SEI005

August 25, 2014

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Judges:

G. Paul Bollwerk, III, Chairman
Dr. Richard F. Cole
Dr. Craig M. White

In the Matter of:	)	
	)	
Strata Energy, Inc.	)	Docket No. 40-9091-MLA
	)	ASLBP No. 12-915-01-MLA-BD01
	)	
(Ross In Situ Recovery	)	
Uranium Project)	)	

INITIAL WRITTEN TESTIMONY OF BEN SCHIFFER

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1.0 WITNESS BACKGROUND INFORMATION

Q.1. Please state your name, position and employer, including duration of employment.
A.1. Ben Schiffer. I am a Senior Geologist and Project Manager at WWC Engineering, where I have been employed for nearly 10 years. My *curriculum vitae* is included as Exhibit SEI006.

Q.2. Please state your education, professional registration and memberships.
A.2 I hold a B.A. in Geology from Whitman College. I am a licensed professional geologist (P.G.) in the State of Wyoming (No. 3446) and have been authorized to practice geology since 2001. I am also a professional member of the Society for Mining, Metallurgy and Exploration (No. 4170811). I also hold professional memberships in the Association of Groundwater Scientists and Engineers and the Wyoming Geological Association.

Q.3. What other uranium ISR projects have you worked on while with WWC Engineering and other entities?
A.3. While at WWC Engineering I have worked on eight uranium ISR projects, including Uranium One's Christensen and Irigaray Ranch Projects (now Willow Creek), Uranerz Hank/Nichols Ranch Project, Ur-Energy's Shirley Basin Project, Uranium Resources Inc.'s Crownpoint Uranium Project, Anatolia Energy's Temrezli Project, Powertech (USA) Inc.'s Dewey-Burdock Project and Strata Energy's Ross ISR Project. While employed by Cogema Resources (now Areva) I was assigned to the Christensen Ranch Project as a Field Geologist and the Holiday-El Mesquite Project in Texas as a Restoration Specialist. In addition, during my tenure at WWC, I have worked on a number of due diligence assessments of ISR facilities in Wyoming, Texas and New Mexico.

Q.4. What has been your role in the Ross ISR Project?
A.4. Beginning in July 2009 and continuing through April 2014 I was responsible for acquiring virtually all regulatory authorizations for the Ross ISR Project, including the Wyoming Department of Environmental Quality (WDEQ) Permit to Mine (No. 802) and NRC Source and Byproduct Material License (SUA-1601). This work included designing, implementing and assessing the pre-license data acquisition programs described herein.

2.0 CONTENTION 1 – ALLEGED FAILURE OF THE FSEIS TO ADEQUATELY CHARACTERIZE BASELINE (I.E., ORIGINAL OR PRE-MINING) GROUNDWATER QUALITY

Q.5. What is the nature of your testimony regarding this contention?
A.5. My testimony demonstrates that the site-wide baseline groundwater quality data were collected and presented in conformance with NUREG-1569 Section 2 (site characterization) (Exhibit SEI007). Further, the procedures for establishing Commission-approved background (CAB) groundwater quality data for each wellfield conform with NUREG-1569 Section 5

(operational monitoring) and meet the requirements of 10 CFR Part 40, Appendix A, Criterion 5B(5). It is my opinion that the baseline groundwater quality data also satisfies 10 CFR Part 40, Appendix A, Criterion 7 and Regulatory Guide 4.14 (Exhibit SEI008). NRC staff's review of the FSEIS (Exhibits SEI009A and SEI009B) and SER (Exhibit SEI010), portions of which are summarized in subsequent answers, documents that the site-wide baseline data conforms with all applicable NRC requirements and guidance. In addition, it is my testimony that these data were collected and presented in conformance with WDEQ-Land Quality Division (WDEQ-LQD) regulations contained in LQD Non-Coal Chapter 11 (Exhibit SEI011) and LQD guidance contained in Guideline No. 4 (In-Situ Mining) and Guideline No. 8 (Hydrology) (Exhibits SEI012A, SEI012B and SEI013).

2.1 Collecting Groundwater Quality Data to Determine Pre-operational Levels for Identifying Excursions and Target Restoration Values after Licensing Follows NRC Guidance

Q.6. Please respond to the allegation that NRC Staff will require additional data in order to establish a credible baseline for use in the regulatory process (Moran, 2011 ¶111, 112; Sass 2011 ¶23).

A.6. It is my testimony that Strata has collected sufficient baseline data to permit the Ross ISR Project. As described in detail within the testimony of Hal Demuth and Errol Lawrence (Exhibit SEI026), acquisition of baseline groundwater quality data for an ISR facility is a phased process. The first phase is the permitting phase during which the applicant must demonstrate the adequacy of site characterization baseline groundwater quality in conformance with Appendix A, Criterion 7 as reflected in NUREG-1569 Section 2. In addition, as part of the permitting phase the applicant must demonstrate appropriate **procedures** for establishing Commission-approved background (CAB) groundwater quality per Criterion 5B(5) as reflected in NUREG-1569 Section 5. The second phase of data collection occurs after the license is issued. At that point the licensee is permitted to install the complete wellfield and monitoring well network which will be used to collect the pre-operational groundwater quality for each wellfield.

Q.7. Where in the approved license application are the procedures addressed for collecting Commission-approved background groundwater quality data for each wellfield?

A.7. Procedures developed by Strata for collecting CAB groundwater quality data for each wellfield and establishing target restoration values (TRVs) and upper control limits (UCLs) based on these data are described in Section 5.7.8.2 of the Technical Report (TR) (Exhibit SEI014C at 234 - 248).

Q.8. Are these procedures also described in the FSEIS?

A.8. Yes. Section 6.3.2.1 (Exhibit SEI009A at 472 and 473) in the FSEIS describes the procedures for establishing Commission-approved background groundwater quality for the production zone and UCLs for over/underlying aquifers in each wellfield. The following excerpts from the FSEIS (Exhibit SEI009A) describe the procedures and NRC Staff's conclusion that the well density used to establish CAB and UCLs is consistent with NUREG-1569 and 10 CFR 40, Appendix A, Criterion 5B(5):

"The post-licensing, pre-operational monitoring of ground water would provide water-quality data to establish NRC-approved constituent concentrations in the ore-zone aquifer pursuant to 10 CFR Part 40, Appendix A, Criterion 5B(5)(a) and UCL constituent concentrations for perimeter monitoring wells and the wells in the overlying and underlying the ore-zone aquifer…". (FSEIS at 472)

"The Applicant also has proposed the installation of one well cluster for every 2 wellfield-hectares [4 wellfield-acres] for its post-licensing, pre-operational data-collection monitoring program. This density is consistent with the range of 1 well per 0.4 ha [1 ac] to one well per 2 ha [4 ac] discussed in the GEIS and the NRC's Standard Review Plan for In Situ Leach Uranium Extraction License Applications, Final Report, NUREG–1569 (NRC, 2009b; NRC, 2003a). This well-cluster spacing has also been used historically at existing uranium-recovery facilities." (FSEIS at 472)

"The Applicant has proposed obtaining at least four samples, with a minimum of two weeks between sampling events, for all perimeter, SM, OZ, and DM wells during post-licensing, preoperational water-quality monitoring of each newly installed wellfield…Results from all of these sample analyses would be averaged arithmetically to obtain an average value as well as a maximum value for use in the NRC's determination of UCLs for excursion detection." (FSEIS at 473)

Q.9. Are the procedures for establishing CAB and UCLs for each wellfield specified in Strata's license?

A.9. Yes. License condition 11.3 (Exhibit SEI015) enforces the procedures for establishing CAB and License condition 11.4 addresses development of the UCLs. License conditions 11.3 and 11.4 require that Strata develop CAB and UCLs in accordance with Section 5.7.8 of the TR (Exhibit SEI014C at 234 - 248).

Q.10. Did NRC staff document its review of these procedures as part of its safety review?

A.10. Yes. NRC Staff documented their review of Strata's plans for establishing CAB and UCLs in the SER (Exhibit SEI010 at 285 and 286), which states, (emphasis added):

"The staff finds that the proposed wellfield and excursion baseline monitoring programs **meet acceptance criteria in SRP [NUREG-1569] Section 5.7.8.3** because the approach is sufficient to define the groundwater protection criteria for restoration and standards for early time detection of an excursion for new wellfields with several minor clarifications as discussed below …"

"The proposed analytical parameters to be included in the baseline monitoring programs **are consistent with those recommended in the SRP [NUREG-1569]**, included in programs at existing ISR facilities, which have operated safely, and covers the constituents, including hazardous constituents, expected to be impact[ed] by the proposed operations …"

"Therefore, staff will include a license condition that provides staff with reasonable assurance that the baseline data for the production aquifer **will provide data to properly establish Commission approved background concentration under Criterion 5B(5)(a)**. The license condition specifies a minimum density for the ore zone baseline

wells to one well per two acres and a minimum of six baseline wells for a Wellfield (Mine Unit) …"

Q.11. In your opinion, has Strata established credible baseline groundwater quality data with respect to the site characterization requirements in NUREG-1569 Section 2?

A.11. Yes. Based on my experience with a number of licensing actions, my understanding of the regulations and guidances combined with feedback from both the NRC and WDEQ during the pre-licensing phase, I am confident that the groundwater quality characterization was more than adequate with respect to Criterion 7 as reflected in Section 2 of NUREG-1569. Moreover, my testimony below describes in detail how NRC staff determined that the site characterization baseline groundwater quality presented in the approved license application is in conformance with the acceptance criteria prescribed in NUREG-1569 Section 2.

2.2 The FSEIS and SER Demonstrate that the License Application Complies with Applicable NUREG-1569 Acceptance Criteria with Respect to Baseline Groundwater Quality

Q.12. Please describe which NUREG-1569 sections or acceptance criteria apply to the evaluation of site characterization baseline groundwater quality.

A.12. Two of the key areas are Section 2.7.1(4) and acceptance criteria 2.7.3(4).

Q.13 What does NUREG-1569 Section 2.7.1(4) specify that a license application should contain?

A.13. NUREG-1569 Section 2.7.1(4) (Exhibit SEI007 at 59) states that the license application for an uranium *in-situ* recovery (ISR) should contain (emphasis added): "Assessment of available ground-water resources and **ground-water quality within the proposed permit boundaries and adjacent properties**, including **quantitative description of the chemical and radiological characteristics** of the ground water and **potential changes in water quality caused by operations**".

