NATURAL RESOURCES DEFENSE COUNCIL'S & POWDER RIVER BASIN RESOURCE COUNCIL'S PETITION FOR REVIEW

EXHIBIT 18

Sept. 12, 2014

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
	)	
(Ross *In Situ* Uranium Recovery Site)	)	ASLBP No. 12-915-01-MLA
	)	

NRC STAFF'S REBUTTAL TESTIMONY

INTRODUCTION

Q.1 **Please state your name, position, and employer, and briefly describe your role in reviewing Strata's application for a license related to the Ross Project.**

A.1a My name is Johari Moore. I am an Environmental Project Manager in the NRC's Office of Federal and State Materials and Environmental Management Programs, Division of Waste Management and Environmental Protection, Environmental Review Branch. My duties related to the Ross Project license application review are described in Exhibit (Ex.) NRC001 at A.1a. NRC002 provides a statement of my professional qualifications.

A.1b My name is John Saxton. I am a Hydrogeologist with the Uranium Recovery Licensing Branch in the NRC's Office of Federal, State and Materials and Environmental Management Programs. My duties related to the Ross Project license application review are described in Ex. NRC001 at A.1b. Ex. NRC003 provides a statement of my professional qualifications.

A.1c My name is Kathryn Johnson. I am a geochemist employed by Attenuation Environmental Company (AEC). I also own and operate Johnson

Environmental Concepts. My duties related to the Ross Project license application review are described in Ex. NRC001 at A.1c. Ex. NRC004 provides a statement of my professional qualifications.

A.1d My name is Anthony Burgess. I am employed by AEC as principal hydrogeologist. I also own and operate my own company, Anthony Burgess Consulting Inc. My duties related to the Ross Project license application review are described in Ex. NRC001 at A.1d. Ex. NRC005 provides a statement of my professional qualifications.

Q.2 Are you familiar with the initial testimony and exhibits filed by the Joint Intervenors in this proceeding?

A.2 (J. Moore, J. Saxton, K. Johnson, A. Burgess) Yes. We have reviewed the testimony of Drs. Richard Abitz and Lance Larson on behalf of the Joint Intervenors that is relevant to the contentions on which we will be testifying. We have also reviewed the relevant supporting information cited by the Joint Intervenors, including their exhibits.

Q.3 What are the contentions on which you will be testifying?

A.3a (J. Moore) I will be testifying on Contentions 1 (Baseline Groundwater Quality), 2 (ACL Bounding Analysis), and 3 (Fluid Migration).

A.3b (J. Saxton) I will be testifying on Contentions 1 (Baseline Groundwater Quality), 2 (ACL Bounding Analysis), and 3 (Fluid Migration).

A.3c (K. Johnson) I will be testifying on Contentions 1 (Baseline Groundwater Quality), 2 (ACL Bounding Analysis), and 3 (Fluid Migration).

A.4d (A. Burgess) I will be testifying on Contentions 1 (Baseline Groundwater Quality) and 3 (Fluid Migration).

CONTENTION 1

Q.1.1 In their Statement of Position Supporting Environmental Contentions 1, 2 and 3, the Intervenors state that the FSEIS's description of baseline groundwater quality conditions departs from NRC guidance – specifically, Sections 2.7.1, 2.7.3, and 2.7.4 of NUREG-1569. Do you agree?

A.1.1 (J. Saxton) No, I do not. NUREG-1569 provides guidance for both the Staff's safety review (for compliance with the Atomic Energy Act) and environmental review (for compliance with NEPA and other statutes) of an applicant's license application. NUREG-1569, Section 2, calls for the provision of site-characterization information; water resources are characterized pursuant to guidance in Section 2.7.

As I explained in my affidavit supporting the Staff's response to the Intervenors' motion for summary disposition of Contention 1 (Ex. NRC012), the Staff found during our review of the Ross Application for compliance with the Atomic Energy Act and NRC safety regulations that the empirical data on groundwater quality collected by Strata met the requirements of 10 C.F.R. Part 40, Appendix A, Criterion 7 and was consistent with guidance in Section 2.7 of NUREG-1569. The Staff expects applicants to characterize the "baseline" of the proposed license area groundwater data in accordance with guidance in NUREG-1569, Section 2.7; characterize or have procedures to characterize nearby water supply users prior to major site construction in accordance with Criterion 7 and Regulatory Guide 4.14; and have procedures to develop the Commission-approved background concentrations under Criterion 5B(5) of Appendix A for the groundwater detection monitoring program for the various regulated units that may be proposed in accordance with Criterion 7A (Ex. SEI007 at B-4).

Strata's application documented groundwater data collected over a two-year period from 24 monitoring wells located throughout the proposed Ross license area (27 wells exist, but two wells were consistently dry and one industrial well could not be sampled.) (Ex. SEI010 at 85-87). The data provided information on both temporal and spatial (i.e., vertical and horizontal) variations in the groundwater quality (Ex. SEI010 at 87-88). The application documented that water quality information was obtained using established sampling and analytical methods and includes parameters listed in Table 2.7.3-1 of NUREG-1569 (Ex. SEI010 at 87-88). The application also documented water quality data from 29 existing water supply wells within 2 miles of the Ross ISR Project (Ex. SEI010 at 83-84). For those wells, the Staff found that Strata's reported sampling and analytical methods were acceptable as industry standard practices and the parameters analyzed were consistent with recommendations in Regulatory Guide 4.14 (Ex. SEI010 at 87-88). The Ross application includes summary statistical and graphical analyses of the groundwater quality data (Ex. SEI010 at 85-87).

Criterion 7 and NUREG-1569 do not specify an exact number of sample locations necessary to establish sufficient information to adequately characterize baseline groundwater quality; however, Section 2.7.2(4) of NUREG-1569 states:

> Evaluate the applicant's assessment of water quality of potentially affected ground-water resources. This information will provide the basis for evaluating potential effects of in situ leach extraction on the quality of local ground-water resources. Verify that a sufficient number of baseline ground-water samples are collected to provide meaningful statistics, that samples are spaced in time sufficiently to capture temporal variations, and that the chemical constituents and water quality parameters evaluated are sufficient to establish pre-operational water quality, including classes of use.

After reviewing the data provided by Strata in the Ross application and in response to requests for additional information, the Staff concluded that the empirical data collected provided meaningful statistical data; the data were spaced sufficiently in time to capture temporal variations; and the water quality parameters evaluated were sufficient to establish pre-operational water quality, consistent with NUREG-1569, Section 2.7.2(4).

The Intervenors are also incorrect to claim that Section 2.7 of NUREG-1569 supports the premise that Strata must provide the Criterion 5B(5) concentration values prior to issuance of its source and byproduct materials license. The guidance on areas of review, review procedures and acceptance criteria for Criterion 5B(5)(a) background concentrations is not found in Section 2.7, but rather in Sections 5.7.8 and 6.1 of NUREG-1569. The format of NUREG-1569 is such that Chapter 2 contains guidance for the Staff's review of the *pre-operational* aspect of the proposed facility, whereas Chapter 5 contains guidance for the Staff's review of the proposed programs *during operations*, and Chapter 6 contains guidance for the Staff's review of the proposed programs *during decommissioning and reclamation*, including groundwater restoration of the wellfields. Thus, NUREG-1569 does not require an application to provide the Criterion 5B(5)(a) background concentrations. Rather, NUREG-1569 calls for procedures to be in place for *subsequent* collection of the Criterion 5B(5)(a) background concentrations during operations. This is further reinforced in Section 1.2 (Proposed Activities – Review Procedures):

> The reviewer should determine whether the application provides a sufficiently comprehensive summary of the nature of the facilities, equipment, and procedures to be used in the proposed in situ leach activity including the name and location. 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.

