Natural Resources Defense Council, Inc.
Powder River Basin Resource Council
New Mexico Environmental Law Center
Energy & Conservation Law

NRDC *et al.*, Comments on NRC's Request for Comment on Potential Resumption of Rulemaking for Ground Water Protection at Uranium In Situ Recovery Facilities

Docket ID NRC–2008–0421.

May 3, 2019

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NRDC

May 3, 2019

Via Electronic Mail

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RE: NRDC, *et al.*, Comments on Request for Comment on Potential Resumption of Rulemaking for Ground Water Protection at Uranium In Situ Recovery Facilities, Docket ID NRC–2008–0421.

Dear Sir/Madam:

The Natural Resources Defense Council ("NRDC"), the Powder River Basin Resource Council ("PRBRC"), the New Mexico Environmental Law Center ("PRBRC"), and the Energy & Conservation Law ("E&CL") write collectively today to timely respond to the Nuclear Regulatory Commission's ("NRC") *Request for Comment on Potential Resumption of Rulemaking for Ground Water Protection at Uranium In Situ Recovery Facilities*, 84 Fed. Reg. 574-578 (Jan. 31, 2019) (hereinafter "NRC Request for Comment") (comment period extended to this day via 84 Fed. Reg. 6,979 (Mar. 1, 2019)).

The NRC has requested views from interested parties on whether the NRC should resume rulemaking to amend its regulations governing the domestic licensing of source material by codifying general requirements to address ground water protection at uranium in situ leach ("ISL") facilities. We provide detail in the following pages, but we commence with a succinct answer for the NRC – no.

The NRC should not resume rulemaking to amend its regulations governing the domestic licensing of source material, which would only further codify the already woeful state of affairs set out in *ad hoc* policies and draft guidance documents the NRC has relied upon. Rather, despite the inadequate protections for ISL recovery found in 10

C.F.R. §40, Appendix A, the NRC should wait until the Environmental Protection Agency ("EPA") has re-proposed and finalized a rule that updates its environmental protection standards for ISL recovery found at 40 C.F.R. §192. For the sake of all parties' precious time and resources, the NRC should not resume a process it will simply have to redo once a revitalized and environmentally-minded EPA acts. Unfortunately, until an EPA rulemaking is finalized and the NRC has promulgated new rules based on improved and far more protective EPA standards, continuing with the status quo is a better option than further entrenching it by codifying the current inadequacies.

I. Statement of Interest

NRDC is a national non-profit environmental organization with over one million combined members and activists. NRDC's activities include maintaining and enhancing environmental quality and monitoring federal agency actions to ensure that federal statutes enacted to protect human health and the environment are fully and properly implemented. Since 1970, NRDC has sought to improve the environmental, health, and safety conditions at the civil nuclear facilities licensed by the NRC under standards set by the EPA.

PRBRC is a grassroots Wyoming organization that promotes responsible extraction of our state's abundant mineral resources. Most of our approximately 1,000 members are rural landowners in Wyoming and many of them are impacted by uranium exploration and production. We have worked to address the negative impacts of uranium production on Wyoming's water and land resources since our founding in 1973. We regularly participate in licensing and permitting activities for ISL projects in Wyoming.

NMELC has been working with low-income communities of color in New Mexico to realize their human rights to a clean environment for 32 years. NMELC frequently works with native communities in northwestern New Mexico seeking to protect their drinking water supplies from proposed ISL uranium recovery. NMELC and its clients are particularly concerned with the health, environmental, and cultural impacts that uranium development has on native communities.

E&CL provides legal services to communities, Tribes, and organizations impacted by the fraught legacy of lax regulation and radioactive contamination produced by the uranium fuel chain, particularly uranium mining and yellowcake production. Based in a Durango, Colorado neighborhood with streets that are literally built on uranium mill tailings, E&CL provides specialized legal services to address human health and environmental impacts, and to help reform Cold War era practices and policies that many current NRC regulations are built upon.

II. Summary of Comments

Following the heels of the withdrawal by the Trump Administration EPA of that agency's twice proposed new uranium ISL standards, the NRC has requested comment on whether it should proceed with a rulemaking to amend its regulations governing the domestic licensing of source material by codifying general requirements to address ground water protection ISL uranium recovery sites. As stated above, our answer to the question in brief is a firm "No." But the NRC also posed three additional questions[1] and our responses to each will guide our comments.

We provide extensive technical and legal support for our comments in the following pages, but we stress in this summary that the NRC should refrain from making a bad situation worse. Instead, the NRC should continue to defer its ISL rulemaking effort until such time that the EPA finalizes updated standards for 40 C.F.R. §192. The reason for this is straightforward. The current process is an ad hoc, regulatory mess utilizing a complicated and ineffective set of standards for protection of public health and the environment. This mess starts with the EPA's regulations, which set the standards that the NRC must follow. Without action by the EPA that provides a coherent, straightforward set of protections for ISL recovery (something that would have been done had either the first or second draft of EPA's ISL rule been finalized), codifying via rule the current inadequacies risks further entrenching a host of bad practices that have allowed for significant and likely permanent contamination of important and increasingly scarce sources of western groundwater. It is the EPA's duty to first update its regulations so that the NRC has rational standards to work from.

Prior to EPA's misguided withdrawal of its proposed rule, the EPA was well within its statutory authority to move forward with its proposal to strengthen and clarify 40 C.F.R. §192, Subpart F standards. Those standards, when promulgated in final form, would have finally started the uranium industry and its direct regulators – the NRC and Agreement States – on a path to a full accounting of the environmental harms and costs of ISL, which has been the principle source of yellowcake production in the United States for the past several decades. Conventional uranium mills have nearly vanished or become the waste disposal sites for ISL projects.

At this juncture we have no evidence or belief that in a new rulemaking the NRC will act to rectify our long-held substantive concerns with the current woeful regulatory

[1] NRC first requested that interested parties identify any issues that should be addressed to protect groundwater at ISL facilities, in either this rulemaking or through the development of guidance documents. Next, the NRC requested that parties identify any issues that should be addressed to enhance public or occupational safety at ISL facilities, in either this rulemaking or through the development of guidance documents. And last, the NRC requested that parties identify any issues that should be addressed to establish a relatively uniform set of requirements for ISL facilities nationwide (both in Agreement States and in non-Agreement States).

regime for uranium ISL – the failure to set an accurate baseline; the failure to restore groundwater quality after mining; the failure to account for fluid migration; and the failure to require meaningful post-closure monitoring. Indeed, to the contrary, the NRC makes clear in its request for comment that, if it resumes this rulemaking, it will simply codify and further entrench the existing set of bad practices, with no meaningful hindrance from a now toothless Trump EPA. NRC Request for Comment, 84 Fed. Reg. at 577. Such a decision will put the agency on a legal collision course with the undersigned and likely several others.

This should be avoided and we urge the NRC to subscribe to the proper course it began in 2010, when it deferred to the (then President Obama era) EPA's well-grounded interpretation that the Uranium Mill Tailing Radiation Control Act is the controlling legal authority for protection of groundwater for ISL sites and, further, obligates the NRC or any Agreement State to implement any invigorated and updated set of 40 C.F.R. §192 standards. The NRC should recognize that the current state of affairs is not protective of human health or the environment and offer support for the EPA's ample authority under the Atomic Energy Act to issue strong updated protections under 40 C.F.R. §192.

Further, the NRC's current interpretation of the statutory regime and regulatory obligations directly allows for significant contamination of scarce sources of western groundwater. The NRC should therefore recognize (as the Obama era EPA clearly did), that the NRC's and Agreement States' reliance on the requirements of the Underground Injection Control ("UIC") program, authorized under separate legal authority, fail to address groundwater protection at ISL facilities. As the EPA noted in its rulemaking effort, if the groundwater is not considered an Underground Source of Drinking Water under the UIC program, as is typically the case at ISL sites, it is not protected under the Safe Drinking Water Act, and the ISL mining area is, for all intents and purposes, used as a disposal site and left, in every instance, severely contaminated. Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings, 82 Fed. Reg. 7,400-7,430, at 7,403 (Jan. 19, 2017).

We therefore reiterate that the NRC should not resume this rulemaking but instead should encourage the EPA to restart its rulemaking process and finalize its strengthened and overdue ISL standards. Below, we lay out the details of our position, commencing with a background explanation of the history and issues attendant to groundwater from ISL recovery facilities as we understand them. We then lay out EPA's legal authority and duty to publish updated, more stringent regulations. Finally, we respond to the NRC's questions in turn.

III. Background

A. Current Regulatory System

The current proposal by the NRC is the most recent in a multi-year and multi-agency process attempting to address groundwater impacts of ISL uranium recovery through rulemaking. The existing statutory and regulatory regime began when Congress passed the Uranium Mill Tailings Radiation Control Act of 1978 ("UMTRCA") (Pub. L. 95-604). UMTRCA added two sections to the Atomic Energy Act ("AEA"). The first addition, AEA Section 275 as added by UMTRCA Section 206, gave the EPA the authority to promulgate uranium milling (and eventually ISL mining) standards that match standards the EPA promulgates under the Safe Drinking Water Act and Resource Conservation and Recovery Act ("RCRA"). 42 U.S.C. § 2022. The second addition, AEA Section 84 as added by UMTRCA Section 205, requires the NRC to ensure management of "byproduct material," including those from uranium mills, conforms to the standards that the EPA sets. 42 U.S.C. § 2114.

This existing regulatory scheme, designed by Congress to address the then-overlooked and serious environmental harms of uranium milling, was assembled in this overlapping way from an archaic set of jurisdictional concerns. The NRC's permitting and enforcement jurisdiction over uranium milling (and eventually ISL mining) – and not over conventional uranium mining – is founded on the perceived national need for the federal government to have full authority over nuclear materials in order to ensure the smooth operation of our weapons and commercial nuclear industries. UMTRCA then superimposed the EPA's standard-setting expertise and authority on the NRC process, with at best grudging acceptance by the NRC staff.

Thus, under UMTRCA's authority, the EPA promulgated regulations at 40 C.F.R. §192 in order to provide explicit environmental standards for uranium milling. Soon after the NRC promulgated regulations at 10 C.F.R. §40, Appendix A for licensing uranium mills to those standards. ISL, treated as a form of milling under the regulations, was not in widespread use at the time of this oversight, so neither agency addressed ISL facilities. Today, we are still struggling with this deficiency because neither the EPA nor the NRC have yet to to correct the regulatory gap. Instead, the NRC has used its 10 C.F.R. §40 rules (meant for mill tailings), agency guidance, and specific license conditions to regulate ISL mining in an ad hoc fashion. The NRC only issued a guidance document to present what the industry applicant must do to obtain an ISL license.[2] The guidance details how the agency will interpret its requirements for groundwater restoration under 10 C.F.R. §40 (the NRC regulations for nuclear "materials" licenses) for ISL sites.

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[2] NRC, *Standard Review Plan for In Situ Leach Uranium Extraction License Applications: Final Report*, NUREG-1569 (June 2003), *available at* http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1569/sr1569.pdf.

We have long been aware of industry complaints that under this current system, it must obtain multiple permits from different regulatory authorities – the NRC, the EPA, state environment departments, and state engineers – but on a practical level, the paper burden is not nearly as heavy as industry suggests. Comparing document submittals documents for different permits from the Dewey Burdock ISL application in South Dakota as one example, it is apparent that industry submitted many of the same documents to the state or the EPA for the operation's UIC application as it did for its NRC materials license. The current regulatory system, which manages to be complicated and dysfunctional at the same time, presents a picture that appears restrictive but fundamentally is not.

More importantly, however, the current system fails to address health and safety and environmental impacts it was intended to protect against.[3] This is why updated standards must be set by the EPA pursuant to its UMTRCA authority and expertise. Only once the EPA has finished its UMTRCA duties will the NRC be equipped with science-based standards and findings needed to inform, update, and implement stand-alone ISL regulations based on the NRC's UMTRCA authority.

B. Rulemaking Attempts

ISL was not in widespread use when the UMTRCA-based regulations were passed but has since became a lower-priced production method that now dominates the industry. In 2006, the NRC finally determined that it would be appropriate to initiate "a rulemaking effort specifically tailored to groundwater protection programs at *in situ* leach [] uranium recovery facilities."[4] The NRC was prompted to act "because the mining of uranium may increase substantially in the near term," and the Commission wanted a clear and transparent process codified.[5] The Commission therefore directed that "[t]he staff should focus on eliminating dual regulation by the NRC and EPA of groundwater protection. The NRC should retain its jurisdiction over the wellfield and groundwater under its [AEA] authority, but should defer active regulation of

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[3] For a full treatment of the lengthy record of environmental harms of the uranium industry, see *Nuclear Fuel's Dirty Beginnings: Environmental Damage and Public Health Risks From Uranium Mining in the American West*, March 2012, G. Fettus and Dr. M. McKinzie, http://www.nrdc.org/nuclear/files/uranium-mining-report.pdf.

[4] *Staff Requirements* – COMJSM-06-0001 – *Regulation of Groundwater Protection at In Situ Leach Uranium Extraction Facilities*, Memorandum From: Secretary Annette Vietti-Cook, To: Luis Reyes, Executive Director for Operations, and Jesse Funches, Chief Financial Officer (Mar. 23, 2006) (ML060820503).

[5] *Path Forward for Rulemaking on Groundwater Protection at In Situ Leach Uranium Extraction Facilities*, Commissioner Jaczko's Comments on COMJSM-06-0001 Regulation of Groundwater At In-Situ Leach Uranium Extraction Facilities (Feb. 20, 2006) (COMSECY-07-0015).

groundwater protection programs to the EPA or the EPA-authorized state through the EPA's underground injection-control permit program."[6]

The NRC effort was doomed from the start, however, because it ignored the authority UMTRCA granted the EPA, and because the NRC attempted to usurp the EPA's ongoing role as the federal agency charged with protecting public health, safety, and the environment from hazards associated with the possession, transfer, and disposal of byproduct materials as defined in section 11(e)(2). 42 U.S.C. § 2022(b) ("The Administrator may periodically revise any standard promulgated pursuant to this subsection.").

For the next four years, NRC Staff worked to develop these regulations and seemingly consulted with the EPA on the correct standards to apply. In 2010, the EPA decided it must first update its own UMTRCA regulations. As UMTRCA requires the NRC to updates its regulations to meet the standards the EPA sets, the NRC deferred its rulemaking process to await the finalization of the EPA's. We remain persuaded this is the right sequence.

The EPA took five years to develop and propose its first set of revisions for 40 C.F.R. §192, at 80 Fed. Reg. 4,156-187 (Jan. 26, 2015) (EPA–HQ– OAR–2012–0788) ("first draft rule"), and then in 2017, the EPA proposed an updated set of revisions at 82 Fed. Reg. 7,400-430 (Jan. 19, 2017) ("second draft rule") (together "proposed rules"). In commenting on the proposed rules, NRDC and others expressed support for the EPA finally taking action.[7] Both the EPA proposed rules appropriately required groundwater protections, transparency with respect to restoration, and monitoring obligations that are well-grounded in law and science and, most pertinent, are a substantial improvement over current protections offered under the regulatory status quo.

Along with NRDC's initial statement of support, however, we expressed concern that the second draft rule was weaker than the first draft rule in certain respects. We provided detail in our specific comments and we urged the EPA to discard many of the changes suggested in the second draft rule. Further, and no less important – and this is

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[6] *Staff Requirements – COMJSM-06-0001 – Regulation of Groundwater Protection at In Situ Leach Uranium Extraction Facilities*, Memorandum From: Secretary Annette Vietti-Cook, To: Luis Reyes, Executive Director for Operations, and Jesse Funches, Chief Financial Officer (Mar. 23, 2006) (ML060820503).

[7] We incorporate by reference both of NRDC's comments here. Environmental Community Comments by NRDC et al., on EPA's 40 CFR 192, Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings, Proposed Rule, 82 Fed. Reg. 7400 (Jan. 19, 2017), Docket ID No. EPA-HQ- OAR-2012-0788; NRDC's May 2015 Comments on 40 CFR 192, Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings, Proposed Rule, 80 Fed. Reg. 4156 (Jan. 26, 2015), Docket ID No. EPA-HQ-OAR-2012-0788 ("NRDC Comments on first draft rule"). Available at: https://www.regulations.gov/document?D=EPA-HQ-OAR-2012-0788-0390.

as true for the context of the NRC's requested comments today as it was in 2017 – there is no technical or legal basis for a less stringent set of revisions than what the EPA proposed in the proposed rules. Any attempt by the NRC or the EPA under the Trump Administration to further weaken the standards runs afoul of clear statutory requirements and is precisely contrary to reams of science on uranium recovery's impact on scarce groundwater and communities across the American West.

But on October 30, 2018, the Trump Administration withdrew the second draft rule. *See* Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings, 83 Fed. Reg. 54,543 (Oct. 30, 2018). In that withdrawal, the Trump EPA arbitrarily and capriciously reversed course on a host of legal and technical issues and opened the door for the NRC's current misguided proposal to resume its efforts to codify the existing dysfunctional system.

IV. The EPA Should Reissue Its Withdrawn Rule

The Trump EPA gave three reasons for withdrawing the second draft rule, each of which lacks legal and evidentiary basis.

- First, altering years of well-grounded understanding, the EPA now joined the NRC and industry in questioning whether it had the authority under UMTRCA to issue the regulations. As we will detail below, the answer is that the EPA does have that authority and this reversal of course was unfounded and an early holiday gift to a polluting industry.
- Second, in another astonishing turn that ignored both years of its own technical work and the vast majority of the record before it, the EPA suggested that it no longer believed that a national rulemaking to promulgate standards is necessary as the Agency believes the existing regulatory structures are sufficient to ensure the targeted protection of public health and the environment at existing ISL facilities. Nothing of the kind is the case and the EPA's assertion flatly contradicted that of its staff.
- Third and finally, the EPA reasoned that the failure of the nuclear renaissance that never was suggests a much lower growth scenario for the uranium market and therefore fewer license applications for new ISL facilities. While we don't wholly disagree with the EPA on the matter of a lower growth scenario for the uranium market, we find it baffling that the EPA would not simply proceed and offer significant and overdue protections for what has been and still will be a persistent polluting concern across the arid West.

We address each claim in turn and we do so in this request for comment for the plain reason that the EPA does have authority to finalize the draft rule, that it is important for the EPA to act, and that it is equally as important for the NRC not to codify and further entrench an already inadequate set of protections, an action which in fact would violate the law.

A. The EPA's Legal Authority

The EPA has ample legal authority under UMTRCA to issue the regulations as provided in the proposed rules. In withdrawing its second draft rule, the EPA for the first time bent to commenters' arguments (primarily the NRC's) regarding the scope of its legal authority. Having previously dismissed these arguments, the EPA provided no reasoning for its new position. A thorough review of the arguments the EPA and the NRC rely on shows their lack of foundation. In publishing its second draft rule, the EPA wrote:

> *Some commenters thought the proposed rules were legally invalid and felt the EPA was overreaching its authority under UMTRCA by proposing standards that are too detailed and prescriptive. The commenters argued the EPA was redefining what UMTRCA established as the EPA's role to set general standards while making the NRC responsible for implementing those standards through its licensing process. These commenters believe that UMTRCA limits the EPA's authority to setting general standards that do not include any prescriptive implementation requirements. The Agency disagrees with those commenters who believe the EPA has redefined its role or overreached its authority in developing the new standards for ISL facilities. Section 206 of the UMTRCA clearly authorizes the EPA to promulgate standards of general application for the protection of public health, safety and the environment from radiological and non-radiological hazards associated with the processing and the possession, transfer and disposal of byproduct material at uranium ISL facilities. See 42 U.S.C. 2022(b).*

Second draft rule, 82 Fed. Reg. at 7,418.

As the EPA expressed in both the proposed rules, the agency has ample health and safety justification for the rulemaking. In promulgating the standards of general application, Section 206 of UMTRCA requires that "the Administrator shall consider the risk to the public health, safety, and the environment, the environmental and economic costs of applying such standards, and such other factors as the Administrator determines to be appropriate." 42 U.S.C. §2022(a). The proposed rules explicitly considered risks to the public health, safety, and the environment, first draft rule, 80 Fed. Reg. at 4,164–65, and environmental and economic impacts, *id.* at 4,180–81; and second draft rule, 82 Fed. Reg. at 7,403–04, *passim*. Additionally, UMTRCA requires that standards issued for non-radiological hazards "shall, to the maximum extent practicable, be consistent with the requirements of [RCRA]." 42 U.S.C. §2022. The proposed rules ensured this consistency by adapting the RCRA corrective action framework to ISL sites and their attendant environmental concerns. Second draft rule 82 Fed. Reg. at 7,400.

Prior rules have also successfully relied on the same statutory authority to issue health and environmental standards for uranium ore byproduct. *See, e.g.,* Health and Environmental Standards for Uranium and Thorium Mill Tailings, 58 Fed. Reg. 60,340 (Nov. 15, 1993) (codified at 40 C.F.R. §192); Environmental Standards for Uranium and Thorium Mill Tailings at Licensed Commercial Processing Sites, 48 Fed. Reg. 45,926 (Oct. 7, 1983) (codified at 40 C.F.R. §192). The proposed rules were a fundamentally similar lawful agency action, and the EPA was well within its rights to issue such standards to protect natural resources such as scarce western groundwater and the communities that will depend on that water long after uranium recovery operations are gone.

In its withdrawal, however, the EPA erroneously parroted the NRC's assertion that the proposed rules "encroached upon NRC's authority and [would] impair the NRC's ability to effectively regulate its ISL licensees." 83 Fed. Reg. at 54,544 (citations omitted). Simply stated, the EPA's rule would do no such thing. The UMTRCA resolved the NRC/EPA conflict by unambiguously assigning to the EPA standard-setting authority and to the NRC implementation and enforcement authority. *See* 42 U.S.C. §2022. This division of jurisdiction does not shield preoperational, stability phase, or other monitoring from the EPA regulation. Instead, as discussed, the EPA correctly determined in rulemaking documents that were subject to public comment that this monitoring would help protect "the public health, safety, and the environment." See 42 U.S.C. §2022(b).

Indeed, the unwisely withdrawn second draft rule did not unlawfully direct the NRC's implementation of the EPA's health and environmental standards any more than the existing regulatory requirements under 40 C.F.R. §192. For example, 40 C.F.R. §192.32(a)(4)(i) requires licensees to "conduct appropriate monitoring and analysis" of radon-222 releases using methods at least as effective as "the procedures described in 40 CFR §61, Appendix B, Method 115." The proposed rules similarly introduced explicit monitoring rules without imposing an impermissible compliance methodology on the NRC. The EPA properly exercised its health and environmental standard-setting authority to require such monitoring, and the NRC's role would only ever be to implement and enforce compliance with this requirement.

The EPA's withdrawal and the NRC's interpretation ignores UMTRCA's legislative decision to make the NRC's implementation role subservient to the EPA's standard setting authority. 42 U.S.C. §2022. Section 206 of UMTRCA explicitly requires: "Within three years after . . . revision of any [subsection (b) EPA] standard, the Commission . . . shall apply such revised standard in the case of any license for byproduct material . . . ." 42 U.S.C. §2022(b). The NRC's regulations cannot overcome this statutory requirement to implement the EPA's standards. Indeed, the NRC's regulatory authority under UMTRCA Section 206 is limited to promulgating rules that "the Commission deems necessary to carry out its responsibilities in the conduct of its licensing activities under this chapter." *Id*. The NRC's licensing "responsibilities" are defined by statute and by the EPA's regulations. To the extent that the NRC's requirements for groundwater protection that it codified in 10 C.F.R. §40, Appendix A or elsewhere become inconsistent with the EPA's standards, they are invalid.

And yet in withdrawing its second draft rule, the EPA explained that there were significant legal concerns regarding whether the proposed rules exceeded the EPA's authority to establish "generally applicable standards." The EPA again kowtowed to the NRC's claim that the EPA's authority to set "generally applicable standards" is limited to issuing only *numerical* standards. 83 Fed. Reg. at 54,544. The NRC based this argument on President Nixon's Reorganization Plan No. 3 of 1970 and legislative history of UMTRCA.[8]

Most of the arguments against respecting the EPA's standard-setting authority are based on conjecture, hypotheticals, and crabbed interpretations of NRC guidance, policy, and practice. Let us first remember that it is well-settled doctrine that the terms of a statute are to be given their plain meaning, and that resorting to legislative history is unnecessary and improper if a statute's plain meaning can be gleaned from its text. *E.g.*, *Shannon v. United States*, 512 U.S. 573, 582 (1994). In determining the scope of the EPA's authority as written by UMTRCA, there is only one way to read the term "standards of general application": as distinguishing that term from standards of *non-general* – i.e., *site-specific* – application. The site-specific licensing is left to the NRC as part of its general licensing authority. 42 U.S.C. §2022(d). That interpretation is plain on its face. There is nothing in the statute that even *implies* a condition that the "standards of general application" may only be numerical standards.

The question is thus whether the standards set by the EPA fit within the term "standards of general application." The obvious answer is yes. The EPA's proposed rule had three parts that would apply to uranium recovery sites: (1) a numerical concentration of radioactivity; (2) a confidence interval that determines compliance with the numerical concentration; and (3) directions as to how sites are to be monitored in order to determine whether the standard is met as wastes migrate beyond the licensed facility into the general environment. These three elements specify a single standard of general applicability in terms that the NRC, with its site-specific authority, would be required to enforce.[9]

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[8] *See* NRC Staff's Comments on the EPA's Proposed Rulemaking for 40 CFR §192, 82 FR 7400 (ML17173A638) (July 17, 2017) (hereinafter "NRC Comm. at __.").

[9] If the standard consisted of only a numerical concentration, *any* measurement in excess of the specified concentration would constitute a violation of law. In specifying a confidence limit, the EPA provided assurances of regulatory flexibility that we believe went too far in light of the NRC's historical laxity, but that is beside the point here; and by specifying where measurements were to be taken (as we suggested, at the monitoring wells), the EPA assured uniformity in enforcement.

The absence of any statutory language even implicitly (much less explicitly) supporting the NRC's arguments should long ago have ended the effort to upset the balance created by Congress in segregating the EPA's standard-setting from the NRC's licensing and enforcement activities. But even if the sources the NRC relies on – the Reorganization Plan and legislative history – were applicable, these sources fail to support the NRC's argument (indeed, to the contrary, a full reading makes it quite clear they support the EPA's original well-grounded exercise of authority). The NRC's comments have no merit and, as clearly happened at least twice during the inter-agency review process where these objections were presumably raised, the EPA should have disregarded them as contrary to UMTRCA's purpose, language, and structure.

1. <u>The Reorganization Plan holds no authority.</u>

The NRC relied on the Reorganization Plan as supporting the limits of EPA's authority. The NRC suggested that "Congress was aware of and considered section 2(a)(6) of the Reorganization Plan No. 3 of 1970 when it enacted UMTRCA," and that "the legislative history shows that Congress structured UMTRCA's grant of authority to the EPA Administrator upon this very provision." NRC Comm. at 13. But the Reorganization Plan is in no way controlling or relevant here. Because UMTRCA's language is plain as to the division of authority, the Reorganization Plan has no legislative effect and is not persuasive as part of UMTRCA's legislative history. Further, unlike UMTRCA, the Reorganization Plan was not passed by both houses of Congress and signed by the President. The Plan is merely a reshuffling of duties and responsibilities among various executive agencies. It was not intended to serve as a pronouncement on EPA's statutory duties and responsibilities. Although NRC and its licensees may prefer the pre-UMTRCA alignments set out in the Reorganization Plan, NRC's licensee-biased preferences cannot revoke the structure and plain language used in UMTRCA that require the NRC (and the terms of specific licenses) to comply with the continued authority of the EPA to engage in standard setting. 42 U.S.C. §2022 (b)(2).

