

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

COMMISSIONERS:

Kristine L. Svinicki, Chairman
Jeff Baran
Stephen G. Burns
Annie Caputo
David A. Wright

In the Matter of

CROW BUTTE RESOURCES, INC.

(License Renewal for the *In Situ* Leach Facility,
Crawford, Nebraska)

Docket No. 40-8943-OLA

CLI-18-08

MEMORANDUM AND ORDER

Today we address the Consolidated Intervenor's petition for review of the Atomic Safety and Licensing Board's second partial initial decision, LBP-16-13. For the reasons outlined below, we deny the petition.

I. INTRODUCTION

This adjudicatory proceeding concerns the Crow Butte Resources, Inc. application to renew its source materials license for an *in situ* leach uranium recovery facility, located near Crawford, Nebraska. Following an evidentiary hearing on nine admitted environmental contentions, the Board issued two separate partial initial decisions. The Board's first decision, LBP-16-7, addressed one contention (Contention 1), resolving it partially in favor of the Consolidated Intervenor and the Oglala Sioux Tribe (together, the Intervenor), and partially in

favor of the NRC Staff.¹ Our decision today addresses the Board's second partial initial decision, which resolved the remaining eight contentions: Contentions A, C, D, F, 6, 9, 12, and 14.

In LBP-16-13, the Board ruled in favor of the Staff on most issues, with the exception of a limited portion of one contention, designated as Contention 12B.² Contentions 12A and 14 challenged whether the Environmental Assessment (EA) adequately discusses the environmental risk of tornadoes and earthquakes, respectively. The remaining six contentions—A, C, D, F, 6, and 9—raised hydrogeological issues. These six contentions concerned whether the Staff's EA adequately addressed the potential pathways for mining-related contaminants to migrate offsite from the Crow Butte License Area. Related concerns included whether the Staff adequately examined potential subsurface connections between the License Area and the Pine Ridge Indian Reservation in South Dakota.³

¹ LBP-16-7, 83 NRC 340 (2016). Contention 1 concerned the Staff's assessment of impacts on historical and cultural resources. Crow Butte has petitioned for review of LBP-16-7; we will address that petition separately. See *Petition for Review of LBP-15-11 and LBP-16-7* (June 20, 2016). In LBP-16-7, the Board outlined the procedural history of this long-pending proceeding. See LBP-16-7, 83 NRC at 347-49.

² Contention 12 as admitted encompassed both the risk of tornadoes and an unrelated issue regarding the potential application of *in situ* leach (ISL) wastewater on land. See LBP-15-11, 81 NRC 401, 438, 442 (2015). The Board in LBP-16-13 addressed the two issues separately as Contention 12A (tornadoes) and Contention 12B (land application of wastewater). Contention 12B focused on the potential environmental impacts of land application of ISL wastewater as they relate to the effects of selenium on wildlife. See LBP-16-13, 84 NRC 271, 425-434 (2016). Crow Butte has also petitioned for review of the Board's ruling on Contention 12B, which we will address separately. See *Petition for Review of LBP-15-11 and LBP-16-13* (Dec. 29, 2016).

³ See LBP-16-13, 84 NRC at 302-03. Members of the Oglala Sioux Tribe reside at the reservation, and some of the Consolidated Intervenor are members of the Tribe.

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For the six hydrogeology-related contentions, the Intervenor did not present all of their evidence on a contention-specific basis. Instead, as the Board described, the Intervenor challenged the EA's analysis of various "related hydrogeologic issues that cut across" multiple contentions.⁴ The Board therefore chose to first address the "overarching factual issues and disputes" before turning to the specific contentions.⁵

Consolidated Intervenor now seek review of LBP-16-13, challenging several Board findings.⁶ The NRC Staff and Crow Butte oppose the petition.⁷

II. BACKGROUND

Because most of the technical issues we address relate to the potential for contaminants to migrate away from the License Area, we provide below a brief description of the relevant hydrogeology of the area, the *in situ* leach process, and Crow Butte's program to detect mining fluids that may be migrating away from a wellfield.

⁴ *Id.* at 285.

⁵ *Id.*

⁶ *Consolidated Intervenor Petition for Review* (Jan. 3, 2017) (Petition). Consolidated Intervenor include the Western Nebraska Resources Council, Owe Aku/Bring Back the Way, Debra White Plume, Beatrice Long Visitor Holy Dance (now deceased), Joe American Horse & Tiospaye, Thomas Cook, and Loretta Afraid-of Bear Cook & Tiwahe. Debra White Plume, Joe American Horse, and Loretta Afraid-of-Bear Cook are members of the Oglala Sioux Tribe. *Id.* at 1 n.1. The Tribe did not join Consolidated Intervenor's appeal.

⁷ See *NRC Staff's Answer Opposing Consolidated Intervenor's Petition for Review of LBP-16-13* (Jan. 30, 2017) (Staff Answer); *Response to Consolidated Intervenor's Petition for Review of LBP-16-13* (Jan. 30, 2017) (Crow Butte Answer).

A. Relevant Area Hydrogeology

Crow Butte recovers uranium from a sandstone layer known alternatively as the Basal Chadron Formation or the Chamberlain Pass Formation (its more recent name).⁸ Crow Butte recovers uranium from a target Ore Zone, 10 to 80 feet thick, located entirely within the Basal Chadron/Chamberlain Pass Formation Aquifer.⁹ The Board described the Aquifer as having “generally poor water quality” and a “high radionuclide content.”¹⁰

Crow Butte conducts its operations in a License Area, which includes a Central Processing Plant, evaporation ponds, and individual mine units with associated injection, production, and monitoring wells. Most of the License Area is underlain by 130- to 480-foot-thick portions of the Upper Brule Aquifer, which Crow Butte designated as the overlying aquifer for the Ore Zone. The Upper Brule Aquifer “produces sufficient quantities of water suitable for domestic and agricultural purposes.”¹¹

The uranium-rich Ore Zone is separated geologically from the Upper Brule Aquifer by a continuous, thick layer referenced in the Board’s decision as the Upper Confining Unit, made up of the Lower Brule Formation, and the Middle and Upper Chadron Formations.¹² The Upper

⁸ The Board throughout its decision acknowledged both names by referring to the formation as the Basal Chadron/Chamberlain Pass Formation, or BC/CPF.

⁹ See LBP-16-13, 84 NRC at 289, 298-99. When referring merely to the “geologic formation or structure,” the Board referred to the “Formation.” When discussing the “groundwater contained in the pores and fractures” of the Formation, the Board referred to the “Aquifer.” See *id.* at 288-89 n.43.

¹⁰ *Id.* at 297 (citing Ex. NRC-010, Final Environmental Assessment for the License Renewal of U.S. Nuclear Regulatory Commission License No. SUA-1534 (Oct. 2014), at 47 (EA)).

¹¹ *Id.* at 290-91, 297.

¹² *Id.* at 291-92.

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Confining Unit ranges in thickness from approximately 100 to 500 feet, depending on its location. The Ore Zone is confined on the bottom by the Pierre Shale Lower Confining Unit. All parties agreed that the Pierre Shale has very low vertical hydraulic conductivity and would prevent Crow Butte's mining liquids from flowing downward past the base of the Basal Chadron/Chamberlain Pass Formation Aquifer.¹³

B. The ISL Process and Excursion Monitoring

The *in situ* leach uranium recovery process involves injecting a leach solution or "lixiviant" into wells drilled into the uranium-bearing formation, here the Ore Zone aquifer.¹⁴ The lixiviant solution consists of native groundwater with added hydrogen peroxide or gaseous oxygen (or both) and sodium bicarbonate. These solutions are delivered to the Ore Zone through an injection well. They oxidize and mobilize uranium contained in the ore body. The resulting uranium-rich solution is then recovered through surrounding extraction wells and piped to a processing facility for removal of the uranium through an ion exchange process.¹⁵

Several of the issues we address today pertain to the potential for offsite groundwater impacts from "excursions." An excursion is "the unintended spread of processing liquids beyond" the mining units.¹⁶ Excursions can occur either horizontally or vertically.

The Board described at length Crow Butte's excursion monitoring program, which contains steps to limit, detect, and correct unintended releases of mining liquids beyond the operating wellfield. To detect excursions, Crow Butte has installed excursion monitoring wells in

¹³ *Id.* at 296.

¹⁴ *See id.* at 287; Ex. NRC-010, EA, at 15.

¹⁵ *See* LBP-16-13, 84 NRC at 287; Ex. NRC-010, EA, at 15.

¹⁶ *See* LBP-16-13, 84 NRC at 286.

the overlying aquifer (the Upper Brule Aquifer) and in perimeter rings surrounding all mine units. The monitoring wells placed in the overlying Upper Brule Aquifer are intended to provide early detection of a vertical excursion (an unwanted vertical flow of process fluids up from the production zone), while the perimeter ring of monitoring wells—screened at the depth of the Ore Zone where the mining occurs—is intended to provide early notice of a horizontal excursion.

License conditions govern numerous aspects of the Crow Butte excursion monitoring program, including distance between monitoring wells, frequency and density of well sampling, corrective actions to be taken in the event of excursions, and excursion reporting requirements.¹⁷ Crow Butte must sample monitoring wells at least every 14 days and more frequently if an excursion is detected. Crow Butte samples the monitoring wells for the following three parameters, which are intended to serve as early “indicators” of an excursion: chloride, conductivity, and total alkalinity. Reaching specified upper control limits of one or more of these parameters in a monitoring well serves as a warning that mining process fluids may have migrated away from the wellfield.

Upon confirmation of an excursion, Crow Butte must take corrective actions. Corrective measures may include adjusting the injection or production rates (or both) in the area of the monitoring well to draw fluids back towards the production zone; pumping wells to increase the recovery of mining solutions; and stopping the injection of lixiviant within the affected area of the mine unit until the excursion is corrected.

¹⁷ See, e.g., Ex. NRC-012, Materials License No. SUA-1534 (Nov. 5, 2014) (License) (License Conditions 11.5, Excursion Monitoring; 11.4, Establishment of Upper Control Limits; 10.4, Monitor Well Spacing); see also LBP-16-13, 84 NRC at 287-88, 350-53.

III. ANALYSIS

In our discretion, we may grant a petition for review, giving due weight to whether a petition raises a substantial question regarding any of the following:

- (i) A finding of material fact is clearly erroneous or in conflict with a finding as to the same fact in a different proceeding;
- (ii) A necessary legal conclusion is without governing precedent or is a departure from or contrary to established law;
- (iii) A substantial and important question of law, policy, or discretion has been raised;
- (iv) The conduct of the proceeding involved a prejudicial procedural error; or
- (v) Any other consideration which we may deem to be in the public interest.¹⁸

We review questions of law *de novo*, but we generally defer to a Board's plausible factual findings when they rest on a detailed weighing of extensive expert testimony and evidence. The Board's main role in our adjudicatory process is to carefully review testimony and exhibits to resolve factual disputes. Where a Board, aided by its technical judges, has "rendered reasonable, record-based" factual findings, we will typically decline to undertake a *de novo* review of underlying facts, absent a substantial question of a "clearly erroneous" material finding.¹⁹

Consolidated Intervenors seek review of LBP-16-13 on both factual and legal questions. After carefully considering all of Consolidated Intervenors' claims, we conclude there is no basis warranting Commission review.