The Criterion 5B(5) background concentrations characterize water quality at designated monitoring wells, which, by license condition, are those used to detect lixiviant excursions from the production zone during operations and establish standards for aquifer restoration after the uranium recovery operations are complete. This is reflected in Condition 11.3 of Strata's license (Ex. SEI015). The information a licensee obtains for background concentrations under Criterion 5B(5) is used to establish standards for a regulatory groundwater detection-monitoring program in order to detect a release. It is also used to establish standards for aquifer restoration after uranium recovery operations are complete. This intended purpose is distinct from the information required of the applicant/licensee by 10 C.F.R. 51.45 and Criterion 7. This site-characterization baseline information is used to characterize the general environmental baseline conditions of the site, and is necessary to evaluate future impacts that may be derived from accidental and unplanned spills or releases, similar to the requirement that all applicants characterize the radiological baseline data in a variety of environmental media prior to major construction. Strata supplied this information in support of both the safety and environmental reviews of its application.

Q.1.2 In A.11 through A.13 of his testimony, Dr. Abitz describes his understanding of "baseline" and "background" groundwater quality and the purpose for characterizing baseline water quality. Can you respond to this discussion?

A.1.2 (K. Johnson, J. Moore, J. Saxton) To support his understanding of baseline water quality standards, Dr. Abitz draws upon U.S. Environmental Protection Agency (EPA) guidance that was prepared "to assist EPA's Regions, the States and the regulated community in testing and evaluating groundwater monitoring data under 40 CFR Parts 264 and 265 and 40 CFR Part 258" (Ex. JTI006). These are regulations implementing the Resource Conservation and Recovery Act (RCRA), which apply to (1) hazardous waste treatment, storage, and disposal facilities and (2) municipal solid waste landfills. These RCRA regulations, and the EPA guidance supporting them, do not apply to the Staff's NEPA-mandated review of the Ross Project in the FSEIS.

In A.13 of his testimony, Dr. Abitz outlines two purposes for gathering baseline groundwater quality information – to understand the state of the affected environment before operations commence, and to serve as restoration target values after operations cease. 10 C.F.R. Part 40, Appendix A, requires the applicant or licensee to gather groundwater quality information in support of both purposes – for the first, under Criterion 7; for the second, under to Criterion 5B(5). Specifically, as we explain in A.1.3 of our initial testimony, Criterion 7 calls for the licensee to provide pre-licensing, site-characterization data, and Criterion 5B(5) calls for the provision of post-licensing, pre-operational groundwater quality data. The FSEIS uses groundwater quality information developed pursuant to Criterion 7 for site-characterization purposes; it is not intended to set the restoration target values for the site or supply data for an excursion-detection monitoring program.

In A.32 of his testimony, Dr. Abitz invokes Criterion 7 as support for his claim that the "NRC Staff's permissive allowance in the FSEIS for the meaningful baseline (i.e., the restoration mark) to be set after NEPA and

licensing processes have concluded is outside the accepted industry and regulatory protocols for establishing baseline water quality." However, the restoration values are set by the program required to supply information pursuant to Criterion 5B(5), not Criterion 7. While later in his testimony (Ex. JTI001 at A.16) Dr. Abitz takes issue with the fact that Part 40, Appendix A sets forth two different sampling programs to gather baseline groundwater data, these two programs are distinct because they are used, in part, for these different purposes that Dr. Abitz describes in A.13 of his testimony.

Finally, throughout his testimony, Dr. Abitz suggests that the FSEIS sets the requirements governing the development of post-licensing, pre-operational baseline groundwater data (e.g., Ex. JTI003 at A.18 and A.32). As we explained in A.1.7 of our initial testimony, the FSEIS's discussion of the process for establishing post-licensing, pre-operational background values describes what is permitted by the NRC's regulations and the specific measures that are required of Strata in its NRC license. The FSEIS does not "approve" the regulatory approach for gathering post-licensing, pre-operational groundwater data.

Q.1.3 In A.14 and A.15 of his testimony, Dr. Abitz discusses the process for establishing baseline groundwater quality at RCRA and CERCLA sites. Can you address the accuracy and relevancy of his statements?

A.1.3 (K. Johnson, J. Saxton) As we discussed in A.1.7 of our initial testimony, RCRA does not impose an absolute requirement that baseline values be established hydraulically upgradient of a disturbed area where sampling at non-upgradient wells will provide an indication of background groundwater quality that is representative or more representative than that provided by upgradient wells. Dr. Abitz states that NRC Regulatory Guide 4.14 (Ex. JTI008 at 4.14-2)

and NUREG-1569 (Ex. SEI007 at 2.32) call for at least one upgradient well for background samples. However, he does place this guidance in the proper context.

Regulatory Guide 4.14 addresses Radiological Effluent and Environmental Monitoring at Uranium Mills. Although some elements of the guidance, such as the sampling of wells and analysis of radiological constituents, can be appropriately applied to ISR facilities, the concept of an upgradient well cannot. A uranium mill as envisioned by Regulatory Guide 4.14 does not include two key features of an ISR facility. First, as noted in A.1.7 of our initial testimony, upgradient water quality is not necessarily representative of the background water quality in the ISR production zone because of the way uranium roll-fronts are formed: The groundwater upgradient of the ore body contains oxygen and is geochemically distinct from the groundwater in the same horizon through the production zone, which is generally oxygen-deficient. Second, natural hydraulic gradients are not disturbed at a uranium mill in the way that they are disrupted by the recovery wells during ISR operation and aquifer restoration. In fact, as described in Sections 2.1.1.2 and 4.5.1.2 of the FSEIS, the inflow of groundwater into the wellfield, which is a disruption of the natural flow gradient, is required at an ISR facility to reduce the likelihood of excursions out of a wellfield. Therefore, because an upgradient well is not required to establish baseline values at the Ross Project ISR site, the FSEIS does not describe such a well.

Finally, as we discuss in A.1.2 of our rebuttal testimony, the EPA guidance cited by Dr. Abitz in A.14 of his initial testimony does not apply to the Staff's environmental review of the Ross Project.

Q.1.4 In A.18 of his testimony, Dr. Abitz suggests that changes to the approach for describing "baseline" groundwater quality in the FSEIS would compel the Staff to conclude that the actual environmental impacts of the Ross Project on groundwater quality would be "LARGE" as defined in the FSEIS. Is this supposition correct?

A.1.4 (K. Johnson, J. Moore) The Staff's assessment of impacts to groundwater quality within the exempted aquifer from the Ross Project is based on a qualitative assessment of the expected post-restoration quality of the groundwater within this aquifer (see Ex. NRC001 at A.1.2, A.1.4, A.1.5, A.1.8, A.1.11). The Staff's assessment focuses on whether the quality of the groundwater will allow the groundwater to be used after restoration in the same manner as it was being used prior to licensing, and will be protective of public health and the environment. The Staff determined that the requirements imposed by 10 C.F.R. Part 40, the requirements imposed by the EPA and Wyoming Department of Environmental Quality (WDEQ), and the conditions in Strata's source and byproduct materials license, would collectively ensure that the groundwater would be available to be used after restoration in the manner that it was being used prior to licensing and would be protective of public health and the environment. Therefore, for these reasons, the Staff found the potential impacts of the Ross Project on groundwater quality to be SMALL.

It is important to note that the Staff's impacts conclusion is not based on a *quantitative* determination that the change in groundwater quality from pre-operation to post-restoration is small or insignificant. The Staff's review of the Ross Project in its FSEIS supplements the GEIS for ISR facilities, and its assessment of the environmental impacts of the Ross Project is consistent with the approach used in the GEIS. Accordingly, the FSEIS, consistent with the

GEIS, defines a SMALL impact as one that is not detectable or is so minor that it will neither destabilize nor noticeably alter any important attribute of the resource considered (Ex. SEI009A at xx). The FSEIS defines a LARGE impact as one that is clearly noticeable and is sufficient to destabilize important attributes of the resource considered (Ex. SEI009A at xxi). Although Dr. Abitz states that the impacts to groundwater quality for the Ross Project will be LARGE, he does not explain why he believes that the impacts will be both "clearly noticeable" and "sufficient to destabilize important attributes" of the groundwater.

