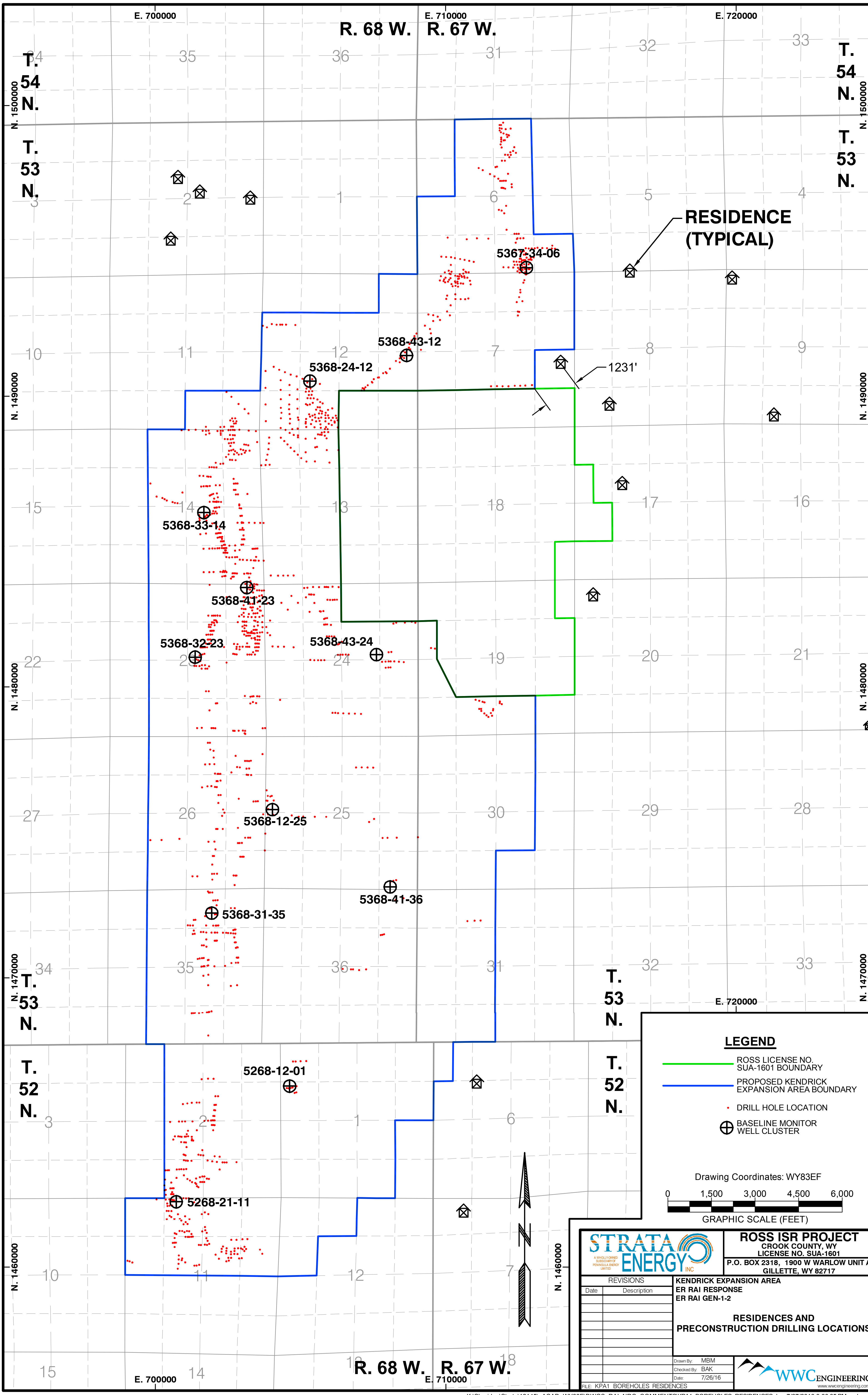
Location Map



Drill Holes on 2012 NAIP Aerial Photography



Drill Holes on 2015 NAIP Aerial Photography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N. 1480000
N. 1470000
N. 1460000
RESIDENCE (TYPICAL)
1231'
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5368-12-25
5368-41-36
5368-31-35
5268-12-01
5268-21-11
LEGEND
ROSS LICENSE NO. SUA-1601 BOUNDARY
PROPOSED KENDRICK EXPANSION AREA BOUNDARY
DRILL HOLE LOCATION
BASELINE MONITOR WELL CLUSTER
Drawing Coordinates: WY83EF
0 1,500 3,000 4,500 6,000
GRAPHIC SCALE (FEET)
STRATA ENERGY INC
ROSS ISR PROJECT
CROOK COUNTY, WY
LICENSE NO. SUA-1601
P.O. BOX 2318, 1900 W WARLOW UNIT A
GILLETTE, WY 82717
REVISIONS
Date
Description
KENDRICK EXPANSION AREA
ER RAI RESPONSE
ER RAI GEN-1-2
RESIDENCES AND
PRECONSTRUCTION DRILLING LOCATIONS
Drawn By: MBM
Checked By: BAK
Date: 7/26/16
WWC ENGINEERING
FILE: KPA1_BOREHOLES_RESIDENCES
K:\Sheridan\Strata\12145_ACAD_WY83E\DWGS_RAI_NRC_COMMENTS\KPA1_BOREHOLES_RESIDENCES.dwg 7/27/2016 3:30:35 PM mal mcgill

RAI – GEN-2 Cumulative Impacts

The Kendrick ER mostly references the cumulative impacts analysis in the Ross Supplemental Environmental Impact Statement (SEIS). The estimated acreage of the Kendrick project area and duration of the project period for the entire Lance District in the Ross ER and Ross SEIS differ from that in the Kendrick amendment. To facilitate the staff's update of the cumulative impacts analysis, provide more information about the current plans for the region:

A. *Update the information provided on potential development in the Lance District with more detail. This should include the potential schedule, staffing (number, new and/or existing workers), and disturbed acreage for Barber; the approximate location of the satellite facility; and an evaluation of how the schedule overlaps with Ross and Kendrick (if this is not already accounted for in Kendrick ER Figure 2.3-2 as Barber is now the only other "Potential Future Production within the Lance District").*

ER RAI GEN-2(A) Response

Peninsula Energy has not released any additional information on the Barber Project since submittal of the Kendrick ER. The information provided in Kendrick ER Section 2.3.2.1.1 provides the most current information on potential schedule, staffing, and disturbed acreage. The potential location of the Barber Satellite Facility remote IX plant has not yet been determined.

RAI – GEN-2 Cumulative Impacts

The Kendrick ER mostly references the cumulative impacts analysis in the Ross Supplemental Environmental Impact Statement (SEIS). The estimated acreage of the Kendrick project area and duration of the project period for the entire Lance District in the Ross ER and Ross SEIS differ from that in the Kendrick amendment. To facilitate the staff's update of the cumulative impacts analysis, provide more information about the current plans for the region:

B. An announcement made by Strata's parent company, Peninsula Energy Ltd, on July 15, 2015, indicated that Strata and Royal USA Inc. have entered into an agreement to acquire the Hauber Project in the Lance District. In this announcement, Peninsula Energy states "Given the high historic mining grade and its proximity to the Lance Projects' Central Processing Plant (CPP), Peninsula has identified Hauber as a strategic regional opportunity that has the potential to be developed as a future satellite operation.…" Provide a time line for this potential opportunity and information about the Hauber Project similar to the information requested and supplied for Barber.

ER RAI GEN-2(B) Response

The most recent update on the Hauber Project was provided in Peninsula Energy's September 2015 Quarterly Activities Report (Peninsula Energy 2015). The report indicates that "under the terms of the Agreement Peninsula acquired 41 mineral claims located approximately 15 miles to the north-northeast of the Lance Projects." The report also indicates that "Peninsula intends to conduct a detailed analysis of the acquired data and will develop an exploration and delineation drilling program for future execution," although the immediate focus is on the completion of construction and commissioning of the Lance Projects. Information on potential schedule, staffing, and disturbed acreages is not available at this time. Kendrick ER Section 2.3.2.1.2.2 provides information on the proximity of the Hauber Project to the proposed KEA and potential transportation routes.

RAI – GEN-2 Cumulative Impacts

The Kendrick ER mostly references the cumulative impacts analysis in the Ross Supplemental Environmental Impact Statement (SEIS). The estimated acreage of the Kendrick project area and duration of the project period for the entire Lance District in the Ross ER and Ross SEIS differ from that in the Kendrick amendment. To facilitate the staff's update of the cumulative impacts analysis, provide more information about the current plans for the region:

C. *Indicate the reason that Richards is no longer being considered as an expansion area, such as technical reasons for unsuitability or that it is being combined with Barber. A comparison of Kendrick ER Figure 2.3-1 and Ross SEIS Figure 2.2 seems to indicate that Barber may include Richards, as well as some area to the north and west of Kendrick not previously considered in the Ross SEIS. Clarify the extent of potential future development in the Lance District.*

ER RAI GEN-2(C) Response

In accordance with 40 CFR § 1508.7, the Kendrick ER evaluated the past, present, and RFFAs and found that within the Lance District, the Barber Project is the only RFFA. A presentation released by Peninsula Energy on July 12, 2016, indicates that the Lance District has the potential for "70+ years of mine life" (Peninsula Energy 2016a). A figure in the presentation depicts numerous projects throughout the Lance District, including Richards; however, at this time these projects are speculative, since resources in these projects have only been partially explored and have not been systematically tested. In addition, there are no proposals or commitments for the resources within these projects at this time.

RAI – GEN-2 Cumulative Impacts

The Kendrick ER mostly references the cumulative impacts analysis in the Ross Supplemental Environmental Impact Statement (SEIS). The estimated acreage of the Kendrick project area and duration of the project period for the entire Lance District in the Ross ER and Ross SEIS differ from that in the Kendrick amendment. To facilitate the staff's update of the cumulative impacts analysis, provide more information about the current plans for the region:

D. Kendrick ER Section 2.3.2.2.2 states that Strata is not aware of any major expansions or new coal mines proposed within 50 miles of Kendrick. Similarly, Kendrick ER Section 2.3.2.2.3 states that Strata is not aware of any plans for future oil and gas production activities near Kendrick. However, the ER does not identify any agencies contacted or the research done to draw these conclusions. Clarify the justification for these conclusions.

ER RAI GEN-2(D) Response

The statement in Kendrick ER Section 2.3.2.2.2 that Strata is not aware of any major expansions or new coal mines proposed within 50 miles of proposed KEA is based on the Task 2 Report of the Powder River Basin Coal Review (U.S. Bureau of Land Management [BLM] 2011). The report provides projected coal development through 2030 and indicates that coal development will be in the form of expansions of existing coal mines. The basis for the projected production ranges included: 1) an analysis of historic Powder River Basin (PRB) production levels in comparison to the gross domestic product (GDP) and national coal demand; 2) an analysis of current PRB coal market forecasts against other coal-producing regions in the United States, and mining and transportation costs of PRB coal as compared with demand and other coal-producing regions; 3) the availability, projected production cost, and quality of future mine-specific coal reserves within the PRB region; and 4) the availability of adequate infrastructure for coal transportation.

Based on recent declines in PRB coal production and mine layoffs, it appears that the potential for significant expansion of PRB coal mining is less likely now than what was evaluated in the PRB Coal Review. Since 2009, coal production and coal prices have generally declined (BLM 2016). Reflecting this, Peabody Energy recently announced that it would cut about 235 hourly and salaried employees, or about 15 percent of its workforce at its North Antelope/Rochelle Mine (Peabody Energy 2016). In its news release, Peabody Energy said it was doing so because of an oversupply of natural gas and warmer weather that has reduced the demand for coal. In similar moves, more than 200 workers were laid off from the Black Thunder Mine and additional coal mining jobs were terminated at other mines, bringing the total estimated layoffs at Wyoming PRB mines to 600 as of June 2016 (Johnson 2016).

The statement in Kendrick ER Section 2.3.2.2.3 that Strata is not aware of any plans for future oil and gas production activities near the proposed KEA is based on information described in Kendrick ER Section 3.1.12, which indicates that oil production in the area has been declining, and the proposed KEA does not overlie any coal seams targeted for coal bed natural gas (CBNG) production. This information is further confirmed in a summary report on Wyoming's Oil and Gas Resources, published by the Wyoming State Geological Survey in February 2015. The report states that Wyoming's oil and gas production will continue to be impacted by national and world energy markets (WSGS 2015). As of the report, there were nine oil and gas development areas seeking permits from the BLM, none of which is located in Crook County, Wyoming. Even if coal seams were near the proposed KEA, the likelihood of natural gas or CBNG production is small, since production within the PRB has been declining since 2009 due to low gas prices, depleted CBNG reservoirs, and competition from large unconventional gas plays outside of the region (WSGS 2014).

RAI – GEN-3 Permit Updates

Kendrick ER Table 1.5-1 identifies necessary environmental approvals and status of each with corresponding Federal and State agencies. These approvals are needed before operations can commence. Following the submission of the license application to the NRC, Strata has continued to prepare, submit, and receive approval on these permits. Therefore, update ER Table 1.5-1 with the current status of proposed, pending, and approved licenses and permits for Kendrick.

ER RAI GEN-3 Response

Table 1.5-1 has been updated to show the current status of proposed, pending, and approved licenses and permits for the proposed KEA as of the time of this submittal. The revised table is included with this response.

Table 1.5-1. Summary of Proposed, Pending and Approved Licenses and Permits for the Kendrick Expansion Area

Regulatory Agency	Permit or License	Status
Federal		
NRC	Source and 11e.(2) Byproduct Material License	SUA-1601 issued April 24, 2014
	KEA Amendment	This application
USACE	Verification of Preliminary Wetlands Delineation	Verification received March 21, 2016
	Nationwide Permit Coverage Authorization	To be prepared – as necessary
State		
WY State Land & Farm Loan Office	Uranium Minerals Mining Lease	Approved: #0-40871 #0-40991
WDEQ/AQD	Air Quality Permit	Approved September 13, 2011, Permit #CT-12198. Will be modified to include the proposed KEA.
WDEQ/LQD	Permit to Mine	Approved, November 16, 2012, Permit #802. Permit amendment application submitted April 14, 2015.
	Mineral Exploration Permit/Drilling Notification	Approved #DN384 and #DN397
WDEQ/WQD	Stormwater WYPDES Permit (construction)	Approved January 17, 2013, Permit #WYR104738. Will be modified to include the proposed KEA.
	Stormwater WYPDES Permit (industrial)	Approved July 19, 2016, Permit #WYR001448.
	Temporary WYPDES Permit (discharge during well testing)	Approved October 21, 2014, Permit #WYG720359. Permit terminated after aquifer tests; new permit will be acquired for mine unit-specific aquifer tests.
WSEO	Permit to Appropriate Groundwater for ISR Wellfield	To be prepared
County		
Crook County	County Development Permits (access road approach and emergency services agreement)	Memorandum of Understanding (MOU) executed April 6, 2011, revised August 5, 2013. May be modified to include the proposed KEA.

RAI – GEN-4 Vanadium

The Ross application and SEIS describe both uranium and vanadium processing taking place at the Ross CPP. Clarify whether vanadium would also be removed from the Kendrick resin, and, if not recovered as a resource, how it is handled as a waste.

ER RAI GEN-4 Response

Vanadium recovered from wellfields within the proposed KEA will be removed from the ion exchange (IX) resin during the elution process, in the same manner as vanadium loaded on the IX resin from wellfields within the current Ross license area. Vanadium is eluted along with uranium and may be recovered as a resource, as described in the approved Ross license application, or managed as a waste. Under current and foreseeable market conditions, the vanadium is handled as a waste. Following elution from the IX resin, the eluant containing uranium and vanadium is processed through the precipitation circuit. Through process chemistry controls, the uranium is preferentially precipitated, while the vanadium remains in solution and is disposed with the liquid waste stream from the precipitation circuit.

RAI – GEN-5 Current Ross Activities

The Kendrick ER indicates that the pregnant lixiviant will be piped to the CPP, where it will go through the ion exchange process resulting in loaded resin, which will then be further processed at the Ross CPP into yellowcake before being shipped to a uranium conversion facility. However, it is the NRC's understanding that the Ross CPP is currently not operational for processing to yellowcake and that the loaded resin resulting from Ross operations is going to another site. Provide the current schedule for the CPP to become fully operational and indicate whether Strata plans to have the resin generated from activities at Kendrick processed to yellowcake at the Ross CPP or whether it will also be shipped off site. Describe where the resin is currently being shipped and details related to the transportation of that resin (e.g., frequency, size). This information is needed to establish the scope of activities and analyze impacts.

<u>ER RAI GEN-5 Response</u>

The Ross CPP is currently designed to process approximately one half of the licensed flow (i.e., 3,750 gpm) through an IX circuit. The IX process removes the uranium as described in the approved Ross license application. After passing through the IX circuit, lixiviant is then refortified with carbon dioxide, sodium bicarbonate, and oxygen and reinjected into the wellfield. Once the IX resin is loaded with uranium, it is shipped to Uranium One's Willow Creek ISR Project (formerly the Irigaray Ranch facility) in Johnson County, Wyoming. Uranium One elutes the resin, which is then returned to the Ross site for reuse in the IX circuit. Uranium One precipitates and dries the Ross uranium. Uranium One is licensed to receive and process loaded IX resin under NRC license SUA-1341.

The number of loaded IX shipments to Uranium One is dependent on the total flow rate through the Ross CPP and the uranium content in the production solution. Based on the licensed flow rate of 7,500 gpm, Section 2.1.3.7 of the Ross ER estimated an annual production rate of 750,000 pounds of U_3O_8. Based upon experience gained from loaded IX resin shipments at the Ross ISR Project from June and July 2016, the average quantity of uranium per shipment was 3,570 pounds. With an annual production of 750,000 pounds, Strata projects approximately 210 shipments per year, or approximately 17 to 18 shipments per month. Each shipment involves transporting the resin 200 miles round trip.

Strata has adopted a staged and scalable development plan for the Ross ISR Project that includes three stages of buildout for the CPP. Stage I includes construction of a portion of the CPP building to accommodate six IX columns and processing equipment with the capacity to process 3,750 gpm of pregnant lixiviant. Uranium-rich resin is shipped off-site for processing, as Stage I facilities do not include elution, precipitation, and drying circuits. The annual production rate for Stage I is 500,000 to 700,000 pounds U_3O_8. Stage II will include the expansion of the CPP building to accommodate an additional six IX columns as well as equipment for elution, precipitation, and drying and packaging. Stage III will include equipment necessary to expand the capacity of the elution, precipitation, and drying circuits. Stages II and III are planned to increase the annual production rate to 1,200,000 and 2,300,000 pounds U_3O_8, respectively (Peninsula Energy 2014).

Stage I construction was completed late in 2015, with production commencing at the Ross ISR Project in December 2015. The construction schedule of Stage II and Stage III facilities is uncertain and will depend on market conditions.

It is currently planned that Stage II construction of the Ross CPP will be completed before uranium recovery operations commence in the proposed KEA. However, since the timing of construction and commissioning of Stage II is market-based, uranium recovered from the proposed KEA may be loaded on IX resin at the Ross CPP and shipped to Uranium One for elution and further processing.

RAI – GEN-6 Mine Unit Overlap

Kendrick ER Figure 2.1-1 depicts the Kendrick mine units. Several of the units appear to overlap into Ross:

A. *One of the units overlaps into the south central part of Ross. Based on this figure, it does not appear to be one of the lettered mine units identified for Kendrick. Confirm that this mine unit is covered in the Kendrick application (e.g., in terms of impacted acreage, schedule) and identify the mine unit that includes it.*

ER RAI GEN-6(A) Response

The wellfield referenced is not within one of the lettered mine units identified within the proposed KEA. This wellfield would be constructed and operated as part of the southernmost mine unit developed within the current Ross license area. The construction, operation, aquifer restoration, and decommissioning timelines for this portion of wellfield are represented as part of the Ross Project in the proposed project schedule in Kendrick ER Figure 1.4-1. The portion of this mine unit and support facilities that lies within the proposed KEA is accounted for in the disturbance estimate in Kendrick ER Tables 1.3-1 and 4.1-1.

RAI – GEN-6 Mine Unit Overlap

Kendrick ER Figure 2.1-1 depicts the Kendrick mine units. Several of the units appear to overlap into Ross:

> *B. A second mine unit overlaps into the northeastern part of Ross. Confirm that this is part of Mine Unit B, as appears to be indicated in Kendrick ER Figure 2.1-1.*

ER RAI GEN-6(B) Response

The wellfield that overlaps into the northwestern portion of the current Ross license area is part of the proposed KEA Mine Unit B; however, only the wellfield and support facilities that are within the proposed KEA are accounted for in the disturbance estimate in Kendrick ER Tables 1.3-1 and 4.1-1.

RAI – GEN-6 Mine Unit Overlap

Kendrick ER Figure 2.1-1 depicts the Kendrick mine units. Several of the units appear to overlap into Ross:

C. *The perimeter monitor well ring for a wellfield in Mine Unit D also appears to overlap into the southeastern portion of Kendrick. Indicate whether the impacts (e.g., disturbed acres) associated with the portion overlapping into Ross are covered in the Kendrick ER.*

ER RAI GEN-6(C) Response

Only facilities proposed within the proposed KEA were accounted for in the disturbance estimate in Kendrick ER Tables 1.3-1 and 4.1-1. The small area of disturbance from perimeter monitor wells and tertiary access roads within the southwestern portion of the current Ross license area are not accounted for in the disturbance estimate in Kendrick ER Tables 1.3-1 and 4.1-1. Based on the length of the perimeter monitor well ring extending into the current Ross license area of approximately 1,350 feet and the typical spacing of 400 feet between perimeter monitor wells, up to four perimeter monitor wells associated with KEA Mine Unit D may be constructed within the current Ross license area. As described in the ER RAI GEN-1 response, the typical surface disturbance associated with monitor well construction is 1,250 square feet per well, or 5,000 square feet (0.1 acre) for four wells. Since the summary of land disturbance for the Ross ISR Project presented in Ross SEIS Table 4.1 presents the anticipated disturbance in whole hectares and acres, the addition of 0.1 acre (0.06 hectare) does not change the previous estimates.

RAI – GEN-7 Impacts of Current Ross Operations

Operations at Ross commenced in December 2015. Now that several months of operations have occurred, Strata is likely accumulating data on actual operations. Because the Kendrick ER relies heavily on many of the assumptions made about Ross for the Ross SEIS, identify any changes in operational parameters that would indicate that one or more of the assumptions made in the Ross SEIS may have been underestimated and provide updated estimates. For example, the Ross SEIS provides assumptions for waste generation rates for various operations and waste types, which are assumed to remain the same during Kendrick operations. If actual operational data indicate that these assumed waste generation rates should be greater, then indicate new bounding waste generation rates.

ER RAI GEN-7 Response

The Ross ISR Project is in the early stages of production ramp up. Stage I will include seven module buildings with equipment to process a maximum flow rate of 3,750 gpm. Four header houses are currently online with the remainder for Stage I to be added by the end of 2016 (Peninsula Energy 2016b). Due to the short operational history and production ramp up, there is no information at this time that would indicate that any of the operational assumptions made in the Ross SEIS or Kendrick ER were underestimated. As expected due to production ramp up, waste generation rates are lower than estimated in the Ross SEIS and Kendrick ER. Within roughly 8 months of operation, less than 20 cubic yard of solid 11e.(2) byproduct material have been generated. 11e.(2) liquid waste is being disposed at a rate of approximately 10.7 gpm. These rates are well below the estimates presented in Ross SEIS Table 4.10, which are based on the maximum licensed flow rate of 7,500 gpm (100 cubic yards/year of solid 11e.(2) byproduct material and 62 gpm for brine and other liquid byproduct waste). Refer to the response to ER RAI WM-3(B) for additional information on actual versus anticipated waste generation rates for the Ross ISR Project.

RAI – GEN-8 Figures

Please provide the electronic files for the figures included in the Kendrick ER. For maps, include either the native CAD files or the shapefiles/layers for input into ArcGIS. In particular, provide the native CAD/shape files for ER Figures 2.1-1, 3.5-2, 3.5-3, and 4.4-1. Having the information electronically would enable the NRC to identify (highlight) certain elements of interest and look at overall spatial distributions of associations.

ER RAI GEN-8 Response

Included in Appendix A to this ER RAI response package are electronic files for the figures in the Kendrick ER as drawings (.dwg files) with the script file executed and external reference files inserted into each drawing. Each drawing is provided in native CAD (AutoCAD) format. Any notes or extraneous text were deleted. Drawings that reference USGS topography are provided with the reference files detached.

RAI – GEN-9 References

Please provide the following documents referenced in the Kendrick ER:

- *Effluent monitoring program required under License Condition (LC) 10.9.*
- *Application for and Wyoming Pollutant Discharge Elimination System (WYPDES) permit for surface discharge of excess permeate.*
- *Whicker, R., P. Cartier, J. Cain, K. Milmine, M. Griffin, 2008, Radiological Site Characterizations: Gamma Surveys, Gamma/Ra-226 Correlations and Related Spatial Analysis Techniques. Operational Radiation Safety, Health Physics, Vol. 95, Supplement 5: S180-S189, November 2008.*
- *WSGS (Wyoming State Geological Survey), 2010, The Origin of Uranium Deposits, by Robert Gregory.*
- *Crook County 2014b, unpublished traffic counts on Crook County roads, provided to WWC Engineering in 2014.*
- *WYDOT (Wyoming Department of Transportation), 2015, unpublished traffic projections for I-90 at Moorcroft, provided to WWC Engineering in 2015.*
- *WYDOT (Wyoming Department of Transportation), 2014b, traffic counts on I-90, 2008 through 2013, provided to WWC Engineering in 2014.*

ER RAI GEN-9 Response

The requested references are included in Appendix B to this RAI response package except for the effluent monitoring program, WYPDES application permit, Whicker et al. 2008 and WSGS 2010. The effluent monitoring program required under LC 10.9 is described in Strata's Environmental Management Program (EMP), which was reviewed by NRC staff during the Ross ISR Project preoperational inspection (NRC 2016, pp. 11-12). In addition, Strata does not plan on using surface discharge for disposal of excess permeate at this time and therefore has not submitted an application for a WYPDES permit. Whicker et al. 2008 is available on the Health Physics Society Website with membership credentials. WSGS 2010 is no longer available at the website listed in the reference section of the Ross ER and is also currently unavailable directly from either the WSGS or University of Wyoming.

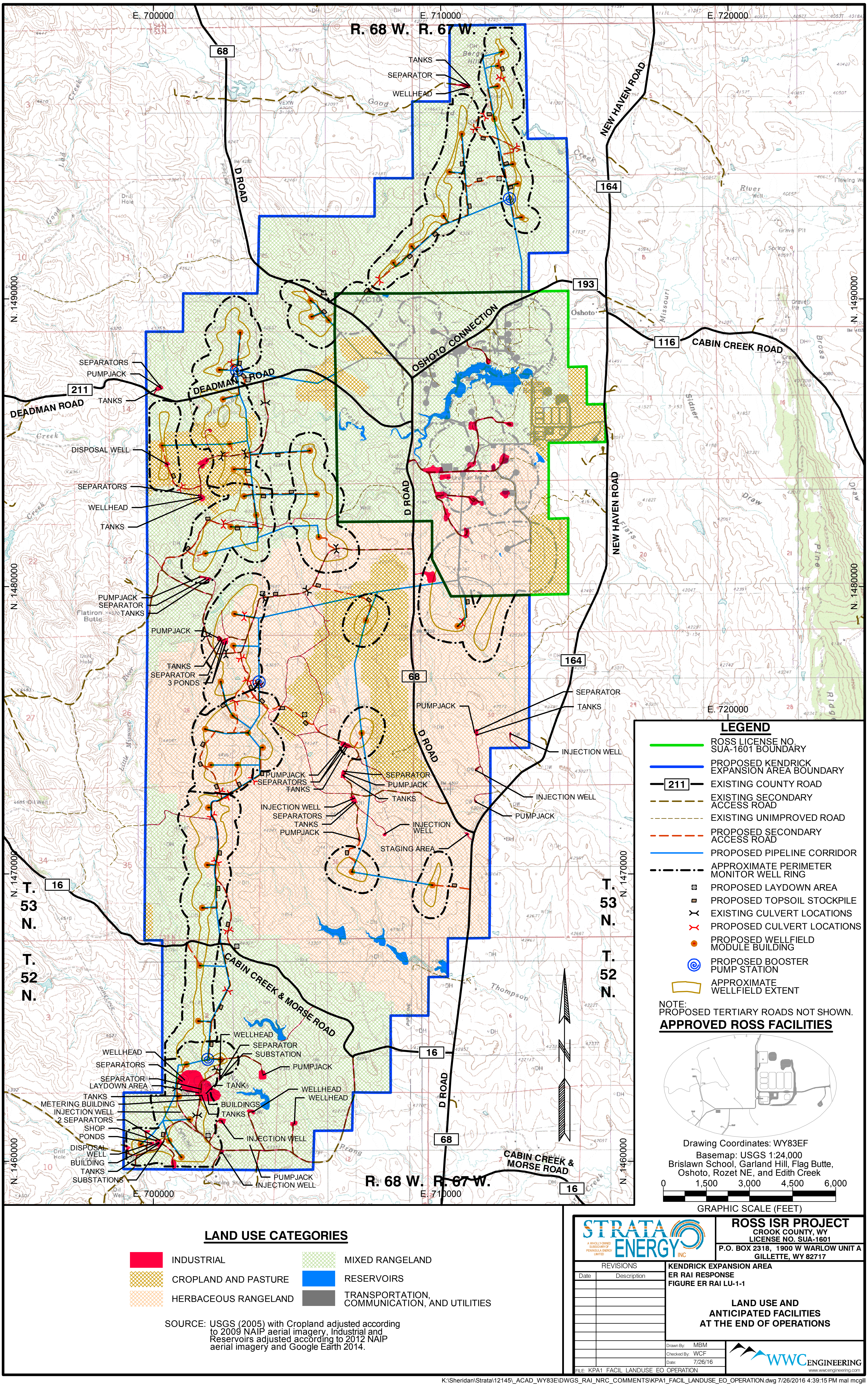
Land Use

RAI – LU-1 View of the Proposed Facility

In its responses to the RAIs for Ross, Strata provided Figure ER RAI GEN-1-1, which overlays the proposed activities for Ross over a map of the license area that also shows the land use categories. Provide a similar figure for Kendrick, showing the facilities present at the end of the construction phase overlaying the land use categories for the site (i.e., combine Figures 4.1-2 and 3.1-3). Alternatively, provide the native CAD or shapefiles/layers so that the NRC staff can develop the figures.

ER RAI LU-1 Response

Figure ER RAI LU-1-1 portrays the land use categories from Kendrick ER Figure 3.1-3 along with the anticipated facilities at the end of operations from Kendrick ER Figure 4.1-2. A native CAD (AutoCAD) file for Figure ER RAI LU-1-1 is provided with the response to ER RAI GEN-8.


R. 68 W. R. 67 W.
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N. 1470000
N. 1460000
DEADMAN ROAD
OSHOTO CONNECTION
D ROAD
NEW HAVEN ROAD
CABIN CREEK ROAD
CABIN CREEK & MORSE ROAD
68
164
193
116
211
16
SEPARATORS
PUMPJACK
TANKS
DISPOSAL WELL
WELLHEAD
SEPARATOR
3 PONDS
INJECTION WELL
STAGING AREA
SUBSTATION
LAYDOWN AREA
METERING BUILDING
2 SEPARATORS
SHOP
PONDS
BUILDING
BUILDINGS
SUBSTATIONS
LEGEND
ROSS LICENSE NO. SUA-1601 BOUNDARY
PROPOSED KENDRICK EXPANSION AREA BOUNDARY
EXISTING COUNTY ROAD
EXISTING SECONDARY ACCESS ROAD
EXISTING UNIMPROVED ROAD
PROPOSED SECONDARY ACCESS ROAD
PROPOSED PIPELINE CORRIDOR
APPROXIMATE PERIMETER MONITOR WELL RING
PROPOSED LAYDOWN AREA
PROPOSED TOPSOIL STOCKPILE
EXISTING CULVERT LOCATIONS
PROPOSED CULVERT LOCATIONS
PROPOSED WELLFIELD MODULE BUILDING
PROPOSED BOOSTER PUMP STATION
APPROXIMATE WELLFIELD EXTENT
NOTE: PROPOSED TERTIARY ROADS NOT SHOWN.
APPROVED ROSS FACILITIES
Drawing Coordinates: WY83EF
Basemap: USGS 1:24,000
Brislawn School, Garland Hill, Flag Butte, Oshoto, Rozet NE, and Edith Creek
0 1,500 3,000 4,500 6,000
GRAPHIC SCALE (FEET)
LAND USE CATEGORIES
INDUSTRIAL
CROPLAND AND PASTURE
HERBACEOUS RANGELAND
MIXED RANGELAND
RESERVOIRS
TRANSPORTATION, COMMUNICATION, AND UTILITIES
SOURCE: USGS (2005) with Cropland adjusted according to 2009 NAIP aerial imagery, Industrial and Reservoirs adjusted according to 2012 NAIP aerial imagery and Google Earth 2014.
STRATA ENERGY INC
ROSS ISR PROJECT
CROOK COUNTY, WY
LICENSE NO. SUA-1601
P.O. BOX 2318, 1900 W WARLOW UNIT A
GILLETTE, WY 82717
REVISIONS
Date Description
KENDRICK EXPANSION AREA
ER RAI RESPONSE
FIGURE ER RAI LU-1-1
LAND USE AND ANTICIPATED FACILITIES AT THE END OF OPERATIONS
Drawn By: MBM
Checked By: WCF
Date: 7/26/16
FILE: KPA1_FACIL_LANDUSE_EO_OPERATION
WWC ENGINEERING
www.wwcengineering.com
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RAI – LU-2 State-Owned Land

The Kendrick ER (e.g., Table 1.3-1) indicates that the proposed project will impact State-owned land. Provide the current use of the State-owned land and the arrangement Strata has with the State for accessing this land.

<u>ER RAI LU-2 Response</u>

Kendrick ER Section 3.1.2 discusses existing land uses within the proposed KEA and the method by which the lands were classified. Existing land uses on State-owned land consist primarily of livestock grazing on lands classified as mixed rangeland and cropland and pasture. In addition, limited oil production occurs on State-owned lands.

Strata has leased the uranium (Lease #0-40871, #0-40979 and #0-40991) from the State of Wyoming relevant to the State-owned portions of the Ross license area and proposed KEA. The State of Wyoming's position on usage within its public lands holdings is to determine the "highest and best use" with respect to economic return on those lands (Wyoming Office of State Lands and Investments [OSLI] 2005). Typically, most of the State-owned surface is leased for livestock grazing, as is the case within the Ross license area and proposed KEA. While Strata's uranium leases grant it the right to construct and maintain the wellfields and associated infrastructure necessary to recover the uranium, Strata also chooses to protect the rights of the grazing lessee.

Strata is working closely with holders of State grazing leases to maintain grazing on the surface while actively mining those State mineral leases. This involves close communication with both the State Board of Land Commissioners and the grazing lessee.

Access is controlled both through the uranium leases, which define Strata's right to access the mineral lease while protecting the grazing leases, and Surface Impact Damage Agreements (SIDAs) between the grazing lessee and Strata. SIDAs define what access activities Strata will have and what compensation (dependent on activity) Strata will pay for any loss of forage. In addition, the OSLI must attest to having examined the mining and reclamation plans. When signing the Surface Owner Consent Form (Form 8), which is part of Strata's amendment application for WDEQ/LQD Permit to Mine No. 802, OSLI indicated that it approved the mining and reclamation plans and reiterated Strata's "right to enter upon, occupy and enjoy such surface areas of the described tracts as are necessary for mining operations, along with other activities contemplated by the lease." The signed Form 8 is provided in Appendix C of this response package.

Transportation

RAI – TR-1 Use of Rail

Kendrick ER Figure 3.2-1 shows that the BNSF Railroad is located to the southwest of Kendrick. Confirm that rail is not expected to be used to support activities at Kendrick, or at Ross as a result of activities at Kendrick. This information will be used to ensure that the current scope of the transportation analysis is sufficient.

ER RAI TR-1 Response

Strata does not currently have plans to utilize the railroad for any activities at the Ross ISR Project or proposed KEA.