It is important to understand that this guidance and other recommendations in NUREG-1569 not only apply to the license application documents, but the subsequent technical and environmental analysis conducted by the NRC Staff as well. NUREG-1569 (Exhibit SEI007 at 28) makes this clear: "Different sections of this standard review plan refer either to a technical evaluation report [SER], an environmental assessment [EIS] or both. Table 1 identifies which sections apply to a technical evaluation report and which to an environmental assessment." Table 1 of NUREG-1569 (Exhibit SEI007 at 30 – 31) clearly shows that the sections and sub-sections relevant to this proceeding are applicable to both the technical and environmental analysis. These key sections and subsections include: 2.6 Geology and Seismology, 2.7 Hydrology, 5.7.8 Ground-Water and Surface-Water Monitoring Programs (Operational), and 6.0 GROUND-WATER QUALITY RESTORATION, SURFACE RECLAMATION, AND PLANT DECOMMISSIONING. Therefore, conformance with NUREG-1569 is not only the responsibility of the license applicant, but also requires documentation of conformance in the SER prepared for each ISR license and the appropriate environmental review document, in

Strata's case the FSEIS. With this in mind, the following testimony addresses how Strata's license application conforms with NUREG-1569 and, as applicable, how the information in the FSEIS is consistent with the guidance in NUREG-1569 as well as the intent of NEPA.

Q.14. Does the approved license application assess "ground-water quality within the license boundary and adjacent properties" as recommended in NUREG-1569?
A.14. Yes. Strata constructed a regional baseline monitoring well network within the license boundary in 2009 and 2010, which is described in the Environmental Report (ER) Section 3.4.3.5.2.1 (Exhibit SEI016A at 275 - 276). The monitoring network, depicted in ER Figure 3.4-14 (Exhibit SEI016A at 372), comprises six well clusters and four piezometers. Each well cluster included four monitoring wells targeting the surficial aquifer (SA), overlying aquifer or shallow monitoring (SM), ore zone aquifer (OZ) and underlying aquifer or deep monitoring (DM) units. In addition, as part of the baseline groundwater inventory, Strata identified all of the currently operable (capable of being sampled) water supply wells within the license boundary and surrounding area beyond 2 km (1.2 mi). The wells, depicted in ER Figure 3.4-33 (Exhibit SEI016A at 391) and summarized in ER Table 3.4-44 (Exhibit SEI016A at 348), were identified through a groundwater rights search, landowner interviews and field investigations. A total of 29 existing water supply wells were identified and sampled including 2 industrial wells, 15 stock wells and 12 wells used for domestic use. No domestic wells are located within the license boundary; all sampled domestic wells were in the surrounding area. The site groundwater quality from the regional baseline monitoring network, existing water supply wells, and historical data from the Nubeth R&D site are described in ER Section 3.4.3.5.2 (Exhibit SEI016A at 275 - 288). Note that one industrial well (789V) located within the license boundary was included in the inventory but due to the nature of the surface infrastructure, Strata was unable to sample the water quality from the well.

Q.15. Where are these (baseline groundwater quality) wells located with respect to the license boundary?
A.15. All of the wells completed as part of the regional baseline monitoring network (six well clusters and four piezometers) are located within the license boundary. Of the 29 existing water supply wells identified within and adjacent to the license area, 2 industrial and one stock well are located within the license boundary.

Q.16. You stated that the second specification of NUREG-1569 Section 2.7.1(4) is to provide a "quantitative description of the chemical and radiological characteristics of the ground water." Was this done in the approved license application?
A.16. Yes. Groundwater quality results are summarized in ER Section 3.4.3.5.2 (Exhibit SEI016A at 275 - 288) for the regional baseline monitoring network, existing water supply wells and historical data from the Nubeth R&D site. Groundwater quality data are available in TR Addendum 2.7-I (Exhibit SEI014I at 9 - 15), and field sheets and laboratory reports are available

in TR Addendum 2.7-J (Exhibit SEI014I at 16 - 817). Additional groundwater quality data were provided to NRC Staff as Excel files in a format used by WDEQ-LQD as part of the ER RAI WR-4 Response (Exhibit SEI017 at 80).

In all, results are reported for over 16,000 chemical and radiological parameters from more than 362 groundwater samples collected during the pre-license site characterization period. Understand that these results do not include samples collected for quality assurance purposes. In my experience and opinion, 16,000 results from more than 362 groundwater samples provides a representative, quantitative description of the baseline groundwater quality within and adjacent to the project boundary. As importantly in my opinion, these data more than meet the intent of NEPA, in particular the implementing regulations at 10 CFR Part 51.45(b) which require that (emphasis added) "The environmental report shall contain a description of the proposed action, a statement of its purposes, [and] **a description of the environment affected**…"

Q.17. How was this information incorporated into the FSEIS?
A.17. Groundwater quality data are summarized in FSEIS Section 3.5.3.3 (Exhibit SEI009A at 181 to 190) for 1) Strata's regional baseline monitoring network, 2) existing water supply wells, and 3) historical data from the former Nubeth R&D site. Not only does the FSEIS summarize the site-wide baseline groundwater quality data, the FSEIS includes the groundwater quality sample results for the regional baseline monitoring network and existing water supply wells in FSEIS Appendix C (Exhibit SEI009B at 3 - 45). I am not aware of any other supplement to the GEIS that actually presents the sample results on a well-by-well, parameter-by-parameter basis for each groundwater sample collected during the pre-license phase of data acquisition.

Q.18. You stated that the third specification of NUREG-1569 Section 2.7.1(4) is to describe "potential changes in water quality caused by operations." Was this done in the approved license application?
A.18. Yes. ER Section 4.4.2.3 (Exhibit SEI016B at 230 - 241) describes potential changes to water quality from oxidation and mobilization of the uranium and vanadium in the OZ aquifer and potential impacts to the non-exempt OZ aquifer outside of the perimeter monitor well rings and vertically adjacent SM and DM aquifers due to excursions.

Q.19. Was this third specification of NUREG-1569 Section 2.7.1(4) addressed in the FSEIS?
A.19. Yes. FSEIS Section 4.5.1.2 (Exhibit SEI009A at 310 - 317) describes the potential impacts to groundwater quality during operations. Relevant information in the FSEIS includes:

- "The uranium and vanadium in the ore-zone aquifer would be oxidized and mobilized by the introduction of lixiviant into the ore-zone aquifer through injection wells" (Exhibit SEI009A at 314).
- "In addition to the uranium and vanadium, other constituents would also be mobilized, including anions, cations, and trace metals" (Exhibit SEI009A at 314).

- "The quality of the non-exempted ore-zone aquifer (i.e., that which is outside the perimeter-monitoring-well ring in the wellfields) could be impacted by a horizontal excursion resulting from a local wellfield imbalance" (Exhibit SEI009A at 315).
- "The potential impacts of the operation of the Proposed Action to ground-water quality in the confined aquifers above and below the ore zone would, therefore, be SMALL. The short-term potential impacts of lixiviant excursions from uranium recovery operation to the OZ aquifer outside the exempted area would be SMALL to MODERATE. Detection of excursions through the network of monitoring wells, followed by the Applicant's pumping of ground water to 'recover' the excursion would reduce long-term impacts to the OZ aquifer outside the exempted portion to SMALL" (Exhibit SEI009A at 317).

Q.20. What does NUREG-1569 Acceptance Criterion 2.7.3(4) specify that a license application should contain?
A.20. NUREG-1569 Acceptance Criterion 2.7.3(4) (Exhibit SEI007 at 62) declares that the hydrologic site characterization is acceptable if it demonstrates that, "Reasonably comprehensive chemical and radiochemical analyses of water samples, obtained within and at locations away from the mineralized zone(s), have been made to determine pre-operational baseline conditions. Baseline water quality should be determined for the mineralized and surrounding aquifers. These data should include water quality parameters that are expected to increase in concentration as a result of *in situ* leach activities and that are of concern to the water use of the aquifer (i.e., drinking water, etc.). The applicant should show that water samples were collected by acceptable sampling procedures, such as American Society for Testing and Materials D4448 (American Society for Testing and Materials, 1992)."

Q.21. Does NUREG-1569 clarify what is meant by "reasonably comprehensive"?
A.21. Yes. "Reasonably comprehensive" explicitly refers to the list of constituents analyzed in baseline groundwater quality samples, specifically NUREG-1569 (SEI007 at 64) states, "The applicant should identify the list of constituents to be sampled for baseline concentrations. The list of constituents in Table 2.7.3-1 is accepted by the NRC for *in situ* leach facilities." Table 2.7.3-1 (Exhibit SEI007 at 63) specifies 34 parameters, including trace and minor elements such as arsenic, selenium and uranium; common constituents such as sodium, chloride and alkalinity; physical indicators such as pH and total dissolved solids; and radiological parameters that include gross alpha and gross beta.

Q.22. So it is your understanding that sampling for all constituents in Table 2.7.3-1 satisfies the specification to provide "reasonably comprehensive" sample parameters, including analyzing "water quality parameters that are expected to increase in concentrations as a result of *in situ* leach activities and that are of concern to the water use of the aquifer"?

A.22. Yes. The acceptance criterion definitely states that monitoring for these 34 constituents "is accepted by the NRC for *in situ* leach facilities" and therefore demonstrates a "reasonably comprehensive" list of chemical and radiochemical analyses. It is these 34 parameters that are expected to increase as a result of ISR and, hence, are of concern to the water use of the aquifer.

Q.23. And did Strata sample for all of the parameters in NUREG-1569, Table 2.7.3-1?
A.23. Yes. As part of the baseline groundwater monitoring program Strata utilized guidance from NUREG-1569, Regulatory Guide 4.14, and WDEQ-LQD Guideline No. 8, Appendix 1. Exhibit SEI018 presents a comparison between these regulatory guidelines and parameters measured by Strata. The table shows that baseline groundwater quality samples were analyzed for all parameters in NUREG-1569 Table 2.7.3-1 with the exception of nitrate as N and dissolved manganese. In these cases, nitrate plus nitrite and total manganese were analyzed instead, in accordance with WDEQ-LQD Guideline No. 8.

Q.24. Were additional parameters analyzed beyond those listed in NUREG-1569, Table 2.7.3-1?
A.24. Yes. Strata analyzed sixteen (16) parameters beyond those listed in NUREG-1569, Table 2.7.3-1 including turbidity, temperature, dissolved oxygen, oxidation-reduction potential, aluminum, total iron, suspended uranium, dissolved and suspended lead-210, dissolved and suspended polonium-210, suspended radium-226, dissolved radium-228, radon-222, and dissolved and suspended thorium-230.

Q.25. You mentioned that another specification of NUREG-1569 Acceptance Criterion 2.7.3(4) is that water samples should be "obtained within and at locations away from the mineralized zone(s)." Does the approved license application provide this information?
A.25. Yes. By combining elements of multiple figures in the approved license application as depicted in Exhibit SEI019, a comparison between the locations of the regional baseline wells, the generalized uranium recovery areas, and OZ potentiometric surface makes it clear that Strata assessed the water quality within and outside of the mineralized zones. Exhibit SEI019 also shows which wells are upgradient, near or downgradient of proposed ISR activities by using groundwater flow arrows.

