STATE OF NEBRASKA

Dave Heineman
Governor

DEPARTMENT OF ENVIRONMENTAL QUALITY
Patrick W. Rice
Acting Director
Suite 400, The Atrium
1200 'N' Street
P.O. Box 98922
Lincoln, Nebraska 68509-8922
Phone (402) 471-2186
FAX (402) 471-2909
website: http://deq.ne.gov

APR 8 2014

Brent Berg, Acting President
Cameco Resources
2020 Carey Avenue, Suite 600
Cheyenne, WY 82001

RE:	Marsland Expansion Area – Crow Butte Resources, Inc.
NDEQ ID:	97146
Program ID:	UIC NE0210960 AQEX
Subject:	RAI for revised Marsland Expansion Area-Petition for Aquifer Exemption

Dear Mr. Berg:

On November 22, 2013, the Nebraska Department of Environmental Quality (NDEQ) received a submittal of information from Crow Butte Resources, Inc. (CBR). This submittal serves as CBR's revisions to the proposed Marsland Expansion Area Petition for Aquifer Exemption. As described in the petition, CBR intends to develop the Marsland resources using in situ recovery (ISR) methods.

NDEQ staff have completed the review of the revised Petition for Aquifer Exemption for the Marsland Expansion Area. NDEQ staff identified certain areas that require clarification, for which we are requesting additional information. Enclosed in the RAI, which has NDEQ's response to CBR's comments on the revisions to the petition, and specific comments, which are organized according to the pages and chapters in the application. If you have any question concerning this letter or the RAI, please contact Nancy Harris, of my staff, at (402) 471-4290 or via email at nancy.harris@nebraska.gov

Sincerely,

Jon Kenning
Water Quality Assessment Section Supervisor
Water Division

Enclosure
cc: Shar Sapp (w/ enclosure)
Doug Pavlick, CBR (w/ enclosure)
David Garrett, USEPA, Region 7 (w/ enclosure)
Tom Lancaster, US Nuclear Regulatory Commission (w/ enclosure)

NDEQ RAI	*Cameco Response*	NDEQ Response
Section 1- Introduction		
1. **Section 1 #1, Proposed Activities, Page 1-1:** Please provide the number of acres in the proposed Marsland Expansion Area (MEA).	*The number of acres within the MEA is given in Section 1.1: "The MEA encompasses approximately 4,622 acres." This sentence has been revised to make it clear it is the acreage within the MEA permit boundary*	Acknowledged.
Section 2- Summary of Regulatory Requirements		
2. **Section 2 #1, Section 2.0, Summary of Regulatory Requirements, Page 2-1:** "... Wyoming Fuel Company (WFC) received an aquifer exemption in 1990 to allow in-situ extraction of uranium from basal sandstone of the Chadron Formation (Federal Register, Vol. 55, No. 100, May 23, 1990)." Please revise this section to reflect the text in the CBR North Trend Expansion Area aquifer exemption request.	*Section 2 was revised to be consistent with the language in Section 2 of the CBR North Trend Expansion Area aquifer exemption request. Note that the North Trend application refers to the "Basal Chadron Sandstone" whereas the MEA application now refers to the "basal sandstone of the Chadron Formation." This change was based on a request from the NDEQ.*	Acknowledged.
Section 3- Description of Proposed Exemption		
3. **Section 3 #1. Section 3.1, Background, Page 3-2, Last Paragraph:** CBR's Figure 1-2 implies such a channel cut into the top of the Pierre Shale, but CBR's Figure 3-10 does not appear to show such a feature. The depositional model of Hansley & Dickinson (1990), pg. 31, which suggests a necessary channel-cut into an underlying impermeable stratum. Please clarify.	*Figure 1-2 depicts the interpreted general extent of the ore body at MEA, not the entire subsurface distribution of the basal sandstone of the Chadron Formation. Figure 1-2 is not intended to indicate the presence of a single channel cut within the Pierre Shale surface at the site. As shown in cross-sections, the extent of the basal sandstone of the Chadron Formation (and therefore the extent of the channel-cut per Hansley and Dickenson's depositional model) is interpreted to extend at least to the MEA boundaries. Figure 3-13 likewise shows only that portion of the Pierre Shale within the permit boundary and as such does not extend*	Acknowledged.

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	to the margins of the river valley that deposited the basal sandstone of the Chadron Formation within the MEA and surrounding areas.	
4. **Section 3 #2. Section 3.3.1, Alluvium, Page 3-6, Lines 11-13:** What does it mean that a particular log pick (here the base of Quaternary alluvium) "has not been verified at MEA"? CBR states that this is an inferred contact". Yet Line 1 states that the alluvium is as much as 30 feet thick"? Please clarify.	*Thickness of quaternary alluvial deposits within the MEA range from 0 to approximately 30 feet thick. As described in the permit application, the thickness of the alluvium and the depth of the contact between the alluvium and Arikaree Group are difficult to discern on geophysical logs due to the variable ground moisture conditions present in the upper portion of the drill hole. A more reliable method of determining the thickness of the alluvium and the depth of contact with the Arikaree Group is from drill cuttings collected from boreholes as described on Lithologic Reports. Lithologic Reports are available for nearly all holes completed in the Marsland Expansion Area. The updated cross-sections depict an alluvium-Arikaree Group contact based on the lithologic descriptions for individual boreholes. The reference to an inferred alluvium Arikaree Group contact has been removed from the text of Section 3.3.1 and the cross-sections.*	Acknowledged.
5. **Section 3 #3. Section 3.3.2, Arikaree Group, Page 3-6, Paragraph 1, Line 1:** CBR identifies the entire Arikaree Group as a water-bearing unit. Nebraska Department of Natural Resources (NDNR) data lists domestic and livestock wells in the MEA	*A revised discussion of aquifers present at MEA has been incorporated into the application. The majority of this discussion is presented in Section 4.2.1, but the revised stratigraphic descriptions presented in Section 3.3 are also relevant. The revised discussion identifies which aquifers are*	Acknowledged.