Geology and Soils

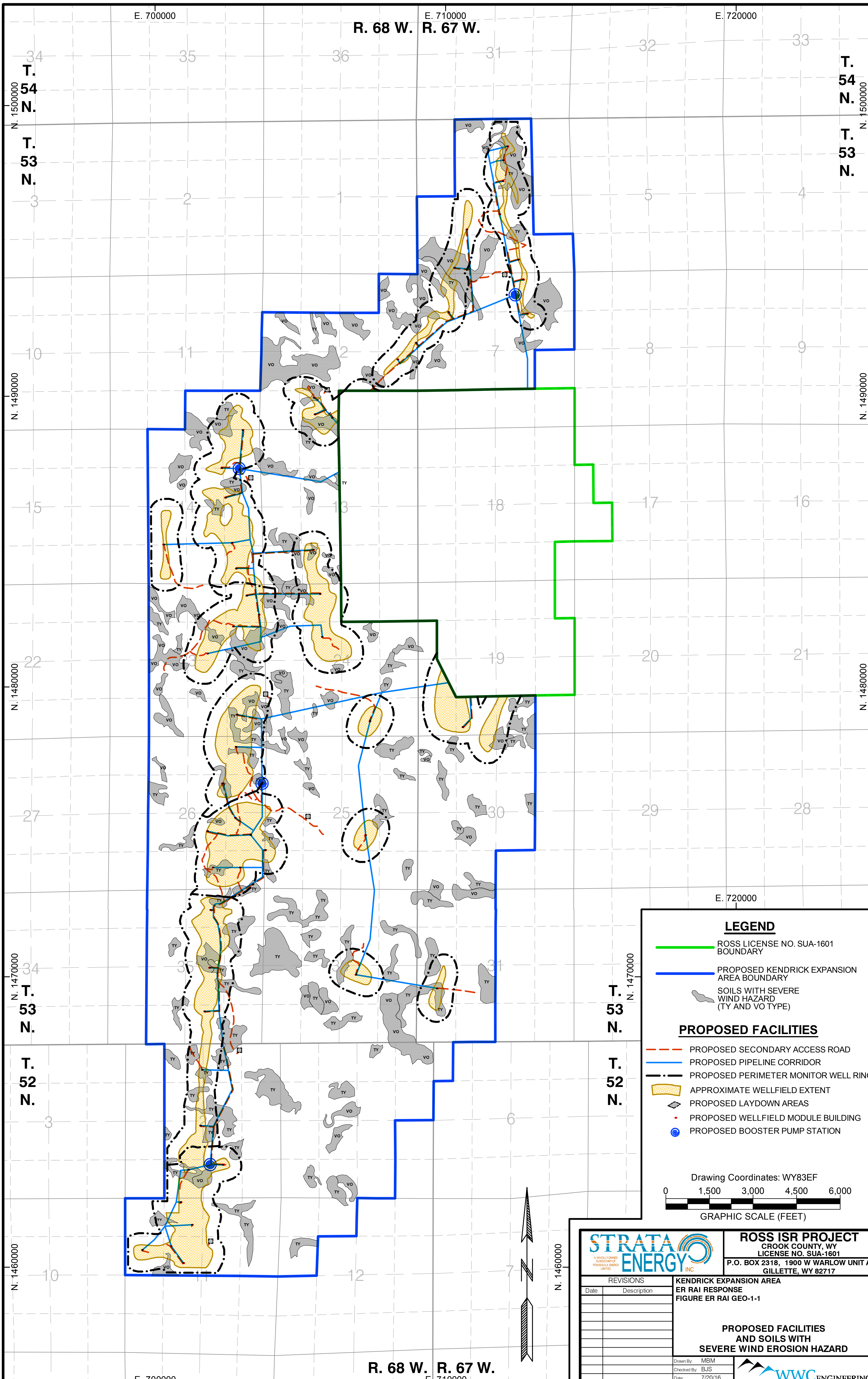
RAI – GEO-1 Soil Survey

Kendrick ER Section 3.3.5.2 discusses the results of the Kendrick soil survey. Provide additional information based on Addendum 3.3-D to support the discussion on erosion (p. 3-50), better detailing, topographically, where the hazard for wind and water erosion is severe, as stated in ER Section 3.3.5.2, and whether this area is to be disturbed as part of the activities proposed for Kendrick.

ER RAI GEO-1 Response

Kendrick ER Addendum 3.3-D, Table A.3 indicates that there are two soil types within the proposed KEA with a severe hazard for wind erosion (Terry fine sandy loam [TY] and Vona fine sandy loam [VO]). None of the mapped soil units has been identified as having a severe hazard for water erosion. Figure ER RAI GEO-1-1 overlays the proposed KEA facilities onto the mapped TY and VO soil units. As indicated in Table A.1 of Kendrick ER Addendum 3.3-D, the TY and VO soil types make up 8.2 and 8.3 percent of the proposed KEA, respectively. Based on the information shown in Figure ER RAI GEO-1-1, the anticipated amount of disturbance in the TY and VO soil types is 69 and 76 acres, respectively.

As described in Kendrick ER Section 5.3.2.1, Strata will minimize soil loss from wind erosion by wetting exposed soil during construction, as necessary, and restoring and re-seeding disturbed areas promptly.



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RAI – GEO-2 Seismology

The discussion in Kendrick ER Section 3.3.6 on seismology and all seismic maps (except Figure 3.3-9) are confined to Wyoming. The ER also focuses on current seismologic events and does not address the occurrence of shallow faulting and basement or deep faults, and whether these should be considered in conjunction with the approved Class I Deadwood well(s) that will be used for wastewater disposal. The following additional information regarding these seismic characteristics are needed:

A. *Ross TR Addendum 2.6-A is referenced for its analysis of faults. However, that analysis did not extend through the greater Kendrick area. As indicated in Buswell (1982), shallow faults may be present in the general area. Discuss in detail the possibility of localized shallow faulting, as well as the presence of fractures within the Fox Hills-Lance sequence. (Buswell, M.D., "Subsurface Geology of the Oshoto Uranium Deposit, Crook County, Wyoming: MS Thesis," South Dakota School of Mines and Technology, 1982.)*

ER RAI GEO-2(A) Response

There is a low possibility of localized shallow faulting within the greater Kendrick area. As stated in Kendrick ER Section 3.3.2.1, no faults of major displacement are known to exist within the proposed KEA and, with the exception of the Black Hills monocline, no significant structural features have been identified. Regarding the Buswell thesis, Section 3.3.2.1 of the Ross ER explains how linear features originally interpreted by Buswell as structural faults are believed by Strata to be depositional rather than structural features consisting of slumps, folds, and differential compaction. Buswell's interpretation of displacement was based on unsurveyed drill holes. Detailed geologic cross sections and structure contour maps constructed by Strata using surveyed drill holes showed that the east-west faults proposed by Buswell are not perceptible. Strata's evaluation of Buswell's interpretation of faulting is summarized in Section 2.3.3.3 of the Ross Safety Evaluation Report (SER), where NRC staff concluded that "Staff agrees with the applicant's departure from Buswell's interpretation of the faults based on the evidence provided in the application." These findings are also summarized in Ross SEIS Section 3.4.4.

Based on evaluation of similar site-specific drilling and hydrologic testing data, no faults of major displacement are known to occur within the proposed KEA. Throughout the course of the drilling program within the proposed KEA, a total of 2,001 exploration/delineation holes were drilled, 261 geophysical logs were used in developing 16 geologic cross sections, and 1,043 feet of core were recovered, none of which shows discernable offset within the Fox Hills-Lance sequence or indication of faulting. In addition, Strata conducted three aquifer tests in 2014 that did not indicate boundary conditions suggestive of barrier-type structures. As stated in Kendrick ER Addendum 3.4-G, Section 5.0, similar ore zone confinement was demonstrated in aquifer tests conducted by Nubeth and Strata in 1977, 1978, 2010, and 2014.

According to the USGS, there are no capable faults (i.e., active faults) with surface expression mapped within or near the proposed KEA. The closest capable faults are located in central Wyoming, 173 miles to the west-southwest, as depicted in Kendrick ER Figure 3.3-7. Additionally, the USGS Quaternary fault and fold database shows no mapped capable faults in the Black Hills of South Dakota or southeastern Montana that are believed to be the source of a Richter magnitude 6 or greater earthquake during the Quaternary (USGS 2006).

RAI – GEO-2 Seismology

The discussion in Kendrick ER Section 3.3.6 on seismology and all seismic maps (except Figure 3.3-9) are confined to Wyoming. The ER also focuses on current seismologic events and does not address the occurrence of shallow faulting and basement or deep faults, and whether these should be considered in conjunction with the approved Class I Deadwood well(s) that will be used for wastewater disposal. The following additional information regarding these seismic characteristics are needed:

B. *Evaluate the potential for induced seismicity as a result of ISR extraction and brine disposal activities.*

ER RAI GEO-2(B) Response

There is a very low potential for induced seismicity as a result of ISR activities. Seismic activity induced by injecting fluids is a result of the weakening of a pre-existing fault by increasing the fluid pressure (Ellsworth 2013). The lack of faults, as discussed in the Kendrick ER and in the response to ER RAI GEO-2(A), suggests little potential of induced seismicity. Further, as discussed in Kendrick ER Section 2.1.2.2.2, each wellfield module will be operated without exceeding the maximum injection pressure, in accordance with LC 10.14 of SUA-1601. More specifically, LC 10.14 requires ISR injection pressures to not exceed the maximum operating pressure specified in Section 3.1.4 of the approved license application. Ross TR Section 3.1.4 specifies that the maximum injection pressure will be less than the formation fracture pressure, which is typically estimated at 0.67 psi per foot of overburden. Adherence to LC 10.14 will result in little potential to create or re-initiate movement along fault planes. Furthermore, ISR operations within the proposed KEA will extract more fluid than is injected, which will prevent the pore fluid pressure from reaching the level where it could weaken faults, if present, to the point of inducing seismicity. Finally, in the many decades of ISR uranium production, there has not been any documented induced seismic events.

Since there would not be any deep disposal wells within the proposed KEA, there would be no potential for induced seismicity from deep disposal well stimulation, including hydraulic fracturing if used. The deep disposal well application for the Ross ISR Project (Ross TR Addendum 4.2-A) describes how hydraulic fracturing treatments may be considered in the future for the deep disposal wells but would only be performed after approval by WDEQ. Larsen and Wittke (2014) evaluated the potential correlation between hydraulic fracturing and induced seismicity from tens of thousands of wells hydraulically fractured in Wyoming and concluded that no correlation has been observed.

Since the brine disposal rate for the Ross deep disposal wells would not increase under the Proposed Action, the low potential for induced seismicity as result of brine injection would not increase; however, it would be extended by an estimated 9 to 11 years. Larsen and Wittke (2014) note that induced seismicity related to injection/disposal wells typically is associated with faults within approximately 0 to 5 miles of the injection well.

There are no known faults within this radius, as described in the approved Ross license application (including the Class I deep disposal well application in TR Addendum 4.2-A) and the response to ER RAI GEO-2(A). As described in the Ross Class I deep disposal well application, the uplift of the Black Hills monocline does not appear to have caused faulting that affects the confining zone east of the monocline, and the strata west of the monocline are uninterrupted by folds or faults. This lack of faults suggests that seismicity caused by the extended duration of brine disposal activities and the Proposed Action is unlikely. The potential for induced seismicity will be reduced or eliminated by maintaining the brine injection pressure at a level that does not exceed the fracture pressure of the receiving formation (Deadwood/Flathead formations).

The USGS recently released a one-year hazard forecast addressing the chance of damage due to induced and natural earthquakes (Petersen et al. 2016). The maps in this hazard forecast show that within northeastern Wyoming there is less than a 1% probability of damage from an earthquake in 2016. Based on the USGS hazard maps, the current Ross license area and proposed KEA are in the lowest risk area for natural and induced earthquakes, and there is a small likelihood for a damaging induced earthquake.

RAI – GEO-3 Land Application

Kendrick ER Table 4.13-1 indicates that excess permeate may be disposed by land application, among other methods, although this is not discussed elsewhere in the application. Clarify whether land application will be used and identify the approvals that would be necessary and the status of obtaining those approvals.

ER RAI GEO-3 Response

11e.(2) liquid waste generated from activities at the proposed KEA, including excess permeate, will be managed and disposed within the current Ross license area using the waste management system approved by NRC under License SUA-1601. Land application of excess permeate is not a currently approved waste management technique for the Ross ISR Project and is not currently planned for management of excess permeate generated from Ross or Kendrick wellfields. Land application of excess permeate may be considered in the future for disposal of excess permeate following additional consultations and approvals. As discussed in Ross TR Section 4.2.3.1.3, consultations submitted to NRC and WDEQ/LQD for approval of land application would include an irrigation plan, site description, area of review evaluation, water balance, detailed environmental characterization, water and soil treatment plans, monitoring plan, and a decommissioning plan.

RAI – GEO-4 Mud Pits

The Kendrick ER (e.g., Section 3.12, p. 3-514; Section 4.3.1.1.1, p. 4-27) refers to the use of mud pits for soil loss mitigation, stating that drill cuttings and drilling wastes are typically disposed on site in mud pits pursuant to U.S. Environmental Protection Agency (EPA) and state regulations. Provide or reference additional information pertaining to the retention of material in mud pits and potential impact on surface soils and surficial aquifers. Also, specify if the management of mud/technologically enhanced naturally occurring radiological material (TENORM) at Kendrick would differ from its management at Ross as described in Ross SEIS Sections 2.1.1.4, 3.13.1, and 4.14.1.1.

ER RAI GEO-4 Response

TENORM comprised of drilling fluids and drill cuttings would be managed using the same procedures approved for the Ross ISR Project, which are described in the above-referenced sections of the Ross SEIS and Ross TR Section 4.2.1.2.1. Potential impacts on surface soils and the surficial aquifers from drilling waste contained in mud pits are expected to be small, as discussed in Ross SEIS Section 4.5.1.1. This conclusion is based primarily on the small volume of drilling fluids used, as well as the nature of bentonite or polymer-based drilling additives, which are designed to limit infiltration of fluids from the borehole to the surrounding aquifers during drilling and isolate the contents of the mud pit from the surrounding environment. Mitigation measures designed to reduce or eliminate potential impacts to surface soils and surficial aquifers are described in Kendrick ER Section 5.11 and include minimizing the quantity of drilling fluids to that which is technically feasible; backfilling, restoring, and re-seeding mud pits, typically within a single construction season; using sediment control best management practices (BMPs); and performing gamma surveys on mud pits during decommissioning to ensure that there are no potential long-term impacts from radioactivity.

In order to evaluate potential radiological impacts from drilling and disposal of drilling waste in mud pits, Lost Creek ISR, LLC (LCI) fitted optically stimulated luminescent (OSL) badges to five operating drill rigs to measure the direct gamma produced from drill cuttings. The OSL badges were attached to the rigs from July 1 to December 31, 2008. LCI determined that none of the badge monitoring results was distinguishable from background levels. In addition, LCI surveyed 12 freshly backfilled mud pits with a calibrated rate meter and found that direct gamma readings from the pits were also indistinguishable from background (LCI 2009).

RAI – GEO-5 Well Locations

Kendrick ER Figure 3.1-6 depicts oil and gas well locations in the vicinity of Kendrick. Other maps, including those in Addendum 3.4-I, also present well locations. However, enhanced oil recovery (EOR) well location and well status posted on the current (2015) Wyoming Oil and Gas Conservation Commission (WOGCC) Web site and other databases do not directly correspond with these figures. For example, there are several more injection and disposal wells listed in the WOGCC database that are not in Addendum 3.4-I.

Discuss the data sources examined to determine well locations, including the relative reliability of these sources. Verify that the maps in Kendrick ER Figure 3.1-6 and Addendum 3.4-I presenting well location and status are internally consistent and reflect the most accurate information. Identify any wells within Kendrick that may be identified in data sources but that were eliminated from the ER, for example because of improper well siting or for other reasons.

ER RAI GEO-5 Response

Kendrick ER Addendum 3.4-I (Groundwater Model) was developed to evaluate all of the wells that withdraw water from the OZ interval, including stock and domestic wells, industrial supply wells, and proposed wells constructed by Strata for ISR operations. The Wyoming State Engineer's Office (WSEO) regulates water withdrawals from aquifers in the State of Wyoming. Therefore, in developing the list of wells to evaluate in Addendum 3.4-I, the WSEO database of groundwater rights was utilized extensively. The WSEO database contains well locations, permitted uses, permitted usage rates, and, in some cases, actual usage reported by the operators for industrial wells. Since the industrial water supply wells in the model domain were all associated with oil and gas development, these wells are often included in the WOGCC database in addition to the WSEO database. However, not all of the industrial water supply wells associated with oil and gas development are included in the WOGCC database, because the WOGCC does not regulate water supply wells. For example, water supply well Edsel WSW #2 (WSEO Permit No. P67659W) and other water supply wells are not included in the WOGCC database. Usually when a water supply well is included in the WOGCC database, it is because the well was drilled for some other purpose (e.g., an oil production well) and later converted to a water supply well.

As noted in the RAI, there are several injection and disposal wells in the WOGCC database that are not included in Addendum 3.4-I. During development of the groundwater model included in Addendum 3.4-I, the injection and disposal wells were evaluated to determine whether they were completed in the OZ aquifer. In all cases, the injection and disposal wells associated with oil and gas development are completed in intervals or reservoirs much deeper than the OZ aquifer (typically the Minnelusa Formation at approximately 5,500 feet below the Kendrick OZ aquifer). There are multiple confining units between the OZ aquifer and intervals or reservoirs in which oil and gas wells are completed. The most significant confining unit is the regional aquitard locally referred to as the Pierre Shale which often exceeds 2,000 feet (610 meters) thick in the area. Since the injection and disposal wells included in the WOGCC database will not impact the OZ aquifer or any of the aquifers of interest in the proposed KEA, these wells were not included in Addendum 3.4-I.

The water supply well locations in Addendum 3.4-I were developed based on a combination of WSEO data, WOGCC data, and field truthing. The wells were located initially based on the legal locations or geographic coordinates provided in the WSEO database. Many of the older WSEO records only provide locations based on quarter-quarter sections. In these cases, the wells were modeled in the center of the quarter-quarter section reported in the WSEO database. In most cases, the WSEO locations were used in the analysis in Addendum 3.4-I because they were close enough to provide adequate resolution given that most of the water supply wells were a significant distance from the proposed wellfields. In some cases, well locations in the WOGCC records vary from the locations in the WSEO database. However, the WOGCC and WSEO records typically place the wells within the same quarter-quarter section. The WOGCC well locations were generally used to verify the WSEO locations, and adjustments were made occasionally when it was clear that the WOGCC location was more accurate. Some of the well locations within and immediately adjacent to the current Ross license area were surveyed as part of the baseline activities. Survey data were used, when available, to locate the wells. Generally, the WSEO and WOGCC well locations are deemed reliable.

With the understanding that not all of the water supply wells are included in the WOGCC database, Kendrick ER Figure 3.1-6 is internally consistent with Addendum 3.4-I. ER Figure 3.1-6 includes nine water source wells within 2 miles of the proposed KEA, only two of which are not included in Figure 3 of Addendum 3.4-I:

- "Prairie Creek State 7-1," located in the SWNE of Section 16, Township 53N, Range 68W. WSEO records report that this well has been plugged and abandoned and the permit is cancelled (Permit No. P73923W). As a result, it was not included in Addendum 3.4-I.
- "Kiehl Unit 8," located in the SESW of Section 30, Township 53N, Range 67W. The WSEO database lists a cancelled permit (Permit No. P84615W) for a well in the same location and depth as the well in the WOGCC database. The WSEO records indicate that this well would have been permitted to remove water only from the Minnelusa Formation, but the well permit was subsequently cancelled and there is no evidence that the well was actually completed. Since this well would not have removed any water from the OZ interval, it was ignored for the purposes of the modeling exercises in Addendum 3.4-I.

As noted above, none of the disposal wells, injector wells, or oil producing wells shown on Kendrick ER Figure 3.1-6 are completed in the OZ interval. Therefore, they were not included in Addendum 3.4-I.

In addition to data available on the WOGCC and WSEO databases, water supply well information was obtained from operator submittals to the BLM and from the operators themselves. As discussed in Addendum 3.4-I, Appendix A, yearly Plan of Development (POD) submittals to the BLM were evaluated to better understand how the wellfields were being operated. Several of the oilfield operators in the area were also contacted directly to determine how the water supply wells were being operated. These communications are summarized in Addendum 3.4-I, Appendix A. Given the multiple sources that were used to develop the data analyzed in Addendum 3.4-I, there is a high degree of confidence that all of the water supply wells in the groundwater model domain have been evaluated.

RAI – GEO-6 Well Abandonment

Kendrick ER Section 3.1.9 states that "Prior to conducting tests for a wellfield data package, Strata will attempt to locate and abandon all historic drill holes within the perimeter monitor well ring for the wellfield…." Kendrick ER Section 5.4.3.1.1 discusses the requirement to locate and abandon historical drill holes (LC 10.12) within the perimeter monitor well ring before conducting tests for the wellfield data package.

A. *Clarify whether this activity will include the identification of oil and gas or other boreholes not related to uranium exploration, and how these boreholes would be identified and located.*

ER RAI GEO-6(A) Response

LC 10.12 does not differentiate between historical drill holes related to uranium exploration or drill holes related to oil and gas development. As such, Strata anticipates that all oil and gas drill holes will be evaluated as part of its efforts to attempt to locate and abandon all historical drill holes prior to conducting mine unit aquifer tests for the wellfield data packages. It is unlikely that any additional action will be required on the part of Strata to abandon oil and gas drill holes or wells, since the WOGCC has formal requirements for abandonment procedures, materials, and reporting, which are contained in Chapter 3 of the WOGCC Rules and Regulations. However, Strata will review WOGCC records to identify drill holes or wells within the mine unit and to verify that they have been properly abandoned. Improperly abandoned drill holes or wells would, if present, be identified during mine unit aquifer tests by communication between aquifers and/or general anomalies in the aquifer test data. If further action is required, Strata will then identify and plug the abandoned oil and gas drill hole or well as necessary. WOGCC rules require abandoned oil and gas wells to be marked with dry hole markers and the locations are recorded in the WOGCC database. In addition, there are typically pads constructed to drill the oil and gas wells, many of which are still visible even decades after site reclamation was completed. Therefore, Strata does not anticipate having difficulty locating any of the abandoned oil and gas drill holes or wells should they require re-abandonment.

RAI – GEO-6 Well Abandonment

Kendrick ER Section 3.1.9 states that "Prior to conducting tests for a wellfield data package, Strata will attempt to locate and abandon all historic drill holes within the perimeter monitor well ring for the wellfield…." Kendrick ER Section 5.4.3.1.1 discusses the requirement to locate and abandon historical drill holes (LC 10.12) within the perimeter monitor well ring before conducting tests for the wellfield data package.

B. *Verify whether Kendrick borehole abandonment will be consistent with methodologies presented in the Ross ER and TR.*

ER RAI GEO-6(B) Response

Historical drill holes and boreholes within the proposed KEA will be plugged and abandoned according to the procedures presented in Addendum 2.6-E of the approved Ross TR with the exception of the plugging sealant. Strata is currently using high density bentonite rather than Type I cement to plug historical drill holes. The current procedures are in accordance with WDEQ/LQD Chapters 8 and 11 Rules and Regulations.

RAI – GEO-6 Well Abandonment

Kendrick ER Section 3.1.9 states that "Prior to conducting tests for a wellfield data package, Strata will attempt to locate and abandon all historic drill holes within the perimeter monitor well ring for the wellfield…." Kendrick ER Section 5.4.3.1.1 discusses the requirement to locate and abandon historical drill holes (LC 10.12) within the perimeter monitor well ring before conducting tests for the wellfield data package.

C. *Provide more extensive discussion on how the historical drill holes will be located, as well as the potential future impact of wells that Strata was unable to abandon, taking into account Amendment 1 of SUA-1601, recent license amendment requests, and stakeholder concerns.*

ER RAI GEO-6(C) Response

The historical Nubeth drill holes were surveyed when they were drilled. In addition, when they were originally abandoned, they were capped with a cement plug containing a metal cap that identified the hole via a unique number. Strata uses the historical survey data for the drill holes to determine the general locations, after which a metal detector is used to find the exact location of the drill holes. In cases where the surface has been disturbed and the cement plug/metal cap is no longer in place, the ground is scraped to look for evidence of the hole. The hole locations are then surveyed so they can easily be found for re-abandonment.

Strata demonstrated the effectiveness of its procedures to locate historical drill holes in the Mine Unit 1 (MU1) Wellfield Data Package (Strata 2015a). Within the MU1 perimeter monitor well ring, Strata was able to locate and re-abandon 89 percent of the historical Nubeth drill holes. Several historical drill holes were within drainages or areas where the ground was disturbed post-Nubeth and were not locatable, and other drill holes were within cultural sites and were not accessible to a drill rig. Nevertheless, the effectiveness of Strata's attempt to locate and re-abandon the historical drill holes is demonstrated by Strata's ability to locate the vast majority of the drill holes and by the demonstration, through aquifer testing, that the OZ aquifer is adequately isolated from overlying and underlying intervals to safely conduct ISR. NRC staff's verification of Strata's efforts to comply with LC 10.12 are documented in its verification of the MU1 Wellfield Data Package, which notes that "Staff found that Strat[a]'s abandonment of the drill holes met the requirements of License Condition 10.12" (NRC 2015a).

Amendment 1 of SUA-1601 revised LC 10.12 based on the initial decision from the Atomic Safety and Licensing Board (ASLB). In addition to the previous requirement to attempt to locate and abandon historical drill holes within the perimeter monitor well ring for each wellfield, the revised LC requires Strata to attempt to locate and abandon historical drill holes that penetrate the underlying DM interval in the area that is downgradient of the wellfield and between the perimeter well ring and the closer of either the Ross license area or the outer boundary of the exempted aquifer (NRC 2015b). In December 2015, Strata submitted an amendment request to revise the language in

LC 10.12 to specifically address the potential downward vertical migration of solutions in an alternate concentration limit (ACL) scenario, to account for site-specific conditions, and for consistency with language proposed by NRC staff as part of the AUC LLC, Inc. licensing process for the Reno Creek ISR Project (Docket #040-9092). The proposed amendment would require Strata to attempt to locate and abandon: (i) all historical drill holes within the perimeter monitor well ring, and (ii) historical drill holes that penetrate the DM interval and are downgradient of the wellfield and between the perimeter monitor well ring and the anticipated point of exposure for a future ACL application (Strata 2015b). Further, the amendment to LC 10.12 requested that if the drill holes were not re-abandoned prior to operations of that specific mine unit, then the drill holes would be located and the cost to re-abandon the drill holes would be in place through financial assurance to cover eventual re-abandonment. Regarding wellfields within the proposed KEA, Strata will comply with the version of LC 10.12 that is in effect at the time the wellfield data packages are prepared.

In the event that Strata is not able to locate and abandon all of the historical drill holes in the area specified by LC 10.12, the potential future impacts are expected to be small for the following reasons:

- Most of the historical Nubeth drill holes are partially or completely sealed due to previous abandonment efforts (i.e., to the standards in place at the time of drilling) or self-sealing due to swelling clay and shale horizons. The geologically young sedimentary formations within the proposed KEA contain swelling clay and shale horizons, and the swelling action of these horizons encountered in a drill hole tends to provide a natural seal. It has been Strata's experience that when entering the historical exploration drill holes, considerable effort must be made to re-drill the holes, indicating that significant sealing has already occurred.

- As demonstrated by the geologic cross sections in Kendrick ER Addendum 3.3-A, the SM aquifer has a higher potentiometric surface than the OZ aquifer across the proposed KEA. Therefore, if there were an unplugged drill hole, groundwater would tend to flow from the SM into the OZ aquifer, which would limit the potential for a vertical excursion into the overlying aquifer.

- Although the potentiometric surface in the DM interval is naturally lower than that in the OZ aquifer, relatively few historical drill holes penetrated the DM interval. Furthermore, as discussed in the response to ER RAI GW-9, the DM interval has a poor yield, poor water quality, and low permeability. Therefore, if fluids were to reach the DM interval due to an unplugged drill hole, the potential impacts to public health and safety would be minimal. Additionally, the low permeability of the DM interval would ensure any fluids introduced from the OZ aquifer would remain in the general vicinity of the unplugged hole, which would limit the extent of the potential impact to the DM interval.

- If an unplugged drill hole is present that provides a significant conduit between intervals, it would be identified during aquifer testing conducted as part of the wellfield data package. In the event that aquifer testing identifies an unplugged drill hole, Strata would use the testing results to help identify the drill hole location so that it could be properly re-abandoned.

- Excursion monitoring would be conducted to provide an early warning of any potential impacts to overlying or underlying intervals, such as through an unplugged drill hole. As described in Kendrick ER Sections 4.4.2.2.3 and 5.4.2.2.1, Strata would conduct routine excursion monitoring and implement corrective actions in the event of a vertical excursion in accordance with LC 11.5 of SUA-1601.

RAI – GEO-7 Paleontology

The Kendrick Class III Cultural Resource Inventory report (p. 4-2) indicates that an unspecified number of "traces" of paleontological material were observed during the September 2014 field effort. For the Ross Class III inventory (p. 4-2 of that report), such occurrences were recorded on "site forms or IF forms" and presumably mapped by GPS. Indicate whether similar field techniques were followed for paleontological occurrences at Kendrick. If they were not, provide justification for why paleontological localities within the Kendrick project area were not mapped and recorded. Also, specify the total number of such occurrences encountered during the inventory.

ER RAI GEO-7 Response

For clarification, p. 4-2 of the Cultural and Paleontological Resource Survey (Kendrick ER Addendum 3.8-A) stated that "A few traces of paleontological material (vertebrate remains) were observed." This implies not many or a small number, which helps explain why the paleontological localities within the proposed KEA were not mapped and recorded similar to the survey reported for the current Ross license area. In addition, the few occurrences in the proposed KEA were characterized as widely scattered, weathered, finger nail-sized fossil bone found on ridge tops. None of the few occurrences appeared to be exposed *in situ* (i.e., embedded in Lance Formation sediments), nor did the specimens include any diagnostic elements or articulating surfaces. Therefore, in the opinion of the surveyors, the traces lacked contextual integrity and were not recommended for further examination. Field notes indicate that only site 48CK2280 included finger nail-sized bone fragments, although prominent ridge tops in the area may also have similar trace paleontological material.

Potential impacts to paleontological resources due to the Proposed Action are discussed in Section 4.8 of the Kendrick ER, and mitigation of these potential impacts is addressed in Section 5.8 of the Kendrick ER. To summarize, although the Lance Formation has a high potential to yield vertebrate fossils, none were discovered during the intensive pedestrian Class III survey. Strata recognizes the high potential and has addressed the discovery of vertebrate fossils in Section F-8 of the EMP, as part of the Unanticipated Discovery Plan (UDP). The UDP includes provisions for training of field personnel with identification of vertebrate fossils, ceasing work as appropriate should a discovery be made, and ensuring protection of the site by supervisory personnel along with reporting and documenting any discoveries.

Surface Water Resources

RAI – SW-1 Other Potential Pollution Sources

Provide a discussion of other potential pollution sources (e.g., agriculture, oil production, other mines) that may discharge to surface water. If there are no sources other than the WYPDES outfalls described in this section and the future WYPDES outfalls associated with the general construction temporary WYPDES permit, indicate so. The additional discussion should address, as applicable, the cumulative impact (past, current, and future) of these pollutant sources, including locations relative to the site, the affected water bodies, and the magnitude and nature of the pollutant discharges, including spatial and temporal variations (i.e., rivers and reservoirs).

ER RAI SW-1 Response

Potential pollution sources that may discharge to surface water and their associated cumulative impacts (past, current, and potential future) are described below. In general, current and potential future WYPDES outfalls associated with preconstruction and construction for the Proposed Action and WYPDES outfalls associated with oil production are the primary expected pollution sources that may discharge to surface water within the proposed KEA.

WYPDES Outfalls Associated with Oil Production

Several WYPDES outfalls associated with oil production exist within the proposed KEA and surrounding area. As described in Kendrick ER Section 3.4.1.8, there are four WYPDES outfalls associated with oil production facilities within or upstream of the proposed KEA. Upstream of the proposed KEA there are two permitted WYPDES outfalls (WY0047295 and WY0095095) and one expired permit (WY0044296). Within the proposed KEA there is one WYPDES outfall (WY0033065). There is also one WYPDES outfall downstream of the proposed KEA (WY0034592). As depicted on Kendrick ER Figure 3.4-4, three of the outfalls are located on the Little Missouri River (WY0095095, WY0033065, and WY0034592), one outfall is located on the upper reaches of Deadman Creek (WY0044296), and one outfall is located within an unnamed contributing subbasin (KB3) of Good Lad Creek (WY0047295). The effluent characteristics of these WYPDES outfalls are provided in Kendrick ER Table 3.4-19, which shows that the produced water discharged from these outfalls is moderately saline (based on a general electrical conductivity range of approximately 3,000 to 5,000 µmhos/cm), chloride concentrations range from 2 to 996 mg/L, radium-226 concentrations range from 4 to 58.1 pCi/L, and pH is approximately neutral.

Based on an evaluation of discharge monitoring report information for these WYPDES outfalls, the monthly average discharge rate has remained relatively consistent from January 2007 through December 2015, except for a few isolated peak discharges, as depicted in Figure ER RAI SW-1-1. Based on this evaluation, it is anticipated that future WYPDES discharges associated with oil production will remain steady or decline from present levels.

The potential for additional future WYPDES discharges related to development of new oil production facilities is small, since oil reservoirs within the proposed KEA are not expansive and are composed primarily of small, barchan dune systems. As described in the response to ER RAI GEN-2(D), no major future oil development is expected.

The potential cumulative impacts from past, current, and potential future WYPDES discharges from oil production are small. The WYPDES discharges may have a minor impact on surface water quality, especially in terms of chloride concentration and salinity, but discharges are generally within permit limits (as described in Kendrick ER Section 3.4.1.8), and the flow rates are low enough that the water typically does not reach the proposed KEA. This is demonstrated by the typically low chloride concentrations at surface water monitoring station SW-2 (where 8 of 9 samples were at or below 11 mg/L, as shown in Kendrick ER Addendum 3.4-D) as compared to the closest upstream WYPDES outfall (WY0033065), with chloride concentrations ranging from 64 to 88 mg/L (Kendrick ER Table 3.4-19).

Agricultural Operations

Potential surface water discharges from agricultural operations are small and infrequent. As described in Kendrick ER Section 3.1.2, the majority of the land (98%) within the proposed KEA is currently used for livestock grazing. Livestock production within the proposed KEA (as described in ER Section 3.1.3) consist primarily of grazing cattle and horses with the potential for sheep in the future. As typically seen with cattle grazing, all known past, current, and potential future pollutant sources are non-point pollution. These may result in localized increases in sedimentation and bacteriological contamination. The Little Missouri River is not currently listed as impaired for any pollutants within or surrounding the proposed KEA (WDEQ/WQD 2014).

There is no known potential for point discharges associated with agricultural operations such as concentrated animal feeding operations (CAFOs) within and surrounding the proposed KEA. According to WDEQ/WQD (2016a) only two CAFOs currently exist in Crook County of the 88 total in the State of Wyoming. These two CAFO are both more than 10 miles away from the proposed KEA and both listed as having expired WYPDES permits (WDEQ/WQD 2016b). Therefore, the potential for future development of a CAFO within or near the proposed KEA is unlikely, since the current agricultural practices of dry land crop production and grazing for livestock production have long been established in the area (since the beginning of the 20th century) and are anticipated to continue into the future.

As described in Kendrick ER Section 4.4.1, the increase of sedimentation during construction and operation of the Proposed Action will be controlled through the implementation of storm water management and erosion control BMPs, which will reduce the potential cumulative impacts from sedimentation. When added to past, current, and potential future agricultural operations, the cumulative impacts will be small. Surface water quality may experience minor, localized impacts from livestock grazing practices, with the potential for increases in sedimentation and bacteriological contamination. CAFOs or other agricultural point sources of pollution are not expected to occur in the future within or surrounding the proposed KEA.

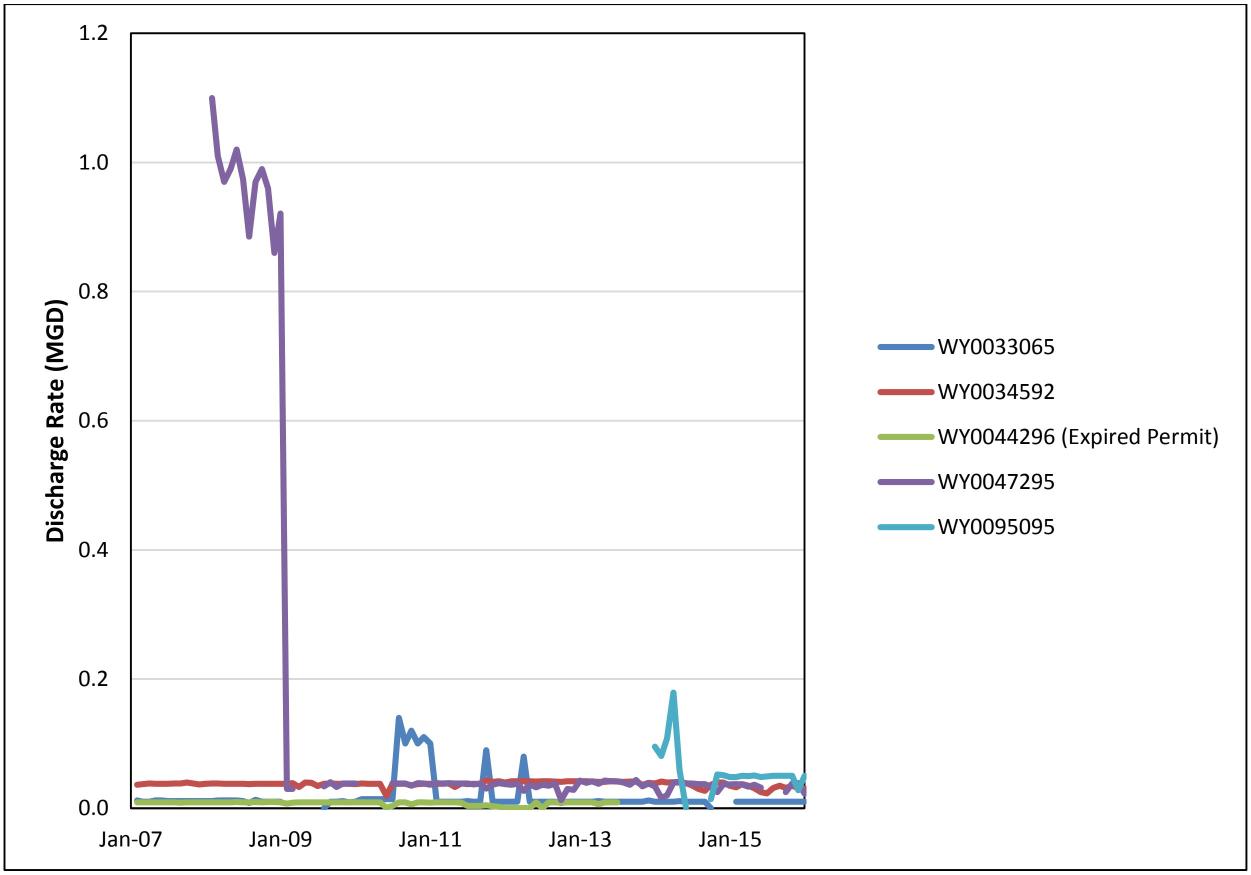
Preconstruction Activities

Potential pollution sources for preconstruction activities are described in the response to ER RAI GEN-1. As described in that response, preconstruction activities within the proposed KEA included conducting three aquifer tests, during which water was discharged to the surface under a temporary WYPDES permit. Potential cumulative impacts from aquifer testing are also addressed in the response to ER RAI GEN-1.

Other Mines

As described in Kendrick ER Section 3.1.8, no other minerals are actively being developed within 2 miles of the proposed KEA other than oil and uranium. Strata is unaware of any potential for other mines with the potential for past, current, or future impacts to surface water resources within the proposed KEA.

