September 18, 2015

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
CROW BUTTE RESOURCES, INC.	)	Docket No. 40-8943-OLA
	)	
(License Renewal for the In Situ Leach	)	ASLBP No. 08-867-02-OLA-BD01
Facility, Crawford, Nebraska)	)	

NRC STAFF'S SUPPLEMENTAL DIRECT TESTIMONY

Introduction

Q.1 Please state your name, position, and employer, and briefly describe your role in reviewing the Crow Butte Resources (CBR) License Renewal Application (LRA) associated with the Crow Butte project.

A.1a My name is David Back. I am a Hydrogeologist at Sanford Cohen and Associates Inc. (SC&A). Exhibit NRC-002 provides a statement of my professional qualifications. I provided technical support to the lead Environmental Project Manager, Mr. Nathan Goodman, for the NRC Staff's environmental review of the CBR License Renewal application. I prepared the sections of the final environmental assessment (EA) that address water resources, including affected environment, impacts, and cumulative impacts.

A.1b My name is Thomas R. Lancaster. I am a Hydrogeologist in the NRC's Office of Nuclear Material Safety and Safeguards, Division of Fuel Cycle Safety, Safeguards, Uranium Review and Licensing Branch. Exhibit NRC-005 provides a statement of my professional qualifications. I serve as the alternate Safety Project Manager for the Crow Butte license renewal. As a technical reviewer, I provided support to the lead

Safety Project Manager, Mr. Ron Burrows, in the NRC Staff's safety review of hydrology- and hydrogeology-related sections of the Crow Butte License Renewal application. In addition, I have provided technical support for several onsite inspections of the CBR facility.

A.1c My name is Dr. Elise Striz. I am a Hydrogeologist in the NRC's Office of Nuclear Material Safety and Safeguards, Division of Fuel Cycle Safety, Safeguards, Uranium Review and Licensing Branch. Exhibit NRC-008 provides a statement of my professional qualifications. I provided support to the lead Safety Project Manager, Mr. Ron Burrows, for the NRC Staff's safety review of hydrology- and hydrogeology-related sections of the Crow Butte License Renewal application. I also provided support to the lead Environmental Project Manager, Mr. Nathan Goodman, in preparing the EA for the NRC Staff's environmental review of the CBR License Renewal application.

Q.2 **Have you testified previously in this hearing?**

A.2 (D. Back, T. Lancaster, E. Striz) Yes. We submitted written testimony on May 8, 2015, as revised July 29, 2015 (Ex. NRC-001-R), and written rebuttal testimony on June 8, 2015, as last revised July 29, 2015 (Ex. NRC-076-R2). We also testified in person at the August 24-28 evidentiary hearing in this proceeding.

Q.3 **Why are you submitting additional testimony today?**

A.3 (D. Back, T. Lancaster, E. Striz) In its September 4, 2015 Order admitting 34 new exhibits, the Board identified six hydrogeological issues that require additional testimony. Our testimony below addresses each of those issues in turn.

Issue 1: Whether the water levels in the Brule aquifer have lowered due to mining activities

Q.1.1 Which new exhibits are relevant to this issue?

A.1.1 (D. Back, T. Lancaster, E. Striz) The new exhibits relevant to this issue include Exhibits BRD-008A (annotated Figure 2.7-3a from Ex. CBR-011), BRD-008B (annotated Figure 2.7-3b from CBR-011), CBR-063 (hydrograph of Brule water levels in well SM 7-17), and CBR-064 (hydrograph of Brule water levels in well SM 7-22). In support of our testimony below, the Staff is submitting Ex. NRC-096, which contains staff-annotated versions of Exhibits BRD-008A and BRD-008B.

Q.1.2 What is your understanding of what each of these exhibits is?

A.1.2 (D. Back, T. Lancaster, E. Striz) Exhibit BRD-008A is Figure 2.7-3a from Ex. CBR-011, the CBR LRA. As described in the LRA, this map was constructed by measuring water levels in existing wells that penetrated the local Brule sand (Ex. CBR-011 at 2-171). It shows the water levels in the Brule aquifer in 1982-1983. The figure was annotated at the evidentiary hearing to identify a pre-mining water level of 3883.7 feet at well #11. Based on the data entries in Table 2.7-5 of the LRA, however, the annotated value is incorrect and should be between 3830 feet and 3834 feet (Ex. CBR-011 at 2-194).

Exhibit BRD-008B is Figure 2.7-3b from Ex. CBR-011, the LRA. As described in the LRA, this map shows the water levels in the Brule aquifer in 2007-2008 (Ex. CBR-011 at 2-171). The figure was annotated at the evidentiary hearing to extrapolate a water level between 3835 and 3845 feet near the location identified in Ex. BRD-008A.

Exhibit CBR-063 is a hydrograph of Brule water levels at SM 7-17 from 1999 through 2015. As shown in Exhibit BRD-008B, SM 7-17 is one of the excursion monitoring wells located nearest to well #11.

Exhibit CBR-064 is a hydrograph of Brule water levels at SM 7-22 from 1999 through 2015. As shown in Exhibit BRD-008B, SM 7-22 is located northwest of SM 7-17 and is one of the excursion monitoring wells located nearest to well #11.

Exhibit NRC-096 contains our annotations of Exhibits BRD-008A and BRD-008B. These annotations identify the vicinity of well 27 and the approximate locations of wells PM-6 and PM-7.

Q.1.3 What do Exhibits CBR-063 and CBR-064 show regarding drawdowns in the Brule aquifer due to mining activities at CBR?

A.1.3 (D. Back, T. Lancaster, E. Striz) Exhibits CBR-063 and CBR-064 are hydrographs of Brule water levels measured biweekly from 1999 to 2015. The hydrographs for both of the wells indicate that the water levels in the Brule aquifer are relatively stable with time and do not show decreasing trends that would suggest impacts from mining activities. Although the water levels do show some oscillations due to climatic conditions (e.g., drought in 2006-2007), the water levels in both excursion wells are higher in 2015 than in 1999.

Q.1.4 Dr. Kreamer testified at the evidentiary hearing that Exhibits BRD-008A and BRD-008B show significant decreases (up to 40 feet) in the Brule aquifer, which he claims may indicate lack of confinement (Tr. at 1785-88). Can you explain the discrepancy between what Exhibits BRD-008A and BRD-008B appear to show and what Exhibits CBR-063 and CBR-064 appear to show?