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screened in the Arikaree. It is insufficient to simply state that particular units are "water-bearing intervals", and then describe them as discontinuous" or "not typically reliable water sources". Title 122, Chapter 1, 006, defines "aquifer" as "a geological formation, group of formations, or part of a formation that is capable of yielding a useable amount of water to a well, spring, or other point of discharge". CBR must define the specific areal extent of each of these units that that "is capable of yielding a useable amount of water", defining not only the map-able boundary or perimeter, but also its thickness, and reservoir properties. CBR is obligated to define all aquifers and USDW within the Area of Review. Please define all aquifers.	*present at MEA, and presents information about aquifer characteristics (e.g., lateral and vertical extent, hydrologic properties derived from grain size analysisand groundwater flow patterns). In addition, installation of new monitoring wells has provided additional data about groundwater levels and potential interaction between the Arikaree Group and Brule Formation. Water quality data for newly installed wells is forthcoming and will be incorporated into a cohesive quarterly monitoring program that will evaluate seasonal water level changes across the MEA.*	
6. **Section 3 #4. Section 3.3.2, Arikaree Group, Page 3-7, Paragraph 2, Line 2:** CBR discusses very fine to medium grain sizes, but of what? Does this include sand, silt or clay? Please clarify.	*Lithologic description of the Arikaree Group has been revised in Section 3.3.2 to incorporate lithologic data from 2013 drilling and coring activities.*	Acknowledged.
7. **Section 3 #5. Section 3.3.2, Arikaree Group, Page 3-7, Paragraph 4, Lines 4-5:** If contacts cannot be distinguished within the Arikaree Group on the basis of logs, then are the three subordinate stratigraphic units discussed below distinguished by	*Discussion of the Arikaree Group as presented in Section 3.3.2 includes lithologic descriptions from regional outcroppings which are included to provide depositional and lithologic characteristics for each formation. These formations outcrop to the north and west of the project area and may*	Acknowledged.

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cores? This is not stated. If they are not distinguished, then why does the text for the next page and a half discuss distinctions? If these are lithologic descriptions from 50 miles away, then that should be stated. Please eliminate all descriptions of stratigraphic units not known to exist in the subsurface of the MEA.	*be assumed to have similar characteristics in the subsurface of the project area. Additional site specific grain size analysis and X-ray diffraction data for the Arikaree Group has been included from core samples collected at five locations within the MEA. A coring program was completed in September 2013 at Marsland within portions of the Arikaree Group to assess mineralogical and hydrologic conditions.*	
8. **Section 3 #6. Section 3.3.2, Arikaree Group, Page 3-7, Paragraph 4, Lines 7-8:** This sentence indicates that the lower contact of the Arikaree Group, the top of the underlying Brule Formation (FM), is also uncertain on logs. What wells/test holes have been drilled in the MEA to define the stratigraphy? And were these holes sampled by mud-logging, coring, sidewall sampling, or some other technique? Please clarify.	*CBR has an on-going drilling program that to date has completed more than 1,800 drill holes in the Marsland Area. A descriptive lithologic report based upon examination of the drill cuttings has been completed for nearly all of these holes. Descriptions of the depth, color, textures, and grain sizes for each horizon are summarized and correlated with the geophysical log. Drill cutting samples are collected at intervals of 5 to 10 feet. The correlation between the geophysical logs and the drill cuttings provides the best means for determining this contact point. When this contact is present on the geophysical logs, it is characterized by an upward increase in the resistivity curve from the underlying finer grained Brule Formation, often moving off scale high, and exhibits a decrease in the SP curve that fluctuates with the fluvial Sediments present in the drill hole, and occasionally will be off scale. No distinguishing features are observed within the Gamma curve. In August, 2013, a coring program sampled the Arikaree Group and Brule and Chadron Formations and Pierre*	Acknowledged.

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	Shale to provide both grain size analysis and mineralogy of the respective formations. The text of Section 3.3 has been revised to include a description of the coring program at MEA. Additionally, Table 3-4 and Figure 3-5 have been added to provide further information on coring activities at MEA.	
9. **Section 3 #7. Section 3.3.2.2, Harrison-Monroe Creek FM, Page 3-8, Paragraph 2:** This unit consists of a 200 foot thickness of only channel sands? How does CBR know its thickness if they can't identify/distinguish it in the subsurface? Is the depositional type (channel sands) identified by log signature, or by some other means? Or is this a stratigraphic assumption based upon deposits tens of miles away? Please clarify.	*This is essentially a reprisal of question Section 3 #5. Discussion of the Arikaree Group presented in Section 3.3.2.2 is based upon lithologic descriptions from regional outcroppings. Additional information based on grain size and XRD analyses has been incorporated into the description of the Arikaree Group.*	Acknowledged.
10. **Section 3 #8. Section 3.3.2.1, Upper Harrison Beds, Page 3-8, Paragraph 2, Line 1:** What does it mean that a "paleosurface" was "overlain" by silica cement? The next sentence states that the paleosurfaces were valleys, but in this case they were "overlain by ... sands". What is the relation of the cement and the sand, that both "overlay" the paleosurfaces? Please clarify.	*The text of Section 3.3.2.1 has been revised to clarify the relation of the cement and paleosurfaces. The term "overlay" is removed for clarification.*	Acknowledged.
11. **Section 3 #9. Section 3.3.2.2, Harrison-Monroe Creek FM, Page 3-8, Paragraph 3, Lines 1-2:** "[F]ine,	*The description of the Harrison-Monroe Creek Formation has been revised in Section 3.3.2.2 to incorporate site-specific*	Acknowledged.

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unconsolidated grey sediments" is not a detailed enough lithologic description. Fine sand? Or fine clastic sediment, meaning silt and clay, or just clay? The permeability of fine sand and clay are very different.	*descriptions of lithology based on observations of drill cuttings and grains size analysis.*	
12. **Section 3 #10. Section 3.3.2.2, Harrison-Monroe Creek FM, Page 3-8, Lines 5-6:** Please change the reference (McFadden and Hunt, Jr. 1998) to (McFadden and Hunt, 1998) in all instances of use.	*All citations in this publication have been revised to change the reference of McFadden and Hunt 1998. The citation in Section 7 has also been revised with the correct page numbers of the publication.*	Acknowledged.
13. **Section 3 #11. Section 3.3.2.2, Harrison-Monroe Creek FM, Page 3-8, Paragraph 4, Lines 8:** How does CBR know the direction of groundwater flow "at the time of formation" of the Harrison- Monroe Creek FM? Note that flow directions vary spatially and features seen miles away do not indicate flow direction within the MEA Area of Review. Please consider eliminating this statement.	*All statements attributed to (Witzel 1974) have been removed from the document as this thesis is not available from Chadron State and cannot be verified independently.*	Acknowledged.
14. **Section 3 #12. Section 3.3.2.3, Gering FM, Page 3-9, Section 1.2.2, Paragraph 3, Lines 3-4:** This sentence discusses "distal and proximal floodplains", a phrase commonly used to indicate as "proximal" close to the riverbank, and as "distal" farther from the riverbank. One expects coarser sediment to settle proximal and finer sediment to settle distal, after a flood. The	*The text of Section 3.3.2.3 has been revised for clarification.*	Acknowledged.