The Reorganization Act itself provides that reorganization plans do not affect agencies' statutory functions or duties. The Act provides that a plan may not "authorize[]an agency to exercise a function which is not expressly authorized by law." 5 U.S.C. §905(a)(4). If a reorganization plan cannot confer on the agency the authority to exercise a function not expressly authorized by law, it would twist logic to permit a reorganization plan to *limit* or *alter* the scope of an agency's function in a way that is not expressly provided by law.[10]

[10] The NRC and its licensees unsuccessfully pressed these arguments year ago in post-UMTRCA litigation, but the NRC and its licensees seem to ignore the results of this litigation. "Moreover, the [Reorganization] Act clearly contemplates the orderly continuity of functions before and after reorganization." *Quivira Mining Co. v. E.P.A.*, 728 F.2d 477, 480 (10th Cir. 1984). *See also* 5 U.S.C. §907(a) ("*A statute enacted*, and a regulation or other action made, prescribed, issued, granted, or performed in respect of or by an agency or function affected by a reorganization

Here, reading the Reorganization Plan to alter the plain terms of the statute – to graft an additional term "numerical" onto the term "standards of general application" – would be incorrect. The Tenth Circuit has recognized the important distinction between presidential reorganization orders, which are "inherently limited and subject to the continuity provision of the enabling Reorganization Act," and Congressional reorganization statutes, which "are not." *See Quivira Mining Co. v. E.P.A.*, 728 F.2d 477, 482 (10th Cir. 1984). "Congress, unlike the President, has the authority to add functions and change substantive provisions." *Id.* The NRC sought to circumvent this important distinction by giving *legal effect* to the presidentially issued Reorganization Plan. Although the agency couched its argument as based on the statute's legislative history, it is clear that the NRC's reliance on the express terms of the Reorganization Plan was an effort to give legal effect to those terms.[11]

Even if the Reorganization Plan could be relied upon to inform the meaning of "standards of general application" in UMTRCA, the terms of the Plan simply do not support the NRC's reading. The Plan transferred to the EPA "[t]he functions of the Atomic Energy Commission under the Atomic Energy Act of 1954 . . . to the extent that such functions of the Commission consist of establishing generally applicable environmental standards for the protection of the general environment from radioactive material." Reorganization Plan No. 3 of 1970, *codified at* 5 U.S.C. Appx. 1. The Plan continues: "As used herein, standards mean *limits on radiation exposures* or levels, or concentrations or quantities of radioactive material, in the general environment outside the boundaries of locations under the control of persons possessing or using radioactive material." *Id.* (emphasis added). EPA's proposed rules precisely fit the Plan's description. The EPA's standards specified a "concentration[]" (a numerical limit with a confidence interval), and provided for monitoring to limit radiation exposure "outside the boundaries" of licensed facilities. Even if the Reorganization Plan could alter the plain terms of UMTRCA, which it cannot, the NRC was incorrect in suggesting that EPA's proposed rules were at odds with the provisions of the Reorganization Plan.

Further, NRC suggested that Congress was aware of the Reorganization Plan and therefore the definition of "standards of general application" in UMTRCA must be read in this light. But had Congress intended to tie the definition of "standards of general application" to the Reorganization Plan's definition, it would have done so, either by referring to the Plan itself or defining the term in the law's "definitions" section. *See*

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under this chapter, *before the effective date of the reorganization, has*, except to the extent rescinded, modified, superseded, or made inapplicable by or under authority of law or by the abolition of a function, *the same effect as if the reorganization had not been made*." (emphases added)).

[11] *See United States v. Gonzales*, 520 U.S. 1, 6 (1997) (rejecting effort based on legislative history to "engraft onto" a statute a requirement that is "in no way anchored in the text of the statute"); *Shannon v. United States*, 512 U.S. 573, 582 (1994) ("[C]ourts have no authority to enforce [a] principl[e] gleaned solely from legislative history that has no statutory reference point.").

UMTRCA, Pub. L. 95-604, section 101. That is not what was done. There is no statutory or legal basis for the NRC to rewrite UMTRCA to constrain the EPA's robust regulatory role that Congress created, in part, to address the tragic failure of the NRC's pre-UMTRCA regulation of uranium mill tailings.

2. <u>The NRC disingenuously relied on a section Congress ultimately deleted from the final UMTRCA.</u>

In addition to the Reorganization Plan, the NRC attempted to point to the legislative history of UMTRCA to support its claim. But, the bill that ultimately was enacted as part of UMTRCA was amended in committee to delete a limitation on EPA's standard-setting authority that was initially included in the draft of the bill. The draft bill would have limited EPA's authority to setting "limits on exposures or levels, or concentrations or quantities, of hazardous material in the general environment." That language, which substantially mirrored the language in the Reorganization Plan, was in a bill under consideration in the House Subcommittee but *was removed prior to enactment of UMTRCA*.

One can see from the changes in the bill's language that Congress affirmatively *rejected* the idea of limiting EPA's authority to issuing numerical-only standards. To make perfectly clear, the bill provided:

> [EPA] shall, by rule, promulgate . . . generally applicable standards and criteria for the protection of the general environment. Such standards and criteria shall—
>
> . . . .
>
> (2) impose *limits on exposures or levels, or concentrations or quantities, of hazardous material* in the general environment . . . ."[12]

This language would have limited EPA's standard-setting authority to numerical standards. The italicized language, however, *was deleted before the law was enacted*. Compare *id. with* 42 U.S.C. §2022(b)(1) ("[EPA] shall, by rule, propose, and within 11 months thereafter promulgate in final form, *standards of general application* for the protection of the public health, safety, and the environment from radiological and nonradiological hazards associated with the processing and with the possession, transfer, and disposal of byproduct material").

[12] *Uranium Mill Tailings Control Act of 1978: Hearing on H.R. 11698, H.R. 12229, H.R. 12938, H.R. 12535, H.R. 13049, H.R. 13650, and H.R. 13382 Before the Subcomm. On Energy and Power, H. Comm. On Interstate and Foreign Commerce*, 95th Cong., at 81 (1978) (quoting H.R. 13650, section 206) ("Hearing Transcript").

We repeat. The language NRC relies upon was deleted from the text of what became law. NRC omitted this fact from its comments on EPA's draft rule. In withdrawing the second draft rule, the Trump EPA ignored it as well.

3. The legislation history support's the EPA's broad authority.

In contrast to the NRC's reliance on language that was explicitly rejected, a full reading of the legislative history of UMTRCA presents a picture that supports the EPA's exercise of the authority to finalize the proposed rules. The legislative history is replete with language indicating that Congress's primary concern in allocating duties between the EPA and NRC was with drawing a distinction between the authority to set requirements that are of *general* application, which Congress assigned to the EPA, and to set requirements that are of *site-specific* application, which went to the NRC.

a. House Committee Reports

Two House Reports include numerous statements emphasizing the distinction between general vs. site-specific requirements. In the first, the Interior Committee explained that: "[t]he NRC is . . . responsible for implementing *general standards and criteria* promulgated by the Administrator of the Environmental Protection Agency." H. Rep. 95-1480(I) (Report of Interior and Insular Affairs Committee), 1978 WL 8518, at *16 ("Interior Committee Report") (emphasis added). The Interior Committee Report elucidates what it means when it says the NRC has responsibility to "implement" the EPA's standards: it directs the NRC to "assure that the technology, engineering methods, operational controls, surveillance requirements and institutional arrangements employed *at the sites* provide the necessary barriers and levels of control to limit public exposure" to give effect to "EPA standards and criteria." *Id.* at *16.

Thus, the Interior Committee Report interpreted the NRC's implementation duties to encompass deploying "technology, engineering methods, operational controls, surveillance requirements and institutional arrangements" *at the sites* themselves. *See also id.* "The EPA standards and criteria" on the other hand "should not interject any detailed or site-specific requirements for management, technology or engineering methods on licensees or on the Department of Energy." *Id.* The phrases "at the sites" and "site-specific" are the key. The language is in accordance with the Congress's distinguishing between general and site-specific requirements.

The standards in the EPA's proposed rules, which were of general application and did not set any requirements for NRC's management, technology, or engineering methods *at the sites*, did not run afoul of the division of authority between the EPA and the NRC envisioned by the Interior Committee or the Congress. The NRC's role of deploying management, technology, and engineering methods at the sites would not be infringed upon by the EPA's standards. Indeed, whether the standards are of a numerical or non-numerical nature has no bearing on the question of whether the NRC retains its authority to deploy those methods to implement and enforce the standards.

Perhaps the most authoritative portion of the legislative history, the Interior Committee Report's "section-by-section analysis," makes no mention – none – of any intention to limit EPA's authority to setting numerical standards. The analysis of Section 206, later amended and ultimately codified at 42 U.S.C. § 2022, reads in its entirety:

> Section 206 requires the [EPA] to set general standards and criteria for the protection of the environment outside the boundaries of mill tailings disposal sites. The standards and criteria would be applicable to both radiological and nonradiological hazards in the piles. Authorities of the EPA under other laws would not be abridged by the new requirements.

Id. at 21. This Committee's Report shows that Congress's concern in enacting section 206 was maintaining a clear division between "general" standards and site-specific requirements. Had Congress intended to impose the additional requirement advocated by the NRC, the Committee surely would have referenced that here (or in the law's definitions section).

The other House Committee Report issued on the bill contains similar language emphasizing the distinction between generally applicable and site-specific requirements. *See*. H. Rep. 95-1480(II) (Report of Interstate and Foreign Commerce Committee), 1978 WL 8519, at *43 ("Commerce Committee Report"). This report, similar to the report described above, provides the most concise and on-point analysis of the bill's provision dividing authority between EPA and NRC – and similarly underscores the general vs. specific application dichotomy emphasized elsewhere. Had Congress intended to limit EPA's authority further in the way advocated by NRC, surely it would have referenced that intent here.

Indeed, the Commerce Committee Report also included a letter sent to the Committee by John O'Leary, Deputy Secretary at the Department of Energy. On the relevant issue, the letter states:

> As we understand it, the licensing and regulation portion of the Committee print provides that the [EPA] will promulgate performance standards for the remedial action while the [NRC] is to have exclusive jurisdiction over the licensing of uranium mill tailings and enforcement of the performance standards set by EPA. We trust that the report language will clearly define the respective roles of these two agencies in order to avoid any possible conflict or inconsistency.

Commerce Committee Report at *48. The distinction here between "performance standards set by EPA" and "licensing . . . and enforcement" precludes the NRC's proposed embellishment of the language in the statute. To the extent the legislative history is relevant, the House Reports are the authoritative documents, and both contradict the NRC's position.

b. Testimony

The legislative history generally shows that Congress consciously and affirmatively intended *not* to limit EPA's standard-setting authority to numerical standards only.

Mr. Hawkins, the most senior EPA official with jurisdiction over radiation risks, urged that the legislation provide the broad standard-setting authority EPA needed to deal with the need to manage mill tailings sites for the long term. In a colloquy with Committee counsel David Finnegan, then-EPA Assistant Administrator for Air and Waste Management Mr. Hawkins described the broad authority EPA needed for effective generally applicable standards:

> Mr. HAWKINS. . . .The effort here is to have the [EPA] address what it is that should be done in carrying out these remedial actions and that could *have a scope which would include the types of maintenance activities following the completion of the actual construction work involved in the remedial activity*, and that could, I think, logically be extended to any future owner and operator of the site, where the material is located. If the legislation does not make that sufficiently clear, then this is a drafting issue that I think we would be glad to help the committee address.
>
> Mr. FINNEGAN. Your intention, then, is to make the regular standards apply to the owners of the sites as well; is that correct- the future owners, as well as present owners?
>
> Mr. HAWKINS. *The standards and criteria ought to be broad enough in their scope and coverage to insure that any time you have to subject the owner or operator of the site to a particular type of behavior in order to assure public health and welfare, that the standards and criteria do cover that eventuality*.

Hearing Transcript at 291-92 (emphases added).

Making the point even more explicit, Mr. William Rowe, EPA Deputy Assistant Administrator for Radiation Programs, and Mr. Floyd Galpin, Head of the Division of Environmental Assessment, Office of Radiation Programs, criticized the limitation on the EPA's authority that would have been imposed by H.R. 13650. Mr. Galpin testified: "There are a couple of areas relative to [the bill] that we particularly had problems with. One was in the limitations that were inferred relative to the way in which EPA could set standards, *that it had to be expressed only in terms of emissions or amounts of material* that were going into the general environment." Hearing Transcript at 385. The hearing continued:

> Mr. GALPIN. Particularly in the case where we are talking about nonradioactive hazardous materials, it may not be the most efficient way, both for writing standards or for implementing them in an enforcement mode, to express those standards in the form of materials going out into the environment. We are talking about long periods of time over which materials may very slowly or gradually move from one place to another.
>
> Mr. DINGELL. If you deal with it in that fashion, you have the full capacity to address the amounts that go out and require the things that are necessary to control the emissions both over the short term or over the long pull, do you not?
>
> Mr. ROWE. It would be very difficult in terms of implementation. For many years you might not be able to measure ray emissions. It may be more efficient to state management practices, general management practices such as RCRA allows us to do, to be able to arrive at the proper type of control.

Hearing Transcript at 385.

In light of this, the testimony from Mr. Rowe quoted by the NRC in their comments on the EPA's proposed rules takes on a different meaning. *See* NRC Comm. at 13. NRC seizes on Mr. Rowe's statement that "[g]eneral[ly] applicable standards is defined in the Atomic Energy Act," and that the term "covers standards which can be quantities, concentrations, and it is particularly defined here as concentrations or quantities of material into the general environment." Hearing Transcript at 393 (cited by NRC Comm. at 13). The NRC asserted that "[a]lthough Dr. Rowe stated that the term 'general[ly] applicable standard' was defined in the AEA, *he was, as shown by his earlier statement, likely referring to Section 2(a)(6) of the 1970 Reorganization Plan*." NRC Comm. at 13 (emphasis added). Mr. Rowe, however, was referring merely to the definition of standards that appeared in the bill under consideration – *the same definition that was deleted before the law was enacted*. Mr. Rowe was not, as NRC asserted, referring to the definition in the Reorganization Plan. Thus, Mr. Rowe's testimony cannot be read as importing the Reorganization Plan's definition into the bill under consideration. He was merely reciting the definition that, at that point in the legislative deliberations, appeared in the bill under consideration.

B. The Existing Framework is Not Sufficient

A standard-setting rulemaking by the EPA is still necessary for the NRC to fulfill its statutory role and to remedy the existing NRC licensing practices that are insufficient to ensure the protection of public health and the environment at ISL facilities. In withdrawing its second draft rule, the Trump EPA subverted Congressional intent and again turned its back on years of analyzing the issue to step into line with the NRC. In publishing its second draft rule, the EPA wrote:

> *The EPA disagrees with commenters who contend that new standards are unnecessary. First, it is in the national interest to protect groundwater resources. Water is becoming a scarce resource, particularly in the arid regions where most ISL currently operate. Groundwater in this region is not exclusively used for human consumption, and has other uses such as livestock production, crop irrigation, and wildlife support. The best way to preserve groundwater for all such uses is to prevent contamination by addressing the source of contamination.*

82 Fed. Reg. at 7,420.

We agree that new standards are necessary, and indeed, long overdue to protect western groundwater and attendant communities because the current system has, in every instance, lead to agency approved aquifer contamination. But it is the EPA that must first produce stringent standards, rather than the NRC, who would only codify the existing inadequacies.

The NRC's and NRC Agreement State reliance on the requirements of the underground injection control program, authorized under separate legal authority, fail to address groundwater protection at ISL facilities adequately. Rather, current NRC interpretation of the statutory regime and regulatory obligations directly allow for significant contamination of scarce sources of western groundwater. As EPA noted in its proposed rules, if the groundwater is not considered an Underground Source of Drinking Water ("USDW"), as is typically the case at ISL sites, it is not protected under the Safe Drinking Water Act ("SDWA") and the ISL mining area is, for all intents and purposes, used as a disposal site and left, in every instance, severely contaminated.[13]

The EPA's UIC regulations are designed to protect USDW by prohibiting the direct injection or migration of foreign fluids into these aquifers. But EPA has clarified that "an aquifer may be exempted from UIC regulation if it is shown to be completely isolated with no possible future uses." EPA, *Technologically Enhanced Naturally*

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[13] An USDW is defined as any aquifer or portion thereof that supplies a public water system or contains fewer than 10,000mg/l total dissolved solids.

Occurring Radioactive Materials from Uranium Mining, at A VI-3 (Apr. 2018).[14] The theory is that an exempted aquifer cannot and will not serve as a source of drinking water because it is situated at a depth or location that makes recovery of the water technically or economically impractical. Thus, currently, any uranium ISL mining company may apply to the EPA or its delegated state for approval of underground injection of solutions that will contaminate the exempted aquifer. Indeed, for years the discovery of producible mineral deposits led to what amounted to an automatic exemption, even in the arid West. Unfortunately, this process of exempting aquifers has allowed the uranium ISL industry to use the mined aquifers as contaminated disposal zones, with the explicit assistance of its ostensible regulator, the NRC.

To be fair, the NRC requires that after an ISL mining and milling operation has concluded, the site must be cleaned up, or "decommissioned," and groundwater quality must be restored. The NRC guidance posits that even after receiving an aquifer exemption under the SDWA, a uranium ISL mine should restore the contaminated groundwater aquifer to NRC-approved background values. Such a level of protection for the scarce resource would ensure that adjacent groundwater aquifers are safeguarded and that other potential future uses of the mined aquifer are not compromised. However, the NRC states that if the contaminated groundwater cannot be restored to the NRC-approved background level, then the aquifer must be restored to the maximum concentration levels set in 10 C.F.R. §40, Appendix A, Table 5C. And if that standard is not achievable – as the NRC notes, "these two options may not be practically achievable at a specific site – then the licensee may propose an alternate concentration limit that it will argue presents no significant hazard." *Id.* at Criterion 5(B)(6). This system allows industry to essentially regulate itself.

In every case, the industry has defaulted to an alternative concentration limit ("ACL") for key parameters such as uranium or radium with little agency complaint. Agreement States such as Texas have adopted similar rules that allow the industry to be relieved of its burden to restore contaminated groundwater. The combination of an aquifer exemption (making the licensee exempt from water quality standards) and a

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[14] Report is available online at https://nepis.epa.gov/Exe/ZyNET.exe/9100I3Y4.txt?ZyActionD=ZyDocument&Client=EPA&Index=2006%20Thru%202010&Docs=&Query=%28an%20aquifer%20may%20be%20exempted%20%29%20OR%20FNAME%3D%229100I3Y4.txt%22%20AND%20FNAME%3D%229100I3Y4.txt%22&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&UseQField=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5CZYFILES%5CINDEX%20DATA%5C06THRU10%5CTXT%5C00000019%5C9100I3Y4.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&slide.

relaxed NRC regulatory scheme allowing alternative limits for key parameters results in aquifer contamination where the ore is mined.

The increasing scarcity of water in the American West is a crucial national issue, and all sources – be they surface water or groundwater – should receive the utmost protection. Further, it's perfectly clear that water demands in the future will increase and groundwater resources will be increasingly relied upon as a consistent, reliable, source of fresh water. However, due to overreliance on groundwater, significant groundwater depletion has been observed by the United States Geological Survey over the past decade. The current drought crises in these regions are causing many communities to scrounge and save for water.

But, as shown, the current system is not preventing water contamination. Evidence of the archaic and deficient regulatory system can be viewed in stark relief via an examination of the evidentiary record of our challenge to an NRC materials license for an ISL uranium mining site in northeastern Wyoming.[15] In that proceeding (hereinafter the "Strata proceeding"), we demonstrated how the ISL process degrades groundwater and causes severe environmental impacts. We demonstrated – and even the NRC's Atomic Safety Licensing Board agreed – that in every instance, the industry cannot restore groundwater to primary or secondary limits and use of ACLs are inevitable. With that in mind, it is of profound import that the scarce groundwater resources in the American West be protected.

Unless the NRC allows the EPA to establish clear, protective rules for the ISL uranium mining industry before following in its turn, groundwater contamination controversies similar to the Strata proceeding are sure to follow, and with those controversies will come degraded sources of scarce groundwater, negative national attention, and vigorous litigation in multiple venues. The EPA had an overdue opportunity to repair what has been an ongoing regulatory morass, clarify the responsibilities of the industry, NRC Staff, and the interested public, and provide needed protections for scarce groundwater resources that have been negatively affected by ISL uranium milling. Before additional harms and unnecessary litigation results, the NRC should wait and encourage the EPA to finish what it began.

This is an issue of significant legal, environmental, economic, and social importance. In the intermountain West, where much of this ISL uranium mining processing has taken place and will continue, population growth, prolonged dry weather conditions, and competing resource extraction technologies (such as coal bed methane drilling) have created severe competition for freshwater resources. Permanent loss or impairment of freshwater aquifers due to contamination from ISL mining activities –

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[15] *In the Matter of Strata Energy, Inc.* Docket No. 40-9091-MLA, can be found online at NRC's electronic hearing docket (https://adams.nrc.gov/ehd/) and we incorporate that record here by reference.

even if those resources are not currently accessed by large populations or are of more marginal quality – is a significant issue for the region both in the short and long term. More importantly, despite a clear legal mandate via its National Environmental Policy Act obligations, the NRC – along with its federal brethren such as the Department of the Interior's Bureau of Land Management – have failed to study the long-term cumulative impacts of sacrificing aquifers in the intermountain West to facilitate the extraction of mineral and energy resources. The NRC recognizing its place behind the EPA can begin to rectify this situation.

Thus, the current system is not working. An update needs to happen, and the EPA revisions to existing standards must take place before the NRC can update its UMTRCA-based licensing and enforcement regulations to meet UMTRCA's health, safety, and environmental protection mandates. Until then, the NRC, its licensees, and the public are left with no choice but to address ISL facilities based on case-by-case implementation and time-consuming adjudication.

C. A Lack Of Growth In The Uranium Industry Does Not Make Updating Regulations Meritless

The final reason the EPA claims it withdrew its second draft rule is that the expected uranium boom, part of the catalyst for drafting the rule, is no longer expected. As noted above, we don't disagree with the notion that there will be no significant domestic uranium recovery boom supporting a revitalized nuclear industry. To the contrary, we expect the moribund prospects for the industry to continue for some time. However, the utility of the strong regulations, led first by the EPA, are still readily apparent to us, simply on the prospect that there should be no portion of existing ISL sites outside of the purview of an updated rule based on protective EPA-promulgated standards. As NRDC demonstrated in our comments on the EPA's first draft rule, ISL sites have phased back and forth between restoration and operational status, sometimes many years apart. NRDC Comments on first draft rule, pages 92-94. Because of that, we see no reason why all operating mines, expansions of current operations, newly proposed mines, or older mines in restoration should have any objection to compliance with newly promulgated rules. The EPA should have required with precise clarity that wellfields that revert back to operating status from restoration/decommissioning status immediately enter the purview of the updated 40 C.F.R. §192, Subpart F rules and prior restoration and monitoring requirements are no longer operable. Alas, we are aware that the agency will require no such thing in the near future.

And with a number of sites currently undergoing active restoration, there is an ongoing failure of a detailed analysis of the environmental impacts of such a significant amount of scarce western water. This is a missed opportunity and an item that must be rectified when and if the EPA does move forward again. With these potential applications of updated standards, a relative paucity of new ISL facilities does not make updated standards worthless.

D. The NRC Must Encourage and Allow the EPA to Finalize Updated Standards

Now that the EPA has withdrawn its rule, the NRC is seeking comment on whether it should resume the rulemaking that it put on hold in 2010 or to defer to the EPA "in anticipation of the need to conform its implementing regulations to the generally applicable standards to be issued by the EPA." NRC Request for Comment, 84 Fed. Reg. at 576. Hence, the NRC is seeking support for throwing out close to twenty years of work and starting again to codify a system that the NRC and the EPA have continuously disagreed on. Although it may appear attractive to deregulation proponents, this *ultra vires* rewrite could foreseeably result in litigation that enjoins NRC issuance and revision of ISL licenses altogether, until UMTRCA-compliant regulations are promulgated by the EPA and the NRC.

The EPA's about-face that the current regulatory framework is sufficient flies in the face of the vast majority of the administrative record of its proposed rules. These same administrative records show that the NRC is also wrong to state that the current system "provide[s] adequate protection to the public health and safety and the environment." *Id*. The NRC makes clear in its notice that the rule it develops will be "based upon many of the license conditions that are contained in current NRC-issues site-specific ISL licenses and would be further informed by the approved methodologies and best practices set forth in those NRC guidance documents." *Id*. at 577. Essentially, the NRC wants to cement in place the current defective system.

After years of rulemaking, we are back where we started and it is unacceptable. Rather than throw out the time and effort that has already been invested, the EPA should finish what it started and the NRC must encourage EPA to do so. Any attempt to install weaker requirements by the NRC or the EPA would violate the law.

IV. NRC's Questions

Now we will address the four numbered items the NRC specifically seeks comments on. As we have made clear throughout this comment, the current system lacks the necessary standards and licensing procedures to protect groundwater at ISL facilities. Here, we will go into detail about specific suggestions for improving that system. However, the NRC cannot be the first to act on these issues. As the NRC must tailor its regulations to the standards EPA sets, the EPA must be the agency to update its regulations first.

A. Issues that Should be Addressed to Protect Groundwater at ISL Facilities, which will Enhance Public or Occupational Safety

The NRC asks commenters to "identify any issues that should be addressed to protect groundwater at ISL facilities" and also "any issues that should be addressed to enhance public or occupational safety at ISL facilities." NRC Request for Comment, 84 Fed. Reg. 577.

Groundwater is a significant source of drinking water supply for municipalities and also a source for agricultural irrigation in the arid American West. *See* Attachment A. Groundwater is an attractive water source to meet these demands because it is accessible in areas without substantial surface water availability, requires relatively less treatment compared to surface water, and is less susceptible to drought conditions. According to the United States Geological Survey ("USGS"), groundwater is the source of drinking water for half the United States. Furthermore, groundwater contributes the largest percentage of source water for agriculture irrigation.[16] Protecting groundwater at ISL facilities will therefore in turn enhance safety.

It's perfectly clear that water demands in the future will increase, therefore groundwater resources will be increasingly relied upon as a consistent, reliable, source of fresh water.[17] Already significant groundwater depletion has been observed by the USGS over the past decade due to overreliance on groundwater. The Central Valley Aquifer of California and the High Plains Aquifer (Ogallala), for example, have observed shocking groundwater volume losses from 1960-2008.[18]

Put simply, there are increased water demands and scarce options to meet those demands. For example, population increases over the last decade in northeastern Wyoming have put increasing stress on the available water supplies. The city of Gillette, Wyoming depends on drinking water from the Fort Union Aquifer and other local aquifers, to provide municipal water supplies. However, water availability in these aquifers are dwindling and the population is projected to substantially increase by 2030. To meet increasing water demands, the city is enacting the Gillette Madison Pipeline Project, a multi-million dollar project, which is routing water from the Madison aquifer, north of Keyhole Reservoir to Gillette via pipeline.[19] The project is intended to meet growing water demands for the next 20 years. This example demonstrates the specific vulnerability of just one region where ISL takes place.

Further, rural, low-income, and communities of color will bear the disproportionate burden of adverse impacts from water scarcity due to over

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[16] USGS, *What is Ground Water?* (Apr. 2011), available at https://pubs.usgs.gov/of/1993/ofr93-643/pdf/ofr93-643.pdf.
[17] *See* Elodie Blanc, et. al., *Modeling U.S. Water Resources Under Climate Change*, Earth's Future, 2, 197–224 (Apr. 24, 2014), available at https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1002/2013EF000214.
[18] Leonard Konikow, USGS, *Groundwater Depletion in the United States (1900-2008),* (2013), available at, https://pubs.usgs.gov/sir/2013/5079/SIR2013-5079.pdf.
[19] *See*, e.g., update from the local government on the topic, 2018 Regional Water Extensions, WWDC Grant Funding Agreements, City of Gillette, City Council Workshop, July 24, 2018 https://www.gillettewy.gov/home/showdocument?id=39509.

appropriation and contamination.[20] For example, in New Mexico approximately 78% of the population gets its drinking water from groundwater sources and 170,000 New Mexicans get their drinking water from private, unregulated wells.[21] Because of the reliance on groundwater for drinking water supplies, in New Mexico counties such as McKinely and Cibola Counties, which are overwhelmingly Native and Latino and where extensive uranium development has occurred, special attention must be paid to protecting groundwater not only for human consumption, but also for cultural purposes. The NRC has demonstrated an historical disdain for the concerns of low-income communities of color; under no circumstances is it appropriate for the NRC to set standards for ISL operations that might impact vulnerable communities in New Mexico or elsewhere.