The Staff considers the important attributes of groundwater quality to be those that are related to the current and future uses of the groundwater. The Staff would find that groundwater quality impacts are LARGE if they destabilize the quality of the groundwater in such a way that its current use becomes compromised. For example, degradation of the quality of groundwater that is currently used as a source of drinking water such that the groundwater could no longer be safely used for this purpose could be considered a LARGE impact, as this would be a destabilization of an important attribute of the groundwater. However, this is not the case for the Ross Project.

As we discuss in A.1.10 of our initial testimony**,** the WDEQ, with the EPA's concurrence, has formally determined that the ore zone aquifer does not currently (and will not in the future) serve as a source of drinking water. The Staff's analysis of the potential impacts to groundwater from the Ross Project and its conclusion that such impacts would be SMALL relies, in large part, on the fact that the production aquifer must be exempted as a USDW in order for operations to commence (see Ex. NRC001 at A.1.10). The many points that the Joint Intervenors raise in an effort to demonstrate that there could be

significant degradation of the quality of the groundwater within the exempted aquifer would not affect the Staff's conclusion unless they also demonstrate that the groundwater could not be restored to a state that would be determined by the NRC to be protective of public health and the environment, in accordance with 10 C.F.R. Part 40, Appendix A. Put another way, even if the Staff were to perform a quantitative analysis of groundwater data collected precisely in accordance with the wishes of Dr. Abitz, there is no information to suggest that the result would compel the Staff to conclude that the Ross Project would impact the exempted aquifer to such an extent that its ability to be used safely for the purposes for which it was used prior to operation of the ISR would be destabilized.

Finally, we would like to address Dr. Abitz's claim that "under the approach approved in the FSEIS, groundwater quality in the proposed mining area will be characterized improperly, resulting in the establishment of very high excursion values and restoration standards that will preclude the use of the water for future domestic, livestock or agriculture needs" (Ex. JTI003 at 11). Strata is required by its WDEQ permit to restore the exempted aquifer to the pre-operational class-of-use (Ex. SEI009A at 2-25). WDEQ proposed, and EPA approved, reclassification of groundwater within the mine unit to Class V Mineral Commercial (Exs. NRC045, SEI034). Dr. Abitz does not present any data in his testimony that would indicate that the aquifer currently meets the standards for domestic, agriculture or livestock use. Therefore, he has not shown that any potential preclusion of these uses resulting from Ross Project operations would have a LARGE impact on groundwater quality in the exempted aquifer.

Q.1.5 In A.22 through A.28 of his testimony, Dr. Abitz challenges the location and distribution of the site characterization wells developed by Strata and described in the FSEIS, and the drilling techniques used to develop those wells. Can you address his arguments?

A.1.5 (K. Johnson, J. Moore, J. Saxton) We addressed the well installation and development techniques used to develop Strata's site characterization wells in A.1.8(1) of our initial testimony. The Staff reviewed the groundwater sampling methods and groundwater quality analytical results presented in Strata's application and supporting documents (see Ex. SEI010 at 85-87). Based on its review, the Staff found the well development techniques Strata used to be consistent with industry practice (Ex. SEI010 at 151-52). These well development procedures include pumping, air lifting, jetting and/or swabbing.

While Dr. Abitz states that professional industry standards recommend that baseline water quality data should be collected using wells that have not been installed and developed with oxygen-rich fluids and air-purging techniques, the U.S. Geological Survey (USGS) report he references (Ex. JTI011) does not support his claim. The USGS report is not a prescriptive document, but rather compiles the various standard methods in use today, and notes the advantages and disadvantages of the different methods described. It also provides guidance on the issues to consider when selecting between methods of well installation. The report does not support Dr. Abitz's claim that Strata "violated the [USGS] professional standards when constructing their monitoring wells" (Ex. JTI003 at 19).

Dr. Abitz also claims that the FSEIS relied upon an insufficiently robust location, number, and distribution of sampling wells for its characterization of the pre-licensing baseline groundwater at the Ross Project site. The location,

number, and distribution of the wells was sufficient for the Staff to determine that the groundwater quality data developed by Strata from these wells satisfied Criterion 7 of 10 C.F.R. Part 40, Appendix A, was consistent with Regulatory Guide 4.14, and was sufficient to permit the Staff to characterize the environment that may be affected by the Ross Project and to support the assessment of the Project's reasonably foreseeable impacts to groundwater quality at the site (see Exs. NRC001 at A.1.4; SEI010 at 87-88). Furthermore, the range of constituents measured in the groundwater samples collected from these wells was consistent with the data for regional groundwater quality, as described in Section 3.5.3.3 of the FSEIS and Section 3.3.4.3.3 of the GEIS (Ex. NRC007 at 3.3-20). This supports the sufficiency of the data set used by the Staff in the FSEIS.

Q.1.6 **Dr. Abitz further states, in A.25 of his testimony, that these wells did not provide representative groundwater information because they were not fully screened through the entire ore interval. Do you agree?**

A.1.6 (K. Johnson, J. Moore, J. Saxton) We do not. In A.1.8(1) of our initial direct testimony, we stated that Strata's site characterization wells provided representative groundwater quality information because the wells were screened over the entire ore-zone aquifer, and referred to Table 3.4-20 and Figures 3.4-15 through 3.47-20 of Strata's ER, incorporated by reference in the FSEIS (Ex. SEI009A at 3-38). It was our assumption that the Joint Intervenors' and Dr. Abitz's arguments regarding biased data from well screening was based on the licensee targeting the narrow ore body zone, generally a 10- to 15-foot interval. By describing the site characterization wells as fully penetrating, we meant that the wells were screened over an interval beyond the ore mineralization, typically over the entire sand interval hosting the ore

mineralization. Having reviewed Dr. Abitz's initial testimony, we now understand that his argument is that these wells were not screened throughout all the sand lenses in the licensee's defined ore zone (OZ) aquifer interval. Although Dr. Abitz is correct that these wells did not screen the entire OZ horizon, as we stated in our initial testimony, the sampling of single sand intervals hosting the ore body is a more appropriate method for characterizing the site, rather than a well screened over several sand intervals that make up the designated OZ horizon. Finally, Dr. Abitz relies upon NUREG-1569 (Ex. SEI007 at 5-43) to support his position. However, this reference is to a discussion of whether or not partially screened or fully screened wells are appropriate for perimeter monitoring wells for the excursion-monitoring program – not for site-characterization wells.

Q.1.7 **In A.23 of his testimony, Dr. Abitz purports to calculate the true concentration of uranium in the groundwater to show that it is orders of magnitude lower than the concentrations discussed in the FSEIS. Can you address this discussion?**

A.1.7 (K. Johnson, J. Saxton) The premise of Dr. Abitz's calculations is flawed. Dr. Abitz assumes a perfect thermodynamic equilibrium between the water quality and the minerals in the aquifer. However, thermodynamic equilibrium is never achieved in aquifers due to water recharge and flow (Ex. NRC046). In addition, the kinetics of pyrite oxidation are slow, and therefore pyrite is commonly found in the presence of oxygenated water. As shown by a study being performed at the Smith Ranch facility, the concentrations of uranium in wells sampled using methods designed to exclude atmospheric oxygen show a uranium concentration of 0.11 mg/L in the ore zone (Ex. NRC047). This concentration is at the high end of the range of uranium concentrations measured in the

monitoring wells at the Ross Project (Ex. SEI009A at 3-40, Table 3.6). The measured uranium concentration (un-impacted by oxygen) of 0.11 mg/L shows that the range of uranium concentrations measured by Strata in the OZ monitoring wells are within the range of reasonable uranium concentrations that are possible under unperturbed conditions.