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sentence, however, cites "sandy siltstone and silty claystone, respectively", so having the coarser sediment distal and the finer sediment proximal. This is counterintuitive, the reverse of the lateral facies expected. Please clarify.		
15. **Section 3 #13. Section 3.3.2.3, Gering FM, Page 3-9, Paragraph 3, Lines 8-10:** This sentence states that the unit "forms steeper slopes" than does the underlying unit; however, the Gering FM is presented in the cross-sections Figures 3-4 a-n and Figure 3-2 as being entirely subsurface in the MEA Area of Review. It is nowhere exposed. It does not present an exposed slope, either steep or shallow. Please revise this description.	*The text of Section 3.3.2.3 has been revised as requested.*	Acknowledged.
16. **Section 3 #14. Section 3.3.3.1, Brule FM, Page 3-10, Paragraph 1, Lines 1-2:** CBR states that the Brule "outcrops throughout most of the Crow Butte area"; however, it is represented in the cross-sections Figures 3-4 a-n as being entirely subsurface in the MEA Area of Review. Please revise this statement accordingly.	*The text of AEP Section 3.3.3.1 has been revised as requested and cross-sections Figures 3.4a-n and Figure 3-2, were revised for clarification and consistency.*	Acknowledged.
17. **Section 3 #15. Section 3.3.3.1, Brule FM, Page 3-11, Paragraph 1, Line 6:** This sentence identifies sandstones within the Brule as being "porous and constitute a part of the regional	*Section 3.3.3.1 has been revised to clarify the distribution of potentially water-bearing units of the Brule Formation across the MEA. Clarifying language has been included to define the channelized sandstones that occur*	Acknowledged.

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aquifer", implying that the remainder of the FM is not aquifer. No attempt it made to define this aquifer portion stratigraphically or aerially. Please provide more information as to its lateral extent.	*near the base of the Orella Member across the MEA as the first overlying aquifer above the production zone.*	
18. Section 3 #16. Section 3.3.3.2, Chadron FM, Page 3-11, Paragraph 1, Lines 2-3: "The Chadron FM conformably overlies the basal sandstone of the Chadron FM ...." If the "basal sandstone of the Chadron FM" is within the Chadron FM, as it must be in order to be the basal part of it, then how can the Chadron FM overlie it? Please be consistent.	*The text of Section 3.3.3.2 has been revised to provide additional information.*	Acknowledged.
19. Section 3 #17. Section 3.3.3.2, Chadron FM, Page 3-11, Paragraph 1, Lines 5-6: CBR states that it uses stratigraphic terms "to be consistent with historical permitting" that are not those used in current formal stratigraphic nomenclature. Please include an additional table that shows the relationship between the formation & members historically used by CBR to the current formal stratigraphic nomenclature. This table should include information about the depth bgs, group formation and members historically used by CBR and compare this with the formation and members used in current formal stratigraphic nomenclature. Please also include	*Table 3-3 has been revised to clarify stratigraphic nomenclature used by CBR in relation to published nomenclature. Some formation names formally recognized by USGS (e.g., Chamberlain Pass Formation, Peanut Peak Member) are only formally recognized in South Dakota but are included for reference purposes. USGS does not formally recognize any subunits of the Chadron Formation in Nebraska.*	Acknowledged.

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more discussion on this topic as well.		
20. Section 3 #18. Section 3.3.3.2, Upper Chadron and Upper/Middle Chadron FM, Page 3-11, Paragraph 1, Lines 2-3: This sentence identifies "tabular and lenticular channel sandstones" within the Upper Chadron FM (Big Cottonwood Creek Member). Please see comment 3 in this section. Please clarify.	*Lithologic descriptions of the upper Chadron and middle Chadron have been revised to incorporate lithologic data from 2013 drilling and coring activities in Section 3.3.3.2.*	Acknowledged.
21. Section 3 #19. Section 3.3.3.2, Upper Chadron and Upper/Middle Chadron FM, Page 3-13, Paragraph 1, Lines 1-6: These two sentences describe what is not at the MEA. Please confine all discussion to what is present, without comparisons to other permitted areas outside of the MEA.	*Observations of cores, drill cuttings, and geophysical log signatures indicate that the upper/middle Chadron unit is not present at MEA; therefore, all reference to the upper/middle Chadron has been removed from this document as suggested by NDEQ. Reference to regional stratigraphy and sedimentology has been retained in the document as appropriate.*	Acknowledged.
22. Section 3 #20. Section 3.3.3.2, Upper Chadron and Upper/Middle Chadron FM, Page 3-13, Paragraph 2, Lines 1-2: CBR states that based upon logs "the upper/middle Chadron has poor reservoir characteristics and minimal water saturation." Please see comment 3 in this section. Please clarify.	*Observations of cores, drill cuttings, and geophysical log signatures indicate that the upper/middle Chadron unit is not present at MEA; therefore, all reference to the upper/middle Chadron has been removed from this document as suggested by NDEQ.*	Acknowledged.
23. Section 3 #21. Section 3.3.3.2, Upper Chadron and Upper/Middle Chadron FM, Page 3-13 Paragraph 1, Lines 8-12: CBR states that because there are no	*Discussion of the confining unit consisting of the upper Chadron and middle Chadron has been revised to incorporate lithologic data from 2013 drilling and coring activities in*	Acknowledged.

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sandstones in this unit (Upper/Middle Chadron FM), "the upper Chadron and middle Chadron FM comprise a thick continuous mudstone and siltstone sequence", thus contradicting Section 3.3.3.2, Upper Chadron and Upper/Middle Chadron FM, Page 3-11, Paragraph 1, lines 2-3, which identified "tabular and lenticular channel sandstones" within the Upper Chadron FM. Please revise to be consistent.	*Section 3.3.3.2.*	
24. **Section 3 #22. Section 3.3.3.2, Upper Chadron and Upper/Middle Chadron FM, Page 3-13, Paragraph 1, Lines 8-12:** CBR states that the cross-sections show "an inferred stratigraphic position" for this unit. Apparently, no reliable "picks" could be found to correlate this unit. In the absence of any cores through this unit at the MEA, it is unwise to infer its existence, or that of any other unit that cannot be confirmed. The cross-sections indicate a level of understanding that does not exist, and thus mislead the public. This unit, and any others merely "inferred" on the cross-sections, should be eliminated and the interval considered generically if there is no data to verify.	*The cross-sections have been modified, removing this inferred reference.*	Acknowledged.
25. **Section 3 #23. Section 3.3.3.2, Upper Chadron and Upper/Middle Chadron**	*Observations of cores, drill cuttings, and geophysical log signatures indicate that the*	Acknowledged.