In its National Brackish Groundwater Assessment, USGS documented the expected increasing demand for groundwater demand that has led to an increased need to protect brackish groundwater[22] that in the past may have been deemed unsuitable for drinking water. USGS writes:

> *In many parts of the country, groundwater withdrawals exceed recharge rates and have caused groundwater-level declines, reductions to the volume of groundwater in storage, lower streamflow and lake levels, or land subsidence. It is expected that the demand for groundwater will continue to increase because of population growth, especially in the arid West. Further, surface-water resources are fully appropriated in many parts of the country, creating additional groundwater demand. Development of brackish groundwater as an alternative water source can help address concerns about the future availability of water and contribute to the water security of the Nation.*[23]

Brackish water is already being treated for use as drinking water. The state of Texas, overwhelmed by historic droughts over the last decade, is planning to partially meet current and future water demands with the treatment of brackish groundwater.[24]

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[20] *See* Christian-Smith, Juliet, et. al., *A Twenty-First Century U.S. Water Policy* at 72-73 (Oxford University Press 2012).
[21] New Mexico Environment Department, Water Resources & Management, https://www.env.nm.gov/water/.
[22] The USGS states that brackish water: "is considered by many investigators to have dissolved-solids concentration between 1,000 and 10,000 milligrams per liter (mg/L)." https://water.usgs.gov/ogw/gwrp/brackishgw/brackish.html.
[23] USGS, *Why Study Brackish Groundwater?*, http://water.usgs.gov/ogw/gwrp/brackishgw/study.html.
[24] Jean-Phillippe Nicot & Bridget Scanlon, *Water use for Shale-gas production in Texas, U.S.*, Environ. Sci. Technol. 46, 3580–6 (2012); *see also* Shelley Kofler, *Drought-Stricken Texas Town Turns To Toilets For Water* (May 6, 2014), available at

It's estimated that roughly 100 brackish groundwater plants are currently being used in Texas and it has been estimated that roughly 13% of the total water supply for the Lower Rio Grande Valley could be met with brackish groundwater by 2060. According to the director of the Texas Desalination Association: "Until recently, brackish water was not considered usable. . . But with chronic drought conditions, it is suddenly becoming more and more useful."[25]

But if there ever were a need for states such as Wyoming, New Mexico, Nebraska, Texas, or South Dakota to access the water in the aquifer where uranium mining took place for agricultural and possibly even drinking water uses, our 2012 survey and initial study, our experience with the Strata case, and our analysis for these comments suggest that such an option would be foreclosed.

Groundwater that does not meet drinking water standards requires "at the end of the pipe" treatment to return water to acceptable drinking water standards, which is costly and carries numerous logistical issues (waste disposal, energy requirements, O&M costs, etc.). In general, financial limitations prompt municipalities to utilize the highest quality source water which requires the least amount of treatment. When relatively high quality (low treatment) source water is unavailable, the next economically available source of water is used. This general trend explains why desalination of sea water is used as a last resort, due to significantly high economical treatment costs. Therefore, preventing water contamination in the first place is regarded by many water resources and environmental engineers as the "best treatment option."

In communities across the West, groundwater is being used like never before and there is strong evidence that it will be increasing relied upon in the future. With that in mind, it is of profound import that the scarce groundwater resources in the American West be protected. But as we demonstrated in the Strata proceeding in every instance we can find the uranium ISL industry cannot restore groundwater to primary or secondary limits. The NRC's current system has failed time and again. Specifically:

- The failure to set an accurate baseline,
- The failure to account for fluid migration,
- The abuse of the Alternative Concentration Limit, and
- The failure to require meaningful post-closure monitoring.

It is these failures that the EPA must address with protective standards, *after which* the NRC must also issue regulations for. Addressing ISL impacts to groundwater

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http://www.npr.org/2014/05/06/309101579/drought-stricken-texas-town-turns-to-toilets-for-water.

[25] David Sneed, Cambria water reclamation plant to start operating soon (Nov. 8, 2014), available at https://www.sanluisobispo.com/news/local/community/cambrian/article39503223.html.

in turn will reduce the human health risks that could result from exposures to radionuclides and toxic heavy metals in well water used for drinking or agriculture in areas located down-gradient from an ISL.[26]

1. Baseline

NRDC again reiterates a point we have made above – setting a sound, scientifically defensible pre-mining original water quality will obviate the need for many potential later conflicts. But the current regulatory regime does not require a meaningful determination of background groundwater concentrations, either prior to licensing or as part of the National Environmental Policy Act process, and what is required for background is as likely as not to "foul the nest" and ensure that inaccurate, less protective restoration goals are established. That's because the NRC allows for groundwater baseline to be set long after the licensing and National Environmental Policy Act process have concluded and allows for improper techniques in establishing baseline.

Examination of the Strata Proceeding, specifically the story maps and the histogram evidence, illustrates that (1) it is not accurate to state that the presence of uranium necessarily equals poor groundwater quality; and (2) it is perfectly clear that ISL activity degrades that groundwater quality, whatever its original state. Using NRC and industry data, NRDC's expert provided a meaningful summary of the data using the entire wellfield data set from Christensen Ranch MU2-6.

The expert created a cumulative histogram for average baseline and each set of post restoration concentration numbers. Attachment A, at ¶58. Ultimately for the Willow Creek Storymap, the majority of the average baseline groundwater samples were below the EPA's drinking water maximum contaminant limit for uranium of 0.03 mg/L (~65%); 28 % had slightly elevated uranium concentrations (0.03-0.09 mg/L) and only 8% were very elevated (0.09 – 3.0 mg/L). Thus, based on factual data from the NRC itself, we differ with the proposition that the presence of significant uranium deposits typically diminishes groundwater quality.

Next, Dr. Larson showed that after mining and restoration activities, the groundwater quality sample distribution showed significant changes to these observed percentages. Roughly 13% of the post restoration samples were extremely contaminated (greater than 3.0 mg/L, which is greater than 100 times the EPA's maximum contaminant limit for safe drinking water standards for uranium), the 'very elevated' uranium concentrations increased from 8% (Baseline) to 54% (Post-restoration). And

[26] *See,e.g.*, Limson-Zamora, M., et. al., *Chronic Ingestion of Uranium in Drinking Water: A Study of Kidney Bioeffects in Humans*, 43 Toxicological Sciences 68-77 (1998). There is a benefit estimated to be at least $8 million per premature death avoided of reducing cancer deaths. First draft rule, 80 Fed. Reg. at 4,157.

finally, the drinking water quality samples decreased from approximately 2/3 of all samples, to roughly 18% of the observed samples. *Id.* Dr. Larson's analysis demonstrated, quantitatively, the severe water quality degradation which occurs as a result of ISL mining.

This straightforward presentation of data from a set of ISL mine units needs to be put into a larger scientific context. All the undersigned are quite aware that groundwater hydrology is astonishingly complex and overall conclusory statements, long foisted on the public by an industry loathe to be regulated, assert that the original water quality in the entirety of mined aquifers is poor. Our evidence, in contrast, conclusively demonstrates that this is not the case and, in fact, if meaningful baseline assessments were required (which, as discussed above, is not the case now), substantial amounts of water could be of high quality (but at this point, we simply don't know as NRC has not required adequate characterization of ISL sites).

2. Excursions and Fluid Migration

The NRC fails under its current interpretation of its regulatory responsibilities to analyze sufficiently the potential for and impacts associated with fluid migration associated with unplugged exploratory boreholes, including the adequacy of an applicant's plans to mitigate possible borehole-related migration impacts by monitoring wellfields surrounding the boreholes and/or plugging the boreholes. ISL recovery can cause migration of contaminants within the ore-bearing aquifer and slow movement of contaminants into upper aquifers through discontinuities or disruptions (e.g., abandoned boreholes) and other possible failure scenarios (leaks, spills, etc.) have the potential to result in significant exposures to individuals outside the production areas. *See* First draft rule at 4,165. This is consistent with our work in the Strata Proceeding where we found that the NRC failed to account for the potential for contaminant excursions in light of an inadequate assessment of aquifer confinement. Specifically, the NRC failed to sufficiently analyze the potential for and impacts associated with vertical fluid migration and unidentified or unsealed drillholes between aquifer units. *See* Attachment A at 50. The EPA's original concerns expressed in its proposed rules were well founded. All of these excursion and migration methods have the potential to result in significant exposures to individuals outside the production areas.

3. ACL

Next, the restoration goals that are set under the current regime, via an inadequate establishing of background groundwater concentrations, are, under the NRC interpretation of its obligations, essentially a process whereby an ACL is the end result every time. More rigorous standards requiring detailed restoration efforts are long overdue. Consider this stilted exchange at the Strata Proceeding hearing where it's finally made clear that no applicant has ever restored to pre-mining water quality, but there have been instances where the industry did not have to seek a license amendment because it was allowed to simply claim restoration had been completed to a prior class of use designation.

> CHAIRMAN BOLLWERK: All right. So, it sounds like, in terms of license amendments, all roads lead to ACL's?
>
> MR. SAXON: That is correct.
>
> CHAIRMAN BOLLWERK: All right. And so, I guess -- well, the question would be relative to number one and number two, have any applicant -- I am sorry. Have any licensees ever come and requested approval under one or two?
>
> MR. SAXON: No, Your Honor.
>
> CHAIRMAN BOLLWERK: So, everyone has been under number three, up to this point, anyway?
>
> MR. SAXON: Number -- it would be under -- at the time it wasn't an ACL because we were instructed to use the class of use standard. So, in order to -- but it is confusing, but that is called the secondary standard or -- it is not an alternate concentration of an ACL. It was an alternate standard, if you will, but it doesn't meet our ACL standard.
>
> CHAIRMAN BOLLWERK: Right.
>
> MR. SAXON: So if they came in and requested that the approved restoration to the class of use over the -- say, Wyoming, UIC standards.
>
> CHAIRMAN BOLLWERK: And that did require a license amendment?
>
> MR. SAXON: No, it didn't.
>
> CHAIRMAN BOLLWERK: It did not?
>
> MR. SAXON: Did not.
>
> CHAIRMAN BOLLWERK: So, that is the only instance where you -- where someone has come in and asked for an approval for restoration plan or restoration standard that did not involve a license amendment?
>
> MR. SAXON: No, it didn't. No, Your Honor.

CHAIRMAN BOLLWERK: Great.[27]

4. Monitoring

And finally, requirements demonstrating stability of the groundwater after restoration are also long overdue. Currently, monitoring groundwater conditions after restoration is typically conducted for a short period of time. Based on the following examples of other ISL sites degradation groundwater long after restoration ended, the 30-year time frame the EPA proposed in its first draft rule, at a minimum, is warranted. Industry and the NRC's assumptions that natural conditions will return are convenient interpretations not grounded in the latest science.

5. Institutional Controls

Institutional controls, long a part of environmental law, play a crucial role in selecting how best to protect the public from incomplete cleanups where contamination is left on site for extended periods of time. Unfortunately, with the continued negligence of EPA and its withdrawal of the proposed rules, we think it likely that institutional controls will be necessary for some of the many ISL sites that will never be fully restored.

Institutional controls are shorthand descriptions for restrictions placed on land, surface water or groundwater use when it is either technically impossible or economically prohibitive to permanently remove the source of pollution or contamination. The types of restrictions can be "active" institutional controls – often colloquially described as "guns, gates and guards" – or "passive" institutional controls, which range from warning notices to keep trespassers off contaminated sites to deed restrictions specifying how the land can be used henceforth. Regardless of whether institutional controls are active or passive, the purpose is to isolate the remaining contamination or potential harm from the public in an enduring fashion.

The study of institutional controls in environmental law and policy is a legacy of incomplete cleanup of both chemical and radioactive sites around the country. Indeed, the United States has thousands of large and small contaminated sites overlain by a myriad of state and federal regulatory regimes where it was either not cost-effective or technically feasible to reduce the volume of contamination to levels that provide adequate protection for unrestricted uses. Thus, institutional controls exist, agencies adopt policies to implement those controls, and in this instance, given what we know of ISL sites, institutional controls should be required.

[27] Transcript of Proceedings at 552–54, *Strata Energy Inc*. (Ross In Situ Recovery Uranium Project), No. 40-9091-MLA (2014) (ASLBP No. 12-915-01-MLA-BD01), *available at* http://pbadupws.nrc.gov/docs/ML1428/ML14280A199.pdf.

The EPA, along with regulatory requirements for institutional controls in the CERCLA context, has issued environmental radiation protection standards for management and disposal of spent nuclear fuel, high-level and transuranic radioactive wastes. The EPA defines active institutional controls in that context as: "(1) controlling access to a disposal site by any means other than passive institutional controls; (2) performing maintenance operations or remedial actions at a site, (3) controlling or cleaning up releases from a site, or (4) monitoring parameters related to disposal system performance." 40 C.F.R. §191.12. EPA defines passive institutional controls in this context as: "(1) permanent markers placed at a disposal site, (2) public records and archives, (3) government ownership and regulations regarding land or resource use, and (4) other methods of preserving knowledge about the location, design, and contents of a disposal system." *Id*. Further, the EPA states "active institutional controls over disposal sites should be maintained for as long a period of time as is practicable after disposal; however, performance assessments that assess isolation of the wastes from the accessible environment shall not consider any contributions from active institutional controls for more than 100 years after disposal." 40 C.F.R. §191.14(a) (emphasis added).

In a thorough report addressing the necessity of institutional controls and the need for them to be more effectively implemented to protect human health and the environment in the context of chemical contamination, in 2005 the Government Accountability Office reviewed (1) the extent to which institutional controls are used at sites addressed by the EPA's Superfund and RCRA corrective action programs; (2) the extent to which the EPA ensures that institutional controls at these sites are implemented, monitored, and enforced; and (3) EPA's challenges in implementing systems to track these controls.[28] The Government Accountability Office ("GAO") found institutional controls were used at most of the Superfund and RCRA sites where cleanup was completed and waste was left in place. Further, the GAO found that while EPA's guidance advises that four key factors be taken into account in selecting controls for a site (the objective, mechanism, timing and responsibility for the institutional control), 69 of the 108 remedy decision documents examined did not demonstrate that all of these factors were sufficiently considered to ensure that planned controls will be adequately implemented, monitored, and enforced. The GAO explained:

> Although EPA has taken a number of steps to improve the management of institutional controls in recent years, we found that controls at the Superfund sites we reviewed were often not implemented before site deletion, as EPA requires. In some cases, institutional controls were implemented after site deletion while, in other cases, controls were not implemented at all. An EPA program official believed that these deviations from EPA's guidance may have occurred because, during the sometimes lengthy period between the completion

[28] *See Hazardous Waste Sites: Improved Effectiveness Of Controls At Sites Could Better Protect The Public*, Government Accountability Office, GAO-05-163, January 2005, available at http://www.gao.gov/assets/250/245140.pdf.

of the cleanup and site deletion, site managers may have inadvertently overlooked the need to implement the institutional controls. *Id*. at 6.

With GAO's cautions in mind and what we know of the permanently contaminated state of ISL sites, we think the caution described above – inadvertently failing to follow EPA protective guidance occurred during the lengthy period of cleanup and license termination – should spur the requirement of institutional controls and not simply reliance on industry.

6. Conclusion And The Contamination That Will Remain

NRC should be concerned over the long term. From research conducted on uranium contaminated water at Cold War era legacy UMTRCA sites, the scientific community has gained detailed information regarding the various site-specific factors which influence uranium mobility. Once liberated into the groundwater, uranium stubbornly remains in the groundwater at concentrations that are well above the EPA's drinking water standards and hazardous to human health. The result has prompted a 40+ years of research and millions of dollars to answer the question, why? While this research has advanced our understanding of uranium geochemistry, especially in techniques for predicting the key environmental factors which impact uranium mobility in groundwater, much of the research suggests: 1) uranium is very difficult to remove through various restoration techniques groundwater, and 2) it will remain elevated in the groundwater for a very long time. Researchers from Stanford studying uranium in shallow groundwater at Rifle, Co were quoted: "*However, studies have shown that groundwater contamination is unexpectantly long lived*" and the article states that site specific conditions predicted uranium will remain elevated in groundwater for "*at least another 100 years at several sites*."[29]

That's partly why ISL industry proposed and intact decommissioning bonds have almost always been insufficient to finance the necessary reclamation and restoration activities: since the industry financial assurance estimates are made by the companies themselves – entities with a financial interest in the result of those calculations – they are not likely to be an accurate representation of restoration and reclamation costs. The calculations have also been repeatedly flawed because they do not consider the difficulty in restoring aquifers to pre-mining conditions and the actual restoration and

[29] *SLAC Scientists Search for New Ways to Deal with U.S. Uranium Ore Processing Legacy* (Jan. 23, 2015), available at https://www6.slac.stanford.edu/news/2015-01-22-slac-scientists-search-new-ways-uranium-ore-processing-legacy.aspx. Further, DOE noted that *"[f]or years the attitude was science can fix anything," said April Gil, environmental team lead for the Department of Energy's Legacy Management. "You can just wait long enough, someone will come up with an idea and we'll be able to put Mother Nature back to the natural state. And we've not been able to do that with uranium."* Laurel Morales, Fronteras, *Feds Try to Clean Uranium Found in Navajo Water* (Mar. 25, 2015)*, available at* http://www.fronterasdesk.org/content/9979/feds-try-clean-uranium-found-navajo-water.

reclamation costs incurred. "Aquifer restoration efforts commonly take much more time and many more pore volumes than initially estimated."[30]

We know no aquifer has been restored to baseline conditions at an ISL facility and the industry has relied upon ACLs as a means to stop restoration activities premature of aquifer clean-up. We believe ACLs should be the exception to the rule – not the exception that proves that rule. And as ACLs are to be used in literally every instance, a conservative calculation of the point of exposure is crucial and must be explicitly required in the revised standards. This approach on all of these matters, if rigorously applied, can bring some long-needed coherency and accountability to ISL recovery. This is where NRC should be putting its expertise and emphasis.

B. Issues that Should be Addressed to Establish a Relatively Uniform Set of Requirements for ISL Facilities Nationwide

The standards and licensing requirements applicable to the creation, fate, transport, storage, and disposal of wastes at ISL facilities warrant nationwide regulations. The NRC's current licensing practice effectively ignores the hazards presented by the temporary and permanent threats posed by these wastes. Most ISL licenses do not disclose or control the unique challenges posed by the ISL waste streams. Instead, many ISL wastes are stored on site and then shipped cross-country to the Energy Fuels' uranium mill. This NRC policy is similar to the failed policy of licensing reactors without first establishing a permanent solution for disposal of high-level wastes.

By allowing disposal decisions outside the UMTRCA's standard setting and licensing process, the ISL industry has concentrated its waste stream into disposal cells with a history of violations tolerated by Utah regulators. Perhaps more important, the lack of regulations applicable to ISL waste allows NRC Staff to downplay and even ignore one of the central concerns of UMTRCA – the NRC's failure to ensure radioactive wastes do not impact vulnerable communities like the White Mesa Ute Indian community. As part of the rulemaking to address ISL wastes, the NRC cannot ignore the increasing number of problems with lack of monitoring, poor construction, and inadequate maintenance of the disposal cells in Rifle, Colorado, Durango, Colorado, Mexican Hat, Utah, to name a few. By ignoring the letter and spirit of UMTRCA when it comes to ISL regulation, the NRC is recreating the pre-UMTRCA conditions that lead to disasters created by poorly regulated conventional uranium milling and waste disposal.

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[30] EPA Comments on Draft GEIS for ISL Uranium Milling Facilities (Nov. 6, 2008), at 5.

C. Should the NRC Proceed with this Rulemaking?

No.

The above comments document why proceeding would be arbitrary and capricious. We reiterate, the NRC should not proceed with this rulemaking but instead should encourage the EPA to finish was it began.

V. Conclusion

The NRC is correct that standards are overdue. But cementing in place the current broken system does not do it. The EPA began nearly a decade ago by convening a Science Advisory Board that urged the EPA to promulgate protective, scientifically and legally sound rules. The EPA has now done so in draft form, twice. With the strengthening measures suggested in these comments and those we made before the EPA, so amply supported by the near entirety of the administrative record, the EPA should move with all dispatch to finalize these rules and finally, after decades of neglect, bring some measure of environmental accountability to the ISL uranium recovery industry. The NRC's proposal to move forward before the EPA can reissue the withdrawn rule, and thus weaken the standards, runs afoul of clear statutory requirements and is precisely contrary to reams of science on uranium recovery's impact on scarce groundwater and communities across the American West.

We thank you for the opportunity to provide these comments and can be reached at the contact information below.

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Attachment A

JTI003-R

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* Recovery Uranium Project)	)	

Pre-Filed Testimony of Dr. Lance Larson on
Contentions 2 and 3

Table of Contents

Expert Witness Background Information

Q. 1. Please state your name, position and employer, including duration of employment.

A. 1. Dr. Lance Larson, Science Fellow, Natural Resources Defense Council. I started with the NRDC Science Center in January 2014 and am located in the Washington D.C. office. I work with the Land and Wildlife, Energy, and Water programs to protect U.S. groundwater resources.

Q. 2. Please state your education, professional registration and memberships.

A. 2. I earned a dual doctorate in environmental engineering and biogeochemistry from the Pennsylvania State University (2013). My graduate research focused on modeling acid mine drainage, arsenic and uranium fate and transport, and biogeochemical interactions between surface and groundwater. I've presented research at scientific conferences in the United States and internationally, and published multiple peer-reviewed research articles regarding interactions of redox-sensitive elements, such as iron, arsenic, and uranium. For example, in 2012 I published a peer-reviewed article on surface and pore-water interactions associated with arsenic and uranium transport in northwestern South Dakota, and in 2011 I published another peer-reviewed article on sediment-bound arsenic and uranium within reservoir sediments in North Dakota. My full resume is attached at JTI004.

Q. 3. Have you worked on *in-situ* Leach (ISL) matters prior to arriving at NRDC?

A. 3. Yes. While finishing my undergraduate degree, I worked a summer internship with RESPEC consulting in Rapid City, SD, which supported surface water hydrology and well log characterization of various geological units associated with Powertech/Azarga's proposed ISL mine near Dewey-Burdock, SD.

Q. 4. What, briefly, have you worked on since you have been at NRDC? How many of these projects have involved groundwater characterization and analysis?

A. 4. My time at the NRDC has been spent working on analyzing historical environmental impacts of ISL mines across the United States, examining the current scientific literature concerning uranium transport and sequestration mechanisms, and reviewing the NEPA documents associated with the Ross ISL project. My other projects with the NRDC are associated with researching the current state of regional groundwater supplies in the United States.

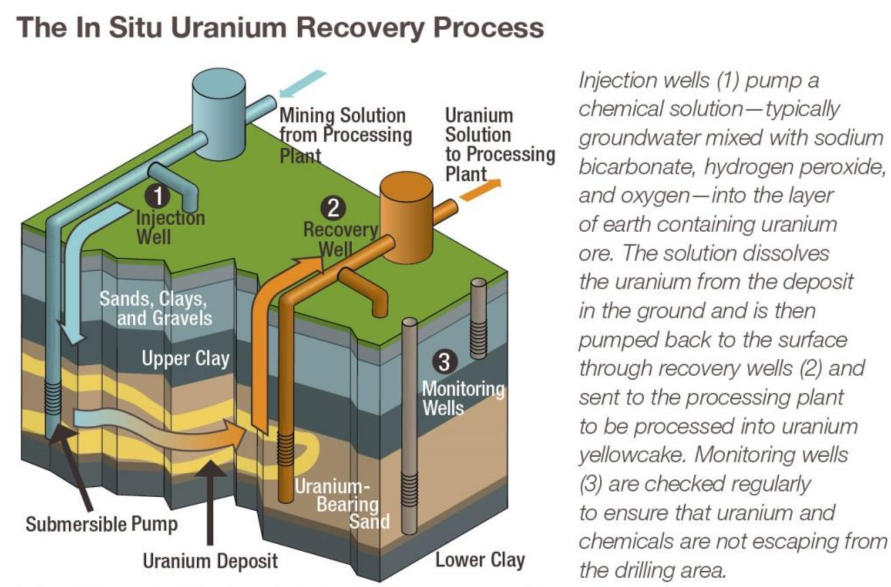
General Background Information Regarding ISL Extraction

Q. 5. Dr. Larson – please describe the ISL uranium recovery process in basic terms.

A. 5. A uranium recovery process has emerged within the last 40 years, termed *in-situ* ("in place") leach (ISL) or *in-situ* recovery (ISR) uranium extraction. This process involves injecting an oxidizing solution into a groundwater aquifer containing naturally occurring uranium ore. The solution dissolves the uranium minerals and the 'pregnant' solution is pumped to the surface, where the uranium is subsequently processed and shipped offsite. The process exploits the redox (oxidation-reduction) characteristics of uranium. This "redox" characteristic matters for the following reason. In the ore body, uranium exists as U^{4+} is a solid, as the mineral uraninite (UO_2(s)), formed by natural conditions over geologic time frames. The injection of a lixiviant solution oxidizes the naturally occurring uraninite ore, creating the U^{6+} oxidation state, which is substantially more soluble.

Q. 6. Dr. Larson I would like to draw your attention to the following figure. What is this?

A. 6. This is a figure taken from the NRC's website on ISL recovery provides a basic graphical representation of the ISL recovery process (http://www.nrc.gov/materials/uranium-recovery/extraction-methods/isl-recovery-facilities.html).



SCHEMATIC FIGURE OF GENERAL IN SITU RECOVERY PROCESS.

Q. 7. Please explain the basics of an underground aquifer.

A. 7. An aquifer is a geological unit which is capable of storing and transmitting significant amounts of water. Aquifers are divided into two broad categories, unconfined and confined. An unconfined aquifer is a shallow aquifer that is 'open' to atmospheric conditions. That is, it is not vertically constrained by an overlying confining unit. An unconfined aquifer's water-level is termed the *water table,* which represents the boundary between the saturated and unsaturated zone. A confined aquifer is overlain by an impervious confining geological unit, *aquiclude* or *aquitard,* which limits vertical transmission of water.

The *potentiometric surface* is the water-level surface for a confined aquifer that is due to the both the elevation and pressure head. When the potentiometric surface exceeds the land elevation, an artesian well or spring will be observed. Internal solid matrix stress and expansion of groundwater in the pore spaces account for the pressure head. Groundwater flows from high-to-low head potential similar to surface water flowing from high to low elevation, due to friction losses within the geological units and reflected with relatively lower potentiometric surfaces.

Q. 8. Have you reviewed the applicant's Environmental Report, DSEIS, FSEIS, and all the associated documentation with the Ross Project?

A. 8. Yes, I have extensively reviewed the applicant's Environmental Report (ER), the Draft Supplemental Environmental Impact Statement (DSEIS) for the Ross Project, the Final Supplemental EIS (FSEIS), and a host of other associated and relevant documents (SEI009A, SEI016A-E). All documents I reviewed are noted and referenced in this Direct Testimony. A complete list can be found at the conclusion of this Direct Testimony and in our referenced exhibits. My conclusions are my own professional opinions and are based upon my review of the relevant documents and my education and experience in such matters.

<u>Contention 2 – The FSEIS fails to analyze the environmental impacts that will occur if the applicant cannot restore groundwater to primary of secondary limits</u>

Q. 9. In your expert opinion, has Strata or NRC Staff analyzed the environmental impacts to groundwater that are likely to exist post-restoration, including what will occur if the applicant cannot restore groundwater to primary of secondary limits, either in the ER, the DSEIS or the FSEIS?