A.1.4 (D. Back, T. Lancaster, E. Striz) Dr. Kreamer based his testimony on the water-level data posted for well #11 in Exhibit BRD-008A. But according to Table 2.7-5 of the LRA, the 12 water level measurements collected between January and December 1982 varied between 3830 and 3834 feet (Ex. CBR-011 at 2-194). Therefore, the water level of 3883.7 for well #11 shown in Figure 2.7-3a (Ex. BRD-008A) is most likely a transcription error. This would explain the apparent discrepancy between the

1982 water levels depicted in Exhibit BRD-008A and those shown for 2008 in Exhibit BRD-008B.

The pre- and post-mining water levels collected in the vicinity of well 27, as indicated by a green square in Exhibit NRC-096, substantiate this interpretation. The pre-mining water level for well 27 was 3808.2 feet (Ex. NRC-096 at 1). Contours of the 2008 water level data showing post-mining water levels indicate a water level between 3805 and 3815 feet (Ex. NRC-096 at 2).

Additional evidence demonstrating that water levels in the Brule aquifer have not been impacted by mining activities is provided by the pre-pumping water levels collected in PM-6 and PM-7 during the first aquifer test. As indicated in Table 2.7A-2 of the first aquifer test report, the water level elevations in 1983 for PM-6 and PM-7, both completed in the Brule aquifer, were 3843.5 and 3845.9 feet, respectively (Ex. BRD-002A at 2.7A(5)). The approximate location of these wells is indicated by a pink circle on page 2 of Exhibit NRC-096. Of particular significance is that the 1983 water level elevations for these wells are very similar to the elevations measured in the Brule aquifer in 2008. This provides another line of evidence that mining activities have not impacted water levels in the Brule aquifer and that the aquifers are hydraulically isolated.

Issue 2: **What is the available head in the Basal Chadron/Chamberlain Pass formation and the maximum anticipated drawdown during Crow Butte's operation and restoration of its mining facility**

Q.2.1 **Which new exhibits are relevant to this issue?**

A.2.1 (D. Back, T. Lancaster, E. Striz) Exhibit CBR-062, the annotated base map of the CBR License Area, is relevant to this issue.

Q.2.2 **What is your understanding of what Exhibit CBR-062 is?**

A.2.2 (D. Back, T. Lancaster, E. Striz) Exhibit CBR-062 shows CBR's annotations of Figure 2.7-4d from the LRA. These annotations show the available head in the Basal

Chadron Sandstone aquifer at nine well locations across the License Area in August 2015. The available head ranges from 147 feet at well CM 10-15 in the northwest corner of the License Area to 435 feet at well CM-7-13 in the southwest portion of the License Area.

Q.2.3 In A.6.9 of your initial testimony, you stated that 47 feet of drawdown represents approximately 10% of the available height of water above the top of the Basal Chadron Sandstone (Ex. NRC-001-R at 87-88). But Exhibit CBR-062 states that the available head is as low as 147 feet in some locations. Can you explain this discrepancy?

A.2.3 (D. Back, T. Lancaster, E. Striz) Our statement that 47 feet of drawdown represents approximately 10 percent of the available height was based on the initial pre-pumping potentiometric surface elevations in the Basal Chadron Sandstone and an estimated consumptive use rate of 105 gallons per minute (gpm). As explained in A.6.10 of our initial testimony, the highest reduction in available head is 16.7% and the average is 9% (Ex. NRC-001-R at 89).

Exhibit CBR-062 computes the available head from the 2015 potentiometric surface, which has been lowered by more than 20 years of continuous pumping. For the data in Exhibit CBR-062 to be relevant for this analysis, the pre-pumping water levels at each of the wells would also need to be presented. This would allow a determination of how much reduction in head has resulted from consumptive water use, which, in turn, would allow a determination of future decreases in available head at anticipated consumptive use rates.

Since this pre-mining well-by-well information is not available, in response to a Staff Request for Additional Information (RAI) the Applicant used pre-pumping water level data in conjunction with a model to estimate drawdowns and available head at expected consumptive water use rates (Ex. NRC-059). Table 7.12-2 of CBR's RAI

response provides the estimated static pre-mining water levels, the available head above the Basal Chadron Sandstone, and the projected drawdowns (Ex. NRC-059 at PDF 10). Since there was uncertainty regarding the drawdown projections, the Staff required the Applicant to check their modeling estimates with actual measured data (Ex. NRC-059 at PDF 11-12). The results of that check are provided in Table 2A of CBR's RAI response (Ex. NRC-059 at PDF 13) and depicted spatially in a map prepared by the NRC Staff that shows the projected and actual drawdowns in the vicinity of the License Area (Ex. NRC-087). As discussed in A.6.9 of our initial testimony, the NRC Staff also compared the pre-mining water levels against the water level elevations in 2009 and concluded that the drawdown projections made by the Applicant were reasonable (Ex. NRC-001-R at 87). As we stated in A.6.10 of our initial testimony:

> This analysis demonstrates that far larger consumptive use rates would likely be needed before the average reduction of available drawdown would reach even 50%. Furthermore, although such rates would result in noticeable environmental effects, they would not destabilize the resource; therefore, even assuming such large consumptive use rates, the impacts are appropriately defined as MODERATE.

(Ex. NRC-001-R at 89). There is nothing in the new exhibits that contradicts this conclusion.

Q.2.4 What consumptive use rate would be required to decrease the potentiometric surface 147 feet? Is that consumptive use rate realistic at the CBR facility?

A.2.4 (D. Back, T. Lancaster, E. Striz) The nearest pre-pumping data point to the area with an available head of 147 feet is RC4, which had a measured water level of 3746 feet in 1983 (Ex. NRC-058 at 1). According to CBR's annotations in Exhibit CBR-062, the 2015 water levels in this area were between 3639 feet at CM10-26 and 3637 feet at CM10-1. Therefore, the water levels have decreased about 108 feet due to consumptive use rates of about 210 gallons per minute. For the potentiometric surface

to decrease an additional 147 feet, consumptive use rates would have to be about 495 gallons per minute. Based on historical and projected pumping rates, this rate is not realistic.

Q.2.5 **Does the information in Exhibit CBR-062 change your conclusion in the EA that short-term impacts from consumptive use during restoration will be no greater than MODERATE?**

A.2.5 (D. Back, T. Lancaster, E. Striz) No. These projections and field measurements are consistent with those made by the Applicant and the NRC Staff and with our original conclusion that the anticipated consumptive use rate would not destabilize the resource (Ex. NRC-001-R at 87-88; Ex. NRC-010 at 83).