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FM, Page 3-13 Paragraph 2: CBR discounts the Upper/Middle Chadron FM (presumably the lower Big Cottonwood Creek Member of the Chadron FM) as an aquifer, but does not reference the Title 122, Chapter 1 006 definition of "aquifer". CBR is obligated to define all aquifers and USDW within the Area of Review. Please clarify.	*upper/middle Chadron unit is not present at MEA; therefore, all reference to the upper/middle Chadron has been removed from this document as suggested by NDEQ. Therefore, no discussion of the upper/middle Chadron in terms of aquifer properties is provided in the document.*	
26. **Section 3 #24. Section 3.3.3.2, Upper Chadron and Upper/Middle Chadron FM, Page 3-13, Paragraph 2, Line 17:** CBR states that the Upper/Middle Chadron FM is not present in some portions of the MEA (though there should be little, if any, uncertainty, if CBR has logged 1,653 boreholes within the MEA). This was not discussed in the Upper/Middle Chadron FM just above. This unit is displayed as a dashed contact in the cross-sections Figures 3-4 a-n, labeled as "inferred Upper/Middle Chadron FM", without any assigned thickness. An exception is Figure 3-4 c, which omits the word "inferred". Figure 3-4 d includes an additional correlated pick absent from all other cross-sections, but also dashed. This may have been intended as an "inferred" top of the Upper/Middle Chadron FM, because it occurs between the labels "Upper Chadron FM" and "Inferred Upper/Middle Chadron	*Observations of cores, drill cuttings, and geophysical log signatures indicate that the upper/middle Chadron unit is not present at MEA; therefore, all reference to the upper/middle Chadron has been removed from this document as suggested by NDEQ. As previously depicted, the cross-sections were intended to show only the inferred upper contact of the upper/middle Chadron. Because this unit is interpreted as being not present at MEA, all Class III and AEP cross sections have been revised to remove all reference to the upper/middle Chadron, including the "inferred" contact.*	Acknowledged.

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FM", but if so, it is not repeated in any of the other interlocking cross-sections. If, in fact, CBR intends to present that this Upper/Middle Chadron FM is completely absent (consistent with most of the cross-sections, but not the text, which states that it occurs "at some locations" [Page 3-13, Section 3.3.3.2, Upper Chadron and Upper/Middle Chadron FM, Paragraph 1, Lines 1-2], and describes it as "overlying" [Page 3-14, Section 3.3.3.2, Middle Chadron FM, Paragraph 1, Line 8] the Middle Chadron FM), then it should not be discussed. It would then be considered absent due to erosion or non-deposition. Certainly no lithologic description (here "typically very fine to fine grained, well-sorted, poorly cemented sandstone") should be given. Please clarify.		
27. **Section 3 #25. Section 3.3.3.2, Middle Chadron FM, Page 3-14, Paragraph 1, Lines 9-10:** CBR states that the Middle Chadron FM "weathers into hummocky, 'haystack-shaped' hills and slopes with a popcorn-like surface", but all of the cross-sections present this Middle Chadron FM as 700-1200' bgs. It does not outcrop within the MEA Area of Review, the subject of this permit application. Please consider eliminating these statements.	*Non-applicable descriptions of Middle Chadron outcrop have been removed from Section 3.3.3.2 to clarify that it does not outcrop within the MEA Area of Review.*	Acknowledged.

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28. **Section 3 #26. Section 3.3.3.2, Middle Chadron FM, Page 3-14, Paragraph 1, Line 15:** CBR states that the Middle Chadron FM can be as thin as 20 feet thick, and yet the cross-sections show a minimum thickness of this unit of about 140 feet (boring M1563). Please clarify.	*The minimum thickness of the middle Chadron Formation presented in Section 3.3.3.2 has been corrected based on reinterpretation of cores, drill cuttings, and geophysical data. As shown on revised Figures 3-4a through 3-4n the actual minimum thickness is approximately 150 feet.*	Acknowledged.
29. **Section 3 #27. Section 3.3.3.2, Middle Chadron FM, Page 3-15, Paragraph 1, Lines 1-3:** This statement of the absence of Upper/Middle Chadron FM is consistent with Page 3-13, Section 3.3.3.2, Upper Chadron and Upper/Middle Chadron FM, Paragraph 1, Lines 1-6; Page 3.13, Section 3.3.3.2, Upper Chadron and Upper/Middle Chadron FM, Paragraph 2, Lines 1-2; and Page 3-14, Section 3.3.3.2, Middle Chadron FM, Paragraph 1, Line 9; though it is inconsistent with Page 3-13, Section 3.3.3.2, Upper Chadron and Upper/Middle Chadron FM, Paragraph 1, Lines 1-2; and Page 3-14, Section 3.3.3.2, Middle Chadron FM, Paragraph 1, Line 10. Please revise relevant portions of the application to be consistent.	*Observations of cores, drill cuttings, and geophysical log signatures indicate that the upper/middle Chadron unit is not present at MEA; therefore, all reference to the upper/middle Chadron has been removed from this document as suggested by NDEQ.*	Acknowledged.
30. **Section 3 #28. Section 3.3.3.2, Middle Chadron FM, Page 3-15, Paragraph 2, Lines 4-5:** CBR states that there is a confining zone, averaging 690ft. thick, above the "Basal Sandstone of the Chadron FM", consisting of the "upper	*Observations of cores, drill cuttings, and geophysical log signatures indicate that the upper/middle Chadron unit is not present at MEA; therefore, all reference to the upper/middle Chadron has been removed from this document as suggested by NDEQ.*	Acknowledged.