Figure ER RAI SW-1-1. WYPDES Discharge Rates



Source: WDEQ/WQD 2016b

RAI – SW-2 Flooding

Kendrick ER Section 3.4.1.3 provides a discussion of the Hydrologic Modeling System (HEC- HMS) model that was developed to estimate the peaks and volumes of floods for various recurrence intervals within Kendrick. Provide an average predicted peak flow (100-year, 24 hour) from Kendrick taking into account that the Ross SEIS (Section 4.5.1.2 p 4-35) states there is a predicted peak flow of 1.4 m^3/s [50 ft^3/s, or cfs] during a 100-year, 24-hour storm which is an increase of less than 1 percent of the peak flow in the Little Missouri River of 170 m^3/s [6,000 ft^3/s]. Reconcile this Ross predicted peak flow with Kendrick data, as necessary, (Kendrick ER, Section 3.4.1.3 Pages 3.71 through 3.73 and referenced Tables 3.4-7 and 3.4-8). Also specify whether the Revised Guidelines for Implementing Executive Order 11988, "Floodplain Management" (draft, 2015), were considered when calculating the flood peaks and volumes, taking into account climate change, and modify calculations as necessary to do so.

ER RAI SW-2 Response

Section 3.4.1.3, Table 3.4-7, and Appendix 3.4-A of the Kendrick ER describe the results of a HEC-HMS model of peak runoff in various stream segments within the proposed KEA during various recurrence intervals (i.e., 2-year to 100-year storm events). Since the proposed KEA includes several drainage basins (as depicted on Kendrick ER Figure 3.4-4), there is no single discharge location from the proposed KEA where a predicted peak flow can be evaluated. Instead, there are several tributaries to the Little Missouri River and Belle Fourche River that drain the proposed KEA. For each minor watershed, peak runoff was modeled at or near the downstream boundary of the proposed KEA. The 100-year peak flows for the various downstream locations are presented in Kendrick ER Table 3.4-7 based on the HEC-HMS model. These range up 2,128 cubic feet per second (cfs), with the largest modeled peak flow occurring on the Little Missouri River at Junction J3.

In contrast, Ross SEIS Section 4.5.1.2 (p. 4-35) describes the potential stormwater runoff from impervious surfaces within the Ross CPP area, including buildings, roads, and parking areas, and how the peak flow from these areas is anticipated to be 50 cfs during a 100-year, 24-hour storm. No such concentrated area of impervious surfaces will be located within the proposed KEA. Impervious surfaces for the Proposed Action will be limited to module buildings and booster pump stations. As discussed in Kendrick ER Section 4.2, roads within the proposed KEA will be gravel, and as roadways become unused they will be reclaimed to their natural condition. Therefore, due to the relatively small disturbed areas, increases in the peak flows in the proposed KEA are expected to be insignificant.

The ER was submitted in March 2015, while Executive Order (E.O.) 11988 was published October 8, 2015, with the draft being published for public comment in February 2015; therefore, the guidance was not taken into account when performing the flood analysis for the ER. However, Strata has reviewed the guidelines for implementing E.O. 11988 (FEMA 2015) and believes that the hydrologic study conducted for the Proposed Action meets the intent of the Order. The intentions of E.O. 11988 as relevant to the Proposed Action along with supporting information are detailed below.

E.O. 11988 Section 2(a)(1) indicates that it should be determined whether proposed action will occur in a floodplain by using best available information and the FEMA effective Flood Insurance Rate Maps. Based on information from the FEMA Flood Map Service Center (2016), the Proposed Action lies within an area that has not been mapped by FEMA. Therefore, a flood inundation study (Kendrick ER Addendum 3.4-C) was conducted within the proposed KEA for the 100-year storm event using best available information, including channel profiles, cross sections, and modeled peak flood levels. Kendrick ER Figure 3.4-5 depicts the 100-year flood inundation boundaries for the drainages within the proposed KEA.

E.O. 11988 Section 2(a)(2) indicates that if an action is to occur within a floodplain, the agency shall consider alternatives to avoid adverse effects and incompatible development. The proposed KEA facilities have been designed to minimize impacts to surface water features. As described in Kendrick ER Section 4.4.1, module buildings and booster pump stations (the only aboveground structures) will not be located within stream channels or within the 100-year flood inundation boundary. Roads will be constructed away from drainages where possible. If it is necessary to cross stream channels, the crossing will be made perpendicular to the channel. ISR injection and recovery wells will not be constructed in existing incised drainage channels.

E.O. 11988 Section 3(b) indicates that if new construction of structures or facilities are to be located within a floodplain, accepted flood proofing and other flood protection measures shall be applied to new construction or rehabilitation. As described previously, module buildings and booster pump stations will not be located within the 100-year flood inundation boundary. Flood protection mitigation measures will be implemented for wells and roads when they must be installed in the 100-year flood inundation area as described in Kendrick ER Section 5.4.1.2.

RAI – SW-3 Wyoming Pollutant Discharge Elimination System (WYPDES)

Provide expected WYPDES discharges including outfall volumes, rates (gpm), and duration, as well as available monitoring data for the existing temporary WYPDES outfalls and the expected flow volumes to outfalls and retention basins.

ER RAI SW-3 Response

The response to ER RAI SW-1 addresses the existing and potential future WYPDES outfalls associated with oil production facilities near the proposed KEA. This RAI response addresses expected WYPDES discharges under the Proposed Action. As described in Kendrick ER Section 4.4.1.1, the only WYPDES discharges expected to occur within the proposed KEA under the Proposed Action are temporary discharges associated with aquifer testing occurring under a temporary WYPDES permit and stormwater discharges occurring under a general Large-Construction Stormwater WYPDES permit. This response describes the anticipated water volumes, rates, and duration of these discharges as well as available monitoring data for existing temporary WYPDES outfalls within the proposed KEA.

Aquifer Testing

Aquifer testing was conducted within the proposed KEA during development of the license amendment application. As described in the response to ER RAI GEN-1 and Kendrick ER Addendum 3.4-G, three aquifer tests were performed for baseline characterization within the proposed KEA. Discharge rates of approximately 7.0, 3.7, and 2.9 gpm were recorded for 24-hour pumping periods during each test. This equates to a volume of nearly 20,000 gallons discharged during the three tests.

ER Section 4.4.1.1 describes how Strata will have coverage under a temporary WYPDES permit to discharge water from future aquifer testing activities. Aquifer tests will be conducted for each mine unit in accordance with LC 10.13 of SUA-1601. The volumes and flow rates for future mine unit-specific aquifer tests within the proposed KEA were estimated based on experience from Mine Units 1 and 2 (MU1 and MU2) within the current Ross license area. The total water discharged during MU1 aquifer testing was approximately 230,000 gallons, including constant rate tests at discharge rates ranging from 4.8 to 31.7 gpm and step-drawdown analyses (Strata 2015a, 2015c). Based on information to date, it is anticipated that MU2 aquifer testing will discharge an estimated 300,000 gallons.

Based on recent experience with MU1 and MU2, Strata anticipates that two or three aquifer tests would be performed in each of the eight planned mine units in the proposed KEA. This computes to approximately 16 to 24 future aquifer tests. Based on an average of about 265,000 gallons used per mine unit within the current Ross license area and taking into account the relatively larger size of the planned mine units within the proposed KEA, it is conservatively estimated that future aquifer tests would discharge up to 400,000 gallons per mine unit. This would equate to about 30 gpm over a 9-day testing period for each mine unit, although actual discharge rates may vary from about 5 to 45 gpm.

The water quality of future WYPDES discharges from aquifer testing within the proposed KEA is expected to be similar to that measured during aquifer testing within the current Ross license area. Table ER RAI SW-3-1 provides typical results from WYPDES discharges during the MU1 aquifer testing. It shows that the measured water quality was well within permit limits. The water quality from future aquifer testing within the proposed KEA also would be similar to the groundwater monitoring results obtained from sampling the regional baseline monitoring network for the OZ aquifer, as summarized in Kendrick ER Addendum 3.4-J. It also would be similar to the monitoring results from the temporary WYPDES discharges associated with the three regional baseline aquifer tests conducted within the proposed KEA. The results from these WYPDES discharges (as shown in Table ER RAI GEN-1-1) were within permit limits except for pH, which exceeded the upper limit slightly in some cases.

<u>Stormwater</u>

Stormwater discharges will be covered under two WYPDES permits for the combined current Ross license area and proposed KEA. A general Large-Construction Stormwater WYPDES permit will cover stormwater discharges related to construction activities, and an Industrial Stormwater WYPDES permit will cover stormwater discharges during operations.

The general Large-Construction Stormwater WYPDES permit will be modified as necessary to include the proposed KEA, as described in Kendrick ER Section 4.4.1.1. The discharge duration and volumes associated with stormwater will vary according to the intensity of storm events. Although these discharges have the potential to impact surface water quality (i.e., though increased sedimentation), BMPs implemented as required by Strata's Stormwater Pollution Prevention Plan (SWPPP) will reduce such impacts.

Strata has submitted and WDEQ/WQD has approved the Industrial Stormwater WYPDES permit application for the Ross ISR Project (Permit #WYR001448). The Industrial Stormwater WYPDES permit is more long-term (life of mine) and is associated with any industrial processes (processing of uranium). The Industrial Stormwater WYPDES permit applies to the areas and facilities surrounding the CPP, including the CPP, administration building, lined retention ponds, diversion berm, and primary access road within the current Ross license area. All other current and future disturbed areas within the current Ross license area and proposed KEA are expected to be covered under the general Large-Construction Stormwater WYPDES permit described above. Retention basins are not currently planned within the proposed KEA.

Table ER RAI SW-3-1. WYG720365 Effluent Limits and Reported Concentrations during MU1 Aquifer Testing

Parameter	**Limit**	**Outfall 001 (WYG720365)**
Duration of Discharge (days)	*31*	12
pH (s.u.)	*6.5-9.0*	8.25-8.48
Total Suspended Solids (mg/L)	*90*	ND
Total Dissolved Solids (mg/L)	*5,000*	1,500-1,590
Total Uranium (mg/L)	*4.0*	0.0012-0.0016
Total Recoverable Radium-226 (pCi/L)	*60*	ND-0.4

ND - Not measured above detection limits
Source: WDEQ 2016

RAI – SW-4 Effluent Monitoring

Kendrick TR Section 3.1.3 states that LC 10.9 requires Strata to establish and conduct an effluent and environmental monitoring program, including surface water monitoring, in accordance with Ross TR Section 5.7.8.2. Verify that the Kendrick environmental monitoring program is consistent with that established at Ross.

ER RAI SW-4 Response

As described in the response to ER RAI EM-2, the environmental monitoring program for Kendrick will be consistent with Ross. The response to ER RAI EM-2(B) describes how the constituents analyzed in surface water samples will be the same as in the approved Ross TR. As described in Kendrick ER Section 6.1.3.1, potential monitoring sites for the Proposed Action include the continued monitoring of three surface water stations and one reservoir (TSRES01) from the Ross program and an additional six grab stations and 12 reservoirs within the proposed KEA, as depicted in Kendrick ER Figure 6.1-1.

RAI – SW-5 Consumptive Use of Surface Water and Nonproduction Ground Water

The Kendrick ER does not directly address the use of surface water and nonproduction ground water (domestic, consumption, dust control, and irrigation) during construction, operation, restoration, and decommissioning, consistent with Table 4.3 in the Ross SEIS. Provide information pertaining to use of these nonproduction resources by Strata at Kendrick, including the basis for the estimates and potential impacts such as those concerning the Oshoto Reservoir. Additionally, provide or reference ground water and surface water use by others in the Kendrick area such as ground water use for EOR. Include sufficient information to understand the cumulative impact of surface and nonproduction ground water use by Strata and others in the Kendrick area.

ER RAI SW-5 Response

Following is an estimate of non-production water usage by Strata and potential impacts of that usage during each project phase for the Proposed Action. In addition, this response addresses current and potential groundwater and surface water use by others within the proposed KEA.

Non-production water usage will include domestic usage, dust control, and water used during construction. The estimated quantity of non-production water usage during each project phase is summarized in Table ER RAI SW-5-1. In general, many of the quantities listed in Table 4.3 of the Ross SEIS would not change under the Proposed Action, since the wellfields within the proposed KEA would be constructed and operated in a phased and sequential manner with those in the current Ross license area, and the use of non-production water would not increase. Additional information on non-production water usage for the Ross ISR Project is found in the response to ER RAI WR-2(A) in Strata (2012).

Domestic Usage

Domestic water usage would be limited to continued operation of the Ross public water supply system. Consistent with Kendrick ER Section 4.13.1.1.2.5, which describes how no domestic wastewater facilities would be constructed within the proposed KEA, no domestic usage would occur within the proposed KEA. Since domestic usage is proportional to the number of employees, which is not anticipated to increase under the Proposed Action, domestic water usage under the Proposed Action generally is anticipated to remain the same as evaluated for the Ross ISR Project. The only exception is that the domestic usage during construction would be lower under the Proposed Action compared to what was evaluated for Ross. Ross SEIS Table 4.3 shows that the estimated Ross construction usage was 0.9 gpm, which was calculated by multiplying 200 construction workers times a per capita usage rate of 6.5 gallons per day (gpd). (As explained in the Ross ER RAI WR-2(A) response, the per capita usage rate was assumed to be half of the operational value during Ross construction and decommissioning, since sinks and toilets would not be available during a significant portion of each project phase.) For Kendrick, a wellfield crew of up to 25 workers is assumed for construction (see Kendrick ER Section 4.2.1.1), but a per capita usage rate of 13 gpd is used, since the Ross public water system would be available for the entire Kendrick construction period. The estimated domestic usage during construction of Kendrick wellfields is therefore estimated to be 0.2 gpm.

Dust Control

Strata does not use surface or groundwater directly for dust control, but instead provides assistance to Crook County to apply magnesium chloride to county roads both within and outside of the current Ross license area under the terms of the MOU between Crook County and Strata. Water for this process is used from the Oshoto Reservoir. Based on actual usage to date, it is conservatively estimated that 500,000 gallons per year may be used by Crook County during application of magnesium chloride for the dust control needs for the current Ross license area and proposed KEA. This equates to nearly 2,400 gpd (1.7 gpm) during approximately May through November when magnesium chloride is typically applied. Based on Ross operational experience, speed controls have been effective for dust control on secondary and tertiary access roads within the current Ross license area, and it is anticipated that speed controls would be the primary mitigation measure for these roads within the proposed KEA. The annualized usage is estimated at 1.0 gpm, including approximately 5 months per year when dust control would not be necessary due to snow cover, frozen conditions, or high soil moisture levels.

Irrigation

At this time, Strata does not anticipate using irrigation water within the proposed KEA or current Ross license area. As the owner of the Oshoto Reservoir, Strata has irrigation water rights available if needed for future irrigation use on lands designated in the WSEO permit, including the CPP area and surrounding lands.

Construction

Water would be used during construction for well drilling. Since the maximum number of drilling rigs within the proposed KEA (12, as described in Kendrick ER Section 4.9.1.1) would be the same as evaluated for Ross, the quantity of well drilling water is assumed to be the same as evaluated for Ross (8.3 gpm). Water usage for wellfield development would continue through much or most of the operation phase as wellfield construction continues.

Since little to no compacted fill would be required for construction activities within the proposed KEA, it is assumed that there will be virtually no water usage associated with wetting compacted fill during construction. This is in contrast to the current Ross license area, where construction of the primary access road, lined retention ponds, CPP area site leveling, and facilities flood control diversion channel required water during construction for wetting compacted fill.

Prior to development of mine unit areas, water will be used for aquifer testing. As addressed in the response to ER RAI SW-3, it is conservatively estimated that up to 400,000 gallons of water will be discharged for aquifer testing in each mine unit. This equates to an estimated 3.2 million gallons for the eight planned mine units within the proposed KEA. Based on the project schedule in Kendrick ER Figure 1.4-1, construction of new mine units is expected to occur annually; therefore, aquifer testing would be conducted approximately annually for the Proposed Action. Based on the 400,000 gallons per mine unit usage estimate, the average annual groundwater consumption rate for aquifer testing is estimated to be 0.8 gpm. This usage would continue throughout most of the operation phase as wellfield construction continues.

During the decommissioning project phase, water would be required during well abandonment. Based on data from Kendrick TR Section 3.0, up to approximately 4,400 recovery and injection wells and 900 monitor wells are anticipated within the proposed KEA. This equates to a conservative total well count of 5,300 within the proposed KEA. It is anticipated that approximately 500 gallons of water per well will be needed for abandonment, based on conservatively high estimates of average roll front depth (900 feet) and water to sealant ratio (50 percent). As such, future well abandonment for the proposed KEA would use approximately 2.65 million gallons of water. As depicted in Kendrick ER Figure 1.4-1, it anticipated that decommissioning will last approximately 10 years, during which an average of about 0.5 gpm would be needed for well abandonment.

Also included under the category of non-production water usage for construction is the water required to re-abandon historical drill holes as required by LC 10.12 of SUA-1601. Kendrick ER Addendum 3.3-C shows that there are 566 historical (non-Strata) drill holes within the proposed KEA. (As described in the response to ER RAI GEN-1(A), holes drilled by Strata begin with “RMR” and were already plugged as part of the preconstruction activities.) Conservatively assuming that all historical drill holes would be re-abandoned (i.e., notwithstanding the fact that not all of them would need to be re-abandoned under the current or potentially revised LC 10.12 language) and based the 500-gallon per hole estimate described above, up to 283,000 gallons of water may be required to re-abandon historical drill holes. Although this would be spread out over several years, it was added to Table ER RAI SW-5-1 as 0.5 gpm under the initial construction phase prior to operation.

Other Water Usage within Proposed KEA

Water usage by others in the proposed KEA includes use of groundwater for enhanced oil recovery (EOR) and stock use. The groundwater model report in Kendrick ER Addendum 3.4-I provides information regarding the estimated uses. Figure 17 in Addendum 3.4-I shows that there are four EOR water supply wells within the proposed KEA (ENL Sophia 1A, Kiehl Water Well #2, WSW #1 West Kiehl Unit, and Mellot Ranch WS #3). Table 16 in Addendum 3.4-I shows that the average flow rate from 2010 to 2014 for these four wells totaled 15.5 gpm. As described in Kendrick ER Section 3.4.3.3, current non-industrial groundwater use within the proposed KEA includes 15 livestock and/or domestic wells. The majority of these wells are used seasonally and only during short periods, and all use is limited to livestock watering, since there are no residences within the proposed KEA; therefore, it is conservatively estimated that approximately 5 gpm total is used by livestock/domestic wells within the proposed KEA. As such, an estimated total of 20.5 gpm is expected from other uses (unrelated to the Proposed Action) within the proposed KEA.

Total Non-Production Water Usage Rate and Volume

Table ER RAI SW-5-1 presents the total estimated non-production water usage during each project phase. It is important to note that except for dust control, which would occur to some extent within both the proposed KEA and current Ross license area simultaneously, the total non-production water usage rate generally would not increase under the Proposed Action, which would merely extend the duration of the potential impacts evaluated for the Ross ISR Project. Non-production water volumes were estimated based on the anticipated duration of each project phase. As shown in Kendrick ER Figure 1.4-1, the duration of construction prior to operation is estimated as 1 year, the duration of operation is estimated as 10 years, the duration of aquifer restoration without concurrent operation is estimated as 2.25 years, and the duration of decommissioning without concurrent aquifer restoration is estimated as 1.5 years. Using these estimated project phase durations and the typical water usage totals in Table ER RAI SW-5-1, the total estimated non-production water usage by Strata and others during construction, operation, aquifer restoration, and decommissioning is 51, 532, 86, and 58 acre-feet, respectively.

Following is a description of the anticipated water sources for the non-production water usage described above. For each type of use, the potential impacts to the available water supply are evaluated. The potential impacts are very similar to those discussed in the response to Ross ER RAI WR-2(B).

Domestic Usage

The Proposed Action would extend the operational duration but not increase the usage rate of the Ross public water supply system. Due to the relatively small domestic usage rate (around 2 gpm) and the distance from the domestic well to existing wells, little or no impacts to regional groundwater supplies are anticipated as result of continued domestic usage.

Dust Control

Surface water would continue to be used to as part of the magnesium chloride application for dust control under the Proposed Action. Specifically, it is anticipated that Crook County would continue to use a portion of Strata's appropriation from Oshoto Reservoir. A portion of the water in Oshoto Reservoir is currently permitted for industrial use (10 acre-feet), which is much more than the current or anticipated future annual use of water for dust control. This allotment may be increased through a permit modification if needed. Strata may also apply to the WSEO for an agreement for temporary use of water from the Oshoto Reservoir for dust control or other uses. During initial construction of the Ross ISR Project, Strata applied for and was granted a temporary use of water agreement to use up to 200 acre-feet of water from the reservoir over a 2-year period for construction purposes (WSEO 2013). This agreement was renewed for an additional 2 years in October 2015.

Irrigation

As no irrigation is planned at this time, no potential impacts to surface water or groundwater are expected.

Construction

Strata plans to use surface water from Oshoto Reservoir or directly from the Little Missouri River (when flow events occur) as a temporary supply during construction activities. The total surface water usage, including dust control and construction (excluding the 0.8 gpm for aquifer testing associated with construction), is estimated to be about 184 acre-feet over the 14.75-year project life under the Proposed Action, or average about 12.5 acre-feet per year (7.7 gpm). By comparison, the annual permitted appropriation for Oshoto Reservoir (the WSEO permit allows one filling annually at the permitted capacity) is 172.7 acre-feet (refer to Kendrick ER Table 3.4-9, Permit P6046R). Since the total annual usage rate is much lower than the permitted capacity of Oshoto Reservoir and since the total anticipated non-production water usage rate under the Proposed Action is similar to that evaluated for the Ross ISR Project, it is anticipated that similarly small impacts to surface water availability would result from the Proposed Action.

Other Water Uses within Proposed KEA

The potential cumulative impacts of water usage by others for industrial and stock use within the proposed KEA coupled with the Proposed Action are described in detail in the response to ER RAI GW-3(B). As described in the response, projected combined impacts of the Ross and Kendrick operations coupled with other uses are not expected to significantly impact groundwater availability.

Table ER RAI SW-5-1. Estimated Non-Production Water Usage

Type of Use	Source	Typical Water Usage (gpm)			
		Construction	**Operation**	**Restoration**	**Decommissioning**
Strata Usage					
Domestic	Groundwater	0.2	1.9	1.6	1.8
Dust Control	Surface Water	1.0	1.0	1.0	1.0
Irrigation	Groundwater	0.0	0.0	0.0	0.0
Construction	Surface & Groundwater	10.1	9.6	0.5	0.5
Subtotal Strata (gpm)		*11.3*	*12.5*	*3.1*	*3.3*
Subtotal Strata (ac-ft)		*18.2*	*201.6*	*11.3*	*8.0*
Other Usage					
Industrial & Stock	Groundwater	20.5	20.5	20.5	20.5
Subtotal by Others (gpm)		*20.5*	*20.5*	*20.5*	*20.5*
Subtotal by Others (ac-ft)		*33.1*	*330.7*	*74.4*	*49.6*
Total Usage by Strata and Others (gpm)		**31.8**	**33.0**	**23.6**	**23.8**
Total Usage by Strata and Others (ac-ft)		**51.3**	**532.3**	**85.7**	**57.6**

Ground Water Resources

RAI – GW-1 Aquifers

Provide additional details about the aquifers at Kendrick:

A. Present a summary of groundwater level changes over time using data Strata has collected since they began taking these measurements in the Kendrick area. Address whether there has been a declining water table, the origin of this event, and whether this affects surface water flow or the occurrence of seeps and springs.

ER RAI GW-1(A) Response

All of the groundwater level data that Strata has collected for the proposed KEA is included in Kendrick ER Addendum 3.4-H (Regional Baseline Monitor Well Hydrographs). Section 3.4.3.2 of the Kendrick ER provides a detailed discussion of water level changes over the time that Strata collected water level data in the proposed KEA. As described in Kendrick ER Addendum 3.4-I, approximately 35 years ago several of the oil fields in the vicinity started using water from the OZ aquifer for enhanced oil recovery (EOR). As shown in Figure 15 in Addendum 3.4-I, these activities have drawn the water levels down near the water supply wells. Since these activities have been ongoing for 35 or more years, the water levels under the influence of EOR are currently at a pseudo steady state.

As discussed in Kendrick ER Section 3.4.3.2.5.2, operational adjustments in the EOR water supply wells over the period in which the Kendrick observations wells were monitored are believed to have caused slight changes in the water levels in several OZ wells, but the changes were minor and there were no significant trends that could be observed throughout the proposed KEA. Similarly, as discussed in Sections 3.4.3.2.5.1, 3.4.3.2.5.3, and 3.4.3.2.5.4, no significant long-term water level trends were observed in the available data for the underlying (DM), overlying (SM), or surficial (SA) aquifers.

Since the data in Addendum 3.4-I were collected, Strata is not aware of any major changes in operation of the EOR water supply wells in the vicinity that would have significantly affected water levels in the proposed KEA. However, Strata began operations in Ross Mine Unit 1 (MU1) in December 2015, which has the potential to affect water levels in the OZ aquifer. After an initial 4 months of operations, Strata observed that the water levels in the perimeter wells surrounding MU1 declined between 2 and 8 feet, with the perimeter wells to the west and southwest reporting more decline than those to the north and east. Due to the fact that the drawdowns in MU1 are relatively small, it is unlikely that they have influenced the potentiometric surface in the proposed KEA as depicted on Figure 3.4-30 of the Kendrick ER.

There are no springs identified within the proposed KEA that would be influenced by fluctuating groundwater water levels in the SM, OZ, or DM units. There are areas along surface water drainages where small seeps occur immediately after large precipitation events and snowmelt and below manmade impoundments storing surface water. However, these seeps are driven almost entirely by precipitation events and/or surface water runoff and do not receive water discharged from aquifer storage.

RAI – GW-1 Aquifers

Provide additional details about the aquifers at Kendrick:

B. *As a supplement to Kendrick ER Section 3.4.3, provide or identify information pertaining to the soil properties of the unsaturated zone necessary to estimate travel times to the water table.*

ER RAI GW-1(B) Response

Within the proposed KEA, the unsaturated zone consists of surficial soils, alluvium (if present), weathered bedrock, and intact bedrock. In most cases, the surficial soils or alluvium would have higher relative permeability, and the intact bedrock would have lower relative permeability. In general, the permeability of the unsaturated zone is expected to vary considerably depending on the depth of surficial soil and the composition of the bedrock. Typically, sandier bedrock will have a higher permeability, whereas clay/shale bedrock is virtually impermeable. Although the surficial soil types have been mapped in detail throughout the proposed KEA (as described in Kendrick ER Addendum 3.3-D), little analysis has been conducted on unsaturated bedrock materials.

As described in Kendrick ER Addendum 3.4-I, Table 3, the top 20 feet in the groundwater model was assigned a horizontal hydraulic conductivity ranging from 5 to 15 ft/day and a vertical hydraulic conductivity ranging from 3 to 10 ft/day. This is consistent with the estimated hydraulic conductivity of the alluvium in the model domain, which is described in more detail within Addendum 2.7-H of the approved Ross TR. The bedrock strata (Lance Aquitard) was assigned a horizontal hydraulic conductivity value of 0.1 ft/day and a vertical hydraulic conductivity of 0.01 ft/day in the groundwater model.

Since the surficial strata vary throughout the proposed KEA, it is appropriate to provide a range of estimated travel times through the unsaturated zone to the water table. In the low-lying areas where alluvium is present, travel times estimated using alluvial hydrologic properties are most appropriate and generally provide conservatively short travel time estimates. The extent of alluvium within the proposed KEA has been mapped in Kendrick ER Figure 3.3-1. Outside of the areas of mapped alluvium where bedrock is close to the surface, it is appropriate to use the hydraulic conductivity values estimated for the Lance Aquitard. As noted in Kendrick ER Addendum 3.4-I, Table 3, the hydraulic conductivity assigned to the Lance Aquitard layer was several orders of magnitude higher than the shale confining units. Therefore, in areas of clay/shale bedrock outcrops, use of Lance Aquitard hydraulic conductivity values developed for the groundwater model will provide conservatively short travel times.

As depicted on Kendrick ER Figure 3.4-31, the surficial aquifer varies in depth from approximately 10 feet below the ground surface within the channel of the Little Missouri River near the Kendrick/Ross boundary to over 100 feet within the highland areas of the proposed KEA. There was even one regional baseline monitor well cluster (5368-41-

36) where the uppermost sand was dry and no surficial aquifer was present. Assuming a vertical hydraulic conductivity ranging from 3 to 10 ft/day, an effective porosity of 0.35, and an average hydraulic gradient of 1 ft/ft, travel time to reach the water table with 10 feet of saturated alluvial material would range from 2.9 to 9.5 days. Since the alluvial material above the water table is not saturated, the actual travel time could be longer because unsaturated material has a lower hydraulic conductivity than saturated material and the values presented Kendrick ER Addendum 3.4-I are for saturated material. In contrast, in the highland areas where the water table is over 100 feet deep, it would take over 28,571 days (78.3 years) for a spill to reach the water table at a hydraulic conductivity of 0.01 ft/day, porosity of 0.35 and a hydraulic gradient of 1 ft/ft. In areas where significant shale exists, the travel time could be even lower. Given Strata's commitments to implement leak detection and spill response and cleanup procedures, it is very unlikely that a spill or leak could reach groundwater except in the limited areas where alluvium is present.

RAI – GW-2 Aquifer Tests

Kendrick ER Addendum 3.4-G includes aquifer test results that deviate from their respective type curves (e.g., p. B-4, B-5, B-6). Provide explanations for aquifer test type curve deviations.

ER RAI GW-2 Response

The deviations from the type curves were due to adjustments in the flow rates during the aquifer tests. For example, on page B-4 of Kendrick ER Addendum 3.4-G, the drawdown versus time plot has a significant increase in slope near the end of the aquifer test. As noted on the field data sheet (page B-3), the flow rate was adjusted from 3.4 gallons per minute to 3.9 gallons per minute approximately 4 hours before the aquifer test was terminated. This adjustment increased the slope of the drawdown versus time plot and can also been seen on the hydrograph (page B-7). Similar deviations in the drawdown versus time plot on page C-4 are also attributed to minor adjustments in the flow rate during the aquifer test.

RAI – GW-3 Ground Water Consumptive Use

Ground water consumptive use is a critical component of the application. Provide additional information on the consumptive use of ground water, including the following:

A. *The Kendrick ER and TR do not directly provide the calculated ground water volumes associated with each phase of module operations. The Kendrick ground water model (ER Addendum 3.4-I) provides estimated operational flow rates (Table 14) and simulated ISR wellfield development activities and schedule (Table 15), as well as other data and information. Provide a methodology whereby estimated ground water volumes may be determined for a given ISR phase so that consumptive use through time can be understood and calculated. Ultimately, this information should provide more detail about historical and current consumptive use of ground water and future anticipated consumptive use rates, including the corresponding increase in consumptive use expected from Kendrick.*

ER RAI GW-3(A) Response

Information from Tables 14 and 15 in Kendrick ER Addendum 3.4-I can be used to calculate the modeled consumptive groundwater use during any stress period. The following steps detail how the consumptive use would be calculated for a given stress period.

- Step 1: At the chosen stress period, use Table 14 to determine the status of each module. The modules will be either not operating, in ISR operations, in groundwater sweep, or in restoration.
- Step 2: Determine the number of wells for each module of concern during the stress period.
  - As noted at the top of page 50, modeled wellfield modules in the current Ross license area include 35 recovery wells and those in the proposed KEA included 28 recovery wells.
  - Figure 17 shows the modeled location of each module. Modules with a "MOD" prefix are located in the current Ross license area and those with an "MU" prefix are located in the proposed KEA.
- Step 3: Multiply the per well bleed rate, groundwater sweep flow rate, and/or restoration bleed rate summarized in Table 15 by the number of wells as appropriate.

As an example, to estimate the consumptive use of groundwater during stress period 25, the calculation would be completed as follows:

- From Table 14, Mod 2-7 and MUE1 are in restoration; Mod 2-4 and MUA1 are in groundwater sweep; and Mod 2-6, MUA4, MUA5, MUA6, MUA7, MUB1, MUB2, MUB3, and MUB4 are in ISR operations. All other Modules are not operating.

- The number of wells in each stage are summarized as follows:
  - Restoration: Mod 2-7 (35 wells) and MUE1 (28 wells), which results in 35 wells in Ross and 28 in KEA.
  - Groundwater sweep: Mod 2-4 (35 wells) and MUA1 (28 wells), which results in 35 wells in Ross and 28 in KEA.
  - ISR operations: Mod 2-6 (35 wells), MUA4 (28 wells), MUA5 (28 wells), MUA6 (28 wells), MUA7 (28 wells), MUB1 (28 wells), MUB2 (28 wells), MUB3 (28 wells), and MUB4 (28 wells), which results in 35 wells in Ross and 224 wells in KEA.
- The per well bleed is summarized on Table 15. Based on bleed rates from Table 15, consumptive use is calculated as follows:
  - Total restoration bleed = 35 wells (Ross) x 0.41 gpm + 28 wells (KEA) x 0.41 gpm = 25.83 gpm.
  - Total groundwater sweep = 35 wells (Ross) x 1.31 gpm + 28 wells (KEA) x 1.31 gpm = 82.53 gpm.
  - Total production bleed = 35 wells (Ross) x 0.219 gpm + 224 wells (KEA) x 0.25 gpm = 63.67 gpm.
  - Total consumptive use during time step 25 = 172.03 gpm.

Using the methods outlined above, the modeled consumptive use of groundwater for both ISR operations as well as projected non-ISR uses is summarized in Table ER RAI GW-3-1. As shown in the table, operations at Kendrick are projected to result in a modest increase in total consumptive use of groundwater. However, the timing of Kendrick operations is such that as wellfields in the current Ross license area cease production, wellfields in the proposed KEA will be brought into production.

The Kendrick groundwater model also considered all of the nearby EOR, stock, and domestic wells completed in the OZ aquifer in the analysis. The total consumptive use modeled for these existing wells within the model domain was 208.3 acre-feet per year, as described in Kendrick ER Addendum 3.4-I, Appendix A. Most of the existing non-ISR OZ wells within the groundwater model domain are located outside of the proposed KEA, as shown on Addendum 3.4-I, Figure 3. Non-ISR groundwater use from the OZ aquifer within the proposed KEA was modeled at 25.1 acre-feet per year.

Table ER RAI GW-3-1 Estimated Consumptive Groundwater Use under the Proposed Action

Year	Estimated Consumptive Use (acre-feet)		
	Ross Wellfields	Kendrick Wellfields	Total
1	30.9	0	30.9
2	61.8	0	61.8
3	92.7	2.8	95.5
4	185.6	11.3	196.9
5	175.9	28.2	204.1
6	148.8	88.2	237.0
7	93.3	187.7	281.0
8	40.5	218.3	258.8
9	0	266.1	266.1
10	0	245.3	245.3
11	0	307.4	307.4
12	0	289.0	289.0
13	0	276.3	276.3
14	0	167.0	167.0
15	0	88.9	88.9
16	0	37.0	37.0
17	0	0	0.0

RAI – GW-3 Ground Water Consumptive Use

Ground water consumptive use is a critical component of the application. Provide additional information on the consumptive use of ground water, including the following:

B. Discuss the combined impacts of consumptive use on ground water availability from Kendrick and Ross, and other proposed ISR facilities, as applicable, in the Lance District.

ER RAI GW-3(B) Response

The groundwater model discussed in Kendrick ER Addendum 3.4-I was developed with the specific goal of assessing potential impacts to groundwater availability from the consumptive use of groundwater for ISR operations in Kendrick and Ross as well as other existing water uses in the vicinity (primarily EOR). As noted in Addendum 3.4-I, Table 14, the model simulated the progression of ISR operations from the current Ross license area to the proposed KEA so that the potential impacts from all phases of both projects could be determined. In addition, as noted on Table 16 in Addendum 3.4-I, the model includes groundwater withdrawals from all non-ISR OZ aquifer water supply wells in the model domain. The combined potential impacts of consumptive use on groundwater availability are discussed in Section 4.4.2 of the Kendrick ER. It describes how the projected combined impacts of the Ross and Kendrick operations are not expected to significantly impact groundwater availability at any of the existing wells within the model domain.

If future ISR facilities are constructed in the Lance District, it is anticipated that they would be constructed in adjacent areas outside of the model domain. Since insufficient detail is available at this time to be able to model future ISR facilities, they were not included in the groundwater model. However, due to the progressive nature of ISR operations, it is anticipated that if operations were to occur in additional areas they would likely be phased with those in the proposed KEA such that the total consumptive use of groundwater would not be expected to increase significantly. Instead, the location where the water is being withdrawn from the aquifer would change over time as operations progress. This concept is illustrated in the figures included in Appendix B of Addendum 3.4-I. The modeled drawdown contours during the early years of operation show that the current Ross license area would be impacted, initially with little to no impacts within the proposed KEA other than those already occurring from EOR operations. As ISR operations progress through time, the drawdown would shift to the proposed KEA, while water levels would recover in the current Ross license area. A key point of emphasis is that the consumptive use rate would not be expected to significantly increase with the development of additional ISR facilities within the Lance District. This is illustrated by the response to ER RAI GW-3(A). Potential impacts from future ISR facilities, if constructed, are expected to be similar to those modeled in ER Addendum 3.4-I. This is consistent with the response to Ross ER RAI CI-1(B), which describes how potential groundwater quantity (drawdown) impacts within the entire Lance District are expected to be similar to those evaluated for the Ross ISR Project (Strata 2012).

RAI – GW-4 Mitigation

The Kendrick ER relies on the Ross ground water model for demonstrating the successful mitigation of excursions and flare. The modeling was not repeated for Kendrick. Clarify why this decision was made and how these elements will be addressed as necessary in the future at Kendrick on a site-specific basis as part of wellfield-specific reports and associated activities.