Q.26. Is this information described in the FSEIS?
A.26. Yes. This is summarized in the FSEIS Sec. 3.5.3.3 (Exhibit SEI009A at 181-188 - 3-42), which describes the groundwater quality of the four aquifers assessed in the approved license application.

Q.27. You also indicated that NUREG-1569 Acceptance Criterion 2.7.3(4) specifies that license applications should demonstrate that "water samples were collected by acceptable sampling

procedures." Does the approved license application describe the standard sample collection procedures that were used?

A.27. Yes. Sampling methods are described in ER Section 3.4.3.5.2.1 (Exhibit SEI016A at 275 - 276). In 2009 and 2010 Strata developed a Sampling and Analysis Plan (SAP), which was reviewed by the WDEQ-LQD. The approved SAP and correspondence with WDEQ-LQD during its review are included as Exhibits SEI020A through SEI020G and SEI021, respectively. While NRC Staff were not provided the SAP, they were briefed on its contents during three quarterly meetings held prior to license application submittal at NRC Headquarters. Summaries of the meetings are provided in Exhibits SEI022, SEI023, and SEI024. The procedures and protocol used to sample each well are described in the SAP (Exhibit SEI020A) at 25 and 26 and include: (1) measuring static water level and conducting a well head inspection upon arrival, (2) pumping the well based on a yield determined during development in order to evacuate the casing of stagnant water and draw in formation water for at least three casing volumes, (3) measuring field parameters including pH, electrical conductivity (EC), temperature, dissolved oxygen and turbidity throughout purging to determine geochemical stability (criteria included three values with less than 10% difference), (4) field filtering and preserving samples as necessary and collecting them in clean, unused plastic containers provided by the laboratory, (5) keeping the samples on ice until delivery to the laboratory, (6) collecting periodic field duplicate samples at ~10% and sample preservation blanks using deionized water at ~10% for quality assurance and quality control measures, and (7) evaluating the quality assurance program using relative percent difference (RPD) for field duplicates, comparison of field EC to laboratory EC, comparison between measured total dissolved solids (TDS) and calculated TDS along with ion balance analysis and holding time/preservation evaluations. Finally, the aqueous water quality results were evaluated for quality assurance and quality control as detailed in TR Addendum 2.7-L (Exhibit SEI014J at 22 - 42) in the approved license application.

Q.28. Do you consider these to be acceptable sampling procedures that are consistent with ASTM D4448 discussed in the NUREG-1569 (SEI007 at 62) and consistent with those used at other ISR facilities?

A.28. Yes. In my experience at uranium ISR facilities and other industrial sites undergoing environmental monitoring of groundwater the sampling procedures are standard and those commonly utilized by environmental technicians. A comparison of the procedures detailed in Exhibit SEI020A at 25 and 26 with ASTM D4448 in terms of sample collection and handling procedures, confirms those used for pre-license characterization at the Ross ISR Project are consistent with those discussed in the ASTM method. Specifically, ASTM D4448 method describes the options for purging wells, measuring and documenting water quality stabilization criteria, choosing the appropriate sampling equipment and technique for each situation, managing sampling containers and preservation appropriately, and delivering samples to the laboratory promptly for analysis. TR Addendum 2.7-L describes how the aqueous samples were

evaluated for quality assurance purposes to ensure data quality objectives were met. Key conclusions of the quality assurance evaluation included the following:

- "Overall, the RPD statistics indicate that the data collected during the baseline monitoring program are valid." (Exhibit SEI014J at 25)
- "Linear regression analysis was completed for field EC and laboratory EC, field turbidity and laboratory turbidity, and measured TDS and calculated TDS. The following summarizes the regression results.
    - Field EC versus laboratory EC: $R^2 = 0.93$
    - Field turbidity versus laboratory turbidity: $R^2 = 0.98$
    - Measured TDS versus calculated TDS: $R^2 = 0.99$." (Exhibit SEI014J at 25)
- "Based on the ion balance analysis all data collected was found to be valid." (Exhibit SEI014J at 26)
- "A review of the holding times found that two constituents exceeded the holding times. In all instances the results were compared to ion balances and other samples. All results with holding time exceedances were within acceptable limits and were included in the baseline monitoring project." (Exhibit SEI014J at 26)

Q.29. Did NRC staff evaluate the approved license application's conformance with NUREG-1569 Acceptance Criterion 2.7.3(4)?

A.29. Yes. NRC's evaluation is described in the FSEIS at 162 and the SER (Exhibit SEI010) at 87-88. The following is from the FSEIS at 162:

"Water resources in the vicinity of Ross Project include both surface water and ground water. Both the quantity and the quality of surface and ground waters are described in this section. 'Pre-licensing, site-characterization' water-quality data have been collected and analyzed by the Applicant in accordance with the following guidelines:

- American Society for Testing and Materials (ASTM) International's Standard D449-85a [D4448-85a], *Standard Guide for Sampling Groundwater Monitoring Wells*, as recommended in the NRC's guidance document, *Standard Review Plan for In Situ Leach Uranium Extraction License Applications*, NUREG–1569 (NRC, 2003b). (The ASTM Standard noted here was replaced by ASTM Standard D4448-01 in 2007.)
- WDEQ's 'Hydrology, Coal and Noncoal,' Guideline No. 8 (WDEQ/LQD, 2005b).
- NRC's Regulatory Guide 4.14, *Radiological Effluent and Environmental Monitoring at Uranium Mills*, Revision 1 (NRC, 1980)."

The FSEIS at 182 further states:

"To comply with the requirements of 10 CFR Part 40, Appendix A, Criterion 7, the Applicant has collected pre-licensing, site-characterization ground-water-quality data from the Ross Project area. These data originate from three sources: 1) data from the Applicant's own pre-licensing, site-characterization monitoring-well network at the Ross Project and the respective analytical data; 2) data from the sampling and analysis of

existing water-supply wells; and 3) historical data from the former Nubeth operation (Nuclear Dynamics, 1978). The first source of groundwater-quality data is the Applicant's own ground-water monitoring network which it constructed in 2009 and 2012 [should be 2010] and which consists of six monitoring-well clusters and four piezometers (Strata, 2011a). The locations of the monitoring-well clusters are shown in Figure 3.14 [Figure 3.15]. Each well cluster would include four monitoring wells targeting the OZ aquifer and the aquifer units above the ore zone (SA and SM) and below the ore zone (DM) (see Figure 3.14 [Figure 3.15]). The Applicant provided construction details of the wells and methods used for ground-water sampling in its ER (Strata, 2011a). The four piezometers in the SA were installed in the portion of the Ross Project area proposed for the Central Processing Plant (CPP) and surface impoundments (Strata, 2011a)."

"Analytical data and field measurements of selected parameters obtained during the 2009 and 2010 quarterly sampling efforts are provided in the Applicant's ER and TR (Strata, 2011a; Strata, 2011b). Water-quality data from samples collected in 2011 and submitted to WDEQ/LQD are provided in information the NRC subsequently received from the Applicant (Strata, 2012a). All of the ground-water-quality data are presented in Appendix C of this SEIS. The Applicant adhered to both the WDEQ/LQD's *Hydrology*, 'Coal and Noncoal,' Guideline No. 8, and the NRC's Regulatory Guide 4.14, Revision 1, during its sampling and analysis efforts, generating the data in Appendix C (WDEQ/LQD, 2005b; NRC, 1980). The data from 2011 are generally consistent with the 2009 and 2010 data; this consistency indicates a representative characterization of ground-water quality …"

NRC staff's evaluation is found in the SER (Exhibit SEI010 at 87 - 88), which states (emphasis added):

- "The staff concludes that the sample results are representative of area-wide pre-operational groundwater quality of the license area **because the sampling meets the acceptance criteria in SRP [NUREG-1569] Section 2.7.3**." (Exhibit SEI010 at 87)
- "Based upon the review conducted by the staff as indicated above and supplemented by the noted license condition to establish a SOP for low-yielding wells (see LC 12.11 in Section 3.1.4), **the information provided in the application meets the applicable acceptance criteria for this section and requirements of 10 CFR Part 40 Appendix A, Criterion 7**." (Exhibit SEI010 at 88)

Q.30. It has been alleged that the six well clusters are not sufficient to characterize baseline conditions for the purpose of developing the license application (Abitz 2011 ¶16.) Describe the factors considered when determining the cluster well density and locations.
A.30. The number and location of the monitoring well clusters were based on a number of factors, including:

- Regulatory considerations as detailed in WDEQ/LQD Guideline 4[1] (Exhibits SEI012A and SEI012B), In Situ Mining and NRC Regulatory Guide 4.14 (Exhibit SEI008 which suggest:
    - That all potentially affected aquifers be sampled (Exhibit SEI012B at 173),
    - A minimum of at least three (3) aerially spaced wells per affected aquifer be sampled (Exhibit SEI012B at 173),
    - At least one (1) production (host aquifer) zone well per square mile (Exhibits SEI012A at 17 and SEI012B at 175), and
    - Samples should be collected quarterly from at least three sampling wells located hydrologically down gradient from the proposed tailings area, at least three locations near other sides of the tailings area, and one well located hydrologically up gradient from the tailings area (Exhibit SEI008 at 3).
- Proximity to existing drilling data,
- Sufficient spatial distribution for the development of potentiometric surfaces, and
- Landowner considerations, including minimization of surface disturbance.

Q.31 In your opinion, did the approved license application satisfy the regulatory criteria in WDEQ-LQD Guideline 4 and Commission guidance in Regulatory Guide 4.14 with respect to the regional baseline monitoring network?

A.31. Yes. As stated in ¶A14, the regional baseline monitoring network utilized by Strata was composed of six well clusters and four piezometers located within the 1,721 acre (2.7) square mile) license boundary. Characterization of the host (OZ), underlying (DM) and overlying (SM) aquifers was done using 6 wells located at each cluster providing a well density of 2.2 wells per square mile. Similarly, the surficial aquifer (SA) was characterized by 6 wells at each cluster plus an additional 4 wells in the central plant area (CPP) for a well density of 3.7 wells per square mile. The wells in the regional baseline monitoring network were located up-gradient (34-7 cluster), side-gradient (14-18 cluster) and down-gradient (34-18 and 21-19 clusters) from the CPP area. Samples were collected quarterly from each well. **In terms of the key guidance provided by WDEQ and NRC in terms of location of monitoring wells and density, this testimony demonstrates that Strata met or exceeded the minimum criteria in WDEQ-LQD Guideline 4 and Commission guidance in NUREG-1569 and Regulatory Guide 4.14.**

Q.32. Did Strata evaluate approaches to pre-license baseline groundwater characterization used in previous ISR applications submitted to the NRC?

A.32. Yes, while developing the Ross ISR Project license application documents, Strata evaluated the baseline groundwater characterizations performed at other ISR facilities in

[1] Note: WDEQ's Guideline No. 4, In Situ Mining, was revised in 2013. The recommendations listed include those in the previous guidance document dated March 2000 as well as the revised guidance dated October 28, 2013.