¹⁸ 10 C.F.R. § 2.341(b)(4).

¹⁹ See *Southern Nuclear Operating Co.* (Early Site Permit for Vogtle ESP Site), CLI-10-5, 71 NRC 90, 98-99 (2010); see also *Entergy Nuclear Generation Co. and Entergy Nuclear Operations, Inc.* (Pilgrim Nuclear Power Station), CLI-12-1, 75 NRC 39, 45-46 (2012); *Hydro Resources, Inc.* (P.O. Box 777, Crownpoint, New Mexico 87313), CLI-06-1, 63 NRC 1, 2 (2006).

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A. Challenges to Board Findings on Excursions

1. Board Findings

In LBP-16-13, the Board evaluated the potential for groundwater impacts from excursions. Although noting that “excursions have occurred,” the Board found “no evidence that those excursions resulted in the transport of contaminants outside of the License Area.”²⁰ Based on monitoring data collected over the course of Crow Butte’s more than 20 years of uranium recovery operations, the Board found that “Crow Butte satisfactorily addressed its excursions and . . . no long-term impacts have appeared to date,” either from vertical or horizontal excursions.²¹

The Board additionally found it unlikely that an “undetected excursion” would occur given specific aspects of Crow Butte’s excursion monitoring program and its operations, specifically (1) the close proximity of the excursion monitoring wells; (2) the low flow rate from the wellfield; and (3) the use of “bleed water that removes more liquid from the aquifer than is reinjected,” a process that maintains an inward hydraulic gradient.²²

The Board therefore agreed with the EA’s conclusion that “the long-term impacts on groundwater from excursions will be SMALL.”²³ The Board based this finding on the EA’s

²⁰ LBP-16-13, 84 NRC at 357.

²¹ *Id.*

²² *Id.* As described in the Board’s decision, Crow Butte experts testified that they use a “bleed” process in which they extract a greater volume of liquids (leach solution and native groundwater) from the mine unit than the volume of leach solution that they inject, causing “an inflow of groundwater into the production area” to prevent the loss and migration of leach solution. See *id.* at 351.

²³ *Id.* at 357.

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analysis of the excursions that occurred during Crow Butte’s prior license term, which included the groundwater monitoring data collected during Crow Butte’s operations. The Board also based its finding on Crow Butte’s continuing obligation under its license to “detect and take corrective action to resolve any excursion.”²⁴

2. Consolidated Intervenors’ Claims

Consolidated Intervenors challenge the Board’s finding on the potential groundwater impacts from excursions. They claim that the EA’s “SMALL impact conclusion” is “impossible to legally justify . . . when there have been long-term, unexplained excursions” in Mine Unit 6 and Mine Unit 8.²⁵ They also claim that the Board erred in concluding that additional monitoring requirements imposed under License Condition 11.12 would mitigate excursions occurring in Mine Units 6 and 8.²⁶ They further argue that the National Environmental Policy Act (NEPA) requires “analytical data demonstrating” how a mitigation measure “will constitute an adequate buffer” against the potential adverse impacts from the authorized activity.²⁷ They claim that here, “even with License Condition 11.12,” Crow Butte’s excursion monitoring program “fails” as a mitigation measure in regard to excursions in Mine Units 6 and 8 because the program can detect “impacts only after they occurred.”²⁸

²⁴ *Id.* at 356-57; *see also id.* at 352-53 (describing corrective actions).

²⁵ *See* Petition at 3.

²⁶ While Consolidated Intervenors refer to License Condition 11.1, we understand them to mean License Condition 11.12, which imposes additional excursion monitoring requirements in the event of excursions in Mine Unit 6 or Mine Unit 8.

²⁷ *Id.* at 4.

²⁸ *Id.*

These arguments do not raise a substantial question with the Board's findings. Consolidated Intervenor's argument suggests that once an excursion is detected, it is already too late to prevent offsite impacts. But the excursion monitoring program's purpose is to prevent offsite impacts by providing a timely alert, thereby prompting corrective actions to stop an excursion *before* any mining fluids can leave the License Area. Crow Butte's excursion monitoring program accordingly encompasses actions both to detect and to terminate excursions. After considering extensive record evidence, the Board found no evidence that any excursion during the course of Crow Butte's many years of operation caused long-term groundwater quality impacts or that any excursion (including those in Mine Units 6 and 8) resulted in contaminants leaving the License Area.

Consolidated Intervenor's also do not identify what further "analytical data" NEPA requires. The Board addressed the excursion monitoring program in detail. The Board's decision notes that there are currently 333 excursion monitoring wells from which Crow Butte conducts bi-weekly sampling for the three excursion parameters, with sampling increased to a weekly basis for any well placed on "excursion status."²⁹ The Board based its findings regarding groundwater impacts on water quality monitoring data gathered during Crow Butte's operating history and specific program requirements imposed by license condition.³⁰ Although NEPA

²⁹ LBP-16-13, 84 NRC at 353.

³⁰ The circumstances are very different than those encountered in *National Parks & Conservation Ass'n v. Babbitt*, on which Consolidated Intervenor's rely for their claim that a "court must be able to review, in advance, how specific measures will bring projects into compliance with environmental standards." See Petition at 4 (citing 241 F.3d 722 (9th Cir. 2001)). In *National Parks & Conservation*, the "intensity or practical consequences" of expected impacts were simply unknown because of an absence of information, and the agency had no evidence that proposed mitigation measures would "combat the mostly 'unknown' or inadequately known effects." See *id.* at 732-34. Here, in contrast, the Board considered water quality monitoring (continued . . .)

does not require that an environmental impact statement (much less an EA) contain a complete mitigation plan, Crow Butte's excursion monitoring program is an established program, set forth in detail, and governed by prescriptive license conditions.

Nor do Consolidated Intervenors' references to excursions that occurred in Mine Units 6 and 8 indicate Board error. In its EA, the Staff disclosed that a "continued number of excursions" have occurred in Mine Units 6 and 8.³¹ The EA states that these vertical excursion events coincided with precipitation events and do "not appear to be a consequence of the migration of lixiviant from the production aquifer."³² But because particular wells located in Mine Units 6 and 8 have continued to experience excursion events and the Staff remains uncertain as to all of the events' origins, the Staff imposed License Condition 11.12 to aid in determining the underlying cause of excursions in these two mine units.³³

License Condition 11.12 applies only in the event that an excursion is confirmed in an excursion monitoring well located in Mine Unit 6 or 8. In that circumstance, Crow Butte must sample the well for natural uranium, in addition to sampling for the three standard excursion

data and other information gathered during Crow Butte's 20-year history of uranium recovery at the site.

³¹ See Ex. NRC-010, EA, at 92.

³² See *id.*

³³ Crow Butte attributed all but one of these recorded vertical excursion events to natural fluctuations of the water quality within the overlying aquifer, where the Mine Units 6 and 8 monitoring wells placed on excursion status are located. The Staff, however, represented that there is insufficient information to reach a definitive conclusion, citing the possibility of spills or other unintended releases of mining fluids as potential causes. See, e.g., Ex. NRC-010, EA, at 92. Crow Butte concluded that one of the recorded vertical excursion events actually was an unintended spill of process fluids, which Crow Butte remediated. The Board agreed that this event was a spill, not an excursion. See LBP-16-13, 84 NRC at 357.

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indicator parameters (chloride, conductivity, and total alkalinity).³⁴ This additional testing for natural uranium is intended to help identify the source of the excursion, and by extension, to help identify any potential recurring issue that may be causing excursions to occur in these particular areas.³⁵

The Board acknowledged that “some uncertainty remains as to the precise cause” of excursions that occurred in Mine Units 6 and 8, noting the Staff’s view.³⁶ But the Board itself agreed with Crow Butte on the excursions’ cause. The Board found that the recorded events in Mine Units 6 and 8 (with the one exception concluded to have been a spill) were due to “natural seasonal fluctuations in groundwater quality” of the overlying Upper Brule Aquifer.³⁷ The Board stressed that there was no evidence in the record that migration of lixiviant from the Crow Butte production zone aquifer had caused the events in Mine Units 6 and 8. Nevertheless, as an additional matter, the Board noted that whatever the underlying cause of any future need to place a well in one of these two units on excursion status, License Condition 11.12 would help ensure that Crow Butte would be able to address the cause.³⁸

Contrary to Consolidated Intervenors’ argument, the Board’s conclusions on groundwater quality impacts from excursions do not hinge on the additional uranium-testing

³⁴ LBP-16-13, 84 NRC at 355 (citing License Condition 11.12).

³⁵ See Ex. NRC-001-R, *NRC Staff’s Initial Testimony* (May 8, 2015), at 14 (Staff’s Initial Testimony) (“the requirement to sample for natural uranium in these mine units is for the purpose of discovering the source of an already identified excursion, not for detecting the excursion itself”).

³⁶ See LBP-16-13, 84 NRC at 355.

³⁷ See *id.* at 367.

³⁸ See *id.*

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requirement imposed by License Condition 11.12. The Board's core conclusions rest on the EA's analysis of groundwater quality data "from excursions in the prior license period," and on Crow Butte's continuing obligation to conduct monitoring to detect, and to take corrective actions to resolve, any excursions.³⁹

Consolidated Intervenors' arguments regarding excursions in Mine Units 6 and 8 do not raise a substantial question of a material factual error or abuse of discretion in the Board's findings regarding excursion impacts. The Board found the cause of the excursions to have been sufficiently explained by Crow Butte, and Consolidated Intervenors have not raised a substantial question as to whether this finding is clearly erroneous. Consolidated Intervenors also have not identified any offsite impacts from excursions that took place in Mine Units 6 and 8. The Board found reasonable the EA's conclusion that the long-term impacts on groundwater from excursions will be small, given Crow Butte's operational history, the license requirements, and the nature of Crow Butte's operational practices (e.g., low flow rate from the wellfield). Indeed, the Board stressed that to date "no corrective actions by Crow Butte" had been required to terminate the excursion events that occurred in Mine Units 6 and 8.⁴⁰

B. Other Claims of Error of Fact or Law Regarding Contaminant Migration and Leaks

In Section II.B of their petition, Consolidated Intervenors raise various claims that appear to dispute Board findings on groundwater quality impacts or findings on surface water impacts.

We address these claims in turn below.

³⁹ See *id.* at 357; Ex. NRC-012, License, at 12 (License Condition 11.5); see *also* Tr. at 1641 (where the Staff's expert stated that even taking into account potential recurrences of excursions in Mine Units 6 and 8, the Staff concluded "the impact would be small" because of required corrective actions).

⁴⁰ See LBP-16-13, 84 NRC at 357; see *also* Ex. NRC-010, EA, at 92.