ER RAI GW-4 Response

Extensive modeling was performed to evaluate perimeter monitor well spacing (i.e., for excursion recovery) and wellfield flare for the Ross ISR Project, since no site-specific estimates were available for these parameters at the time of licensing. The Ross modeling utilized typical aquifer hydraulic properties and a representative wellfield configuration. As described in Kendrick ER Addendum 3.4-G, the hydraulic parameters calculated during the 2014 aquifer testing program in the proposed KEA were similar to those within the current Ross license area. The geology in the proposed KEA is also very similar to that in the current Ross license area. Because both the geology and the aquifer parameters are similar between the proposed KEA and current Ross license area, any additional modeling is expected to yield similar predictions to previous modeling exercises in Ross. As such, the modeling performed for Ross is expected to be representative of the proposed KEA. Furthermore, as described in Section 3.1.3.3 of the Ross Safety Evaluation Report (SER), previous modeling results supported the spacing of perimeter wells up to 600 feet from the production zone, but Strata committed to a spacing of no more than 400 feet in response to an RAI. NRC is currently considering an amendment request submitted in December of 2015 that would allow spacing the perimeter wells up to 500 feet from the production zone. Therefore, Strata's current and proposed perimeter monitor well spacing is more conservative than what was supported by previous modeling.

In accordance with LC 10.13 of SUA-1601, additional site-specific aquifer testing and geologic evaluations will be conducted for each mine unit, with the results provided to NRC staff in a wellfield data package prior to operations. The aquifer testing conducted for the wellfield package is very robust and typically consists of multiple observation wells across the mine unit. As a result, the aquifer parameters across the mine unit are defined to a much greater detail in the wellfield package. Similarly, additional geological cross sections are prepared as part of each wellfield data package to define the geology within the wellfield in more detail. Recognizing that there are local heterogeneities within the OZ aquifer, LC 10.13 specifically requires Strata to adequately define heterogeneities that may affect groundwater flow paths within the ore zone for each mine unit. If the aquifer parameters or geology encountered in the mine unit vary significantly from those assumed in the Ross model, additional site-specific analyses utilizing the increased geologic and hydrologic resolution obtained from development of the wellfield data package would be conducted to assess how the differences may affect operations. Since the orebody would be more clearly defined in the wellfield data package, any additional analysis would be conducted on planned wellfield configurations whereas additional analyses performed on data currently available would need to rely on generic wellfield patterns and regional baseline hydrologic and geologic properties.

RAI – GW-5 Ore Zone Potentiometric Surface

Kendrick ER Figure 3.4-28 shows the potentiometric surface of the ore zone. However, this figure is based on data from January 2015 and does not reflect the recently initiated ISR operations at Ross. Provide an updated figure, or indicate when updating of the ore zone potentiometric surface map will take place and whether this map will reflect the propagation of wellfield extraction.

ER RAI GW-5 Response

Strata has not developed an updated OZ potentiometric surface since ISR operations were initiated in December 2015. As required by WDEQ/LQD Permit to Mine No. 802, Strata will provide an annual report to the WDEQ/LQD in November. The annual report will include water levels measured at the perimeter monitor wells surrounding the operating mine unit(s).

At this time, only Ross Mine Unit 1 (MU1) is in operation. Between December 2015 and April 2016, the water levels in the MU1 perimeter monitor wells declined between 2 and 8 feet. The perimeter monitor wells to the west and southwest of MU1 had the highest measured drawdown, while those to the north and east had the least measured drawdown. Since the drawdowns due to operations are minor and localized, any updates to the OZ potentiometric surface map would show little to no change. The OZ potentiometric contours are presented in Kendrick ER Figure 3.4-28 on 10-foot contour intervals. If this map were to be updated with the water levels measured in MU1 in April 2016, only very minor changes in the surface immediately surrounding MU1 would be observed. The water level changes have not yet propagated outside of the Ross license area and would not substantially affect the potentiometric surface in the proposed KEA. Therefore, even if the potentiometric surface map were updated, no changes would be observed in the potentiometry within the proposed KEA due to current operations.

RAI – GW-6 Geochemistry

Ground water quality varies between aquifer units. For example, variation in the ground water quality of the Kendrick shallow monitoring aquifer is evident in Kendrick ER Table 3.4-33 and Addendum 3.4-J, wherein shallow monitoring aquifer ground water in the southwest portion of the project area appears to exhibit higher sulfate concentrations compared with the shallow monitoring aquifer ground water in northern areas. Water extracted from the ore zone aquifer exhibits a narrower compositional range variation, with only one well in the north showing higher sulfate. Explain the variations in ground water quality, particularly with respect to the interconnection of aquifer units (both laterally and vertically).

ER RAI GW-6 Response

This RAI response addresses differences in groundwater quality within and between monitoring intervals within the proposed KEA. The relative differences are compared to those within the current Ross license area and evaluated with respect to the potential interconnection of aquifer units.

SM Aquifer

Water quality variation in the SM aquifer within the proposed KEA is consistent with that in the Ross license area and readily explained by natural geochemical processes in the Lance-Fox Hills aquifer system and by lithological variability within the SM aquifer. Figure ER RAI GW-6-1 presents the average sulfate concentration at each SM aquifer regional baseline monitoring well, using the average concentrations presented in Table 3.4-33 of the Kendrick ER. This figure also presents the potentiometric surface contours of the SM aquifer based on Kendrick ER Figure 3.4-30. Generally, the sulfate concentration in the SM aquifer decreases from the upgradient (east to northeast) to downgradient (west to southwest) direction within the proposed KEA. This upgradient to downgradient decrease in sulfate is consistent with the findings for the current Ross license area. As noted in Section 3.4.3.5.2.2 of the Ross ER, "a transition from sulfate to bicarbonate [was] observed in the downgradient direction in the SM wells."

Two factors described in the Ross ER explain the general decrease in sulfate in the SM aquifer in this area. First, Ross ER Section 3.4.3.5.1 describes how the dominant reactions controlling the chemical quality of water in the regional Lance-Fox Hills aquifer system are cation-exchange softening, resulting in increasing sodium levels, and sulfate reduction, resulting in decreased sulfate levels and a trend toward bicarbonate dominance. The SM aquifer sampling results are consistent with these processes, including strong sodium dominance and a trend toward reduced sulfate levels in the downgradient direction. Second, Ross ER Section 3.4.3.2.3 and Kendrick ER Section 3.4.3.2.3 describe how the lithology of the SM aquifer is discontinuous in this area, making correlation of sandstone units difficult over long distances. This local lithological variation is believed to be the reason for the distinct water quality of well 5268-12-01SM compared to the other SM wells. As described in Section 3.4.3.4.1.2 of the Kendrick ER, this was the only one of the 12 SM wells that exhibited sulfate dominance, while the other 11 SM regional baseline monitoring wells exhibited bicarbonate dominance.

The variability in the SM aquifer water quality within the proposed KEA is consistent with that in the current Ross license area. This is demonstrated in Figure ER RAI GW-6-2, which provides a box plot comparison of the average SM well sulfate concentration in the proposed KEA with that in the current Ross license area using data obtained from Kendrick ER Table 3.4-33 and Ross ER Table 3.4-34. This figure shows that variability expressed as the difference between the upper and lower quartiles is very similar between the proposed KEA and current Ross license area. The anomalously high sulfate concentration at well 5268-12-01SM appears as an outlier. Generally, the sulfate concentration within the SM aquifer is lower within the proposed KEA, which is expected due to it being generally downgradient from the current Ross license area.

<u>OZ Aquifer</u>

As stated in the RAI, water quality in the OZ aquifer demonstrates a narrower compositional range, at least in terms of major ion composition. Section 3.4.3.4.1.2 of the Kendrick ER describes how the range in sulfate concentration was about 35% to 45% of the anions in the OZ aquifer (except for well 5368-43-12OZ, which was dominated by sulfate), compared to about 25% to 45% in the SM aquifer (except for well 5268-12-01SM, as previously discussed).

The narrower compositional range in OZ aquifer major ion chemistry within the proposed KEA is consistent with that observed within the current Ross license area. A comparison of Figures 3.4-30 and 3.4-31 in the Ross ER shows that the relative contribution of sulfate/bicarbonate varies more in the SM than the OZ aquifer within the current Ross license area.

One area where greater variability is present in the OZ than the SM aquifer is in the concentrations of uranium and radionuclides. Kendrick ER Table 3.4-28 and Ross ER Table 3.4-29 present the range of constituent concentrations in each monitoring interval. Within the proposed KEA, the dissolved uranium concentration varied by more than a factor of 30 in the OZ aquifer, or about twice as much as in the SM aquifer. Similarly, within the current Ross license area, the dissolved uranium concentration varied by more than a factor of 20, or at least 4 times as much as in the SM aquifer. Similarly, the radionuclide concentrations were generally higher and exhibited greater variability in the OZ than SM aquifers within the proposed KEA and current Ross license area.

Less variability in the OZ aquifer major ion composition compared to the SM aquifer is explained by natural geochemical processes and the hydrogeologic setting of the two aquifers. Section 3.4.3.1.3 of the Kendrick ER describes how regional baseline monitor wells installed in the OZ aquifer demonstrate hydraulic consistency throughout the proposed KEA, while Section 3.4.3.2.3 describes how the variability of the hydraulic gradient in the SM aquifer is due to the inherent variability of the sedimentary layers comprising this unit. It is not surprising that the SM aquifer, which is comprised of the first sand overlying the ore zone interval and may not necessarily correlate between well clusters, would have greater variability in major ion chemistry than the OZ aquifer, which demonstrates hydraulic consistency throughout the proposed KEA.

Potential Interconnection of Aquifer Units

Water quality variations between the various aquifer units/monitoring intervals support the conclusion that there is not significant interconnection between aquifers within the proposed KEA. As described in Section 3.4.3.4.1.2 of the Kendrick ER, major ion chemistry, TDS, and other constituent concentrations vary between aquifers. The SA zone has the greatest variability in major ion chemistry and TDS, with a mixture of cation and anion dominance and variation in TDS by a factor of 2. The OZ water quality is distinguished from that in the SM by elevated concentrations of uranium and radionuclides and slightly higher relative proportions of sulfate on average. The DM interval water quality is very distinct from that in the shallower aquifers due to relatively high concentrations of chloride, as described in Section 3.4.3.5.2.2 of the Ross ER.

Other evidence that the OZ aquifer is sufficiently isolated from overlying and underlying intervals to safely conduct ISR is presented in the Kendrick ER. This includes regional pumping tests, which demonstrated that no effects from pumping in the OZ aquifer were measured in any of the overlying SM or underlying DM unit wells at the three well clusters tested (refer to Section 3.4.3.1.2 and Addendum 3.4-G of the Kendrick ER). In addition, Sections 3.4.3.1.3 and 3.4.3.2 of the Kendrick ER describes how there are potentiometric surface elevation differences between aquifers across the proposed KEA. These differences indicate that there is not significant interconnection between aquifers. Moreover, as described in Sections 3.4.3.1.3 and 4.4.2.2.3 of the Kendrick ER, geologic evaluation and hydrologic testing conducted in support of each wellfield data package will also be utilized to demonstrate the integrity of the underlying and overlying confining units, through monitoring the vertically adjacent interval monitor wells while stressing the OZ aquifer. This testing will be conducted in support of the wellfield data packages required by LC 10.13 of SUA-1601.

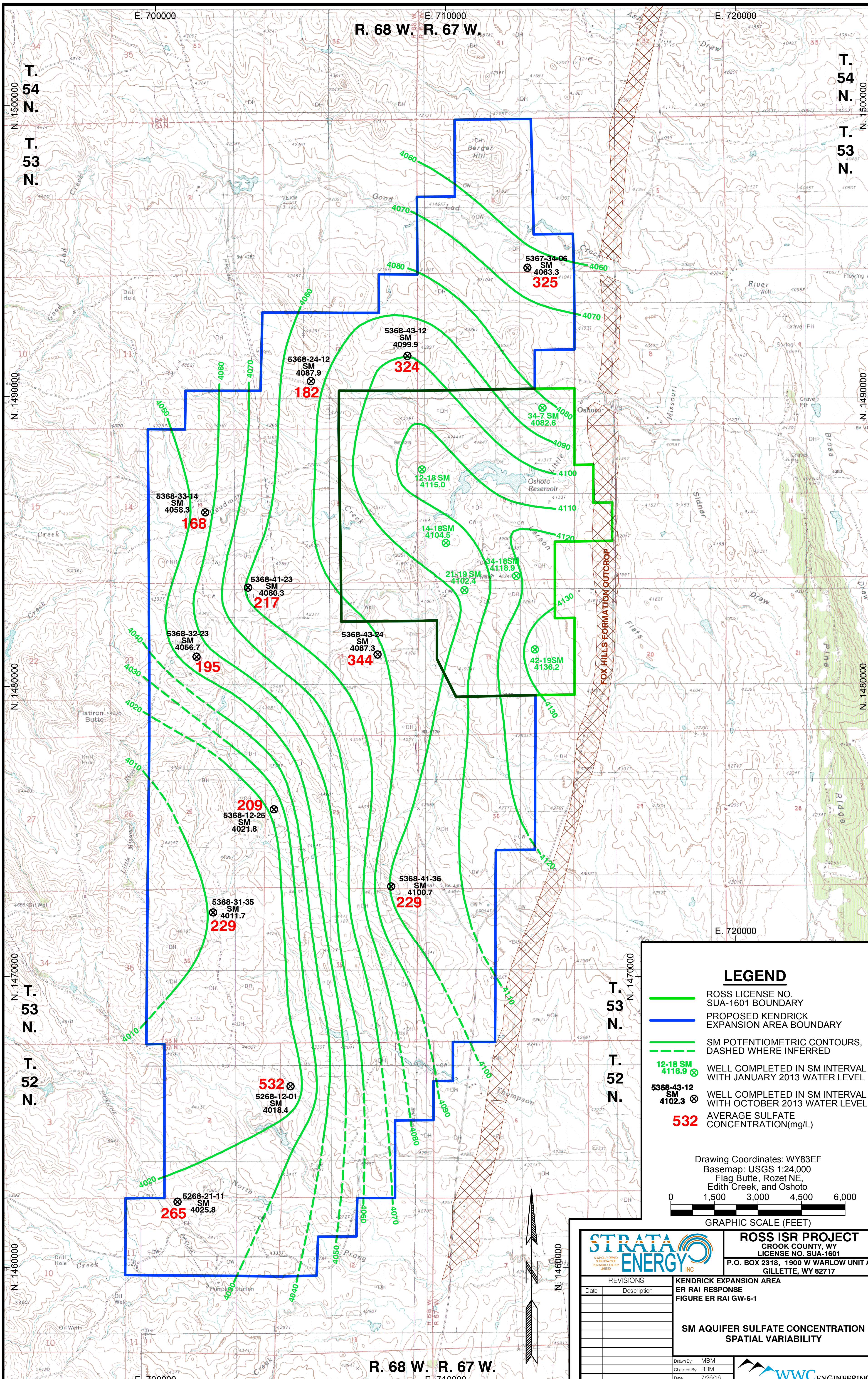

R. 68 W. R. 67 W.
T. 54 N.
T. 53 N.
T. 52 N.
FOX HILLS FORMATION OUTCROP
LEGEND
ROSS LICENSE NO. SUA-1601 BOUNDARY
PROPOSED KENDRICK EXPANSION AREA BOUNDARY
SM POTENTIOMETRIC CONTOURS, DASHED WHERE INFERRED
12-18 SM 4116.9 WELL COMPLETED IN SM INTERVAL WITH JANUARY 2013 WATER LEVEL
5368-43-12 SM 4102.3 WELL COMPLETED IN SM INTERVAL WITH OCTOBER 2013 WATER LEVEL
532 AVERAGE SULFATE CONCENTRATION(mg/L)
Drawing Coordinates: WY83EF
Basemap: USGS 1:24,000
Flag Butte, Rozet NE, Edith Creek, and Oshoto
0 1,500 3,000 4,500 6,000
GRAPHIC SCALE (FEET)
STRATA ENERGY INC
ROSS ISR PROJECT
CROOK COUNTY, WY
LICENSE NO. SUA-1601
P.O. BOX 2318, 1900 W WARLOW UNIT A
GILLETTE, WY 82717
REVISIONS
Date Description
KENDRICK EXPANSION AREA
ER RAI RESPONSE
FIGURE ER RAI GW-6-1
SM AQUIFER SULFATE CONCENTRATION SPATIAL VARIABILITY
Drawn By: MBM
Checked By: RBM
Date: 7/26/16
FILE: KPA1_POT_SM_SULFATE
WWC ENGINEERING
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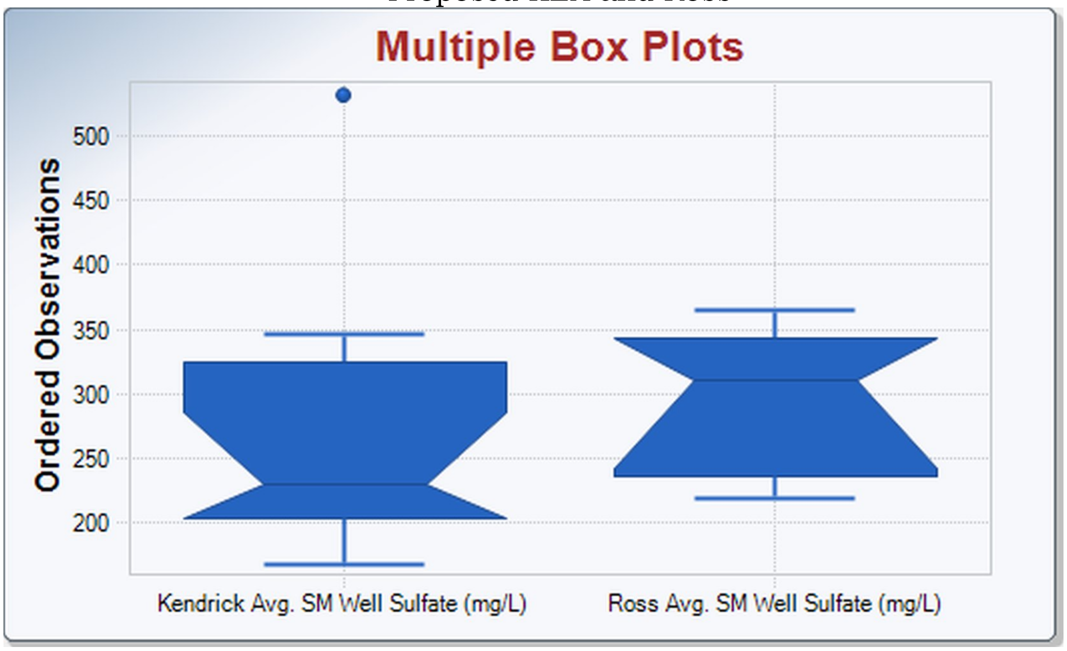
Figure ER RAI GW-6-2. SM Aquifer Sulfate Variability Comparison between Proposed KEA and Ross



RAI – GW-7 Current Ground Water Use

Kendrick ER Section 4.4.2.2.4 states that Strata "plans to work with the oil company to abandon the wells and replace them with an alternate well," referring to existing oil production water wells that would be impacted by Kendrick operations. Provide a summary of any existing agreements, plans, or permit conditions in place at Ross that may serve as the basis for this approach.

ER RAI GW-7 Response

LC 10.19 of SUA-1601 requires Strata to demonstrate in the wellfield data package that proposed operations are outside of the area of influence of the industrial wells when operations are conducted south of the Little Missouri River. Furthermore, the LC stipulates that if principle activities are being conducted at a wellfield and operations of the onsite industrial water supply wells have not been discontinued, the effluent monitoring program will include monthly sampling of water pumped from the industrial wells.

In accordance with commitments in the approved license application, Strata has entered into an agreement with the oil production company operating within the Ross license area to abandon the existing industrial water supply wells when Strata's ISR operations may interfere with the wells. As part of the agreement, Strata will provide an alternate source of water to replace the existing industrial water supply wells. Strata anticipates that this agreement will serve as a template for any future agreements that may be necessary to avoid interference with other water supply wells in the proposed KEA.

RAI – GW-8 Well Classification

Kendrick ER Section 3.4.3.4.1.2 provides ground water well classifications. The calculations performed by Strata did not appear to take into account adjusted gross alpha activity (GAA) in accordance with the EPA Radionuclides Rule. Indicate whether GAA was considered and if not, why this adjustment was considered unnecessary. Alternatively, provide revised calculations taking GAA into account.

ER RAI GW-8 Response

The gross alpha activity reported in the Kendrick ER did not take into account adjusted gross alpha activity (GAA). The tables in Appendix D include the adjusted GAA and the updated well classification and comparison to standards tables from Kendrick ER Section 3.4.3.4.1.2. The revised tables provide the gross alpha adjusted to remove uranium activity using a dissolved uranium mass-to-activity conversion factor of 0.67 pCi/µg as specified in 40 CFR § 141.25.

The revised tables in Appendix D show that for the SM and OZ zones, there is no change in the probable groundwater classifications whether gross alpha or adjusted GAA is used. For the SM interval, none of the regional baseline monitor wells exceeded the gross alpha WDEQ class of use standards or EPA MCL previously, and the adjusted GAA values are also below the standards. For the OZ interval, 9 of 12 wells exceeded the WDEQ class of use standards and EPA MCL in one or more samples based on the unadjusted and adjusted GAA. For these reasons Kendrick ER Tables 3.4-34, 3.4-35, 3.4-37, and 3.4-38 do not change as a result of using adjusted GAA. For the SA interval, four wells that were previously shown to exceed the gross alpha WDEQ class of use standards and EPA MCL do not exceed the respective standards when adjusted GAA is considered. Table 3 in Appendix D provides the adjusted GAA values for the SA interval wells.

RAI – GW-9 Deep Monitoring Zone Monitoring

Kendrick ER Section 3.4.3.3, pages 3-100 to 3-102, concludes that the deep monitoring (DM) zone is not an aquifer due to lack of significant yield. Kendrick TR Section 3.1.6, pages 3-10 to 3-12, proposes a phased approach to DM monitoring based upon criteria including the thickness of the confining shale above the DM (i.e., BF1 or BF2), thickness of the DM, DM characteristics (i.e., permeability), and well performance (yield). Strata also submitted a request to the NRC to amend LC 11.3 to reflect Strata's position that the DM is typically not an aquifer. Based on data and operational experience from Ross Mine Unit 1, provide an analysis of the impacts assuming that the NRC approves this amendment request, versus those if the request is not approved. The analysis should address how the reduced or lack of DM monitoring affects ground water and operations in comparison to the retention of DM monitoring as currently addressed in the Ross license.

ER RAI GW-9 Response

As part of the MU1 wellfield data package, Strata conducted a detailed analysis of the expected yield from the DM wells (Strata 2015a). Attachment 5 (the Aquifer Test Report) of the MU1 wellfield data package shows that the average estimated yield from the DM interval wells is 0.06 gpm, and the average calculated hydraulic conductivity is 0.001 ft/day. The average yield of 0.06 gpm is insufficient to be usable for stock watering, which is the primary use of wells in the area. Furthermore, due to the significant depth to the DM interval, it would not be economically feasible to construct DM water supply wells considering the low yield and the fact that there are multiple higher yielding aquifers above the DM interval. As a result, Strata does not consider the DM interval to be a usable aquifer, so any potential water quality or quantity impacts to the interval would have no effect on public health or the environment.

During development of the MU1 wellfield data package, Strata also characterized the water quality in the DM interval. As described in Section 6.2.7 of the MU1 wellfield data package, the chloride concentration in the DM interval averaged 559 mg/L, which was more than 70 times the average concentration in the OZ wells. A comparison of DM interval water quality to the WDEQ groundwater class of use standards indicates that the groundwater in all DM wells is not suitable for domestic or agricultural use (Class I or Class II). Although the water quality is likely suitable for livestock use (Class III), the limited yield precludes use of the DM interval as a stock water source. Due to the poor quality of the water found in the DM interval, if there were mixing from the OZ interval, the concentrations of some constituents including chloride likely would be improved rather than degraded.

If the request to amend LC 11.3 of the SUA-1601 is not approved, Strata will continue twice monthly excursion monitoring of the DM wells. During excursion monitoring, water is removed from the DM wells, which draws down the water level in the DM interval. This decline in the DM water level increases the hydraulic gradient between the OZ and DM interval, which increases the risk of water from the OZ interval entering the

DM interval if there is a hydraulic conduit present. The withdrawals of water during sampling all result in consumptive use of groundwater from the DM interval. Conversely, if the license amendment request is approved, there would be no twice monthly sampling events, the water levels in the DM interval would remain unchanged, and no water would be removed from the DM interval. Practically, there would be no potential impacts to public health or the environment regardless of whether the license amendment request is granted or denied, since water from the DM interval is not currently used and does not have adequate quality or quantity to support future use.

If the license amendment request is approved, there is a small chance that if there were a hydrologic conduit between the OZ and DM intervals, the water quality in the DM interval could be impacted by fluids from the OZ interval and not detected. However, as discussed previously, the hydraulic conductivity of the DM interval is extremely low. As such, if fluids from the OZ aquifer were to reach the DM interval, it is unlikely that they would move out of the vicinity of the impacted area and affect a large portion of the DM interval. Since the hydraulic conductivity of the DM interval is so low, it is anticipated that in the event of communication only very small volumes of fluid would be able to transfer into the DM interval, which would likely have negligible impacts on the DM interval.

There is the potential that portions of the DM interval may produce more water than those evaluated in MU1. As described in the license amendment request, in those areas where the DM interval may yield higher volumes of water, it would be monitored as part of the excursion detection program required by LC 11.3.

Terrestrial Ecology

RAI – TER-1 Habitat Disturbance

Add to Kendrick ER Table 3.5-1 a column that indicates the number of acres expected to be disturbed for each habitat type, and a column that indicates the percentage of that habitat that would be disturbed. Include a statement with information about any assumptions about how disturbances were estimated. For example, indicate whether Strata assumed that only a small part of the wellfield extent would be disturbed (i.e., around the injection and extraction wells), or whether there is a larger assumed area.

ER RAI TER-1 Response

Figure ER RAI TER-1-1 depicts the vegetation classifications and habitat types from Kendrick ER Figure 3.5-2 along with proposed facilities from Kendrick ER Figure 2.1-1. Table ER RAI TER-1-1 provides the number of acres expected to be disturbed within each habitat type and the corresponding percentage of each habitat type that would be disturbed. The following assumptions were used to calculate the disturbed area.

1. Wellfield disturbance was calculated as the entire wellfield pattern area. This method provides a conservatively high estimate of surface disturbance, since some of the land between injection and recovery wells would remain undisturbed.
2. Estimated disturbance corridor widths for access roads and pipelines are as follows:
    a. Secondary access road – 25 feet
    b. Secondary access road with pipeline – 35 feet
    c. Tertiary access road – 8 feet
    d. Pipeline – 25 feet

Note that there are two instances where the disturbance of a vegetation or habitat type is anticipated to be significantly lower than what is shown in Table ER RAI TER-1-1. These include the Reservoir/Stockpond and Wetland habitat types. As described in Kendrick ER Section 5.4.1.2, facilities generally would be placed outside of the 100-year flood inundation area, which means that surface water features including reservoirs, stockponds, and wetlands would be avoided where possible. The simple overlay of Kendrick ER figures used to create Figure ER RAI TER-1-1 does not include wellfield-specific details showing how the surface water features would be avoided. These details would be provided prior to operations in wellfield data packages prepared for each mine unit in accordance with LC 10.13 of SUA-1601. Further, Kendrick ER Section 5.4.1.3 describes how Strata would mitigate potential impacts to wetlands by enhancing existing wetlands or constructing new wetlands, as required by the U.S. Army Corps of Engineers.

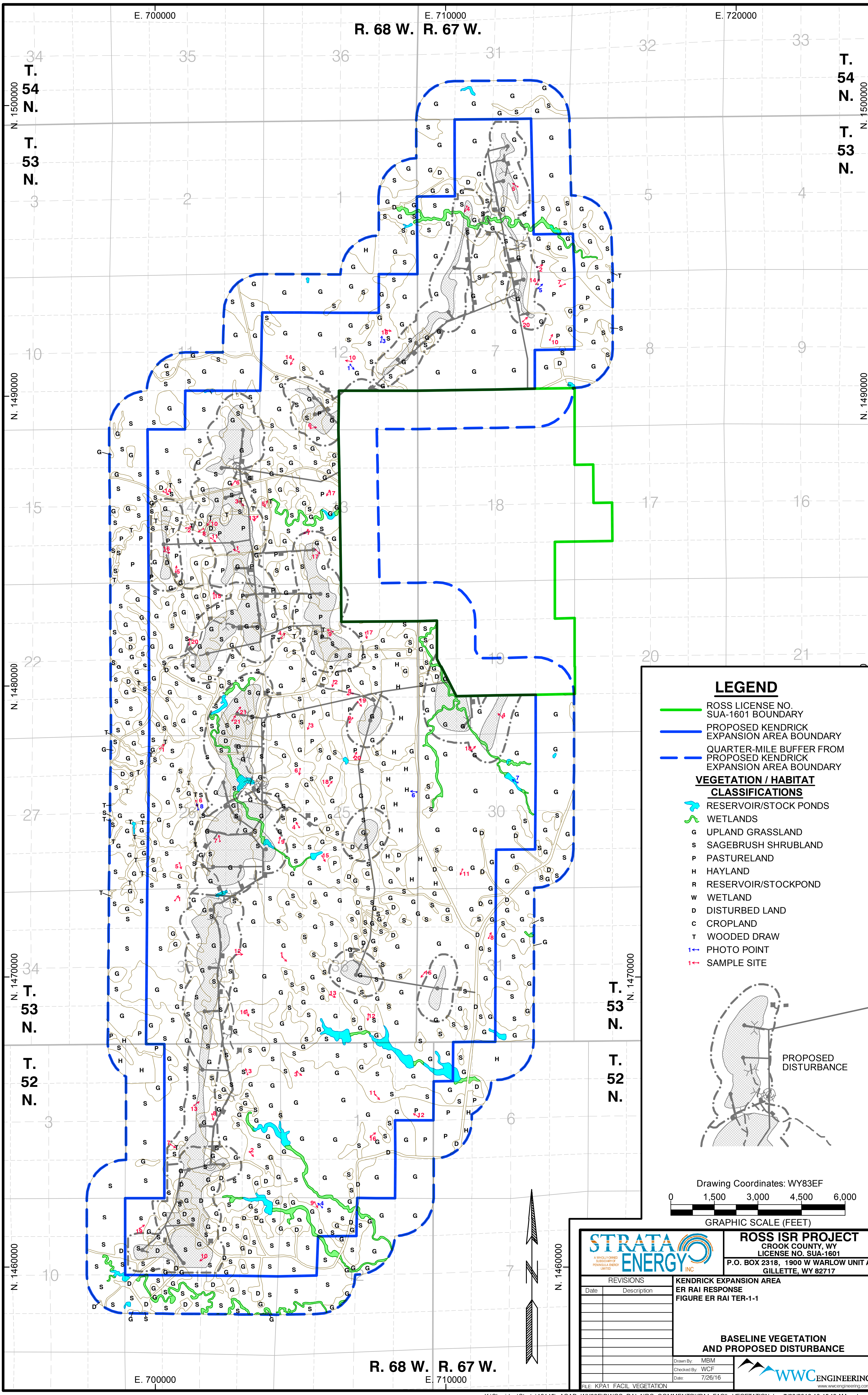
Table ER RAI TER-1-1. Vegetation or Map Unit Survey Results and Anticipated Disturbance

Vegetation or Habitat Type[1]	Proposed KEA		Anticipated Disturbance	
	Acres	**%**	**Acres**	**% of Vegetation or Habitat Type Disturbed**
Upland Grassland	4,430.3	56.3	565.9	12.8
Sagebrush Shrubland	2,407.3	30.5	310.4	12.9
Pastureland	518.1	6.6	107.2	20.7
Hayland	202.5	2.6	1.9	0.9
Reservoir/Stockpond[2]	37.6	0.5	4.6	12.2
Wetland[2]	47.9	0.6	7.7	16.1
Wooded Draw	36.5	0.5	5.7	15.6
Disturbed Land	193.5	2.4	46.6	24.1
Total	**7,873.7**	**100.0**	**1,050.0**	**-**

[1] See Figure ER RAI TER-1-1.

[2] See Kendrick ER Table 3.4-20; potential wetland areas identified in ER Table 3.4-20 include both Wetland and Reservoir/Stockpond vegetation map unit in this table.

Source: Intermountain Resources 2014 Kendrick Project Vegetation Survey (Kendrick ER Addendum 3.5-A)


R. 68 W. R. 67 W.
T. 54 N.
T. 53 N.
T. 52 N.
E. 700000
E. 710000
E. 720000
N. 1500000
N. 1490000
N. 1480000
N. 1470000
N. 1460000
LEGEND
ROSS LICENSE NO. SUA-1601 BOUNDARY
PROPOSED KENDRICK EXPANSION AREA BOUNDARY
QUARTER-MILE BUFFER FROM PROPOSED KENDRICK EXPANSION AREA BOUNDARY
VEGETATION / HABITAT CLASSIFICATIONS
RESERVOIR/STOCK PONDS
WETLANDS
G UPLAND GRASSLAND
S SAGEBRUSH SHRUBLAND
P PASTURELAND
H HAYLAND
R RESERVOIR/STOCKPOND
W WETLAND
D DISTURBED LAND
C CROPLAND
T WOODED DRAW
PHOTO POINT
SAMPLE SITE
PROPOSED DISTURBANCE
Drawing Coordinates: WY83EF
0 1,500 3,000 4,500 6,000
GRAPHIC SCALE (FEET)
STRATA ENERGY INC
ROSS ISR PROJECT
CROOK COUNTY, WY
LICENSE NO. SUA-1601
P.O. BOX 2318, 1900 W WARLOW UNIT A
GILLETTE, WY 82717
REVISIONS
Date Description
KENDRICK EXPANSION AREA
ER RAI RESPONSE
FIGURE ER RAI TER-1-1
BASELINE VEGETATION AND PROPOSED DISTURBANCE
Drawn By: MBM
Checked By: WCF
Date: 7/26/16
WWC ENGINEERING
FILE: KPA1_FACIL_VEGETATION
K:\Sheridan\Strata\12145_ACAD_WY83E\DWGS_RAI_NRC_COMMENTS\KPA1_FACIL_VEGETATION.dwg 7/28/2016 10:45:19 AM mal mcgill

RAI – TER-2 Maintenance Practices

Provide specific details on operational and maintenance (O&M) practices that would take place during Kendrick activities that could affect biota (e.g., describe the practice of swabbing and its frequency). Kendrick ER Section 4.5.1.2 anticipates that O&M impacts would be less than construction impacts. Provide a statement of how much and what kind of project activity would typically occur within Kendrick during O&M to serve as the basis for a conclusion about potential impacts to biota. For example, would one vehicle travel and check wellfields each day?

ER RAI TER-2 Response

As described in Kendrick ER Section 4.5.1.2, the primary reason that there would be less potential impacts to vegetation and wildlife during the operation phase of the Proposed Action compared to the construction phase is that most potential terrestrial ecology impacts would be caused by surface disturbance associated with construction activities. Section 4.5.1.2 also describes how there would be decreased vehicular traffic during operations, which would decrease the risk of vehicular collisions with wildlife and noise that could disrupt wildlife populations. As requested, this RAI response provides additional information about anticipated activities during the operation phase with potential to impact biota. Operation and maintenance activities that would take place within the proposed KEA during operation include routine inspection and monitoring of the wellfield facilities; excursion monitoring and environmental sampling; well mechanical integrity testing (MIT) and workover activities; and response/cleanup to any leaks or spills. A description of each O&M activity is included below. Table ER RAI TER-2-1 shows estimated vehicle trip frequencies associated with each activity. The table shows that the estimated frequency of trips associated with O&M activities within the proposed KEA is anticipated to average about 6 vehicles per day. By comparison, Kendrick ER Section 4.2.1.1 describes how wellfield construction would be carried out by approximately 25 people. At 1 to 4 people per vehicle, this would result in 7 to 25 vehicles per day for wellfield construction, which is more than during operation and represents a greater potential impact to biota.

Routine inspection and monitoring of the wellheads, module buildings, valve vaults, and booster pump stations would be conducted during operations. Strata has instituted a continuous wellfield monitoring program for the Ross ISR Project, where roving wellfield personnel routinely visit wellfield facilities in order to comply with the inspection and monitoring frequencies required by SUA-1601. As stated in Kendrick TR Section 5.3, Strata will extend the continuous wellfield monitoring program to the KEA facilities.

Excursion monitoring of the perimeter, overlying, and underlying monitor wells would be conducted on a twice monthly basis during operations in accordance with LC 11.5 of SUA-1601. In addition, an environmental monitoring program would be instituted as specified in Table 6.1-1 of the Kendrick ER. The program would include sampling of water supply wells, surface water, air, soil, sediment, and direct radiation at intervals ranging from weekly to annually.

In accordance with LC 10.5 of SUA-1601, injection, recovery, and monitor wells at the KEA would require MIT every 5 years, or whenever well maintenance activities require the use of equipment or procedures which could damage the well. Routine MIT would be staggered so that within a 5-year period, all wells would receive testing. In addition, well workover activities such as swabbing and well enhancement are currently being conducted on a daily basis at the Ross ISR Project. It is likely that these activities would also be required in the KEA wellfields.

As described in Kendrick ER Section 4.5.1.2, operational activities also may include spill response and cleanup in the event of an unanticipated leak or spill. Potential impacts would be mitigated by implementing approved spill response procedures and restoring and re-seeding areas where contaminated soil has been removed.

Table ER RAI TER-2-1 Anticipated Vehicle Trip Frequencies Associated with O&M Activities

O&M Activity	Estimated Vehicle Frequency	Vehicle Type
Wellfield Inspection and Monitoring	2 vehicles/day	Pickup truck
Excursion Monitoring	1 vehicle/day	Pickup truck
Environmental Sampling	<1 vehicle/day	Pickup truck
Well MIT	<1 vehicle/day	Pickup-mounted MIT unit
Well Workover Activities	2 vehicles/day	Pickup-mounted pulling unit and water truck
Spill Response and Cleanup	<1 vehicle/day (as needed)	Pickup truck and trailer-mounted pump
Total:	**6 vehicles/day**[1]	

[1] Conservatively assumes that the combination of environmental sampling, well MIT, and spill response and cleanup would result in 1 vehicle/day.