Wyoming. Exhibit SEI025 summarizes the results of the evaluation which compares the number and density of pre-license baseline groundwater monitoring wells installed at the Ross ISR Project with Moore Ranch (SUA-1596), Nichols Ranch (SUA-1597) and Lost Creek (SUA-1598).

Q.33. How did the pre-license baseline characterization efforts performed by Strata at the Ross ISR Project compare with the pre-license baseline characterization efforts performed at the other licensed facilities?

A.33. The pre-license baseline characterization efforts performed by Strata at the Ross ISR Project were generally more robust than the baseline characterization efforts performed at other facilities. Characterization of the surficial aquifer at Ross included 10 wells providing a density of 3.7 wells per square mile while other licensees all had a density of less than 1.0 well per square mile. Similarly, the underlying aquifer was characterized using 6 wells at Ross for a density of 2.2 wells per square mile while the density of monitor wells at other facilities ranged from 0.6 to 1.1 wells per square mile. For the overlying and host aquifers, Strata used 6 wells in each interval for a density of 2.2 wells per square mile, which exceeded the density of both Moore Ranch (SUA-1596) and Lost Creek (SUA-1598), but was less than the density for these intervals at Nichols Ranch (SUA-1597). Not only did Strata generally have more regional baseline wells, they also submitted more water quality samples than the other applicants. As part of the license application Strata submitted **8 quarters** of monitoring data whereas the other licensees only submitted 1-5 quarters of monitoring data in their applications.

2.3 The FSEIS and SER Demonstrate that the License Application Complies with CFR Part 40, Appendix A, Criterion 7

Q.34. How do you respond to the allegation that the application does not provide "complete baseline data on a milling site and its environs" as required by 10 CFR Part 40, Appendix A, Criterion 7 (Abitz and Larson 2014 ¶18)?

A.34. The key requirement of 10 CFR Part 40, Appendix A, Criterion 7, in terms of pre-license baseline is: "At least one full year prior to any major site construction, a preoperational monitoring program must be conducted to provide complete baseline data on a milling site and its environs." The remaining requirements of Criterion 7, including Criterion 7A, apply to the construction and operating phases. These requirements are not relevant to Contention 1, and are not addressed in this written testimony. The following addresses compliance with this requirement.

As shown in A.33 of this written testimony, compliance with 10 CFR Part 40, Appendix A, Criterion 7 is clear. In fact, in terms of groundwater quality, Strata's pre-license monitoring program was conducted for **two years** hence the 8 quarters of water quality data assessed by NRC staff more than complies with this regulatory requirement. Compliance with 10 CFR Part 40, Appendix A, Criterion 7 is also provided in the A.29, which documents

NRC Staff's review in the FSEIS and SER in terms of these critical regulations governing ISR licensing.

Is it important to understand that certain site-wide data are required prior to license issuance, while additional information will be obtained for each wellfield prior to operations. This is summarized in NUREG-1569 (Exhibit SEI007 at 36):

> "Reviewers should keep in mind that the development and initial licensing of an *in situ* leach facility is not based on comprehensive information. This is because *in situ* leach facilities obtain enough information to generally locate the ore body and to understand the natural systems involved. More detailed information is developed as each area is brought into production. Therefore, reviewers should verify that sufficient information is presented to reach only the conclusion necessary for initial licensing. However reviewers should not expect that information needed to fully describe each aspect of a full operation will be available in the initial application."

Since NUREG-1569 is the primary Commission guidance document for ISR facilities to comply with 10 CFR Part 40, Appendix A criteria and since Strata has demonstrated conformance with applicable NUREG-1569 acceptance criteria for pre-operational baseline groundwater quality characterization (i.e., Section 2.7.3 acceptance criteria), it would seem clear that the license application did in fact provide "complete baseline data on a milling site and its environs."

2.4 The Application Provides Complete Baseline Water Quality Data Collected by Strata and Demonstrates that Current Data are Similar to Data Collected by Nubeth 30 Years Earlier

Q.35. How do you respond to the allegation that the FSEIS and application do not appropriately summarize complete baseline field and laboratory water quality data for the historic and recent data sets (Abitz and Larson, 2014 ¶29 Moran, 2011 ¶42)?

A.35. Contrary to the intervenors' assertions, the FSEIS and application did in fact appropriately summarize the field and laboratory water quality data. Baseline field and laboratory water quality data for the historical and recent data sets have been summarized in Section 3.4 of the ER (Exhibit SEI016A at 275 - 288 and 331 - 358). Tables 3.6 and 3.7 of the FSEIS also summarize water quality data from Strata's regional baseline monitoring network as well as the historical Nubeth wells. In addition, the FSEIS includes the groundwater quality sample results for the regional baseline monitoring network and existing water supply wells in Appendix C (Exhibit SEI009B at 3 through 45). It is my testimony that the information in the ER and FSEIS clearly demonstrates that, "The average water quality for each aquifer zone and the range of each indicator in the zone have been tabulated and evaluated" according to the guidance in NUREG-1569 acceptance criterion 2.7.3(4) (Exhibit SEI007 at 64).

Q.36. Please respond to the allegation that the application is deficient because detailed pre-Strata water quality data have not been provided in the application (Moran 2011, ¶39).

A.36. Contrary to intervenors assertions, water quality data from Nubeth's "five-spot" test pattern and associated monitor wells are summarized in ER Tables 3.4-53 and 3.4-54 (Exhibit SEI016A at 357 - 358). ER Table 3.4-53 provides baseline concentrations of uranium and key radiological constituents (gross alpha and radium-226) from the surrounding monitor wells, injection wells and production well. ER Table 3.4-54 provides concentrations of the same radiological parameters from the wells following preliminary restoration efforts at the site. In addition, ER Figure 1.2-1 (Exhibit SEI016A at 65) provides concentrations of radium-226, uranium, TDS and selenium from the Nubeth production well (19XX) over a 32-year time span beginning in 1978. Pre-Strata water quality data are also summarized in Section 3.5.3 of the FSEIS and tabulated in FSEIS Table 3.7 (Exhibit SEI009A at 185).

2.5 There Is No Evidence that the Nubeth R&D Site Has Had Any Impact on Site-Wide Baseline Groundwater Quality Characterization Conducted by Strata

Q.37. To your knowledge, was the groundwater restored following the Nubeth R&D operations?

A.37. Yes. As depicted on ER Figure 1.2-1 (Exhibit SEI009A at 65), concentrations of critical parameters such as radium-226, uranium, TDS and selenium were at or below the levels measured prior to initiation of the 5-spot test activities by October 14, 1981. Moreover, the correspondence in TR Addendum 1.2-A, Nubeth R&D (Nuclear Dynamics/Sundance Project) Site Decommissioning Documents (Exhibit SEI014D at 10) between Mr. Al Stoick, Manager Nubeth Joint Venture and the WDEQ-LQD dated April 25, 1983 clearly documents LQD's confirmation that groundwater was restored in accordance with applicable standards: "On the basis of information supplied by your company and on the basis of confirmation water samples taken November 24, 1983, the Land and Water Quality Divisions concur that restoration of the groundwater at the Sundance Project [Nubeth] has been done to meet applicable water quality standards." The letter goes on indicating, "[a]ccordingly, ND Resources and the Nubeth Joint Venture are released from any further aquifer and groundwater restoration requirements for this area." In addition to full release by two divisions of the WDEQ (Land and Water Quality), the NRC indicated by letter on June 9, 1983, "[w]e have reviewed available ground-water restoration data for your Oshoto site project [Nubeth]. Based on this review, we have concluded that the ground water has been adequately restored." (Exhibit SEI014D at 12 - 16)

In fact, within 2 years of these recommendations, the NRC terminated the license thereby fully validating not only the groundwater restoration but full site decontamination and decommissioning.

Q.38. In comparison to the 1,721 acres included in the Ross ISR Project license boundary, what was the approximate aerial extent of the Nubeth R&D site?

A.38. The total area of the pattern and support facilities was approximately 7 acres, or less than one-half of 1 percent of the total Ross license area. Exhibit SEI019 depicts the Ross license boundary as well as the area of the 5-spot test pattern and associated process building.

Q.39. Is it possible that the restored groundwater could have left the immediate vicinity of the Nubeth R&D site after restoration was complete?
A.39. I cannot envision any way that this could have happened. Nubeth turned over ownership of the production well (19XX) and project water supply well (789V) to an oil company around 1982. The oil company used the water produced from the wells for enhanced oil recovery using water-flood techniques. Wyoming Oil and Gas Conservation Commission[2] records show that the wells have been in continuous use since that time, which is why the cone of depression depicted on Exhibit SEI019 encompasses the Nubeth R&D site. The cone of depression is essentially a groundwater sink which draws water from the surrounding aquifer to these wells. The water withdrawn from these wells over more than 30 years was injected into the Minnelusa Formation at around 6,000 feet below ground surface, thereby removing any potential contaminants that might have biased Strata's site-wide, pre-license water quality characterization.

Q.40. It has been alleged that the cluster wells in the regional baseline monitoring network were established in zones impacted by Nubeth R&D activities (Abitz, 2011 ¶23). Were any of the cluster wells down gradient of, or within, the footprint of the Nubeth R&D site?
A.40. None of Strata's regional baseline monitoring well network fall within the footprint of the Nubeth R&D site. In fact, due to the cone of depression caused by the 30+ years of pumping by oil companies, all of Strata's wells are upgradient of the Nubeth R&D site. Since the wells are upgradient of the Nubeth R&D site, it is impossible that any of the restored groundwater could have affected the site-wide, pre-license water quality as assessed by Strata, WDEQ and NRC.

2.6 Detailed Water Quality Was Collected and Presented for Private Water Supply Wells in Accordance with Regulatory Guidance

Q.41. In assembling the approved license application, what guidance and/or regulations were used to guide Strata's evaluation of private water supply wells?
A.41. Both WDEQ-LQD and NRC provide guidance for applicants. WDEQ-LQD guidance is provided in Guideline 4 In-Situ (Exhibits SEI010A and SEI010B) as well by regulation in Chapter 11 In Situ Mining (Exhibit SEI011). Applicable NRC guidance is found in NUREG-1569 (Exhibit SEI007) and Regulatory Guide 4.14 (Exhibit SEI008).

Q.42. What do these guidance documents and regulations specify for evaluation of private water supply wells in a uranium ISR license application?
A.42. Specifications by guidance document and/or regulation are included below. It is important to clarify that there are two general types of evaluations described in the guidance documents and regulations. The first is a description of the water resources or an inventory of surface and groundwater rights surrounding the proposed project. The second, which is

[2] Operators of hydrocarbon recovery facilities in Wyoming are required to disclose for the public injected volumes on a monthly and/or annual basis to the Wyoming Oil & Gas Conservation Commission [wogcc.state.wy.us]

emphasized in Commission Regulatory Guide 4.14, is an analysis of radiological constituents in the water supply wells. The specific guidance document criteria and regulatory requirements are quoted in the following bullets, with emphasis added.