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and middle Chadron units", but on Page 3-11, Section 3.3.3.2, Upper Chadron FM, Paragraph 1, Lines 2- 3 identifies "tabular and lenticular channel sandstones" in the Upper Chadron FM. Page 3-13, Section 3.3.3.2, Upper Chadron and Upper/Middle Chadron FM, Paragraph 2, Lines 1-2 discuss "the upper/middle Chadron" as having "poor reservoir characteristics and Minimal water saturation", and yet in numerous other locations in the text CBR states that this unit does not exist, or is unidentifiable, at the MEA. The Middle Chadron has been discussed as "mudstone and claystone" (Page 3-14, Section 3.3.3.2, Middle Chadron FM, Paragraph [?], line 9), and thus not aquifer. Please revise relevant portions of the application to be consistent.	*Thin (0.1 to 0.15 meter) tabular and lenticular sandstones are observed within the upper Chadron at Toadstool Park (Terry and LaGarry 1998) and similar features have been interpreted as present at MEA based on cores, drill cuttings, and geophysical log review. However, no water has been observed within these thin sandstones and their presence is not expected to affect the overall upper confinement of the production zone. Descriptions of the upper Chadron in Section 3.3.3.2 have been revised for clarification.*	
31. **Section 3 #29. Section 3.3.3.2, Basal Sandstone of the Chadron FM, Page 3-15, Paragraph 1, Lines 5-6, and 11-12:** CBR's discussion reverses the stratigraphic order of the two paleosols. It is more logical to discuss the paleosol developed into the upper surface of the unit in question, and then the paleosol developed upon the underlying unit in a subsequent discussion of that unit. Please consider revising.	*The text of Section 3.3.3.2 has been revised as requested.*	Acknowledged.

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32. **Section 3 #30. Section 3.3.3.2, Basal Sandstone of the Chadron FM, Page 3-16:** CBR defines the overall depositional environment of this unit as "Channel", and the texture sandstone", fining upward. This suggests a point bar sequence of a meandering channel deposit (see Bernard, H. A., and LeBlanc, R. J., 1965, Resume of the Quaternary geology of the northwestern Gulf of Mexico), but CBR does not note this. The matter is critical for prediction of preferential groundwater flow through the unit. It is highly probable that the preferential flow pathway in this unit will be in a "Shoestring" configuration, occupying the near-base of the channel fill. The best prospecting model for CBR would thus not assume uniform blanket deposits of this " Basal Sandstone of the Chadron FM". It would be logical to core through this target unit in multiple locations in order to determine its sedimentological texture, and thus depositional model, and most probable preferential flow pathways. Please clarify.	*Cameco must carefully balance the cost of additional data collection against the potential increase in production. Although an increased level of detail would provide a more exacting depositional model, Cameco's operational experience and historical recovery rates at Crow Butte have shown that the well density and well construction methods planned will allow for efficient mining in the similar depositional environment at Marsland. Nonetheless, Cameco will look for opportunities to improve our understanding of the depositional environment and increase productivity.*	Acknowledged. However, the Department understands that Cameco will be able to obtain a substantial level of geologic information for the Basal Sandstone through development of MEA and installation of injection and production wells. Could this information be used to refine the depositional model and identify the most probable preferential flow pathways for subsequent mine units at MEA?
33. **Section 3 #31. Section 3.3.3.2, Basal Sandstone of the Chadron FM, Page 3-16 and Section *3.3.4,* Montana Group, Pierre Shale, Page 3- 18:** Comments on these pages state that the base of the Chadron Formation	*As requested, revisions were made to Section 3.3.3.2 and Section 3.3.4.*	Acknowledged.

NDEQ RAI	*Cameco Response*	NDEQ Response
and the top of the Pierre Shale dip gently to the north/northwest. Figure 3-10 indicates that the elevation of the top of the Pierre in the northernmost section of the AOR is approximately 3,240 feet while the elevation at the south is approximately 3,100 feet. This indicates that the base of the Chadron/top of the Pierre is actually dipping to the south/southeast. Please revise the text in this section.		
34. **Section 3 #32. Section 3.3.3.2, Basal Sandstone of the Chadron FM, Page 3-16, Paragraph 1:** CBR states that this unit consists of "up to four distinct sandstone packages ... separated by variable amounts of interbedded clay", but no detailed cross-sections showing these "packages" are presented. And what is the textural trend within these "packages"? Are they each fining-upwards point bar sequences suspended within finer, perhaps floodplain, matrix? Are they coarse braided stream lenses? Flow pathways through either would be very different, and would greatly affect solution mining efficiency. Please clarify.	*As noted above, Cameco must carefully balance the cost of additional data collection against the potential increase in production. Although an increased level of detail would provide additional information on the sandstone packages, Cameco's operational experience and historical recovery rates at Crow Butte have shown that the well density and well construction methods planned will allow for efficient mining at Marsland. Nonetheless, Cameco will look for opportunities to improve our understanding of the sandstone packages and increase productivity.*	Acknowledged. However, the Department understands that Cameco will be able to obtain a substantial level of geologic information for the Basal Sandstone through development of MEA and installation of injection and production wells. Could this information be used to obtain additional efficiency for solution mining for additional mine units at MEA?
35. **Section 3 #33. Section 3.3.3.2, Basal Sandstone of the Chadron FM, Page 3-16, Paragraph 1, Lines 6-7:** CBR states that the top of the Pierre Shale dips	*The text of Section 3.3.3.2 has been revised as requested.*	Acknowledged. **Section 3.3.4, Montana Group, Pierre Shale, Paragraph 1, Page 3-22:** The second to last sentence in this paragraph still says that the contact between the Pierre Shale

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to the north-northwest. This is an unconformity, and the concept of "dip" is ill-suited to such an irregular surface, but the general trend appears, according to Figure 3-10 (an inaccurate map), to be roughly southeast. Please correct these statements in the revised application and omit discussion related to the "dip."		and Chadron Formation "dips." Please revise various sections of this application as needed to correct this.
36. **Section 3 #34. Section 3.3.3.2, Basal Sandstone of Chadron FM, Page 3-16, Paragraph 2, Line 4:** CBR distinguishes the depositional model of this unit (braided stream), though addition of Andrew Miall's (1977) A review of the braided-river depositional environment in the references would be useful. The bottom line here is that a target stratum of this depositional model implies spotty, low-efficiency, production from solution mining, leaving numerous lenses behind when they are isolated by preferential recovery from coarser, more permeable lenses in hydraulic continuity. This implies the need for a high well density and low withdrawal rates to maximize productivity. Please consider this in your well field design.	*Cameco must carefully balance the cost of additional data collection against the potential increase in production. Although an increased level of detail would provide a more exacting depositional model, Cameco's operational experience and historical recovery rates at Crow Butte have shown that the well density and well construction methods planned will allow for efficient mining in the similar depositional environment at Marsland. Nonetheless, Cameco will look for opportunities to improve our understanding of the depositional environment and increase productivity.*	Acknowledged. However, the Department understands that Cameco will be able to obtain a substantial level of geologic information for the Basal Sandstone through development of MEA and installation of injection and production wells. Could this information be used to refine the well field design for additional mine units?
37. **Section 3 #35. Section 3.3.3.2, Basal Sandstone of Chadron FM, Page 3-17, Paragraph 3, Line 17:** CBR states that the Ur compounds derive from	*As requested, a conclusion regarding the uranium deposition was added to Section 3.3.3.2.*	Acknowledged.