CONTENTION 2

Q.2.1 **In A.22 and A.66 of his initial testimony, Dr. Larson states that it is "inconceivable" that the Ross Project will have a SMALL impact on groundwater quality. Can you address this statement?**

A.2.1 (K. Johnson, J. Moore, J. Saxton) We describe the definitions of SMALL and LARGE in A.1.4 of our rebuttal testimony. As discussed in A.2.8 of our initial testimony and A.2.2 of our rebuttal testimony, the Staff concluded that the impacts to groundwater quality of the exempted aquifer from the Ross Project will be SMALL and temporary in part because the restoration of constituents to levels other than the post-licensing, pre-operational Commission-approved background concentration requires a finding by the NRC that the hazardous constituent concentration values are shown to be protective of public health and safety. In other words, as described in A.1.4 of our rebuttal testimony, 10 C.F.R. Part 40, among other requirements, will ensure that the groundwater would be available to be used after restoration in the manner that it was being used prior to licensing and would be protective of public health and the environment. Neither Dr. Larson nor Dr. Abitz shows that the impacts of the project will destabilize or noticeably alter an important attribute of the groundwater. While Dr. Larson and the Intervenors claim that the impacts of restoration to an ACL rather than the Criterion 5B(5) background values would be "significant," the experiences of the ISR facilities we discuss in the FSEIS

enabled us to conclude that restoration to alternate concentration limits has not changed the class-of-use of the affected aquifer and has not impacted the quality of groundwater outside the affected aquifer.

We would also like to address the statements throughout Dr. Larson's testimony that failing to restore groundwater to the primary restoration goal of post-licensing, pre-operational background concentrations is tantamount to restoration failure. The Commission's regulations and guidance allow a licensee to restore groundwater to either the Commission-approved background concentration of that constituent in the groundwater; the respective value given in the table in paragraph 5C of Appendix A if the constituent is listed in the table and if the background level of the constituent is below the value listed; or to an alternate concentration limit established by the Commission, which is subject to a finding that the a concentration is as low as reasonably achievable and will not pose a substantial present or potential hazard to human health or the environment. The Staff will not approve restoration until the concentrations of the hazardous constituents are shown to meet one of these three criteria. Therefore, the term "restoration" as used in the FSEIS allows for hazardous constituent concentrations that meet any of these criteria.

Q.2.2 In Q.12 of Dr. Larson's initial testimony, the Intervenors state that the FSEIS relies on the discussion of historical restoration approvals in the FSEIS to conclude that the impacts to groundwater quality from the Ross Project will be SMALL. Can you address this claim?

A.2.2 (K. Johnson, J. Moore, J. Saxton) This claim is incorrect. The FSEIS does not rely upon the discussion of historical restoration approvals presented in the FSEIS (Ex. SEI009A at 4-46) to arrive at the conclusion that the impacts from

restoration of the Ross Project will be SMALL. We describe some of the bases for our conclusion in A.1.4 and A.2.1 of our rebuttal testimony. The discussion of historical restoration approvals added to Section 4.5.1.3 of the FSEIS is intended to provide further information concerning what groundwater quality at the time of restoration of the Ross Project could look like based upon historical experience at other ISR sites that have received the NRC's approval of groundwater restoration values. Based on our review of these sites, we concluded that historically, restoration of groundwater to alternate concentration limits has not changed the class-of-use of the affected aquifer and has not impacted the quality of groundwater outside the affected aquifer (Ex. SEI009A at 4-48).

Q.2.3 **In A.12 and A.22 of his testimony, Dr. Larson states that the Staff's FSEIS fails to present any meaningful understanding of the "irretrievable and irreversible environmental degradation of groundwater quality, which the FSEIS does not acknowledge or discuss." Is this true?**

A.2.3 (K. Johnson, J. Moore, J. Saxton) This claim is not true. The Staff presents its assessment of irreversible and irretrievable commitments of resources in Table 8.1 of the FSEIS (Ex. SEI009A at 8-18-10). To the extent that Dr. Larson is claiming that the Staff's discussion of the three sites for which the Commission has approved restoration is deficient, we address his specific concerns throughout our initial and rebuttal testimony.

Q.2.4 **In A.23 of his initial testimony, Dr. Larson suggests that the Staff should have prepared a quantitative bounding analysis of actual future Ross Project groundwater quality impacts based on a "representative number of sites" and presented that data visually in the FSEIS. Do you agree?**

A.2.4 (K. Johnson, J. Moore, J. Saxton) We do not agree. First, as we discussed in A.2.7 of our initial testimony, the three sites discussed in the FSEIS are a "representative number of sites" insofar as these are the only three commercial ISR sites for which the Commission has approved restoration since the 1980s. Second, we prepare a site-specific supplemental EIS, such as the FSEIS for the Ross Project, in a manner consistent with the GEIS for ISR projects unless there are site-specific considerations that warrant a departure from the GEIS. We do not believe that any site-specific considerations for the Ross Project mandate the presentation of groundwater data in a visually interactive format.

Q.2.5 In A.16 through A.20 of his testimony, Dr. Larson describes the Staff's discussion of the Crow Butte Wellfield 1, Smith Ranch-Highland A-Wellfield, and Irigaray Mine Units 1-9 restoration approvals. Can you address his assessment of the information the Staff provided in the FSEIS for these sites?

A.2.5 (K. Johnson, J. Moore, J. Saxton) In these paragraphs, Dr. Larson raises many of the same issues that he and Dr. Abitz raised in their Joint Third Declaration, and to which we responded in our initial testimony at A.2.6 through A.2.11. Dr. Larson specifically focuses on uranium concentrations in the exempt aquifer at the time restoration was approved at Crow Butte Wellfield 1, Smith Ranch-Highland Wellfield A, and Irigaray Wellfields 1-9. At the time these wellfields were permitted and until March 2005, the Wyoming Class I domestic groundwater standard for uranium was 5 mg/L (Exs. NRC048, NRC049). Although the approved restoration concentrations for uranium concentrations at these sites exceeded post-licensing, pre-operational values, they did not exceed the Class I domestic use standard of 5 mg/L.

We also note that Dr. Larson repeats the argument that the Staff "justified [the] failure" of Crow Butte to restore Wellfield 1 to primary or secondary restoration standards, and that the "Staff's justification is flawed." As we explain in A.2.9 of our initial testimony, this statement fails to recognize that the FSEIS describes the NRC's prior decision to approve restoration of this wellfield – the FSEIS does not purport to justify or support the prior licensing decision to approve restoration for this facility.

Q.2.6 Dr. Larson discusses for the first time in his initial testimony data from Willow Creek/Christensen Ranch Mine Units 2-6 (A.21 and A.41 through A.60 of his testimony). Is this information relevant to the Staff's analysis or conclusions in the FSEIS?

A.2.6 (K. Johnson, J. Moore, J. Saxton) No, it is not. As we explain in the FSEIS (Ex. SEI009A at 4-46), the Staff did not present data on restoration at this facility because the facility has not received Commission approval for restoration. Therefore, it does not provide a useful set of data for the purposes of determining what a Commission-approved ACL for the Ross Project could look like. In its Technical Evaluation Report (TER) of the Christensen Ranch Mine Units 2-6, the NRC evaluated the restoration that was conducted by the licensee for each mine unit 2-6 (Ex. JTI035 at 69). In sum, the NRC: (1) identified the constituents for which the mean value of the wells in the wellfield were less than the baseline mean value or the National Primary Drinking Water Regulations MCLs; (2) compared the concentrations that were predicted to be in the perimeter wells around a wellfield in the future with MCLs for those constituents that were above baseline and above drinking water MCLs; (3) evaluated the stability of measured concentrations by the statistical analysis of the trends in concentrations of specific constituents; and (4) determined

additional corrective actions that are needed for excursions and restoration (see Ex. JTI035). The NRC identified additional corrective actions that would be needed for all of the Christensen Ranch mine units. The fact that the Commission has not yet approved restoration for this facility and has requested additional information from the licensee demonstrates that the NRC carefully reviews restoration reports submitted by licensees and does not approve restoration until the Staff can make the determination that concentrations of hazardous constituents in the groundwater will be protective of public health and the environment.

Dr. Larson's intent when providing information on this site appears to be to demonstrate that the groundwater will remain degraded after restoration, and he states that the impacts of this degradation have not been meaningfully analyzed in the FSEIS. However, the Staff, in its bounding analysis in Section 4.5.1.3 of the FSEIS, does acknowledge that post-restoration concentrations of hazardous constituents can exceed the post-licensing, pre-operational concentrations and, in some cases, by several orders of magnitude. However, following from the impacts assessment methodology presented in the GEIS, the FSEIS focuses on the fact that the Commission will only approve restoration with these elevated concentrations if they are determined to be protective of human health and the environment. This fact is borne out by Commission's decision not to approve restoration at Christensen Ranch until further information on groundwater quality is provided by the licensee.