NRC—

- "Ground-water samples should also be collected quarterly from each well within **two kilometers** of the proposed tailings area that is or could be used for drinking water, watering of livestock, or crop irrigation." (Regulatory Guide 4.14 Section 1.1.2, Exhibit SEI008 at 3).
- "All ground-water samples collected near the tailings area should be analyzed for dissolved natural uranium, thorium-230, radium-226, polonium-210, and lead-210. Ground-water samples from sources that could be used as drinking water for humans or livestock or crop irrigation should also be analyzed for suspended natural uranium, thorium-230, radium-226, polonium-210, and lead-210. (Regulatory Guide 4.14 Section 1.2, Exhibit SEI008 at 4).
- **"**The staff review should include the location, nature, and amounts of present and projected surface-and ground-water use (e.g., water supplies, irrigation, reservoirs, recreation, and transportation) **within 3.3 km [2 mi]** of the site boundary {0.8 km [0.5 mi] for research and development operations} and the present and projected population associated with each use point." (NUREG-1569 Section 2.2.1, Exhibit SEI007 at 42).
- "Although the specific requirements may vary from site to site, the general purpose for determining land and water use patterns is to provide supporting data for exposure calculations, cost-benefit analyses, and determinations of air emissions (e.g., dust). A **3.3-km [2-mi]** distance from the site boundary is an acceptable area for which land and water use data should be collected. One acceptable method for presenting these data is for the applicant to provide the information requested in the Standard Format and Content of License Applications, Including Environmental Reports (NRC, 1982), Section 2.2. The information presented should include:

    (a) Maps showing the locations of nearest residences, ground-water supply wells, and abandoned wells

    (b) Types of present and projected (life of facility) water use (e.g., municipal, domestic, agriculture, livestock) and descriptions of the methodology and sources used to develop projections

    (c) Present and projected (life of facility) water use estimates, by type, for both ground water and surface water, including present and projected withdrawal, and descriptions of the methodology and sources used to develop projections

    (d) For existing ground-water wells, well depth, ground-water elevations, flow rates, drawdown, and a description of the producing aquifer(s)

    (e) The locations of abandoned wells and drill holes, including the depth, type of use, condition of closing, plugging procedure used, and date of completion for each well or drill hole within the site area and within 0.4 km [.25 mi] of the well field boundary" (Exhibit SEI007 at 43).

WDEQ-LQD--

- "For groundwaters within the permit area and on adjacent lands:

  (A) The names (or numbers), descriptions, and a map of all wells installed for water supply or monitoring and all wells which penetrate the production zone. The description shall include: names of present owners, well completion data, producing interval(s), and variations in water level to the extent such information is available in the public records and from a reasonable inspection of the property.

  (B) A list and map of all adjudicated and permitted groundwater rights.

  (xii) A list and map of all abandoned wells and drill holes, giving location, depth, producing interval(s), type of use, condition of casing, plugging procedures and date of completion for each well or drill hole within the permit area and on adjacent lands to the extent such information is available in public records and from a reasonable inspection of the property." (WDEQ-LQD Chapter 11 Non-Coal, Exhibit SEI011 at 9).
- "Appendix "B" (for lands adjacent to Permit or R&D License area) 1. List of names and last known addresses of: a. Owners of record of surface rights of lands immediately adjacent to the proposed Permit or R&D License area, b. Any other persons having a valid legal estate of record within **one-half (2) mile** of the Permit or R&D License area such as **water rights** and rights-of-way owners, etc." (WDEQ-LQD Guideline 4, Exhibit SEI012A at 11).
- "Appendix "D" Water rights

  Locations and present owners of all wells inside and within **2 mile** of the license area should be included. Information concerning plugging and well completion and producing interval(s) (to the extent such information is available in the public record or by a reasonable inspection of the property) is also requested." (WDEQ-LQD Guideline 4, Exhibit SEI012A at 18).
- "B. Supportive Information in Addition to R&D License Requirements
  - 1. Water Rights--A list and map of all adjudicated water rights inside and within three miles of the permit area boundary must be provided. The locations and present owners of all wells within **three miles** of the license area (including plugging techniques, well completion techniques, and producing intervals) must be provided, to the extent such information is available in the public records and from a reasonable inspection of the property." (WDEQ-LQD Guideline 4, Exhibit SEI012A at 29).

Q.43. In your opinion, did the approved license application provide these data consistent with the relevant guidance documents and regulation?

A.43. Yes. ER Section 3.4.3.5.2.3 (Exhibit SEI016A at 284 - 287) provides text detailing the groundwater resources inventory and monitoring conducted on 29 wells within and surrounding the license boundary. Further, tabulations of historical groundwater use are provided in ER Tables 3.4-23 and 3.4-24 (Exhibit SEI016A at 321 - 322), and groundwater rights within 2 miles of the license boundary are provided in Table 3.4-25 (Exhibit SEI016A at

323 - 328). Water quality measured in the 29 wells is summarized in ER Tables 3.4-45 (Industrial), 3.4-46 (Stock) and 3.4-49 (Domestic) (Exhibit SEI016A at 349 - 350 and 353). In addition, ER Figure 3.4-33 (Exhibit SEI016A at 391) depicts the water supply wells sampled quarterly beginning in 3Q09. At least 12 of the private water supply wells are beyond the 1.2 miles (2 km) suggested by Regulatory Guide 4.14.

Q.44. Does the FSEIS document Strata's efforts to assess the water quality of the wells within 1.2 miles (2 km) as suggested by Regulatory Guide 4.14?

A.44. Yes. The FSEIS at 188 - 190 discusses the water quality measured in the 29 private water supply wells and concludes:

> "The water-supply wells were sampled in consecutive quarters in 2009, 2010, and 2011 with the same methods established for monitoring wells (Strata, 2011a). The results of the water-quality analyses are provided in the Applicant's license application and subsequent information received by the NRC (Strata, 2011a; Strata, 2012a); all of the data provided by the Applicant are included as Appendix C in this SEIS. Comparisons between the measured water quality and the WDEQ's Use standards and the EPA's Primary and Secondary MCL standards are also discussed in the Applicant's ER (WDEQ/WQD, 2005b; 40 CFR 141; Strata, 2011a)." (Exhibit SEI009A at 188).

3.0 CONTENTION 2 - ALLEGED FAILURE OF THE FSEIS TO ANALYZE THE ENVIRONMENTAL IMPACTS THAT WILL OCCUR IF THE APPLICANT CANNOT RESTORE GROUNDWATER TO PRIMARY OR SECONDARY LIMITS

3.1 The Application and FSEIS Demonstrate that Potential Impacts to Groundwater Will Be Small.

Q.45. Are Strata's proposed groundwater restoration methods described in the FSEIS?

A.45. Yes. The groundwater restoration methods proposed in Strata's approved license application are described in detail in FSEIS Section 2.1.1.3 (Exhibit SEI009A at 118 - 121). These include the industry-standard and time proven methods of reverse osmosis (RO) treatment with reinjection of the permeate, groundwater sweep (where water is withdrawn without reinjection), groundwater transfer, groundwater recirculation, and stability monitoring.

Q.46. Did Strata evaluate the effectiveness of the proposed groundwater restoration methods?

A.46. Yes. Strata evaluated the effectiveness of the proposed groundwater restoration methods in the approved license application through a comparison to other ISR projects with successful groundwater restoration programs, specifically at Irigaray, Christensen Ranch, Crow Butte and Smith Ranch-Highland. A summary of the comparison to Ross can be found in ER Section 5.4.2.2 (Exhibit SEI016B at 410 - 411). Restoration method analogs are described in TR Sections 6.1.6.3 and 6.1.6.4 (Exhibit SEI014C at 293 - 296) and a comparison between pre-recovery water quality at Ross with that at the analog facilities is presented in TR Figure 6.1-3 (Exhibit SEI014C at 311).

Q.47. Did NRC staff evaluate the effectiveness of the proposed groundwater restoration methods?

A.47. Yes. NRC staff evaluated Strata's proposed groundwater restoration methods and determined that they will be adequate to meet Criterion 5B(5) standards, as documented in the SER:

- "Staff finds that the restoration methods, excluding the use of reductant, are acceptable because they reflect historical ISR industry restoration practices that have achieved the groundwater protection standards of 10 CFR Part 40, Appendix A, Criterion 5B(5) and are included as acceptable methods in acceptance Criterion (3) in SRP [NUREG-1569] Section 6.1.3." (Exhibit SEI010 at 311).
- "Staff finds that the applicant's phased approach to restoration is consistent with the acceptance criterion (3) of SRP [NUREG 1569] Section 6.1.3 which allows flexibility and innovation in approaches to restoration, and that applicants are not limited to using one restoration method for all wellfields." (Exhibit SEI010 at 312).

It is important to emphasize that the analysis of potential impacts in the FSEIS is not based solely on Strata's commitment to restore groundwater. Groundwater restoration to Criterion 5B(5) standards will be required by License Condition 10.6 (Exhibit SEI015 at 7-8). This is documented in the FSEIS (Exhibit SEI009A) at 119:

> "Based upon the NRC staff's review of the Applicant's commitments in the license application coupled with Condition No. 10.6 in the Draft Source and Byproduct Materials License pertaining to ground-water restoration, the NRC staff is reasonably assured that the Applicant would restore ground water to the ground-water-protection standards of 10 CFR Part 40, Appendix A, Criterion 5B(5) and would provide the information for the NRC's determination required per 10 CFR Part 40, Appendix A, Criterion 5D (NRC, 2014a; NRC, 2014b)."

The FSEIS (Exhibit SEI009A) also notes at 314 - 315 that:

> "…impacts to the water quality of the ore-zone aquifer within the wellfields would be short term because aquifer restoration that would be required by the Source and Byproduct Materials License would return these constituent concentrations to each wellfield's respective NRC-approved post-licensing, pre-operational concentrations, numeric water-quality criteria, or specific ACLs as approved by the NRC (NRC, 2014b License Condition 10.6; 10 CFR 40)."