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alteration of rhyolitic ash. Hansley & Dickinson (1990), page 30, states that this U compound deposition occurred "not long after deposition of the basal Chadron sandstone", hence according to Terry and LaGarry (1998) during the Late Eocene (33-37 million years ago (mya)). If that is CBR's conclusion, then it could be added here. Please address.		
38. **Section 3 #36A. Section 3.4, Structural Geology, Page E-20:** Attention was paid to whether faulting existed either in the general NW Nebraska area or in the MEA in particular. The treatment on faulting in the area has some omissions. Hunt identified two normal faults that occur in Agate Springs Fossil Beds area and that trend roughly NGOE. Offsets in exposed Arikaree Formation strata can be seen on the south side of the Niobrara River valley to the west. The fault strikes project towards the general MEA (perhaps the southern part). The fault trends are parallel to that of the Toadstool and a number of other faults in the area. The Toadstool and this area in general lies along a zone of reactivation of a Precambrian basement trend, known as the Colorado lineament that includes a number of faults that cut Tertiary strata. It has been proposed that in Colorado this zone presents a seismic risk. All of this easily available	*See attached Response Section 3 #36A.*	Acknowledged. The reference for Hunt, 1990, needs to be included in the reference section. Please revise the reference to Section 3.4, not 4.3.

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information that may be pertinent is missing from the report. Please address.		
39. **Section 3 #36B. Section 3.4, Structural Geology, Page E-20, Fault size, detection and significance:** Detailed mapping in the Toadstool Geologic Park area and a region north of Harrison has brought to light a fairly dense array of faults within Chadron Formation strata that trend in different directions (e.g. Maher and Shuster, 2012). Many of these faults are fairly small with meters of movement or less, but some members of a trend have offsets of several tens of meters. There is no reason why this could not happen elsewhere (and it may be concentrated within the White River Group and largely absent in the overlying Arikaree Group). The report argues based largely on drill hole data that faults do not exist. However, there is no discussion of what size offset could reasonably be detected using the drill hole data, and what smaller faults may be undetected, or what size of fault would be significant to the integrity of the site. It may very well be that the smaller faults would be insignificant hydrologically or otherwise, but this is also not discussed. Please address.	*See attached Response Section 3 #36B.*	Acknowledged.

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40. Section 3 # 36C. Section 3.4, Structural Geology, Page E-20: A reason faults may be of significance here is that they can serve as either barriers to or conduits for groundwater flow. There is no discussion of which might be the case here. In a related note, there is no discussion of fracture permeability (joint systems), even though several publications discuss the character of fracture permeability in the Brule Formation. Fracture permeability can exist in otherwise tight rocks and can be quite localized. Clastic dikes also exist in these rocks elsewhere and would make good conduits. It very well could be that fracture permeability in most of the Chadron Formation is close to non-existent, and a good seal exists between the Brule and the ore-bearing lower Chadron, but any serious discussion or evidence of consideration appears to be missing. Please address.	*No fault gouge, offset fractures, or clastic dikes have been observed within the upper or middle Chadron Formation or any other geological unit in the 280 vertical feet of core collected at MEA. While there is potential for these faults, joint systems, and clastic dikes to be present, speculation about their presence is not supported by subsurface data. If significant fracture permeability or other preferential groundwater flow pathways between the Brule Formation and the upper Chadron Formation were present, downward vertical groundwater gradients and potentiometric surface depressions would be expected within the Brule Formation at those locations. However, available groundwater level data indicate that groundwater flow within the Brule Formation is consistent with expected regional trends (NDNR 2004). Similarly, if significant permeability existed between the Brule Formation and basal sandstone of the Chadron Formation, pump test results would indicate hydrologic connectivity between the two units.*	Acknowledged.
41. Section 3 #36D. Section 3.4, Structural Geology, Page E-20: The isopachs (e.g. of the Brule) show some distinctive bulls eye's anomalies. The pattern is not one that appears to be geologic in origin. Instead I suspect they represent inconsistent interpretation of the logs. Since much of the cross section geometry is based on log picks, it would be useful to know more about how the picks were made (one	*The isopach maps have been reviewed and revised to correct survey elevation errors that were present within the dataset. These elevation errors were the result of using different surveying techniques over the life of the project. The corrections have greatly reduced the "bulls eye" patterns, and a review of those remaining anomalies have been confirmed. The revised isopachs are shown in Figures 3-6 through 3-9. Selection of the intervals shown on the maps and cross-*	Acknowledged.

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operator, multiple operators, blind comparisons). Is there any chance that some seismic sections could be done? It would help support the cross section interpretation. Please address.	*sections were made by project geologists and reviewed by senior geologic staff. CBR does not intend to complete any seismic work at this time.*	
42. **Section 3 #37. Section 3.4, Structural Geology, Page 3-20, Paragraph 1, Lines 8-9:** CBR states that "The pre-Oligocene Black Hills uplift (<37 mya) occurred prior to the deposition of the Eocene-Oligocene strata of the White River Group." What is the age of the rhyolitic ash discussed earlier? Is this not from the Black Hills uplift?	*Hansley et al. (1989) attributed the source of the uranium mineralization to the abundant rhyolitic ash that is present throughout the entire White River Group. Larson and Evanoff (1998) used 40AR/39AR dating methods on nine known White River tuff deposits. The ages ranged from 35.97 mya to 30.05 mya. The White River volcaniclasts were first described by Darton (1901), and he proposed the Black Hills uplift as the source for the material (Darton, 1912). Further study by Wanlass (1923) argued that the Black Hills plutons were too small to have produced the volume of material seen throughout the White River Formation. Other studies have continued to pursue the source area of the volcaniclastic material. Larson and Evanoff (1998) identified the Great Basin in eastern Nevada and western Utah as the most likely source area based on age, grain size and thickness observations. The Great Basin region was active with explosive rhyolitic volcanism during the 35 to 29 mya time period of White River Formation deposition. Additional discussion has been provided in Section 3.3.3.2.*	Acknowledged.
43. **Section 3 #38. Section 3.4, Structural Geology, Pine Ridge Fault, Page 3-22:** According to the last paragraph, five	*The TCEA cross sections and cross section location map have been included as a new Appendix C and updated text was added to*	Acknowledged. **Appendix C, Three Crow Expansion Are Geologic Cross-Sections, Figure E.1-3a, Three Crow Structural Cross-Section A-**