Q.2.6 **Even if drawdowns were sufficient to lower the water level to the top of the Basal Chadron Sandstone, would that necessarily result in a LARGE short-term impact?**

A.2.6 (D. Back, T. Lancaster, E. Striz) No. Since ground water from the Basal Chadron Sandstone is not important with respect to maintaining surface water flow or wetlands, the primary impacts of lowering the head will be related to the energy costs to lift the water higher to the surface. As explained during our testimony at the evidentiary hearing, if the consumptive use rates stay below the sustainable yield of the aquifer such that the water is not being mined, the resource will not become destabilized and the impact will not be greater than MODERATE (Tr. at 1408-09).

Issue 3: Whether the results from the four pump tests demonstrate a hydraulic connection between the Brule and Basal Chadron/Chamberlain Pass formations

Q.3.1 **Could you please identify and briefly describe the new exhibits that are relevant to this issue?**

A.3.1 (D. Back, T. Lancaster, E. Striz) The relevant new exhibits are Board exhibits BRD-002A, BRD-002B-R, and BRD-002C, which are the reports prepared for CBR on

aquifer pumping tests 1 (conducted in 1982), 2 (conducted in 1987) and 3 (conducted in 1996), respectively. We have reviewed these exhibits, as well as Ex. CBR-012, the report prepared for CBR on aquifer pumping test 4 (conducted in 2002).

Q.3.2 Based on your review of Exhibit BRD-002A, the report for Aquifer Test 1 (1982), is there any reason to believe that Test 1 does not demonstrate confinement of the Basal Chadron sandstone aquifer from the overlying Brule aquifer? What information in the report supports the conclusion that there is confinement?

A.3.2 (D. Back, T. Lancaster, E. Striz) No, the information in the Test 1 report (Ex. BRD-002A) demonstrates that the Basal Chadron Sandstone is hydraulically isolated from the overlying Brule Aquifer for several reasons. First, as shown in Figure 2.7A-2 (Ex. BRD-002A at 2.7A(9)), the two observation wells completed in the overlying sands of the Brule Formation (i.e. PM-6 and PM-7) did not show response to pumping in the Basal Chadron (Ex. BRD-002A at 2.7A(15)). Second, all of the drawdown curves indicate that the Basal Chadron Sandstone is fully confined.

We note that several of the figures presented indicate that a small amount of water is being released from storage in the overlying and underlying aquitards (e.g., Ex. BRD-002A at 2.7A-4 through 2.7A-7). CBR explained that the water being released from the aquitard is entirely derived from the several feet of Red Clay located immediately above the top of the Basal Chadron Sandstone (Ex. BRD-002A at 2.7A(26)). Based on the very small deviation of the drawdown curve from the theoretical prediction we agree with this explanation. The change in pore pressure caused by the pumping essentially squeezed the water out of the clay and into the adjacent aquifer. Based on consolidation tests the change in pore pressure, however, did not propagate through the clay and into the overlying claystone (Ex. BRD-002A at 2.7A(26)).

Q.3.3 Based on your review of Ex. BRD-002B-R, the report for Aquifer Test 2 (1987), is there any reason to believe that Test 2 does not demonstrate confinement of the Basal Chadron sandstone aquifer from the overlying Brule aquifer? What information in the report supports the conclusion that there is confinement?

A.3.3 (D. Back, T. Lancaster, E. Striz) No, the information in the Test 2 report (BRD-002B-R) demonstrates that the Basal Chadron Sandstone is hydraulically isolated from the overlying Brule Aquifer for several reasons. First, as shown in Figure 2.7-21 (Ex. BRD-002B-R at 2.7(49)), the overlying confining layer piezometer (UCP-1) showed no response to pumping from the Basal Chadron Sandstone. Second, as shown in Figure 2.7-21 of BRD-002B-R, the Brule Aquifer monitoring well (BMW-1) showed no response to pumping from the Basal Chadron Sandstone (Ex. BRD-002B-R at 2.7(49)). Third, all of the drawdown graphs shown in Figures 2.7-12 through 2.7-14 (pages 2.7(38) to 2.7(40) of Ex. BRD-002B-R) indicate a fully confined aquifer. Finally, there are no indications of recharge in the recovery graphs (Figures 2.7-18 through 2.7-20, pages 2.7(44) to 2.7(46) of Ex. BRD-002B-R).

We note that during the aquifer test it is likely that the overlying and underlying aquitards yield small amounts of water squeezed from storage due to pore pressure changes.

Q.3.4 Based on your review of Exhibit BRD-002C, the report for Aquifer Test 3 (1996), is there any reason to believe that Test 3 does not demonstrate confinement of the Basal Chadron sandstone aquifer from the overlying aquifer? What information in the report supports the conclusion that there is confinement?

A.3.4 (D. Back, T. Lancaster, E. Striz) No, the information in the Test 3 report (Ex. BRD-002C) demonstrates that the Basal Chadron Sandstone is hydraulically isolated from the overlying Brule Aquifer for several reasons. First, as shown in Figure 6 of Exhibit BRD-002C, the Brule Aquifer monitoring well (BOW96.1) showed no response to

pumping from the Basal Chadron Sandstone (Ex. BRD-002C at PDF 19). Minor fluctuations (approximately 0.04 ft.) attributable to barometric pressure and ambient temperature changes were observed, however. Third, the drawdown graphs provided in Appendix C of Ex. BRD-002C indicate a fully confined aquifer. Fourth, there are no indications of recharge in the recovery graphs presented in Appendix C.

As with Tests 1 and 2, it is likely that the overlying and underlying aquitards yield small amounts of water squeezed from storage due to pore pressure changes.

Q.3.5 Based on your review of Ex. CBR-012, the report for Aquifer Test 4 (2002), is there any reason to believe that Test 4 does not demonstrate confinement of the Basal Chadron sandstone aquifer from the overlying aquifer? What information in the report supports the conclusion that there is confinement?

A.3.5 (D. Back, T. Lancaster, E. Striz) No, the information in the Test 4 report (Ex. CBR-012) demonstrates that the Basal Chadron Sandstone is hydraulically isolated from the overlying Brule Aquifer for several reasons. First, as shown in Appendix B of the Test 4 report, no drawdown was observed in the Brule observation well (SM9-10) (Ex. CBR-012 at PDF 35). Second, the drawdown graphs provided in Appendix D of the Test 4 report (Ex. CBR-012) indicate a fully confined aquifer. Although a number of perturbations were observed in the drawdown curves, as the Staff explained at the evidentiary hearing, these perturbations are transient in time and do not reflect a recharge boundary (Tr. at 1303-13). Furthermore, the Staff agrees that a reasonable explanation for the perturbations in the drawdown curves is that the drawdown rates were affected by pressure perturbations from operations at the adjacent wellfields (Ex. CBR-012 at PDF 11-12). Finally, there are no indications of recharge in the recovery graphs presented in Appendix D of the Test 4 report (Ex. CBR-012).