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1. Testing For Contaminants

Consolidated Intervenors challenge the Board's conclusion that there is no evidence of excursions having transported contaminants outside of the License Area.⁴¹ Specifically, they argue that the Board failed to "logically connect" its conclusion "to the fact that Crow Butte is *not* required to test for any such contaminants because they are not excursion parameters."⁴² Consolidated Intervenors further claim that "no one is testing for the migration of contaminants that may be caused by lixiviant that leaks from the mining operation in the form of excursions or leaks."⁴³ They argue that the NRC "has not justified not requiring that data to be obtained and reported by Crow Butte," and that the Board erred in not requiring "a supplemental NEPA document to confirm whether there has been contamination off-site."⁴⁴

Consolidated Intervenors direct the above arguments to the Board's finding on potential groundwater impacts from excursions. In a nutshell, they suggest that more water quality testing is necessary to determine if there have been groundwater quality impacts. They leave unclear, however, whether they are challenging the adequacy of Crow Butte's testing of the excursion monitoring wells or Crow Butte's water quality testing at other locations (e.g., private water supply wells). Nor do Consolidated Intervenors specify the additional test data that they believe are necessary.

In any event, these generalized claims do not identify error in the Board's conclusion that excursions have not caused offsite contamination. The potential for contaminants from Crow

⁴¹ Petition at 4 (citing LBP-16-13, 84 NRC at 357).

⁴² *Id.*

⁴³ *Id.*

⁴⁴ *Id.*

Butte's operations to migrate offsite was a primary focus of this adjudicatory proceeding and therefore the frequent focus of hearing testimony, Board questioning, and other record evidence. The Board based its groundwater-impacts findings on numerous inter-related considerations, none of which Consolidated Intervenors specifically address or challenge.

As we outline further below, Consolidated Intervenors had the opportunity to, and to a large extent did, challenge the adequacy of the water quality testing that Crow Butte performs. For example, the Board received the Intervenors' testimony both on the adequacy of Crow Butte's sampling of the excursion monitoring wells and its sampling of private wells. In its decision, the Board considered an array of water quality tests and ultimately found that all the test results supported its conclusion that mining fluids have not migrated outside of the Crow Butte License Area. Consolidated Intervenors do not identify error in the Board's reasoning.

a. Water Quality Testing of Excursion Monitoring Wells

The purpose of establishing and testing a network of excursion monitoring wells is to be able to detect the migration of process fluids—fluids that could carry contaminants—“long before” these solutions “could seriously degrade the quality of ground-water outside the well field area.”⁴⁵ Excursion parameters therefore are selected to provide “the earliest warning” of a lixiviant excursion, and “not because they are the chemicals of most concern in groundwater protection.”⁴⁶ A number of factors bear on the effectiveness of excursion monitoring, including

⁴⁵ See Ex. NRC-013, Standard Review Plan for In Situ Leach Uranium Extraction License Applications, Final Report, J. Lusher (June 2003), at 5-38 (SRP).

⁴⁶ *Strata Energy, Inc. (Ross In Situ Uranium Recovery Project)*, CLI-16-13, 83 NRC 566, 600 (2016), *aff'd*, *Nat. Res. Def. Council & Powder River Basin Res. Council v. NRC*, 879 F.3d 1202 (D.C. Cir. 2018). In LBP-16-13, the Board outlined the reasons why Crow Butte selected chloride, conductivity, and alkalinity as the excursion indicators. As the Board described, Crow Butte's experts testified that chloride is highly mobile in groundwater, and therefore would be expected to “show up quickly in a monitoring well if lixiviant escapes the wellfield.” See (continued . . .)

the excursion parameters selected for testing, the placement of and distance between the monitoring wells, the frequency of well sampling, the thickness of the overlying aquifer that is being monitored, and the parameter concentrations established as the upper control limits to determine when to place a well on excursion status.⁴⁷ The hearing encompassed evidence on all these factors.

Notably, the Intervenors litigated the adequacy of Crow Butte's water quality sampling of the excursion monitoring wells. Contention A, as admitted and litigated, questioned (1) whether Crow Butte should also be required to test for uranium as an excursion indicator, and (2) whether the frequency of Crow Butte's routine bi-weekly excursion well sampling is "sufficient to identify the potential impacts of non-radiological contaminants."⁴⁸

The Board ruled in favor of Crow Butte and the Staff on Contention A, both on the adequacy of the three selected excursion parameters and the frequency of the well sampling. The Board found "no record evidence that the addition of uranium as a standard excursion indicator would provide any significant information beyond that obtained from using only

LBP-16-13, 84 NRC at 375 (referencing Crow Butte testimony). Chloride also is introduced into the lixiviant itself through the ion exchange process used to recover uranium, thereby rendering chloride a good indicator of lixiviant movement. And Crow Butte's experts testified that chloride is simple to detect because the native groundwater in the area has low background levels of chloride. See *id.* As to alkalinity, Crow Butte stated that because bicarbonate is a major constituent added to the lixiviant, in the event of an excursion event one would expect an increase in the total alkalinity concentration of the groundwater. Crow Butte's experts also testified that conductivity is an excellent indicator of overall groundwater quality. See *id.*

⁴⁷ See Ex. NRC-013, SRP, at 5-38.

⁴⁸ LBP-16-13, 84 NRC at 373. The Staff states that Contention A as admitted did not encompass whether the excursion monitoring should test for additional "constituents 'or contaminants'" other than uranium. See Staff Answer at 9 n.40.

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chloride, conductivity, and total alkalinity.”⁴⁹ Similarly, the Board also rejected as unnecessary the introduction of “tracers” into the mine units to identify subsurface flow paths as a method to assess the influence of *in situ* leach solutions on groundwater. Although acknowledging that the use of tracers recommended by two of the Intervenor’s experts “could be scientifically sound,” the Board stated that the experts were unable to suggest “why chloride, conductivity, and total alkalinity do not already serve the same function as would these tracers.”⁵⁰ Therefore, Consolidated Intervenor’s challenge to the Board’s findings regarding the choice of parameters used in the excursion monitoring program does not identify any substantial question for review.

b. Testing of Private Wells’ Water Quality

Crow Butte does not limit its water quality testing to the excursion monitoring wells. As part of its environmental monitoring program, Crow Butte also conducts quarterly groundwater testing at private water supply wells located within a one-kilometer radius of an individual wellfield.⁵¹ Crow Butte samples nineteen private wells for natural uranium and radium-226. The EA states that this testing is intended to detect impacts to groundwater quality in aquifers surrounding the wellfields “[i]n the unlikely event that a ground water excursion is not detected and corrected.”⁵² Crow Butte provides the results of these quarterly tests to the NRC in semi-

⁴⁹ LBP-16-13, 84 NRC at 377. The Board noted that its finding regarding the excursion indicators is based on the Crow Butte operation and site, and might not apply equally to another proceeding. *See id.* at 377-78 n.752.

⁵⁰ *Id.* at 377.

⁵¹ *See id.* at 350-51, 355-56, 376. The Board noted that some documents in the record describe the required radial distance for private well sampling as one mile instead of one kilometer, but that this discrepancy did not affect its findings. *Id.* at 351 n.555.

⁵² *See* Ex. NRC-010, EA, at 94.

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annual reports.⁵³ The water sampling of the private wells is an additional layer of screening to help ensure that migration of lixiviant is detected.

As the Board described, the EA concludes that water quality remained consistent with baseline levels recorded before Crow Butte began its uranium recovery operations, with “no discernible trends in the monitoring data.”⁵⁴ Staff experts testified that the data from the private wells does “not indicate that mining liquid has migrated beyond the individual mine sites within the License Area.”⁵⁵ The Board agreed that the water quality test data from the private wells shows that the groundwater “has not exceeded radiological background levels.”⁵⁶ And because all but one of the private wells are placed in the overlying aquifer (the Upper Brule Aquifer), the Board found that the test data also shows that vertical excursions, spills, and leaks from Crow Butte’s operations have not had an adverse impact on the overlying aquifer.

We note, further, that the Board specifically questioned the parties’ experts regarding the need to sample for additional parameters other than uranium and radium.⁵⁷ The Board was able to review and weigh the experts’ differing opinions on whether testing the private wells for additional parameters was warranted. While more expansive testing may provide added assurance that there has been no offsite contamination, here the Board was satisfied that the

⁵³ See, e.g., Ex. CBR-018, Crow Butte Uranium Project, Radiological Effluent and Environmental Monitoring Report for Third and Fourth Quarters, 2013 (Feb. 28, 2014), app. A (Monitoring Report).

⁵⁴ See LBP-16-13, 84 NRC at 355.

⁵⁵ See *id.*

⁵⁶ *Id.* at 358.

⁵⁷ See, e.g., Tr. at 1436-45, 1475-76 (referencing Ex. INT-047, *Expert Testimony of Mickel Wireman* (Apr. 29, 2015), at 8).

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water sampling already conducted, together with all other evidence presented, indicated contaminants from the mining operations have remained within the License Area.⁵⁸

Consolidated Intervenors may disagree with the Board's ultimate findings, but they have neither addressed the relevant evidence in the record nor otherwise identified Board error or abuse of discretion.

2. Surface Water Quality Impacts

In addition to the groundwater quality testing, Crow Butte also monitors for potential impacts to surface waters. In its EA, the Staff stated that potential impacts to surface waters would be most likely to impact nearby surface streams and impoundments.⁵⁹ Pursuant to license requirements, Crow Butte quarterly tests for uranium and radium-226 at two nearby surface streams, Squaw Creek and English Creek, sampling locations both upstream and downstream of the Crow Butte facility.⁶⁰ Crow Butte further tests sediment samples taken annually from specific locations on Squaw Creek and English Creek, upstream and downstream from the Crow Butte facility, and from three impoundments on English Creek.⁶¹ Sediment

⁵⁸ See, e.g., LBP-16-13, 84 NRC at 346-48, 358, 363-64, 370-72, 386-96. The Board also extensively addressed Crow Butte's groundwater restoration program, which includes baseline water quality tests that were performed for a number of constituents. The Board found that, based on "record evidence . . . relating to the number of constituents the NRC Staff requires to be monitored to comply with its restoration program," Crow Butte's "selection of parameters to test for groundwater contamination and its obligation to continue to test for those parameters in its renewed license is sufficient to detect migration of groundwater constituents, including uranium." See *id.* at 420. The Board additionally noted other water quality monitoring, offsite or regional, performed by the South Dakota Department of Environmental and Natural Resources or the Nebraska Department of Environmental Quality. See, e.g., *id.* at 359, 363, 383, 388.

⁵⁹ See Ex. NRC-010, EA, at 83.

⁶⁰ LBP-16-13, 84 NRC at 381-82; Ex. NRC-001-R, Staff's Initial Testimony, at 19.

⁶¹ LBP-16-13, 84 NRC at 382; Ex. NRC-010, EA, at 83.