Aquatic Ecology

RAI – AQ-1 Seeps/Springs

Kendrick ER Section 3.5.4.2.7 states that some perennial seeps/springs are present. However, the ER does not describe their link to the potentially impacted aquifer. There is no mention as to the importance of this habitat type to the aquatic setting.

A. If these seeps/springs are linked to the potentially impacted aquifer, describe the potential impacts to aquatic resources that are present in them.

ER RAI AQ-1(A) Response

The springs and seeps referenced in Kendrick ER Section 3.5.4.2.7 are not fed by the potentially impacted aquifer, but are rather fed by surface runoff. As described in the response to ER RAI GW-1(A), these small seeps occur immediately after large precipitation events and snowmelt and from infiltration from “man-made” impoundments storing surface water. They are not linked to the potentially impacted aquifer. As stated in Kendrick ER Section 3.4.2.2, all aquatic resources that are not “man-made” are wetlands that occur along the ephemeral or intermittent streams within the proposed KEA, with most classified as seasonally flooded.

RAI – AQ-1 Seeps/Springs

Kendrick ER Section 3.5.4.2.7 states that some perennial seeps/springs are present. However, the ER does not describe their link to the potentially impacted aquifer. There is no mention as to the importance of this habitat type to the aquatic setting.

B. *Describe the maintenance practices to be implemented (if needed) for wetlands or springs/seeps.*

ER RAI AQ-1(B) Response

No maintenance practices would be implemented for springs and seeps, since there is no link between these features and the potentially impacted aquifer. Maintenance practices for wetlands within the proposed KEA would be limited to ensuring that the water source for the wetlands is left undisturbed. Mitigation measures described in Section 5.4.1.3 of the Kendrick ER would be implemented to ensure that the Proposed Action does not result in a net loss of wetlands.

Meteorology, Climatology, and Air Quality

RAI – AIR-1 Kendrick-Specific Emissions Data

Kendrick ER Section 4.6 refers to the Ross air emissions analysis instead of performing one specifically for Kendrick. Ross SEIS Section 4.7.1.1 refers to the ISR Generic Environmental Impact Statement (NUREG-1910) and its analysis for the ISR facility in Crownpoint, NM, for assessing possible offsite concentrations of air pollutants.

A. *Kendrick emissions are not quantified. Ross SEIS Table 4.4 provides emissions data by year. Provide similar data for the years in which Kendrick would be operating. Specifically, for purposes of use in the Kendrick SEIS, expand upon Table 5-2, "Emissions Summary," of the "Air Quality Permit Application Chapter 6, Section 2, Wyoming Air Quality Standards and Regulations – Ross In-Situ Uranium Recovery*

ER RAI AIR-1(A) Response

Table ER RAI AIR-1-1 summarizes maximum estimated emissions from the Ross ISR Project, including within the current Ross license area and proposed KEA. The maximum annual yellowcake production of 3 million pounds per year and the maximum recovery flow rate of 7,500 gpm would not increase under the Proposed Action, which would extend the operating life of the central processing plant (CPP) and related infrastructure installed for the Ross ISR Project. Therefore, equipment fleet sizes, activity levels, and emission rates for the Proposed Action are projected to be the same, by project phase, as those originally projected for the Ross ISR Project. The difference is that the emissions would occur over a longer period than for Ross alone, and the four project phases would overlap differently, as explained below.

Table ER RAI AIR-1-2 shows the potential schedule, by phase, for the Ross ISR Project assuming the Kendrick license amendment is issued within 4 years of the commencement of wellfield construction within the current license area. This table is a synthesis of Kendrick ER Figure 1.4-1. All four project phases are anticipated to be active during years 6 through 13. As a result, these 8 years reflect the highest total emissions. The potential overlap of four project phases explains the relatively higher emissions during this time period compared to those evaluated for the Ross ISR Project, where it was not projected that all four project phases would overlap. In addition, since the net disturbance area would change from year to year, particulate (PM_{10} and $PM_{2.5}$) emissions are projected to vary due to the contributions from wind erosion (Table ER RAI AIR-1-3). Maximum particulate emissions from wind erosion are expected to occur in year 12 (80.4 tons PM_{10}), making this the highest year for overall PM_{10} emissions (356.9 tons).

Table ER RAI AIR-1-1. Potential Air Emissions for Life of Proposed Action

Units and Type of Emissions	Year after License Amendment Issuance																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Tons PM_{10}	184.8	198.3	200.0	197.5	199.3	290.1	301.2	316.4	335.1	348.0	355.3	356.9	346.1	169.5	153.9	123.2	113.7	97.8	87.4
Tons $PM_{2.5}$	27.7	29.7	30.0	29.6	29.9	43.5	45.2	47.5	50.3	52.2	53.3	53.5	51.9	25.4	23.1	18.5	17.1	14.7	13.1
Tons NO_x	183.4	223.0	223.0	245.7	245.7	310.0	310.0	310.0	310.0	310.0	310.0	310.0	310.0	128.2	128.2	88.6	88.6	65.9	65.9
Tons CO	40.5	49.2	49.2	54.1	54.1	67.9	67.9	67.9	67.9	67.9	67.9	67.9	67.9	28.4	28.4	19.7	19.7	14.8	14.8
Tons SO_2	10.9	13.4	13.4	14.9	14.9	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	8.4	8.4	5.8	5.8	4.3	4.3
Tons TOC	13.4	16.6	16.6	18.4	18.4	23.5	10.3	7.1	7.1	5.3	5.3	5.3	5.3	10.3	10.3	7.1	7.1	5.3	5.3
Tons VOC	0.71	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.71	0.71	0.71	0.71
Tons HAP	3.61	4.24	4.24	4.57	4.57	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	2.81	2.81	2.12	2.12	1.78	1.78
Tons CO_2	7,130	12,245	12,245	13,087	13,087	15,472	15,472	15,472	15,472	15,472	15,472	15,472	15,472	8,457	8,457	3,343	3,343	2,500	2,500
Tons HCl	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00
Tons H_2O_2	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000
Curies Rn-222	0.0	316.2	316.2	631.4	631.4	631.4	631.4	631.4	631.4	631.4	631.4	631.4	631.4	631.4	631.4	631.4	631.4	0.0	0.0

Table ER RAI AIR-1-2. Potential Project Schedule after Issuance of Kendrick License Amendment

Year after License Issued	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Construction Phase	■	■	■	■	■	■	■	■	■	■	■	■	■						
Operation Phase		■	■	■	■	■	■	■	■	■	■	■	■	■	■				
Aquifer Restoration Phase				■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Decommissioning Phase						■	■	■	■	■	■	■	■	■	■	■	■	■	■

Table ER RAI AIR-1-3. Potential Net Disturbance and Estimated Particulate Emissions

Year	Affected Area (acres)			Emissions (tons/year)	
	Disturbed	**Reclaimed**	**Net Exposed**	**PM_{10} Emissions**	**$PM_{2.5}$ Emissions**
1	112.3		112.3	12.8	1.9
2	36.3	67.8	80.9	9.2	1.4
3	36.3	21.8	95.4	10.9	1.6
4	0.0	21.8	73.6	8.4	1.3
5	38.0	21.8	89.8	10.2	1.5
6	65.3	35.6	119.5	13.6	2.0
7	111.9	14.5	216.9	24.7	3.7
8	147.7	14.8	349.9	39.9	6.0
9	182.8	18.4	514.3	58.6	8.8
10	158.2	45.0	627.5	71.5	10.7
11	148.2	84.3	691.4	78.8	11.8
12	138.3	124.4	705.3	80.4	12.1
13	59.1	153.7	610.6	69.6	10.4
14		140.4	470.2	53.6	8.0
15		136.7	333.5	38.0	5.7
16		119.9	213.5	24.3	3.7
17		83.2	130.3	14.9	2.2
18		39.4	91.0	10.4	1.6
19		91.0	0.0	0.0	0.0

RAI – AIR-1 Kendrick-Specific Emissions Data

Kendrick ER Section 4.6 refers to the Ross air emissions analysis instead of performing one specifically for Kendrick. Ross SEIS Section 4.7.1.1 refers to the ISR Generic Environmental Impact Statement (NUREG-1910) and its analysis for the ISR facility in Crownpoint, NM, for assessing possible offsite concentrations of air pollutants.

B. *Project, Crook County, Wyoming" (June 2011) to show years through completion (about year 20) of the Kendrick expansion.*

<u>ER RAI AIR-1(B) Response</u>

Tables ER RAI AIR-1-1 and AIR-1-2 above show the projected emission rates and overall project schedule with the addition of the proposed KEA.

RAI – AIR-1 Kendrick-Specific Emissions Data

Kendrick ER Section 4.6 refers to the Ross air emissions analysis instead of performing one specifically for Kendrick. Ross SEIS Section 4.7.1.1 refers to the ISR Generic Environmental Impact Statement (NUREG-1910) and its analysis for the ISR facility in Crownpoint, NM, for assessing possible offsite concentrations of air pollutants.

C. *Kendrick ER Section 4.6 cites the Ross data, and Ross SEIS Section 4.7 discusses potential pollutant concentrations. Clarify how the Kendrick emissions overlap with the Ross emissions.*

ER RAI AIR-1(C) Response

Figure 1.4-1 in the Kendrick ER superimposes the anticipated project schedule under the Proposed Action, which includes eight mine units, with the anticipated schedule for the currently licensed Ross ISR Project. Projected emission rates are based on the years in which each project phase is active, with emissions from a given phase having already been established in the approved Ross license application and air permit application. For each year, Table ER RAI AIR-1-1 presents the sum of emissions from all project phases active at the current Ross license area and proposed KEA in that year. Table ER RAI AIR-1-2 provides the overall schedule of active phases.

RAI – AIR-2 Kendrick Air Permit Information

Provide the following related to the air permit application for Ross, as amended for Kendrick:

A. Provide specifics on expected release points at Ross and Kendrick.

ER RAI AIR-2(A) Response

Since the recovery solution (uranium-enriched lixiviant) from wellfields within the proposed KEA would undergo uranium recovery and, potentially, yellowcake processing at the CPP within the current Ross license area, CPP emission release points would remain the same. Wellfield release points would follow the active mine units shown in Kendrick ER Figure 2.1-1.

RAI – AIR-2 Kendrick Air Permit Information

Provide the following related to the air permit application for Ross, as amended for Kendrick:

> B. *Describe gaseous effluent control systems.*

ER RAI AIR-2(B) Response

The principal source of gaseous emissions would be internal combustion engine exhaust. In general, light vehicles and commercial trucks would be equipped with standard engine controls to meet applicable EPA exhaust standards. For construction equipment (e.g., drill rigs, excavators, mobile equipment, etc.), no special engine controls are in place within the current Ross license area, and none are planned within the proposed KEA. For conservatism, uncontrolled engine emission factors from AP-42 have been incorporated into the emissions inventory for all engines.

RAI – AIR-2 Kendrick Air Permit Information

Provide the following related to the air permit application for Ross, as amended for Kendrick:

C. *Provide the models and assumptions used to determine concentrations, if included in the air permit application.*

ER RAI AIR-2(C) Response

The Ross ISR Project air permit application to the Wyoming Department of Environmental Quality, Air Quality Division (WDEQ/AQD) did not contain modeling of ambient pollutant concentrations. WDEQ/AQD does not require an air quality impact analysis for ISR projects. Certain ISR projects have been modeled in conjunction with NEPA actions, but not for regulatory purposes.

RAI – AIR-2 Kendrick Air Permit Information

Provide the following related to the air permit application for Ross, as amended for Kendrick:

D. Provide concentrations at points outside the site boundary, if included in the air permit application.

ER RAI AIR-2(D) Response

Refer to the response to ER RAI AI-2(C). WDEQ/AQD does not require an air quality impact analysis for ISR projects.

RAI – AIR-3 Particulate Emission Controls and Mitigation Measures

For drill rigs, identify the type of engines (i.e., Tier 1 or Tier 2) being used, and whether add-on controls such as catalyst and diesel particulate filters to achieve lower emission rates are being used. For controlling visible dust plumes at the project site, describe the actions and timeframes for those actions if a visible plume is observed.

ER RAI AIR-3 Response

The drill rigs currently used by Strata are older than 1998 and may include some Tier 1 engines. No add-on controls are currently being used. As discussed in the RAI AIR-2(B) response, no specific engine controls are assumed for the drill rigs, either within the current Ross license area or proposed KEA. Equipment fleets owned by Strata or its contractors, including drill rigs, are selected based on availability.

Fugitive dust at the project site would be routinely mitigated through the application of dust suppressant (water and/or magnesium chloride), the enforcement of speed limits, and prompt revegetation of disturbed areas. Beyond these standard practices, visible dust plumes will be immediately addressed through targeted application of water spray. As described in the response to ER RAI SW-5, fugitive dust on county roads has been and would continue to be mitigated through providing assistance to Crook County to apply magnesium chloride to county roads both within and outside of the current Ross license area under the terms of the MOU between the Crook County and Strata. In addition, Strata worked with Crook County to place crushed limestone on portions of the New Haven Road and D Road, and landowners have commented that this has significantly reduced dust on the affected road segments.

RAI – AIR-4 Kendrick and Ross Greenhouse Gas Emissions

Update the estimates of greenhouse gases and other releases in Tables 5.5, and 5.6 of the Ross SEIS for Kendrick.

ER RAI AIR-4 Response

Table ER RAI AIR-4-1 lists the estimated greenhouse gas (GHG) emissions for the Ross ISR Project and the Proposed Action during the peak emissions year. Combustion emissions from diesel powered equipment have been updated and combined with emissions from the diesel generator. A comparison between Table ER RAI AIR-4-1 and Ross SEIS Table 5.6 shows that the only increase in direct GHG emissions would be related to diesel powered equipment, since the Proposed Action would not increase the recovery flow rate or yellowcake production rate. The reason for the increase in diesel powered equipment operation is the anticipated overlap of all four project phases under the Proposed Action, as explained in the response to ER RAI AIR-1(A).

Indirect GHG emissions have been added to the quantities reported in the Ross SEIS. Current practice of reporting GHG emissions is to estimate electricity consumption and include potential GHG emissions from the off-site generation of this electricity.

Table ER RAI AIR-4-2 relates the maximum estimated GHG emissions shown in Table ER RAI AIR-4-1 to U.S. and global GHG emissions in 2013.

Table ER RAI AIR-4-1. Estimated Maximum Annual Direct and Indirect Greenhouse Gas Emissions under the Proposed Action

MAXIMUM-CASE YEAR (METRIC TONS/YEAR)	
CO_2 from Uranyl Tricarbonate Breakdown	640
CO_2 from Sodium Bicarbonate in Eluate	775
CO_2 from Product Drying	871
CO_2 from Space Heaters	1,049
CO_2 from Diesel Powered Equipment	14,036
TOTAL Direct GHG Emissions	17,371
CO_2e from Electricity Consumption	10,601
TOTAL Direct and Indirect GHG Emissions	27,972

Table ER RAI AIR-4-2. Comparison to U.S. and Global Greenhouse Gas Emissions

United States (EPA, tonnes in 2013)	6,673,000,000
Proposed Action % of U.S.	0.00042%
Global (JRC, tonnes in 2013)	35,300,000,000
Proposed Action % of Global	0.00008%

Noise

RAI – NOI-1 Estimated Noise Levels

Kendrick ER Section 4.7.1.1.1 states that Table 4.7-1 shows the estimated noise levels for construction equipment 1,462 feet away (minimum distance from planned well and nearby residence). It states that "the table shows that the maximum estimated noise level at a nearby residence, resulting from a drill rig operating at the closest potential well location, would be well below the nuisance level of 55 dBA." However, Table 4.7-1 shows that the drill rig would have the lowest noise level of all the construction equipment at a point 1,462 feet away, and all of the other equipment listed in the table would have a maximum noise level of 50 dBA or higher, with 9 of the 12 equipment types listed having a maximum noise level above the nuisance level of 55 dBA. Clarify the ER's conclusion based on the data in the table.

ER RAI NOI-1 Response

Kendrick ER Table 4.7-1 provides noise level ranges for a variety of construction equipment at the residence closest to a proposed perimeter monitor well location. The reason that the text in Kendrick ER Section 4.7.1.1.1 focused on noise from a drill rig is that the drill rig would be the primary piece of equipment operating closest to the nearest residence due to monitor well construction. For perimeter monitor well installations, most of the equipment listed in Table 4.7-1 would not be necessary. In addition to a drill rig, other common types of equipment used at well locations include compressors, cementing units (the noise from which is estimated to be at or below that from a concrete mixer listed in Table 4.7-1), and backhoes. Although Table 4.7-1 shows that all three of these types of equipment have the potential to slightly exceed the annoyance noise threshold of 55 dBA in the worst-case scenario (i.e., the closest monitor well to the residence), the duration that these other types of equipment would be used at a well location is much shorter than that for a drill rig and varies considerably depending on the intensity of the particular task the equipment is assigned. Typical backhoe use at a drill site rarely exceeds 1 hour at a time and normally occurs during construction of the drill pit, intermittently during drilling/well installation for short periods of time, and during reclamation of the drill site. Similarly, cement-based grout is mixed during a relatively short period of time during well construction, and the cementing unit is normally operated for less than 1 hour. Drilling and installing a monitor well require approximately 8 to 10 hours per day for 2 days of continuous engine and equipment noise from the drill rig, which would have greater potential to result in noise impacts to the nearest residence than the short duration, less frequently used equipment during well construction.

RAI – NOI-2 Noise Receptors at Kendrick

Kendrick ER Section 3.7 relies on the baseline noise study done for Ross in 2010, described in Ross ER Section 3.7.3 and Addendum 3.7-A and Ross SEIS Section 3.8. Clarify further that this baseline remains accurate for Kendrick by:

A. *Indicating how long it takes to construct a well (i.e., how long would the receptor be hearing the noise), whether other residences (besides the nearest) are close enough to a planned well to experience these levels, and how many wells are planned at those locations.*

ER RAI NOI-2(A) Response

Typical perimeter monitor well drilling and construction require approximately 2 days per well. The next two proximal residences at distances of 2,473 and 3,140 feet from the nearest proposed perimeter monitor well locations would experience less annoyance level noise due to both distance and topography. Figure ER RAI VIS-1-1, provided with the response to ER RAI VIS-1, depicts the approximate perimeter monitor well rings and nearby residences. The closest residence lies southeast of proposed Mine Unit A (1,462 feet), the next proximal residence is located southeast of proposed Mine Unit G (2,473 feet), and the next proximal residence is located east of proposed Mine Unit A (3,140 feet). At a distance of 2,473 feet from a perimeter monitor well, only a backhoe would have the potential to exceed the annoyance noise level, with an estimated range of 38-56 dBA. At a distance of 3,140 feet, all of the equipment anticipated to be operated would generate less noise than the 55 dBA annoyance level. As discussed in the response to ER RAI NOI-1, the duration of backhoe use at a typical drill site rarely exceeds 1 hour at a time. Therefore, the potential impacts to other residences would be minor. The perimeter monitor well networks are comprised of a ring of wells surrounding a wellfield pattern area. The wells are typically spaced up to 400 feet apart and at similar distances from the pattern areas. Based on the geometry of the potential wellfield and the spacing between perimeter monitor wells, up to three perimeter monitor wells could be close enough to the second nearest residence to slightly exceed the annoyance threshold during infrequent and relatively short duration backhoe operation.

RAI – NOI-2 Noise Receptors at Kendrick

Kendrick ER Section 3.7 relies on the baseline noise study done for Ross in 2010, described in Ross ER Section 3.7.3 and Addendum 3.7-A and Ross SEIS Section 3.8. Clarify further that this baseline remains accurate for Kendrick by:

B. Indicating whether any of the residences are sufficiently close to planned road construction to experience noise from those activities, and if so how long they would generally be exposed.

ER RAI NOI-2(B) Response

The minimum distances between proposed secondary access roads and the three nearest residences are approximately 2,190, 3,137, and 3,713 feet, respectively, as depicted on Figure ER RAI VIS-1-1 provided with the response to ER RAI VIS-1. Using the equation in Kendrick ER Section 4.7.1.1 along with the estimated noise levels in Kendrick ER Table 4.7-1, the estimated noise level at the nearest residence for the two most commonly used pieces of equipment for secondary access road construction would be 46-60 dBA for a grader and 49-63 dBA for a heavy truck using a belly dump. Front-end loaders may also be used and would have estimated noise levels ranging from 39-57 dBA at the nearest residence. Typical duration of operation for these types of equipment for construction of secondary access roads is no more than 1 day. Furthermore, all three nearest residences are significantly closer to gravel county roads than to the nearest secondary access roads and therefore would be subject to significantly more noise from bentonite hauling and other traffic on the county roads than from secondary access road construction within the proposed KEA.

RAI – NOI-2 Noise Receptors at Kendrick

Kendrick ER Section 3.7 relies on the baseline noise study done for Ross in 2010, described in Ross ER Section 3.7.3 and Addendum 3.7-A and Ross SEIS Section 3.8. Clarify further that this baseline remains accurate for Kendrick by:

C. *Indicating whether the residences considered in the Ross study are representative of those closest to potential noise-generating activity at Kendrick, as well as roads where increased traffic will travel over a longer time than estimated in the Ross SEIS.*

ER RAI NOI-2(C) Response

The Ross ER Section 3.7.3 evaluated baseline noise levels at three nearby residences (Strata Field Office, residence N-1, which is the residence located southeast of the Ross CPP in Figure ER RAI VIS-1-1, and residence N-2, which is located east-northeast of the Ross CPP in Figure ER RAI VIS-1-1). The distances from these residences to the nearest existing (Ross) or proposed perimeter monitor well ring are 1,764 feet (N-1), 1,862 feet (Strata Field Office), and 2,436 feet (N-2). In comparison, the response to subpart A of this RAI provides similar distances for the three residences closest to the proposed KEA perimeter monitor well rings, i.e., 1,462, 2,473 and 3,140 feet, respectively. Representativeness is demonstrated by consistent distances from potential noise-generating activity (in this case perimeter monitor well construction). Therefore, the analysis in Kendrick ER Section 4.7, as substantiated by the response to ER RAIs NOI-1 and NOI-2, is representative of potential impacts to nearby residences at both the current Ross license area and proposed KEA.

Ross ER Section 3.7.3 evaluated baseline noise levels at three nearby residences that are all adjacent to the New Haven Road (CR 164), which is on the primary access route to the Ross CPP and, along with D Road (CR 68), the roads most likely to see a longer duration of traffic if the Kendrick amendment is approved. An additional two residences adjacent to D Road are depicted on Figure ER RAI VIS-1-1. With the approval of the Kendrick amendment, these residences would see potential traffic-related noise impacts from extended operations under the Proposed Action. Based on the proximity of these two residences to the D Road, the results of the Ross noise impact study would be representative at these locations. Ross ER Section 4.7.1.1 evaluated potential traffic-related noise impacts at the N-1 residence, which was one of the three nearest residences to the current Ross license area and located adjacent to the primary access route. Based on the results of the detailed noise survey conducted at the Strata Field Office and the relative distance of the N-1 residence to the New Haven Road (600 feet, compared to 50 feet for the field office), it was estimated that the N-1 residence might experience an increase in the frequency of annoyance noise levels related to traffic on the New Haven Road by about 80%. This impact was evaluated during the initial construction phase of the Ross ISR Project, when up to 24 heavy truck trips per day were projected along the primary access route (refer to Ross ER Table 4.2-1). By comparison, the two residences shown near D Road on Figure ER RAI VIS-1-1 are somewhat closer than the N-1 residence to the primary access route (230 to 310 feet as compared to 600 feet). Based on the equation presented in Kendrick ER Section 4.7.1.1.1 and Ross ER Section 4.7.1.1, the noise resulting from heavy truck traffic along the primary access route at the two residences is expected to be about 6 to 9 dBA higher than at the N-1 residence. However, this would be offset by the lower frequency of heavy truck shipments under the Proposed Action compared to that evaluated during the initial construction phase of the Ross ISR Project. Since the Proposed Action does not include construction of additional processing facilities, lined retention ponds, or deep disposal wells, the number of material and equipment shipments would be significantly fewer during construction of proposed KEA wellfields compared to initial Ross construction.

RAI – NOI-2 Noise Receptors at Kendrick

Kendrick ER Section 3.7 relies on the baseline noise study done for Ross in 2010, described in Ross ER Section 3.7.3 and Addendum 3.7-A and Ross SEIS Section 3.8. Clarify further that this baseline remains accurate for Kendrick by:

> *D. Since some activities have begun at Ross, providing information on the resulting noise that would be included in the Kendrick baseline.*

ER RAI NOI-2(D) Response

No operational measurements of noise levels at nearby residences have been conducted following initiation of operations at Ross. However, Strata has an open-door policy for all landowners, and none to date has expressed concern for noise-related impacts due to operations. Furthermore, Strata has conducted noise monitoring at operating drill rigs and cementing units for assessment of occupational noise exposure and determined that the noise levels are consistent with those used to estimate potential noise impacts at nearby residences, as presented in Ross ER Table 4.7-1 and Kendrick ER Table 4.7-1.

Historic and Cultural Resources

RAI – CUL-1 Class III Survey

Provide a qualification statement for the survey principal investigator. The issue of field surveyor's qualifications has come up during previous licensing hearings. Thus, the curriculum vitae should be on file.

ER RAI CUL-1 Response

A curriculum vitae and resume for the Class III survey principal investigator are included in Appendix E to these responses.

RAI – CUL-2 Inadvertent Discovery Plan

Confirm that the current Ross ISR Inadvertent Discovery Plan will be applicable to Kendrick.

ER RAI CUL-2 Response

The Ross ISR Project Inadvertent Discovery Plan (as amended), which is contained in the Strata Environmental Management Program (EMP) will be applicable to all activities conducted under License SUA-1601, including those within the proposed KEA following license amendment approval.

RAI – CUL-3 Effect of Kendrick Effect on Ross Properties

Explain what impact, if any, Kendrick activities will have on identified Ross cultural resources. For example, it appears that Kendrick Mine Unit B crosses over into the Ross project boundary and will potentially affect 48CK2014. There is also a seemingly undesignated mine unit in the southern part of Ross (RAI – GEN-6) that will affect presently unevaluated site 48CK2078. Finally, the perimeter well ring of Kendrick Mine Unit D overlaps into the southwestern part of Ross where a Tribal district eligible for the National Register of Historic Properties is located (48CK2227). The perimeter well ring of Mine Unit D may also encroach on the Tribe component of 48CK2087, which was recorded by the Tribal survey of Ross but lies within Kendrick.

ER RAI CUL-3 Response

The following addresses potential effects to identified cultural resources within the current Ross license area from proposed KEA activities on a site-by-site basis.

Site 48CK2014—Fasting circle and cairn. No direct, project-related adverse effects would occur to the site, as it will be avoided. Indirect effects, primarily visual, may occur due to the nearby presence of uranium mineralization. In order to minimize adverse visual effects, nearby wellhead covers and header houses may be a neutral color (e.g., tan or brown). In order to prevent direct effects, the site boundary will be staked and, if ground disturbing activities are proposed within 100 feet of the site, Strata may use a tribal monitor during excavation of drill pits to ensure the site is not disturbed.

Site 48CK2078—Prehistoric camp site. The site is in the southwest corner of the current Ross license area and remains unevaluated for listing at this time. Evaluative testing of the site was completed in June 2016 with an eligibility recommendation to be provided to NRC staff in the 4th quarter of 2016. If the site is determined to be not eligible for listing on the NRHP, then there cannot be a project effect. However, if the site is eligible for listing, Strata will either avoid the site if possible or conduct data recovery and reporting consistent with either the Ross Programmatic Agreement or subsequent agreement(s).

Site 48CK2087—Cairn and bovine wallows. No direct, project-related effects would occur to the site as it will be avoided. Indirect effects from KEA-related activities may occur and would be primarily visual in nature. In order to minimize indirect effects, Strata may use neutral colors for wellhead covers and header houses. In order to prevent adverse direct effects, the site boundary will be staked. If perimeter monitor wells are required within 100 feet of the site, Strata may employ a tribal monitor during drill pit excavation to ensure the site is not disturbed.

Site 48CK2227—Plant gathering area. Strata will avoid the plant gathering area by moving the adjacent perimeter monitor wells out of the historic district. Therefore, there will be no direct adverse effect to the site. Indirect effects would be primarily visual in nature and may be minimized by the use of neutral colors on nearby wellhead covers and header houses.

Visual/Scenic Resources

RAI – VIS-1 Visibility of Kendrick Activities from Existing Residences

The Kendrick ER and TR do not seem to include specific analysis of Kendrick activities and their visual impact on residences. Provide information on the Kendrick activities that would be visible from existing residences and mitigative steps being taken (such as painting schemes and solicitation of input from stakeholders).

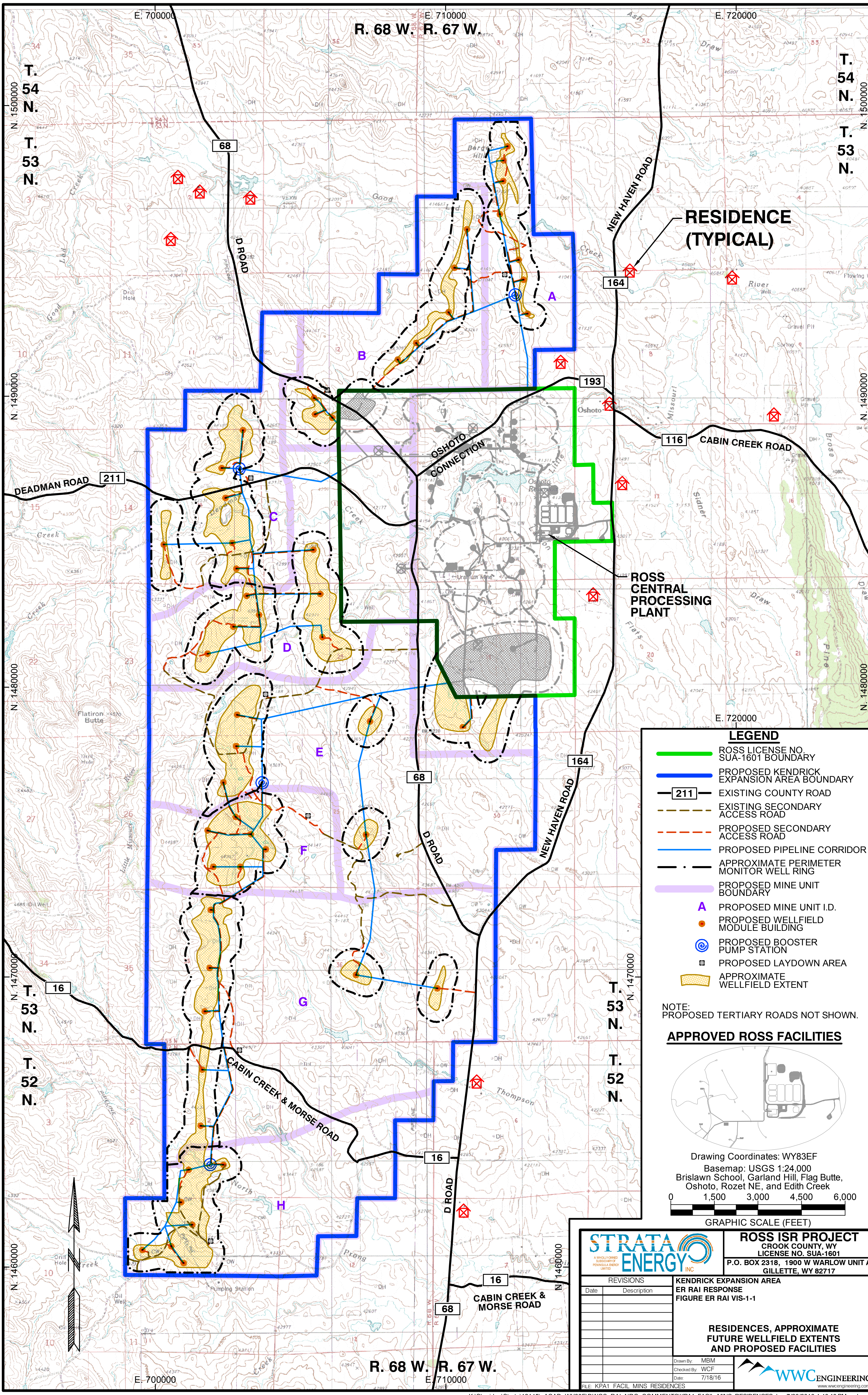
ER RAI VIS-1 Response

Potential visual impacts are discussed in Kendrick ER Section 4.9, and Section 5.9 addresses proposed mitigation measures. Potential impacts during construction primarily would result from wellfield construction, including equipment and fugitive dust. Potential operational impacts would result from the presence of wellhead covers, header houses, booster pump stations, access roads, and overhead power lines, as well as the ongoing mechanical integrity testing and well swabbing/stimulation efforts. Potential aquifer restoration impacts include the altered landscape from infrastructure, well monitoring, and fugitive dust. Decommissioning impacts would be very similar to the construction impacts but would result in a return of the KEA wellfields to a pre-construction landscape.

To reduce or avoid potential visual/scenic resources impacts on nearby residences, Strata has proposed the following mitigation measures in Kendrick ER Section 5.9:

- Using neutral colors for wellhead covers, module buildings, and booster pump stations.
- Revegetating wellfields to help conceal wellhead covers.
- Reclaiming and re-seeding mine units as they receive regulatory approval for aquifer restoration.
- Aligning access roads with the terrain to avoid straight-line appearance and to avoid large cuts and fills.
- Minimizing the amount of nighttime drilling and turning lights away from residences.
- Restricting the proximity of operating drill rigs to any residences at night.
- Preparing a light pollution operational monitoring plan.
- Reducing fugitive dust by using dust suppression, enforcing speed limits, and promptly revegetating disturbed areas.

Proposed project facilities (from Kendrick ER Figure 2.1-1) and nearby residences (from Kendrick ER Figure 3.1-4) are depicted on Figure ER RAI VIS-1-1. Distance and topography will limit the visibility of project activities from the residences, and the mitigation measures discussed in Kendrick ER Section 5.9 and summarized above will further reduce the minor visual effects at these locations.


R. 68 W.
R. 67 W.
T. 54 N.
T. 53 N.
T. 52 N.
E. 700000
E. 710000
E. 720000
N. 1500000
N. 1490000
N. 1480000
N. 1470000
N. 1460000
RESIDENCE (TYPICAL)
ROSS CENTRAL PROCESSING PLANT
OSHOTO CONNECTION
DEADMAN ROAD
D ROAD
NEW HAVEN ROAD
CABIN CREEK ROAD
CABIN CREEK & MORSE ROAD
68
164
193
116
211
16
A
B
C
D
E
F
G
H
LEGEND
ROSS LICENSE NO. SUA-1601 BOUNDARY
PROPOSED KENDRICK EXPANSION AREA BOUNDARY
211 EXISTING COUNTY ROAD
EXISTING SECONDARY ACCESS ROAD
PROPOSED SECONDARY ACCESS ROAD
PROPOSED PIPELINE CORRIDOR
APPROXIMATE PERIMETER MONITOR WELL RING
PROPOSED MINE UNIT BOUNDARY
A PROPOSED MINE UNIT I.D.
PROPOSED WELLFIELD MODULE BUILDING
PROPOSED BOOSTER PUMP STATION
PROPOSED LAYDOWN AREA
APPROXIMATE WELLFIELD EXTENT
NOTE: PROPOSED TERTIARY ROADS NOT SHOWN.
APPROVED ROSS FACILITIES
Drawing Coordinates: WY83EF
Basemap: USGS 1:24,000
Brislawn School, Garland Hill, Flag Butte, Oshoto, Rozet NE, and Edith Creek
0 1,500 3,000 4,500 6,000
GRAPHIC SCALE (FEET)
STRATA ENERGY INC
ROSS ISR PROJECT
CROOK COUNTY, WY
LICENSE NO. SUA-1601
P.O. BOX 2318, 1900 W WARLOW UNIT A
GILLETTE, WY 82717
REVISIONS
Date
Description
KENDRICK EXPANSION AREA
ER RAI RESPONSE
FIGURE ER RAI VIS-1-1
RESIDENCES, APPROXIMATE FUTURE WELLFIELD EXTENTS AND PROPOSED FACILITIES
Drawn By: MBM
Checked By: WCF
Date: 7/18/16
FILE: KPA1_FACIL_MINS_RESIDENCES
WWC ENGINEERING
K:\Sheridan\Strata\12145_ACAD_WY83E\DWGS_RAI_NRC_COMMENTS\KPA1_FACIL_MINS_RESIDENCES.dwg 7/26/2016 4:40:10 PM mal mcgill

Socioeconomics

RAI – SOC-1 Tax Revenue

Supplement the information in the Kendrick ER (Table 4.10-1) and Ross SEIS Section 4.11 to indicate how much of the tax revenue is attributable to Kendrick (including property taxes), and how much accrues to the state vs the county. Provide the amounts of tax payments made for 2015 and to whom. This information will be used to determine impacts of Strata operations on county revenue.

ER RAI SOC-1 Response

Kendrick ER Section 4.10.1.2 discusses potential impacts to Crook County and the State of Wyoming due to tax revenue accruals. To summarize, the taxes are based on the pounds of minerals produced and sold, including severance taxes, State royalties, and production taxes. Kendrick ER Table 4.10.1 provides the estimated major tax revenues attributable specifically to the anticipated uranium production from wellfields within the proposed KEA (i.e., 8.8 million pounds of U_3O_8, as described in Kendrick ER Table 4.10-1 and Section 7.1). Property taxes attributable to the proposed action will include those associated with wellfield construction and associated infrastructure within the proposed KEA, which are estimated to be minimal, and property taxes resulting from continued operation of the Ross CPP for an estimated additional 9 to 11 years under the Proposed Action, which will depend on the level of buildout of the CPP (refer to the response to ER RAI GEN-5). General distribution of the tax revenue is as follows: Crook County receives the production taxes and property taxes based on the county mill levy; the State of Wyoming receives the severance taxes and State royalties.