A. 9. No, and I will explain in detail in the pages that follow.

<u>Proposed Aquifer Restoration</u>

Q. 10. Dr. Larson, please explain what it means to "restore" an ISL mining site.

A. 10. According to the FSEIS (SEI009A at p. 2-35), the groundwater restoration at the site will follow the progression

1) Groundwater sweep
2) Reverse osmosis (RO) permeate injection
3) Recirculation
4) Chemical treatment
5) Stability monitoring

Groundwater sweep (1) involves collective recovery pumping in the wellfield to capture elevated constituents in ISL impacted water. Following groundwater sweep, RO permeate injection (2) occurs as a 'pump-and-treat' method where recovered groundwater is treated using RO and the permeate is re-injected into the wellfield. After RO permeate injection, 'hot spots' (where uranium concentrations remain elevated) are focused using recirculation (3), which aims to homogenize elevated groundwater concentrations through dilution. Recirculation is similar RO permeate injection, except the recovered groundwater is not treated with RO. In certain instances, chemical injection treatment (4), typically hydrogen sulfide gas or NaS, is injected in an attempt to reduce groundwater concentrations further. Upon completion of the restoration phase, 12 months of stability monitoring (5) is required to confirm that wellfield water quality concentrations are stable and water quality parameters of concern are not migrating beyond the permit boundary. The costs of groundwater restoration at ISL sites are significant, typically 40% of the entire project budget (JTI029; p 55 in pdf, p 48 in document).

Q. 11. Now that we have established the concept of what restoration is and how it's supposed to work, how well have restoration efforts worked in the ISL uranium mining industry?

A.11. I have reviewed extensive empirical data and results, published by industry, academia, or regulators on this issue, and these data uniformly suggest groundwater restoration to pre-mining baseline levels for uranium concentrations has been overwhelmingly unsuccessful (JTI030; p.16). I will address the issue of what specific instances of ISL restoration look like several times in the testimony that follows.

<u>NRC Staff/FSEIS Characterization of Aquifer Restorations</u>

Q. 12. NRC Staff included in the FSEIS (SEI009A at 4-46) a discussion of three historical aquifer restoration activities that received NRC approval, including examples of hazardous constituent concentration values that the agency found protective of human health and the environment. The FSEIS relies on these examples to conclude that the impacts of the Ross Project on groundwater quality will be "small," FSEIS at 4-45 to 4-48, and Staff, in their April 14, 2014 Answer to Intervenors' FSEIS Contentions, defended against Joint Intervenors' FSEIS contention on this issue by asserting these examples provide "an idea of what a range of possible ACLs for the Ross Project might look like, and accordingly are representative of the impacts that might result should Strata be unable to restore the Ross

wellfields to post-licensing, pre-operational values." Dr. Larson, can you address the adequacy of Staff's presentation in the FSEIS in this regard?

A.12. Yes I can address Staff's presentation and I will do so in the following paragraphs. But in summary, in the FSEIS (SEI009A at pages 4-45 to 4-48) Staff presented a short discussion and limited data from NRC approved restorations at three sites – a) Crow Butte mine unit 1, b) Smith Highland Ranch ISL mine unit A, and c) the Irigaray ISL site (mine units 1-9). The FSEIS also purports to disclose what happened with d) the Nubeth Project, a 1970s ISL project conducted in the same proposed permit area as the Ross site. Staff's discussion of each of these four sites is inadequate and fails to present any meaningful understanding of what is certain to occur at as a result of the Ross Project: irretrievable and irreversible environmental degradation of groundwater quality, which the FSEIS does not acknowledge or discuss. And it certainly does not constitute a bounding analysis that could inform a decision maker of the likely environmental impacts. I will review in turn each of the three examples listed in the FSEIS sites, as well as issues associated with the Nubeth ISL groundwater restorations.

Q.13. Even though it was the last you mentioned, as it's contained within the Ross Project boundary, let's start with the Nubeth Project. What happened here?

A.13. According to the FSEIS (SEI009A at p. 3-39), the Nubeth project had two separate ISL leach operations which were conducted within the current Ross permit boundary. Project A was a single push-pull (the injection and recovery processes were used with one well) which was located "*1000 ft north of Oshoto Reservoir*" and occurred in 1976. Project B was a research and development project located "*3,000 feet south of Oshoto Reservoir*" which occurred began in 1978.

Q. 14. Can you show the results of the Nubeth project?

A. 14. I created the table below to display the complete results from project B of the Nubeth restoration (SEI009A at p. 5-28). Samples for individual wells associated with the Nubeth ore zone operation (3x, 4x, 5x, 6x, 11x, 12x, 19x, and 20x) are shown for 'baseline' (NRC017; p.66 in pdf) and Restoration/Post-Restoration. The NRC Staff presented the highlighted data in Table 5.4 of the FSEIS, and omitted four other 1981 samples taken post-restoration (NRC018; p 47-53 in pdf and JTI031; p. 8-11 pdf). When the average restoration/post-restoration values are compared to the average 'baseline', the percent increase for post-restoration, average uranium values (range from 109 – 2640 %) are greater than the values the NRC Staff provided in Table 5.4. Well 4x, 6x, and 12x were near or below uranium concentrations reported by the NRC Staff, yet all post-restoration sample averages exceeded average 'baseline' uranium concentrations. These data are critical to assessing the potential environmental impacts to water quality from previous ISL restorations near the applicant's proposed mining activities, yet the FSEIS did not provide a complete analysis with the available data.

	Baseline - (Nuclear Dynamics 1978 - ML12135A358) Nubeth Well - Uranium Concentration (mg/L)									Restoration and Post-Restoration Nubeth Well - Uranium Concentration (mg/L)							
Date	3x	4x	5x	6x	11x	12x	19x	20x		3x*	4x*	5x ^	6x ^	11x ^	12x ^	19x*	20x*
	0.071	0.08	0.1	0.075	0.079	0.073	0.3	0.006		0.12	0.21	0.1	0.09	0.1	0.09	8	0.094
	0.059	0.067	0.077	0.08	0.065	0.049	0.069	0.002		0.18	0.12	0.09	0.1	0.1	0.09	1.1	0.081
6/1978	0.068	0.086	0.068	0.1	0.079	0.064	0.069	0.003		0.64	0.16	0.09	0.1	0.1	0.09	1.4	0.088
	0.089	0.12	0.057	0.098	0.088	0.059	0.077	0.002		0.51	0.16		0.1	0.1	0.09	0.84	0.065
	0.068	0.09	0.11	0.095	0.082	0.067	0.078	0.002		0.24	0.22	0.08	0.1	0.08	0.11	0.48	0.068
Average =	0.071	0.089	0.082	0.090	0.079	0.062	0.119	0.003	Average =	0.338	0.174	0.090	0.098	0.096	0.094	2.36	0.079
Max =	0.089	0.12	0.11	0.1	0.088	0.073	0.3	0.006	Max =	0.64	0.22	0.1	0.1	0.1	0.11	8	0.094
							Percent Change (Averages) =			**476**	**196**	**109**	**109**	**122**	**151**	**1993**	**2640**

Highlighted values presented by the NRC staff in Table 5-4, p. 5-28, FEIS
^ - May - September 1979 (Nuclear Dynamics 1980 - ML13274A287)
* - March - October 1981 (ND Resources 1982 - ML13274A178)

URANIUM CONCENTRATIONS FROM NUBETH ISL OPERATIONS. "BASELINE" URANIUM CONCENTRATIONS ARE ON THE LEFT AND POST-RESTORATION VALUES ARE ON THE RIGHT

(MG/L). THE HIGHLIGHTED VALUES SHOW THE DATA PRESENTED IN THE SEI009A, P.5-28. PERCENT CHANGE WAS CALCULATED AS (POST-RESTORATION/BASELINE) * 100.

Along with inadequately presenting the restoration data from Nubeth project B, no data or discussion is presented from groundwater restorations from Nubeth project A, which was located within the proposed permit boundary, except for Table 3.7 (SEI009A, p. 3-41) which displays a pre-test sample that does not aid in understanding what happened with the restoration of the aquifer after leaching occurred. However, groundwater restorations at the Nubeth project A were unsuccessful as well (JTI032 p. 14-15; and p. 87).

Q.15. So what do these results from the Nubeth Project mean?

A. 15. In my expert opinion, failure to restore the groundwater after a short six-month pilot-scale single well leaching project should have clearly communicated to the NRC Staff that it will not be possible to restore a full-scale commercial ISL operations in 8 months as the FSEIS claims (SEI009A; p.2-35). I believe the FSEIS seriously underestimates the time necessary to restore groundwater after full-scale ISL operations, such as the Ross Project. Additionally, and perhaps more importantly, the Nubeth Project indicates that at this particular site, Strata will be unlikely to restore groundwater to primary or secondary standards. This conclusion is confounded by the fact that either Nubeth Project used only a single injection well, whereas commercial operations of ISL, like the Ross Project, use hundreds of wells, which means that groundwater restoration at the commercial scale will be even more difficult to obtain. In this regard, I also examined the results from commercial ISL operations in the United States, such as Crow Butte ISL, Smith Highland Mine Units A, and Willow Creek ISL, which serve as additional evidence of the expected groundwater impacts at the Ross ISL project. The details of groundwater restoration activities at those sites, and subsequent groundwater contamination, will be discussed in depth in the following section.

Q. 16. Let's move to the Crow Butte Wellfield 1. In its FSEIS, what did the NRC allege happened and then what actually happened?

A. 16. With respect to Crow Butte Wellfield 1: briefly, the NRC approved the restoration of Wellfield 1 after 30 of 37 water-quality parameters were returned to 'baseline' or Wyoming Class I Domestic Use Standards. Similar to other ISL groundwater restoration results, radium-226 and uranium concentrations were not restored. In the FSEIS, NRC Staff justified this failure with this statement:

"*The NRC determined that the radium-226 and uranium concentrations at 31 percent and 18 percent above post-licensing, pre-operational concentrations were protective of human health and the environment (Crow Butte Resources, 2001; NRC023 p. 10). The applicable condition in Crow Butte's NRC license was changed to require stability monitoring beyond the six-month period, as necessary to ensure no increasing concentration trends were exhibited*." (SEI009A; p. 4-46).

NRC Staff's justification is flawed. First, there is no risk or dose calculation to support the contention that the elevated radium-226 and uranium concentrations pose no threat to human health and the environment. The NRC staff incorrectly analyzed the groundwater restoration data from Crow Butte mine unit 1 and stated that uranium concentrations increase by only 18% post-restoration, whereas concentrations actually increased 18.8 times baseline concentrations (NRC036; p. 2), as is seen in the chart immediately below this paragraph. I demonstrated this error in a March 31, 2014 declaration on behalf of the Joint Intervenors (at ¶35). The difference is great, yet even after the NRC acknowledged its error after issuance of the FSEIS, (NRC036; p. 2) the NRC staff asserted the error made no impact on the qualitative aquifer impacts being "SMALL and temporary" (JTI033; p. 18 and p. 19). To the contrary, groundwater concentrations observed at 1.73 mg/L (shown in the figure below) suggest very high contamination relative to the 0.03 mg/L drinking water standards and there is no discussion or demonstration from Staff that the effects on the aquifer are temporary, reversible, or retrievable, yet NRC staff state these levels are "SMALL" (JTI033; p. 18 and p. 19). In sum, this NRC staff example of ISL restoration demonstrates a failure to accurately and thoroughly analyze the significant environmental impacts that arise when ISL operators fail to restore contaminated groundwater at ISL sites.

Table 3: Parameters Below UIC Permit Standards

Parameter	Baseline Average (Primary Goal)	UIC Permit Standard	Stabilization Average Water Quality
Arsenic (mg/l)	<0.002	0.05	0.017
Calcium (mg/l)	12.5	125	19.9
Total Carbonate (mg/l)	351	609	421
Iron (mg/l)	<0.044	0.30	<0.09
Potassium (mg/l)	12.5	125	13.2
Magnesium (mg/l)	3.2	32	5.3
Molybdenum (mg/l)	<0.069	1.00	0.10
Vanadium (mg/l)	<0.066	0.2	0.11
Radium-226 (pCi/l)	229.7	584	303
Uranium (mg/l)	0.092	5.0	1.73

It should be noted that, of the ten parameters that meet the UIC permit standards but were not returned to baseline concentrations, when standard statistical methods are applied to the baseline data, the concentrations of five of these parameters are statistically the same as baseline. The NRC states in NUREG-1569[2] that "...the baseline average plus three standard deviations is another method for establishing primary restoration targets that has been found acceptable by the NRC." CBR recognizes that this method of determining baseline concentrations is not the method approved in CBR's License. CBR is required to restore the affected groundwater on a mine unit average to the average baseline concentration with no statistical analysis of the data. However, CBR believes that NRC should consider statistical methods when determining whether acceptable efforts have been made to return Mine Unit 1 to baseline condition. Using NRC-accepted methods, five of the ten parameters are statistically at baseline concentration on a mine unit average.

[2] USNRC, NUREG-1569, *DRAFT STANDARD REVIEW PLAN for In Situ Leach Uranium Extraction License Applications*, October 1997.

RESTORATION RESULTS AT CROW BUTTE MINE UNIT 1 COMPARED TO AVERAGE BASELINE CONCENTRATIONS. URANIUM SPECIFICALLY IS HIGHLIGHTED.

Q. 17. Let's turn to the Smith Ranch Highland Wellfield A. In the FSEIS what did the NRC allege happen and what really happened?

A. 17. The NRC next discussed groundwater restoration at Smith Ranch-Highland Wellfield A (SEI009A; p. 4-46). There, the NRC stated 31 of 35 water-quality parameters were restored to 'baseline' concentrations; but again, little analysis was provided with respect to constituents not restored to 'baseline' values. Specifically, the NRC Staff did not discuss the post-restoration concentrations of uranium and heavy metals in the ore field. The Smith Ranch-Highland facility observed elevated post-restoration contaminant concentrations, relative to 'baseline', for arsenic (3000%), selenium (7000%), and uranium (7060%)(NRC037; p.8 in pdf). Specific spatial and temporal uranium groundwater concentrations from Smith Highland Wellfield A and B will be presented later in this document.

Q. 18. And turning to the third example of "restoration" provided by the NRC in its FSEIS, what happened with Irigaray Mine Units 1-9?

A. 18. Next, the FSEIS referenced the restoration approval at Irigaray Mine Units 1-9 (SEI009A; p.4-46) and stated that even though several water quality parameters were not restored, concentrations in excess of post-licensing, pre-operational levels would not exceed EPA MCLs for groundwater outside the aquifer exemption boundary (SEI009A; p.4-46). In fact, results from the Irigaray Mine Units reflect similar failures as those described above to restore uranium to baseline concentrations. I created the table below to show the restoration results for average baseline and average stability uranium concentrations for each mine unit. This data is not discussed in any detail in the FSEIS (JTI005A-R; p.259-346).

Irigaray Mine Unit	Average Baseline	Average Stability Rounds 1-4	% Change Average Stability 1-4
Mine Unit 1	3.042	0.988	32%
Mine Unit 2	0.130	3.782	2908%
Mine Unit 3	0.023	2.878	12515%
Mine Unit 4	0.046	2.420	5292%
Mine Unit 5	0.020	1.493	7467%
Mine Unit 6	0.112	1.854	1663%
Mine Unit 7	0.119	1.456	1226.8%
Mine Unit 8	0.041	1.591	3923%
Mine Unit 9	0.066	1.825	2751%

Uranium Concentrations (mg/L)

In industry's restoration summary report, industry describes the results as acceptable, saying: "*COGEMA has expended significant effort to restore the groundwater quality within the Irigaray wellfield to baseline conditions. At the completion of the Irigaray groundwater restoration program, the ore zone aquifer has been restored to standards consistent with Best Practicable Technology (BPT) and NRC's ALARA (As Low As Reasonably Achievable) principle. In this regard, over 840 million gallons of water were processed over an 11.5-year period, and an average of 13.7 pore volumes were treated for the entire wellfield. Treatment volumes exceeded the amounts included in the approved treatment plan.*" (NRC030; p.86 in pdf, p. 4-18).

In summary, the Irigary site was not restored to baseline concentrations despite an 11.5 year groundwater restoration period and 13.7 pore volumes recirculated in the aquifer

Q. 19. Does this site raise concerns regarding how baseline and restoration efforts are related?

A. 19. Yes it does. Here, 'baseline' values from Irigaray (Mine Unit 1) were significantly elevated from research and development mining activities prior to 1976 (NRC020; p. A-6, 4th paragraph and subsequent pages). Baseline uranium groundwater concentrations for Irigaray mine unit 1 were collected between 11/9/1976 – 2/24/1977 (JTI034; p.256 in pdf or p. B-4). Therefore, baseline uranium groundwater samples were biased towards high concentrations. These 'baseline' data from Irigaray were presented as the minimum, maximum, and averaged for all wellfields (wellfields 1-9) (NRC032; p. 3). The entire Irigaray restoration results for all wellfields were presented as a single combined wellfield (NRC030; p.71 in pdf, p. 4-3 in document), a COGEMA Mining Report from 2005 that stated as follows:

"*In May 2003, COGEMA Mining, Inc. met with WDEQ personnel to discuss the restoration status of the Irigaray and Christensen Ranch projects. At that time, it was proposed and agreed that one restoration report package (this report [referring to the original document]) would be submitted for the Irigaray project. This would entail combining all baseline data from Units 1 through 9 together for a larger database. It was recognized that the data from Units 1 through 9 are more meaningful when combined as a whole than if presented as several individual packages. Thus, a combined baseline data set was compiled from the ore zone baseline wells located in Production Units 1 through 9 and is included in Table 4-2 [original document].*"

All wellfields (1-9) were combined for a composite average 'baseline' and compared to restoration composite concentrations, as determined by COGEMA and WDEQ. However, 8 of the 9 wellfields (Wellfields 2 through 9) have significantly lower average 'baseline' uranium concentrations (range 0.023 – 0.13 mg/L) relative to the composite average 'baseline' value of 0.52 mg/L. Again, see the table I created above for the specific values for each mine unit. Thus, the elevated 'baseline' samples collected after research and development activities at Wellfield 1 skewed the composite wellfield average uranium concentration to a higher average value of 0.52 mg/L.

Consequently, the new restoration table gives the illusion that the overall post-restoration average uranium concentrations increased from only 0.52 to 1.83 mg/L (~3.52x increase). However, when compared to the initial average 'baseline' uranium concentrations for each wellfield, the average post-restoration uranium increases for Wellfields 1 through 9 are substantially higher. This post-operations and post-restoration manipulation of data essentially masks the reality of the groundwater impacts of the mining operations.

In brief, WDEQ approved a restoration and concluded further attenuation monitoring was not required and wells within the wellfield could be abandoned (NRC035; p. 4). The NRC Staff agreed with WDEQ's assessment of the restoration on September 20, 2006 (NRC034; p. 1).

Q. 20. So what's your conclusion from reviewing this example provided by the NRC?

A. 20. With respect to baseline, the examples demonstrate that previous mining activities and operations bias 'baseline' values to high concentrations, and pre-industrial baseline does not exist at these ISL mining sites. These examples and observations support the related nature of

Intervenor's Contentions 1 and 2: in that, the NRC Staff and the applicant have neither established an adequate baseline nor addressed the certain and degrading impact to groundwater resources when alternative concentration limits are set after restoration fails.

<u>Disclosure Of Impacts of the Ross ISL Project</u>

Q. 21. Since the Ross Project has yet to take place, we can't precisely know end results. But in contrast to Staff's presentation, can we look with more detail at sites where similar restoration plans have been approved and what might transpire?

A. 21. Yes. Commercial ISL sites in the United States have used the same restoration techniques as what's being proposed for the Ross ISL groundwater restoration. For example, at Christensen ranch, mine unit 4, the same restoration process was followed as proposed in the Ross FSEIS.

For example: The NRC staff states (JTI035; p. 33):

"*As reported by the licensee, production at MU-4 was initiated in June 1994 at MOD42, August 1994 at MOD43, and December 1994 at MOD41. Operations continued until August 1997. Groundwater sweep phase of the restoration was initiated at all three modules in August 1997 and completed at all modules in July 1998. The volume of water associated with the groundwater sweep activities was 1.93 PVs. After a three year hiatus, the next phase of restoration consisted of the groundwater treatment with RO permeate injection. This phase was initiated at MOD43 in April 2001, and at the other two modules in February-March 2002. The groundwater treatment phase was completed by March 2003. A total of 9.84 PVs is associated with the groundwater treatment phase. Injection of hydrogen sulfide gas as a reductant was initiated during the final stages of the groundwater treatment phase for MOD42 from January 2003 to March 2003. The final phase of restoration consisted of groundwater recirculation to spread the hydrogen sulfide* *reductant to modules MOD41 and MOD43. This phase of restoration was initiated in March 2003 and concluded in April 2004. The total volume of water associated with the groundwater recirculation phase is 1.0 PVs.*" (*Cf*. SEI009A at p.2-35 and 2-36).

The results from Christensen ranch show severe contamination of uranium occurred while following the standard NRC groundwater restoration plan, which is also being proposed for the Ross ISL operation. Average groundwater uranium concentrations increased from 0.044 mg/L to 3.83 mg/L during the last stability round sampling event, an increase of roughly 87x, as summarized below. I created the table below based solely on the data provided by the NRC at: JTI005A-R; p.65-84). Further, concentrations as high as 16 mg/L were observed in one well, which is 533x the drinking water standard (0.03 mg/L). If this is any indication, similar groundwater degradation at the Ross project is inevitable.

Baseline			Post-restoration, Stability Round 4 Sampling		
Average	0.044	mg/L	Average	3.83	mg/L
Max	0.37	mg/L	Max	16.0	mg/L
Min	0.005	mg/L	Min	0.009	mg/L
n	49		n	15	

COMPARISON OF AVERAGER BASELINE URANIUM GROUNDWATER CONCENTRATIONS AND POST-RESTORATION STABILITY ROUND 4 URANIUM CONCENTRATIONS FOR CHRISTENSEN RANCH ISL, MINE UNIT 4.

Q.22. In light of these examples, what is your professional opinion regarding the likely impact of the Ross Project on groundwater quality?

A.22. Relying on the examples the NRC cites in the FSEIS, the Christensen Ranch results shown above, and the examples I will discuss later in my testimony, it is my professional opinion that it is inconceivable that the Ross Project will have a "SMALL and Temporary" impact on groundwater quality, as the FSEIS concludes (SEI009A; p. xxx). There is no discussion of the irretrievable and seemingly irreversible impacts of this process. To the contrary, if the FSEIS were to consider the actual baseline conditions on the site and compare those values to the reasonably anticipated conditions post-restoration, the FSEIS would disclose that the Ross Project will have significant environmental impacts. The public, and the agency, should confront this reality before allowing this project to proceed.

Q.23. We have discussed your concerns with the other sites relied upon. In your professional opinion, is there more the FSEIS could have, and should have, disclosed regarding the likely outcome at the Ross Project, other than referring to other sites?

A.23. Absolutely. While it is of course impossible to predict precisely what the post-restoration values are going to be at the site, the experience at these other sites allow the Staff to, at the very least, prepare a bounding analysis disclosing the boundaries of the likely outcomes. Such a meaningful bounding analysis would show quantitatively – derived from a representative number of sites – what the actual groundwater impacts would be rather than a few anecdotal and qualitative conclusions such as Staff presents in the FSEIS. Further, Staff certainly has the resources to visually present and analyze the restoration results for a number of sites. As will be discussed later in my testimony, I have done just such a visual presentation for two sites. By failing to confront the degradation of water quality that is, in my professional opinion, certain to be the result of this project, or to disclose a detailed analysis of what I consider to be the likely outcomes, the FSEIS has fundamentally masked serious and irretrievable degradation of environmental resources.

Discussion of Restoration Criteria

Q. 24. Let's talk about timeframes for restoration and their relationship to the FSEIS's failure to evaluate the virtual certainty an Alternative Concentration Limit (ACL) will be required. Has the NRC done an adequate job of presenting and analyzing how long restoration will take to restore to primary, secondary, or ACL standards and the relationship between the timeline and likely outcomes?

A. 24. No. This is true for several reasons that I will now detail. As an initial matter, the suggested eight-month restoration period is far too short and inadequate to restore to either a baseline or secondary standard given the past history of failed ISL restorations at other ISL sites. Such a short time period inevitably consigns the affected aquifer to even more significant degradation than might occur with a longer effort.

Proposed restoration timeframes are based on the NRC definition of a pore volume as "*a term used by the ISL industry to represent the volume of water that fills the void space in a given volume of rock or sediment* (FSEIS; p. 2-36)". Here, the FSEIS relies on Strata's estimate that 9.5 pore volumes is an acceptable limit (SEI009A; p. B-46). NRC Staff has agreed with Strata on using a pore volume estimation and arbitrary pore volume selection approach similar to the demonstrated failed restoration at numerous other mine units, including the examples from the Irigaray ISL site and Christensen Ranch mine unit 4.

But the FSEIS provides no basis for that prediction other than the claim that it is "*within the range currently used by the uranium-recovery industry*." Given the experience at other ISL sites, where as I have discussed previously, groundwater quality has been seriously degraded; relying upon the pore volume from other sites only further confirms the serious groundwater contamination results are inevitable from this project. Only if the FSEIS disclosed that Strata would pump many *more* pore volumes than has occurred at other ISL sites could the FSEIS have predicted that the results here might be better than at these other sites.

Moreover, the low pore volume estimate ties directly to the likely outcome at the site in light of what has happened elsewhere. As I have explained, one of the bases on which restoration has been deemed adequate elsewhere is that "best efforts" have been made over a long period of time. Here, since NRC has only required a financial security tied to this inadequate pore volume estimate, it is likely that – as has occurred elsewhere – a higher level of remaining groundwater contamination will be permitted than would occur had a scientifically rigorous estimate been prepared as to the pore volume likely to be necessary to restore groundwater to something even approaching true baseline levels.

Storymap visual representations of data which support Contention 2

Willow Creek ISL - Baseline Water Quality and Post-Restoration Water Quality

Dr. Larson, you have created visual representations to illustrate changes in groundwater quality at ISL uranium recovery sites. We have here JTI005B-R, Storymap #1, *A Visual Representation Of The Failure to Restore Contaminated Groundwater at a Selected Portion of the Willow Creek ISL Uranium Mining Site*. We also have JTI005B-R, Storymap #2, *A Visual Representation Of The Failure to Restore Contaminated Groundwater & Depiction of Near-Surface Contamination at a Selected Portion of the Smith Ranch ISL Uranium Mining Site.*

Q. 25. First, what is meant by the term "Storymap"?

A. 25. A Storymap is a visual, interactive representation of spatial data coupled with detailed descriptions of the significance of the data. If a user is shown a static map or a spreadsheet, without context or the ability to interact, it is much more difficult to assimilate the information. Storymaps are a way of allowing any user to understand the data in a meaningful context.

Q. 26. Alright, now let's get started on how you created these visual representations. Is Storymap a computer assisted GIS program that is commercially available? Where would

one be able to purchase it? Does the program rely upon you for all information necessary for the program to generate accurate visual representation?

A. 26. The software package is commercially available by ESRI, termed ArcGIS. ArcGIS is commonly used by engineers, military, academics, community planners, and scientists (http://www.esri.com/). Contained within ArcGIS, ArcMap was specifically used to assimilate, locate, and organize the NRC's spreadsheet data to spatial locations. In certain instances, industry maps were 'georeferenced' to provide increased accuracy of wells and/or approximate locations of uranium ore and wellfields. Georeferencing is the process of calibrating maps (which do not have physical locations in GIS) to known spatial locations. This is a common practice to increase the accuracy of spatial data.

The ArcMap files were converted to an interactive application provided by ESRI, termed 'Storymaps'. Storymaps are ESRI's vehicle for providing ArcMap data into a story format, so that the relevance of the data can be explained to a broad audience. The software program is solely a means of displaying spatial data and has no effect on the data quality or source.