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samples are tested for natural uranium, radium-226, and lead-210. Crow Butte provides this sampling data to the NRC in semi-annual effluent monitoring reports.⁶²

Crow Butte and the Staff testified that the surface water samples show that neither stream has been adversely affected by Crow Butte's operations and that "there was also no evidence of any contamination being transported to surface waters outside the License Area."⁶³ The Board agreed that the impact of "Crow Butte's excursions, spills, and daily operations on surface water is small."⁶⁴

a. Lead-210 Claims

Consolidated Intervenors claim that the Board "abused its discretion and was clearly erroneous" in concluding that mining impacts on surface waters would be small, given "unexplained increases in radioactive Lead-210 readings at the English Creek drainage."⁶⁵ They argue that the Board should have required the Staff to issue a "supplemental NEPA document to explain the increases in Lead-210."⁶⁶

The Board, however, specifically considered the evidence from "Crow Butte's quarterly sampling of surface water and its annual sampling of stream sediment in Squaw and English Creeks," concluding that the sampling results from more than 20 years of operation indicate that "contaminants from Crow Butte's operations have remained within the License Area."⁶⁷ With no

⁶² See, e.g., Ex. CBR-018, Monitoring Report, at 4 & app. H.

⁶³ See LBP-16-13, 84 NRC at 382 (Board describing Staff's conclusion in EA).

⁶⁴ See *id.* at 387-89 (citing Ex. NRC-010, EA, at 82-85).

⁶⁵ See Petition at 4.

⁶⁶ *Id.* at 5.

⁶⁷ LBP-16-13, 84 NRC at 388.

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elaboration or other support, Consolidated Intervenors cite to a two-page discussion in the EA of surface water quality monitoring. But the Board cited the same discussion to support its conclusions.⁶⁸ The Board also referenced a 2014 environmental monitoring report, which contains more recent creek and stream sediment sampling results than the EA.⁶⁹

Consolidated Intervenors do not address any of the English Creek sampling data on lead-210. They do not, for example, identify any discernible trend in lead-210 levels, or point to evidence of significant increases over preoperational levels. Their argument appears to be based on the EA's acknowledgment that there have been some elevated lead-210 readings that may not yet be definitively explained. But the EA also states that lead-210 levels were already high in pre-operational samples taken from certain English Creek locations.⁷⁰ Based on its review of the evidentiary record, and specifically taking into account English Creek, the Board agreed with the EA's assessment that potential impacts to surface waters from Crow Butte's operations historically have been and in the renewed license term "will be SMALL."⁷¹ Because Consolidated Intervenors neither address any lead-210 monitoring data nor address any

⁶⁸ See *id.* at 387-88 (citing Ex. NRC-010, EA, at 83-85); see also *id.* at 364 ("the EA states that sampling of surface waters and sediments . . . yielded no evidence of contamination").

⁶⁹ See *id.* at 382 n.797; Ex. CBR-018, Monitoring Report, § 3.3 & app. H. The report also notes that pre-operational samples taken from the English Creek drainage showed elevated levels of natural uranium and lead-210 compared to other surface water locations.

⁷⁰ See Ex. NRC-010, EA, at 84.

⁷¹ See LBP-16-13, 84 NRC at 387-89 (citing Ex. NRC-010, EA, at 85).

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evidence presented on this issue,⁷² we have insufficient basis to question the Board's overall assessment of surface water quality impacts.

b. Evaporation Pond Leaks

In another challenge to the Board's findings on surface water impacts, Consolidated Intervenor claim that the Board "erred in failing to find that the [evaporation] pond liners are subject to deterioration," and that as a result "there may be unknown leaks through the bottom" of Crow Butte's wastewater evaporation ponds.⁷³ More specifically, they refer to the testimony of Intervenor's expert Ms. Linsey McLean, who stated that the plastics used in the pond liners may easily degrade, causing the liners to become brittle and leak.

But the Board did not conclude that the liners would not be subject to deterioration. Rather, it found that Crow Butte has sufficient protective measures in place to detect potential evaporation pond leaks. These measures include the following: (1) the daily monitoring of pond water levels; (2) the monitoring of shallow wells installed around the ponds to detect leaks; (3) dikes and berms to divert runoff away from the ponds; (4) the use of both a primary and a secondary pond liner; and (5) a leak detection system (in the underdrain system) installed between the primary and secondary liners.⁷⁴ While the Board acknowledged Ms. McLean's testimony on pond liner degradation, it found "no record evidence" to suggest that the liner material would degrade "soon after its two year warranty."⁷⁵ But no matter the lifespan of the

⁷² The Staff states that the Intervenor did not raise this issue before the Board during the hearing. See Staff Answer at 12 n.59.

⁷³ Petition at 5.

⁷⁴ See LBP-16-13, 84 NRC at 384-85, 390-91.

⁷⁵ *Id.* at 390-91.

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pond liners' integrity or how soon leaks can occur due to degradation, the Board found that Crow Butte, through its protective measures, sufficiently "minimized potential leaks and spills from these ponds."⁷⁶

Consolidated Intervenors also argue that "no evidence was provided by [the Staff] or Crow Butte of any monitoring underneath the evaporation ponds."⁷⁷ But the Board specifically questioned Crow Butte on how leaks to the bottom pond liner would be detected.⁷⁸ Crow Butte's expert testified that leaks to the bottom liner would be detected by the monitoring wells that are installed around the ponds.⁷⁹ He further testified that in his eight years of experience at the Crow Butte site, pond leaks have only occurred near the upper water line and no leaks have occurred at the bottom of the pond.⁸⁰

Consolidated Intervenors do not address the Board's reasoning, and we discern no reason to second-guess the Board's findings regarding the potential for evaporation pond leaks to impact surface water quality. No support is provided for the claim that the EA "should be supplemented to state greater impacts" due to "unknown but clearly possible and unmonitored leaks from the bottom of the evaporation ponds."⁸¹

⁷⁶ *Id.* at 390.

⁷⁷ Petition at 5.

⁷⁸ *See* Tr. at 1537-41, 1811-12.

⁷⁹ *Id.* at 1539, 1811-12.

⁸⁰ *See id.* at 1541.

⁸¹ Petition at 5.

c. Small Chronic Leaks

As a final challenge to the Board's findings on surface water quality impacts and monitoring, Consolidated Intervenors argue that the Board abused its discretion and made a clearly erroneous finding that small chronic pipe leaks would not have significant environmental impacts.⁸² Specifically, Consolidated Intervenors argue that a long-term leak "had existed at the Crow Butte mine resulting in lixiviant leaking into the ground," and there "has never been any testing of the environmental consequences of this long term leak."⁸³ They further claim that due to the impacts of small chronic leaks, the Board should have required the Staff both to withdraw its Finding of No Significant Impact (FONSI) and to prepare an environmental impact statement.

But here the Board considered the potential impacts of leaks. The Board addressed the EA's analysis of leaks from pipes, wells, evaporation ponds, and vertical excursions that occurred in the earlier license term. And the Board considered protective measures in place to prevent and minimize the impacts of spills and leaks. Given Crow Butte's monitoring results and its actions to resolve leaks, the Board agreed with the EA's conclusion that the impacts of spills and leaks to surface waters to date have been negligible.⁸⁴ The Board also acknowledged the Intervenors' argument that "Crow Butte may have experienced small chronic pipe leaks," but it found no record evidence that any such leaks would be likely to occur in the future, or that, even were they to occur, they would cause significant impacts.⁸⁵ Consolidated Intervenors do not address any evidence in the record on chronic leaks, the impacts that they may have

⁸² *Id.* at 5 (citing LBP-16-13, 84 NRC at 387).

⁸³ *Id.* at 6.

⁸⁴ LBP-16-13, 84 NRC at 387-89.

⁸⁵ *Id.* at 387 (additionally taking into account record evidence on plausible hydrogeological pathways for contaminants).

caused, or their likelihood of recurrence. We therefore find no basis to review the Board's findings on surface water quality impacts.

C. Challenges to Aquifer Pumping Tests

Consolidated Intervenors next challenge the Board's findings related to the adequacy and interpretation of aquifer pump tests that Crow Butte conducted. Because this issue is technically complex, we first provide a brief background on the topic.

1. Aquifer Tests

Crow Butte conducted aquifer tests to evaluate the hydraulic characteristics of the ore-bearing Basal Chadron/Chamberlain Pass Aquifer and the integrity of the confining layers in the Upper Confining Unit above the Ore Zone. Crow Butte conducted these tests between 1992 and 2002 as it developed its operations.⁸⁶ These were long-term tests with pumping durations that ranged from 51 to 72 hours and pumping rates that varied from 24 gallons per minute (gpm) to 51 gpm, depending on the test.

As a general matter, aquifer tests measure an aquifer's response to the induced stress of pumping. They typically involve pumping groundwater from a pump well at a specific rate for a specific time while monitoring for changes in the water levels of the pumping well and of surrounding observation wells. The level of "drawdown" observed in a well refers to how much (if any) the groundwater level in the well dropped during the pumping. Drawdown curves can be plotted to show the drawdown versus log time. Once the pumping stops, water levels again are monitored to determine the aquifer's recovery time. Aquifer test results, including the drawdown

⁸⁶ The first test was conducted in November 1982, the second in June 1987, the third in September 1996, and the fourth in August 2002.

(continued . . .)

and recovery data, are used to assess the aquifer's hydraulic conductivity, transmissivity, and storativity.⁸⁷

2. Consolidated Intervenor's Claims

a. Test 2: Recharge Boundary Claim

In LBP-16-13, the Board agreed with Crow Butte and the Staff that the results of all four aquifer tests indicated no hydraulic connection between the Basal Chadron/Chamberlain Pass Formation Aquifer (of which the Ore Zone is a portion), and the overlying Upper Brule Aquifer.⁸⁸ Consolidated Intervenor's now challenge the Board's findings regarding the second aquifer test, which we refer to as Test 2. They claim that the Board misrepresented their position, and made clearly erroneous findings by relying on incorrect data interpretations that the Staff and Crow Butte provided. Consolidated Intervenor's highlight the testimony of Dr. David Kreamer who, in evaluating the results of Test 2, found evidence of a recharge boundary.⁸⁹

At issue is whether Test 2 demonstrated a recharge boundary indicating a hydraulic connection between the Basal Chadron/Chamberlain Pass Formation and the Upper Brule Aquifer. For Test 2, three observation wells (to observe drawdown) were placed in the Basal Chadron/Chamberlain Pass Formation Aquifer, and an additional observation well was placed in the overlying Upper Brule Aquifer. The test also involved the use of piezometers, two-inch diameter tubes with highly sensitive stone porous caps, used to measure changes in moisture

⁸⁷ "Storativity" refers to the volume of available water within an aquifer, expressed as a coefficient.

⁸⁸ *Id.* at 329.

⁸⁹ The term "recharge" refers to water entering an aquifer. A "recharge boundary" reflects "an area or zone of the aquifer with increased groundwater flow," such as a water source that may continue to replenish the aquifer. See *id.* at 320.

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and pressure. One piezometer was placed in the Upper Confining Unit, at a level approximately 15 feet above the top of the Basal Chadron/Chamberlain Pass Formation. Another was placed below the Basal Chadron/Chamberlain Pass Formation in the Lower Confining Unit.