Q.2.7 In A.21 through A.66 of his initial testimony, Dr. Larson presents "storymaps" of groundwater quality data from two ISR sites – Willow Creek/Christensen Ranch Mine Units 2-6 and Smith Ranch-Highland Mine Units A and B. Have you reviewed the information presented in these

storymaps? Do these storymaps affect the analysis or conclusions reached by the Staff in the FSEIS?

A.2.7 (K. Johnson, J. Moore, J. Saxton) We have reviewed the description of the program and the screenshots of the storymaps contained in Dr. Larson's initial testimony. Based on our review of this information, we have concluded that none of the information provided in the description of the storymaps or the screenshots of the storymaps included in his testimony affect the bounding analysis provided by the Staff in Section 4.5.1.3 of the FSEIS or the Staff's conclusion regarding the impacts of the Ross Project on groundwater quality.

First, as we explain in A.2.6 of our rebuttal testimony, the Willow Creek Christensen Ranch facility did not receive restoration approval from the NRC. Therefore, the storymap of groundwater quality data for that facility is irrelevant for the purposes of the Staff's discussion of historical Commission approvals of aquifer restoration, because the values purportedly shown on the storymap for this facility are not indicative of "Commission approved" secondary restoration values for uranium or any other concentration. As such, they do not shed light on what a Commission-approved ACL for the Ross Project might look like. The data from Smith Ranch-Highland "Mine Unit B" in the storymap for the Smith Ranch-Highland facility is also not relevant to the Staff's bounding analysis for the same reason – it has not received restoration approval from the Commission.

Second, Dr. Larson states in A.27, A.32, and A.34 of his testimony that the storymaps purport to be no more than visual representations of data that can be found on the NRC's website. Dr. Larson's descriptions of his storymaps and post-restoration data do not include the date of the sampling that produced the data he highlights. Therefore it is not clear whether the data he highlights

were collected at the time the aquifer restoration was approved for Smith Ranch-Highland Wellfield A, or were collected as longer-term monitoring data, as discussed in A.2.10 of our initial testimony. Assuming that the data are from the1999 sampling that was the basis for the restoration approval, the storymaps do not affect our analysis or conclusions in the FSEIS because the relevant data were already considered by the Staff for the Commission's approval of restoration of Smith Ranch-Highland A-Wellfield in the FSEIS (Ex. SEI009A at 4-46).

Q.2.8 **In A.12 through A.15 of his initial testimony, Dr. Larson discusses the Nubeth research and development project. Dr. Larson claims that the FSEIS fails to provide a complete analysis of the available data on Nubeth (A.14) and states that the experience of Nubeth indicates that Strata will be unlikely to restore groundwater to primary or secondary standards (A.15). Can you address his claims?**

A.2.8 (K. Johnson, J. Moore, J. Saxton) The Nubeth water quality is discussed in Section 3.5.3.3 of the FSEIS to support the Staff's description of the characteristics of the existing site, and in Section 5.7.2 as part of the FSEIS's assessment of cumulative impacts. The Staff discusses the FSEIS's description of the Nubeth project in A.1.8 of our initial testimony. We did not discuss the Nubeth project in the context of our discussion of historical aquifer restoration approvals in Section 4.5.1.3 of the FSEIS because it is not an analogous site. The Nubeth project was a small R&D operation (one recovery well and four injection wells over two acres of a seven acre project area) in comparison to Ross Project (see Ex. SEI009A at 2-12). In addition, the historical records on the Nubeth project do not provide sufficient information to compare restoration to that which will be conducted at the Ross Project (Ex.

NRC018 at 7-8). Although the Nubeth project is not included in the bounding analysis, the data necessary to evaluate the uranium concentrations at the time restoration was approved is provided in Table 5.4 of the FSEIS (Ex. SEI009A at 5-28). The data in Table 5.4 show that uranium concentrations that exceeded the post-license, pre-operational baseline at the time restoration was approved ranged from 0.07 mg/L to 0.48 mg/L. This range of uranium concentrations is less than the range described in our bounding analysis.

In addition, we would like to note that Dr. Larson incorrectly states that the analysis of samples from four wells sampled in 1981 was omitted from the Staff's analysis. The analysis of the samples from wells 3X, 4X, 19X, and 20X taken in October 1981 are included in Table 5.4 in the FSEIS and labeled appropriately (Ex. SEI009A at 5-28). Dr. Larson's approach of averaging all of the measurements taken from samples collected during the groundwater sweep and during the stability period, rather than using the final concentration for comparison against baseline as done by the Staff, is not appropriate because of the changing and improving nature of the quality of groundwater undergoing restoration. The objective of restoration is to lower the concentrations of uranium and other constituents in groundwater over time. The average of the concentrations during the time period of restoration does not reflect the concentrations in the groundwater at the time restoration was approved.

Finally, Dr. Larson's discussion of the Nubeth project to make the point that Strata is unlikely to restore groundwater to primary or secondary standards does not affect our impacts assessment in the FSEIS because, as described in A.2.2 of our rebuttal testimony, the FSEIS assumes that this could be the case.

CONTENTION 3

Q.3.1 Have you reviewed the declarations and testimony regarding Contention 3 presented as exhibits by the Intervenors?

A.3.1 (A. Burgess, K. Johnson, J. Saxton) Yes. We have reviewed all relevant exhibits, and we will discuss the statements made in Abitz Direct Testimony (Ex. JTI001), and Larson Direct Testimony (Ex. JTI003).

Q.3.2 In A.38 of his testimony, Dr. Abitz faults the Staff's conclusion in the FSEIS that uranium will not be included as an excursion parameter because other constituents move through the aquifer faster than uranium and would indicate excursions before radionuclides and other elements move outside the production zone. Dr. Abitz alleges that, the Staff's conclusion is inaccurate and an oversimplification. He claims that uranium-carbonate will be highly mobile in groundwater and the FSEIS should have taken note of that fact. Do you agree with these statements?

A.3.2 (K. Johnson) No, I do not agree with Dr. Abitz's characterization of the Staff's analysis and his characterization of uranium as an excursion indicator. As discussed in greater detail in A.3.2.10 of our Direct Testimony (Ex. NRC001), the geochemical reactions discussed by Dr. Abitz are the very reason for which uranium is not monitored as an indicator parameter for excursions, while the Staff's use of other elements with no potential for interfering chemical reactions in the aquifer is consistent with past practice and recommendations. I agree with Dr. Abitz that the presence of carbonate ions in the lixiviant enhances the mobility of uranium, however, the degree of mobility and the extent of adsorption depends upon the carbonate and uranium concentrations and pH of the groundwater. *See* Curtis, et al. at 8 (Ex. JTI022 at 8). As the levels of these variables change, particularly as the concentrations of carbonate

decrease as an excursion moves away from the production area, the extent of uranium complexed with carbonate would decrease and therefore the adsorption of uranium on iron hydroxides and clay minerals would increase. In addition, as uranium is transported outside of the production area which has not been impacted by lixiviant, the presence of organic carbon and reduced minerals will retard the mobility of uranium. As soon as adsorption or other mechanisms of uranium retardation become measureable, uranium is no longer a conservative indicator of an excursion.

Q.3.3 **In paragraph A.39 of his Direct Testimony, Dr. Abitz further claims that "the debate is not over the mobility of uranium, but whether uranium should be included as one of the excursion indicators." Would you please respond to this statement?**

A.3.3 (K. Johnson, J. Saxton) As discussed in more detail in A.3.2.10 of our Direct Testimony (Ex. NRC001), the point is not whether uranium may increase in the groundwater from an excursion, but rather which parameter should be monitored as a leading indicator to identify the excursion most quickly. Based on existing guidance, the recommendations are not to include uranium as an early-time excursion parameter. For example, NUREG-1569, page 5-41 (Ex. SEI007) states that uranium is a poor excursion indicator. NUREG/CR-3709 (Ex. NRC050) also states the following:

> Many potential indicators (such as uranium and pH) are not conservative, and their values will change rapidly as the lixiviant interacts with the sediment. In general, dissolved species that interact with the sediment do not travel as rapidly as water and thus would not be useful as an early indicator of an excursion.