Q. 27. Where can the Board find the Storymap on the web and how can they be accessed?

A. 27. The interactive maps can be accessed by anyone with an internet connection at the following links:

Willow Creek – Christensen Ranch ISL ( ) - http://isl-uranium-recovery-impacts-nrdc.org/Willow-Creek/

Smith Ranch ISL - http://isl-uranium-recovery-impacts-nrdc.org/Smith-Highland/

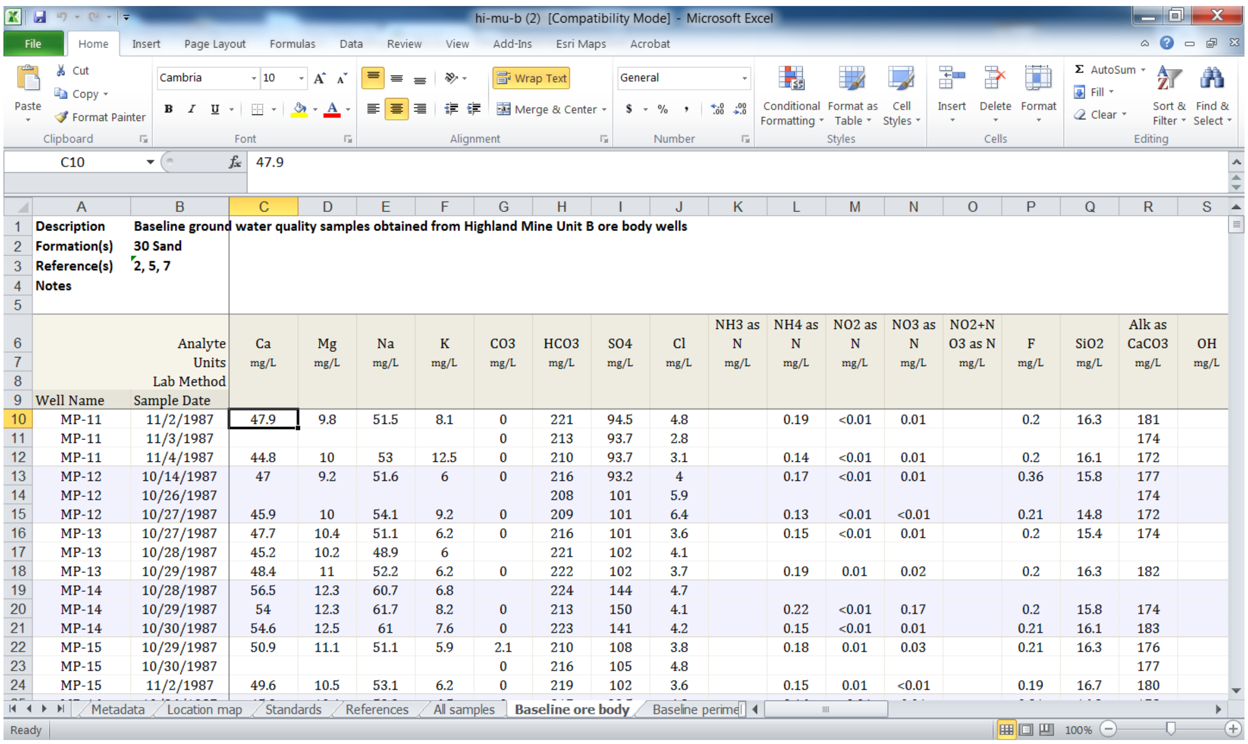
Importantly, I am the only person that can alter the Storymaps or how the underlying source data can be imported into the program.

Q. 28. Before we walk through what the Storymaps tell us, where did you obtain the data you used to create these visual representations?

A. 28. The NRC has provided groundwater data for commercial ISL operations in spreadsheet format. The spreadsheets can be found on the NRC website for ISL operations, but are attached at JTI005A-R. However, much of the environmental groundwater data stored in these spreadsheets are in a format that the general public would have a hard time locating, interpreting, and understanding the significance. Therefore, to make the groundwater impacts from ISL operations visual, I created two interactive maps that allow any user to view the results and impacts of ISL recovery. You can click on various wells to learn more information about concentration values, specific well numbers, and the history of excursions. All data is sourced with the original document or spreadsheet locations online. The information is taken from NRC published data and reports, which are all publically available.

Q. 29. So every piece of data you used came from the NRC website?

A. 29. Yes, the data originated from industry reporting baseline water quality in the ore body, overlying, underlying and perimeter monitoring wells. In all of the wells, the term *baseline* (i.e. not the new term "*commission-approved background*") is consistently used to show the data used to assess excursions and compare restoration results. Therefore, while NRC staff has recently changed the terminology of these samples as either "*post-licensing, pre-operational ground-water monitoring*" (SEI009A; p. 2-25) or "*commission-approved background*", the term "baseline" will be used throughout the Storymaps to stay consistent with the NRC staff's terminology used in the NRC staff provided spreadsheets. I have included a screen shot of the Smith Highland Mine Unit B to demonstrate what the NRC spreadsheet displays (see figure below, all data at JTI005A-R). Any usage of the term 'baseline' within the Storymaps is synonymous with the NRC staff's new definitions "*post-licensing, pre-operational ground-water monitoring*" or "*commission-approved background*", and not the old definition of '*baseline*' as used throughout the NRC staff's provided data.



Description	Baseline ground water quality samples obtained from Highland Mine Unit B ore body wells
Formation(s)	30 Sand
Reference(s)	2, 5, 7
Notes	

Analyte		Ca	Mg	Na	K	CO3	HCO3	SO4	Cl	NH3 as N	NH4 as N	NO2 as N	NO3 as N	NO2+NO3 as N	F	SiO2	Alk as CaCO3	OH
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lab Method																		
Well Name	Sample Date																	
MP-11	11/2/1987	47.9	9.8	51.5	8.1	0	221	94.5	4.8		0.19	<0.01	0.01		0.2	16.3	181	
MP-11	11/3/1987					0	213	93.7	2.8								174	
MP-11	11/4/1987	44.8	10	53	12.5	0	210	93.7	3.1		0.14	<0.01	0.01		0.2	16.1	172	
MP-12	10/14/1987	47	9.2	51.6	6	0	216	93.2	4		0.17	<0.01	0.01		0.36	15.8	177	
MP-12	10/26/1987						208	101	5.9								174	
MP-12	10/27/1987	45.9	10	54.1	9.2	0	209	101	6.4		0.13	<0.01	<0.01		0.21	14.8	172	
MP-13	10/27/1987	47.7	10.4	51.1	6.2	0	216	101	3.6		0.15	<0.01	0.01		0.2	15.4	174	
MP-13	10/28/1987	45.2	10.2	48.9	6		221	102	4.1									
MP-13	10/29/1987	48.4	11	52.2	6.2	0	222	102	3.7		0.19	0.01	0.02		0.2	16.3	182	
MP-14	10/28/1987	56.5	12.3	60.7	6.8		224	144	4.7									
MP-14	10/29/1987	54	12.3	61.7	8.2	0	213	150	4.1		0.22	<0.01	0.17		0.2	15.8	174	
MP-14	10/30/1987	54.6	12.5	61	7.6	0	223	141	4.2		0.15	<0.01	0.01		0.21	16.1	183	
MP-15	10/29/1987	50.9	11.1	51.1	5.9	2.1	210	108	3.8		0.18	0.01	0.03		0.21	16.3	176	
MP-15	10/30/1987					0	216	105	4.8								177	
MP-15	11/2/1987	49.6	10.5	53.1	6.2	0	219	102	3.6		0.15	0.01	<0.01		0.19	16.7	180	

Q. 30. And each piece of data on the NRC spreadsheets on the agency's website has an ADAMS accession number associated with it?

A. 30. Yes, the ADAMS accession numbers are located in the "References" tab in each spreadsheet.

Q. 31. Can you link directly to the original data from either Storymap?

A. 31. Yes. I include on the left hand side of the screen in the text a link to the NRC spreadsheets and their associated data.

Q. 32. Did you modify, alter or change the data in any way?

A. 32. No, I did not modify the data, although I did have to average the data to provide a representative baseline value. Specifically, in each spreadsheet there are four baseline samples taken over time. In the Storymaps I created, the four baseline samples were averaged to create one baseline sample for each well. This is to show representative baseline conditions in the well. I take no position on the adequacy of the baseline concentrations in the NRC spreadsheets. I am simply analyzing the available data. Baseline values were rounded to the nearest hundredth decimal place by the Storymap. When samples measured below detection, the lowest detection limit (rather than using zero, which would bias averages to lower sample magnitudes) was used in the averaging process (i.e. <0.0003 mg/L = 0.0003 mg/L). The color scheme was arbitrarily set by the Storymap template.

Q. 33. And with the display of the post restoration phase and excursion phase (also on the left) – are they displayed the same way?

A. 33. Essentially yes. Again, each well is demarcated by a dot. The post restoration phase has a color scheme associated with it to indicate a range of values. However there, the last round of sampling was used for the color scheme. But, I have ensured exact well concentration magnitudes are presented when specific wells are selected. With respect to the excursions, horizontal excursions are quotes from NRC staff copied directly from the NRC's comments on the Christensen Ranch restoration report (JTI035; various sections throughout). The shallow uranium and selenium concentrations observed at Smith Highland were selected from the first sample taken from each well (JTI036; p. 57-85).

Q. 34. So in short, from the perspective of the data, this is simply a visual representation of the spread sheets that can be found on NRC's websites?

A. 34. Yes, the Storymaps display NRC's groundwater data in a suitable format for a general audience.

Q. 35. Does the program draw assumptions from data? Or is the data entirely from the sources you import into the program?

A. 35. Again, as I described above, relative color hues are created by the program. The program places or "bins" the ranges of concentrations into groups which it identifies by color hues. The color schemes were held close for baseline and post-restoration samples so as to not mislead the user. However, regardless of relative color schemes, any well can be selected to show the exact baseline concentration magnitude or concentration changes over time.

Q. 36. Are there multiple calculations/manipulations of data?

A. 36. No. The program simply demonstrates the source data provided by the NRC spreadsheets into a spatial, graphical format that any user can visualize the groundwater impacts of ISL. Average values were calculated for baseline and all values were shown for stability rounds 1-4.

Q. 37. So what do we know about the data from the NRC sources – is the spreadsheet data collected by routine and consistent procedures and/or methods?

A. 37. The spreadsheets contain links to original document sources via the 'reference' tab. According to the NRC website which supplied the spreadsheet data (JTI005A-R),

"*The links below contain in-situ recovery (ISR) wellfield baseline and restoration ground water quality data collected from the licensed ISR Smith Ranch site for regulatory purposes. Hard copies of this information are publicly available in ADAMS, ADAMS legacy or in State records, however, to improve public access to the data, standardized MS Excel spreadsheets are being made available. The spreadsheets listed below contain the ISR wellfield ground water quality data for Smith Ranch and Highlands Uranium Project mine units through January 2012 (Contact:* **ISRgroundwaterquality.Resource@nrc.gov***)"*

Note, '*baseline*' was used by NRC staff to describe the pre-mining groundwater data which was used to set monitoring well UCLs and groundwater restoration goals. Therefore, 'baseline' will be used throughout the Storymaps to describe the groundwater data used to set UCLs and assess restoration performance.

Q. 38. Is the spreadsheet data input in a routine matter, with little variation in way data is input into system?

A. 38. Spreadsheets are a similar format, regardless of the ISL operation. The NRC's spreadsheet template appears to be consistent regardless of operation or mine unit.

Q. 39. So, circling back to the finished product of the Storymaps– are your visual depictions verifiable or able to be duplicated?

A. 39. Yes, as long as a user has access to an internet connection, Microsoft Excel, and ArcGIS software package, and a thorough understanding of GIS, any user could replicate these

Storymaps. All of these software packages are very common place for science and engineering consultants. ESRI has provided step-by-step tutorials on how to create Storymaps from ArcGIS files.

Q. 40. So in summary, the Storymaps simply accurately and appropriately reproduce the spreadsheets in such a way as to make them visually intelligible?

A. 40. Yes, in a spreadsheet format, it is very difficult to collect, assimilate, and understand the groundwater impacts. I've simply made the spreadsheet data visual, to make the user able to understand the actual groundwater impacts from measured, quantitative data provided by the NRC staff.

Q. 41. So now that we've established what they are, let's turn to what they show. Let's look at the first screen.

A. 41. The first site we'll investigate is Willow Creek/Christensen Ranch ISL, mine units 2-6. The source groundwater uranium data for these mine units can be found here (JTI005A-R; p. 2-220). I have learned that parts of mine unit 5 have returned to production, and the groundwater chemistry there is considerably altered beyond what concentrations are shown (JTI037; p.1). These data are simply the 'first' baseline and 'first' post-restoration results at Willow Creek/Christensen Ranch ISR after active groundwater restoration and available via the NRC spreadsheets.

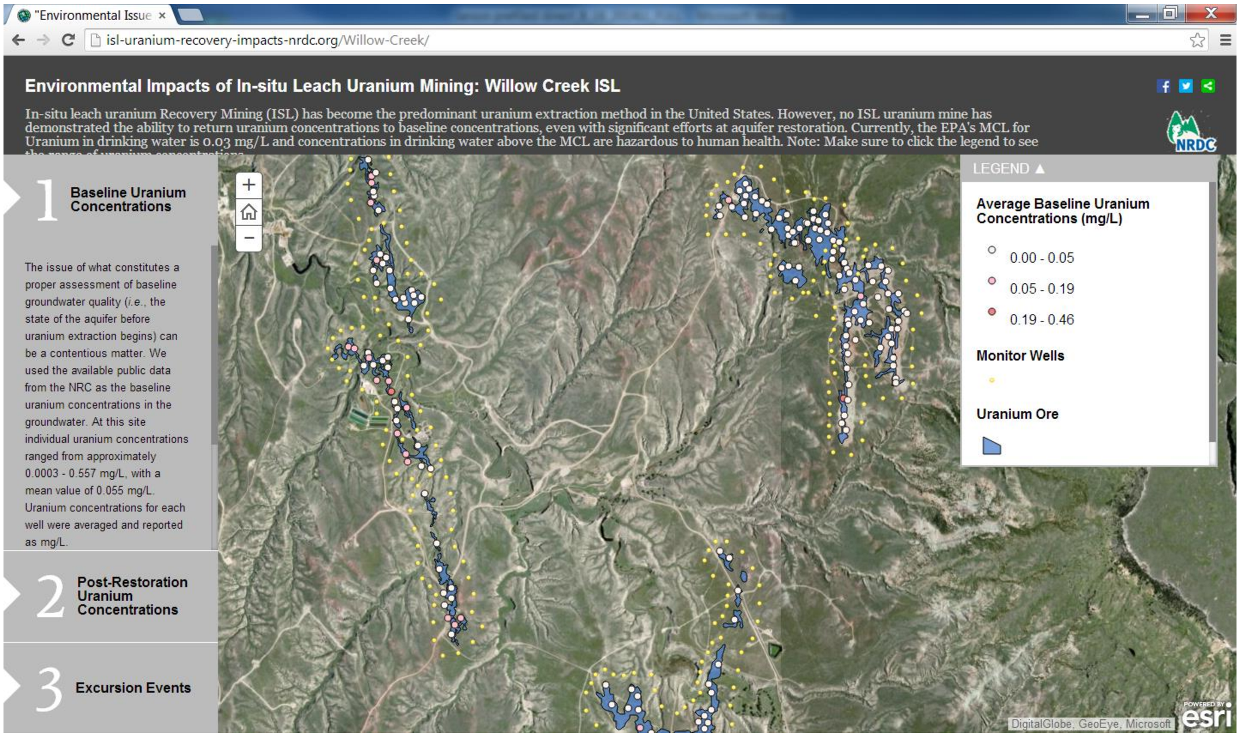
Q. 42. First we have to get it loaded up on the screen and working – can you walk us through the simple steps to do that?

A. 42. The user can type, copy and paste, or 'click' the link http://isl-uranium-recovery-impacts-nrdc.org/Willow-Creek/ to access the storymap (JTI005B-R). Make sure the left hand tabs have completely loaded before interacting with the map. Once the webpage is loaded, click the ‘legend’ to expand.

Q. 43. Now, that we are up and loaded, what are we looking at first?

A. 43. The first Storymap is broken into three tabs: 1) the ‘baseline’ uranium groundwater concentrations, 2) the post-restoration uranium groundwater concentrations, and 3) excursion reports. 1) ‘Baseline’ (Now termed - “*Commission-approved Background*” or “*Post-Licensing Site Characterization Background*”) uranium concentrations are collected before mining occurs and are used to assess the restoration targets values and UCLs. 2) Four samples are collected for one year following restoration activities to determine if groundwater concentrations are not statistically increasing (i.e. ‘stable’). 3) Excursions occur when measured excursion parameters exceed baseline UCLs due to escaping mining fluids, either horizontal or vertical.

The first screenshot seen below is the average uranium baseline groundwater concentrations (mg/L) for mine units 2-6 from an aerial viewpoint (below and JTI005B-R; p.2). The yellow dots are horizontal monitoring wells delineating various mine units, the blue regions are uranium ore, and the various interior wells are ore body sampling wells. The ‘redness’ of the interior wells is proportional to the average baseline uranium concentration observed at that well. A short description of the storymap is located above the map and left hand pane describes the baseline tab specifically.



Q. 44. So first let's understand the picture – you can cursor up and down, just as one would Google Earth or another such program, and then what?

A. 44. The user can fully interact with the map and pan north-south-east-west and to zoom in and out (to a certain extent). When selected, ore zone wells have a 'pop-up' window that displays addition information.

Q. 45. What's the listing on the left?

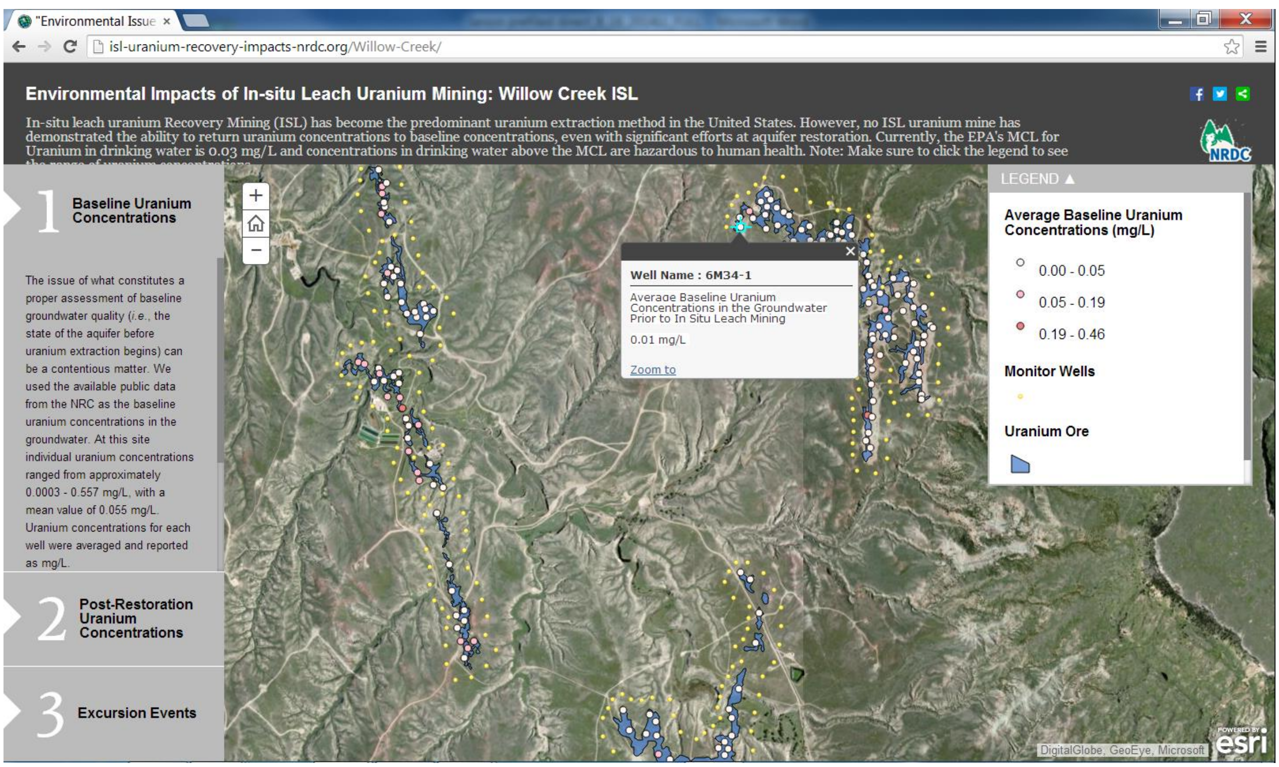
A. 45. The left pane shows three different tabs which display the 'story'. The first tab is already showing, which is the 'Baseline Uranium Concentrations'. A short description is located below the title. The second tab is labeled 'Post-Restoration Uranium Concentrations' and third 'Excursion Events'. If nothing shows on the left, 'refresh' the browser window.

Q. 46. Where is the legend to explain the map?

A. 46. The legend is located in the top right portion of the map. The legend can be 'clicked' to either expand or collapse.

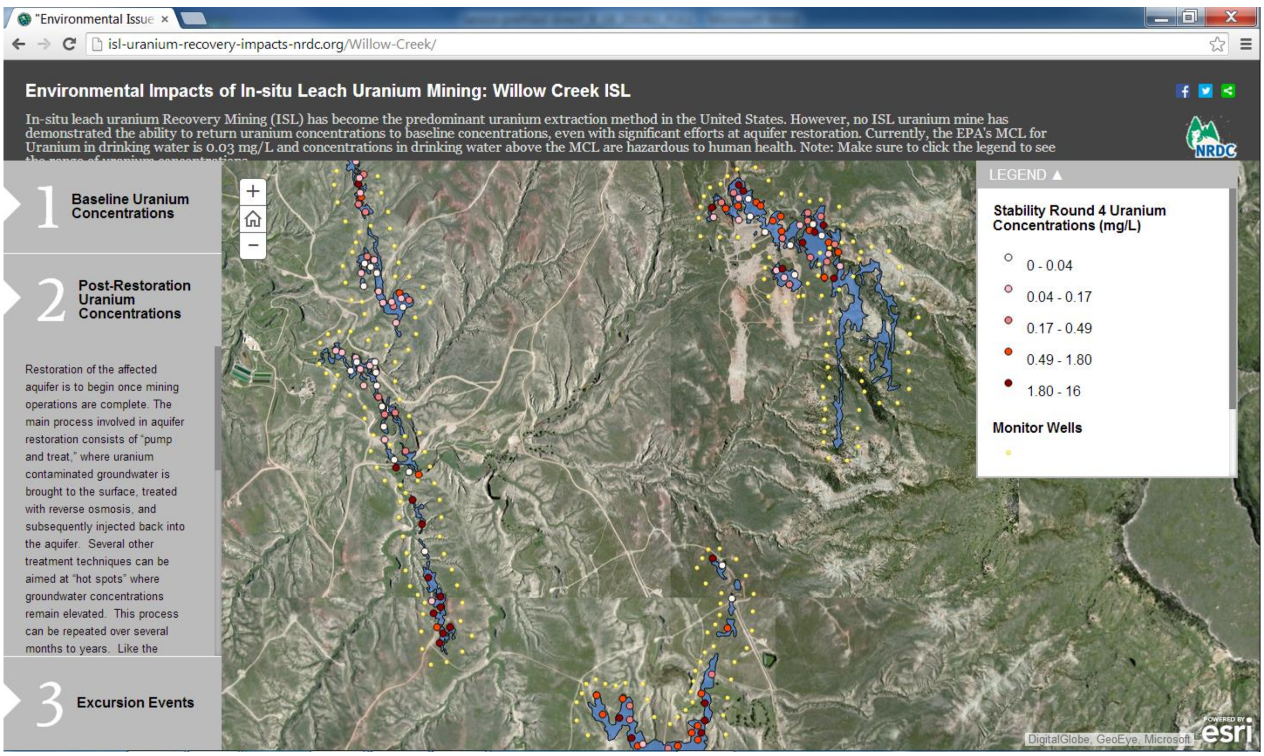
Q. 47. What happens if the user points to a circle on the screen, clicks with his or her mouse or keypad?

A. 47. To investigate any given well specifically, move the cursor over the interior well and 'click'. The image below shows the result of clicking on a given well (JTI005B-R; p.3). A small pop-up window appears which shows the average baseline uranium concentration (in mg/L) for that given well and the well name (6M34-1). The average uranium baseline concentration was 0.01 mg/L for this well.



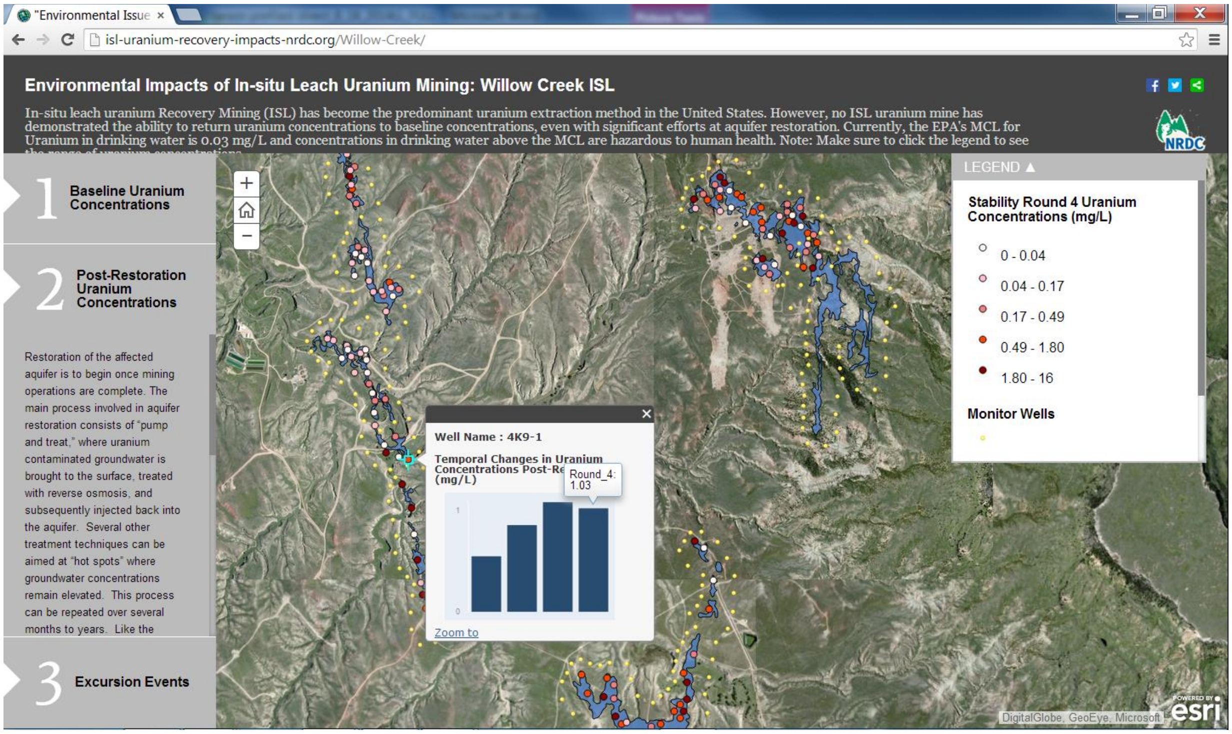
Q. 48. What does the second tab (Post-Restoration Uranium Concentrations) show in relation to the first tab (Baseline Uranium Concentrations)?

A. 48. Upon 'clicking' on the second tab (Post-Restoration Uranium Concentrations), immediately the user notices most wells have darkened considerably, due to contamination of uranium that could not be removed from the aquifer. These data show the measured uranium concentrations in groundwater once mining and groundwater restoration have occurred. Once restorations are completed, four stability measurements are taken to confirm the relative stability of the contaminants of concern.