As Consolidated Intervenors describe, Dr. Kreamer testified that the results of a drawdown semi-logarithmic plot for Test 2 showed a “recharge boundary appearing at a little more than 30 minutes into the test.”⁹⁰ Specifically, he stated that while the plot depicting the drawdown results from one of the observation wells in Test 2 used “only the late time data,” he had modified the plot to contain “additional early time interpretation.”⁹¹ With the new data, he concluded that the redrawn curve showed a “clear recharge boundary, which can be interpreted as additional vertical flow.”⁹² The Staff and Crow Butte disputed Dr. Kreamer’s analysis on several grounds.

Among their arguments, both the Staff and Crow Butte claimed that data from the early part of the aquifer test is not representative of aquifer properties and behavior, and therefore should not be used to evaluate whether a recharge boundary exists.⁹³ As the Board described, they stated that the equations underlying relevant analyses assume that the well discharge remains constant, and that release of water stored in the aquifer “is immediate and directly

⁹⁰ Petition at 7.

⁹¹ Ex. INT-079, *Supplemental Testimony of Dr. David Kreamer* (Sept. 16, 2015), at 7 (Kreamer Supplemental Testimony); see also LBP-16-13, 84 NRC at 323.

⁹² Ex. INT-079, Kreamer Supplemental Testimony, at 7.

⁹³ See, e.g., LBP-16-13, 84 NRC at 323-24 (citing Ex. NRC-103, *NRC Staff’s Supplemental Rebuttal Testimony* (June 8, 2015), at 24-25 (Staff Supplemental Rebuttal Testimony)); Ex. CBR-074, *Supplemental Testimony of Crow Butte Resources* (Sept. 28, 2015), at 13-15 (Crow Butte Supplemental Testimony).

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proportional to the rate of decline of the pressure.”⁹⁴ But in actuality, the Staff and Crow Butte claimed, there may be a “time lag between the pressure decline and the release of stored water,” and “initially also the well discharge may vary as the pump is adjusting itself to the changing head.”⁹⁵ They went on to state that “as the time of pumping extends, these effects are minimized and closer agreement may be attained.”⁹⁶

Crow Butte and the Staff also argued that the amount of water stored in the pumped well, which the Board refers to as “wellbore storage,” can affect the early-time drawdown data of the pumping and observation wells.⁹⁷ Crow Butte argued that due to water stored in pumping and observation wells, the “measured drawdown in early time is less than what [] should theoretically be observed using analytical type-curve matching techniques,” and therefore the use of early time data could give a “false impression of aquifer leakage.”⁹⁸ Crow Butte’s expert testified that the well used in the aquifer tests had a 500 foot head and could store “well in excess of 500 gallons considering just the casing, and not even including the gravel pack,”

⁹⁴ See LBP-16-13, 84 NRC at 321.

⁹⁵ See Ex. NRC-103, Staff Supplemental Rebuttal Testimony, at 16 (quoting Ex. NRC-110, Kruseman, G.P. and N.A. de Ridder, Analysis and Evaluation of Pumping Test Data, International Institute for Land Reclamation and Improvement, Publication 47 (1994), at 64 (page 2 of Ex. NRC-110) (Kruseman and de Ridder). A longer excerpt of the Kruseman and de Ridder publication was admitted into evidence as Ex. CBR-081.

⁹⁶ *Id.*

⁹⁷ See, e.g., LBP-16-13, 84 NRC at 321-23, 324; Ex. NRC-103, Staff Supplemental Rebuttal Testimony, at 25.

⁹⁸ Ex. CBR-074, Crow Butte Supplemental Testimony, at 12.

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which he stated also should be considered in determining the effects of wellbore storage on drawdown data.⁹⁹

In short, Crow Butte and the Staff claimed that only the later-time drawdown data from an aquifer test should be used to assess whether a recharge boundary exists, that the Test 2 report properly excluded early-time data from the drawdown curve, and that Dr. Kreamer improperly used early-time data in his redrawn curve.¹⁰⁰ The Board agreed that “later-time drawdown data is superior for estimating aquifer parameters and detecting leakage,” and therefore found that Dr. Kreamer had not discredited the results for Test 2.¹⁰¹

Consolidated Intervenors now claim that the Board erroneously discounted Dr. Kreamer’s evidence of a recharge boundary. In particular, they claim that the Board’s “decision to disregard ‘early time data’” was based on “an incomplete understanding of how to use ‘early time data’ in an aquifer test.”¹⁰² Consolidated Intervenors also contend that the Board relied on Crow Butte and Staff arguments that misrepresented how to properly evaluate and analyze aquifer test data. They argue that “no evidence” exists to support the Board’s conclusion that wellbore storage could influence aquifer test results “so far into the test”—that is, “at a little more than 30 minutes into the test,” at which point on the drawdown plot Dr. Kreamer discerned what he interpreted to be evidence of a clear recharge boundary.¹⁰³ They also argue that Crow Butte

⁹⁹ See Tr. at 2539-40.

¹⁰⁰ See LBP-16-13, 84 NRC at 323-24.

¹⁰¹ *Id.* at 330.

¹⁰² See Petition at 7.

¹⁰³ *Id.*

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misrepresented the aquifer test data evaluation and analysis methods described in a technical publication (authored by Kruseman and de Ridder), and conclude that a proper interpretation of the publication supports Dr. Kreamer's position.¹⁰⁴

We decline to revisit the Board's findings on Test 2. While we have the authority to review factual questions *de novo*, we are disinclined to do so when a Board has issued a plausible decision that rests on carefully rendered findings of fact, supported by the record. As we see the record, a variety of evidence supports the Board's conclusion that Test 2 did not demonstrate the presence of a recharge boundary.

Crow Butte and the Staff presented ample evidence in support of their argument that "early time" data may be less reliable and that instead "late time" data should be used to assess whether a recharge boundary exists.¹⁰⁵ The referenced Kruseman and de Ridder publication, for example, notes that wellbore storage "effects may last from a few minutes to many minutes, depending on the storage capacity of the well."¹⁰⁶ At the hearing, the Board questioned the parties extensively on the use of early-time data. Dr. Kreamer opined that by "about seven or eight minutes in," the wellbore storage effects "would be insignificant."¹⁰⁷ Crow Butte's expert (Mr. Robert Lewis) disagreed that the drawdown data would be valid by that point in pumping time and argued that "early time data less than about 37 minutes" would be unreliable "in this

¹⁰⁴ See *id.* at 7-8 (referencing Ex. CBR-081, Kruseman and de Ridder).

¹⁰⁵ See, e.g., LBP-16-13, 84 NRC at 321-24.

¹⁰⁶ See Ex. CBR-081, Kruseman and de Ridder, at 52.

¹⁰⁷ See Tr. at 2526.

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type of analysis.”¹⁰⁸ As part of this discussion, Dr. Kreamer and Mr. Lewis disagreed over the choice of a value to use in a formula provided in the Kruseman and de Ridder paper, relating to the evaluation of aquifer pump test data to estimate hydraulic properties.¹⁰⁹ These were highly technical fact-specific discussions, reflecting a “battle of the experts” over how long into Test 2 the potential effects of wellbore storage, and other factors separate from the aquifer’s response to the pumping, may have influenced and thereby invalidated drawdown data recorded for the well.

Consolidated Intervenor now argue that in considering the specific pumping rate used in Test 2, the “maximum” time it would have taken to remove the stored water from the well would have been less than 9 minutes.¹¹⁰ As the Staff notes, Consolidated Intervenor’s calculation using the Test 2 pump rate does not appear to have been submitted to the Board such that the other parties had the opportunity to respond.¹¹¹ The argument therefore appears inappropriately raised for the first time on appeal.¹¹² In any event, the Board’s decision does not hinge on the question of wellbore storage effects.

But even if we assume that the effects of wellbore storage were diminished by the 9-minute mark of pumping on Dr. Kreamer’s re-drawn curve, the Board outlined other evidence

¹⁰⁸ See *id.* at 2536; Ex. CBR-074, Crow Butte Supplemental Testimony, at 14-15 (addressing the Cooper-Jacob method of analysis).

¹⁰⁹ See Tr. at 2537-40 (referencing Ex. CBR-081, Kruseman and de Ridder).

¹¹⁰ See Petition at 7.

¹¹¹ See Staff Answer at 14 n.70.

¹¹² See *Hydro Resources, Inc.* (P.O. Box 777, Crownpoint, NM 87313, CLI-06-29, 64 NRC 417, 421 (2006)); *Carolina Power & Light Co.* (Shearon Harris Nuclear Power Plant), CLI-01-11, 53 NRC 370, 383 (2001) (arguments not raised before Board are deemed waived).

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contesting Dr. Kreamer's interpretation of the curve. As we describe in more detail below, Staff and Crow Butte experts disagreed that Dr. Kreamer's curve demonstrated a recharge boundary because, in their opinion, "when a recharge boundary is encountered the drawdown does not continue along the same slope" in the plot.¹¹³ The Board moreover considered and weighed the parties' differing interpretations of the drawdown curve in light of other results from Test 2, other evidence from the three additional aquifer tests, and "other lines of evidence" presented on the integrity of the Upper Confining Unit.¹¹⁴ In light of the extensive record, Consolidated Intervenor has not identified any clear error or overlooked material evidence warranting review of the interpretation of Test 2 results.

Significantly, Crow Butte and the Staff did not focus purely on the use of early-time test data, but contested Dr. Kreamer's opinion regarding the presence of a recharge boundary on several grounds. First, Mr. David Back testified for the Staff that if a recharge boundary "had been encountered within the first 30 minutes of the test," the water "would have to have been derived from the overlying and underlying confining units, and water changes would have been detected" by the highly sensitive piezometer placed in the Upper Confining Unit, which was located just 81 feet away from the pumping well and only 15 feet above the top of the Basal Chadron Sandstone.¹¹⁵ Yet as the Board noted, "neither the overlying confining layer

¹¹³ Ex. NRC-103, Staff Supplemental Rebuttal Testimony, at 25. Moreover, even if we presume, for purposes of argument, that the drawdown data was valid from the 9-minute point, it is not clear to what extent Dr. Kreamer considered earlier time drawdown data points in determining where to redraw the curve.

¹¹⁴ See, e.g., LBP-16-13, 84 NRC at 323-27, 328-30; see also *id.* at 346-48.

¹¹⁵ See Ex. NRC-103, Staff Supplemental Rebuttal Testimony, at 25; see also LBP-16-13, 84 NRC at 323-24, 328.

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piezometer nor the overlying aquifer [Upper Brule Aquifer] monitor well showed any response to the pumping from the [Basal Chadron/Chamberlain Pass Formation] [A]quifer during the test.”¹¹⁶

The Board also found that in none of the four aquifer tests had there been any “groundwater response in any of the Upper Brule Aquifer observation wells.”¹¹⁷ In other words, despite the continuous pumping durations of 51 to 72 hours, there were no water level changes—no drawdown—detected in the observation wells placed in the overlying Upper Brule Aquifer.