<u>Issue 4</u>: <u>Whether the Basal Chadron/Chamberlain Pass formation exists beneath the Pine Ridge reservation and its connection (if any) to the Basal Chadron/ Chamberlain Pass formation beneath the license renewal area</u>

Q.4.1 Could you please identify and briefly describe the new exhibits that are relevant to this issue?

A.4.1 (D. Back, T. Lancaster, E. Striz) The Intervenors have provided Exhibits INT-072 through INT-077 as support for their claim that the Basal Chadron Sandstone (Chamberlain Pass Formation) exists at the Pine Ridge Reservation. Exhibit INT-072 is an abstract from a Geological Society of America (GSA) presentation in May 2012 which describes a study of natural uranium contamination in ground water at the Pine Ridge Reservation. According to Exhibit INT-072, the High Plains aquifer and the Chamberlain Pass Formation are used as sources of drinking water at the Pine Ridge Reservation, but the exhibit does not provide any additional information on the locations or types of these sources.

Exhibit INT-073 is an abstract from a GSA presentation in October 2006 that describes a provisional revision to the lithostratigraphy of the White River Group in Nebraska and South Dakota to include the Chamberlain Pass Formation. The abstract does not identify specific locations where the Chamberlain Pass Formation exists at or beneath the surface of the Pine Ridge Reservation.

Exhibit INT-074 is an abstract from a 2012 presentation at the 122nd Annual Meeting of the Nebraska Academy of Sciences that describes the surface and subsurface distribution of uranium bearing strata in northwestern Nebraska and southwestern South Dakota. Exhibit INT-074 states that natural devitrification of the Chamberlain Pass outcrops is the likely source of natural uranium contamination of soils, sediments and surface waters near Whitney, Nebraska, and several communities in the Pine Ridge Reservation (Oglala, Calico, Pine Ridge, Rockyford, Red Shirt, Scenic, and Interior, South Dakota). This exhibit also identifies subcrops of the Chamberlain Pass Formation as the likely source of natural ground water contamination at other communities at Pine Ridge Reservation (including Pine Ridge,

Wounded Knee, Manderson, Porcupine, Evergreen, Kyle, Potato Creek, and Wanblee, South Dakota).

Exhibit INT-075 is an abstract from an April 2010 presentation at an annual meeting of the GSA Rocky Mountain Section which describes the revised lithostratigraphy of the White River Group in Nebraska and South Dakota. The abstract states the revised White River Group includes the Chamberlain Pass Formation, which is redescribed as pedogenically modified volcanic ash. The abstract does not identify specific locations where the Chamberlain Pass Formation exists at or beneath the surface of the Pine Ridge Reservation.

Exhibits INT-076 and INT-077 are USGS reports of geological studies at Badlands National Park, which is located in the northwest corner of the Pine Ridge Reservation. Exhibit INT-076 is a 2001 USGS report entitled "The Cretaceous – Tertiary Boundary Interval in Badlands National Park, South Dakota." On page 5, the report describes the presence of the Chamberlain Pass Formation below the Chadron formation in the White River Group and bounded above by the Interior Paleosol. Exhibit INT-077 is a 2003 USGS report entitled "Geology of Badlands National Park: A Preliminary Report." On page 9, this report states that the Chamberlain Pass Formation is located below the Chadron Formation and the Interior Paleosol but above the Yellow Mounds Paleosol.

Finally, in addition to exhibits provided by the Intervenors, Exhibit BRD-003, the complete version of the report excerpted in Exhibit NRC-026, is a 2014 USGS report on ground water modeling conducted on the Pine Ridge Reservation.

Q.4.2 What evidence, if any, do the new exhibits provide regarding the existence of the Chamberlain Pass Formation on or beneath the Pine Ridge Reservation?

A.4.2 (D. Back, T. Lancaster, E. Striz) Exhibit INT-072 states that the Chamberlain Pass Formation is used for drinking water by residents of the Pine Ridge Reservation, but

does not identify the type of supply (e.g., well) or any specific locations of such supplies. Exhibit INT-074 states that outcrops of the Chamberlain Pass Formation are the source of uranium contamination of soils, sediments and surface waters in Whitney, Nebraska, and in several towns in South Dakota, including Oglala, Calico, Pine Ridge, Rockyford, and Red Shirt. Exhibit INT-074 also states that subcrops of the Chamberlain Pass Formation are the source of uranium contamination of ground water at other communities at Pine Ridge Reservation (including Pine Ridge, Wounded Knee, Manderson, Porcupine, Evergreen, Kyle, Potato Creek, and Wanblee, South Dakota).

Exhibit INT-073 describes a provisional revision of the White River Group lithostratigraphy to include the Chamberlain Pass Formation, but does not provide any specific locations where this formation exists on or beneath the Pine Ridge Reservation. Similarly, Exhibit INT-075 discusses revising the lithostratigraphy to include the Chamberlain Pass Formation in South Dakota, but again does not identify specific locations of the formation. Exhibits INT-076 and INT-077 report that the Chamberlain Pass Formation is present on outcrops in the Badlands National Park, which is located in the northwestern corner of the Pine Ridge Reservation.

Taken together, these exhibits identify several outcrops and/or subcrops of the Chamberlain Pass Formation in Badlands National Park and state that they are present in several locations on the Pine Ridge Reservation. They do not provide any evidence of the extent of the Chamberlain Pass Formation beneath the reservation, however.

Q.4.3 What evidence, if any, do the new exhibits provide regarding the use of wells in the Chamberlain Pass formation for drinking water on the Pine Ridge Reservation?

A.4.3 (D. Back, T. Lancaster, E. Striz) Exhibit INT-072 states that the Chamberlain Pass is relied upon as a source of drinking water, but provides no information on how or where (e.g., locations of wells) this formation is used as a drinking water source. Exhibit NRC-098, an abstract by Botzum et al. cited in Exhibit INT-074, makes this same claim.