The general effectiveness of groundwater restoration at NRC-licensed facilities is described in the FSEIS (Exhibit SEI009A) at 624 (emphasis added):

> "…NRC staff examined ground-water data from the NRC-licensed ISR facilities for which NRC recently approved aquifer restoration (COGEMA's Irigaray/Christensen Ranch facility, Power Resources Inc.'s Smith Ranch/Highland Uranium Project facility, and Crow Butte Resources' Crow Butte facility). The NRC staff has approved 11 wellfield restorations at these 3 facilities. Aquifer-restoration activities are also

continuing a wellfields for which restoration has not yet been approved by the NRC. The aquifer-restoration data show that pre-operational concentrations are attainable for many parameters (i.e., 50 to 70 percent of the 35 parameters commonly monitored), but the pre-operational concentrations have not been attained for other constituents; in particular, the major and trace cations with solubilities most susceptible to the oxidation state of the aquifer water (i.e., iron, manganese, arsenic, selenium, uranium, and vanadium) as well as radium-226 (NRC, 2009c). **However, for the approved aquifer restorations, ground-water quality in the exempted aquifer met all regulatory standards for the respective State's or EPA's UIC program and had the water-quality values designated for its class of use prior to uranium-recovery operation. In addition, water quality modeling shows that concentrations decrease over time due to natural attenuation and that drinking-water standards are met at the perimeter of the exempted aquifer. Therefore, the impacts to ground water outside of the exempted aquifer for each of the approved aquifer restorations do not pose a risk to human health and the environment."**

Further support for the effectiveness of groundwater restoration at ISR facilities is found in IAEA-TECDOC-720 (Exhibit SEI035 at 5, emphasis added):

> "**In most cases today wellfield restoration is routine**. This has helped to assure both federal and state regulators that ISL mining does not significantly impact the environment. As a result, in May 1989, **a representative of the U.S. Nuclear Regulatory Commission (NRC) wrote that "Based upon the accumulation of operational data and information, it has become apparent that ISL operations pose no significant environmental impacts**."

Beyond NRC Staff's evaluation of the restoration methods proposed at the Ross ISR Project, it is equally important to understand that restoration was typically done to prior class of use and that to my knowledge, this was done at virtually every if not every ISR project. Prior class of use was the restoration standard in Wyoming and Nebraska prior to NRC imposing Criterion 5B(5). What this meant was that water in the exempted aquifer could be used for whatever it was used for **prior** to ISR operations and restoration (e.g. stock watering or irrigation). It is also my understanding that prior class of use may be considered when preparing and evaluating an ACL application. Restoring groundwater quality within the exempted aquifer to prior class of use helps ensure that potential environmental impacts are small.

Q.48. Please describe the analysis prepared by Strata that demonstrates the potential impacts to groundwater will be small.

A.48. ER Sections 4.4.2 and Section 5.4.2 (Exhibit SEI016B at 228 - 246 and 402 - 414, respectively) describe the potential groundwater impacts and mitigation of potential groundwater impacts for the Ross ISR Project, respectively. Strata demonstrates that the impacts to groundwater will be small by describing the mitigation procedures including groundwater restoration and monitoring. In addition, TR Section 6.1.6.3 (Exhibit SEI014C at 293 - 295) presents restoration method analogs for the Irigaray, Christensen Ranch, Smith Ranch-Highland, and Crow Butte facilities. The analogs support the restoration methods proposed for the Ross

ISR Project. In addition, TR Section 6.1.8 describes the potential environmental impacts from restoration (Exhibit SEI014C at 297 - 298).

Q.49. Please respond to the allegation that the application does not disclose detailed chemical compositions for the leach fluids, process fluids, and liquid wastes (Moran 2011 ¶83, 84, 85, 86).
A.49. The allegation is incorrect. Uranium ISR uses the native groundwater present in the host aquifers, therefore (as discussed previously) these data have been provided in both the ER and TR Sections 3.4.3.5.2 and 2.7.3.5.2, respectively. In addition, TR Section 3.1.3.1 (Exhibit SEI014C at 31) describes the composition of the lixiviant proposed at the Ross ISR Project and includes a table showing the anticipated water quality during uranium recovery (TR Table 3.1-1, Exhibit SEI014C at 49). Moreover, TR Section 6.1.6.2 (Exhibit SEI014C at 291 - 293) provides an estimate of the water quality at the end of production, with tabulations comparing the results to the ISR GEIS in TR Table 6.1-9 (Exhibit SEI014C at 307) and to similar ISR projects in TR Table 6.1-10 (Exhibit SEI014C at 308). Finally, an estimate of the quality of the liquid waste product or 'brine' is discussed in TR Section 6.1.4.4 and summarized in Table 6.1-6 (Exhibit SEI014C at 287 - 288 and 304). NRC Staff in the SER made the following conclusion:

> "By providing information on the methods that would be used to control liquid effluents and obtaining a permit from WDEQ for Class I deep disposal wells, the staff finds that the applicant has described liquid waste effluents and disposal methods in accordance with acceptance criteria (1), (2), (7), and (8) in SRP [NUREG-1569] Section 4.2.3 (NRC, 2003). Therefore, Strata's plans are acceptable to the NRC staff." (Exhibit SEI010 at 194).

3.2 The Application and the FSEIS Clearly Specify Aquifer Restoration Criteria and Standards

Q.50. It has been alleged that the FSEIS does not include adequate discussion regarding aquifer restoration techniques and success probabilities (Moran 2011 ¶70, Abitz and Larson 2014, ¶42, 43, and 44).
A.50. The FSEIS specifically evaluates the effectiveness of aquifer restoration at historically and currently operated ISR facilities at the following locations:

- "As described earlier in this section, most of the ground-water-quality parameters in wellfields for which the NRC has approved restoration were either returned to post-licensing, pre-operational concentrations or Class I Domestic Use standards. For the few parameters that exceeded post-licensing, pre-operational concentrations or Class I Domestic Use standards, the concentrations in the ground-water did not change the class of use and did not represent a potential impact to the ground water outside the aquifer-exemption boundary." (Exhibit SEI009A at 322)
- "Evaluation of the restoration conditions in Nubeth's wells provides a short-term assessment of past impacts. The longer-term impacts from Nubeth can be determined by a comparison of Nubeth's pre-operational water-quality data with Strata's pre-licensing, site-characterization water-quality data, as described in SEIS Section 3.5.3. The data presented in Tables 3.6 and 3.7 in SEIS Section 3.5.3 suggest that the

current water quality in the ore zone and the SM aquifers are the same as each were at the time of Nubeth's pre-operational sampling." (Exhibit SEI009A at 429)

Q.51. Does the FSEIS evaluate the effectiveness of operational controls in place to protect groundwater quality at historically and currently operated ISR Facilities?

A.51. Yes. The following excerpts from the FSEIS describe the NRC's evaluation of operational controls at historically and currently operated ISR Facilities.

- "As discussed in GEIS Section 2.11.3, the historical record for several licensed ISR facilities indicates that excursions occur at ISR operations (NRC, 2009b). Most of the excursions are horizontal and were recovered within months after detection. Vertical excursions tend to be more difficult to recover than horizontal excursions, and in a few cases, remained on excursion status for as long as eight years. The vertical excursions were traced to thinning of the confining geologic unit below the ore zone and improperly abandoned drillholes from earlier exploration activities (NRC, 2009b)." (Exhibit SEI009A at 311)
- As described in SEIS Section 2.1.1.2, GEIS Section 4.11.4 documented that vertical excursions tend to be more difficult to recover than horizontal excursions. Historically, the source of a vertical excursion is something other than built-up pressure, which is generally the source of horizontal excursion and an attribute of the uranium-recovery process that can be readily adjusted (i.e., the pressure relieved). Pressure relief would reverse horizontal excursions. The probable cause for a vertical excursion is a failed casing in a nearby injection well. Therefore, immediate cessation of lixiviant injection is a prudent corrective action to prevent more from escaping. For a horizontal excursion, although cessation of injection is not a requirement, reducing the rate of injection might be performed in combination with increased pumping. No changes were made to the SEIS beyond the information provided in this response." (Exhibit SEI009A at 625)
- "As discussed in GEIS Section 2.11.2, the NRC staff has reviewed the record of spills and leaks at operating ISR facilities as well as the requirements for an operator's reporting incidents of releases and implementing corrective actions (NRC, 2009b). The analysis of impacts to soil, surface water, and shallow ground water from spills and leaks are provided in the SEIS Sections 4.4.1.2 and 4.5.1.2. As described in these sections of the SEIS, impacts to soil and water resources would be mitigated by the operational controls that would be in place to reduce the likelihood of releases, in addition to the requirements for reporting and taking corrective action. The NRC's assessment determined that the impacts that could result from leaks and spills from pipes and from the surface impoundments at the Ross Project would be SMALL." (Exhibit SEI009A at 623 - 624)

Q.52. It has been alleged that the parameters listed in Table 5.7-2 of the TR are far too limited to provide detailed understanding of the possible impacts to groundwater quality (Moran, 2011 ¶79). Please describe how the parameter list was developed.

A.52. The parameter list provided in TR Table 5.7-2 (Exhibit SEI014C at 253) is a reflection of the Commission guidance provided in NUREG-1569, Table 2.7.3-1 (Exhibit SEI007 at 63) and

WDEQ-LQD Guideline 8, Appendix 1 (Exhibit SEI013 at 42 - 47) along with more than 30 years of assessing impacts from the ISR industry. See A.21 through A.24 for more information regarding the adequacy of the water quality parameters measured by Strata. NRC staff review of the parameter list is found in the SER (Exhibit SEI010 at 285):

> "The proposed analytical parameters to be included in the baseline monitoring programs are consistent with those recommended in the SRP [NUREG 1569], included in programs at existing ISR facilities, which have operated safely, and covers the constituents, including hazardous constituents, expected to be impact by the proposed operations."

Q.53 It has been alleged that the application does not clearly define the chemical constituents that will be sampled during aquifer restoration monitoring (Moran 2011, ¶71). What chemical constituents will be sampled during groundwater restoration monitoring?

A.53. TR Table 6.1-2 (Exhibit SEI014C at 300) of the approved license application provides constituents to be measured during restoration monitoring. The parameters include static water level, electrical conductivity, field temperature, field pH, lab pH, ammonia, alkalinity, lab electrical conductivity, nitrate-nitrite, total dissolved solids, gross alpha, gross beta, dissolved radium-226, dissolved radium-228, dissolved arsenic, dissolved barium, dissolved boron, dissolved cadmium, dissolved chromium, dissolved copper, fluoride, dissolved iron, total iron, dissolved lead, total manganese, dissolved mercury, dissolved molybdenum, dissolved nickel, dissolved selenium, dissolved uranium, dissolved vanadium, and dissolved zinc. It is worthwhile to note that in terms of compliance with 10 CFR Part 40 Appendix A, Criterion 5B(5), measurement and reporting of these parameters would more likely be done during the stability monitoring phase than necessarily during the actual restoration phase.

Q.54. The intervenors expert also states that the list of aquifer restoration criteria should be detailed and extensive (Moran 2011 ¶71). Please comment on how the list of potential chemical constituents monitored during restoration was developed and how it compares to other ISR projects.