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cross sections constructed south of the Three Crow Expansion Area (TCEA) Class III UIC permit boundary do not support the presence of the Pine Ridge Fault within the AOR for the TCEA permit. Please include these cross sections as additional figures in the aquifer exemption request.	*Section 3.4. The existing Appendices (C-E) are now designated D-F.*	**A'**: This figure shows the groundwater flow direction in the basal sandstone of the Chadron Formation. According to this figure, groundwater flows uphill in portions of the TCEA. Please clarify. Also, given that this is the aquifer exemption application for MEA, not TCEA, is information on the groundwater flow direction needed?
44. **Section 3 #39. Section 3.4, Structural Geology, Page 3-20:** Why are the other faults not discussed with equal stature in this Application as the Pine Ridge Fault? Neither are presented by CBR as near the MEA (more than 12 miles and 6 miles, respectively, from the MEA, according to Figures 3-1and 3-11).	*Additional text has been incorporated into Section 3.4 to expand the fault discussions.*	Acknowledged.
45. **Section 3 #40. Table 3-1, Proposed Aquifer Exemption Location:** The location for T29N, R51W Section 1 should be W ½, W ½ of NE ¼, and W ½ of SE ¼, T29N, R51W, Section 2 should be NW ¼, E ½, and T29N, R51W, Section 13 should be NE ¼, E ½ of SE ¼.	*Table 3-1 was revised to incorporate the correct coordinates.*	Acknowledged.
46. **Section 3 #41. Figure 3-1, Bedrock Geology:** Please include additional figures showing the structure contour maps of each unconformity. The purpose of these maps would be to highlight any channels developed into the underlying units. It is probable that any preserved fill within such presumed channels would most likely	*Structural contour maps showing the elevations of the upper surfaces of the Brule Formation, Chadron Formation, basal sandstone of the Chadron Formation, and Pierre Shale have been completed and are presented as Figures 3-10 through 3-13, respectively. Additionally, isopach maps prepared for the Arikaree Group, Brule Formation, combined upper and middle*	Acknowledged.

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have a different texture than later sediment deposited above that fill (it would likely contain channel sands). This should also be discussed in the appropriate portions of the application.	*Chadron Formation, and basal sandstone of the Chadron Formation are presented as Figure 3-6 through 3-9, respectively. The text of Section 3.3 has been revised to include descriptions of the lithologic changes across the unconformable Pierre-Chadron, Chadron-Brule, and Brule- Arikaree contacts. In many locations, these unconformities are represented by channel sandstones overlying or incised into overbank mudstones. However, in some locations, mudstones or siltstones overlie texturally-similar deposits and geophysical log signatures or color differences are used to differentiate between formations.*	
47. **Section 3 #42. Figure 3-3 and 3-4 a-n, Marsland Cross-Sections:** The vertical scale of the cross-sections makes their interpretation almost impossible. Please include additional cross-sections with much greater vertical exaggeration in scale,but showing only the target horizon, in which it may have been possible to distinguish depositional facies.	*Revised cross-sections have been prepared for the application showing the production zone and immediate confining layers to provide greater detail.*	Acknowledged.
48. **Section 3 #43. Figure 3-3 and 3-4 a-n, Marsland Cross-Sections:** There is an apparent lack of uniformity of the calibration of the logging suites of the wells used in the cross-sections. NDEQ can only trust the quality of the correlation "picks" denoting the formations. The apparent jaggedness of the "tops" is due to geographic location of wells not coinciding with	*The geophysical logs selected for the cross-sections were determined based upon log quality and location. Logging equipment is calibrated monthly at the U. S. Department of Energy test pits located in Casper, Wyoming. Correlative "picks" for the various horizons have been made and reviewed by Cameco Resources geologic staff and are consistent with historical permitting. Cross-sections have been reviewed and revised to*	Acknowledged.

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the consistent stratigraphic dips of the formations (some are slightly cross-gradient, resulting in an artificial jaggedness).	*reflect correct elevation data that was in error due to multiple surveying techniques.*	
49. **Section 3 #44. Figure 3-3 and 3-4 a-n, Marsland Cross-Sections:** Elevations 3500 and 3400 are repeated on all the cross-sections. The lowest elevation shown on these figures should be 200 feet lower than that shown. Please revise.	*The cross-sections have been revised with the correct elevations.*	Acknowledged. **Figure 3-4a, Marsland Cross-Section A-A':** The left and right side appear to be cut off on this image. Please revise.
50. **Section 3 #45. Figure 3-10, Marsland Structure Map:** This figure is labeled as a "structure map" but uses isopleths that are keyed as "groundwater potentiometric surface" data. Please correct.	*Figure 3-10 was revised as requested. Due to the inclusion of additional figures, this figure is now designated as Figure 3-13.*	Acknowledged.
51. **Section 3 #46. Figure 3-11, Structural Geology Map:** The fault can be seen in Figure 3-1, but the North Trend Expansion Area (NTEA) and Crow Butte Facility (CBF) are not labeled on this Figure. Please include the NTEA and CBF on this figure in the revised application.	*Figure 3.11was revised as suggested. The figure number was changed to 3-14 due to the additions of new figures in Section 3.*	Acknowledged.
52. **Section 3 #47.Figure 3-11, Structural Geology Map:** Please include an additional figure showing the data from Figure 3-11 in a cross- sectional view.	*This figure is presented to provide an understanding of the regional geologic structures that are present in the area surrounding the MEA. This information is based upon DeGraw (1969) and other more recent research that has been compiled to produce Figure 3-11. CBR can neither confirm*	Acknowledged.