Exhibits NRC-025 and BRD-003 are USGS reports that were prepared in cooperation with the Oglala Sioux Tribe (see Ex. NRC-025 at PDF 1, Ex. BRD-003 at PDF 1). These reports provide, respectively, an evaluation of the water quality of public water supply wells at the Pine Ridge Reservation for 1992-1997 and a conceptual and numerical model of ground water flow in the Ogallala and Arikaree Aquifers on the Pine Ridge Reservation. Although both reports were focused on assessing drinking water sources, quality and quantity at the reservation, neither of the reports identify the Chamberlain Pass Formation in the subsurface geology at the Pine Ridge Reservation, or its use as a ground water source at the reservation. Both reports state that the formations in the White River Group (the Brule and Chadron) are too impermeable to act as a significant source of drinking water on the reservation (*see* Ex. NRC-025 at 7, Ex. BRD-003 at 8-11). In addition, the 2014 USGS report used wells and test holes drilled at depths ranging up to 1100 feet below ground surface to identify the depth and name of the aquifer providing a drinking water source (Ex. BRD-003 at 13 (Figure 5)). The 1999 USGS report used 44 wells ranging in depth from 60 to 2,640 feet and 14 springs to describe each drinking water source on the reservation (*see* Ex. NRC-025 at 10, 12). The Chamberlain Pass Formation (or the Basal Chadron Sandstone) was not identified as a drinking water source based on this well, test hole and spring data. Therefore, the information in Exhibits NRC-025 and BRD-003 contradict the general statements in Exhibits INT-072 and INT-074 that

the Chamberlain Pass is used as a drinking water source on the Pine Ridge Reservation.

Also, even if the Chamberlain Pass Formation is used as a drinking water source on the Pine Ridge Reservation, as explained in A.D.4 of our initial testimony (Ex. NRC-001-R at 31-33) and in response A.4.4 below, the Intervenors have not provided any evidence of a continuous pathway by which contaminants could travel from the Basal Chadron Sandstone aquifer at the CBR facility to the Chamberlain Pass Formation where it may exist at the Pine Ridge Reservation.

Q.4.4 What evidence, if any, do the new exhibits provide regarding a connection between the Basal Chadron Sandstone aquifer beneath the CBR facility (License Area) and the Chamberlain Pass Formation at the Pine Ridge Reservation?

A.4.4 (D. Back, T. Lancaster, E. Striz) The new exhibits do not provide any evidence of a connection between the Basal Chadron Sandstone aquifer at the CBR facility and the Chamberlain Pass Formation in areas where it may exist at the Pine Ridge Reservation. As explained in A.4.2 above, the USGS has identified the Chamberlain Pass Formation in Badlands National Park, located in the northwest portion of the Pine Ridge Reservation (see INT-076 and INT-077). Other than that, exhibits INT-072 and INT-074 state the presence of isolated outcrops or subcrops of the Chamberlain Pass Formation on the Pine Ridge Reservation but do not give specific evidence to support that claim. All of the locations mentioned in INT-072 and INT-074 are 50 miles or more from the closest boundary of the CBR facility.

As explained in A.D.4 of our initial testimony (Ex. NRC-001-R at 31-33) and A.D.20 through A.D.23 of our rebuttal testimony (Ex. NRC-076-R2 at 45-48), there is no continuous pathway between the Basal Chadron Sandstone aquifer at the CBR facility and the Chamberlain Pass Formation at Pine Ridge. We explained in A.D.4 of our initial testimony that the Basal Chadron Sandstone pinches out a few miles

northeast of Crawford, and that there are 25 miles of aquitard between the pinch out and the southeastern boundary of the reservation. Ex. NRC-001-R at 32. In addition, as shown in Exhibit NRC-097, the Pierre Shale and Niobrara Shale outcrop between the CBR facility and the Pine Ridge Reservation, in the southwest corner of South Dakota just north of Dawes County, Nebraska. The Pierre Shale and the Niobrara Shale underlie the Basal Chadron Sandstone at the CBR facility and in northwest Nebraska (*see* Ex. CBR-011 at 2-101). The outcrops of these marine shales, which extend for miles, effectively prevent any connection of the Basal Chadron Sandstone aquifer at the CBR facility to the Chamberlain Pass Formation on the Pine Ridge Reservation. We note that in the evidentiary hearing, the Intervenors expressed no concerns about confinement characteristics of the Pierre Shale (Tr. at 1028). This additional evidence affirms our earlier testimony on Contentions C and D that there is no evidence of a physical connection between the Basal Chadron Sandstone Aquifer at the CBR license area and any formation which supplies drinking water on the Pine Ridge reservation.

Q.4.5 Do any of these exhibits (INT-072 to INT-077) affect the Staff's conclusions (or prior testimony) regarding potential impacts to surface waters (Contention C), communication between aquifers (Contention D), or failure to use recent research (Contention F)?

A.4.5 (D. Back, T. Lancaster, E. Striz) As stated above in A.4.4, Exhibits INT-072 to INT-077 do not provide any evidence of a continuous permeable pathway from the Basal Chadron Sandstone aquifer located at the CBR license area to any outcrops or portions of the Chamberlain Pass Formation within the Pine Ridge Reservation. Numerous documents and descriptions of the Basal Chadron aquifer at the CBR license area indicate it does not outcrop anywhere in or near the license area and pinches out both north and east of the license area. In addition, numerous lines of

evidence as described in A.D.3 of our initial testimony (Ex. NRC-001-R at 27-31) demonstrate the Basal Chadron Sandstone aquifer has and continues to be confined from the overlying Brule aquifer so no continuous pathway exists for contamination from the CBR license area to reach any source of drinking water (surface water or ground water) at the Pine Ridge Reservation.

In addition, Exhibits INT-072 and INT-074 contradict the Intervenors' claims in Contentions C and D that CBR operations are the source of contamination of drinking water supplies at the Pine Ridge Reservation. Specifically, Exhibit INT-072 states that "naturally elevated uranium levels" in the Chamberlain Pass Formation on the Reservation are "due to devitrified volcanic glass within the aquifer." Similarly, Exhibit INT-074 states, "Outcrops of the CPF are herein recognized as the source of uranium contamination of soils, sediments, and surface waters near the communities of Whitney, Nebraska and Oglala, Calico, Pine Ridge, Rockyford, Red Shirt, Scenic, and Interior, South Dakota." Finally, Exhibit NRC-098, which is referred to in Exhibit INT-074, states that "Volcanic ash within the aquifers is the primary source of elevated uranium levels in the region's groundwater." The presence of natural uranium contamination reported in these documents refutes claims made in both Contention C and Contention D that CBR operations are the source of contamination to the Pine Ridge Reservation drinking water supplies through either a surface water or ground water pathway.