Strata paid $11,956 in property taxes to Crook County in 2015, which are completely attributable to the currently licensed Ross ISR Project. These taxes were paid on land owned by Strata and based on the level of construction to date of the Ross CPP. Since production did not commence until December 2015, no information from 2015 is available on severance taxes and State royalties. Strata can provide more information regarding tax payments to the State of Wyoming and Crook County in late 2016 or early 2017 if necessary.

Public and Occupational Health

RAI – POH-1 Occupational Injury and Fatality Rates

Clarify whether the occupational injury and fatality rates provided in the Ross RAI responses (ER RAI P&O Health-1a) apply to Kendrick.

ER RAI POH-1 Response

Since licensed activities within the proposed KEA would involve the same types of tasks to be performed and risks to be faced by workers, the occupational injury and fatality rates provided in the Ross ER RAI P&O Health-1 response are applicable to the Proposed Action. This response provides updated information from that in the Ross RAI response where available.

Occupational injury and fatality data for the uranium ISR industry are no longer reported by the Wyoming State Mine Inspector, since the industry is now regulated by OSHA. The only uranium mining statistics contained in the annual Mine Inspector reports now pertain to conventional mining and milling (e.g., Kennecott's Sweetwater Project and the Energy Fuels Wyoming Sheep Mountain Project), which are regulated by MSHA and are not comparable to solution mining. Therefore, Strata is not aware of any more recent data to update the information on occupational injuries for the Wyoming uranium ISR industry that was presented in the Ross ER RAI response.

Figure ER RAI P&O Health-1-1 in the Ross ER RAI response depicts quarterly initial worker's compensation claims for the mining industry as a whole in Wyoming from 2006 through 2010. These data are available from the Wyoming Department of Workforce Services and include claims originating from uranium ISR projects. More recent information available since Figure ER RAI P&O Health-1-1 was prepared includes the following quarterly initial worker's compensation claims for the mining industry (Wyoming Department of Workforce Services 2016):

- First quarter 2011: 319
- Second quarter 2011: 251
- Third quarter 2011: 319
- Fourth quarter 2011: 253
- First quarter 2012: 333

The data from 2011 and the first quarter of 2012, which are the most recent data available, are similar to the previous data reported in the Ross ER RAI response. It should be understood that the uranium industry in Wyoming is relatively small in comparison with other mining (e.g., coal) and any significant changes in the uranium industry would be masked in the data for the mining industry as a whole.

RAI – POH-2 MILDOS Modeling

Strata used MILDOS to calculate radionuclide releases and doses. While Kendrick ER Table 4.12-2 provides some site-specific MILDOS input data, all of the input data is needed to independently evaluate the modeling. In order to verify the applicant-calculated doses provided in Kendrick ER Table 4.12-3, provide one input/output run representative of a population dose calculation, and one input/output set representative of a maximally exposed resident calculation. In addition, provide GIS coordinates of the new Kendrick wellfields that would be representative of potential release points for radon emissions.

ER RAI POH-2 Response

The RAI requests MILDOS inputs/outputs for population dose calculations, which were not calculated for the proposed KEA or approved Ross ISR Project. The population dose calculation function, also known as the collective dose, provides a way of assigning a dose to the population of cities in the vicinity of a facility. This method is considered a "speculative and uncertain measure of risk" for populations where the individuals are expected to receive below 10 rem (100 mSv), as defined in the Health Physics Society Position Statement "Radiation Risk in Perspective" (Health Physics Society 2010). As the maximum estimated dose to a resident as a result of the Proposed Action is 1.48 mrem/yr (refer Kendrick ER Table 4.12-3), a population dose would be inappropriate for this site. This methodology was also not applied for the approved Ross license application for the same reason, and that MILDOS model was accepted by NRC staff as described in the Ross SEIS, which states: "The NRC review of the Applicant's radiological-impacts modeling independently verified that appropriate exposure pathways were modeled and reasonable input parameters were used."

To minimize MILDOS runs for the Proposed Action, all source terms were run as independent MILDOS runs, so that the results for any combination of wellfields in production or restoration could be added together to provide a total dose at any time during operations. The maximum dose was to the receptor "Wesley" at year 6, during which it was assumed that all mine units within the current Ross license area would be in operation along with Mine Units A and B within the proposed KEA. Additionally, the CPP was always assumed to be in operation during any scenario. The combination of the results of these four input files result in the 1.48 mrem/yr dose assigned to resident "Wesley." The input/output files for the Welsey receptor, the maximally exposed member of the public, are provided in Appendix F to this RAI response package. Table ER RAI POH-2-1 provides the geographic coordinates of the proposed KEA wellfields.

Table ER RAI POH-2-1. Geographic Coordinates of Proposed KEA Wellfields

Wellfield	**Latitude (WGS84)**	**Longitude (WGS84)**	**Elevation (Ft)**
Mine Unit A	44.602352	-104.950498	4184.64
Mine Unit B	44.594130	-104.965738	4247.03
Mine Unit C	44.580217	-104.988894	4279.76
Mine Unit D	44.571265	-104.978173	4249.80
Mine Unit E	44.553126	-104.973247	4319.64
Mine Unit F	44.545979	-104.986091	4425.66
Mine Unit G	44.531046	-104.978043	4375.15
Mine Unit H	44.512890	-104.983667	4323.65

RAI – POH-3 Dose to Workforce

According to Strata, all Strata employees are badged at this time in Ross operations. Provide the first quarter 2016 employee monitoring results for radiation exposure. In addition, if possible provide estimates of the percentages or numbers of employees who will likely be badged during the upcoming years of operations at Ross and Kendrick.

ER RAI POH-3 Response

During the first quarter of 2016, Strata issued optically stimulated dosimeters (OSLs) to 38 employees (i.e., all full-time employees). The average dose in the quarter was 0.68 mrem. The maximum dose for the quarter was 4 mrem, which was received by an operator. This maximum dose would result in an annual dose that is less than 1 percent of the exposure limit in 10 CFR § 20.1201 (i.e., 5,000 mrem).

Strata will continue to issue dosimetry to all full-time employees until an adequate dose history has been determined for each job category. Strata believes that collecting an adequate dose history should take at least one year after steady state operating conditions are reached. Once an adequate dose history is obtained, Strata plans to review the exposures for each job category in comparison with the requirements in 10 CFR § 20.1502. Based on the experience of other ISR operations, it is likely that Strata will determine that dosimetry will not be necessary for job categories other than operators, radiation safety staff, laboratory personnel, and some management personnel. This group would currently represent approximately 30 percent of the workforce.

Waste Management

RAI – WM-1 Mixed Waste

Mixed waste is not discussed in the Kendrick ER. Confirm that the response to Ross ER RAI Waste-1(A) is applicable to Kendrick and state how this waste stream would be managed. This information is needed to ensure all potential waste types are addressed in the impact analysis.

ER RAI WM-1 Response

Consistent with the response to Ross ER RAI Waste-1(A), mixed waste will not be generated within the proposed KEA. The only Atomic Energy Act (AEA)-regulated waste generated within the proposed KEA under the Proposed Action would be 11e.(2) byproduct material, which is excluded from regulation as hazardous waste under the Resource Conservation and Recovery Act (RCRA). Specifically, 40 CFR § 261.4(a)(4) excludes byproduct material as defined by the AEA from the definition of wastes that are regulated under RCRA.

RAI – WM-2 Waste Minimization

The Kendrick ER does not provide a waste minimization plan. Confirm that the waste minimization plan for Ross presented in Ross ER Section 4.13 is applicable to Kendrick and indicate how the plan would be modified to address any Kendrick-specific aspects, if applicable.

ER RAI WM-2 Response

The waste minimization plan described in Ross ER Section 4.13 is applicable to licensed activities within the proposed KEA. Since the Proposed Action would not increase the production flow rate or modify any of the approved uranium recovery, aquifer restoration, or waste management procedures for the Ross ISR Project, no changes would occur in the procedures to minimize AEA-regulated or non-AEA-regulated waste streams under the Proposed Action. As described in Kendrick ER Section 4.13.1, the anticipated waste quantities and waste management systems for the approved Ross ISR Project are not anticipated to change under the Proposed Action.

RAI – WM-3 Preconstruction Waste

Ross SEIS Section 3.13.1 states that "An average of 23,000 L (6,000 gal) of ground water, in addition to 12 m^3 (15 yd^3) of drilling muds, are produced during the development and sampling of monitoring wells," specifically referencing preconstruction. Kendrick ER Table 4.13-1 also gives these same figures for construction.

A. *As cited in Ross SEIS Section 4.13.1 from the Ross ER, ground water is also produced during well testing conducted to characterize aquifer properties. This TENORM liquid waste is discharged under a temporary WYPDES permit. Identify whether this is already included in the estimates in Kendrick ER Table 4.13-1, as well as the volume of this waste.*

ER RAI WM-3(A) Response

Aquifer testing will be conducted within each mine unit prior to operations in accordance with LC 10.13 of SUA-1601. The aquifer testing water will be TENORM liquid waste and will be discharged under a temporary WYPDES permit issued by WDEQ/WQD. This waste stream was not included in Kendrick ER Table 4.13-1. As described in the response to ER RAI SW-3, the expected volume of water generated during aquifer testing and discharged under a temporary WYPDES permit as TENORM liquid waste is estimated to be as high as 400,000 gallons per mine unit. Strata does not consider this wastewater to be classified as "preconstruction" wastewater, since these aquifer tests would be conducted after construction of mine unit-specific monitor well networks and a portion or all of the injection and recovery wells in a mine unit. Only aquifer testing conducted prior to license amendment application submittal using regional baseline monitor wells is considered under the preconstruction activities. Refer to the response to ER RAI GEN-1 for additional information on preconstruction aquifer testing.

RAI – WM-3 Preconstruction Waste

Ross SEIS Section 3.13.1 states that "An average of 23,000 L (6,000 gal) of ground water, in addition to 12 m^3 (15 yd^3) of drilling muds, are produced during the development and sampling of monitoring wells," specifically referencing preconstruction. Kendrick ER Table 4.13-1 also gives these same figures for construction.

B. Break out wastes from preconstruction and construction for Kendrick based on the experience with Ross, now that activities have commenced, if data are available.

ER RAI WM-3(B) Response

Preconstruction activities are described in the response to ER RAI GEN-1. As described in the previous RAI response, Strata does not consider aquifer testing associated with the development of mine units within the proposed KEA to be a preconstruction activity. As described in the response to ER RAI GEN-1, preconstruction wastes that have been or may be generated within the proposed KEA include approximately 23,000 cubic yards of drill cuttings and 9.5 million gallons of drilling wastewater associated with exploration/delineation drilling and regional baseline monitor well cluster construction.

Table ER RAI WM-3-1 provides a comparison between anticipated waste quantities at the Ross ISR Project and typical actual quantities based on approximately 8 months of operation from December 2015 through July 2016.

Table ER RAI WM-3-1. Anticipated and Actual Waste Quantities for the Ross ISR Project

Waste Stream	Estimated Typical Quantity	Actual Typical Quantity	Notes
AEA-Regulated Waste			
Excess Permeate	C: 0 gpm O: 57 gpm R: 0 gpm D: 0 gpm	C: 0 gpm O: 0 gpm	Not currently generated, since RO is not currently used to treat production bleed.
Brine and Other 11e.(2) Liquid Waste	C: 0 gpm O: 62 gpm R: 227 gpm D: <10 gpm	C: 0 gpm O: 11 gpm	Averaging 1.4% production bleed, which is expected to decrease as operations progress.
Solid 11e.(2) Byproduct Material	C: 0 cy O: 100 cy/yr R: 100 cy/yr D: 4,000 cy	C: 0 cy O: 30 cy/yr	Extrapolated based on <20 cy accumulated from December 2015 - July 2016.
Non-AEA-Regulated Waste			
TENORM	C (per well): drilling fluid: 6,000 gal drill cuttings: 15 cy O,R,D: 0 gal 0 cy	C: 6,000 gal/well (drilling fluid) 15 cy/well (drilling fluid) O: 0 gal; 0 cy	
Solid Waste - Industrial or Municipal Solid Waste	C: 15 cy/wk O: 15 cy/wk R: 15 cy/wk D: 15 cy/wk	O: 6 cy/wk	
Solid Waste - Recyclable Solid Waste	C: 5 cy/wk O: 5 cy/wk R: 5 cy/wk D: 5 cy/wk	O: 0 cy/wk	General solid waste is not currently being recycled.
Solid Waste - Construction/ Demolition Waste	C: 5 cy/wk O: 5 cy/wk R: 5 cy/wk D: 2,000 cy	C: 15 cy/wk O: 15 cy/wk	Associated with ongoing wellfield construction.
Solid Waste - Petroleum-Contaminated Soil	C: <1 cy/wk O: <1 cy/wk R: <1 cy/wk D: <1 cy/wk	C: 0 cy/wk O: 0 cy/wk	
Hazardous Waste	< 220 lb/mo (<100 kg/mo) (C,O,R,D)	C: 30-70 lb/mo O: 30-70 lb/mo	

Table ER RAI WM-3-1. Anticipated and Actual Waste Quantities for the Ross ISR Project (Cont.)

Waste Stream	Estimated Typical Quantity	Actual Typical Quantity	Notes
Non-AEA-Regulated Waste (Cont.)			
Used Oil	C: 5 gal/mo O: 5 gal/mo R: 5 gal/mo D: 5 gal/mo	C: 5 gal/mo O: 5 gal/mo	
Used Oil Filters and Oily Rags	C: <20 lb/mo O: <20 lb/mo R: <20 lb/mo D: <20 lb/mo	C: <10 lb/mo O: <10 lb/mo	
Domestic Sewage	C: 2,600 gpd O: 800 gpd R: 300 gpd D: 1,200 gpd	O: 819 gpd	Estimated based on 38 employees plus 25 contract wellfield workers x 13 gpd per person.

Abbreviations:

C - Construction
O - Operation
R - Aquifer Restoration
D - Decommissioning
cy - cubic yards
gal - gallons
gpd - gallons per day
mo - month
wk - week
yr - year

RAI – WM-4 Disposal of Construction/Demolition Waste

Kendrick TR page 1-9 states: "Non-AEA-regulated solid waste will include construction debris and decontaminated material and equipment. Due to potential limitations at local landfills, Strata anticipates managing at least a portion of the non-AEA-regulated solid waste on company-owned property consistent with WDEQ/Solid and Hazardous Waste Division (SHWD) requirements."

Kendrick ER page 4-103 states: "Construction/demolition waste will be transported to a municipal landfill for disposal in a designated containment system or disposed on-site in a WDEQ/SHWD approved facility on Strata-owned surface within or adjacent to the original Ross license area."

Identify if a construction/demolition landfill will be, or has been, established at Ross or Kendrick for use by Strata. If so, provide the location of the landfill. This includes a landfill to be used for decommissioning wastes. Identify the location where Strata currently disposes of its municipal waste.

ER RAI WM-4 Response

An on-site landfill has not been established within the current Ross license area or proposed KEA. Strata currently plans to permit an on-site landfill through WDEQ/SHWD that would only be used to dispose of uncontaminated concrete during decommissioning. This is described in Strata's 2015 annual surety estimate for SUA-1601, which assumes that 100 percent of concrete with no potential for contamination (e.g., building footings) and 80 percent of concrete with potential for contamination (e.g., CPP and CPP Truck Bay buildings) would be disposed on site (Strata 2016). The planned location of the future on-site landfill is within the lined retention ponds, following pond decommissioning. Strata currently disposes of its municipal waste at the Campbell County Landfill.

RAI – WM-5 Disposal Location for Byproduct Material

Identify the location where Strata is sending solid byproduct material to be disposed and its distance in road kilometers/miles from Ross and Kendrick.

ER RAI WM-5 Response

Strata has an agreement with Pathfinder Mines Corporation to dispose of solid byproduct material at its tailings cell in the Shirley Basin in Wyoming. The site is approximately 234 road miles (377 road kilometers) from the Ross CPP.

Cost Benefit Analysis

RAI – CB-1 Market Conditions

Provide information on the current cost of and market conditions for the following:

A. *The yellowcake market, similar to that provided in the Ross ER*

ER RAI CB-1(A) Response

Demand for uranium to fuel nuclear power plants continues to grow as the nuclear industry expands. The world's appetite for energy is expanding at a fast pace, driven largely by modernization of the developing nations. At the same time as total energy demand is growing, there is a growing impetus to reduce the burning of carbon-based fuels.

Nuclear energy provided 10.9% of the world's electricity in 2012 (Nuclear Energy Institute 2016a). In 2015, 13 countries relied on nuclear energy to supply at least one-quarter of their total electricity. France leads these countries with 76.3% of its electricity generated by nuclear power. In the United States, 19% of the electricity was produced from nuclear power in 2013. Projections for the share of nuclear generation in the U.S. from 2013 to 2040 decline in all scenarios, with the projected share in 2040 ranging from 15% to 18%. High construction costs for nuclear plants limit their competitiveness to meet new demand in the U.S. In the near term, 5.5 gigawatts (GW) of additions are planned by 2020, offset by 3.2 GW of retirements over the same period. After 2025, 3.5 GW of additional nuclear capacity is anticipated, based on relative economics. An additional 10 to 13 GW of nuclear capacity is projected to be added by 2040 to meet demand growth, as a result of higher costs for the alternative technologies and/or higher capacity requirements. Annual energy growth in the U.S. from nuclear power is estimated at 0.2% from 2013 to 2040 (U.S. Energy Information Administration 2015).

While the growth of nuclear energy in the U.S. is expected to be slow, nuclear power is the world's second fastest-growing energy source, with consumption projected to increase by 2.3% per year between 2013 and 2040. Worldwide electricity generation from nuclear power is projected to increase from 2.3 trillion kilowatt hours (kWh) in 2012 to 4.5 trillion kWh in 2040, with energy security concerns and limits on greenhouse gas emissions encouraging the development of new nuclear capacity. In addition, world average capacity utilization rates for nuclear power plants have continued to rise over time, from about 68% in 1980 to about 80% in 2012. In some regions, utilization rates could continue rising in the future. Factors underlying the nuclear power projections include the consequences of the Fukushima Daiichi disaster in Japan, the planned retirements of nuclear power plants in Europe under current policies, and continued strong growth of nuclear power capacity in Asia (primarily China and India). Average annual growth rates for nuclear electricity generation from 2012 to 2040 include 9.6% in China, 7.9% in India, and 2.9% in the other Asian countries. China has the largest projected increase in nuclear capacity, adding 139 GW from 2012 to 2040, followed by

36 GW in India, and 8 GW in the remaining Asian countries. In the Middle East, nuclear capacity is projected to increase from less than 1 GW in 2012 to 22 GW in 2030 (U.S. Energy Information Administration 2016a).

As of May 2016, 30 countries worldwide are operating 444 nuclear reactors for electricity generation, and 63 new nuclear plants are under construction in 15 countries (Nuclear Energy Institute 2016a). In the U.S., construction is under way on two reactors in Georgia, two in South Carolina, and one in Tennessee. China, to reduce its reliance on coal, had 22 new nuclear plants under construction as of April 2016 (Nuclear Energy Institute 2016b).

New generation reactors are more efficient than older units, and that will help offset the growth in demand. Nevertheless, over the coming years, usage of uranium as a fuel for nuclear power plants is forecast to grow at a fast pace. At present, the world's nuclear power reactors, with combined capacity of some 375 GWe, require about 150 million pounds of uranium from mines or elsewhere each year (World Nuclear Association 2016). U.S. nuclear power reactors purchased a total of 57 million pounds U_3O_8 from U.S. and foreign suppliers during 2015. Nearly half of these purchases originated from two countries, Canada and Kazakhstan, providing 17 million pounds and 11 million pounds of uranium, respectively (U.S. Energy Information Administration 2016b).

Total production of U.S. uranium concentrate in 2015 was 3.3 million pounds U_3O_8, 32% less than in 2014, from seven facilities: one mill in Utah (White Mesa Mill) and six ISR plants (Crow Butte, Hobson ISR Plant/La Palangana, Lost Creek, Nichols Ranch, Smith Ranch-Highland, and Willow Creek). The six ISR plants are located in Nebraska, Texas, and Wyoming. Total shipments of uranium concentrate from U.S. mill and ISR plants were 4.0 million pounds U_3O_8 in 2015, 12% less than in 2014. U.S. producers sold 3.6 million pounds of uranium concentrate in 2015 at a weighted-average price of $42.86 per pound U_3O_8 (U.S. Energy Information Administration 2016c).

At the end of 2015, the White Mesa Mill in Utah was operating, processing alternate feed with a capacity of 2,000 short tons of ore per day. The Shootaring Canyon Uranium Mill in Utah and Sweetwater Uranium Project in Wyoming were on standby with a total capacity of 3,750 short tons of ore per day. There is one mill planned for Colorado (Pinon Ridge Mill) and one heap leach plant planned for Wyoming (Sheep Mountain) (U.S. Energy Information Administration 2016c).

At the end of 2015, six uranium ISR plants were operating with a combined capacity of 13.8 million pounds U_3O_8 per year (Crow Butte in Nebraska; Hobson ISR Plant/La Palangana in Texas; and Lost Creek, Nichols Ranch, Smith Ranch-Highland, and Willow Creek in Wyoming). The Ross CPP was becoming operational in Wyoming. There were seven ISR plants planned in New Mexico, South Dakota, Texas, and Wyoming (U.S. Energy Information Administration 2016c).

The general need for production of uranium is assumed in the operation of nuclear power reactors. In reactor licensing evaluations, the benefits of the energy produced are weighed against environmental costs, including a prorated share of the environmental costs of the uranium fuel cycle. The incremental impacts of typical mining and milling operations required for the fuel cycle are justified in terms of the benefits of energy generation to the society in general. However, the specific site-related benefits and costs of an individual fuel-cycle facility such as the Ross ISR Project must be reasonable as compared to that typical operation.

Strata has evaluated the costs and the benefits associated with uranium production in order to determine whether development of the proposed KEA is feasible. Although prices for uranium have decreased since the Fukushima Daiichi disaster, increased global demand for uranium to supply existing and new power reactors is expected to result in price increases for uranium over the next several years. Although the specific amount of yellowcake produced will depend on the market price and the cost of production, Strata anticipates producing about 750,000 pounds of U_3O_8 per year. Based on current information and projections, the anticipated life of the Ross ISR Project is 8 to 12 years. Resources in the proposed KEA will be necessary to supplement and eventually replace mine units in the current Ross license area.

RAI – CB-1 Market Conditions

Provide information on the current cost of and market conditions for the following:

> *B. The vanadium market, assuming that vanadium would continue to be produced at the Ross CPP, including from Kendrick extractions*

ER RAI CB-1(B) Response

Under current market conditions, the recovery of vanadium as a resource is not considered economically viable for the Ross ISR Project. Strata does not expect that this will change during operation under the Proposed Action. Therefore, under current and foreseeable market conditions, the vanadium recovered from wellfields within the current Ross license area and proposed KEA will be managed as a waste as discussed in the response to ER RAI GEN-4.

RAI – CB-2 Internal Costs

Provide updated internal costs of the project as shown in Table 7.5-1 of the Ross ER.

<u>ER RAI CB-2 Response</u>

Table ER RAI CB-2-1 presents the estimated internal project costs of the Ross ISR Project along with the Proposed Action. The estimates provided in Table ER RAI CB-2-1 were updated based on the recently approved financial assurance estimate (Amendment 5 to SUA-1601; see correspondence in ML16126A287 and the Safety Evaluation Report in ML16126A291).

The estimates to obtain the right to mine, construction, and operations provided in Ross ER Table 7.5-1 were very conservative and generally captured the costs to conduct ISR in the proposed KEA. Therefore, the cost estimates for these items in Table ER RAI CB-2-1 remain unchanged from those in Ross ER Table 7.5-1.

Table ER RAI CB-2-1. Estimated Internal Project Costs

Item	Present Worth (1,000 $US)
Obtain right to mine (claims, surface access and permits)	13,000
Facility construction[1]	40,000
Operation and maintenance	74,000
Groundwater restoration[2]	5,134
Decommissioning (including decontamination) [2]	2,732
Surface reclamation[2]	312
Total	135,178

1 Due to sequential development of wellfields, some of the facility construction costs are distributed throughout the life of the project rather than concentrated at the beginning.

2 Includes plant area facilities and Mine Unit 1 and a portion of Mine Unit 2, including restoration, reclamation, and decontamination costs as estimated in the latest Ross Surety update.

RAI – CB-3 Resource Commitments

Section 5.8 of NUREG-1748, "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs," suggests that an EIS should analyze and discuss the following:

- *irreversible and irretrievable commitment of resources,*
- *unavoidable adverse environmental impacts, and*
- *relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity.*

Therefore, provide information on the land, water, raw materials, and other natural and manmade resources to be committed for the construction, operation, aquifer restoration, and decommissioning of the Kendrick wellfields and the extended operation of the Ross CPP facilities. These commitments should include, but not be limited to, consumptive use of surface and ground water, energy expanded in the form of fuel for equipment and vehicles, electrical energy, and materials that would be consumed or reduced to unrecoverable forms such as concrete, asphalt, steel, process chemicals and gases, uranium, vanadium, or other element resources retrieved from the aquifer.

ER RAI CB-3 Response

The following response provides information on the land, water, raw materials, and other natural and manmade resources to be committed for the construction, operation, aquifer restoration, and decommissioning of the wellfields within the proposed KEA and the extended operation of the Ross CPP. As recommended by NUREG-1748 and NUREG-1569, it includes a description of the duration of potential impacts and mitigation measures to alleviate or reduce impacts, where applicable.

Land Resources

As described in the Kendrick ER (e.g., Table 1.3-1), up to 1,050 acres or 13 percent of the 7,873.7-acre proposed KEA would be disturbed under the Proposed Action. Surface disturbance would not result in any long-term commitment of land resources (i.e., lasting beyond decommissioning), since much of the disturbance would be reclaimed after construction and all disturbed areas would be reclaimed to be suitable for pre-construction uses during decommissioning. Therefore, consistent with the NRC staff evaluation in Table 8.1 of the Ross SEIS, there would be no irreversible or irretrievable impacts to land use within the proposed KEA.

There would be short-term, unavoidable impacts to land use resulting from wellfield fencing, which would temporarily restrict access to livestock. Similarly, the CPP would continue to operate for an additional 9 to 11 years, during which livestock access would continue to be restricted from the fenced CPP area within the current Ross license area. Such impacts would be limited in duration to the 12 to 15-year project life. They would be mitigated by establishing surface use agreements with surface owners/lessees to provide mitigation or compensation for temporary loss of areas currently used for livestock grazing, and by phasing wellfield development such that not all of the wellfield modules would be fenced during most of the construction and operation phases (refer to Kendrick ER Section 4.1.1.1.4).

Water Resources

The response to ER RAI SW-5 describes how the total surface water usage is estimated to be about 184 acre-feet over the life of the Proposed Action. This is equal to an average annual consumption of about 12.5 acre-feet over the approximately 14.75-year project life. To put this into perspective on a local level, the annual permitted appropriation for the Strata-owned Oshoto Reservoir is 172.7 acre-feet (refer to the response to ER RAI SW-5). Therefore, the average annual surface water consumption is estimated to be about 7 percent of the annual appropriation amount of this reservoir. On a regional basis, the average annual discharge volumes at the nearest gaging stations on the Little Missouri River and Belle Fourche River are 55,745 and 49,954 acre-feet, respectively (refer to Kendrick ER Tables 3.4-1 and 3.4-2). The average annual surface water consumption is less than 0.03 percent of these amounts. Based on the relatively small surface water usage compared to local and regional water availability, there would be no irreversible or irretrievable impacts to surface water by the Proposed Action. This is consistent with Table 8.1 of the Ross SEIS, which similarly concluded that although small amounts of surface water would be used for construction activities and dust control, they would be replaced by normal precipitation.

Groundwater consumption would occur primarily as a result of operation and aquifer restoration of the wellfields within the proposed KEA. Kendrick ER Section 2.1.2.2.2 describes how the typical production bleed rate is anticipated to average 1.25 percent of the recovery flow rate. Therefore, during operations, about 98.75 percent of the groundwater recovered from the ore zone aquifer would be recirculated and reinjected. Additional groundwater would be consumed during aquifer restoration, up to a maximum rate of 227 gpm during concurrent operation and aquifer restoration (refer to Kendrick ER Table 4.13-1). As described in the response to ER RAI GW-3(A), the total estimated volume of groundwater consumed during operation and aquifer restoration under the Proposed Action, including wellfields with the current Ross license area and proposed KEA, is approximately 3,043 acre-feet. This equates to an average consumption rate of approximately 260 acre-feet per year during the approximately 12-year operating life of the project. In addition, a much smaller volume of groundwater would be consumed by non-production uses. Strata's total non-production groundwater usage over the life of the project is estimated to be about 55 acre-feet, including aquifer test discharges and domestic usage associated with continued operation of the Ross public water system (see response to ER RAI SW-5).

Kendrick ER Section 4.4.2.2.4 and the response to ER RAI GW-3(B) describe how potential groundwater consumption impacts would be short term and would not be expected to materially decrease the yield from any wells. Groundwater modeling demonstrates that the water levels would likely recover substantially within a few months after aquifer restoration is completed within each wellfield, and that recovery of the OZ aquifer throughout the proposed KEA would be largely achieved within 15 years following aquifer restoration. As demonstrated by the modeled groundwater recovery, there would be no irreversible or irretrievable commitments of groundwater resources under the Proposed Action. This is consistent with Table 8.1 of the Ross SEIS, which found that the lower groundwater levels in the OZ and SM aquifers would be replaced by normal recharge over time.

Kendrick ER Section 5.4.2.1.2 describes the mitigation measures that would help ensure that consumptive use of groundwater is minimized during operation and aquifer restoration. These include but are not limited to minimizing production bleed by frequent wellfield balancing, employing two stages of reverse osmosis (RO) to treat production bleed and restoration fluids, and employing limited and selective groundwater sweep.

<u>Resources Retrieved from the Aquifer</u>

The removal of uranium from the subsurface would be an irreversible and irretrievable commitment of resources. As described in Kendrick ER Section 7.1, the Proposed Action would enable the production of an estimated 8.8 million pounds of U_3O_8 within the proposed KEA. The uranium would be irreversibly removed from the ground (i.e., it could not be restored), and it would be irretrievably committed to the commercial nuclear fuel cycle instead of being available for other future uses. Similarly, as described in the response to ER RAI GEN-4, vanadium coproduced with uranium would be removed from the subsurface.

<u>Fuel for Equipment and Vehicles</u>

In order to prepare the emissions inventory that is provided in response to ER RAIs AIR-1 through AIR-4, it was necessary to estimate the annual quantity of fuel required for diesel-powered mobile equipment operating with the current Ross license area and proposed KEA and the diesel backup generator, space heaters, and dryers operated for an extended duration at the Ross CPP. At the peak year, when construction, operation, aquifer restoration, and decommissioning are assumed to all occur simultaneously, the maximum estimated diesel fuel consumption (including mobile equipment and the backup generator) is approximately 1.1 million gallons per year.

The emissions inventory estimates that the peak natural gas consumption for space heaters and dryers would be approximately 33 million standard cubic feet per year. This is a conservatively high estimate, since it is based on the maximum licensed yellowcake production rate of 3 million pounds per year. Currently, Strata is using propane as a heating fuel rather than natural gas. The propane equivalent of this maximum annual natural gas consumption is approximately 380,000 gallons of propane per year. Since Strata is currently operating the Ross CPP without the use of dryers, current propane consumption is much lower, estimated at approximately 102,000 gallons per year.

Electrical Energy

The emissions inventory provided in the response to ER RAIs AIR-1 through AIR-4 includes an estimate of electricity consumption. The maximum anticipated electricity consumption, as calculated in the emissions inventory, is approximately 15,000 megawatt-hours (MWh) per year. By comparison, current electricity consumption is estimated to be about 8,000 MWh per year.

Other Materials Consumed or Reduced to Unrecoverable Forms

Since no new processing facilities would be constructed under the Proposed Action, construction materials generally would be limited to those used to construct wellfields and associated pipelines, access roads, module buildings, booster pump stations, and power lines within the proposed KEA. These materials include PVC well casing, cement used to seal the annular space between the well casing and boreholes, bentonite used in drilling muds, HDPE pipe, steel valves and piping appurtenances, electrical wire, wellhead covers, module building and booster pump station construction materials (primarily steel and concrete), and gravel road base. Additional cement and bentonite would be used during decommissioning to plug and abandon injection, recovery, and monitor wells.

Environmental Monitoring

RAI – EM-1 Air Monitoring Stations

Strata has proposed to use five air particulate monitoring sites for the operational airborne radiation monitoring program. Passive radon and gamma radiation monitoring would be conducted at 11 sites, 5 of which are co-located with the air particulate monitoring sites. A comparison of Kendrick ER Figure 3.11-30 and Figure 6.1 in the Ross SEIS (Ross ER Addendum 3.6-A, Figure 3) indicates that at least two of the sites may already be in use as part of monitoring for Ross. Ross SEIS Figure 6.1 also indicates that some Ross sampling stations may be located within Kendrick, although they are not identified in Kendrick ER Figure 3.11-30. Clarify any overlap between monitoring stations for Ross and Kendrick.

ER RAI EM-1 Response

For clarification, none of the air monitoring stations shown on Kendrick ER Figure 3.11-30, which were used for baseline radiological sampling and which are proposed for operational monitoring at the proposed KEA, are in use as part of the Ross operational air monitoring network. Although several of the Ross air monitoring stations are physically located within the proposed KEA, no overlap in the Ross and KEA air monitoring programs currently exists. The operational environmental monitoring programs for the Ross ISR Project would be expanded and modified to include the proposed KEA, upon approval of the license amendment, rather than having separate monitoring programs. Strata has recognized the need for an air monitoring network which would integrate the proposed KEA into the currently approved Ross monitoring network and is investigating how the combined network would satisfy the requirements of Regulatory Guide 4.14.

RAI – EM-2 Environmental Monitoring Program

Kendrick ER Chapter 6 states that the environmental monitoring program for Kendrick is the same as that for Ross. However, the program as described in Kendrick ER Chapter 6 has some differences. Clarify whether the Kendrick program differs from that at Ross, particularly addressing the following:

A. *The Ross program has soil samples collected to 15 cm as well as subsurface samples collected to 150 cm, as described in Ross SEIS Section 6.2.2. Kendrick ER Section 6.1.2 states that all soil samples will be collected to a depth of 5 centimeters. The Ross program includes analyzing the soil and sediment samples for gross alpha, which is not mentioned for the Kendrick program.*

ER RAI EM-2(A) Response

The operational environmental soil sampling program within the proposed KEA will be the same as that approved for the Ross ISR Project. Operational soil samples will be collected at the air monitoring stations to a depth of 15 cm, the same depth specified in Strata's Environmental Management Program (EMP) developed to satisfy LC 10.9 of SUA-1601, not the 5-cm sampling depth indicated in Kendrick ER Section 6.2.2. Soil samples will be analyzed for total uranium, radium-226, lead-210, and gross alpha, which is also consistent with the EMP for SUA-1601. Kendrick ER Section 6.2.2 and Table 6.1-1 inadvertently omitted gross alpha measurement. The EMP specifies that subsurface samples may be collected for preoperational monitoring, but that routine operational monitoring at the air monitoring stations will only include surface soil samples. The EMP was reviewed by NRC staff as part of the preoperational inspection for SUA-1601 (NRC 2016).

RAI – EM-2 Environmental Monitoring Program

Kendrick ER Chapter 6 states that the environmental monitoring program for Kendrick is the same as that for Ross. However, the program as described in Kendrick ER Chapter 6 has some differences. Clarify whether the Kendrick program differs from that at Ross, particularly addressing the following:

B. The Ross program (Ross SEIS Section 6.2.4) has surface water samples analyzed for Po-210 (as called for in Regulatory Guide 4.14); however, the Kendrick program does not (Kendrick ER Section 6.1.3.1). The Ross program is also analyzing surface water for gross alpha and gross beta, which are not mentioned for the Kendrick program.

ER RAI EM-2(B) Response

The surface water samples will be analyzed for dissolved and suspended uranium, radium-226, thorium-230, lead-210, polonium-210, gross alpha, and gross beta, in accordance with the Ross EMP and Section 5.7.8.2 of the approved Ross TR. Kendrick ER Section 6.1.3.1 and Table 6.1-1 inadvertently omitted polonium-210, gross alpha, and gross beta from the list of analytes.

RAI – EM-2 Environmental Monitoring Program

Kendrick ER Chapter 6 states that the environmental monitoring program for Kendrick is the same as that for Ross. However, the program as described in Kendrick ER Chapter 6 has some differences. Clarify whether the Kendrick program differs from that at Ross, particularly addressing the following:

C. *The Ross program (Ross SEIS Section 6.2.5) has ground water samples analyzed for Th-230, Po-210, and Pb-210 (as called for in Regulatory Guide 4.14); however, the Kendrick program does not (Kendrick ER Section 6.1.3.2). The Ross program is also analyzing ground water for gross alpha and gross beta, which are not mentioned for the Kendrick program.*

ER RAI EM-2(C) Response

Private wells within 2 kilometers (1.2 miles) of the perimeter monitor well rings will be sampled and analyzed for dissolved and suspended uranium, radium-226, thorium-230, lead-210, polonium-210, gross alpha, and gross beta, in accordance with the Ross EMP. Kendrick ER Section 6.1.3.2 and Table 6.1-1 inadvertently omitted suspended uranium, thorium-230, polonium-210, lead-210, gross alpha, and gross beta from the list of analytes.

RAI – EM-2 Environmental Monitoring Program

Kendrick ER Chapter 6 states that the environmental monitoring program for Kendrick is the same as that for Ross. However, the program as described in Kendrick ER Chapter 6 has some differences. Clarify whether the Kendrick program differs from that at Ross, particularly addressing the following:

D. For non-radiological contaminants, Ross SEIS Section 6.3.1 indicates that Strata's operational monitoring program for Ross will "continue" the quarterly surface water sampling done for the pre-operational monitoring. Confirm the assumption that this means Strata will sample for the same constituents during operations as for the baseline sampling. However, Kendrick ER Section 6.2.1 only lists pH, conductivity, temperature, uranium, Ra-226, Th-230, and Pb-210 for operational sampling, while Kendrick ER Addendum 3.4-D lists many additional constituents sampled for the baseline. If Strata decided to change what is sampled during operations (including cutting the non-radiological constituents) (unlike for Ross), provide the reasons for the change.