Q. 49. What happens when a well is selected in the Post-Restoration Uranium Concentrations tab?

A. 49. Different from the baseline tab, all four stability rounds are shown in the pop-up window (see image below, for well 4K9-1) (JTI005B-R; p.5). Only the fourth round sampling concentrations were used to indicate the level of red shade.



Q. 50. What does the vertical axis tell us?

A. 50. The vertical y-axis shows the groundwater uranium concentration (in mg/L) for a given well. The range of values on the y-axis were automatically created by the storymap application based upon the range of minimum and maximum concentrations observed at that given well. However, the user can scroll-over any bar to see the exact concentration of uranium in mg/L (see figure above – 1.03 mg/L or ~34.3x the safe drinking water limit).

Q. 51. And what does the horizontal axis tell us?

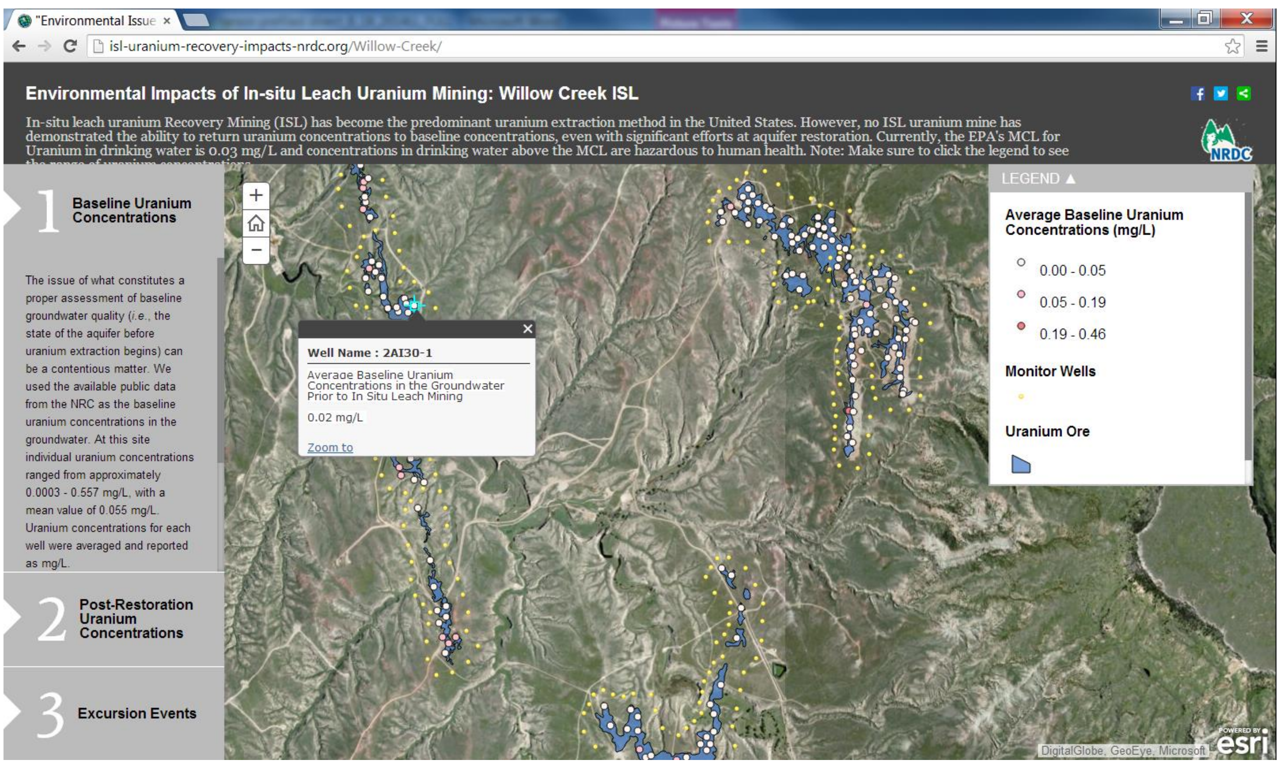
A. 51. No data is located on the x-axis. The x-axis simply shows the temporal sampling events for a given well. In other words, each column was one groundwater stability sample. Exact sampling dates are located in the original spreadsheets.

Q. 52. Now that we've scrolled around the screen a bit, let's start with some examples of what the Willow Creek Storymap shows us. Let's look at a specific well and start with its baseline number.

A. 52. Selecting the 'baseline' tab again: the first well selected was located in mine unit 2, named 2AI30-1.

Q. 53. What is the original baseline here?

A. 53. The NRC staff's spreadsheet data presented for the baseline concentrations as 0.026, 0.037, 0.022, 0.004 mg/L, resulting in an average concentration of 0.0223 mg/L. When 2AI30-1 is selected, the baseline value presented is 0.02 mg/L, which was rounded to the nearest hundredth decimal (JTI005B-R; p.6).

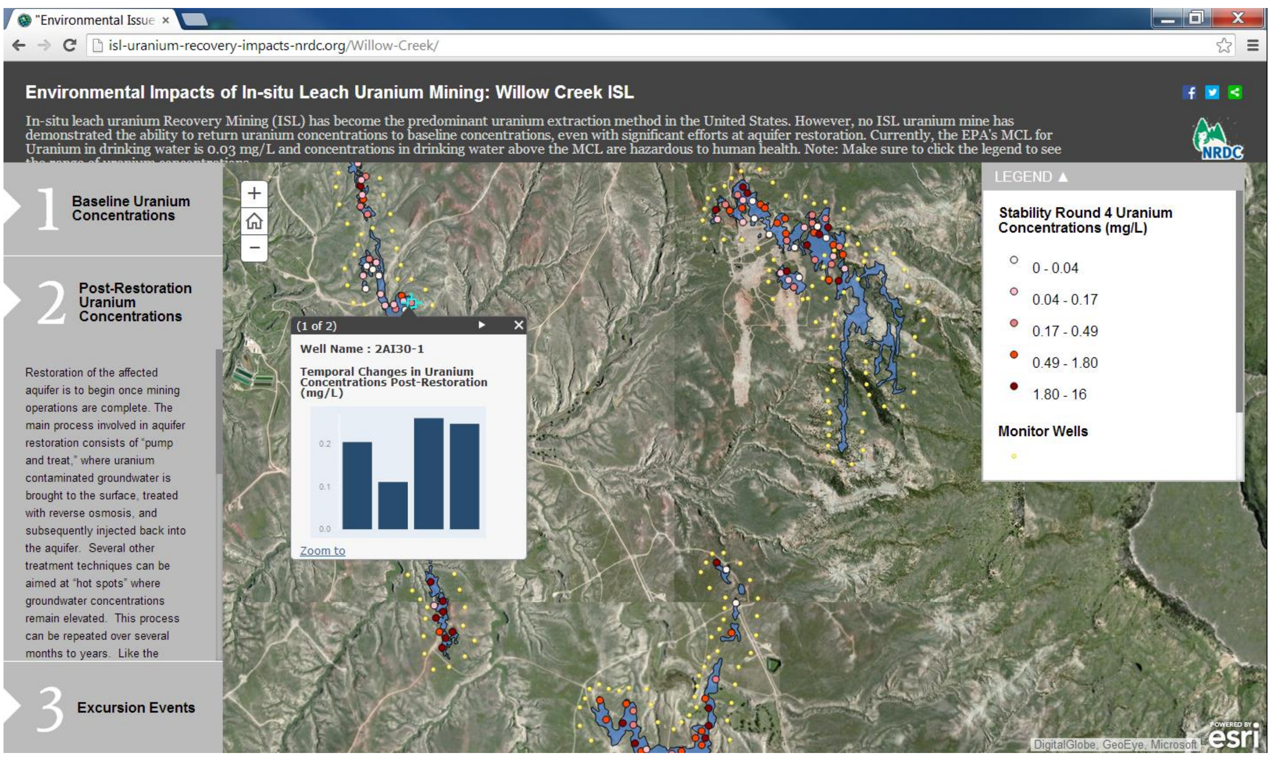


Q. 54. And you can access the data and spreadsheet the information came from?

A. 54. Yes, the original NRC staff's spreadsheet is located at the following link (JTI005A-R; p. 2-220). Or the user can access this well specifically by opening the original excel file titled "Christensen Ranch Mine Unit 2", and selecting the 'Baseline ore body' tab.

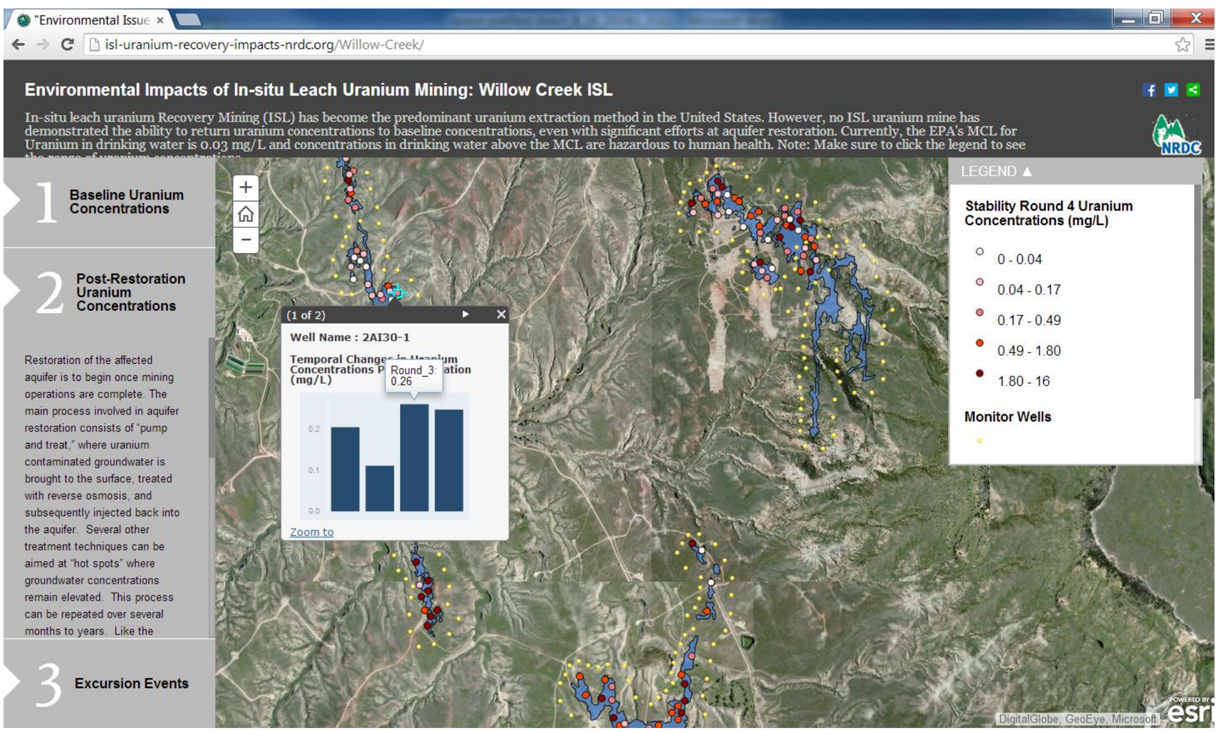
Q. 55. Now let's turn to what happened with that well. How do I find that?

A. 55. Now click the tab on the left side of the screen labeled "Post-Restoration Uranium Concentrations", find well 2AI30-2 in mine unit 2, and click the well again. Notice that the well has a slightly darker red color, indicating the uranium concentration has increased substantially relative to the baseline average.



Q. 56. Let's look to see what happened with the same well. What is meant by "post-restoration" and what does the reader see here? What do each of the columns represent?

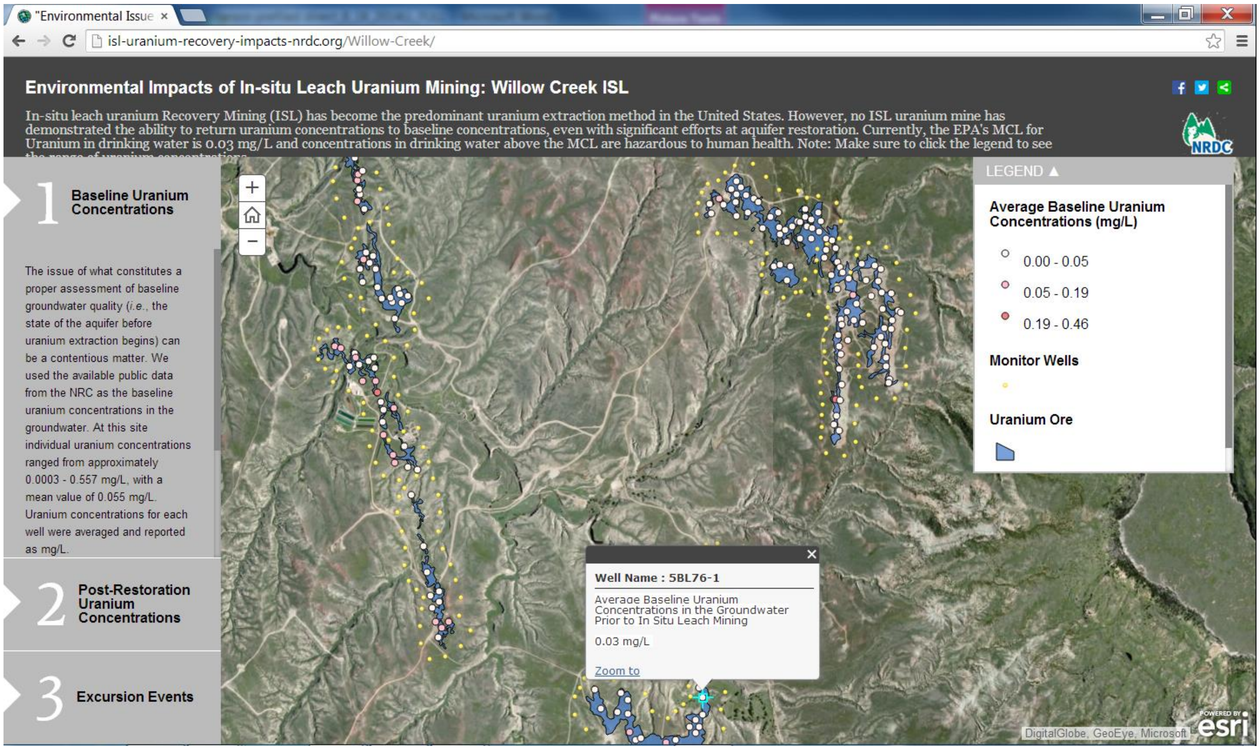
A. 56. When well 2AI30-1 is selected, the pop-up window displays four columns instead of a single value. These columns represent the four stability sampling rounds which occurred after active groundwater restoration. According to the NRC staff's spreadsheet, the sample dates were 4/8/2004, 7/15/2004, 10/12/2004, and 1/4/2005, indicating that the entire stability sampling for this well was approximately nine months. According to the NRC staff's spreadsheet, the corresponding uranium concentrations were as followed, 0.207, 0.113, 0.263, 0.25 mg/L. These values become apparent when you 'scroll' over the columns with the mouse cursor (JTI005B-R; p.8). At this well after active restoration, the lowest observed uranium concentration (0.113 mg/L) was approximately 5x higher than the average baseline concentration (0.0223 mg/L) and approximately 3.8x higher than safe drinking water standards (0.03 mg/L).



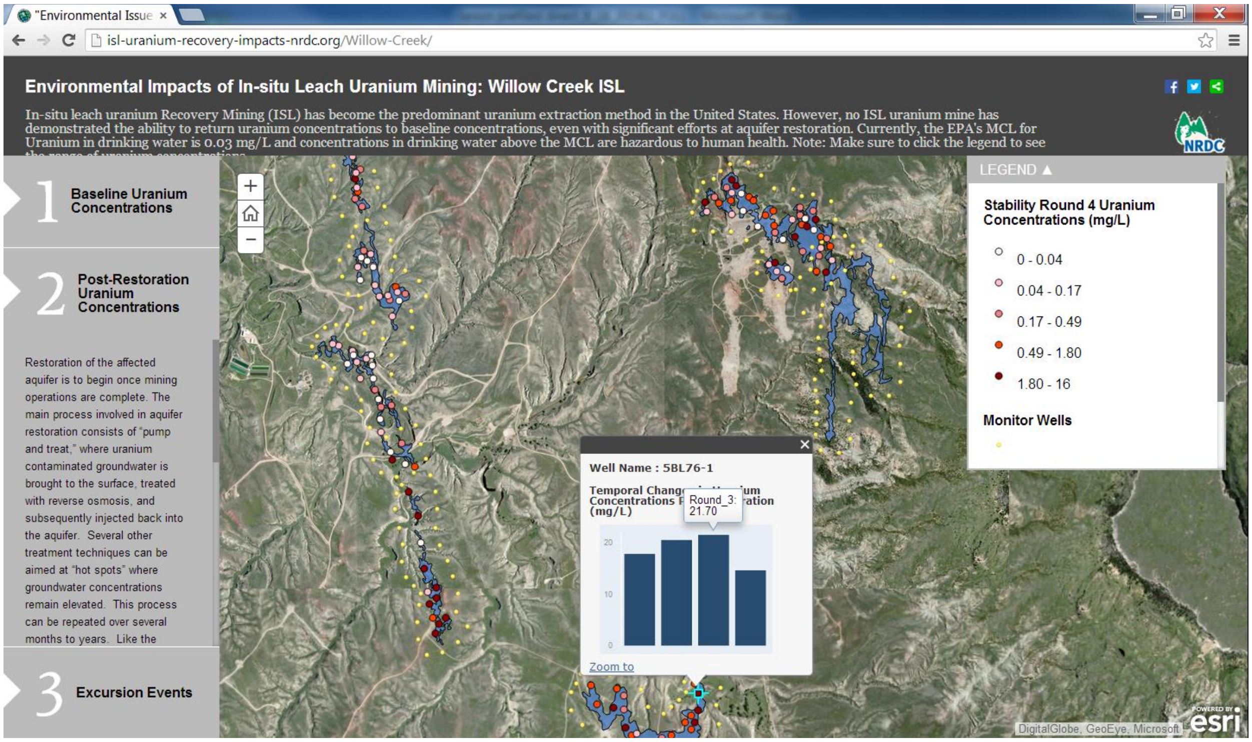
Q. 57. What about the restoration results at other wells?

A. 57. Let's examine another example of groundwater contamination. Select the 'Baseline Uranium Concentrations' tab and select well 5BL76-1 in mine unit 5 (JTI005B-R; p.9). According to the NRC staff's spreadsheet, the average baseline uranium concentration was ~0.03

mg/L (0.027, 0.031, 0.021, and 0.024 mg/L taken 9/1/1994, 9/15/1994, 9/28/1994, and 10/12/1994, respectively).

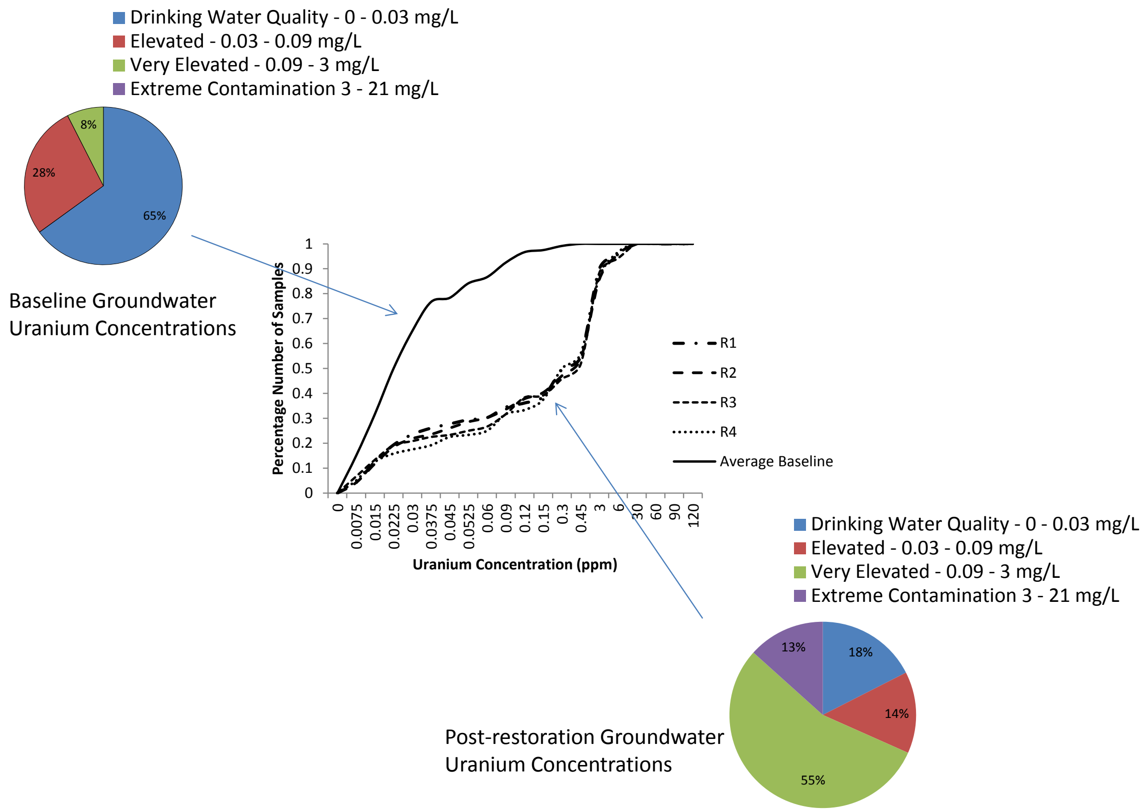


To observe the impacts of ISL mining, select the 'Post-Restoration Uranium Concentration' tab and select well 5BL76-1 (JTI005B-R; p.10). Scroll over the various blue columns to view the groundwater uranium concentration values after active restoration was complete. The observed groundwater uranium concentrations can only be described as extreme: 18.0, 20.7, 21.7, and 14.8 mg/L which were 600x, 690x, 723x, and 493x average baseline and safe drinking water standards. This well represents the highest concentrations of uranium in groundwater observed from the Christensen Ranch ISL operation from this data set. I encourage the reader to select various wells to observe specific impacts (JTI005B-R).



Q. 58. Is there a way to look at this data set holistically? That is, can we see the entirety of the impact to the aquifer? For example, what is the difference for all samples, between average baseline and post-restoration uranium concentrations?

A. 58. Yes we can look at the data as a whole and I have analyzed the sample well distributions between average baseline and post-restoration uranium concentrations due to ISL and groundwater restorations. Using the entire wellfield data set from Christensen Ranch MU2-6, I created a cumulative histogram for average baseline and each post restoration phase sampling round concentrations (denoted as "R1, R2, R3, R4"). The figure below shows the results of the analysis, displaying the distribution of data, in this case, cumulative distribution of data. The y-axis shows the percent number of samples which observe uranium concentrations at various magnitudes. To interpret the figure, choose a concentration of uranium (for example: 0.03 mg/L), and read the corresponding value on the y-axis. For pre-mining baseline conditions, the percentage of samples with concentrations of 0.03 mg/L or less is approximately 65%, while post-restoration samples show the percentage of samples at or below 0.03 mg/L was approximately 18%. The pie charts summarize these distributions, for average baseline conditions (top left) and post-restoration conditions (bottom right).



Q. 59. In light of what this chart show us, how do ISL activities change the groundwater quality distribution of uranium concentrations?

A. 59. Elevated uranium concentrations (0.03-0.09 mg/L) were observed in 28% of the baseline samples and very elevated (0.09 – 3.0 mg/L) represented 8% of the baseline samples, however the majority of the average baseline groundwater samples were below the MCL for uranium of 0.03 mg/L (~65%, n = 120).

Upon mining and restoration activities, the groundwater quality sample distribution shows significant changes to these observed percentages. For example, a new category termed 'extreme contamination' was created to describe samples >3.0 mg/L (>100x safe drinking water standards). These 'extreme contamination' samples represented roughly 13% of all observed post-restoration groundwater wells. Further, the 'very elevated' uranium concentrations increased from 8% (Baseline) to 59% (Post-restoration). Finally the drinking water quality samples decreased from approximately 2/3 of all samples, to roughly 18% of the observed samples. This analysis demonstrates, quantitatively, the severe water quality degradation which occurs as a result of ISL mining, which is not disclosed or discussed in the FSEIS.

The total amount of groundwater affected from ISL mining at Christensen Ranch mine unit 2-6 was estimated by industry as 1.04 billion gallons of groundwater (JTI038, p.21).

Q. 60. What do these results tell us about the potential impacts to the groundwater from the Ross project and the need to evaluate information regarding the reasonable range of hazardous constituent concentration values that are likely to be applicable if the applicant is required to implement an Alternative Concentration Limit (ACL)?

A. 60. As discussed previously, Willow Creek/Christensen ranch, mine unit 4 (located in the bottom left of the Storymap, wells start with the number 4), the same restoration process was followed as proposed in the Ross FSEIS.

For example: The NRC staff states (JTI035; p. 33):

"*As reported by the licensee, production at MU-4 was initiated in June 1994 at MOD42, August 1994 at MOD43, and December 1994 at MOD41. Operations continued until August 1997. Groundwater sweep phase of the restoration was initiated at all three modules in August 1997 and completed at all modules in July 1998. The volume of water associated with the groundwater* *sweep activities was 1.93 PVs. After a three year hiatus, the next phase of restoration consisted of the groundwater treatment with RO permeate injection. This phase was initiated at MOD43 in April 2001, and at the other two modules in February-March 2002. The groundwater treatment phase was completed by March 2003. A total of 9.84 PVs is associated with the groundwater treatment phase. Injection of hydrogen sulfide gas as a reductant was initiated during the final stages of the groundwater treatment phase for MOD42 from January 2003 to March 2003. The final phase of restoration consisted of groundwater recirculation to spread the hydrogen sulfide reductant to modules MOD41 and MOD43. This phase of restoration was initiated in March 2003 and concluded in April 2004. The total volume of water associated with the groundwater recirculation phase is 1.0 PVs.*"

It's also important to note that the complete active restoration for this mine unit only, was roughly 11 months for groundwater sweep, 1-2 years for RO permeate injection, and roughly 13 months for groundwater recirculation.

Groundwater restoration techniques and pore volume requirements at this mine unit followed the same progression as described by the NRC staff for Ross (SEI009A; p.2-35 – p. 2-37) with a far shorter active groundwater restoration time frame of 8 months (SEI009A; p.2-35). Similar or worse, groundwater degradation at the Ross project is virtually inevitable and such impacts have not been meaningfully analyzed in the FSEIS.