Finally, with respect to Contention F, we acknowledge that the USGS has identified the Chamberlain Pass Formation at the Badlands National Park in Exhibits INT-076 and INT-077. However, we note that Exhibits INT-076 and INT-077 both state on their cover pages that the reports have not been reviewed for conformity with the North American Stratigraphic Code (NASC). More importantly, as we explained in our initial testimony at A.F.6 (Ex. NRC-001-R at 57), the Staff considered use of the

Chamberlain Pass nomenclature during its review of the LRA but rejected it because the Staff could not verify the acceptance of "Chamberlain Pass Formation" by USGS in Nebraska. As stated in our initial testimony at A.F.6 (Ex. NRC-001-R at 57), the USGS does not identify the Chamberlain Pass Formation in Nebraska and states that the White River Group is composed of the Chadron Formation and the Brule Formation. In addition, we note that USGS did not use the Chamberlain Pass nomenclature in recent published reports on ground water quality and ground water modeling at the Pine Ridge Reservation (Ex. NRC-025 and Ex. BRD-003), but again identified the Chadron Formation and Brule Formation as the formations comprising the White River Group.

As we stated at the evidentiary hearing, the NASC requires, among other things, that a change be widely accepted and put into use widely, and to date the USGS has not done so with regard to the Chamberlain Pass nomenclature (Tr. at 1817-19). We also note that use of the terminology is not uniformly accepted in Nebraska, as indicated in footnote 1 of Exhibit NRC-099, which uses "Chadron Aquifer" to refer to the lower White River Group, but recognizes that some authors include the Chamberlain Pass Formation and Chadron Formation. Finally, as we stated in A.F.7 of our initial testimony (Ex. NRC-001-R at 58), adopting the "Chamberlain Pass" nomenclature in lieu of Basal Chadron Sandstone would have no bearing on the hydrological behavior of the unit, and thus no bearing on the Staff's safety or environmental impact conclusions in the SER or EA.

Issue 5: To what degree (if any) do the additional exhibits affect the conclusions regarding the structure of the White River feature and the NRC Staff's maximum likelihood modeling

Q.5.1 Could you please identify and briefly describe the new exhibits that are relevant to this issue?

A.5.1 (D. Back, T. Lancaster, E. Striz) Exhibit NRC-093 contains a summary of information related to the Staff's modeling of the White River feature. Exhibit NRC-094 is a report that in part describes the Bayesian Maximum Likelihood Analysis (BMLA) method that the Staff used. Board exhibits BRD-007A through BRD-007J contain the Staff's input/output files used in the modeling. Exhibits BRD-007A through BRD-007E are for Simulation 1, and Exhibits BRD-007F through BRD-007J are for Simulation 2.

Q.5.2 Please describe your concerns regarding the Staff's modeling of the White River structural feature following preparation of the summary report, Exhibit NRC-093.

A.5.2 (D. Back, T. Lancaster, E. Striz) Ground water flow modeling is dependent on three factors: the purpose of the model, the availability of measured field data to design and parameterize the model, and the skill of the modeler. Ground water modeling is also an iterative process, in which the modeler makes certain initial assumptions and then fine tunes the model parameters and other features to optimize the calibration based on his/her modeling skill. Hundreds of modeling runs may be done in this iterative process. Optimally, the ground water modeler documents the justification for the selection of the model design, input parameters and other decisions made to calibrate and verify the final model. In this case, the models were developed and calibrated, but no documentation or final report describing the development, parameterization or calibration of the final models was prepared, and the person who did the modeling left the agency over two years ago. Therefore, we have no information on which to evaluate the selection of the design of the models or evaluate their calibration.

The purpose of the ground water modeling and BMLA for the White River structural feature was to assess the uncertainty associated with defining the feature in various ways: as a sealing fault with little to no flow, as a conductive fault with low or high flow, or the absence of any fault or feature. As discussed in A.D.20 of our initial testimony (Ex. NRC-001-R at 46) and A.D.10 of our rebuttal testimony (Ex. NRC-076-

R2 at 32-33), the data used in the model was derived from measured field data at the North Trend Expansion Area (NTEA) site, including boring logs, the aquifer pumping test conducted in 2006, and measured water levels. We are only able to assess the final models available by reviewing the model design and data which is present in the model files. We are not, however, able to determine why the modeler chose specific values for input parameters or explain the iterative approach the modeler used to calibrate the models.

We have reviewed all of the Simulation 1 and 2 ground water flow models provided by the modeler and have summarized the information in Exhibit NRC-093. For Simulation 1, the model features (grid, boundaries, etc.) and the majority of input parameters appear to be generally acceptable because they fall within the range of field observed data and features. However, the modeler selected a value of recharge which greatly exceeds the rule of thumb of assigning 10 to 20 percent of historical annual precipitation as the recharge value. We do not know and thus cannot justify the basis for this selection. In addition, in Simulation 1 the modeler calibrated a steady state model to transient pumping test data. Again, no justification was provided for this approach. Given these concerns, we are unable to defend the use of the selected recharge value and the calibration of the Simulation 1 models.

In the Simulation 2 ground water flow models, the model features (grid, boundaries, etc.) and input parameters are generally acceptable because they fall within the range of field observed data and features. In Simulation 2, the modeler selected no recharge to any of the ground water flow models, which is an acceptable conservative value of recharge given the low and seasonally variable precipitation historically reported at the North Trend site. However, the modeler again used a steady state calibration of the model to transient pumping test data, without providing a

justification for this approach. Given this concern, we are unable to defend the calibration of the Simulation 2 models.

Q.5.3 If the Staff's modeling of the White River structural feature is not considered, does that affect the Staff's conclusions about the White River structural feature with respect to Contentions C and D?

A.5.3 (D. Back, T. Lancaster, E. Striz) If the modeling is not considered, that does not affect the Staff's conclusions, because the modeling was only one of a number of bases for concluding that the White River feature is not a transmissive fault and does not serve as a conduit for transporting contaminants to the White River and the Pine Ridge Reservation. In our initial testimony at A.D.21 (Ex. NRC-001-R at 46-47) and our rebuttal testimony at A.D.18 (Ex. NRC-076-R2 at 44) we specifically stated that the modeling was not essential to the Staff's conclusions regarding confinement of the Basal Chadron sandstone aquifer or expected environmental impacts, but was an additional line of evidence.

In A.D.10 of our initial testimony (Ex. NRC-001-R at 38-39), we discussed all of the bases other than the modeling for our conclusions regarding the White River structural feature. First, as we stated in our initial testimony, the White River structural feature is located approximately 2 miles from the northwest boundary of the CBR License Area (LA). As stated in our initial testimony (Ex. NRC-001-R at 38), and also as discussed at the evidentiary hearing (*see* Tr. at 1086), CBR is required by license condition to operate under an inward hydraulic gradient, which creates a cone of depression that draws fluids into the LA. This has reversed the flow direction of ground water in the Basal Chadron Sandstone aquifer from northwest to southeast in the northwest portion of the LA, and prevents the movement of water through the Basal Chadron Sandstone aquifer towards the White River. We also note that, even if contaminants could move from the LA toward the White River, the time of travel from

the LA boundary to the White River structural feature would be several hundred years. During this travel time, advection, dispersion, sorption, and geochemical processes (e.g., redox) would reduce the concentration of any contaminants of concern.