NUREG/CR-3709 at 5 (Ex. NRC050). Additionally, NUREG/CR-3967, page 42 (p. 60 of Ex. NRC020) states:

> With [Maximum Baseline Level (MBL)] concentrations of only a few parts per billion (ppb), a rise of a few ppb in trace element concentrations is probably meaningless. Therefore, it is recommended that the UCLs for trace elements be set at 1000 ppb (1 mg/L) above MBL or an order of magnitude above MBL, whichever is less. For example, if the MBL concentration for uranium is 1000 ppb (1 mg/L) the [upper control limit (UCL)] would be 2000 ppb (2 mg/L) and if its MBL concentration is 20 ppb (0.020 mg/L) its UCL would be 200 ppb (0.200 mg/L). Such increases in uranium concentration should be sufficient indicators of an excursion.

Based on staff's experience, the MBL for most ISR ore bodies is greater than 0.1 mg/L. Using the recommendations in NUREG/CR-3967, the UCL for uranium would be set at 1 mg/L. However, also based on staff's experience, when an excursion is first detected by exceedances of UCLs for chloride, conductivity, and alkalinity, uranium concentrations are less than 0.3 mg/L, well below the recommended UCL.

Uranium enters the discussion of appropriate excursion indicators due to the high level of uranium contained in the lixiviant.[1] The high levels themselves require consideration of uranium as an excursion indicator, but, as explained above, it is not conservative and as such, uranium would be a poor early time indicator of an excursion.

Dr. Abitz cites three examples where uranium was detected in the fluids at a monitoring well under excursion status, thus supporting his contention that uranium should be an excursion parameter. *See* Abitz Direct Testimony at A.39. The Staff responds to these examples in more detail in A.3.2.11 and A.3.2.12 of our Direct Testimony (Ex. NRC001). In the first example from Staub et al., 1986, page A-57 (Ex. NRC020), Dr. Abitz correctly states that the reference document reports that significant increases in sodium, sulfate and

[1] Dr. Abitz states in A.39 of his initial testimony (Ex. JTI001) that the levels of uranium in the lixiviant are three to four orders of magnitude greater than the levels at the wells.

uranium were present when well M-2 went on excursion status. However, Dr. Abitz failed to report that this excursion occurred while it was a research and development facility where activities are typically conducted that are not conventional operations; the well went on excursion status because of the detection of the excursion parameters (carbonate plus bicarbonate and chloride) and not specifically uranium; and the uranium UCL was established as the highest baseline plus 0.015 mg/L (which was subsequently modified to the MBL plus 1 mg/L). Staub et al. (1986) also reports that other wells were placed on excursion status due to uranium levels that were several thousanths of mg/L above their uranium UCLs and concluded that "[n]atural variations in uranium concentrations appear to be the cause of elevated uranium concentrations in wells that have high uranium levels but normal levels of other parameters."

The second example cited by Dr. Abitz in WDEQ, 2011 (Ex. NRC039) reports uranium concentrations as high as 5.5 mg/L at the PRI facility. Dr. Abitz failed to report that the cited elevations were at a well that experienced long-term excursion status; the well was on excursion status because of the elevated levels of chloride and conductivity; the elevated uranium levels cited by Dr. Abitz were present after the well was on excursion status for a year; and the reported uranium concentrations at that well after being on excursion status for six months was 0.8 mg/L, which would not have triggered the excursion status if the UCL were set at the typical level of 1 mg/L. Staff agrees that long-term excursion status is undesirable and have included license conditions in Strata's license to require additional corrective actions upon discovery of an excursion. Furthermore, staff will not approve restoration of a welllfield until a licensee demonstrates that any affected groundwater in the area of a well that

was on excursion status during a wellfield's history is protective of human health and the environment (e.g., Technical Evaluation Report for Christensen Ranch (Ex. JTI035)).

Similar to Dr. Abitz's second example, the third example cited by Dr. Abitz in Uranium One, 2010 (Ex. NRC040) is again from a well that had been on long-term excursion status at the Christensen Ranch facility. Dr. Abitz failed to report that in this example, the Staff took significant action to address the long term excursion at this well in the Staff's Technical Evaluation Report for the licensee's request for approval of the Christensen Ranch mine units (Ex. JTI035). The Staff did not approve the restoration for Christensen Ranch due, in part, to the incomplete corrective actions for this well. Staff provided a detailed evaluation of the impacts that the licensee would have to address prior to the Staff approving any restoration. The Staff required the licensee in that case to undertake corrective actions including determining the extent of elevated levels of both radiological and non-radiological constituents and mitigating any levels above established groundwater protection standards. The Wyoming Department of Environmental Protection issued a letter to the licensee essential concurring with NRC's Staff's assessment. (Ex. NRC051)

Q.3.4 **Dr. Abitz further claims in A.39 of his Direct Testimony that the FSEIS "is silent on the extent to which mining activities will destroy the reducing geochemical conditions in the exempted aquifer." Do you agree?**

A.3.4 (K. Johnson) I do not agree. As stated in more detail in A.3.2.10 of the Staff's Direct Testimony, GEIS Section 2.4.1.2 (Ex. NRC007 at 2-17) and FSEIS Section 2.1.1.2 (Ex. SEI009A at 2-28) clearly describe how lixiviant will disturb the geochemical conditions of the ore zone (OZ). The concern about the reducing geochemical conditions of the production zone is not relevant in the

discussion of excursion indicators. An excursion, by definition is the movement of groundwater from inside to outside the production area. It is not the state of reducing conditions inside of the production area, as indicated by Dr. Abitz, but outside the production area that are relevant to the selection of indicator parameters for detecting a horizontal excursion. The reducing conditions that occur naturally outside the production area would not have been altered by the injection of lixiviant inside the production area. Therefore, in the event of a horizontal excursion, retardation of uranium would be predicted to occur as lixiviant is transported out of the production area to the monitoring wells near the edge of the exempted aquifer.

Q.3.5 In paragraph A.39 of his Direct Testimony, Dr. Abitz cites the evaluation of excursions in Staub et al., 1986 and the USGS study that modeled U(VI) transport processes. What role did this study play in the Staff's analysis?

A.3.5 (K. Johnson) The points raised by Dr. Abitz from the evaluation of excursions in Staub et al., 1986 (Ex. NRC020) are discussed in A.3.2.10, A.3.2.11 and A.3.2.12 of the Staff's Direct Testimony (Ex. NRC001). In general, Staub et al., supports NRC's practice of using conservative elements of chloride, conductivity, and carbonate as indicator parameters for detecting excursions. The historical review of excursions documents that excursions were detected and corrected without the inclusion of uranium as an indicator parameter. The USGS study (Ex. NRC042) mentioned by Dr. Abitz addresses the geochemical processes affecting restoration within the production zone; and only indirectly informs the discussion of excursions. As discussed in more detail in A.3.2.13 of the Staff's Direct Testimony (Ex. NRC001), the USGS study was used in development of Section 2, *In-Situ* Leach Uranium Recovery and Alternatives, of

the GEIS (Ex. NRC007) and was also cited in Section 5.7.2, Cumulative Impacts, Water Resources, Ground Water, of the FSEIS (Ex. SEI009A at 5-30).