Second, in disputing Dr. Kreamer’s claim that his re-drawn plot showed a recharge boundary, Mr. Back testified that a plot showing a recharge boundary would “not continue along the same slope,” but instead “continues to curve upward, as opposed to following a line of a constant slope, as the cone of depression moves outward and encounters greater recharge.”¹¹⁸ Mr. Back stated that “when a boundary condition is hit in an aquifer pumping test, it provides a continuous source of water,” and therefore the plot “*would continue* to move off of that straight line as you moved out with time,” the “whole curve would curl up,” and “[y]ou would never get back to that straight line again.”¹¹⁹ In other words, Mr. Back testified that Dr. Kreamer’s re-drawn plot for the Test 2 observation well did not show evidence of a hydraulic connection to the

¹¹⁶ LBP-16-13, 84 NRC at 328.

¹¹⁷ *Id.* at 394.

¹¹⁸ See Ex. NRC-103, Staff Supplemental Rebuttal Testimony, at 25; see *also* Tr. at 2527 (describing that an example of “what a recharge boundary looks like in a straight line analysis” can be seen at Ex. NRC-108, C.W. Fetter, Jr., Applied Hydrogeology, University of Wisconsin-Oshkosh (undated), at 3 (Applied Hydrogeology)).

¹¹⁹ See Tr. at 1303-05 (emphasis added).

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overlying aquifer because the deviation from the theoretical drawdown line did not curve upward.¹²⁰

The Board described the same principle in addressing the Test 4 results. The Board noted Mr. Back's argument that "for the data to indicate a recharge boundary, the plot of time vs. drawdown would continue to deviate from the straight line plot with increasing time," meaning the plot would "never return to the straight line again."¹²¹ The Board further observed that Dr. Kreamer, in discussing Test 4, had "agreed with Mr. Back that the plot would continue to deviate from the straight line drawdown curve when a recharge boundary had been encountered."¹²²

Third, the Staff and Crow Butte did not dispute that the Test 2 results may have detected relatively "small amounts of water" coming from the clay of a confining unit, "squeezed from storage due to pore pressure changes during the aquifer pumping test."¹²³ But both parties testified that any amounts of water were relatively insignificant, and further that the aquifer test report estimated that it would take "more than 2.8 million years for a molecule of water to move through" the Upper Confining Unit.¹²⁴ The Board agreed that a "small" recharge "observed in

¹²⁰ See Ex. NRC-108, Applied Hydrogeology, at 3 (example of semi-logarithmic drawdown-time curve depicting recharge boundary).

¹²¹ LBP-16-13, 84 NRC at 327.

¹²² See *id.* (citing Tr. at 1307-08, where Dr. Kreamer stated that he "agreed with Mr. Back that a classic recharge would have continued out").

¹²³ See *id.* at 324.

¹²⁴ See *id.* at 325, 328; see also, e.g., Tr. at 1333 (where Dr. Elise Striz, for the Staff, testified that any leakage or small recharge detected in aquifer tests were "miniscule and would not contribute in any significant manner to this huge Basal Chadron aquifer over the lifetime of the mine operations"); Tr. at 2517 (Mr. Back's statement that tests detected potential leakage of (continued . . .)

some aquifer pumping test data” resulted from “the extensive stress applied to the confining units during these aquifer pumping tests,” but that otherwise all four aquifer tests showed “virtually no leakage” through the Upper Confining Unit.¹²⁵

Fourth, Crow Butte’s witnesses testified that core samples of clay strata taken from the Upper Confining Unit were analyzed for their hydraulic properties and found to be “very impermeable.”¹²⁶ As an additional matter, Mr. Wade Beins testified for Crow Butte that the data gathered during the operating history of the 203 excursion monitoring wells placed across the overlying Upper Brule Aquifer also could be seen as akin to a long-term “pumping test across the entire site.”¹²⁷ He stated that data routinely collected from these monitoring wells have not indicated a reduction in the water levels in the Upper Brule Aquifer, another indication of the lack of transmissivity between the Upper Brule Aquifer and the Basal Chadron/Chamberlain Pass Formation Aquifer.¹²⁸ The Board agreed that the water level data confirms that “there has been no drawdown in the Upper Brule Aquifer due to Crow Butte’s pumping from the [Basal Chadron/Chamberlain Pass Formation] Aquifer during its mining operations.”¹²⁹

only “small amounts” of water). For Test 1, water volume calculations based on the pumping period reflected a reading of .00001884 gallons per square foot. See Tr. at 2519.

¹²⁵ LBP-16-13, 84 NRC at 394; see also *id.* at 330.

¹²⁶ See *id.* at 325 (noting vertical hydraulic conductivities of less than 1×10^{-10} cm/sec).

¹²⁷ See Tr. at 1315.

¹²⁸ See also Ex. NRC-076-R2, *NRC Staff’s Rebuttal Testimony* (June 8, 2015), at 36 (continuous operations over 20 years “have essentially acted as a surrogate for a very long aquifer pumping test,” and while the “potentiometric surface of the Basal Chadron Sandstone aquifer has decreased approximately” 15 meters “there has been very little change in the potentiometric surface in the overlying Brule aquifer”).

¹²⁹ LBP-16-13, 84 NRC at 349.

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In short, the Board found multiple lines of evidence to be consistent with the findings that “there is no significant hydraulic connection between” the Upper Brule Aquifer and the Basal Chadron/Chamberlain Pass Formation Aquifer, and similarly, that there is “adequate confinement of the Basal Chadron/Chamberlain Pass Formation Aquifer.”¹³⁰ Consolidated Intervenorors have not articulated a substantial question with respect to these determinations.¹³¹

¹³⁰ See *id.* at 330; see also *id.* at 348-49 (the “plethora” of water data taken from the excursion monitoring wells in the Upper Brule Aquifer shows there has been “little drawdown in the Upper Brule Aquifer from the time” operations began at the License Area).

¹³¹ We note two additional arguments raised in regard to Dr. Kreamer’s claim of a recharge boundary. Consolidated Intervenorors argue that there was “uncontroverted evidence” that Dr. Kreamer’s “conclusion regarding the existence of a recharge boundary” in Test 2 was “more than 98% accurate.” See Petition at 8. This claim was part of the dispute over the validity of the early-time drawdown data that Dr. Kreamer had considered in redrawing the curve in the semi-logarithmic plot; specifically, Dr. Kreamer challenged Crow Butte’s claim that drawdown data from earlier than 37 minutes into the pumping should be disregarded as invalid. Referencing the Kruseman and de Ridder publication, Dr. Kreamer claimed that by introducing 2% error into Crow Butte’s calculation, the results would show that drawdown data from an earlier time (e.g., 7.4 minutes) should be considered valid. See Tr. at 2538-39. But Mr. Lewis disputed this argument on more than one ground, including that Dr. Kreamer was using for his calculations a particular value that was “an exception to the rule . . . not the rule.” See Tr. at 2539-40. Thus, this evidence was not uncontroverted, and the argument does not call the Board’s overall conclusions into substantial question. More significantly, whether Dr. Kreamer’s redrawn curve using earlier drawdown times depicts the presence of a recharge boundary is a *separate* question—also contested—going to the interpretation of his plot. We therefore disagree that the referenced Kruseman and de Ridder publication or other evidence “unequivocally demonstrates that Dr. Kreamer’s conclusion” that his redrawn plot shows a recharge boundary “is more than 98% accurate.” See Petition at 8.

Consolidated Intervenorors additionally claim that Dr. Kreamer identified corroborating evidence of a recharge boundary in the “residual time-drawdown data” for an observation well in Test 2, and that “no evidence was introduced to counter” his claim. See Petition at 8 (citing Ex. INT-079, Dr. Kreamer’s Supplemental Testimony, at 7). But Mr. Lewis disagreed that the curve at issue showed evidence of a recharge boundary. See Tr. at 2544-46. And both Crow Butte and the Staff also testified that there was no indication of recharge in the recovery graphs for aquifer Test 2. See LBP-16-13, 84 NRC at 323 & n.330; see also Tr. at 2516.

b. Test Design and Test Interpretation Methods

Consolidated Intervenor also argue that the pump test results may have been analyzed using inappropriate methods.¹³² They claim that the Board “accepted less than rigorous pump test designs and interpretations for the characterizations of pre-mining aquifers.”¹³³ But Consolidated Intervenor neither support these claims with evidence from the record nor otherwise call into question the Board’s findings regarding the adequacy of the tests’ design and implementation.

The Board questioned Dr. Kreamer on whether he had any evidence that the tests were not conducted “consistent with the industry standard techniques used for this type of test.”¹³⁴ While Dr. Kreamer did not view the tests as “optimal,” he stated that he had no opinion regarding whether “the standards were or were not met.”¹³⁵ As the Board highlighted, Dr. Kreamer agreed that the test analysis methods that were used are “common industry-accepted tests for evaluating the results of aquifer pumping tests.”¹³⁶ The Board acknowledged that the methods assume that the aquifer will have “homogeneous, isotropic responses,” a criticism raised by Dr. Kreamer.¹³⁷ But the Board found that Crow Butte recognized the simplified

¹³² See Petition at 9.

¹³³ See *id.*

¹³⁴ See Tr. at 1275.

¹³⁵ See *id.*

¹³⁶ See *id.* at 1299; see also LBP-16-13, 84 NRC at 319.

¹³⁷ See LBP-16-13, 84 NRC at 319. The Board used “homogeneous” to mean an aquifer that has constant hydraulic properties (e.g., the same permeability) at all distances and depths, and “isotropic” to mean an aquifer that has constant hydraulic properties in all directions, vertical and horizontal. See *id.* at 319 n.295. In contrast, the Board used “heterogeneous” to refer to a (continued . . .)

underlying assumptions of the tests, and “was prepared to make appropriate allowances for the use of more complex algorithms if there were any deviations” in the actual test data from the assumed aquifer characteristics.¹³⁸ The Board concluded that none of the data from the actual tests “indicated sufficient deviations” from the underlying aquifer assumptions “to necessitate the use of more complex models.”¹³⁹ Consolidated Intervenors do not identify any evidence in the record calling these findings into question.

As part of their argument challenging the pump test designs and interpretations, Consolidated Intervenors also list three American Society of Testing Materials (ASTM) standards for the proposition that these standards should have been used, but were not.¹⁴⁰ But Consolidated Intervenors do not specify how these standards identify material error in the Board’s decision, or even whether these standards were addressed in the record.¹⁴¹ The Board addressed the adequacy of the aquifer tests at various points in its decision.¹⁴² Consolidated

geologic formation with hydraulic properties (e.g., permeability) that vary with distance and depth.

¹³⁸ See *id.* at 330; see also Tr. at 1298-99 (where Dr. Kreamer agreed that deviations from assumed homogeneity would show up in actual data results).

¹³⁹ See LBP-16-13, 84 NRC at 330.

¹⁴⁰ See Petition at 9.

¹⁴¹ The Staff claims that two of the listed ASTM standards do not appear to have been raised before the Board at all (in which case they would be inappropriately raised on appeal). The Staff further notes that the third standard is listed on a Staff exhibit identifying the standards Crow Butte used to analyze the aquifer tests. See Staff Answer at 15 & n.73; Ex. NRC-080, ASTM Standards for the Analysis of Hydraulic Characteristic of Aquifer by Aquifer Pumping Tests.

¹⁴² See, e.g., LBP-16-13, 84 NRC at 316-20, 328, 330, 394.