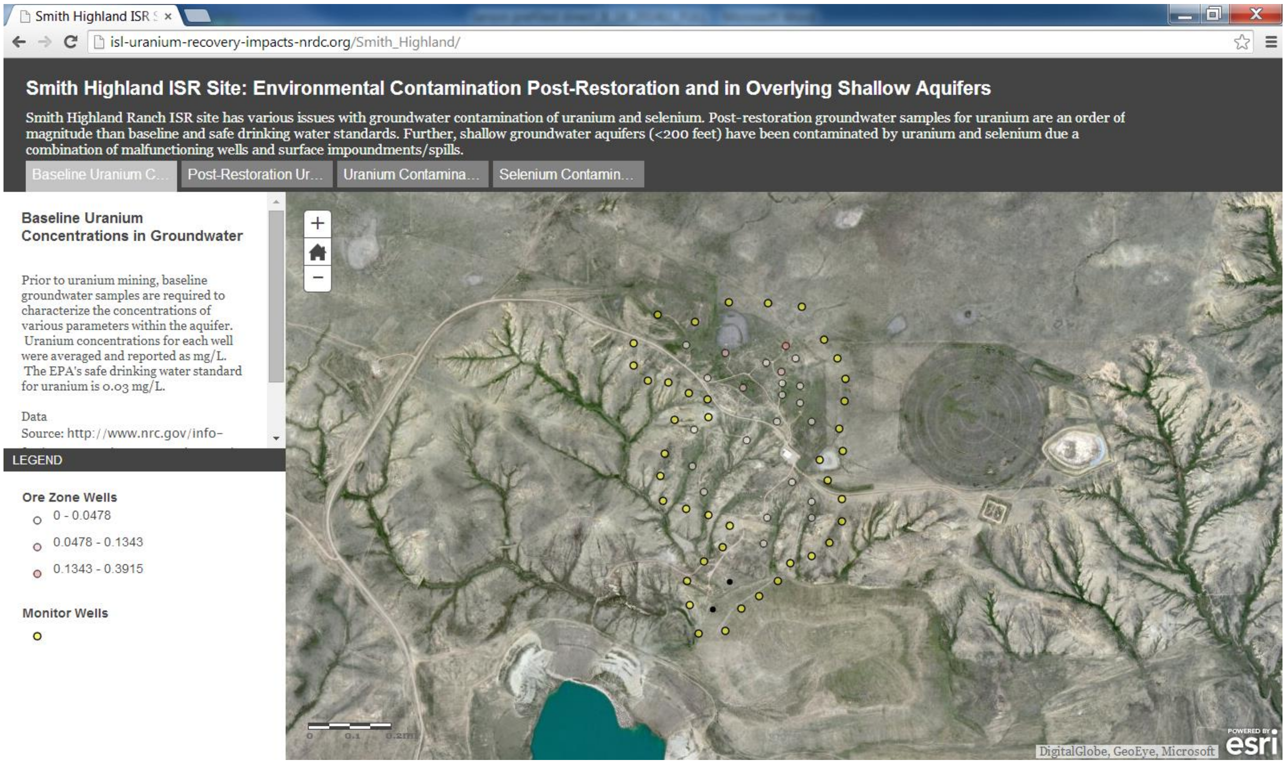
Smith Highland Mine Units A and B - Baseline/Post-restoration

Q. 61. Let's now turn to the second Storymap – Smith Ranch. We don't need to walk through all the steps we did before as it basically works the same –

A. 61. Yes, it works the same way. Follow the link http://isl-uranium-recovery-impacts-nrdc.org/Smith_Highland/. (JTI005B-R; p.1, 21-31). While fundamentally the same as the Willow Creek ISL Storymap, this Storymap has four tabs which are located below the header text (instead of three on the left hand side) and the legend is located in the bottom left hand corner (JTI005B-R; p.21). The monitor wells are in yellow and the ore zone wells are for both Smith Highland mine unit A and B. Mine unit A wells are MP-1, MP-2, MP-3, MP-4, and MP-5. Mine unit B wells are MP-11 through MP-31 (excluding MP-17; which was not included in the original NRC Staff's spreadsheet). Wells MP-26 and MP-27 do not have publically available baseline data, therefore are represented as black dots. However, post-restoration data was available for these wells, though comparison to baseline is not possible. While spatially overlapping, the difference between mine units A and B is the depth to the uranium ore was variable for either operation. The screen shot below is an overview shot of Smith Highland A and B. And again, I take no position on the adequacy of the NRC's baseline information. I am simply working with the available data from the agency.

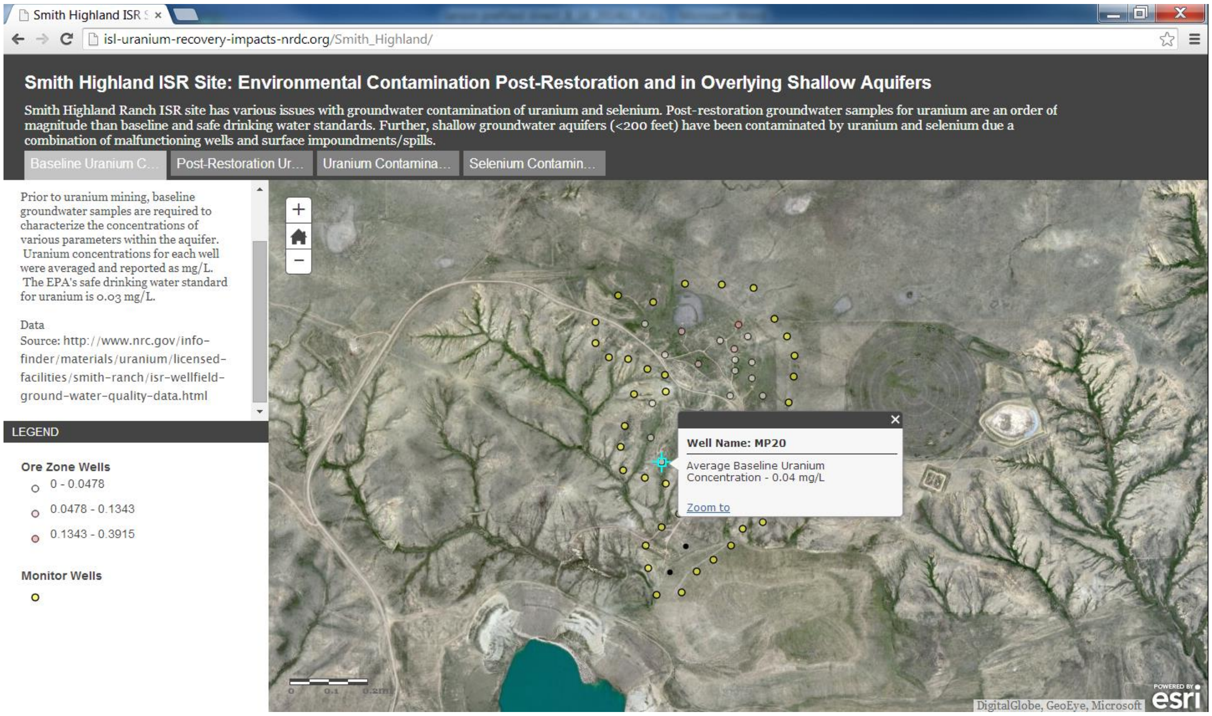
According to the NRC Staff's spreadsheet, for Smith Highlands mine unit A (Mine unit A and mine unit B are separate uranium ore bodies located at different depths, though spatial locations are overlapping), the start of restoration period was 7/1/1991 and the end of restoration period was 12/1/1998, which was approximately 6.5 years of active restoration. For mine unit B, the start of restoration period was 7/1/1991 and the end of restoration period was 6/1/2004, which was approximately 13 years (JTI039; p. 25 in pdf; p.16 in document). Due to the spatial proximity, Smith Highland mine units A and B will be displayed together. However, it should be noted that the groundwater ISL processes and restoration attempts occurred at different depths.

It should also be noted that the groundwater restoration from Smith Highland mine unit A has been approved by the NRC (SEI009A; p. 4-46).



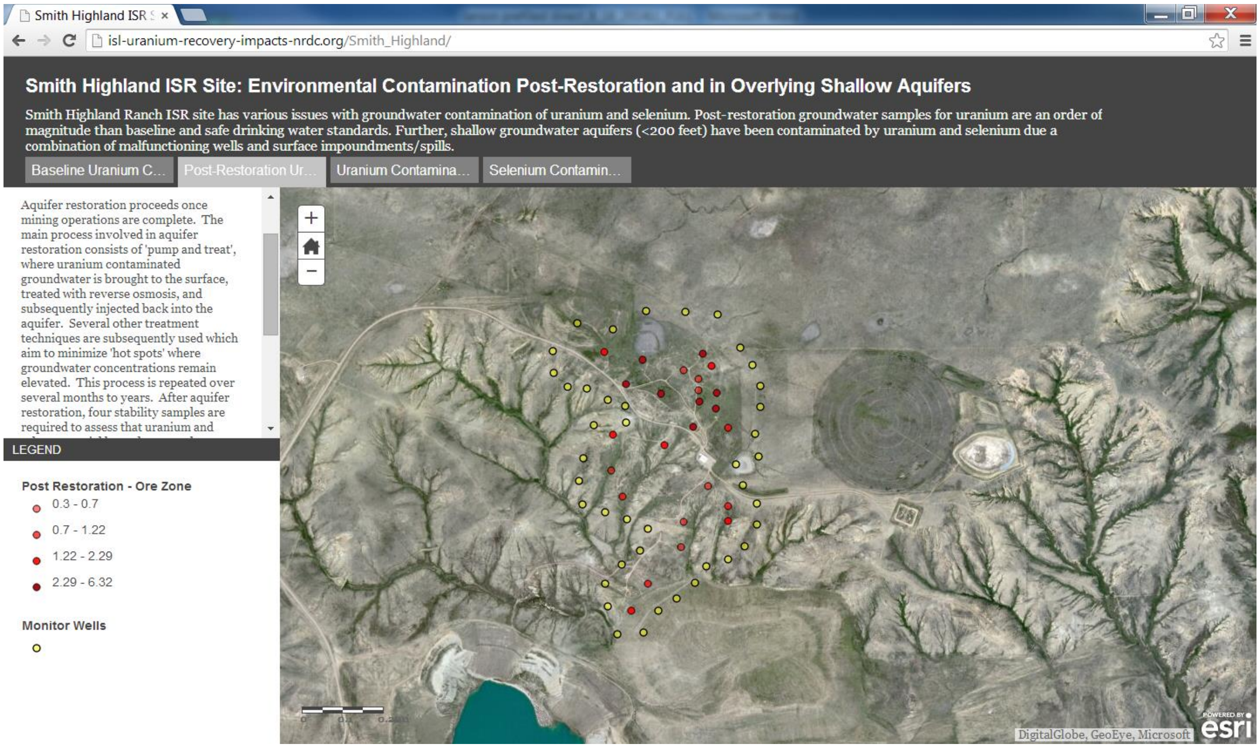
Q. 62. What happens when you select an ore body well under the 'Baseline Uranium Concentrations in Groundwater' tab (inside the monitor wells)?

A. 62. Similar to the Willow Creek Storymap, a 'pop-up' window displays the average baseline uranium concentration in mg/L. For well MP20, included in the screen shot below, the average baseline uranium concentration was approximately 0.04 mg/L, slightly above EPA's drinking water standard (0.03 mg/L). The range of average uranium baseline concentrations were roughly 0 – 0.39 mg/L.



Q. 63. How successful was groundwater restoration at Smith Highland, mine units A and B?

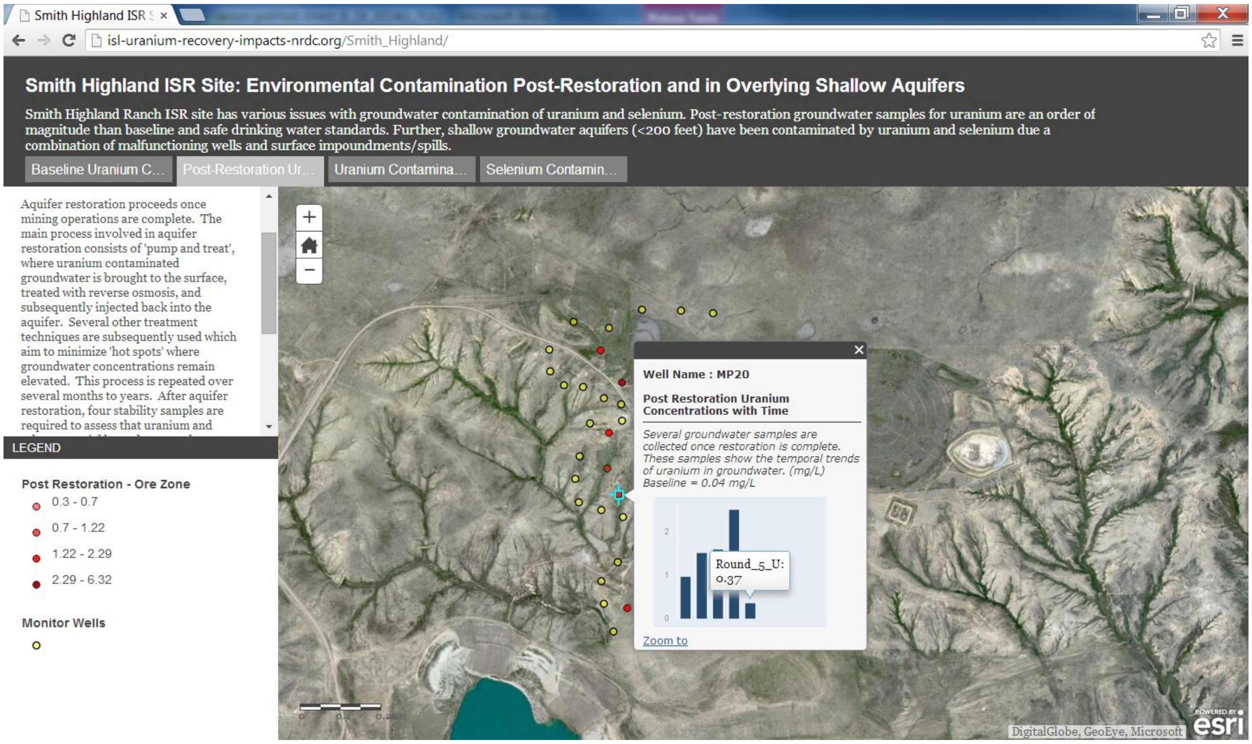
A. 63. Select the ‘Post-Restoration Uranium Groundwater Concentrations” tab. Notice the immediate change in darkness of the ore body wells. Also notice the legend has changed to reflect the range of observed uranium concentrations has drastically darken to represent an increase in groundwater uranium concentrations. Uranium concentrations for the first sample post-restoration were 0.3 – 6.32 mg/L. I’ve included an overview shot of post restoration below (JTI005B-R; p.23).



Q. 64. Let's talk briefly about some wells when "Post-Restoration Uranium Groundwater Concentration" well is selected?

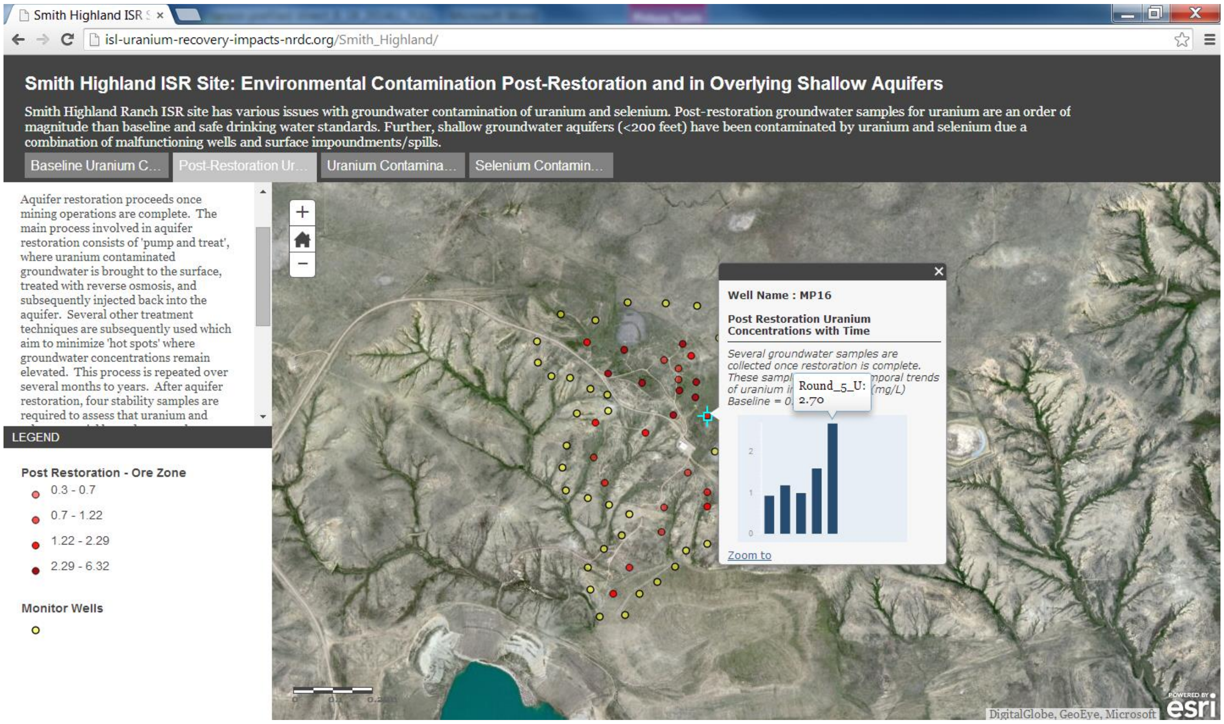
A. 64. Similar to the Willow Creek ISL Storymap, upon selection of a well the measured uranium concentrations over time are displayed in the 'pop-up' window. The actual concentrations are displayed when the cursor is placed on the vertical bars (Figure Below).

Once again I selected well MP20. The cursor shows the results of the 5th sampling round, which was the last and lowest uranium concentration measured (0.37 mg/L). In the text box above the vertical columns, the average uranium baseline concentration is present for comparative purposes. In this case the average uranium baseline concentration was 0.04 mg/L, suggesting the last and lowest uranium concentration observed post-restoration was 10x higher than the baseline and roughly 12x higher than safe drinking water standards (0.03 mg/L). Here is a representative screen shot (JTI005B-R; p.24).



Q. 65. What about another well? Are most wells elevated post-restoration?

A. 65. Yes, the user is encouraged to select various wells and examine and compare the post-restoration and baseline uranium concentrations in the groundwater. Well MP16 (JTI005B-R; p.25) shows a sharp increase in uranium concentrations at the last sampling event (2.70 mg/L), which exceeded the average baseline uranium concentration by ~270x.



Q. 66. Again, why is the failure to restored groundwater at Smith Highland Ranch ISL mine units A and B relevant for the Ross ISL project and its failure to evaluate the virtual certainty that the applicant will be unable to restore groundwater and the need to analyze the range of hazardous constituent concentration values that are likely to be applicable if the applicant is required to implement an Alternative Concentration Limit (ACL) in accordance with 10 C.F.R. Part 40, App. A, Criterion 5B(5)(c)?

A. 66. Relying on the examples the NRC cites in the FSEIS, the Christensen Ranch results I discussed at 21, and the clear visual representation that are the Storymaps, it is my professional opinion that it is inconceivable that the Ross Project will have a "SMALL and Temporary" impact on groundwater quality (SEI009A concludes at xxx and at 4-34 to 4-50). To the contrary, if the FSEIS were to consider the actual baseline conditions on the site and compare those values to the reasonably anticipated conditions post-restoration as evidenced by the Storymaps and the underlying NRC data, the FSEIS would disclose that the Ross Project will have significant and irreversible environmental impacts.

<u>Contention 3: The FSEIS fails to include adequate hydrological information to demonstrate Strata's ability to contain groundwater fluid migration.</u>

Q. 67. In your expert opinion, have Strata or NRC Staff in the ER, the DSEIS, or the FSEIS presented adequate hydrological information to demonstrate Strata's ability to contain groundwater fluid migration?

A. 67. No. I have several areas of significant concern. First, I have fundamental disagreements with the NRC over how they either interpret basic geochemical interactions that will take place in the subsurface when efforts to establish baseline are commenced and, more important, when mining commences. Second, the FSEIS fails to account for the potential for contaminant excursions in light of an inadequate assessment of aquifer confinement. Specifically, the FSEIS has failed to sufficiently analyze the potential for and impacts associated with vertical fluid migration, and unidentified or unsealed drillholes between aquifer units. This is directly relevant to the FSEIS's failure to analyze sufficiently the potential for and impacts associated with fluid migration associated with unplugged exploratory boreholes, including the adequacy of applicant's plans to mitigate possible borehole-related migration impacts by monitoring wellfields surrounding the boreholes and/or plugging the boreholes. Further, the early detection systems will be inadequate to capture potential for fluid migration and there is a failure to understand the aquifer geochemistry. I explain in detail below.

Q. 68. Let's start with your first point so I can understand your concerns about the failure to analyze sufficiently the potential for and impacts associated with fluid migration associated with unplugged exploratory boreholes. What is your dispute with the FSEIS's presentation of basic geochemical interactions that will take place in the subsurface when efforts to establish baseline are commenced and, more important, when mining commences?

A. 68. The fact that Strata will be unable to restore wellfields to pre-mining, scientifically and statistically defensible baseline concentrations is associated with the NRC Staff and Strata's failure to acknowledge the reaction kinetics and thermodynamics of uranium ore geochemistry. Strata and NRC staff understand that ore deposits form over the period of hundreds of thousands to millions of years. During these immense time intervals, the fluvial deposits accumulate uranium where reducing conditions are favorable for precipitation of uranium. Strata and the NRC staff also understand that injection of an oxidizing-bicarbonate lixiviant destroys the natural balance in the ore-zone geochemical conditions over a period of a few years by pumping very high levels of oxidants and complexing agents through the ore zone. Under these anthropogenic induced changes, materials along the lixiviant flow path are oxidized and the reducing capacity built up in the sediments over hundreds of thousands to millions of years is substantially altered in a matter of months.

Thus, while the FSEIS assumes that the restoration phase will simply involve efforts to remove the contamination that remained in the groundwater as a result of the operations phase, NRC Staff ignores that uranium and other materials disrupted by the ISL process will continue to remain obstinately elevated into the groundwater long after operations have been completed. Several hypotheses have been proposed to explain these severely elevated uranium concentrations, post-restoration. Researchers have suggested that lixiviant is stored in confining units, or at least geological units of relatively lower hydraulic conductivity, and provides a continual source of oxidizing capacity to the ore (JTI040; p. 8 in pdf, p. 36 in document). The USGS has suggested that the continual re-introduction of dissolved oxygen in the RO permeate injection process may be further degrading the aquifer's reducing capacity (JTI041; p.2 in pdf). Finally, our understanding of uranyl-carbonate complexes has greatly increased over the past decade, which reveals that uranyl-carbonate complexes are relatively unreactive, and hence stubbornly mobile compared to uranyl-hydroxide complexes (JTI042; Figures 3 and Figure 4, p. 4. JTI043; Abstract).

Regardless, empirical data show the ISL process will create substantial contamination into the groundwater that will continue to degrade water quality, and a significant component for the post-restoration efforts will be remediating the ongoing contamination that will occur long after operations are over. None of this is disclosed or discussed in the FSEIS. And further, the failure to analyze all of the above sufficiently in conjunction with the potential for and impacts associated with fluid migration associated with unplugged exploratory boreholes exacerbates the likely results and makes this oversight more troubling.

Q. 69. Let's turn to the next issue – aquifer confinement. First explain what it is and why it matters for the conclusions related to fluid migration and the failure to analyze sufficiently the potential for and impacts associated with unplugged exploratory boreholes made in the FSEIS.

A.69. Aquifer confinement occurs when an aquifer is bounded by an overlying and underlying geologic unit of relatively lower permeability. If an aquifer used for ISL is confined, then the lixiviant solution and associated contaminants of concern are prevented from moving vertically.

Q. 70. Have previous ISL sites proven aquifer confinement? Have vertical fluid excursions occurred under confined aquifer conditions?

A. 70. There are several examples of vertical excursions in aquifers that were allegedly confined. The NRC staff has determined previous ISL sites were confined aquifers and therefore would not allow for vertical fluid excursions. For example, the NRC stated in 1988, in the Environmental Assessment (EA) for Malapai Resources, Christensen Ranch In Situ Leach Satellite operation:

"*This data [aquifer testing characterizations] would theoretically indicate that ground-water flow would be contained by the aquitards and concentrated within the production zone. Further evidence of the confining characteristics associated with the units bounding the production zone has been evidence by the successful operation of the Christensen Ranch Research and Development operation*. (JTI044; p. 26)"

However analysis of the Christensen Ranch Restoration Technical Evaluation Report (TER), in 2008, shows that vertical excursions were an environmental issue. To quote (JTI035; p. 11), "*First, excursions in the <u>shallow aquifer</u> in the vicinity of the southern area of MU-2 and the northern area of MU-3 indicate an impact greater than a single well.*" At this same site, NRC Staff included a comment about how the groundwater monitoring parameter values, called upper control limits (UCLs), in an overlying aquifer were set extremely high, not allowing them to detect a fluid migration:

"*The staff evaluated the setting and found spatial nexus between the wells that were, or have been reported, on excursion. The relations are: (1) well 2MW-89 is located between MU-2 South and MU-3, (2) three (2MW-68S, 3MW-46S, and 3MW-48S) of five wells in the shallow aquifer overlying the southernmost portion of MU-2 South and northernmost of MU-3 have been on excursion either during operations (3MW-48S and 3MW-46S), or during or subsequent to restoration (2MW-68S and 3MW-48S); and (3), established UCLs for two other wells in the shallow aquifer in that area (2MW-70S and 2MW-72S) are <u>extremely high, limiting their potential to detect an excursion</u>.*" (JTI035; p. 22)

Like many reported excursion events, the precise source of the vertical excursions was unclear. The NRC confirmed this uncertainty with the following statement:

"*Furthermore, the staff notes that the documentation by the licensee on the source of the excursions for wells in the overlying aquifer is inconclusive. For example, for the 1991 excursion at well 3MW-48S, the licensee noted that the excursion in the overlying aquifer could be through well completions, exploration boreholes or hydraulic communication between aquifers*." (JTI035; p. 23)

Q. 71. Have the NRC staff or other regulators made the same erroneous assumption about confined aquifers at other sites?

A. 71. Yes, it was found that "*aquifer testing procedures have had more limited success in determining the potential for vertical excursions*" (*citing* Staub et al., NRC020, p.32). Staub further supported this statement with an analysis of vertical excursions at Irigaray in the late 1970s:

"*WMC investigated possible reasons for the excursions in wells SM-1, SM-6, and SM-7 beginning in April, 1979. Geologic and hydrologic data were studied, including geophysical logs, core data, geologic cross sections, and pump test data. WMC (1980) [original document] could find no evidence of natural hydraulic connection between the Upper Irigaray Sandstone and the Coal Unit* (Staub et al. 1986, NRC020, p.A-28, 2nd paragraph)*." As a result of these diagnostic tests, WMC (1980) concluded that the most likely pathways for lixiviant migration to the Coal Unit in Production Units 4 and 5 during 1980 were unplugged exploration boreholes* (NRC020; p.29, 4th paragraph)*."*

In other words, the standard methods for proving aquifer confinement could not predict nor explain vertical excursions.

Q. 72. Could unidentified, unsealed abandoned boreholes affect aquifer confinement?

A. 72. Absolutely, the consensus for vertical excursions appears to be directly related to the number of abandoned, unidentified exploration drillholes, or failed well casings (NRC020; p.29, last paragraph; p.30, 2nd paragraph). In other words, "*vertical excursions are directly related to the intensity of drilling activity*" (NRC020; p.48 in pdf., p. 30 in doc, 1st paragraph). Even where an aquifer was naturally confined, a drillhole or abandoned well creates preferential vertical flow paths. And many such drillholes create many pathways for those contaminants.

Q. 73. What is your concern with the FSEIS's discussion of abandoned boreholes at the Ross project site?

A. 73. The principal issue is that in order to justify its conclusion of a confined OZ aquifer, the FSEIS assumed that the more than 1,682 abandoned Nubeth drillholes in the project area would all be plugged prior to Strata's operations, thereby removing these holes as a source of contaminant migration (SEI009A; p. 3-37). However, the FSEIS disclosed that only 759 of those drillholes – or less than 50% – had even been identified, FSEIS at 2-28, and the FSEIS did not explain the basis for assuming that the remaining more than 800 holes would be located. Further troubling, the FSEIS stated that of the 759 drillholes, only 55 of them had been sealed (FSEIS; p. 2-48, 3rd paragraph). However, as of May 9, 2013 625 Nubeth exploratory drillholes have been located and 86 have been plugged by Strata (SEI009A, p.85, response to RP032-060).

These drillhole numbers, while inconsistent, demonstrate an alarming potential for uranium bearing lixiviant to migrate to overlying or underlying aquifers. According to the most recent well abandonment numbers, Strata has yet to find 1,057 Nubeth wells (1,682 – 625) and has yet to plug and abandon 1,596 Nubeth drillholes (1,682 – 86). Further, these numbers do not include the proposed wellfield development proposed for ISL activities in the Ross permit boundary, ranging from "*1,400-2,200 recovery and injection wells in addition to 34 to 140-250 monitoring wells*" (SEI009A; p.5-54, 5th paragraph).