A.54. The list of constituents in TR Table 6.1-2 (Exhibit SEI014C at 300) of the approved license application was developed for consistency with Commission guidance in NUREG-1569, Table 2.7.3-1 (Exhibit SEI007 at 63) and WDEQ-LQD Guideline 8, Appendix 1 (Exhibit SEI011 at 42 - 47). Note that the parameters listed in NUREG-1569, Table 2.7.3-1 are all the parameters likely to be affected by ISR. A comparison of the parameters provided in TR Table 6.1-2 with licensed facilities at Moore Ranch (SUA-1596), Nichols Ranch (SUA-1597) and Lost Creek (SUA-1598) indicates that the parameters proposed by Strata are consistent with or in some cases exceed the number of parameters used by other licensees to establish Commission-approved background.

3.3 Experience at Nubeth's R&D and Other ISR Operations Demonstrates Successful Aquifer Restoration.

Q.55. It has been alleged that operational problems encountered at the Nubeth R&D site could translate into restoration problems for Strata's Ross ISR Project (Moran 2011, ¶74; Sass 2011 ¶22). Please describe how major obstacles encountered at Nubeth would be handled using technological advancements over the last 35 years?

A.55. The Nubeth R&D site was operated approximately 35 years ago and represents one of the first ISR research and development projects established in Wyoming. As with any new technology (which ISR was in 1978) there are initial operating issues that are overcome as the industry matures which is the purpose of a research and development project. The 5-spot test pattern at the Nubeth R&D site operated for 8 months before entering the restoration phase. The restoration phase consisted of an extended groundwater sweep phase followed by stability monitoring. The Nubeth R&D site restoration did not include groundwater treatment through ion exchange and RO systems. ISR facilities today typically conduct an extensive RO phase during groundwater restoration to decrease the amount of water consumed during restoration as well as decrease the dissolved constituents in the groundwater. The process of RO treatment with permeate injection, as proposed by Strata, involves pumping water from the wellfields to the CPP for treatment using ion exchange columns and RO units. The treated water (permeate) is returned to the host aquifer using the same infrastructure (wells and piping) that were used during uranium recovery. Treatment is measured using pore-volume displacements, or the amount of groundwater contained in the host aquifer, and evaluated based on the volumes treated. Beyond improved treatment methods, restoration efforts today include minimization of dissolved oxygen (often through a more limited groundwater sweep phase as proposed by Strata in the approved license application) to promote reducing conditions in the host aquifer along with better tracking and reporting of restoration success. Also, pH control is monitored and emphasized during both the uranium recovery and restoration phases. One of the most important advancements in support of restoration is adequate effluent management capacity. NRC staff reviewed Strata's proposed water management and concluded in the SER:

> "For its deep well disposal plans, the applicant has shown that it would be in compliance with the NRC regulations for the alternate disposal of byproduct material in 10 CFR 20.2002, as well as the dose limits in 10 CFR 20.1301. By providing information on the methods that would be used to control liquid effluents and obtaining a permit from WDEQ for Class I deep disposal wells, the staff finds that the applicant has described liquid waste effluents and disposal methods in accordance with acceptance criteria (1), (2), (7), and (8) in SRP [NUREG-1569] Section 4.2.3 (NRC, 2003). Therefore, Strata's plans are acceptable to the NRC staff." (Exhibit SEI010 at 209).

Q.56. Considering the fact that restoration was successful at the Nubeth R&D site and the industry now has an additional 35 years of technological development to draw on is there any

reason to believe that Strata would not be able to successfully restore the groundwater at the Ross ISR Project?

A.56. No. As detailed in the approved license application and FSEIS, there are numerous examples of successful restoration of ISR wellfields. In fact, Nubeth used the most basic method, groundwater sweep, and was able to successfully restore the 5-spot test pattern following 8 months of operation. The approved license application, in TR Section 6.1.6.4 (Exhibit SEI014C at 295 and 296) provides a list of specific improvements proposed by Strata garnered through decades of gaining new knowledge regarding restoration. Some of these improvements include; adequate restoration infrastructure, use of RO units during production (in addition to restoration), adequate RO capacity, maintenance of production bleed, and the use of groundwater modeling to guide restoration hydraulics. In my opinion, by utilizing technological advancements and lessons learned by the ISR industry over the preceding 35 years, restoration at the Ross ISR Project is virtually assured.

4.0 CONTENTION 3 - ALLEGED FAILURE OF THE FSEIS TO INCLUDE ADEQUATE HYDROLOGICAL INFORMATION TO DEMONSTRATE SEI'S ABILITY TO CONTAIN FLUID MIGRATION.

Q.57. Please describe the nature of your testimony on this contention.

A.57. The site-wide hydrogeologic characterization conducted for pre-license purposes at the Ross ISR Project was performed in conformance with NUREG-1569 Section 2 (site characterization). In addition, the procedures for establishing hydrogeologic data for each wellfield are in conformance with NUREG-1569 Section 5 (operations). Moreover, it is also my testimony that the information in the approved license application and FSEIS demonstrates that the production zone aquifers are sufficiently isolated such that ISR operations can be conducted safely in accordance with the NRC license and within the exempted aquifer.

4.1 The FSEIS and the Approved License Application Sufficiently Analyze the Potential for Impacts Associated with Fluid Migration through Unplugged Boreholes.

Q.58. Please respond to the allegation that there is lack of confinement due to unplugged or improperly plugged exploration holes (Larson and Abitz 2014, 55; Moran 2011, ¶22, 31; Abitz, 2011 ¶13).

A.58. Strata proposes to conduct ISR in the Upper Fox Hills Formation and Lower Lance Formation. The targeted aquifer (the OZ aquifer) is geologically confined throughout the entire license boundary. The OZ aquifer is confined below by a very fine-grained shale unit approximately 50 feet thick, which separates the OZ from a thin sandstone at the base of the Fox Hills Formation referred to as the deep monitoring (DM) zone. Underlying the DM zone is the Pierre Shale, which is a dark gray, silty marine shale over 2,000 feet thick within the license boundary. Overlying the OZ aquifer is a Lance Formation shale that varies in thickness from approximately 20 to 80 feet across the license area. The shale separates the OZ aquifer from the nearest overlying aquifer, which is referred to as the SM aquifer.

As described in ER Section 3.4.3.5.2.1 and TR Section 2.7.3.5.2.1 of the approved license application (Exhibit SEI016A at 275 and Exhibit SEI014A at 210), Strata has constructed six monitor well clusters within the license boundary as part of the regional baseline monitoring network (see also A.14., A.15., A.30., A.31. and A.33. of this testimony). At each monitor well cluster, separate wells were completed in the SA, SM, OZ, and DM aquifers. Static water levels measured at each well clearly show several to tens of feet of difference between the aquifers. The difference in the levels demonstrates that they are hydrologically isolated. ER Figures 3.4-15, 3.4-16, 3.4-17, 3.4-18, 3.4-19 and 3.4-20 (Exhibit SEI016A at 373 - 378) depict the well completions and static water levels at each cluster and clearly depict the differences in water levels in the various aquifers. If historical exploration boreholes were causing a lack of confinement, the water levels in the monitor wells would be very similar if not the same; this is simply not the case.

Q.59. In addition to water level differences are there also differences in water quality between the various aquifers?

A.59. Yes. ER Figures 3.4-27, 3.4-28, 3.4-29, 3.4-30, 3.4-31 and 3.4-32 (Exhibit SEI016A at 385 - 390) depict the water quality measured in the different aquifers using piper (trilinear) diagrams. The piper diagrams allow comparison of major ion chemistry and visibly depict the unique water qualities measured in the four aquifers assessed in the approved license application. The diagrams show unique water quality characteristics between the SA, SM, OZ and DM aquifers. Similar to the differences in water levels, the differences in major ion chemistry between the aquifers clearly indicate that these water bearing intervals are isolated from one another. Otherwise the water quality would be the same.

Q.60. Please describe the measures that Strata has committed to take to ensure that communication between the ore zone and the underlying or overlying aquifers does not result in lack of containment of ISR solutions.

A.60. Prior to operating each wellfield, Strata will be required to demonstrate that the production zone is hydraulically isolated from underlying and overlying aquifers. As part of this process, Strata will be required to perform delineation drilling and detailed mapping of the ore bodies targeted for ISR operations and the lithology of overlying and underlying sand units and confining units. This information will be used to revise the conceptual geologic model and design the monitoring well network for each wellfield. Following installation of the monitoring well network, plugging and abandonment of all SEI and historic drillholes not completed as wells within the perimeter ring, and successful mechanical integrity testing of the wells, aquifer tests will be conducted to demonstrate that the production zone is hydraulically isolated from overlying and underlying aquifers. The results of these tests will be provided to the NRC for review and verification as well as to the WDEQ-LQD for review and approval. Beyond the commitments in the approved license application, NRC Staff have included specific license conditions for mechanical integrity testing (LC 10.5), plugging and

abandonment (LC 10.12) and the composition of the hydrologic test or wellfield package (LC 10.13). to be submitted to NRC.

Q.61. Please describe NRC staff's review of Strata's procedures to locate and mitigate potential impacts from unplugged or improperly plugged exploration holes.
A.61. The FSEIS discusses NRC staff's assessment of the proposed procedures in multiple sections. Select quotations include:

- "…historical exploration and/or delineation drillholes would be located through the use of a hand-held metal detector that would locate the brass cap associated with each drillhole, usually with its identification number. After a drillhole is located, to properly abandon it, a small drilling rig would be set up over the drillhole to ream it out to its total depth. A cement slurry or bentonite grout would then be introduced from the bottom up to the ground surface along the entire drillhole length. Details of each drillhole's abandonment would be documented in a record (examples in Strata, 2011b, Addendum 2.7-F). These would be filed at Strata's Oshoto Field Office in the appropriate drillhole file and would be provided with the respective "hydrologic-test data package" (NRC, 2014b)." (Exhibit SEI009A at 110)
- "To prevent communication between aquifers during uranium-recovery operations, as indicated in Condition No. 10.12 of the Draft Source and Byproduct Materials License, the Applicant will attempt to locate and properly abandon all historical drillholes located within the ring of perimeter-monitoring wells in each wellfield prior to conducting tests for the respective 'hydrologic-test data package' required by the NRC for the Applicant to begin wellfield operations (see SEIS Section 2.1.1.1 and the Draft License currently available as NRC, 2014b)." (Exhibit SEI009A at 181)

Q.62. Please summarize Strata's evaluation of potential unplugged or improperly plugged exploration holes.
A.62. The approved license application in TR Section 2.6.4 (Exhibit SEI014A at 153 - 154) discusses the methods used to find historic exploration holes:

> "During initial exploration efforts by Nubeth and predecessors, in excess of 1,500 holes were drilled in the current permit boundary with at least another 200 within a ½ mile buffer around the permit. In order to best utilize the data acquired for the project, Strata initiated a hole finding and surveying program in 2008. Due to the presence of metal plugs in the shallow subsurface of each hole, a metal detector was utilized to accurately locate the holes, stake them and then re-survey using a conventional coordinate system (versus a local system)."