(continued . . .)

Intervenors have not sufficiently called into question the Board's conclusions on the overall adequacy of the tests and test interpretation methods.

D. Augmentation of the Staff's Environmental Review

Consolidated Intervenors also argue that the Board abused its discretion by correcting "mistakes in the Final EA."¹⁴³ More specifically, they argue that the EA contained incorrect information regarding tornadoes, but that the Board "during the hearing . . . corrected the mistake and inserted the correct information into the record."¹⁴⁴ Similarly, they state that to correct deficiencies in the EA, the Board improperly inserted information concerning earthquakes into the record.¹⁴⁵ Additionally, Consolidated Intervenors argue that the Board both deleted material information, "such as the White River modeling," and added "material items such as earthquake and tornado and hydrogeological analyses in order to cure NEPA violations."¹⁴⁶ Consolidated Intervenors claim that the Board should have "required the NRC Staff to prepare and publish for public comment a supplemental NEPA document" containing corrected information.¹⁴⁷

Consolidated Intervenors' arguments do not identify legal error or abuse of discretion regarding the Board's augmentation of the record of decision. Following a hearing involving an extensive case record, the Board issued a comprehensive decision addressing at length the

¹⁴³ See Petition at 6.

¹⁴⁴ *Id.*

¹⁴⁵ *Id.*

¹⁴⁶ See *id.* at 2.

¹⁴⁷ See *id.* at 6.

(continued . . .)

evidence presented. Consistent with longstanding NRC practice, the Board in LBP-16-13 augmented the environmental record of decision with additional information from the hearing record, none of which materially altered the Staff's conclusions on the potential impacts of the proposed licensing action.

We long have held that initial decisions of the presiding officer on NEPA issues, and our own decisions, augment and “become part of the environmental ‘record of decision.’”¹⁴⁸ Our hearings provide in-depth scrutiny of the contested aspects of the Staff's environmental review. Evidence presented as part of the hearing record therefore often may refine, amplify, or correct a point made in the Staff's environmental review document. For an adjudicatory decision on the Staff's NEPA document to note available, amplifying information that aids in comprehending the Staff's review and conclusions—including the sufficiency of, or any deficiency in, those conclusions—enhances public disclosure and the NRC's decisionmaking. As we discuss below, the Board's determination that the EA did not provide sufficient information was cured by analysis of additional information provided by the Staff via testimony throughout the hearing. None of the additional analysis of information from the hearing record that the Board referenced in its decision changed the Staff's overall conclusions on the potential impacts of the Crow Butte uranium recovery operations during the renewed license term.¹⁴⁹

¹⁴⁸ *Louisiana Energy Services, L.P.* (National Enrichment Facility), CLI-06-15, 63 NRC 687, 707 n.91 (2006); *see also, e.g., Strata*, CLI-16-13, 83 NRC at 595 (the “hearing record, and subsequent decision on a contested environmental matter augment the environmental record of decision”); *Louisiana Energy Services, L.P.* (Claiborne Enrichment Center), CLI-98-3, 47 NRC 77, 89 (1998) (“The adjudicatory record and Board decision (and, of course, any Commission appellate decisions) become, in effect, part of the FEIS.”); *Hydro Resources, Inc.* (P.O. Box 15910, Rio Rancho, NM 87174), CLI-01-4, 53 NRC 31, 53 (2001).

¹⁴⁹ We do not mean to suggest that gaps in an EA necessarily can be cured by a presiding officer or Commission adjudicatory decision. Certain material deficiencies may warrant further staff analysis. In such a circumstance, it may be necessary to evaluate whether the license (continued . . .)

Consolidated Intervenors do not suggest that any of the Board's additional discussion about earthquakes or tornadoes is inaccurate, or that more information on these topics is necessary to adequately evaluate the environmental impacts of Crow Butte's continued operations. Nor do they claim that the environmental record, as augmented, depicts a seriously different environmental picture than that outlined in the EA.¹⁵⁰ Their complaint, as we understand it, is that the Board made corrections and added analysis, not that the corrections or analyses are incorrect, or that they change the impacts picture in any significant way.

Turning to the specific topics raised in the petition, we discern no necessity for a new NEPA document or new round of public comment.¹⁵¹ For example, with regard to tornadoes, the Board found that the Staff "did not violate NEPA by failing to discuss tornadoes in the EA."¹⁵² In other words, the Board found no deficiency in the EA as written because tornado-related impacts are "remote and speculative" possibilities that do not warrant analysis in the EA.¹⁵³ Consolidated Intervenors do not argue otherwise.

should remain in effect, taking into account the nature of the NEPA deficiency and any other appropriate considerations. See *Oglala Sioux Tribe v. NRC*, 896 F.3d 520, 536-38 (D.C. Cir. 2018).

¹⁵⁰ We note, also, that Consolidated Intervenors had full opportunity during the hearing to challenge any evidence presented.

¹⁵¹ And with respect to EAs, an agency has "significant discretion in determining when public comment is required." See *Wildearth Guardians v. U.S. Fish and Wildlife Serv.*, 784 F.3d 677, 698 (2015) (quoting *Taxpayers of Michigan Against Casinos v. Norton*, 433 F.3d 852, 861 (D.C. Cir. 2006)); see also 40 C.F.R. § 1501.4(b).

¹⁵² See LBP-16-13, 84 NRC at 424.

¹⁵³ See *id.* The Board further noted that the Staff in its Safety Evaluation Report had addressed the probability of a tornado strike. See *id.* at 423-24.

(continued . . .)

As to the EA's seismic assessment, the Board found that, while the Staff had addressed the historical earthquakes in Nebraska, the EA was deficient because the Staff also should have considered "recent earthquakes in South Dakota and eastern Wyoming"—particularly, two seismic events in 2011 that occurred in South Dakota about 25 miles north-northwest of the license area that were felt in Crawford, Nebraska.¹⁵⁴ However, the Board concluded that Staff witnesses' testimony cured this defect by demonstrating that including data from these additional earthquakes would not change the EA's conclusions. The Staff at the hearing provided analysis on the characteristics and hazards of *all* earthquakes within a 100-mile radius of the License Area, regardless of the state in which they occurred. Because this additional earthquake data fell within the range of magnitudes and hazards already identified and analyzed in the EA, the Board agreed with the Staff that none of the new earthquake data changed the accuracy of the EA's current analysis.¹⁵⁵ And the Board further noted that the Intervenors had presented no evidence to the contrary. The Board therefore found that adding the new earthquake information "would not affect the EA's description of typical seismic activity and level of seismic hazard," and "that this additional analysis cures this deficiency in the EA."¹⁵⁶

Consolidated Intervenors do not argue that the Board's overall finding on the earthquake analysis is incorrect or that further earthquake analysis is necessary. Here, the hearing served to examine the earthquake issue in depth. The Board's concern over the omitted information on earthquakes from neighboring states, which it characterized as a deficiency, was that the information might affect the EA's conclusions. But the Staff dispelled any uncertainty over the

¹⁵⁴ See *id.* at 438.

¹⁵⁵ *Id.* at 436-38.

¹⁵⁶ *Id.* at 438.

additional data's effect on the analysis by showing that the new information was consistent with that already considered. Consolidated Intervenor do not suggest otherwise.

In short, by referencing the Staff's analysis of the nearby states, the Board appropriately cured any deficiencies and amplified the NEPA record of decision with evidence from the hearing—with absolutely no change to the assessment of potential seismic impacts. To require the Staff to formally supplement the EA with additional, already-reviewed information that no party suggests has a material impact on the EA's conclusions—and that indeed strengthens the Staff's conclusions—would serve no important NEPA goal.¹⁵⁷

Consolidated Intervenor also claim that the Board inappropriately deleted from the EA a discussion involving "White River modeling."¹⁵⁸ Over the course of the hearing, the Staff determined that it would no longer rely on "its hydrogeologic modeling of the White River Feature" because the Staff was missing information on the underlying assumptions used in the modeling.¹⁵⁹ The Staff therefore requested that the Board accord the modeling no weight. The Staff nonetheless maintained that it was not necessary to revise the EA because the modeling

¹⁵⁷ See *NRDC*, 879 F.3d at 1210-12 (where Board augmented environmental record of decision with additional information but the information did not alter Board's conclusion, no "harmful consequence of the supplementation" was identified and there was therefore "nothing to be gained by ... consider[ing] the same information again"); *Friends of the River v. FERC*, 720 F.2d 93, 106 (D.C. Cir. 1983) (declining to remand for new environmental impact statement where agency, in response to public comments, already had investigated and addressed issues in publicly accessible opinion).

¹⁵⁸ Petition at 2.

¹⁵⁹ See LBP-16-13, 84 NRC at 314.

(continued . . .)

was “only one of a number of bases” for the Staff’s conclusions regarding the White River Feature.¹⁶⁰

The Board agreed that the modeling was not necessary to the Staff’s White River Feature analysis. Even disregarding the modeling results, the Board found that the Staff had taken a “hard look” at the structure of the White River Feature and its transmissivity.¹⁶¹ Consolidated Intervenors do not contest the Board’s conclusions on the White River Feature, only that the Board’s decision effectively amended the EA to eliminate any further reliance on the modeling. But we view the Board’s action as an appropriate refinement of the environmental record that does not alter the Staff’s conclusions.

In short, the Staff need not formally supplement its NEPA review document every time new information or analysis comes to light. We consider whether new information shows the proposed action would affect the environment “in a significant manner or to a significant extent not already considered.”¹⁶² The information must present “‘a seriously different picture of the environmental impact of the proposed project’ from what was previously envisioned.”¹⁶³ We also look to whether additional information is necessary to reach a determination on the adequacy of the Staff’s conclusions on a material issue—whether the Staff has taken the necessary “hard look” at reasonably foreseeable environmental impacts. Consolidated

¹⁶⁰ See *id.* at 307.

¹⁶¹ See *id.* at 314 (noting “several different lines of compelling evidence” for the Staff’s position).

¹⁶² See *Marsh v. Oregon Nat. Res. Council*, 490 U.S. 360, 374 (1989).

¹⁶³ See, e.g., *Hydro Resources, Inc.* (P.O. Box 15910, Rio Rancho NM 87174), CLI-04-39, 60 NRC 657, 659 (2004) (quoting *Sierra Club v. Froehlke*, 816 F.2d 205, 210 (5th Cir. 1987)).

(continued . . .)

Intervenors have not identified any matter warranting further analysis or supplementation of the EA.

Consolidated Intervenors also argue that because the Staff issued the renewed license while the adjudication was ongoing, the “federal action occurred” and therefore it was too late for the Board to augment the environmental record with information from the hearing record.¹⁶⁴ While our rules permitted the Staff to issue the license pending completion of the adjudicatory proceeding, the license effectively remains provisional until the adjudicatory proceeding is completed. Our rules allowed the Staff to issue the renewed license after it had completed its safety and environmental reviews, concluded issuance of the license would not endanger the public health and safety or the common defense and security, and issued a FONSI.¹⁶⁵ The presiding officer, however, has the authority to make findings of fact and conclusions of law on matters put into controversy in an adjudicatory proceeding.¹⁶⁶ Depending on the resolution of those matters, the Staff may “issue, deny, or appropriately condition” the license, in accordance with adjudicatory findings.¹⁶⁷ Until this adjudicatory proceeding provided under the Atomic Energy Act (AEA) is completed, the agency will not have reached a final decision on the licensing action. And while no further action is required with respect to the matters addressed in this decision for the reasons described above, to the extent that additional analysis may be required under NEPA for other issues, our regulations governing license renewal provide that

¹⁶⁴ See Petition at 2.