ER RAI EM-2(D) Response

The "continue" in Ross SEIS Section 6.3.1 refers to the frequency (quarterly) of surface water sampling and the sites to be sampled. Ross SEIS Section 6.2.4 indicates that the "analytical parameters to be analyzed in the operational surface-water monitoring program are dissolved and suspended uranium, gross alpha and beta, Pb-210, polonium-210 (Po-210), Ra-226, and Th-230, unless sufficient cause can be demonstrated to measure a parameter less frequently." The environmental monitoring procedures for Kendrick will be consistent with Ross. As described in the response to part B of this RAI, surface water samples will be analyzed for dissolved and suspended uranium, radium-226, thorium-230, lead-210, polonium-210, gross alpha, and gross beta as well as field measurements including temperature, pH, and conductivity.

RAI – EM-2 Environmental Monitoring Program

Kendrick ER Chapter 6 states that the environmental monitoring program for Kendrick is the same as that for Ross. However, the program as described in Kendrick ER Chapter 6 has some differences. Clarify whether the Kendrick program differs from that at Ross, particularly addressing the following:

E. For ground water monitoring, Kendrick TR Table 5.7-2 lists the parameters to be sampled for. Gross beta is included in the Ross program (and the ISR GEIS) but is not included on the Kendrick list, although the Kendrick list does have additional elements not on the ISR GEIS list. Explain why gross beta was not included on the Kendrick list.

<u>ER RAI EM-2(E) Response</u>

Gross beta was inadvertently omitted from Kendrick TR Table 5.7-2. Wellfield background water quality will include gross beta, in accordance with the approved parameter list for SUA-1601, which is specified in Table 5.7-2 of the approved Ross license application, which was amended in License Amendment 2 to SUA-1601 (NRC 2015c).

RAI – EM-3 Operational Monitoring of Water Supply Wells

Kendrick ER Section 6.2.2.2, on non-radiological monitoring, states that existing water supply wells will be monitored during operations as described in ER Section 6.1.3.2, which described radiological monitoring only and not the non-radiological constituents that are the topic of this section. Section 6.3.2.1 of the Ross SEIS implies that Strata would sample for the constituents listed in ISR GEIS Table 8.2-1 for both the existing wells and the monitoring wells. Confirm this assumption (or provide clarification) and provide an example of a report.

ER RAI EM-3 Response

Ross SEIS Section 6.3.2.1 (Post-Licensing, Pre-Operational Ground-Water Sampling and Water-Quality Analysis) only refers to wells used to establish post-licensing, pre-operational groundwater quality within each mine unit, as required by LC 11.3 of SUA-1601. Such wells are located within the ore zone of each mine unit and do not include existing water supply wells. Ross SEIS Section 6.2.5 states that nearby domestic, livestock, and industrial water-supply wells would be sampled quarterly and analyzed for dissolved and suspended uranium, gross alpha, gross beta, lead-210, polonium-210, radium-226, and thorium-230. As described in the response to ER RAI EM-2, the environmental monitoring program for Kendrick will be consistent with Ross. In addition to the radiological parameters, field measurements for pH and conductivity will also be measured during sampling, in accordance with the Ross EMP and approved Ross license application.

Strata has submitted two Semi-Annual Effluent and Environmental Monitoring Reports to the NRC as required by LC 11.1(D) of SUA-1601. The most recent report, for the period of July 1 through December 31, 2015, can be found in the NRC ADAMS database under Accession Number ML16076A276.

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APPENDIX A

Kendrick ER Electronic Drawing Files

(CD only)

APPENDIX B

Kendrick ER Requested References

Crook County Road and Bridge - Morgan Ellsbury November 21, 2014
Personal communication with Beth Kelly (WWC Engineering)

2014 Traffic Counts
Cabin Creek at Oshoto where it meets New Haven Road
91 vehicles per day
14 day count = 1,286 vehicles
Cabin Creek at Carlile
108 vehicles per day
14 day count = 1,515 vehicles
D-Road at I-90
379 vehicles per day

TRAFFIC STUDY

DATE: JANUARY 23, 2015

SECTION: MOORCROFT
COUNTY: CROOK

ROUTE: I90
R M: 153.412
2013 AADT: = 5115(EST)
2040 AADT: = 8840(EST)
TRUCKS =17.0%
DHV = 15.0%
FC = 1

MRS2014

WYDOT - Mike Sandidge December 4, 2014

Personal communication with Beth Kelly (WWC Engineering)

2009		2010		2011		2012		2013	
ALL VEH.	TRUCKS	ALL VEH.	TRUCKS	ALL VEH.	TRUCKS	ALL VEH.	TRUCKS	ALL VEH.	TRUCKS
2,786	500	2,794	490	2,764	490	2,756	409	2,704	402
2,485	470	2,492	450	2,465	423	2,458	458	2,411	456

APPENDIX C

Wyoming Office of State Lands and Investments
Surface Owner Consent Form (Form 8)

SURFACE LANDOWNER'S CONSENT

I, Jason Crowder, Assistant Director, Office of State Lands and Investments, CERTIFY that the State of Wyoming holds surface rights on the following lands on which the State of Wyoming holds mineral estate rights:

Lot 2 (35.57) ada NWNE, SWNE, SENW, NWSE	Section 1	T. 52 N.	R. 68 W.
Lot 1 (35.48) ada NENE, SENE, NESE	Section 2	T. 52 N.	R. 68 W.
NE1/4NE1/4	Section 11	T. 52 N.	R. 68 W.
W1/2NW1/4	Section 12	T. 52 N.	R. 68 W.
ALL	Section 36	T. 53 N.	R. 68 W.
____Section____		T. ____N.	R. ____W.
____Section____		T. ____N.	R. ____W.

County of Crook.

I have examined the mining and reclamation plans, prepared by WWC Engineering in compliance with the Wyoming Environmental Quality Act, and do hereby approve said plans, and reiterate certain provisions within the State of Wyoming Uranium Mining Lease 0-40991 and 0-40871 issued to Strata Energy, Inc. (Section 1 and Section 4(A)), which grant the lessee's right to enter upon, occupy and enjoy such surface areas of the described tracts as are necessary for mining operations, along with other activities contemplated by the lease.

Dated this 10th day of April, 2015.

[signature]
Assistant Director – Office of State Lands and Investments
(Signature)

Jason Crowder
Name (printed or typed)

Jamie VanHatten 4-10-15
Witness (Signature) (Date)

Jamie VanHatten
Witness Name (printed or typed)

Form 8 – Surface Owner Consent Form
Revised 6_2013

Land Quality Division

APPENDIX D

Updated Groundwater Quality Tables for Adjusted Gross Alpha Activity, Well Classifications, and Comparison to Standards

Table 1. Cluster Well Gross Alpha and Adjusted GAA

Parameter	Units	SA	SM	OZ
Gross Alpha	pCi/L	<2 - 49.4	<2 - 8.2	<2 - 99.3
Adjusted GAA	pCi/L	<2 - 9.8	<2 - 8.2	<2 - 80.5

Table 2. Comparison of Probable WDEQ Classes of Use

Zone	**Probable WDEQ Groundwater Class**	**Suitability**
SA	II - III	Irrigation or livestock
SM	II - III	Irrigation or livestock
OZ	III - IV	Livestock or industrial

Table 3. SA Zone Adjusted GAA

Well ID	1Q13	2Q13	3Q13	4Q13
5268-12-01SA	3.3	1.9	<2	3.7
5268-21-11SA	DRY[1]			
5367-34-06SA	<2	<4	<4	<4
5368-12-25SA	8.4	6.2	2.4	2.8
5368-24-12SA	2.8	2.2	2.9	2.0
5368-31-35SA	9.2	9.8	3.8	6.2
5368-32-23SA	DRY			
5368-33-14SA	<2	<2	<2	<2
5368-41-23SA	<2	8.2	7.7	<2
5368-41-36SA	DRY			
5368-43-24SA	<2	<2	<2	<2

1 As described in Kendrick ER Section 3.4.3.4.1.1, well 5268-21-11SA did not yield sufficient water for sample collection; the single sample collected from this well in March 2013 was determined to be unrepresentative of the SA water quality and was not evaluated further.

Table 4. SA Zone Comparison with WDEQ Class of Use Standards

Well ID	Probable WDEQ Class of Use	Parameters Exceeding Class I Standards[1]	Parameters Exceeding Class II Standards[1]	Parameters Exceeding Class III Standards[1]
5268-12-01SA	II	TDS		
5268-21-11SA	DRY[2]			
5367-34-06SA	III	TDS, sulfate, manganese	Sulfate	
5368-12-25SA	III	TDS	Sulfate	
5368-24-12SA	II	TDS		
5368-31-35SA	II	TDS		
5368-32-23SA	DRY			
5368-33-14SA	II	TDS, manganese		
5368-41-23SA	III	TDS	Sulfate	
5368-41-36SA	DRY			
5368-43-24SA	II	TDS		

1 *pH and iron were not compared to class of use standards since these constituents are easily treatable.*

2 As described in Kendrick ER Section 3.4.3.4.1.1, well 5268-21-11SA did not yield sufficient water for sample collection; the single sample collected from this well in March 2013 was determined to be unrepresentative of the SA water quality and was not evaluated further.

Table 5. SA Zone Comparison with EPA Standards

Well ID	**Parameters Exceeding EPA Primary MCLs**	**Parameters Exceeding EPA Secondary MCLs**[1]
5268-12-01SA	Arsenic	TDS
5268-21-11SA (Dry[2])		
5367-34-06SA		TDS, sulfate, manganese
5368-12-25SA		TDS, aluminum
5368-24-12SA	Arsenic	TDS
5368-31-35SA		TDS
5368-32-23SA (Dry)		
5368-33-14SA		TDS, manganese
5368-41-23SA	Uranium	TDS
5368-41-36SA (Dry)		
5368-43-24SA	Uranium	TDS

1 *EPA designates secondary standards as non-enforceable contaminants that may cause cosmetic or aesthetic effects in drinking water.*

2 *As described in Kendrick ER Section 3.4.3.4.1.1, well 5268-21-11SA did not yield sufficient water for sample collection; the single sample collected from this well in March 2013 was determined to be unrepresentative of the SA water quality and was not evaluated further.*

Table 6. SM Zone Adjusted GAA

Well ID	1Q13	2Q13	3Q13	4Q13
5268-12-01SM	<2	<4	<2	4.0
5268-21-11SM	<2	<2	<2	<2
5367-34-06SM	4.7	2.6	2.5	6.6
5368-12-25SM	<2	<2	2.1	<3
5368-24-12SM	6.5	<2	<2	<2
5368-31-35SM	<2	<2	<3	<3
5368-32-23SM	2.0	<3	<2	2.8
5368-33-14SM	<2	<2	3.1	8.2
5368-41-23SM	<2	<2	<2	4.4
5368-41-36SM	<2	<2	<4	<3
5368-43-12SM	<3	<3	3.3	2.2
5368-43-24SM	<2	<5	<3	3.3

Table 7. OZ Zone Adjusted GAA

Well ID	1Q13	2Q13	3Q13	4Q13
5268-12-01OZ	17.5	16.6	15.2	8.5
5268-21-11OZ	37.1	39.1	42.4	54.0
5367-34-06OZ	21.8	28.9	19.9	23.6
5368-12-25OZ	<2	<3	2.9	<3
5368-24-12OZ	8.9	13.1	9.9	15.1
5368-31-35OZ	78.7	80.5	73.3	72.3
5368-32-23OZ	22.8	27.9	13.1	7.8
5368-33-14OZ	22.1	23.4	19.1	22.3
5368-41-23OZ	5.1	8.0	4.2	<2
5368-41-36OZ	24.4	11.8	10.7	12.9
5368-43-12OZ	20.7	35.4	31.7	28.4
5368-43-24OZ	<2	3.9	<4	5.4

APPENDIX E

Class III Survey Principal Investigator Curriculum Vitae and Resume

David M. Ferguson
Research Archaeologist
Cultural Resource Division
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GCM Services, Inc.
P. O. Box 3047
Butte, Montana 59702
(406) 723-4387; fax 723-4388

Education: MA Anthropology, Archaeology Emphasis, 1993, University of Montana, Missoula

BA Psychology (history minor), 1988, University of Montana, Missoula

Professional experience:

5/96 - present: Archaeologist/General Manager of GCM Services, Inc., Butte, MT

7/90 - 5/96: Archaeologist and Project Director, GCM Services, Inc., Butte, MT

10/91 - 10/92: Project Co-director, Missouri River Corridor Archaeological Investigation and National Register Multiple Properties Nomination, Lewis and Clark County, Montana, (independent contract) for the Montana State Historic Preservation Office/National Park Service.

7/87 - 9/89: Field Assistant/Field Supervisor, GCM Services, Inc., Butte, MT

Recent Project Experience (as project director and report author unless otherwise noted)**:**

2016 Magnetometer survey and NRHP evaluations of selected sites on Western Energy Company's Area G, Rosebud County, Montana (report in progress).

Archaeological testing of a Paleo-Indian occupation site, 24MA778, Madison County, Montana conducted for Great West Engineering and Montana Department of Transportation (report in progress).

Archaeological testing and NRHP evaluation of three sites on the Ross ISR Project, Crook County Wyoming, conducted for Strata Energy (report in progress).

Archaeological testing and NRHP evaluation of 11 sites on the Kendrick ISR Amendment, Crook County Wyoming, conducted for Strata Energy (report in progress).

Montana Burial Board testimony and Native American Consultation on human remains relocation at the Rosebud Mine, Rosebud County, Montana (report in progress).

A Class III Cultural Resource Inventory of 1280 acres within Western Energy Company's Area G, Rosebud County, Montana (report in progress).

A Cultural Resource Data Recovery Plan to Mitigate Proposed Impacts to Archaeological Site 24BH1739. Prepared for Cloud Peak Energy, LLC, Spring Creek Coal Mine, Decker, MT.

Archaeological Evaluations at Four Sites (24BH1736, 24BH1737, 24BH1739, 24BH1740) at the Spring Creek Mine, Big Horn County, Montana. Prepared for Cloud Peak Energy, LLC, Spring Creek Coal Mine, Decker, MT.

Excavation of Sharptail Ridge Site 24BH1737. Prepared for Cloud Peak Energy, LLC, Spring Creek Coal Mine, Decker, MT.

Archaeological Testing at 24JF699, A Stratified Occupation Site in Jefferson County, Montana. Prepared for Montana Department of Transportation, Helena, Montana.

2015 A Class III Cultural Resource Inventory of Fox Farm Road, Cascade County, Montana STPU 5220(4) FOX FARM RD-GREAT FALLS UPN 8193000. Prepared For Morrison-Maierle, Inc., Helena, MT and Montana Dept. of Transportation, Helena, Montana.

A Class III Cultural Resource Inventory of a Proposed Oregon Creek Streambed Rehabilitation Project on the Mount Haggin Wildlife Management Area, Deer Lodge County, Montana. Prepared for Big Hole Watershed Committee, Divide, Montana and Montana Department of Fish, Wildlife & Parks, Butte, Montana.

A Class III Inventory of Road Improvement Projects of the "Belmont Drive" Segment of the Marysville Road, Lewis and Clark County, Montana. Prepared for Stahly Engineering, Helena, MT.

A Class III Cultural Resource Inventory and Proposed Oil Lease Development, Crook County, Wyoming. Prepared for Kenneth Schuricht, Moorcroft, Wyoming.

A Class III Cultural Resource Inventory and Assessment of a Mineral Claim near French Bar, Lewis and Clark County, Montana. Prepared for Ira Tillotson, Marquette, Michigan.

A Class III Cultural Resource Inventory and Assessment of the Egge Irrigation Ditch and Diversion, Golden Valley County, Montana. Prepared for MT Fish, Wildlife & Parks, Helena, Montana.

48CK1603, 48CK2073, 48CK2076, 48CK2083, 48CK2075, 48CK2085, 48CK2229 & 48CK2231 & amended site records for: 48CK2083, 48CK2229, 48CK2230 and 48CK2231 at the Proposed Ross ISR Project, Crook County, Wyoming. Prepared for Strata Energy, Gillette, WY and WWC Engineering, Sheridan, WY

A Class III Cultural Resource Inventory of Strata Energy's Proposed Inventory of Kendrick Expansion Area, Crook County, Wyoming. Prepared for Strata Energy, Gillette, WY and WWC Engineering, Sheridan, WY

A Class III Cultural Resource Inventory of Antelope Coal Mine's Dragline Pad Access Road IBR, Converse County, Wyoming. Prepared for Cloud Peak Energy, LLC's Antelope Coal Mine, Wright, Wyoming

Archaeological Investigations at the Rattlesnake Point Site: Assessment of Effects of a Proposed Water Pipeline at 24BH2317, Big Horn County, Montana. Prepared for Cloud Peak Energy, LLC, Spring Creek Coal Mine, Decker, MT.

2014 National Register of Historic Places Evaluation: 24BH3699 at the Spring Creek Mine, Big Horn County, Montana. Prepared for Cloud Peak Energy, LLC, Spring Creek Coal Mine, Decker, MT.

Archaeological Testing: 24PW206 at the Proposed Brown's Lake Fishing Access Site, Powell County, Montana. Prepared for MT Fish, Wildlife & Parks, Helena, Montana.

A Cultural Resource Inventory of the Sunny Brook Colony Water Pipeline, Choteau County, Montana. Prepared for Sunny Brook Colony, Chester, MT and Water Right Solutions, Inc., Helena, Montana.

A Class III Cultural Resource Inventory of the Brown's Lake Fishing Access Site, Powell County, Montana. Prepared for MT Fish, Wildlife & Parks, Helena, Montana.

A Class III Cultural Resource Inventory and Assessment of a Proposed Streambed Rehabilitation on French and Moose Creek in the Mount Haggin Wildlife Management Area, Deer Lodge County, Montana. Prepared for Deer Lodge Valley Conservation District, Deer Lodge, Montana.

A Class III Cultural Resource Inventory of the Gordon Butte Pumped Storage Hydro Project, Meagher County, Montana. Prepared for GB Energy Park, LLC, Bozeman, Montana.

A Class III Cultural Resource Inventory of the American Creek Road Reconstruction Corridor Deer Lodge County, Montana. Prepared for MT Fish, Wildlife & Parks, Butte, Montana.

Record and Assessment of the Bert Mooney Airport Terminal, Butte, Montana. Prepared For Morrison-Maierle, Inc., Helena, MT.

A Class III Cultural Resource Inventory of the Ueland Prevost Road Channel Reconstruction Future Fisheries Project, Silver Bow County, Montana. Prepared for MT Fish, Wildlife & Parks, Helena, Montana.

Archaeological Investigations at Lincoln Gulch Site 24DL151 for the Proposed Realignment of State Highway 274 (aka Secondary 569), Deer Lodge County, Montana (STPS 569-1(1)15). ARPA Permit #M106087 (MT924.3). Prepared For Morrison-Maierle, Inc., Helena, MT and Montana Dept. of Transportation, Helena, Montana.

Archaeological Investigations at Moose Creek Site 24DL154 for the Proposed Realignment of State Highway 274 (aka Secondary 569), Deer Lodge County, Montana (STPS 569-1(1)15). ARPA Permit #M106087 (MT924.3). Prepared For Morrison-Maierle, Inc., Helena, MT and Montana Dept. of Transportation, Helena, Montana.

A Class III Cultural Resource Inventory of the 2014 East Fork Exploration Plan Westmoreland Resources' Absaloka Mine, Big Horn County, Montana. Prepared for Westmoreland Resources, Inc., Hardin, Montana

A Class III Cultural Resource Inventory of Cloud Peak Energy's 2014 Mine Road Project, Spring Creek Coal Mine, Big Horn County, Montana. Prepared for Cloud Peak Energy, LLC, Spring Creek Coal Mine, Decker, MT.

A Class III Cultural Resource Inventory of the Deer Lodge Airport's Proposed "Parcel A" Expansion Area, Powell County, Montana. Report prepared for Morrison-Maierle, Inc., Bozeman, MT

A Class III Cultural Resource Inventory of the Poindexter Slough Fish Habitat Improvement Project, Beaverhead County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Dillon, MT and Beaverhead Watershed Committee, Dillon, MT.

2013 A Cultural Resource Inventory and Assessment of Montana Fish, Wildlife and Parks Proposed Ruby Creek Stream Bank Rehabilitation, Madison County, Montana. Prepared for MT Fish, Wildlife & Parks, Helena, Montana.

Coauthor with Garren Meyer - NRHP Evaluations of 46 Archaeological Properties, Western Energy Company's Area F, Treasure and Rosebud Counties, Montana. Prepared for Western Energy Company, Rosebud Mine, Area C, Colstrip, MT

A Class III Cultural Resource Inventory and Assessment of a Proposed Fish Barrier French Creek in the Mount Haggin Wildlife Management Area, Deer Lodge County, Montana

A Class III Cultural Resource Inventory and Assessment of the Proposed French Gulch Streambed Rehabilitation Project, Deer Lodge County, Montana

A Class III Cultural Resource Inventory of 2013 Exploration Drilling License Modification, Spring Creek Mine, Big Horn County, Montana. Prepared for Cloud Peak Energy Resources, LLC, Spring Creek Coal Mine, Decker, MT.

A Class III Cultural Resource Inventory of Spring Creek Coal Mine's Proposed Water Pipeline Line Route Across Tongue River Reservoir State Park, Big Horn County, Montana. Prepared for Cloud Peak Energy Resources, LLC, Spring Creek Coal Mine, Decker, MT.

A Class III Cultural Resource Inventory of the Bailey Reservoir Fishing Access Site, Hill County, Montana. Prepared for MT Fish, Wildlife & Parks, Helena, Montana.

A Class III Cultural Resource Inventory of 20 Acres of BLM Land for the Pugsley Ranch Irrigation Pivot, Liberty County, Montana. Prepared for Pugsley Ranches, Inc., Chester, Montana.

A Class III Cultural Resource Inventory of the LBM II Tracts at the Spring Creek Mine, Big Horn County, Montana. Prepared for Cloud Peak Energy Resources, LLC, Spring Creek Coal Mine, Decker, MT.

Coauthor with Garren Meyer – Cloud Peak Energy Company's 2012 Survey Area, Spring Creek Coal Mine, Big Horn County, Montana. Prepared for Cloud Peak Energy Resources, LLC, Spring Creek Coal Mine, Decker, MT.

A Class III Cultural Resource Inventory of the Darlington Ditch Fisheries Enhancement Corridor, Gallatin County, Montana. Prepared for Madison-Gallatin Chapter of Trout Unlimited, Bozeman, Montana and MT Fish, Wildlife & Parks, Helena, Montana

A Class I and Class III Cultural Resource Inventory of Peabody Powder River Operations, LLC's Proposed Reroute of Mackey Road, Campbell County, Wyoming. Prepared for Powder River Operations, LLC, Gillette, WY under Authorization of Forest Service Special Use Permit #CAN357HR expiring December 31, 2015

A Class III Cultural Resource Inventory of Spring Creek Coal Mine 2013 Exploration Drilling Program, Big Horn County, Montana. Prepared for Cloud Peak Energy Resources, LLC, Spring Creek Coal Mine, Decker, MT.

2012 A Class III Cultural Resource Inventory of Spring Creek Coal Mine's Proposed Water Pipeline Line Route Across BLM Land in Big Horn County, Montana. Prepared for Cloud Peak Energy Resources, LLC, Spring Creek Coal Mine, Decker, MT.

Archaeological Testing and NRHP Evaluations at 24DL151 and 24DL154 along the Proposed Realignment of State Highway 274 (aka Secondary 569), Deer Lodge County, Montana (STPS 569-1(1)15). Prepared For Morrison-Maierle, Inc., Helena, MT and Montana Dept. of Transportation, Helena, Montana.

A Class III Cultural Resource Inventory of a Proposed Animal Control Fence at Bowman Field, Deer Lodge County, Montana. Prepared For Morrison-Maierle, Inc., Missoula, MT.

Archaeological Investigations at 24BH1737, Big Horn County, Montana. Prepared for Cloud Peak Energy Resources, LLC, Spring Creek Coal Mine, Decker, MT.

A Class III Cultural Resource Inventory of Swimming Woman Creek Construction Corridor Golden Valley County, Montana, Prepared For Golden Valley County, Ryegate, MT.

A Class I Cultural Resource Inventory Spring Creek Coal Mine's Potential Permit Boundary, Big Horn County, Montana. Prepared for Cloud Peak Energy Resources, LLC, Spring Creek Coal Mine, Decker, MT.

A Class III Cultural Resource Inventory of a Construction Corridor for a Proposed Re-Alignment of US Highway 212, Powder River County, Montana, East of Ashland East NH 37-2(24) 63. Prepared For Montana Department of Transportation, Helena, MT.

A Class III Cultural Resource Inventory of Exploration Drilling Sites for the Antelope Coal Mine, Converse and Campbell Counties, Wyoming. Prepared for Cloud Peak Energy Resources, LLC, Antelope Coal Mine, Gillette, Wyoming and Aqua Terra Consultants, Inc., Sheridan, WY.

National Register of Historic Places Evaluations of Five Sites (48CK2071, 48CK2072, 48CK2073, 48CK2077 and 48CK2083) at the Proposed Ross ISR Project, Crook County, Wyoming. Prepared for Strata Energy, Gillette, WY and WWC Engineering, Sheridan, WY

A Cultural Resource Inventory of Montana Resources' Land North and West of the Yankee Doodle Tailings Pond, Silver Bow County, Montana. Prepared for Montana Resources, Inc., Butte, Montana

A Cultural Resource Inventory of Spring Creek Coal Mine's Proposed and Alternative Power Line Routes across BLM Land Big Horn County, Montana. Prepared for Spring Creek Coal, Decker, Montana

2011 A Class III Cultural Resource Inventory of a Proposed Construction Area for the Judith River Slide Repair, Montana Secondary Route 426, Fergus County, Montana: MDT Project No. CN-7726000. Prepared for Montana Department of Transportation, Helena, Montana by GCM Services, Inc.

A Cultural Resource Inventory of Proposed Fisheries Enhancement Projects on the Middle Fork and South Fork Horse Creek, Park County, Montana. Prepared for MT Fish, Wildlife & Parks, Helena, Montana

A Class III Inventory of Road Improvement Projects on the Benchmark and Sun Canyon Roads, Northern Lewis and Clark County, Montana. Prepared for Stahly Engineering, Helena, MT.

A Class III Cultural Resource Inventory of Nine Drill Locations at Spring Creek Coal Mine's 2011 South Exploration License (2), Big Horn County, Montana. Prepared for Cloud Peak Energy Resources, LLC, Spring Creek Coal Mine, Decker, MT and Aqua Terra Consultants, Inc., Sheridan, WY.

A Class III Inventory of the Proposed Transmission Line in Beaverhead County, Montana. Prepared for Legacy Consulting, Butte, MT.

A Class III Cultural Resource Inventory Spring Creek Coal Mine's 2011 Exploration Drilling Program, Big Horn County, Montana. Prepared for Cloud Peak Energy Resources, LLC, Spring Creek Coal Mine, Decker, MT and Aqua Terra Consultants, Inc., Sheridan, WY.

A Class III Cultural Resource Inventory OverSite Resources LLC's Gordon Butte Wind Farm Project, Meagher County, Montana. Prepared for Oversite Resources, LLC, Bozeman, MT

A Class III Cultural Resource Inventory and Assessment of a Proposed Fish Barrier on Elkhorn Creek in the Beartooth WMA, Lewis and Clark County

A Class III Cultural Resource Inventory and Assessment of Proposed Improvements at the Canyon Creek WMA, Lewis and Clark County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

A Class III Cultural Resource Inventory and Assessment of a Proposed Fish Barrier on Elkhorn Creek in the Beartooth WMA, Lewis and Clark County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

A Class III Inventory of the Otter Creek Coal Tracts, Powder River County, Montana. Prepared for Hydrometrics, Billings, MT.

A Class III Cultural Resource Inventory of Northern Telephone Cooperative's Proposed Fiber Optic Line Routes on State Lands in Toole County, Montana. Prepared for Northern Telephone Cooperative, Sunburst MT.

Class I Cultural Resource Inventory (records and literature search) of an Area Adjacent to the Rawhide Mine Permit Area in Campbell County, Wyoming. Prepared for Peabody Powder River Operations, LLC, Gillette, WY.

A Class III Inventory of the Proposed Foster Gulch Road Reconstruction, Lewis & Clark County, Montana. Prepared for Legacy Consulting, Butte, MT.

A Class III Inventory of a Proposed Fence and Irrigation Project on the Sterling Ranch, Lewis & Clark County, Montana. Prepared for Legacy Consulting, Butte, MT.

2010 A Class III Cultural Resource Inventory of the Poindexter Slough Fishing Access Site's Northwest Parcel, Beaverhead County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

A Class III Cultural Resource Inventory of Strata Energy's Proposed ROSS ISR Uranium Project, Crook County, Wyoming. Prepared for Strata Energy, Gillette, WY and WWC Engineering, Sheridan, WY

A Class III Cultural Resource Inventory of the Rocky Reef Spring Creek Habitat Improvement Project, Cascade County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

A Class III Cultural Resource Inventory of the Wesen Dam Project, Valley County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

Western Power and Smelting Company Smelter, 24PA973, within the New World Historic Mining District, Park County, Montana. Prepared for Gallatin National Forest, Bozeman, MT.

A Class III Cultural Resource Inventory of the Government #2A Well Site, Toole County, Montana. Prepared for Keesun Corporation, Cut Bank, Montana

A Class III Cultural Resource Inventory of the CK May Excavating Borrow Pit, Phillips County, Montana. Prepared for CK May Excavating, Belgrade, Montana

A Class III Cultural Resource Inventory of the Keesun Corporation 16-19 Federal Oil Well, Toole County, Montana. Prepared for Keesun Corporation, Cut Bank, Montana

A Class III Cultural Resource Inventory of the Keesun Corporation 8-8 Federal Oil Well, Glacier County, Montana. Prepared for Keesun Corporation, Cut Bank, Montana

A Class III Cultural Resource Inventory of the Proposed Northern Telephone Cooperative's Kevin Rim Fiber Optic Line, Toole County, Montana. Prepared for Northern Telephone Cooperative, Sunburst MT.

A Class I and Class III Cultural Resource Inventory of the Caballo Mine's Southwest Amendment Area, Campbell County, Wyoming. Prepared for the Caballo Mine, Gillette, WY.

A Class III Cultural Resource Inventory of Three Proposed FWP Irrigation Projects, Beaverhead County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

A Class III Cultural Resource Inventory of the Montana-Alberta TIE Ltd. Proposed Transmission Line Selected Route: Glacier, Pondera, Teton, Chouteau and Cascade Counties, Montana. Prepared for Montana-Alberta TIE Ltd., Calgary, Alberta, Canada.

2010 Addendum to: Results of Archaeological Testing at the Proposed Russell Gates Fishing Access Site Expansion, Missoula County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

A Class III Cultural Resource Inventory of the 2010 Exploration Drilling Program on the Spring Creek Coal Mine, Big Horn County, Montana. Prepared for Spring Creek Coal, Decker, MT.

A Class III Cultural Resources Inventory of Signal Peak Energy's Bull Mountains Mine No. 1 Subsidence Study Area, Musselshell County, Montana. Prepared for Signal Peak Energy, Roundup, MT.

2009 Windmill II Site 24BH3077 Located within Westmoreland Coal Company's Absaloka Mine South Extension, Big Horn County, Montana. Prepared for Westmoreland Resources, Inc., Hardin, Montana

A Class III Cultural Resource Inventory of the Keesun Corporation 8-8 Federal Oil Well, Glacier County, Montana. Prepared for Keesun Corporation, Cut Bank, Montana

A Cultural Resources Reconnaissance of Standing Structures and Rock Art on Slopes Greater than 25% at Signal Peak Energy's Bull Mountains Mine No. 1 Subsidence Study Area, Musselshell and Yellowstone Counties, Montana. Prepared for Signal Peak Energy, Roundup, MT.

A Class III Cultural Resource Inventory of the Proposed Martinsdale Wind LLC Wind Turbine Project, Wheatland County, Montana. Prepared for AMEC Earth and Environmental, Helena, MT and Martinsdale Wind, LLC.

A Class III Cultural Resource Inventory of the Croft Petroleum Company's Proposed Oil Wells Federal 4-10, 7-2, 2-9, Toole County, Montana. Prepared for Croft Petroleum Company, Cut Bank, MT.

A Class III Cultural Resource Inventory of the Proposed Oil Well Federal 4-14, Toole County, Montana. Prepared for KGH Operating Company, Billings, MT.

A Class III Cultural Resource Inventory of the Hedge Ditch Diversion Dam Replacement, Ravalli County, Montana. Prepared for Morrison Maierle, Missoula, MT.

A Class III Cultural Resource Inventory of the Bitter Root Irrigation District Replacement Siphon I, Ravalli County, Montana. Prepared for Morrison Maierle, Missoula, MT.

A Class III Cultural Resource Inventory of the 2009 Exploration Drilling Program on the Spring Creek Coal Mine, Big Horn County, Montana. Prepared for Spring Creek Coal, Decker, MT.

A Class III Cultural Resources Inventory of Signal Peak Energy's Bull Mountains Mine No. 1 Subsidence Study Area, Musselshell County, Montana. Prepared for Signal Peak Energy, Roundup, MT.

A Class III Cultural Resource Inventory of Western Energy Company's 2009 Exploration Drilling Program, Rosebud County, Montana.

A Class III Cultural Resource Inventory of 42 Proposed Coal Exploration Drilling Locales, Big Horn County, Montana. Prepared for Westmoreland Resources, Hardin, Montana.

A Class III Cultural Resource Inventory of Thirteen Exploratory Core Drilling Locations and Access Routes for Antelope Coal Company, Converse County, Wyoming. Prepared for Aqua Terra Consultants, Inc., Sheridan, WY.

Class I/III Cultural Resource Inventory of the North Hilight LBA, Campbell County, Wyoming. Prepared for Thunder Basin Coal Co., Wright, WY.

A Class III Cultural Resource Inventory of the Lower Fish Creek Channel Rehabilitation Project, Jefferson County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

A Class III Cultural Resource Inventory of the Fish Barrier Installation on Smith Creek, Choteau County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

Class I/III Cultural Resource Inventory of the West Hilight LBA, Campbell County, Wyoming. Prepared for Thunder Basin Coal Co., Wright, WY.

With Jennifer Petersen - A Class I Cultural Resource Inventory of Proposed Teom Locations Campbell County, Wyoming. Prepared for West Roundup Resources, Inc., School Creek Mine, Gillette, WY.

With Jennifer Petersen - A Class I Cultural Resource Inventory of the Proposed Naturener Rim Rock Energy Wind Farm, Locations, Glacier and Toole Counties, Montana. Prepared for AMEC Earth and Environmental, Helena, MT and NaturEner Rim Rock Energy, LLC, Denver, CO.

With Jennifer Petersen - A Class I and Class III Cultural Resource Inventory of Caballo Coal Company's Caballo West LBA Resource Report Area, Campbell County, Wyoming. Prepared for Caballo Coal Company and Powder River Coal Company, Gillette, WY.

Class I/III Cultural Resource Inventory of the South Hilight LBA, Campbell County, Wyoming. Prepared for Thunder Basin Coal Co., Wright, WY.

2008 With Dale Decco - A Class III Cultural Resource Inventory of Secondary Highway 313 in Big Horn County, Montana, Hardin-South 313-1(16)0 CN 5793. Prepared For Montana Department of Transportation, Helena, MT.

With Dale Decco - A Class III Cultural Resource Inventory of the Bert Mooney Airport, Butte, Montana. Prepared for Morrison-Maierle, Inc., Helena, MT.

A Class III Inventory of the Kalispell Line Valve 5 to 6 Loop Natural Gas Pipeline, Flathead County, Montana. Prepared for Legacy Consulting and Northwestern Energy, Butte, MT.

Archaeological Monitoring at the Utica Bison Kill Site, 24JT324, Judith Basin County, Montana. Prepared for Montana Department of Transportation, Helena, MT.

A Class III Cultural Resource Inventory of the Proposed Leach Farm Water Pipeline Project, Liberty County, Montana. Prepared for Leach Farm, Ledger, MT and the Bureau of Reclamation, Billings, MT.

A Class III Cultural Resource Inventory of an Addition to Westmoreland Resources, Inc. Absaloka Mine's Crow South Extension, Big Horn County, Montana. Prepared for Westmoreland Resources, Inc., Hardin, MT.

A Class III Cultural Resource Inventory of the Crystal Lake Fishing Access Site, Lincoln County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

A Class III Cultural Resource Inventory of the Proposed Gibson Dam Hydroelectric Transmission Line, Lewis and Clark and Teton Counties, Montana. Prepared for Whitewater Engineering Corporation, Bellingham, WA.

A Class I Cultural Resource Inventory of the West Antelope II General Analysis Area, Converse and Campbell Counties, Wyoming. Prepared for EDE Consultants, Sheridan, WY and Rio Tinto's Antelope Coal Mine, Wright, WY.

A Class III Cultural Resource Inventory of a Proposed Borrow Pit, Campbell County, Wyoming. Prepared for Thunder Basin Coal Company, Gillette, WY.

A Class III Cultural Resource Inventory of the Proposed Belfry Bridge Over Silver Tip Creek, Carbon County, Montana. Prepared for Legacy Consulting and Northwestern Energy, Butte, MT.

A Cultural Resource Review of the Elias/Perkins Mill Gulch Subdivision, Madison County, Montana. Prepared for Gendreau-Elias Engineering & Surveying, Inc., Butte, MT.

A Class I/III Cultural Resource Inventory for Three Proposed Core Drilling Locations Within the Jacobs Ranch Coal Company's West Jacobs Ranch LBA Study Area, Campbell County, Wyoming. Prepared for Aqua Terra Consultants, Inc., Sheridan, Wyoming.

A Cultural Resources Review of the Proposed Lost Lakes Subdivision, Madison County, Montana. Prepared for Lost Lakes Development Company, LLC, Kinston, NC.

A Class III Cultural Resource Inventory of the Montana-Alberta TIE Ltd. Proposed Transmission Line: Alternative 4 Route; Glacier, Pondera, Teton, Chouteau and Cascade Counties, Montana. Prepared for Montana-Alberta TIE Ltd., Calgary, Alberta, Canada.