In addition, TR Addendum 2.6-E (Exhibit SEI014F at 27 - 34) provides a tabulation of the drillholes within and adjacent to the license boundary. This information was updated for the FSEIS with results found in Exhibit SEI009A at 623 as a response to intervenor's Comment RP032-060.

4.2 The FSEIS Adequately Addresses Excursion Detection Parameters and Excursion Recovery Methods

Q.63. Please respond to the allegation that NRC has "failed to analyze and model the subsurface geochemistry and potential for contaminant excursion" in reference to Strata using chloride, conductivity, and total alkalinity as excursion indicators and not using uranium as an excursion indicator (Larson and Abitz 2014, ¶48, 49, 50).

A.63. Chloride, conductivity, and total alkalinity were selected as excursion indicators based on nearly 40 years of industry experience and Commission guidance in NUREG-1569. With respect to use of uranium as an excursion indicator, NUREG-1569 states:

> "Uranium is not considered a good excursion indicator because, although it is mobilized by *in situ* leaching, it may be retarded by reducing conditions in the aquifer." (Exhibit SEI007 at 138)

Support for this recommendation in NUREG-1569 comes from Deutsch, W.J., et al. in NUREG/CR–3709, *Method of Minimizing Ground-Water Contamination From In Situ Leach Uranium Mining,* which concludes at page xv that "the redox-sensitive elements and the major cations are too reactive with the sediments to be reliable indicators. The major anions (chloride and sulfate) were determined to be less reactive and may be effective indicators, providing that their concentrations in the leaching solution are significantly above that in the ground water."

In fact, for the underlying (DM) interval, Strata proposed and NRC Staff accepted an alternate excursion indicator parameter of sulfate in-lieu of chloride, due to the site specific geochemical characteristics of the aquifer.

Q.64. Please respond to the allegation that there is no credible scientific basis demonstrating that adjustments in pumping rates can recapture a lixiviant plume if a well goes on excursion status (Larson and Abitz, 2014 ¶51).

A.64. In my experience as well as that of Mr. Knode's (SEI001) recovering excursions through adjusting pumping rates from nearby production wells is a standard method, **Strata's own site-specific modeling confirms this approach**. Specifically, in Section 4.11 of TR Addendum 2.7-H (Groundwater Model) it was demonstrated that adjusting pumping rates will be effective in recapturing a lixiviant plume (Exhibit SEI014H at 142 - 160).

4.3 The FSEIS and SER Demonstrate that the License Application Complies with Applicable NUREG-1569 Acceptance Criteria with Respect to Hydrogeologic Characterization

Q.65. It has been alleged that Strata did not supply sufficient hydrogeologic data to demonstrate hydraulic isolation of the aquifers (Abitz 2011 ¶9, 10; Moran 2011 ¶13, 24; Sass 2011 ¶15, 20, 21). Please describe how Strata developed the hydrogeologic data for the approved license application that was used in the development of the FSEIS and SER.

A.65. The hydrogeologic data in the application were prepared in accordance with the Commission guidance in NUREG-1569.

Q.66 Please elaborate on the NUREG-1569 criteria applicable to evaluation of geology in a license application.

A.66. Sections 2.6.1 through 2.6.3 of NUREG-1569 (Exhibit SEI007 at 54 - 57) provide a narrative and acceptance criteria to be used by NRC staff to evaluate geological components of license applications. The narrative in Section 2.6.1 includes at least 14 suggestions such as geologic maps, structural maps, isopach maps, stratigraphic maps, cross-sections, geophysical well-log data, and similar graphical presentations of these data. Section 2.6.2 describes the review procedures for the suggestions in Section 2.6.1, while the acceptance criteria are detailed in Section 2.6.3 (pages 55 - 57). These include 13 detailed criteria that should be included in the license application.

Q.67. Does the SER document NRC staff's determination of whether these geology acceptance criteria were met?

A.67. Yes. NRC Staff's review of the geology for the approved license application is documented in Section 2.3.3.3 of the SER (Exhibit SEI010 at 48 - 55) and concludes at 55:

> "…staff finds that the applicant's description of the site-specific geology meets the review procedures in Section 2.6.2 and acceptance criteria in Section 2.6.3 of the SRP [NUREG-1569] (NRC, 2003), because the application contains a local stratigraphic description based on sampling, geophysical logs, geologic cross-sections, isopach and structural contour mapping and fence diagrams, a geologic and geochemical description of the ore zone and units immediately surrounding the ore zone and a description of the local geologic structures. The information was verified by staff's independent review of published data primarily for the former R&D facility. The mapping was clearly labeled, exhibited locations of all features discussed in the application (well locations, cross-section lines), drawn at appropriate scales and included proper geographic references."

Q.68. Please describe the NUREG-1569 acceptance criteria for characterizing site-wide hydrogeology in a license application.

A.68. Section 2.7.2 of NUREG-1569 describes review procedures, and Section 2.7.3 provides the acceptance criteria (Exhibit SEI007 at 59 - 64) used by the NRC staff to evaluate the hydrogeologic components of a license application.

Q.69. Did NRC staff determine if these hydrogeologic acceptance criteria were met?

A.69. Yes. NRC staff's review of the regional and site hydrogeology for the approved license application is documented in Sections 2.4.3.3 and 2.4.3.4 of the SER, respectively (Exhibit SEI010 at 65 - 92). In addition, hydrogeology evaluation findings are presented in SER Section 2.4.4 (Exhibit SEI010 at 92 - 93).

The following presents NRC's conclusions on the regional hydrogeology (Exhibit SEI010 at 67):

"The staff finds that the applicant adequately described the regional hydrogeology in accordance with the review procedures in Section 2.7.2 and acceptance criteria in Section 2.7.3 of the SRP [NUREG 1569] (NRC, 2003) by describing the setting using established mapping from published sources (e.g. USGS). Staff based this determination on the quality and quantity of the hydrogeologic information provided by the applicant, as independently confirmed and verified by the staff. Staff verified the information on the municipal water supply sources and concludes that the information is accurate but notes that only completion depths are published for several municipal water supply wells and, for the most part, the applicant interpreted the formations for which the wells are completed. Based on the reported depths to the municipal wells and other information (e.g., well-documented thicknesses of the mapped formation and established water quality for the various aquifers), staff finds that the applicant's assessment of the aquifers screened by the municipal water supply wells is reasonable. Staff agrees that the municipal water supply wells are not completed in the Fort Union-Lance aquifer except for the water supply well for the Town of Moorcroft as noted by the applicant"… Guidance in the SRP [NUREG-1569] (NRC, 2003) states:

'The regional map should represent the mineralized zone aquifer and should encompass the likely consequences on any affected highly populated areas.' and 'To construct a regional potentiometric map, a reasonable effort should be made to consider as many existing wells as possible.'

"Staff finds that the regional hydrogeologic information provided by the applicant is consistent with the above guidance and provides a basis for staff's determination that the proposed operations can be conducted safely. The impacts of the operations on the regional water resources will be addressed in the Supplemental Environmental Impact Statement (SEIS) being prepared by NRC staff."

The following summarizes NRC staff's review of the hydrologic site characterization in the SER (Exhibit SEI010 at 93, emphasis added):

"Based upon the review conducted by the staff, discussed above, and information that will be provided by the applicant in accordance with the above license conditions, staff finds that the applicant will be able **to control the migration of production fluids in the subsurface and thus meets the applicable acceptance criteria** for this section and thus meets requirements of 10 CFR 40.31(b) and will meet requirements of 10 CFR 40.41(c), if issued a license."

Q.70. Did the staff address potential impacts due to operations on regional water resources in the FSEIS?

A.70. Yes. Section 4.5.1.2 of the FSEIS (Exhibit SEI009A at 317) includes the following summary regarding potential impacts to water quality:

"Detection of excursions through the network of monitoring wells, followed by the Applicant's pumping of ground water to 'recover' the excursion would reduce long-term potential impacts to the OZ aquifer outside the exempted portion to SMALL."

5.0 REFERENCES

Abitz, R., 2011, Declaration of Dr. Richard Abitz on Behalf of the Natural Resources Defense Council and Powder River Basin Resource Council, ADAMS Accession No. ML11300A191, October 23, 2011, Attachment to the Petition to Intervene and Request for Hearing by the Natural Resource Defense Council and Powder River Basin Resource Council, PDF pages 106 to 132.

Abitz, R., 2013, Second Declaration of Dr. Richard Abitz on Behalf of the Natural Resources Defense Council and Powder River Basin Resource Council, ADAMS Accession No. ML13126A402, May 6, 2013, Exhibit 2 to Natural Resources Defense Council's and Powder River Basin Resource Council's Joint Motion to Resubmit Contentions and Admit One New Contention in Response to Staff's Supplemental Draft Environmental Impact Statement.

Deutsch, W.J., et al. NUREG/CR–3709, "Method of Minimizing Ground-Water Contamination From In Situ Leach Uranium Mining." Washington, DC: NRC. 1985.

Larson, L. and R. Abitz, 2014, Joint Third Declaration of Dr. Richard Abitz and First Declaration of Dr. Lance Larson on Behalf of the Natural Resource Defense Council and Powder River Basin Resource Council, ADAMS Accession No. ML14091A004, March 31, 2014, Exhibit 1 to Natural Resource Defense Council's and Powder River Basin Resource Council's Joint Motion to Migrate or Amend Contentions, and to Admit Contentions in Response to Staff's Final Supplemental Draft Environmental Impact Statement.

Moran, R.E., 2011, Declaration of Robert E. Moran on Behalf of the Natural Resources Defense Council and Powder River Basin Resource Council, ADAMS Accession No. ML11300A191, October 24, 2011, Attachment to the Petition to Intervene and Request for Hearing by the Natural Resource Defense Council and Powder River Basin Resource Council, PDF pages 12 to 69.

Sass, R.L., 2011, Declaration of Dr. Ronald L. Sass on Behalf of the Natural Resources Defense Council and Powder River Basin Resource Council, ADAMS Accession No. ML11300A191, October 25, 2011, Attachment to the Petition to Intervene and Request for Hearing by the Natural Resource Defense Council and Powder River Basin Resource Council, PDF pages 70 to 105.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)		
	)		
Strata Energy, Inc.	)	Docket No.	40-9091-MLA
	)	ASLBP No.	12-915-01-MLA-BD01
	)		
(Ross In Situ Recovery	)		
Uranium Project)	)		

AFFIDAVIT OF BEN SCHIFFER

I declare under penalty of perjury that my statements in prefiled Exhibits Ben Schiffer Initial Written Testimony (SEI007) and Ben Schiffer CV (SEI008) are true and correct to the best of my knowledge and belief.

Benjamin J. Schiffer, P.G.

Executed in Sheridan, WY
this 25th day of August, 2014