Second, in A.D.10 of our initial testimony we identified several bases for concluding that the White River structural feature would not affect the hydraulic confinement of the Basal Chadron Sandstone aquifer (Ex. NRC-001-R at 39):

> Hypothetically, even if contaminants could reach the White River structural feature, there are many lines of evidence supporting the conclusion that from within the Pierre Shale to the ground surface, the White River structural feature is a monoclonal form that does not offset the geologic contact between the Pierre Shale and Basal Chadron or members of the Chadron and Brule Formations and, therefore, does not affect the hydraulic confinement of the Basal Chadron Sandstone aquifer. These lines of evidence include the continuity of the Chadron Formation-Pierre Shale contact and overlying units across the structural feature based on 130 geophysical logs (Ex. NRC-028 at F-19 to F-25); the vertical gradient and potentiometric ground water surfaces of the Basal Chadron Sandstone aquifer and the Brule aquifer over the area of the structural feature (Ex. NRC-028 at G-15 and G-16); aquifer tests in the area that demonstrate the integrity of the overlying confining unit (Ex. NRC-028 at G-9 to G-11); and distinct geochemical variations among aquifers (Ex. NRC-028 at G-9).

Third, in A.D.9 of our initial testimony (Ex. NRC-001-R at 37-38), we explained that NDEQ independently evaluated the White River structural feature during its review of CBR's aquifer exemption petition for the NTEA. NDEQ's review, which included review by an independent panel of geology experts, concluded that CBR's interpretation of this feature as a fold was plausible and that there is no evidence of faults or contaminant pathways between the Basal Chadron Sandstone aquifer and the Brule aquifer within the NTEA. Ex. NRC-001-R at 37-38.

The bases discussed above, and in our initial and rebuttal testimony, provide ample evidence supporting the Staff's conclusions regarding the White River structural feature, independent of any consideration of the Staff's modeling. The Intervenors have not provided any evidence to the contrary; i.e., that the White River structural

feature is a conductive fault, or that it has transported contaminants to and impacted the water quality of the White River.

We addressed the Intervenors' claims of impacts to water quality in the White River and potential transport of contaminants to drinking water at Pine Ridge in A.C.7 and A.C.9 of our initial testimony (Ex. NRC-001-R at 23, 24-25). There, we explained that the South Dakota Department of Environment and Natural Resources (SD DENR) has found no evidence of contamination in the White River associated with CBR operations. On the contrary, as we explained in our initial testimony at A.D.23 (Ex. NRC-001-R at 49-50), the claims of elevated levels of uranium in wells at the Pine Ridge Reservation are most likely explained by natural sources. In fact, as discussed in A.4.5 above, several of the Intervenors' new exhibits provide additional support for this view (see Ex. INT-072 and Ex. INT-074), as does Exhibit NRC-098, which is cited in Exhibit INT-074.

Q.5.4 If the model was not essential to the Staff's analysis, why was it included in the SER and the EA?

A.5.4 (D. Back, T. Lancaster, E. Striz) Ground water flow modeling is considered a valuable tool by hydrogeologists to assess ground water flow behavior that has not or cannot be practically defined by field measurement. Although all hydrogeologists recognize that all ground water flow modeling is inherently non-unique and known to carry substantial uncertainty, it is often conducted to simulate the current behavior or predict the future behavior of a ground water flow system.

The purpose of the ground water flow modeling and associated BMLA for the White River structural feature included in the SER and EA was to assess the likelihood of several conceptual site models which defined the feature as a sealing fault with little to no flow, a conductive fault with low or high flow, or absent. The calibration of the different models provided the input data to the BMLA, which was used to assign a

probability to the different definitions of the structural feature. These probabilities were then used in the SER and EA as a screening tool to eliminate unlikely features in the ground water flow system scenarios.

The Staff hydrogeologist who performed the modeling was an author of the original 2012 CBR SER and included the modeling and BMLA in that document. After that person left the agency, there was no reason to question the validity of the modeling and BMLA; therefore, they remained in the final 2014 SER (Ex. NRC-009) and were included in the EA (Ex. NRC-010).

We recognize that ground water flow modeling can be a useful tool for the purposes outlined above; however, it is always subject to substantial uncertainty and should never be the only basis for any conclusion. As stated in A.5.3 above, the Staff based its conclusions regarding the White River structural feature on a number of bases, not just the modeling. Therefore, the modeling was not essential to the Staff's conclusions.

Q.5.5 You provided Ex. NRC-094, NUREG/CR-6940, as an exhibit. Was the model used for the White River feature consistent with what was used in NUREG/CR-6940?

A.5.5 (D. Back, T. Lancaster, E. Striz) Chapters 1, 2 and 3 of NUREG/CR-6940 provide a detailed description of the BMLA method, and Chapter 4 provides an example application detailing the selection of a conceptual site model, the ground water flow model design and calibration, and the associated BMLA. The document also describes the method and application of Maximum Bayesian Likelihood Model Averaging (MBLMA) which was not used in the Staff's analysis of the White River structural feature.

The focus of NUREG/CR-6940 is the BMLA and MBLMA, not the ground water modeling used to generate inputs for the BMLA. The application of the BMLA as described in the SER and EA appears to be consistent with NUREG/CR-6940.

Although NUREG/CR-6940 uses a specific modeling example to demonstrate the BMLA and MBLMA, the document's focus is on the Bayesian methods, not the modeling used to generate inputs to the methods. As such, it does not prescribe how to conduct ground water flow modeling (i.e., it does not specifically discuss how to select model parameters or how to calibrate a model). Therefore, we cannot compare the parameter selection, calibration, or other details of the ground water model example in NUREG/CR-6940 with the Staff's modeling of the White River structural feature.

Issue 6: To what degree (if any) do the additional exhibits illustrate the ground water flow directions in the Arikaree and Brule aquifers underlying the Pine Ridge reservation and the license renewal area

Q.6.1 Could you please identify and briefly describe the new exhibits that are relevant to this issue?