¹⁶⁵ See, e.g., 10 C.F.R. §§ 2.103(a); 2.1202(a).

¹⁶⁶ See *id.* § 2.340(e)(1); see also *id.* § 2.1210(a).

¹⁶⁷ See *id.* § 2.340(e)(2).

(continued . . .)

the original license will remain in effect pending a final determination on the renewal application.¹⁶⁸

In sum, Consolidated Intervenors have not identified any issue on which the Board abused its discretion or violated NEPA requirements. Because NEPA itself does not require an agency to conduct environmental hearings, our hearings held under the AEA serve to probe and publicly ventilate the details of the Staff's review.¹⁶⁹ An adjudicatory decision following a hearing on an EA (or an environmental impact statement) therefore often will contain some further detail on the Staff's review. But none of the information that Consolidated Intervenors raised as warranting issuance of a new "corrected" NEPA document presents a seriously different picture of the environmental impacts associated with Crow Butte's license renewal application. Nor do Consolidated Intervenors identify any matter necessitating further Staff analysis, or any information materially changing the Staff's assessment of impacts. The Board's detailed discussion of the hearing record, and our decision today, augments and refines the agency's publicly available environmental record of decision, consistent with our longstanding practice and NEPA's goals.

¹⁶⁸ See *id.* §§ 2.109(a); 40.42(a).

¹⁶⁹ See *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 & 3), CLI-15-6, 81 NRC 340, 388 (2015) (citation omitted) (NRC hearings allow for "more rigorous public scrutiny . . . than does the usual 'circulation for comment'").

IV. CONCLUSION

For the reasons discussed above, Consolidated Intervenors' petition for review of LBP-16-13 is *denied*.

IT IS SO ORDERED.¹⁷⁰

For the Commission

NRC Seal

/RA/

Annette L. Vietti-Cook
Secretary of the Commission

Dated at Rockville, Maryland,
this 29th day of November, 2018.

¹⁷⁰ Commissioner Burns did not participate in this matter.

Additional Views of Commissioner Baran

Although I join the majority in denying Consolidated Intervenors' petition for review, I disagree with much of the reasoning in section III.D. of the decision. I write separately because I continue to believe that the NRC Staff should prepare and consider an adequate NEPA environmental review before making a licensing decision. That is a core requirement of NEPA.¹ If the Commission allows the Board to augment and "cure" an inadequate NEPA document *after* the agency has already made a licensing decision, then a fundamental purpose of NEPA is frustrated. In two recent cases, the D.C. Circuit has expressed the same concern.

The Court's decision in *NRDC v. NRC* was hardly an endorsement of the Commission's practice of permitting the Board to augment an inadequate NEPA document after the fact.

While the Court found that there was no concrete harm in that particular case, the Court stated:

We do not mean to imply the procedure the Board followed was ideal or even desirable. Certainly it would be preferable for the FEIS to contain all relevant information and the record of decision to be complete and adequate before the license is issued.²

In *Oglala Sioux Tribe*, the Court of Appeals went even further in broadly criticizing the agency's practice. The Court explained:

The National Environmental Policy Act, however, obligates every federal agency to prepare an adequate environmental impact statement *before* taking any major action, which includes issuing a uranium mining license. The statute does not permit an agency to act first and comply later. Nor does it permit an agency to condition performance of its obligation on a showing of irreparable harm.³

The Court added:

The agency's decision in this case and its apparent practice are contrary to NEPA. The statute's requirement that a detailed environmental impact statement be made for a

¹ *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 349 (1989).

² *NRDC v. NRC*, 879 F.3d 1202, 1212 (D.C. Cir. 2018).

³ *Oglala Sioux Tribe v. NRC*, 896 F.3d 520, 520 (D.C. Cir. 2018).

(continued . . .)

“proposed” action make clear that agencies must take the required hard look *before* taking that action.⁴

This is the same underlying principle that I discussed in my separate opinions in *Powertech*, *Turkey Point*, and *Strata*.⁵ In each of those cases, the Board identified significant deficiencies in the NEPA reviews on which the Staff relied in making its licensing decisions. As a result, the agency did not have a complete picture of the environmental impacts of the proposed licensing actions before the Staff made its licensing decisions in those cases.

Here, however, with respect to the issues raised in Consolidated Intervenors’ petition for review, the hearing revealed that the environmental impacts of the proposed licensing action were appropriately identified in the EA. The hearing showed that, without augmentation, the Staff’s EA provided an adequate basis for NRC to make a licensing decision. For example, with respect to tornadoes, the Board identified no deficiency in the EA as written because it found that tornado-related impacts were “remote and speculative” possibilities that did not warrant analysis in the EA.⁶ The Staff also introduced seismic information at the hearing from a wider geographic range than that considered in the EA, but the Board found that adding this additional information “would not affect the EA’s description of typical seismic activity and level of seismic hazard.”⁷ And with regard to the EA’s discussion concerning hydrogeologic modeling of the White River Feature, which the Staff ultimately recommended should be given no weight, the

⁴ *Id.* at 532.

⁵ *Powertech USA, Inc.* (Dewey-Burdock In Situ Uranium Recovery Facility), CLI-16-20, 84 NRC 219, 269 (2016); *Florida Power & Light Co.* (Turkey Point Nuclear Generating Units 3 and 4), CLI-16-18, 84 NRC 167, 177-78 (2016); *Strata Energy, Inc.* (Ross In Situ Uranium Recovery Project), CLI-16-13, 83 NRC 566, 603-05 (2016).

⁶ LBP-16-13, 84 NRC 271, 424 (2016).

⁷ *Id.* at 438.

(continued . . .)

Board determined that the modeling was not necessary to the Staff's White River Feature analysis. Even without the modeling results, the Board found that the Staff had taken a "hard look" at the structure of the White River Feature and its transmissivity and had included sufficient information in the EA to reach its conclusion.⁸

In other words, the Board ultimately found no significant deficiency in the NEPA analysis regarding the issues that Consolidated Intervenors raise here. With respect to these issues, the agency had an adequate EA on which to make a licensing decision at the time of that decision. Rather than augmenting or "curing" a significantly deficient NEPA analysis, the information obtained through the Board's hearing process actually confirmed the sufficiency of the Staff's review. Because the hearing revealed that the EA was adequate with respect to the issues raised in Consolidated Intervenors' petition for review, I agree with my colleagues that it is not necessary to require the Staff to prepare a supplemental NEPA document or make a new licensing decision.

⁸ See *id.* at 314 (noting "several different lines of compelling evidence" for the Staff's position).

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of)
)
CROW BUTTE RESOURCES, INC.) Docket No. 40-8943-OLA
)
In-Situ Leach Uranium Recovery Facility,)
Crawford, Nebraska)
)
(License Renewal))

CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing **COMMISSION MEMORANDUM AND ORDER (CLI-18-08)** have been served upon the following persons by Electronic Information Exchange, and by electronic mail as indicated by an asterisk.

Office of Commission Appellate
Adjudication
U.S. Nuclear Regulatory Commission
Mail Stop O-16B33
Washington, DC 20555-0001
E-mail: ocaamail@nrc.gov

U.S. Nuclear Regulatory Commission
Office of the Secretary of the Commission
Mail Stop O-16B33
Washington, DC 20555-0001
Hearing Docket
E-mail: hearingdocket@nrc.gov

Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission.
Mail Stop T-3F23
Washington, DC 20555-0001

U.S. Nuclear Regulatory Commission
Office of the General Counsel
Mail Stop O-15D21
Washington, DC 20555-0001
Marcia J. Simon, Esq.
Emily Monteith, Esq.
Susan Vrahoretis, Esq.
OGC Mail Center
E-mail:
marcia.simon@nrc.gov
david.cylkowski@nrc.gov
emily.monteith@nrc.gov
Susan.Vrahoretis@nrc.gov
OGCMailCenter@nrc.gov

Michael M. Gibson, Chairman
Administrative Judge
E-mail michael.gibson@nrc.gov

Richard E. Wardwell
Administrative Judge
E-mail: richard.wardwell@nrc.gov

Brian K. Hajek
Administrative Judge
E-mail: brian.hajek@nrc.gov

Joseph D. McManus, Law Clerk
Joseph.Mcmanus@nrc.gov

Sarah B. Ladin, Law Clerk
Sarah.Ladin@nrc.gov

DOCKET NO. 40-8943-OLA

COMMISSION MEMORANDUM AND ORDER (CLI-18-08)

Winston & Strawn, LLP
 101 California Street
 San Francisco, CA 94111
 Louise Dyble
 Counsel for Crow Butte Resources, Inc.
 E-mail: trsmith@winston.com
ldyble@winston.com

Winston & Strawn, LLP
 1700 K Street
 Washington, DC 20006
 Carlos L. Sisco, Paralegal
 Counsel for Crowe Butte Resources, Inc.
 E-mail: csisco@winston.com

Tyson Smith
 889 Marin Drive
 Mill Valley, CA 94941
 Counsel for Crow Butte Resources, Inc.
 E-mail: tsmith@nuclear.law

McGuire Law Firm
 625 South 14th Street, Suite C
 Lincoln, Nebraska 68508
 Mark D. McGuire
 Counsel for Crow Butte Resources, Inc.
 E-mail: mdmcguire46@gmail.com

Owe Oku, Debra White Plume,
 and David House
 P.O. Box 2508
 Rapid City, South Dakota 57709
 Bruce Ellison, Esq.
 E-mail: belli4law@aol.com

Ved Nanda Center for International and
 Comparative Law
 1075 Waite Drive
 Boulder, CO 80303
 Andrew Reid, Esq.
 Counsel for Oglala Sioux Tribe
 E-mail: lawyerreid@gmail.com

Thomas J. Ballanco*
 945 Taraval Avenue, # 186
 San Francisco, CA 94116
 Counsel for Joe American Horse, Thomas Cook,
 Loretta Afraid-of-Bear Cook, Slim Buttes
 Community, and Pine Ridge Reservation, South
 Dakota 57770
 E-mail: HarmonicEngineering@gmail.com

Western Nebraska Resources Council
 Chief Joseph American Horse
 Thomas K. Cook, Francis E. Anders
 P.O. 3014
 Pine Ridge, South Dakota 57770
 E-mail: arm.legal@gmail.com

David C. Frankel, Esq.
 1430 Haines Ave., #108-372
 Rapid City, SD 57701
 Counsel for Consolidated Intervenors
 E-mail: arm.legal@gmail.com

[Original signed by Clara Sola _____]
 Office of the Secretary of the Commission

Dated at Rockville, Maryland
 The 29th day of November, 2018