Q. 74. In light of these experiences at previous ISL sites, what is your professional opinion regarding the likelihood of vertical excursions of contaminants at the Ross site?

A. 74. Vertical excursions are likely given experience at other sites. As is evident from the examples above, it is difficult to assess whether an aquifer is truly confined. The lack of well plugging and not identifying hundreds of abandoned wells show that Strata and the NRC staff have not adequately demonstrated ability to maintain vertical fluid migrations from the ore zone aquifers.

Q.75. What, in your view, should the FSEIS have included to address this issue?

A.75. The FSEIS should have disclosed that excursions are likely, and then addresses the steps that will be taken to address them when detected. Instead, based on the assumption that the aquifer is confined the FSEIS presumes excursions are unlikely.

<u>A Storymap visual representation of data which support Contention 3 – Fluid Migration</u>

Horizontal and Vertical Excursions at Willow Creek/Christensen Ranch ISL

Q. 76. Dr. Larson, we've focused on the FSEIS's failure to sufficiently explore the potential for and impacts associated with fluid migration associated with unplugged exploratory boreholes, including the adequacy of applicant's plans to mitigate possible borehole-related migration impacts by monitoring wellfields surrounding the boreholes and/or plugging the boreholes. What can excursion events tell us about problems related to fluid migration and how might those problems be exacerbated by the failure thus far at the proposed Ross Site

to identify and seal the boreholes? In short, why is understanding fluid migration important at ISL operations, especially in light of the possible borehole-related migration impacts?

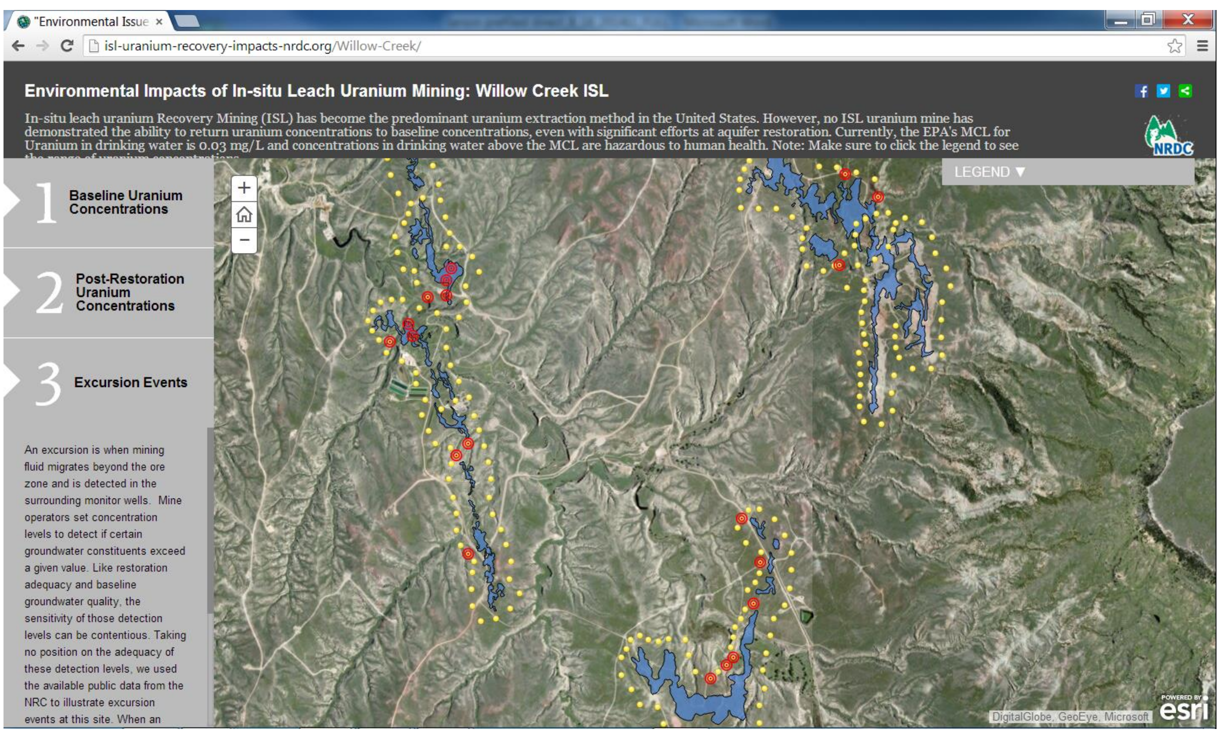
A. 76. It is important because the groundwater can be affected by vertical or horizontal excursions and boreholes play a significant role. The NRC acknowledges the potential for this problem (“*Excursions can be caused by an improper water balance between injection and recovery wells, undetected high-permeability geological strata or faults,* ***improperly plugged or abandoned drillholes****, discontinuity with the confining layers, poor well integrity, or unintended fracturing in the uranium-recovery zone or surrounding geological strata*.” SEI009A document at 2-30 see also, (“*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*.” SEI009A, p.4-37.

However, the NRC dismisses the possibility of fluid migration and associated excursions via the boreholes at the Ross site by asserting “*[b]reaches to the integrity of the confining unit from historical exploration and delineation drillholes will be minimized by the applicant’s locating and abandoning the drillholes within the wellfields (citing License Condition 10.12* .” SEI009A; p.4-42.

With the number of unfilled and unlocated boreholes, the potential for problematic vertical migration is significant, notwithstanding a license condition that assures us the holes will be filled. The Texas example cited by Dr. Abitz in his testimony filed this day (at ¶ 41) illustrates this point precisely. There, the Texas regulator issued a “Notice of Violation” that detailed losing track of the boreholes and failing to properly manage them (JTI026; p. 3-8) – all in direct violation of express license conditions.

Q. 77. So turning back to the Storymaps, what can they show us about fluid migration and excursions?

A. 77. Repeated excursions are examples of unwanted fluid migration and the Storymaps and the underlying NRC data shed some light on how they can impact ISL sites. Excursion data was not examined in detail the FSEIS. Open the Willow Creek ISL storymap (http://isl-uranium-recovery-impacts-nrdc.org/Willow-Creek/; (JTI005B-R; p.1, 32-34), and select the 'Excursion Events' tab on the left hand side of the screen to view groundwater issues associated with fluid migrations (See figure below. JTI005B-R; p.32).



Q. 78. So what are the big red cross hairs?

A. 78. The red crosshairs are monitoring wells where a horizontal or vertical excursion was reported. The link is found on left side of the page in the text.

Q. 79. Again, just as with the baseline numbers and the post restoration numbers, from where did this information come?

A. 79. These data were taken from the NRC staff's Technical Evaluation Report (TER) concerning the groundwater restorations at Christensen Ranch (JTI035, various paragraphs throughout).

Q. 80. And where did the text in the box that comes up when one clicks the link?

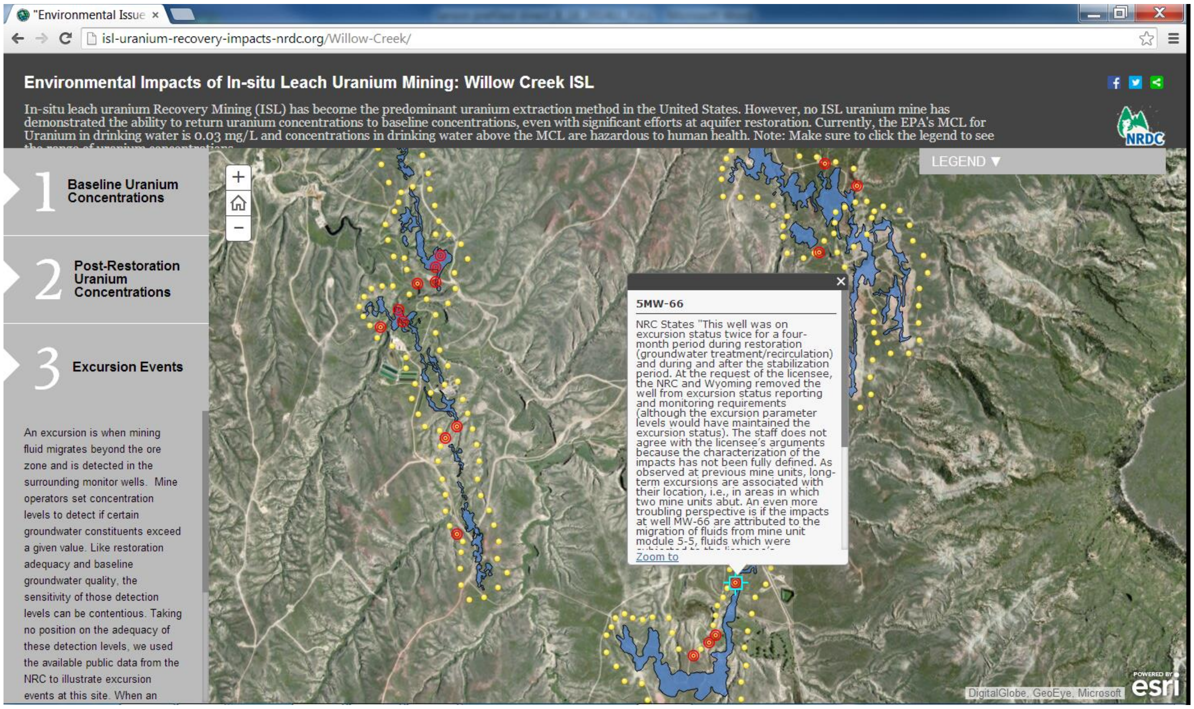
A. 80. The text reprints the NRC staff's Technical Evaluation Report (JTI035, various paragraphs throughout). In other words, it was the NRC staff's direct assessment for each individual excursion event.

Q. 81. What are some examples of the excursions?

A. 81. When horizontal excursions occur, pumping rates are adjusted to capture the contaminant plume. In most cases, this is an effective technique to recover horizontal excursions; however some wells remain on excursion status for months or even years. I have selected an excursion example that would be classified as a MODERATE to LARGE environmental impact according to the NRC staff's qualitative assessment. Select the monitor well 5MW-66 in mine unit 5 (JTI005B-R; p.33). The NRC staff's assessment in the TER of this excursion event from the TER is displayed in the pop-up window:

"*NRC States: This well was on excursion status twice for a four-month period during restoration (groundwater treatment/recirculation) and during and after the stabilization period.*

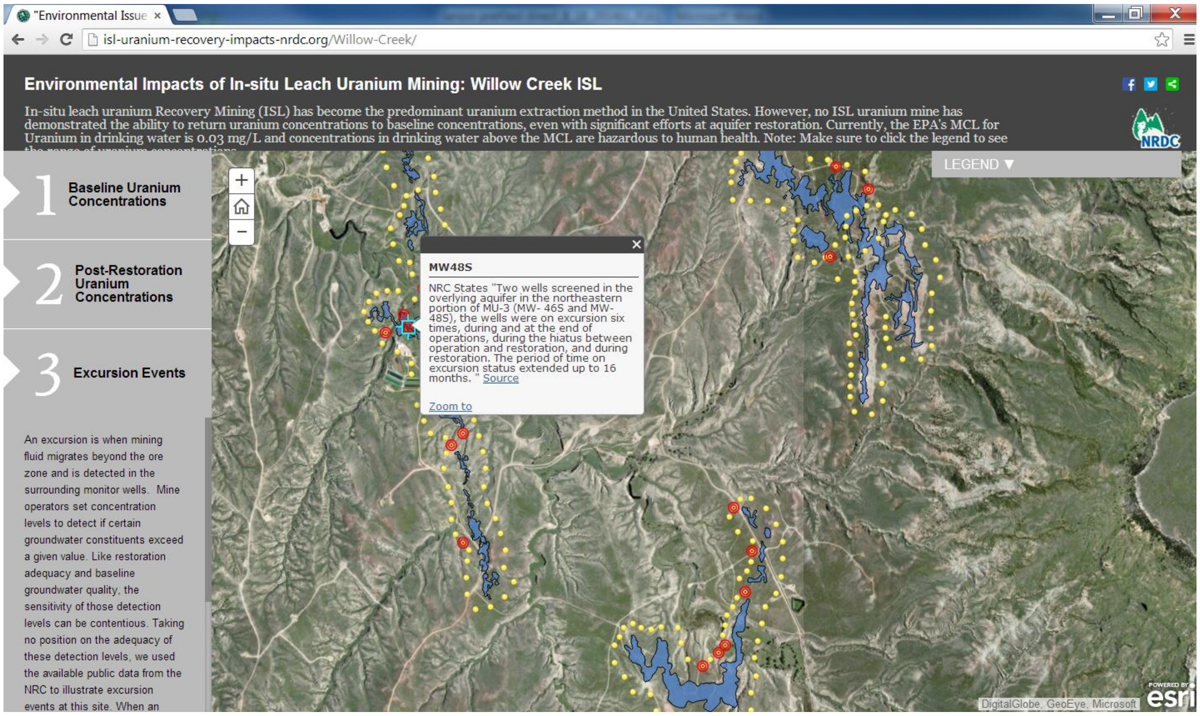
At the request of the licensee, the NRC and Wyoming removed the well from excursion status reporting and monitoring requirements (although the excursion parameter levels would have maintained the excursion status). The staff does not agree with the licensee's arguments because the characterization of the impacts has not been fully defined. As observed at previous mine units, long-term excursions are associated with their location, i.e., in areas in which two mine units abut. An even more troubling perspective is if the impacts at well MW-66 are attributed to the migration of fluids from mine unit module 5-5, fluids which were subjected to the licensee's restoration. The staff notes that several excursions have been noted at several wells along the downgradient edge of this module (eg wells 5MW-52 and 5MW-54 located south of 5MW-66 and wells 5MW-8 and 5MW-16 located north of 5MW-66). If the impacts at 5MW-66 reflect the migration from a restored aquifer, similar impacts may be expected at the downgradient perimeter in the future. <u>The licensee's argument that the transport will remain within the boundaries of MU-5 is questionable</u>." (JTI035; p.42,43)



This example of a horizontal fluid migration shows that adjusting pumping rates is not a 'one-size-fits-all' solution for correcting fluid migrations. Monitor well 5MW-66 first went on excursion status on 8/21/2001 and has been on-and-off excursion status for over a decade (from JTI062). Uranium concentrations up to 2.0 mg/L have been observed at well 5MW66, and there was little explanation for the source of the excursion, based on which direction the groundwater was flowing (i.e., potentiometric surface) and the source ore locations (JTI045; p.8 and figures 5,7).

According to the NRC staff, vertical excursions are difficult to resolve as well, observed by selecting well MW48S (S – stands for shallow monitoring well; (JTI005B-R; p.34)).

The NRC staff state *"Two wells screened in the overlying aquifer in the northeastern portion of MU-3 (MW- 46S and MW-48S), the wells were on excursion six times, during and at the end of* *operations, during the hiatus between operation and restoration, and during restoration. The period of time on excursion status extended up to 16 months."*



Finally, and importantly, regardless of the exact cause of any of these reported excursions (i.e. unfilled or unlocated boreholes, imbalanced wellfield operations, well failure, thinning or discontinuous confining units, etc.), these fluids migrations not only occur regularly at ISL operations, but have significant groundwater impacts if uncorrected. Corrective actions, such as adjusting pumping rates, can recover horizontal excursions. However this solution is incapable of solving every horizontal excursion and has very little value for recovering vertical excursions, the kind most likely to occur in the event of analyze sufficiently the potential for and impacts associated with fluid migration associated with unplugged exploratory boreholes, including the adequacy of applicant's plans to mitigate possible borehole-related migration impacts by monitoring wellfields surrounding the boreholes and/or plugging the boreholes.

Q. 82. Have fluid excursions occurred at the Smith Highland Ranch ISL operation?

A. 82. Yes, horizontal and vertical excursions (as well as failed well casings and surface leaks) have been documented at various mine units at the Smith Highland ISL operation (ML14202A113; p. 21). Like the Willow Creek ISL project, those aquifers for mine units C, E, and F were allegedly confined (JTI046; p. 17 – 20).

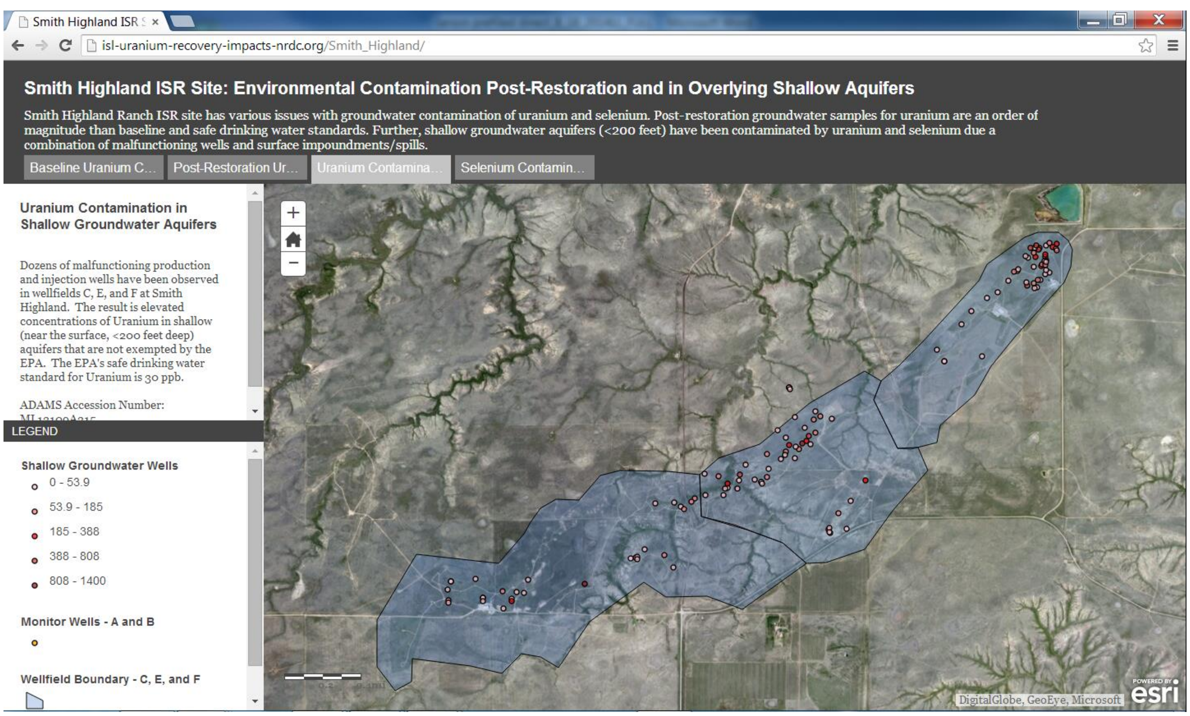
According to NRC staff's spreadsheet, wells of the overlying aquifer at Smith Highland mine unit F were located at depths ranging from 435 – 570 ft. However, much of the contamination was observed in sand aquifers located <200 feet deep. Therefore, the observed groundwater contamination in the shallow aquifers was unable to be detected by overlying excursion monitoring wells.

Q. 83. What data is presented in the Smith Highland Excursion Storymap?

A. 83. The data from the Smith Highland ISL map shows extensive elevated groundwater concentrations of uranium and selenium in the shallow (~<200 ft depth), non-uranium ore bearing aquifers. These elevated concentrations of uranium and selenium were reportedly the result of dozens of failed ISL injection well casings in mine units C, E, and F (JTI036; p. 8). It's possible that leaky surface impoundments and vertical fluid migration through high preferential flow paths such as abandoned/unidentified drillholes could have contributed to elevated concentrations at Smith Ranch. Therefore, similar results could transpire at the Ross Project if there is a failure to identify and seal the unplugged exploratory boreholes. Again, regardless of the exact pathway of contamination, severe concentrations of contaminants of concern are observed in the shallow (<200 feet deep) aquifer.

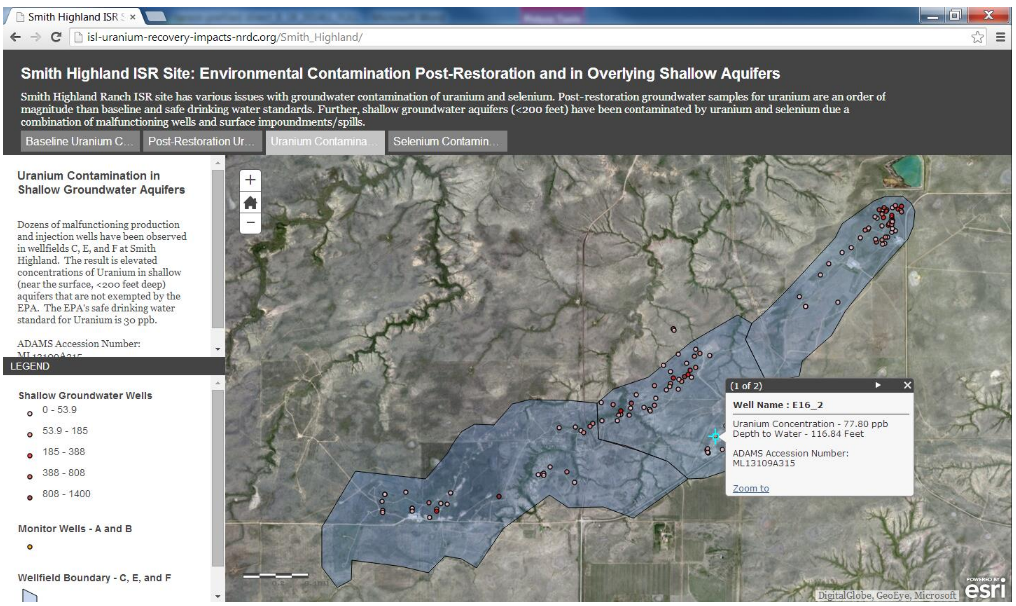
Q. 84. How do you visualize these shallow groundwater impacts using the Smith Highland storymap?

A. 84. Open the Smith Highland storymap URL (http://isl-uranium-recovery-impacts-nrdc.org/Smith_Highland/; (JTI005B-R; p.1, 35-36), and select the third tab labeled "Uranium Contamination in Shallow Groundwater Aquifers". See the image below for the initial view. The blue regions represent the wellfield boundary for mine units C, E, and F. The dots indicate groundwater wells sampled and the color is proportional to the concentration of uranium in the groundwater.



Q. 85. What information does selecting a well present?

A. 85. When a well is selected, the 'pop-up' window displays the well name, groundwater uranium concentration (ppb), the measured depth to water (feet), and the ADAMS accession number. I've selected well E16_2 as an example (JTI005B-R; p.36). The groundwater uranium concentration was 77.80 ppb and the depth to water was 116.84 feet deep. The total depth for well E16_2 was 130 feet (JTI036, p.54).



The impacts from Selenium contamination in the shallow groundwater can be observed in a similar fashion by selecting the fourth tab "Selenium Contamination in Shallow Groundwater Aquifers". The EPA MCL for selenium is 50 ppb (or 0.05 mg/L). As is apparent, the environmental impacts are significant. None of this sort of analysis of irretrievable and irreversible impacts are present in SEI009A.

Conclusion

Q. 86. Dr. Larson, you've explained and demonstrated extensively how the FSEIS fails to analyze the environmental impacts that will occur if the applicant cannot restore groundwater to primary or secondary limits and how the FSEIS fails to include adequate

hydrological information to demonstrate SEI's ability to contain groundwater fluid migration. Can you please briefly summarize why it is so important the FSEIS addresses these issues in the context of groundwater protection in the American West?

A. 86. Groundwater is a significant source of drinking water supply for municipalities and also a source for agricultural irrigation in this part of the country. Groundwater is an attractive water source to meet these demands because it is accessible in areas without substantial surface water availability, requires relatively less treatment compared to surface water, and is less susceptible to drought conditions. According to the USGS, groundwater is the source of drinking water for half the United States. Furthermore, groundwater contributes the largest percentage of source water for agriculture irrigation, which consumes roughly 80% of all US water consumption (JTI047).

Water demands in the future will increase (JTI048), therefore groundwater resources will be increasingly relied upon as a consistent, reliable, source of fresh water. However due to overreliance on groundwater, significant groundwater depletion has been observed by the United States Geological Survey over the past decade. The Central Valley Aquifer, Ca and High Plains Aquifer (Ogallala), have already observed shocking groundwater volume losses from 1960-2008 (JTI027).

The current drought crises in these regions are causing many communities to scrounge and save for water. For example, a community in Texas (Wichita Falls) recently began using treated, recycled wastewater (sewage water), for municipal drinking water, as few available options for water sources could be used to meet demands (http://www.npr.org/2014/05/06/309101579/drought-stricken-texas-town-turns-to-toilets-for-water). California communities are currently enacting strict water usage fines for community members to deal with a record drought. Future water issues will be compounded significantly, suggesting water supplies will be increasingly scarce and using fresh water sources wastefully, for any means, is shortsighted.

Q. 87. Turning toward the issue before the Board, why does groundwater matter so much in this regional area of the West? In this particular area of Wyoming?

A. 87. Population increases over the last decade in northeastern Wyoming have put increasing stress on the available water supplies. The city of Gillette, Wyoming depends on drinking water from the Fort Union Aquifer and other local aquifers, to provide municipal water supplies. However, water availability in these aquifers are dwindling and the population is projected to substantially increase from 37,000 to 57,000 by 2030. To meet increasing water demands, the city is enacting the Gillette Madison Pipeline Project, a 217.6 million dollar project, which will route water from the Madison aquifer, north of Keyhole Reservoir to Gillette via pipeline (http://www.gillettewy.gov/index.aspx?page=902). The project is intended to meet growing water demands for the next 20 years. This example demonstrates the specific vulnerability of this region to increased water demands and the scarce options to meet those demands.

Q. 88. Would significant groundwater contamination or long-term degradation of a groundwater aquifer really matter, even if no one has is currently accessing that groundwater for water right now?

A. 88. If the groundwater which has contaminant levels above the US EPA's drinking water standards is used directly as a primary source of drinking water it carries a risk of detrimental health impacts. Groundwater that does not meet drinking water standards would require "at the end of the pipe" treatment to return water to acceptable drinking water standards, which is costly and carries numerous logistical issues (waste disposal, energy requirements, O&M costs, etc.).

In general, financial limitations prompt municipalities to utilize the highest quality source water which requires the least amount of treatment. When relatively high quality (low treatment) source water is unavailable, the next economically available source of water is used. This general trend explains why desalination of sea water is used as a last resort, due to significantly high economical treatment costs. Therefore, preventing water contamination in the first place is regarded by many water resources and environmental engineers as the 'best treatment option'.

Q. 89. And what about the groundwater affected by the Lance District projects? Are there specific impacts in the near or long term?

A. 89. In the FSEIS and license for the Ross ISL project the NRC Staff has approved the same groundwater restoration methods which have failed to meet baseline and/or safe drinking water standards at every previous ISL site, and for technical and scientific reasons, will not result in groundwater quality meeting primary or secondary standards. As demonstrated throughout this document, it's common for 'restored' post-mining groundwater at ISL operations to exceed that value, and in some wells by an order of magnitude or more.

The volume of contaminated water within the ore zone is not trivial, and the impacted water volumes can be (depending on the site specific geology and aquifer properties) in the hundreds of millions of gallons groundwater per mine unit. For example, industry estimated the total affected volume for Christensen Mine Units 2-6 was approximately 1.04 billion gallons of groundwater (JTI038, p.21).

For all the reasons above and based on review of the relevant data, it is my professional opinion that no ISL mine site has ever fully restored the groundwater to pre-mining 'baseline' conditions. And equally important, the FSEIS fails to consider and acknowledge this likelihood and any subsequent environmental impacts of permanently contaminated groundwater.

Q.90. Does this conclude your testimony.

A. 90. Yes.

I, Dr. Lance N. Larson, do hereby declare under penalty of perjury that my statements in the foregoing testimony and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 C.F.R. § 2.304(d).

/(electronic signature approved)/
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