Q.3.6 **Dr. Abitz also alleges in A.40 of his Direct Testimony that the FSEIS is 1) vague and contradictory in its conclusion that corrective actions would prevent the increase of radionuclides and certain elements, and 2) that the proposed corrective actions do not have a credible scientific basis. Please respond to these claims.**

A.3.6 (K. Johnson) As discussed in more detail in A.3.2.10 of the Staff's Direct Testimony (Ex. NRC001), the statement of fact that Dr. Abitz faults simply explains that, but for Strata's corrective actions required by License Condition 11.5 (Ex. SEI015), levels of radionuclides and other elements would increase in aquifers outside the production zone if excursions were to occur. There is nothing vague or contradictory about that statement. The scientific basis for the corrective actions, as discussed in more detail in A.3.2.11 of the Staff's Direct Testimony, is the basic hydrologic principles of water movement in the aquifer. The historical record of excursions demonstrates that adjustments in pumping and injection rates are successful in correcting excursions and that the geochemical characteristics (redox conditions in the aquifer, the availability of various complexing anions, microbial community structure) asserted by Drs. Abitz and Larson are not relevant.

Q.3.7 **In A.41 of his Direct Testimony, Dr. Abitz faults the Staff's analysis in that it assumes the applicant will be able to locate and properly abandon the "thousands of drillholes" within the Ross Project Area. Dr. Abitz further claims that there should have been a full accounting of all improperly abandoned drillholes. In A.73 and A.74 of his Direct Testimony, Dr. Larson similarly argues that the Staff's assumption of a confined OZ**

aquifer is based on the assumption that Strata will plug all Nubeth drillholes in the Ross Project Area, and that lack of well plugging and failure to identify all abandoned wells show that the Staff has not adequately demonstrated an ability to maintain vertical fluid migration. What is your response to these criticisms?

A.3.7 (A. Burgess) As discussed in greater detail in A.3.1.5 of the Staff's Direct Testimony (Ex. NRC001), Strata has demonstrated the feasibility of locating and plugging historical drillholes. Strata stated in its TR that prior to performing the pumping test on well 12-18OZ, 55 historical drillholes within a 522-feet radius feet of the test well were located and plugged (Exs. SEI014F, Addendum 2.6-E at 1; SEI014G, Addendum 2.7-F at 13). No response was observed in either the shallow monitoring (SM) or deep monitoring (DM) aquifers, indicating that the locating and plugging of historical drillholes was successful.

As noted in A.3.1.11 of the Staff's Direct Testimony an historical borehole has the potential to lead to a vertical excursion only if all of the following conditions are met:

- The historical borehole is located within the area circumscribed by the perimeter monitoring well ring,
- The hydraulic conductivity of the fill within the well bore is significantly higher than the hydraulic conductivity of the confining unit,
- Lixiviant is present at the borehole location in the ore zone (OZ aquifer), and

- The piezometric head in the ore zone aquifer is above the piezometric head in the overlying and/or underlying aquifer with which the borehole is connected.

Many of the historical boreholes would fail to meet all of these criteria, and thus would not be a potential vertical excursion pathway. The presence of a piezometric head difference of 130 feet across the upper confining unit indicates that historical boreholes have not had a significant impact on the unit's overall hydraulic properties and ability to act as a confining unit.

Q.3.8 **Dr. Abitz further claims in A.41 of his Direct Testimony that there is no assurance that the drillholes will be properly abandoned because the Staff is only asking for an "attempt" by Strata. Drs. Abitz, in A.41, and Larson, in A.76, also cite an example where a facility in Texas violated a license condition to locate and abandon all drillholes as evidence that license conditions don't address the issue of excursions through drillholes. Please respond to these criticisms.**

A.3.8 (J. Saxton) Dr. Abitz mischaracterizes the requirement to attempt to locate and properly abandon the drillholes. This is not a commitment or promise that the Staff is merely asking Strata to keep. Strata is required by License Condition 10.12 (Ex. SEI015) to attempt to locate and abandon all drillholes located within the well ring perimeter. Failure to comply with this requirement will put Strata in violation of its license, and the Staff does not assume that Strata will fail to comply with its obligations and requirements, including its license conditions.

Also, as explained in greater detail in A.3.1.8 and A.3.1.9 of the Staff's Direct Testimony (Ex. NRC001), due to the difficulty of identifying the drillholes and the additional mitigation measures proposed by Strata, the Staff accepted

Strata's commitment and included it as a license condition as part of a risk-informed, performance-based licensing strategy rather than prescriptively requiring Strata to locate and abandon all drillholes. Satisfaction of License Condition 10.12 requires that Strata will make a good faith effort to abandon all drillholes. Strata will need to report this effort in the wellfield data package since the Staff will not concur on the wellfield package if the documentation shows insufficient efforts were made to properly abandon the drillholes. If Strata began operations in the wellfield prior to receiving Staff's concurrence, Strata would be in violation of its license conditions. Dr. Abitz, at A.41 in his Direct Testimony, asserts that "[I]t is highly unlikely that SEI's commitment [to locate and abandon historical boreholes] will be little more than a promise left unfulfilled." However, facts tell a different story. As stated by Mr. Knode in his Direct Testimony: "Since the permit application was submitted, Strata has made significant progress in locating historical Nubeth exploration drillholes . . .. [W]ithin the Ross project area estimated mine unit boundaries, 92% of the historical exploration drillholes have been located." (Ex. SEI001 at A.25).

Drs. Abitz's and Larson's use of the Texas example is inappropriate. In that situation the licensee violated a license condition. As stated above, the Staff does not assume that Strata will fail to comply with its obligations and requirements, including its license conditions.

Q.3.9 **In A.77 through A.85, Dr. Larson uses "Storymaps" to illustrate occurrences at the Willow Creek/Christensen Ranch ISL facility and Smith Highland Ranch ISL facility. What impact does the information within the "Storymaps" have on the Staff's analysis in the FSEIS?**

A.3.9 (A. Burgess, K. Johnson, J. Saxton) Through the use Storymaps, Dr. Larson provides a graphical means of presenting data. They are illustrative of

unrelated sites in different geographical units and hydrological settings from the Ross projects. Consequently, Dr. Larson's presentations do not impact the Staff's analysis for the FSEIS because license conditions and evaluations for the Ross project are or will be more stringent (*See* Staff Direct Testimony at A.3.1.8), and the facts of each project are so unique that they must be evaluated on a case-by-case basis. Furthermore, the licenses for the sites presented in the Storymaps were issued in the 1980s and do not reflect the additional experience gained, and more stringent conditions imposed on licensees since that time. In addition, as discussed by NRC staff above in A.2.6, the Storymaps do not affect the bounding analysis provided by the Staff in Section 4.5.1.3 of the FSEIS or the Staff's conclusion regarding the impacts of the Ross Project on groundwater quality.

Q.3.10 **In A.42 of his Direct Testimony, Dr. Abitz claims that because control, prevention, and remediation were unsuccessful at other ISL sites, Strata will have limited options to correct vertical excursions in the SM aquifer. Do you agree with that claim?**

A.3.10 (A. Burgess, K. Johnson) We do not agree. As explained in greater detail in A.3.2.6 of the Staff's Direct Testimony (Ex. NRC001), requirements on licensees have become more stringent since the time that Dr. Abitz references. Although vertical excursions are more difficult to address, the current standard of practice required in licenses for monitoring, detection, and restoration activities have been successful in ameliorating vertical excursions. In particular the current practice set forth in License Condition 11.5 (Ex. SEI015) will minimize the impacts from vertical excursions. NRC requires that upon detection of a vertical excursion, Strata must cease injection of lixiviant into the production area surrounding the monitoring well until it demonstrates to the

satisfaction of NRC that the vertical excursion is not attributed to leakage through any abandoned drillhole.

Q.3.11 In A.43 of his Direct Testimony, Dr. Abitz claims that the number of wells and duration of pump tests were inadequate to supply sufficient hydrological information to demonstrate satisfactory groundwater control. Dr. Abitz additionally claims that the FSEIS does not address any of the significant data gaps in the conceptual and numerical hydrologic models put forward to support Strata's license application. Please respond to these claims.

A.3.11 (A. Burgess, J. Saxton) As discussed in more detail in A.3.2.4 of the Staff's Direct Testimony (Ex. NRC001), the type of pumping tests used met the acceptance criteria in the Standard Review Plan, NUREG-1569 (Ex. SEI007), and we consider the level of data provided from those tests sufficient for the FSEIS.