A Class III Cultural Resource Inventory of the Proposed Weber Ranch, Merritt Spring Creek and Elkhorn Creek Barrier Fisheries Enhancement Project, Lewis and Clark County, Montana. With contributions by Dale Decco. Prepared for Legacy Consulting and PPL Montana, Butte, MT.

Class III Cultural Resource Inventory of the Proposed Point of Rocks Fishing Access Site, Park County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

A Class III Cultural Resource Inventory of the Swan Lake Subdivision, Lake County, Montana. Prepared for Bird's Eye View, LLC, Seattle, WA.

A Class III Cultural Resource Inventory of the Sterling Ranch Fishing Access Site, Lewis & Clark County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

Class III Cultural Resource Inventory of the Proposed Raynold's Pass Fishing Access Site, Madison County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

With Dale Decco - A Class III Cultural Resource Inventory of Secondary Highway 234 in Hill County, Montana. Taylor Hill Road MT 234 1(16)21 CN 6382. Prepared for the Montana Department of Transportation, Helena, MT.

An Historical Assessment of the Thompson Creek Road Bridge Replacement Project, Sheridan County, Wyoming. Prepared for WWC Engineering, Sheridan, WY.

A Class III Cultural Resource Inventory of the Proposed Jack Creek Channel Relocation Fisheries Enhancement Project, Madison County, Montana. Prepared for Legacy Consulting and PPL Montana, Butte, MT.

A Class III Cultural Resource Inventory of Proposed Reconstruction Alignments Along Secondary State Highway 274 (AKA Secondary 569), Deer Lodge County, Montana (STPS 569-1(1)15). Prepared for the Montana Department of Transportation, Helena, MT.

A Class III Cultural Resource Inventory of the Howe Property Fishing Access Site, Sanders County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

A Class III Cultural Resource Inventory of the Little Blackfoot Fishing Access Site, Powell County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

A Class III Cultural Resource Inventory of the Omimex Canada, Ltd. Proposed Gas Pipeline to Gas Well 2971-1 Federal, Phillips County, Montana. Prepared for Omimex Canada, Ltd., Butte, MT.

2007 A Class III Cultural Resource Inventory of the Poindexter Slough Fishing Access Site, Beaverhead County, Montana. Prepared for Montana Fish, Wildlife & Parks, Helena, MT.

Archaeological Testing and Evaluation at Site 24TL777, Toole County, Montana. Prepared for the Montana Department of Transportation, Helena, MT.

A Class III Cultural Resource Inventory of the West Antelope II EIS Additions, Converse County, Wyoming. Prepared for EDE Consultants, Sheridan, WY.

Caballo West LBA EIS. Prepared for WWC Engineering, Sheridan, WY.

A Class III Cultural Resource Inventory of the Rock Creek Habitat Enhancement Project, Granite County, Montana. Prepared for Montana Fish, Wildlife & Parks, Helena, MT.

A Cultural Resource Inventory of the Proposed Natural Gas Wells Dezort 16-23 and Dezort 1-35. Prepared for Omimex Canada, Ltd., Butte, MT.

A Class III Cultural Resource Inventory of the Savage Mine Proposed Expansion Area near Savage, Montana. Prepared for Western Energy Company, Colstrip, MT.

A Class III Cultural Resource Inventory of the Big Sky Spur Road Trail, Gallatin County, Montana. Prepared for Stahly Engineering & Associates, Inc., Helena, MT.

An Evaluation of Archaeological Sites 24BH545 and 24BH546 on the Spring Creek Coal Mine, Big Horn County, Montana. Prepared for Rio Tinto Energy America, Decker, MT.

A Cultural Resources Review of the Proposed Samuels 20 Subdivision, Gallatin County, Montana. Prepared for Bechtle-Slade, PC, Bozeman, MT.

A Cultural Resources Review of the Proposed Yellowstone Ranch Preserve Subdivision, Gallatin County, Montana. Prepared for Bechtle-Slade, PC, Bozeman, MT.

A Class III Cultural Resource Inventory of the Omimex Canada, Ltd. Proposed Gas Well 1860-2 Federal, Phillips County, Montana. Prepared for Omimex Canada, Ltd., Butte, MT.

A Class III Cultural Resource Inventory of Rio Tinto Energy America's Kennecott Uranium Project Exploration Drilling Program, Fremont County, Wyoming. Prepared for Rio Tinto Energy America, Windsor, CO.

A Class III Cultural Resource Inventory of Spring Creek Coal Company's Pearson Creek Permit Amendment Area, Big Horn County, Montana. Prepared for Rio Tinto's Spring Creek Coal Mine, Decker, MT.

An Archaeological Review of the Proposed Clyde Park Meadows Subdivision, Park County, Montana. Prepared for Absaroka Consultants, Inc., Clyde Park, MT.

A Class III Cultural Resource Inventory of the Proposed Upper McKee Spring Creek Restoration Fisheries Enhancement Project, Madison County, Montana. Prepared for Legacy Consulting Services, Butte, MT.

An Archaeological Review of the Proposed Shields River Bluffs Subdivision, Park County, Montana. Prepared for Absaroka Consultants, Inc., Clyde Park, MT.

An Archaeological Review of the Proposed Absaroka View Subdivision. Prepared for Absaroka Consultants, Inc., Clyde Park, MT.

A Class III Cultural Resource Inventory of a Proposed Construction Area at the Southeast Edge of Butte, Montana. Prepared for ERM Rocky Mountain, Greenwood Village, CO.

A Class III Cultural Resource Inventory of the Proposed Alberta-Montana TIE, Ltd. Powerline, Glacier, Toole, Pondera, Chouteau, Teton & Cascade Counties, Montana. Prepared for AMEC Earth & Environmental, Helena, MT.

A Cultural Resource Review of the Whiskey Flats Subdivison, Phase III, Granite County, Montana. Prepared for Water & Environmental Technologies, Butte, MT.

A Class III Cultural Resource Inventory of the Proposed Carter's Ferry Fishing Access Site, Chouteau County, Montana. Prepared for Montana Fish, Wildlife & Parks, Helena, MT.

A Cultural Resource Review of "1880s Ranch" Subdivision, Deer Lodge County, Montana. Prepared for Water & Environmental Technologies, Butte, MT.

A Class III Cultural Resource Inventory of Montana Highway 59, Powder River County, Montana: Wyoming Line North STPP 54-1(8)0. Prepared for Montana Department of Transportation, Helena, MT.

A Class III Cultural Resource Inventory of the Bureau of Land Management Drain System Easements at the Proposed Aspen Trails Ranch Subdivision, Lewis & Clark County, Montana. Prepared for Morrison-Maierle, Inc., Helena, MT.

A Class III Cultural Resource Inventory: A Re-examination of Selected Parcels within the Spring Creek Coal Mine Permit Area, Big Horn County, Montana. Prepared for Rio Tinto's Spring Creek Coal Mine, Decker, MT.

2006 Non-Intensive Cultural Resource Inventory of the Proposed "T" Pasture South Subdivision, Broadwater County, Montana. Prepared for Bechtle-Slade, PC, Bozeman, MT.

Non-Intensive Cultural Resource Inventory of the Proposed Old Prairie Ranch Subdivision, Broadwater County, Montana. Prepared for Bechtle-Slade, PC, Bozeman, MT.

An Archaeological Review of a Site of Special Concern to the Northern Cheyenne Tribal Cultural Monitors Located on the Rio Tinto Spring Creek Coal Mine Property, Big Horn County, Montana. Prepared for Rio Tinto Spring Creek Coal Mine, Decker, MT, and the Bureau of Land Management, Miles City, MT.

Coauthor with Jennifer Petersen – A Class III Cultural Resource Inventory of the Caballo Mine 2007 Off Lease Drilling Areas (Exploration License WYW 173369), Campbell County, Wyoming. Prepared for Powder River Coal Company, Gillette, WY.

Proposed Nettik Subdivision, Dillon, Montana. Prepared for the National Affordable Housing Network, Butte, MT.

Proposed Bear Creek Estates Subdivision, Madison County, Montana. Prepared for SBC Investments, West Yellowstone, MT.

A Class III Cultural Resource Inventory of the Proposed Headwaters State Park Pedestrian Trail Development, Gallatin County, Montana. Prepared for Montana Fish, Wildlife & Parks, Helena, MT.

A Class III Cultural Resource Inventory of the Proposed Monture Creek Fishing Access Site Road Protection Project, Powell County, Montana. Prepared for Montana Fish, Wildlife & Parks, Helena, MT.

A Cultural Resource Review of the Proposed Mandeville Creek Subdivision, Bozeman, Montana. Prepared for Bechtle-Slade, PC, Bozeman, MT.

A Cultural Resource Review of the Proposed North Forty Mixed-Use Development, Ennis, Montana. Prepared for Bechtle-Slade, PC, Bozeman, MT.

Areas and State Lands Along the ConocoPhillips/Momentum Energy Group Joint Pipeline Corridor, Converse and Campbell Counties, Wyoming. Prepared for Billings, MT and Momentum Energy Group, LC, Durango, CO.

Mandeville Creek (90 acres), Madison County, Montana. Prepared for Bechtle-Slade, PC, Bozeman, MT.
North Forty Property (44 acres), Madison County, Montana. Prepared for Bechtle-Slade, PC, Bozeman, MT.

Coauthor with Jennifer Petersen - Yellowstone Ranch Preserve (approximately 720 acres), Madison County, Montana. Prepared for Bechtle-Slade, PC, Bozeman, MT.

Lower Family Ranch (approximately 960 acres), Madison County, Montana. Prepared for Bechtle-Slade, PC, Bozeman, MT.

A Class I Inventory of the Proposed Little Thunder Creek Blocking Dike and Diversion, Campbell County, Wyoming. Prepared for Thunder Basin Coal Company, Wright, WY.

Trout Creek SE STPP 6-1(98)30, Sanders County, Montana. Prepared for Montana Department of Transportation, Helena, MT.

A Class III Cultural Resource Inventory of a Proposed Parking Area at the Erwin Bridge Fishing Access Site, Gallatin County, Montana. Prepared for Montana Fish, Wildlife & Parks, Helena, MT.

A Cultural Resource Review of the Upland Meadows Subdivision, Madison County, Montana. Prepared for Upland Enterprises, LLC, Ennis, MT.

A Class I Cultural Resource Inventory of the Proposed Alberta-Montana TIE, Ltd. Powerline, Glacier, Toole, Pondera, Chouteau, Teton & Cascade Counties, Montana. Prepared for AMEC Earth & Environmental, Helena, MT.

Recordation and NRHP Evaluation of the North Side Ditch, Bannack, Montana. Prepared for Montana Fish, Wildlife & Parks, Helena, MT.

A Cultural Resource Inventory of the Proposed Churn Creek Subdivision, Gallatin County, Montana. Prepared for Bechtle-Slade, PC, Bozeman, MT.

A Class III Cultural Resource Inventory of proposed radio tower location, Sweetgrass Hills, Montana. Prepared for Northup-Grumman, Helena, MT.

Coauthor with Garren Meyer - Crow South Extension Survey, 2800 Acres, Big Horn County, Montana. Prepared for Westmoreland Resources, Inc., Hardin, MT.

School Creek Historic Context of Peabody Energy’s West Roundup Resources School Creek Mine, Campbell County, Wyoming. Prepared for Peabody Energy, St. Louis, MO, and West Roundup Resources, Inc., Gillette, WY.

School Creek Paleontology of Peabody Energy’s West Roundup Resources School Creek Mine, Campbell County, Wyoming. Prepared for Peabody Energy, St. Louis, MO, and West Roundup Resources, Inc., Gillette, WY.

A Historical Assessment of Four Road Segments Petitioned for Abandonment Associated with the Yellowstone River Ranch Estates, LLC. Park County, Montana. Prepared for Octagon Consulting Engineers, Emigrant, MT.

Site Form Addendum for 24LA271, Ringneck Ranch. Prepared for Montana Fish, Wildlife & Parks, Helena, MT.

A Class III Cultural Resource Inventory of US Highway 2 in Toole and Liberty Counties, Montana: Galata East & West NH 1-4(28)300. Prepared for Montana Department of Transportation, Helena, MT.

2005 Coauthor with Garren Meyer - A Class III Cultural Resource Inventory of Decker Coal Company's Lease Application Area, Big Horn County, Montana. Prepared for Western Water Consultants, Sheridan, WY.

A Class III Cultural Resource Inventory of the Proposed Shields River Fishing Access Site, Park County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

A Class III Cultural Resource Inventory of the Proposed Discovery Vista Subdivision near Livingston, Park County, Montana. Prepared for Octagon Consulting Engineers, Emigrant, MT.

Peabody Energy's West Roundup Resources Inc., School Creek Mine Class I/Class III Cultural Resource Project, Campbell County, Wyoming (23,080-Class I; 2,880 acres-Class III) for Peabody Energy, St. Louis, MO and Gillette, WY.

A Class III Cultural Resource Inventory of the Omimex Canada, Ltd. Proposed Three Gas Wells, Phillips County, Montana.

A Class III Cultural Resource Inventory of the Proposed Meadowlark Ranch Subdivision near Belgrade, Gallatin County, Montana. Prepared for PC Development Bozeman, MT.

A Class III Cultural Resource Inventory of a Proposed Subdivision near Livingston, Park County, Montana. Prepared for Octagon Consulting Engineers, Emigrant, MT.

A Class III Cultural Resources Inventory of the Proposed Decker Coal Mine-to-Spring Creek Coal Mine Dragline Transport Corridor in Big Horn County, Montana. Prepared for Kennecott Energy's Spring Creek Coal Mine, Big Horn County, MT.

A Class III Cultural Resource Inventory of the Sand Creek Bridge Replacement, Rosebud County, Montana BR 9044(17) Sand Creek 7 km East of Cartersville. Prepared for Montana Department of Transportation, Helena, MT.

A Class III Cultural Resource Inventory of the Powderville Bridge Replacement, BR 9038 (10) Rosebud County, Montana. Big Powder River - 3 km East of Powderville. Prepared for Montana Department of Transportation, Helena, MT.

A Class III Cultural Resource Inventory of the Rose Creek Hatchery Site, the Cedar Island Development Site, and the Lake 5 Fishing Access Area. Flathead and Lake Counties, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

A Class III Cultural Resource Inventory of three stream channel rehabilitation projects in Southwestern Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

A Class III Cultural Resource Inventory of Lincoln-East NH 24-3(25) 76, Lewis and Clark County, Montana. Prepared for Montana Department of Transportation, Helena, MT.

2004 A Cultural Resource Inventory of Selected Coal Tracts in the Otter Creek Valley, Powder River County, Montana. Prepared for Great Northern Properties, LP, Golden, CO. (2,400 acres)

A Class III Cultural and Paleontological Resource Inventory of the Otter Creek Study Area, Powder River County, Montana; with contributions by Jennifer Petersen. Conducted for Montana Department of Natural Resources and Conservation, Helena, MT and Great Northern Properties, LLC. (7,200 acres)

An NRHP Evaluation of the Emma Hamlin Homestead, 48CO1258 within the West Antelope Permit Amendment Area. Prepared for Kennecott's Antelope Coal Company, Gillette, WY.

Cultural Resource Inventory of Sites in Ekalaka, Carter County, Montana. Prepared for Frost Construction, WY.

Crow South Extension Survey of 2800 acres. Big Horn County, Montana. Prepared for Westmoreland Resources, Inc., Hardin, MT.

SE Battle Gas Wells, Blaine County, Montana. Prepared for Ominex, Butte, MT.

Cultural Resource Inventory and Assessment: Proposed Marysville Post Office, Lewis and Clark County, Montana. Prepared for Hessler Architects, Great Falls, MT.

Results of Archaeological Testing at the Proposed Russell Gates Fishing Access Site Expansion, Missoula County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

A Class III Cultural Resource Inventory of the Proposed Scotty Brown Fishing Access Site and Disposal Property, Powell County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

A Class III Cultural Resource Inventory of 31 Proposed Coal Exploration Drilling Locales, Big Horn County, Montana. Prepared for Westmoreland Resources, Inc., Hardin, MT.

A Class III Cultural Resource Inventories of the North Antelope Rochelle Mine's South and North Powerline Corridors, Campbell County Wyoming. Prepared for Powder River Coal Company, Gillette, WY.

A Class III Cultural Resource Inventory of Two Proposed Parking Areas near the Henneberry Fishing Access Site, Beaverhead County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

A Cultural Resources Review of Athena Energy's 3 Proposed Gas Wells, Phillips County, Montana. Prepared for Athena Energy, LLC, Butte, MT.

NRHP Assessment and Documentation of the Montana Fish, Wildlife & Parks West Yellowstone Enforcement Compound, Gallatin County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

Documentation and NRHP Assessment of the Old Gallatin Field Terminal Building, Gallatin County, Montana. Prepared for Morrison-Maierle, Inc., Bozeman, MT.

A Class III Cultural Resource Inventory of a Proposed FWP Fisheries Enhancement Project on Tenmile Creek, Lewis and Clark County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

A Class III Cultural Resource Inventory of a Proposed FWP Fisheries Enhancement Project on the Shields River, Park County, Montana. Prepared for Montana Department of Fish, Wildlife & Parks, Helena, MT.

An Intensive Cultural Resource Inventory of the Circle Town/County Airport Property, McCone County, Montana. Prepared for Stelling Engineers, Inc., Great Falls, MT.

A Class III Cultural Resource Inventory of the Libby Airport, Lincoln County, Montana. Prepared for Morrison-Maierle, Helena, MT.

A Class I Cultural Resource Inventory of a Portion of the Rochelle Hills POD Converse and Campbell Counties, Wyoming. Prepared for Yates Petroleum Inc., Gillette, WY.

A Class III Cultural Resource Inventory of a Proposed Veterans Benefits Administration Facility at Fort William Henry Harrison, Lewis and Clark County, Montana. Prepared for The LA Group, Saratoga Springs, NY, and Fort Harrison Veterans Administration Center, Helena, MT.

A Cultural Resource Inventory of the Proposed Kennedy Subdivision, Gallatin County, Montana. Prepared for Thomas, Dean and Hoskins, Bozeman, MT.

Proposed Barton Gulch Subdivision, Madison County, Montana. Prepared for Headwaters Realty, Twin Bridges, MT.

A Class III Cultural Resource Inventory of a Proposed Construction Area at the Bert Mooney Airport, Butte, Montana. Prepared for Morrison-Maierle, Bozeman, MT.

A Cultural Resource Inventory of the Ravalli County Airport, Hamilton, Montana. Prepared for Morrison-Maierle, Bozeman, MT.

Cultural Resource Inventory of the Reno Road Realignment (County Road 83), Campbell County, Wyoming. Prepared for Triton Coal Company, LLC, North Rochelle Mine, Gillette, WY.

2003 A Class III Cultural Resource Inventory of the USFS Medicine Bow National Forest Buckley Land Exchange, Campbell, Converse and Weston Counties, Wyoming. Conducted for the Medicine Bow National Forest, Thunder Basin National Grasslands, Douglas Ranger District (3,800 acres).

Mitigation of the Little Daisy Mine Reclamation Project, Park County, Montana. Report prepared for Gallatin National Forest, Bozeman, MT.

A Class III Cultural Resource Inventory and Assessment of the Porcupine CBM Plan of Development, Campbell County, Wyoming. Prepared for O&G Environmental, Denver, CO, and Bill Barrett Corporation, Gillette, WY.

A Class III Cultural Resource Inventory and Assessment of the Rutter Gas Well and Access, Teton County, Montana. Report prepared for the Rutter Trust and The Bureau of Land Management, Great Falls, MT.

A Class III Cultural Resource Inventory and Assessment of Antelope Coal Company's West Antelope LBA Addition (3000 acres), Converse County, Wyoming. Report prepared for Antelope Coal Company.

A Class III Cultural Resource Inventory of the Apollo Gold/Montana Tunnels proposed permit expansion area, Jefferson County, Montana. Report prepared for Apollo Gold, Inc., Jefferson City, MT.

A Class III Cultural Resource Inventory of the Silverbow Corridor Borrow areas.
Report conducted for the Montana Department of Environmental Quality (DEQ), Mine Waste Cleanup Bureau, Helena, MT.

A Class III Cultural Resource Inventory of Eight Dams in the Rattlesnake Wilderness, conducted for Mountain Water Company, Missoula, MT.

A Class III Cultural Resource Inventory of the Deer Lodge Airport's Proposed Expansion. Report prepared for Morrison-Maierle, Inc. and the Powell County Airport.

A Class III Cultural Resource Inventory of Seven Highway Culverts in eastern Montana. Report prepared for WWC Engineering, Helena, MT and the Montana Department of Transportation, Helena, MT.

A Class III Cultural Resource Inventory and construction monitoring at the Nevada City Wastewater treatment facility, Madison County, Montana. Conducted for Entranco, Inc., Helena and Virginia City, MT.

Paleontology resource inventories of two parcels of Thunder Basin National Grassland in Campbell County, Wyoming for Triton Coal Company, Gillette, WY.

Cultural Resource Inventory of two parcels of Thunder Basin National Grassland in Campbell County, Wyoming. Prepared for Triton Coal Company's Thunder Basin National Grassland in Campbell County, Wyoming for Triton Coal's Special Use Permit Modification.

Paleontological resource report on a parcel of Thunder Basin National Grassland in Campbell County, Wyoming. Prepared for Thunder Basin Coal Company's Black Thunder Mine, Wright, WY.

A Class III Cultural Resource Inventory of the Silver Creek Reclamation Corridor in the Marysville Historic Mining District, Lewis and Clark County, Montana (12.5 miles). Task Order 6, conducted for the Montana Department of Environmental Quality (DEQ), Mine Waste Cleanup Bureau, Helena, MT.

2002 A Class III Cultural resource inventory of the Cottonwood Creek Study Area, Carbon County, Montana. (2,400 acres) Conducted for the Bureau of Land Management (BLM), Montana State Office, Billings, MT.

Testing and Evaluation of the Utica Bison Kill 24JT324, Reviewed by the Montana Department of Transportation, Helena, MT.

Mitigation of the Gregory Mine Reclamation Project: Task Order 5. Prepared for the Montana Department of Environmental Quality, Abandoned Mine Cleanup Bureau, Helena, MT.

Archaeological Investigations at the Utica Bison Kill Site, 24JT324, in conjunction with the Hobson-Utica (STPS 239-1(2)0) highway overlay project. Conducted for Stelling Engineers and the Montana Department of Transportation.

A Class III Cultural Resource Inventory of Hobson-Utica (STPS 239-1(2)0) highway project. Conducted for Stelling Engineers and the Montana Department of Transportation.

Mitigation of the Homestake, Gold Dust, Tredennick and Black Warrior Mines Remediation Project. Historical and photo documentation of the three mines in Park County, Montana. Prepared for Gallatin National Forest, Bozeman, MT.

2001 Testing and Evaluation of the Willow Creek Site, 24LC1023 and the Alice Creek Site, 24LC1015, for the Helena National Forest, Helena, MT.

A Class III Cultural Resource Inventory of Carbon County Line-East (STPS 421-2(2)9) and 7 Km East of Columbus-East (STPS 421-1(3)6) highway projects. Conducted for WWC Engineering and the Montana Department of Transportation.

A Class III Cultural Resource Inventory of Peabody Energy Company's North Ashland Project (3,700 acres) in Rosebud County, Montana.

A Class III Cultural Resources Inventory and Assessment of Antelope Coal Company's West Antelope LBA Study Area, Converse County, Wyoming (3,800 acres).

2000 A Class III Cultural Resources Inventory and Assessment of Antelope Coal Company's Antelope Creek Study Area, Converse County, Wyoming (1,200 acres).

A Class III Cultural Resources Inventory and Assessment of Pittsburg and Midway Coal Mining Company's Ash Creek Study Area, Sheridan County, Wyoming (3,500 acres). Prepared for Western Water Consultants. Reviewed by the Bureau of Land Management, Buffalo, WY.

A Class III Cultural Resources Inventory of the Union Pacific Resources Company - BLM Land Exchange, Sweetwater County, Wyoming (4,600 acres). Report prepared for and reviewed by Bureau of Land Management, Rawlins, WY.

National Register of Historic Places Nomination of the Dorr Ranch. Prepared for the USDA Forest Service, Medicine Bow National Forest, Douglas Ranger District's Thunder Basin National Grasslands 2000 Conservation Project, Douglas, WY.

Project Codirector - A Class III Cultural Resources Inventory and Assessment of Thunder Basin National Grasslands 2000 Conservation Program (5,700 acres). Report prepared for USDA Forest Service, Medicine Bow National Forest, Douglas Ranger District, Douglas, WY.

Cultural Resources Inventory and Assessment of Xeno-Solid State Geophysical Seismic Exploration Program, Blaine County, MT.

Cultural Resources Inventory and Assessment of Geophysical Services, Inc. - John Brown Seismic Exploration Program, Blaine County, MT.

Cultural Resources Inventory and Assessment of the Ringling North and South Highway 89 Reconstruction Corridor, Meagher County, Montana, for Montana Department of Transportation.

Cultural Resources Inventory and Assessment of the East Glacier Highway 2 Bridge Reconstruction Corridor, Glacier County, Montana, for Sverdrup Civil, Inc., and Montana Department of Transportation.

Cultural Resources Inventory and Assessment of the Belt North and South Highway 89 Reconstruction Corridor, Cascade County, Montana, for Sverdrup Civil, Inc. and Montana Department of Transportation.

Cultural Resources Inventory and Assessment of the Bald Butte Quarry Proposed Expansion, Niobrara County, Wyoming, for Western Water Consultants, Inc., Sheridan, Wyoming.

1999 Project Codirector - Cultural Resources Inventory and Assessment of Powder River Coal Company's Tract L Proposed Permit Expansion Area, Campbell County, Wyoming (14,500 acres).

Cultural Resources Inventory and Assessment of Jacobs Ranch Coal Company's Proposed New Lease Area, Campbell County, Wyoming (7,000 acres).

Cultural Resources Inventory and Assessment of Triton Coal Company's Proposed North Rochelle New Lease Area, Campbell County, Wyoming (1200 acres).

Cultural Resources Inventory and Assessment of the Colstrip South Highway 39 Reconstruction Corridor, Rosebud County, Montana, for Entranco, Inc. and Montana Department of Transportation.

Cultural Resources Inventory and Evaluation of Upper Snake River and South Fork of the Snake River Land Exchanges, Idaho, for the Idaho Falls District of the Bureau of Land Management.

Cultural Resources Inventory and Evaluation of Atlanta 8" Gas Pipeline, Phillips County, Montana for North American Resources Company (Agency reviewer, BLM).

1998 Cultural Resources Inventory and Assessment of the Cow Creek, LLC Land Exchange, Campbell and Johnson County, Wyoming. (10,500 acres)

Cultural Resources Inventory and Assessment of the Horse Creek Extension Study Area, Campbell County, Wyoming for Antelope Coal Company.

Cultural Resources Inventory and Assessment of the High Point 1 and 2 EFR project, Twin Falls, Idaho (1100 acres). Bureau of Land Management, Shoshone, Idaho.

Cultural Resources Inventory and Assessment of the Main Canal Range Seeding Project, Twin Falls, Idaho (2100 acres). Bureau of Land Management, Shoshone, Idaho.

Cultural Resources Inventory and Assessment of the Wood Tick Fire EFR project, Twin Falls, Idaho (700 acres). Bureau of Land Management, Shoshone, Idaho.

Cultural Resources Inventory and Assessment of the Goat Fire EFR project, Twin Falls, Idaho (1000 acres). Bureau of Land Management, Shoshone, Idaho.

Inventory and Evaluation of 23 Proposed Gas Well Locations, Phillips County, Montana for North American Resources Company (Agency reviewer, BLM).

Coauthor - Archaeological Investigations at Janney Rockshelter 24BH1117 and Pillar Site 24BH2630. Westmoreland Resources, Inc.

1997 Cultural Resource Inventory and Assessment of Clubfoot Creek - Lost Leg Timber Sale on the Northern Cheyenne Indian Reservation, Montana, for Bureau of Indian Affairs.

Cultural Resources Inventory and Assessment of the Horse Creek Study Area, Campbell County, Wyoming for Antelope Coal Company.

Field Supervisor - NRHP Evaluations for Area D East, Big Horn County, Montana, for Western Energy Co.

Cultural Resource Inventory and Assessment of Treasure Mountain, Lincoln County, Montana, for Sno.engineering, Inc.

A Class III Cultural Resources Inventory and Evaluation of approximately 400 acres near Cardwell, Jefferson County, Montana, for Golden Sunlight Mines, Inc.

A Class III Cultural Resources Inventory of 1700 acres near Tiber Dam, Liberty County, Montana. (Agency: Bureau of Reclamation).

Cultural Resource Inventory and Assessment: Silver Lake East Dam and West Dam, Deer Lodge County, Montana, for MSE-HKM, Inc.

Cultural Resource Inventory and Evaluation of Greenway Corridor, Silver Bow County, Montana, for Pioneer Technical Services.

Inventory and Evaluation of 19 Proposed Gas Well Locations, Phillips County, Montana for North American Resources Company (Agency reviewer, BLM).

1996 A Class III Cultural Resources Inventory of Proposed Spring Creek Coal Company Mine Expansion, Powder River County, Montana (1700 acres). Reviewing Agency: Montana Department of Environmental Quality and Office of Surface Mining.

A Class III Cultural Resources Inventory of the Proposed Valdus Norris Project Gold Mine, Madison County, Montana (1200 acres). Prepared for Valdus Operations, Inc. Reviewing agency: Bureau of Land Management, and Montana Department of Environmental Quality.

Cultural Resource Inventory of the Geco Prakla Bull Creek 3-D Seismograph Exploration Project, Billings County, North Dakota. Prepared for Geco Prakla, Calgary, Alberta, Canada.

Cultural Resource Inventory: Proposed Meridian Oil - Cinnamon Creek 3-D Seismograph Exploration Project, McKenzie County, North Dakota. Prepared for Geco Prakla, Calgary, Alberta, Canada.

A Class III Cultural Resources Inventory of Inyan Kara Land Exchange, Weston County Wyoming (1620 acres). Prepared for Inyan Kara Grazing Association, Reviewing agency: Medicine Bow National Forest, Douglas.

A Class III Cultural Resources Inventory of Fort William Harrison, Lewis and Clark County, Montana (1300 acres). Prepared for Labat Anderson Incorporated. Reviewing agency: Bureau of Land Management and Department of the Army, Army National Guard.

A Class III Cultural Resource Inventory of the Bowdoin Gas Pipeline, Phillips County, Montana for North American Resources Company (60 acres). Reviewing agencies: Lewistown District, Bureau of Land Management.

1995 Project Codirector - A Class III Cultural Resource Inventory of Elkhorn Mining District, Jefferson County, Montana. Prepared For Santa Fe Pacific Gold. Reviewing agencies: Beaverhead / Deerlodge National Forests and Montana Department of State Lands (9000 acres).

Project Codirector - A Class III Cultural Resource Inventory of CENEX Front Range Pipeline. Prepared For CENEX, Incorporated and coordinate by Trigon Engineering Incorporated and Morrison-Maierle Environmental Corporation. Reviewing agencies: Army Corps of Engineers and Montana Department of State Lands.

Project Codirector - A Class III Cultural Resource Inventory of Indian Creek Utility Tract. Conducted for Pegasus Gold Corporation (700 acres). Reviewing agency: Bureau of Land Management

1994 Project Codirector - A Class III Cultural Resource Inventory of Indian Creek Road Right-of-Way. Conducted for Broadwater County. Reviewing agency: BLM.

Cultural Resource Inventory and Assessment of Red Lodge Mountain Ski Area, Carbon County, Montana. Conducted for Sno.Engineering, Bellevue Washington and Red Lodge Mountain, Inc. Red Lodge, Montana. (2090 acres). Reviewing agency: Custer National Forest.

Cultural Resource Inventory and Assessment of Stone Creek Road Realignment and Stream Habitat Improvement Project, for Barretts Minerals, Inc., Madison County, Montana. Reviewing agency: BLM.

Project Codirector - Cheyenne-Osage Land Exchange Cultural Resources Inventory and Assessment , Thunder Basin National Grassland, Medicine Bow National Forest, Converse and Weston Counties, Wyoming. (14,600 acres). Reviewing agency: Medicine Bow National Forest.

Cultural Resource Inventory of Powder River Coal Company's Permit Expansion Area (Tracts C and D), Campbell County, Wyoming (3,200 acres). Reviewing agency: Medicine Bow National Forest, BLM.

1993 Cultural Resource Inventory of Proposed Fiber Optic Cable Route for Hicks and Ragland/InterBel, Rexford to Fortine, Montana. Reviewing agency: Kootenai National Forest.

Cultural Resource Inventory of Powder River Coal Company's Permit Expansion Area (Tract B). Campbell County, Wyoming (3,200 acres). Reviewing agency: Medicine Bow National Forest, BLM.

Cultural Resource Inventory of Powder River Coal Company's Permit Expansion Area (Tract A). Campbell County, Wyoming (7,000 acres). Reviewing agency: Medicine Bow National Forest, BLM.

Field Supervisor - Dilts Land Exchange Inventory, Thunder Basin National Grassland, Medicine Bow National Forest, Converse County, Wyoming. (10,200 acres)

Field Supervisor - Westmoreland Resources Absaloka Mine Expansion Inventory, Bighorn County, Montana (3000 acres). Reviewing agency: Montana Department of State Lands, OSM.

1992 Field Supervisor - Envirocon/ASARCO/ARCO, Upper Blackfoot Inventory, Lewis and Clark County, Montana (640 acres). Reviewing agency: Lewis and Clark National Forest.

Bureau of Reclamation, Fresno Reservoir, Hill County Inventory. (1200 acres)

Archaeological Investigation, Zortman Mine, Zortman Mining, Inc., Phillips County, Montana (1300 acres). Reviewing agency: Bureau of Reclamation.

1991 Field Supervisor, Archaeological Investigations, Kootenai National Forest, Sanders County, Montana. (27,000 acres)

Field Supervisor, Archaeological Investigations, Blackfeet Indian Reservation, St Marys, Montana. (4000 acres)

1990 Field Supervisor, Archaeological Investigation, Spring Creek Coal Mine, Bighorn County, Montana (2500 acres). Reviewing agency: Montana Department of State Lands, OSM.

Field Supervisor, Archaeological Investigation, Noranda New World Mine, Hydrometrics, Cooke City, Park County, Montana (3000 acres). Reviewing agency: Gallatin National Forest.

Field Assistant, Archaeological Investigation, Lee Coulee, Peabody Coal Company, Rosebud County, Montana (1200 acres). Reviewing agency: Montana Department of State Lands, OSM.

1989 Field Supervisor, Archaeological Investigation / Historical inventory, Montana Department of Highways, Evaro-Dirty Corner, Lake County, Montana.

Field Supervisor, Archaeological and Historical Inventory, Montana Department of Highways, Somers-East, Flathead County, Montana.

Field Assistant, Archaeological and Historical Inventory, Pleasant Valley, Delta Engineering, Montana Department of Highways.

Field Assistant, Archaeological and Historical Inventory, Montana Department of Highways, Musselshell East and West, Roundup, Montana.

Field Assistant, Archaeological and Historical Inventory, Montana Department of Highways, Big Timber North, Montana.

Field Assistant, Archaeological and Historical Inventory, Pegasus Corporation, Basin Creek Mine, Jefferson County, Montana. (800 acres) Agency: Deerlodge National Forest.

Field Assistant, Archaeological and Historical Inventory, Kendall Mine Venture, Hydrometrics, Fergus County, Montana. (600 acres)

Field Assistant, Historical Inventory, German Gulch, Beal Mountain Project, Pegasus Corp., Silver Bow County, Montana (250 acres) Agency: Deerlodge National Forest.

Field Assistant, Archaeological and Historical Inventory, Montana RCL sites, Federal Aviation Administration.

1988 Field Assistant, Archaeological and Historical Inventory, Montana Department of Highways, Buffalo Road, Laurel, Montana.

Field Assistant, Archaeological and Historical Inventory, Montana Department of Highways, Ennis-North, Madison County, Montana.

Field Assistant, Archaeological Inventory, Bull Mountains, Yellowstone Coal Company, Musselshell County, Montana. (250 acres)

Field Assistant, Archaeological and Historical Inventory, Bureau of Indian Affairs, Early-Bird Fire, Northern Cheyenne Reservation. (8000 acres)

1987 Field Assistant, Excavation of Cooley Site (24RB1059) and Medicine Root site, Western Energy Company, Rosebud County, Montana

Field Assistant, Archaeological testing at the Montana City stratified site complex, Jefferson County, Montana, for GCM Services, Inc., Butte

Resume for David Ferguson, GCM Services, Inc.

David M. Ferguson - Senior Archaeologist, Vice President and General Manager

Education
MA, Anthropology, Archaeology Emphasis, 1992, University of Montana, Missoula.
BA, Psychology, history minor, 1988, University of Montana, Missoula.

Professional Employment
5/96 - present: Senior Archaeologist and Project Director, co-owner and vice president, GCM Services, Inc.

7/90 - 5/96: Senior Archaeologist and Project Director, GCM Services, Inc., Butte, MT

10/91- 10/92: Project Co-director, Missouri River Corridor Archaeological Investigation and National Register Multiple Properties Nomination, Lewis and Clark County, Montana, National Park Service Contract.

7/87-9/89: Field Assistant and Field supervisor, GCM Services, Inc., Butte, MT

David Ferguson serves as general manager and vice-president of GCM Services, Inc., and has worked on all phases of archaeological inventory and mitigation work as a senior archaeologist. Ferguson's specialties are lithic technology, intra and inter-site patterns at archaeological sites and historic hard rock mining and milling technologies. Incorporating the latest magnetometer remote sensing in conducting NRHP evaluations of prehistoric sites, Ferguson has worked with Gene Munson and others to revolutionize the process of identifying and evaluating buried archaeological remains using remote sensing. Ferguson specializes in baseline inventory projects and the NRHP evaluation of prehistoric cultural properties. Ferguson has 29 years professional experience working in the archaeology of Montana, Wyoming and Eastern Idaho.

APPENDIX F

MILDOS Input/Output Files for
Maximally Exposed Member of the Public

(CD only)