A.6.1 (D. Back, T. Lancaster, E. Striz) Board exhibits BRD-006 and BRD-017, which are annotated versions of a figure on page 15 of Exhibit OST-001, show directions of ground water flow in the Arikaree aquifer on the Pine Ridge Reservation. Exhibit BRD-017 contains annotations by Dr. LaGarry identifying an area with specific arrows showing directions of ground water flow and the names of the towns on the reservation that Ms. White Face identified as having water wells in the Arikaree aquifer. Additionally, Exhibit BRD-004 (Souders-Patterson, 2004) discusses ground water flow directions in the Arikaree aquifer.

Q.6.2 In Exhibits BRD-006 and BRD-017, Dr. LaGarry circled certain arrows that he claims show flow in the direction of the Pine Ridge Reservation from the CBR facility. Does this information impact the Staff's earlier testimony regarding lack of a pathway through the Arikaree aquifer to Pine Ridge Reservation?

A.6.2 (D. Back, T. Lancaster, E. Striz) No. Using the distance measuring tool in Google Maps, we have determined that the closest point of the area circled by Dr. LaGarry in

Exhibits BRD-006 and BRD-017 is greater than 50 miles east-northeast of the CBR facility. For the purposes of distinguishing surface features and map information within Exhibits BRD-006 and BRD-017 (e.g., ground water contour elevations, town names, and surface water names, etc.), we have provided Exhibit NRC-100, which is a version of the base map used to create annotated Exhibits BRD-006 and BRD-017 obtained from the USGS website. We have added the circled area to Exhibit NRC-100 as well. In addition, Exhibit NRC-101 provides a "close up" view of the portion of Exhibit NRC-100 containing the circled area in Exhibits BRD-006 and BRD-017.

Regarding the ground water flow arrows within the southern portion of the circled area on Exhibit BRD-017, we acknowledge that ground water in the Arikaree aquifer enters the reservation from Nebraska. According to Exhibit NRC-101, the leftmost arrow within the circled area shows northward flow into Denby, South Dakota. However, as shown in Exhibit NRC-102 (annotated Figures 29 and 30 from Ex. BRD-004), a ground water mound located south of the circled area in the Arikaree aquifer will act as a barrier to ground water flow from the region of the CBR facility to the circled area.

The Intervenors have not provided evidence of a pathway for ground water migration from the production zone at the CBR facility to the Arikaree aquifer nor have they provided any evidence of a pathway through the Arikaree aquifer in the region of the CBR facility to the reservation. As CBR testified in the hearing, the Arikaree is dry (not saturated) within the License Area (Tr. at 1170). Furthermore, as shown on page 2 of Exhibit NRC-102, all ground water flow in the overlying aquifers in and around the License Area discharges to the White River. Therefore, water would have to flow cross-gradient and over a ground water mound to reach the area identified by Dr. LaGarry in Exhibit BRD-017 (Ex. NRC-101 at 2). Finally, the Intervenors have not provided any evidence of a ground water system(s) that could transport contaminants

from the CBR facility over such a significant distance (greater than 50 miles) without being affected by advection, dispersion, sorption, and geochemical processes (e.g., redox).

Q.6.3 Mr. Wireman stated in written and oral testimony that there are differing reports of ground water flow direction in the Brule aquifer at and near the CBR facility. Is there anything in the new exhibits that changes the Staff's understanding of ground water flow directions in the Brule at and near the CBR facility?

A.6.3 (D. Back, T. Lancaster, E. Striz) With regard to Exhibit BRD-004, Mr. Wireman appears to be referring to the following statement from the license renewal application (Ex. CBR-011 at 2-170):

> Souders (2004) states that aquifers within the White River Basin, which encompasses the northern half of Dawes County, are "nearly nonexistent". He indicates that a groundwater divide occurs to the south of the CSA along the Pine Ridge; groundwater north of this divide in the CSA and License Area flows to the north, northwest, and northeast, depending on location with respect to the White River.

This statement refers to ground water flow regime in the White River Basin, which includes areas west, south, and east of the CBR facility. Therefore, it makes sense that Souders would state that the direction of flow would be "north, northwest and northeast, *depending on location with respect to the White River*." (Ex. CBR-011 at 2-170 (emphasis added).) In our rebuttal testimony at A.C.6, we addressed Mr. Wireman's concern as follows (Ex. NRC-076-R2 at 15):

> Based on reported water-level data, the SER and LRA both state that the Brule flows northwest direction south of the White River (i.e., at the CBR site) (Ex. NRC-009 at 22, Ex. CBR-011 at 2-171). This is not inconsistent with the information in the LRA citing Souders, which reports that regionally the flow direction is north, northeast, or northwest depending on location with respect to the White River (Ex. CBR-011 at 2-170). All of the reported information indicates that ground water flow in the Brule is towards the White River since the river acts as a regional drain for ground water.

We also testified in A.C.6 of our rebuttal testimony that the ground water flow directions in the Brule aquifer may change due to various causes, such as precipitation events or potentially pumping water from local private wells in the Brule aquifer (Ex. NRC-076-R2 at 16). The Staff has not identified any information in Exhibit BRD-004 to contradict its earlier testimony regarding flow in the Brule aquifer.

September 18, 2015

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 40-8943-OLA
CROW BUTTE RESOURCES, INC.	)	
	)	ASLBP No. 08-867-02-OLA-BD01
(License Renewal for the In-Situ Leach	)	
Facility, Crawford, Nebraska)	)	

AFFIDAVIT OF DAVID BACK

I, David Back, do hereby declare under penalty of perjury that my statements in the foregoing testimony and in prefiled Exhibit NRC-002 (Statement of Professional Qualifications of David Back) are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR 2.304(d)

____

David Back
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Executed in Falls Church, VA
this 18th day of September, 2015

September 18, 2015

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
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(License Renewal for the In-Situ Leach	)	
Facility, Crawford, Nebraska)	)	

AFFIDAVIT OF THOMAS LANCASTER

I, Thomas Lancaster, do hereby declare under penalty of perjury that my statements in the foregoing testimony and in prefiled Exhibit NRC-005 (Statement of Professional Qualifications of Thomas Lancaster) are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR 2.304(d)

____
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Executed in Rockville, MD
this 18th day of September, 2015

September 18, 2015

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket No. 40-8943-OLA
CROW BUTTE RESOURCES, INC.	)	
	)	ASLBP No. 08-867-02-OLA-BD01
(License Renewal for the In-Situ Leach	)	
Facility, Crawford, Nebraska)	)	

AFFIDAVIT OF ELISE STRIZ

I, Elise Striz, do hereby declare under penalty of perjury that my statements in the foregoing testimony and in prefiled Exhibit NRC-008 (Statement of Professional Qualifications of Elise Striz) are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR 2.304(d)

____

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Executed in Rockville, MD
this 18th day of September, 2015