We also disagree that there are significant data gaps in the conceptual and numerical hydrologic models that would affect the adequacy and conclusions of the FSEIS. As discussed in more detail in A.3.2.5 in the Staff's Direct Testimony, the Staff used the guidance provided by NUREG-1569 in its evaluation of Strata's license application and in its development of the FSEIS, and the Staff concluded that the available data met the relevant acceptance criteria.

Q.3.12 In A.44 of his Direct Testimony, Dr. Abitz claims that communication between the SM and OZ horizons is evident in the 24-hour pump test data from well 12-18OZ. Do you agree?

A.3.12 (A. Burgess) I do not agree. As discussed in more detail in A.3.2.7 and A.3.2.8 of the Staff's Direct Testimony (Ex. NRC001), this was a 72-hour test,

not a 24-hour test; and the data shows that the fluctuations in water levels in Well No. 12-18SM are not related to the pumping of Well No. 12-18OZ. Dr. Abitz's conclusion of a communication between the OZ and SM aquifers based upon water chemistry is discussed below in A. 3.12.

Q.3.13 Dr. Abitz claims in A.45 of his Direct Testimony that the proximity of wells 12-18SM and 12-18OZ illustrate that "the closer a pair of sample plots for a given cluster well, the higher the probability for groundwater contamination by communication between the two groundwater zones during ISL operations." Please respond to this claim.

A.3.13 (K. Johnson, J. Saxton) The flaws in Dr. Abitz's assessment of the water quality in paired SM and OZ wells was discussed in A.3.2.8 of the Staff's Direct Testimony. Two key points invalidating Dr. Abitz's conclusions of mixing between the two aquifers are: 1) the difference between the water quality in 14-18 SM and 14-18 OZ is not due to a lower density of exploration boreholes as Dr. Abitz postulates;[2] and 2) Dr. Abitz erroneously describes well 22x-19 as screened through the OZ and SM whereas well 22x-19 is really screened through the OZ and the DM aquifers.

In addition, Dr. Abitz does not provide any data to establish that the ratio of sulfate and sodium naturally occurring in the OZ and SM aquifers are distinct. Dr. Abitz presents the case that the linear relation between sodium and sulfate concentrations are indications of mixing between the SM and OZ zones via boreholes. The Staff's interpretation is that the relation depicted by

[2] In A.3.2.8 of the Staff's initial testimony (Ex. NRC001), the Staff discusses Dr. Abitz's argument that the distinctly different water chemistry from wells 14-18OZ and 14-18SM indicates mixing between 12-18OZ and 12-18SM. The Staff explained that a comparison of the density of historical drillholes around wells 14-18 and 12-187 clearly shows that the density of exploration drillholes is not lower around cluster 14-18. Thus, it is more likely that the spread of the OZ data represents natural heterogeneity in the water chemistry.

Dr. Abitz is naturally derived, and in all likelihood the range in naturally occurring concentrations of water quality parameters in the OZ and SM aquifers overlap one another, making the evaluation put forth by Dr. Abitz meaningless. As discussed in A.3.1.4 and A.3.1.11 of the Staff's Direct Testimony, the boreholes are not necessarily open, but would very likely have residual mud that would, under static conditions, minimize fluid flow through the borehole. This interpretation is supported by the potentiometric surface contouring[3] of the various horizons as shown in the TR. *See* Technical Report, Figures 2.7-21 (DM), 2.7-22 (OZ) and 2.7-24 (SM) (Ex. SEI014A). Based on review of the surfaces, the minimum elevation of the potentiometric surface for the SM zone is 4066 ft-MSL whereas that for the OZ zone is 3954 ft-MSL. The approximate 100-foot difference in potentiometric surface is not consistent with the mixing model proffered by Dr. Abitz. Furthermore, the depression in the potentiometric surface of the SM zone which could indicate a sink (either by direct pumping of an industrial well or some leakage (including boreholes) through the confining layer to the underlying OZ), the depression is located significantly south of the 12-18 nested wells and does not support the mixing of the 12-18SM with 12-18OZ as alleged by Dr. Abitz. The location of the depression in the potentiometric surface would suggest the communication through boreholes, if any, is predominant in the area of well cluster 21-19. However, the quality from the wells in that cluster does not support mixing in Dr. Abitz's presentation.

[3] Potentiometric surface contours are lines that connect points of equal water elevations that were measured in wells, i.e., the water levels (elevations expressed as feet above mean sea level) are equal along each line.

Q.3.14 Finally, in A45 of his Direct Testimony, Dr. Abitz alleges that the FSEIS is silent on the operation of the high-yield industrial wells. Is Dr. Abitz correct?

A.3.14 (K. Johnson, J. Saxton) No, Dr. Abitz is incorrect. As discussed in more detail in A.3.2.9 of the Staff's Direct Testimony (Ex. NRC001), the construction and potential for operation of the industrial water-supply wells, including Well No. 22x-19, were considered in the Staff's analysis in FSEIS Section 4.5.1.2, pages 4-38 through 4-40 (Ex. SEI009A), and the Staff included License Condition 10.19 (Ex. SEI015), which focuses on high-yield industrial wells and places restrictions on wellfield operations in areas influenced by continued pumping from the industrial water-supply wells.

September 12, 2014

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
	)	
(Ross *In Situ* Uranium Recovery Site)	)	ASLBP No. 12-915-01-MLA
	)	

AFFIDAVIT OF ANTHONY BURGESS

I, Anthony S. Burgess, do hereby declare under penalty of perjury that my statements in prefiled Exhibits NRC044 (Rebuttal Testimony of Johari Moore, John Saxton, Kathryn Johnson, and Anthony Burgess) and NRC048 (Statement of Professional Qualifications of Anthony Burgess) are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR 2.304(d)

_____

Anthony S. Burgess, Ph.D.
Attenuation Environmental Company
27606 NE Union Hill Road
Redmond, WA 98053
(425) 880-4550
tonyabcenv@gmail.com

Executed in Redmond, WA
this 12th day of September, 2014

September 12, 2014

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	)	

AFFIDAVIT OF KATHRYN JOHNSON

I, Kathryn O. Johnson, do hereby declare under penalty of perjury that my statements in prefiled Exhibits NRC044 (Rebuttal Testimony of Johari Moore, John Saxton, Kathryn Johnson, and Anthony Burgess) and NRC047 (Statement of Professional Qualifications of Kathryn Johnson) are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR 2.304(d)

_____

Kathryn O. Johnson, Ph.D.
Attenuation Environmental Company
24054 Palmer Gulch Road
Hill City, South Dakota, 57745
605.391.9955
kjohnson@johnsonenviro.com

Executed in Hill City, South Dakota
this 12th day of September, 2014

September 12, 2014

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	)	

AFFIDAVIT OF JOHARI MOORE

I, Johari Moore, do hereby declare under penalty of perjury that my statements in prefiled Exhibits NRC044 (Rebuttal Testimony of Johari Moore, John Saxton, Kathryn Johnson, and Anthony Burgess) and NRC045 (Statement of Professional Qualifications of Johari Moore) are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR 2.304(d)

_____

Johari Moore
U.S. Nuclear Regulatory Commission
Mail Stop T-8F5
Washington, DC 20555-0001
(301) 415-7694
Johari.Moore@nrc.gov

Executed in Rockville, MD
this 12th day of September, 2014

September 12, 2014

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NUCLEAR REGULATORY COMMISSION

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	)	

AFFIDAVIT OF JOHN SAXTON

I, John Saxton, do hereby declare under penalty of perjury that my statements in prefiled Exhibits NRC044 (Rebuttal Testimony of Johari Moore, John Saxton, Kathryn Johnson, and Anthony Burgess) and NRC046 (Statement of Professional Qualifications of John Saxton) are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR 2.304(d)

_____

John Saxton
U.S. Nuclear Regulatory Commission
Mail Stop T-8F5
Washington, DC 20555-0001
(301) 415-0697
John.Saxton@nrc.gov

Executed in Rockville, MD
this 12th day of September, 2014