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	nor deny the accuracy of the information presented on this figure except for those features that are discussed within this application. Cross-sections are included within the application to illustrate the structural geology within the MEA. Cross-sections of the regional geology outside of the MEA boundaries are out of the scope of this application. Cameco maintains that the regional structural data presented in the application, including the revised discussion of nearby faults, is sufficient for this application. As noted above, due to the addition of new figures, this figure is now designated as Figure 3-14.	
Section 4—Hydrology of the Marsland Expansion Area		
General Comments		
53. Section 4 #1: CBR frequently discusses the MEA stratigraphy "by absence" that is, by discussing what is not present, but does occur at the other permitted CBR sites. This goes so far as to include description of entire strata that are absent at the MEA. Instead, please describe only that is actually present at the site to be permitted as a result of this Application: the MEA. Please do not compare it in the Application to the other permitted sites.	*Cameco uses other regional information to inform our understanding of the Marsland site. Extra discussion of regional context is appropriate as other reviewers may not be familiar with the subject matter. Cameco has removed irrelevant stratigraphic discussions throughout the document.*	Acknowledged.
54. Section 4 #2: This level of stratigraphic detail is unjustified by the actual geological data from the MEA Area of Review. Please revise to indicate the	*As noted in Comment Section 4 #1, Cameco uses other regional information to inform our understanding of the Marsland site. Discussion of regional geologic context is*	Acknowledged.

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level of scientific confidence that is supported by specific site data. If any surficial geology is cited, please qualify it based the distance away from the MEA where particular features were observed, any subsurface indications either of continuity or discontinuity, and any variability or consistency of subsurface log character or core description to that surficial geology.	*appropriate as other reviewers may not be familiar with the subject matter. Observations of outcrop and subsurface data from outside of the MEA serve to further our understanding of stratigraphic trends and depositional environments within the MEA. Regional observations are supplemented further by observations of lithology from borehole and core data gathered in 2013. The application has been revised to distinguish between regional and site-specific observations. Cameco has removed irrelevant stratigraphic discussions throughout the document.*	
55. **Section 4 #3:** The texts contain inconsistent stratigraphic statements, at one place discussing absence of a unit, and in a later place discussing the supposed texture of the (absent) sediment.	*The text of the petition has been revised to remove reference of geologic units that are absent within the MEA, including descriptions texture and lithology.*	Acknowledged.
56. **Section 4 #4:** Please ensure that the stratigraphy is consistently discussed in a logical order, from top to bottom. The test contains stratigraphic discussions that are somewhat inconsistent. For example the general order is from top to bottom, but there is discuss of a paleosol below the unit that then developed into the unit (this should be reversed).	*The text has been reviewed and revised where inconsistencies in stratigraphic order are present. The discussion of the Upper Interior Paleosol in Section 3.3.3.2 has been moved so that it is consistent with the top-to-bottom order of the overall stratigraphy discussion.*	Acknowledged.
57. **Section 4 #5:** CBR submitted results from 55 test holes that were logged	*CBR has completed coring programs in 2011 and 2013 across the Marsland Expansion*	Acknowledged.

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with standard electronic logging suites. Please indicate if any of the 1,653 holes were cored. Detailed core descriptions across the MEA could have yielded discussion of sedimentological textures, and thus depositional models and most probable preferential flow pathways. Such an effort could also have confirmed log responses, and provided correlation "picks". The detailed textural statements in the Application are excerpted from previously published studies of outcrops of the same stratigraphic units miles away from the MEA. This does not account for potential lateral change in these units. Site-specific data is needed in this application.	*Area. In 2011, two holes were completed and in 2013 an additional five holes were cored to provide site specific information across the project area. The site specific results of the coring programs have been incorporated into the body of the text and are presented in Table 3-4. The coring locations are shown in Figure 3-5.*	
58. Section 4 #6: The Application's lithologic descriptions of strata are too general, and lack genetic analysis (determination of depositional environments) based upon textural trends. This missing level of analysis means that most likely preferential flow pathways are not identified, and these would greatly increase the efficiency of solution mining.	*Additional data regarding lithology obtained during recent drilling and coring has been incorporated throughout the document.*	Acknowledged.
59. Section 4 #7: Please include an additional table that shows the relationship between the formation & members historically used by CBR to the current formal stratigraphic	*Table 3-1 has been revised to clarify stratigraphic nomenclature used by CBR in relation to published nomenclature. Some formation names formally recognized by USGS (e.g., Chamberlain Pass Formation,*	Acknowledged. Table 3-1 is a description of the proposed aquifer exemption location, while Table 3-3 is the representative stratigraphic section for the MEA. Please correct this reference accordingly.

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nomenclature. This table should include information about the depth bgs, group formation and members historically used by CBR and compare this with the formation and members used in current formal stratigraphic nomenclature. Please also include more discussion on this topic as well.	*Peanut Peak Member) are only formally recognized in South Dakota but are included for reference purposes. USGS does not formally recognize any subunits of the Chadron Formation in Nebraska.*	
60. Section 4 #8: CBR has not defined the aquifers present in the MEA. The areal extent, mapped perimeter, thickness, reservoir properties, and water qualities of each "aquifer", as defined in Title 122, Chapter 1 006 must be determined and presented. Please address	*This comment has been addressed in the context of the response to Section 3 #3.*	Acknowledged.
61. Section 4 #9: From Figure 4-1, it is apparent that there are many active irrigation wells within the AOR surrounding the MEA. These are almost certainly drawing water from beneath the MEA seasonally, and the probability of long well screens and deep, continuous gravel packs likely result in significant piezometric effect within the target stratum. Please address this issue.	*The presence of high capacity irrigation wells both within and near the Marsland Expansion Area that are screened in the Arikaree Group and Brule Formation will have a seasonal impact on those aquifers. CBR has installed additional monitoring wells within both the Arikaree Group and the Brule Formation between the anticipated wellfield and the irrigation wells. These wells will be sampled quarterly for 1 year to establish baseline data for both water quality and water levels. This sampling will allow for a full assessment of the impacts that these wells may have upon those aquifers within the mining area. Figures 4-2, 4-3 and 4-4a show the locations of these additional monitoring wells. Pumping test data has confirmed that these irrigation wells will*	Acknowledged.

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	have no effect upon the production zone aquifer (basal sandstone of the Chadron Formation) as it is separated from these overlying aquifers by several hundred feet of siltstones, clays and mudstones that constitute the upper confinement. No irrigation wells are completed in the basal sandstone of the Chadron Formation.	
Specific Comments		
62. **Section 4 #10. Section 4.1, Surface Water, Page 4-1:** Based of a review of Google Earth images, it appears that the Niobrara River is less than one-fourth mile from the southern site boundary. Please provide the actual distance from the site to the Niobrara River.	*Section 4.1 was revised to provide the distance (0.24 miles) of the southern permit boundary to the Niobrara River.*	Acknowledged.
63. **Section 4 #11. Section 4.2.1, Groundwater Occurrence and Flow Direction, Page 4-1, Paragraph 1, Line 1:** CBR lists the Arikaree FM as a water bearing interval. Please see comment 3 for section 3. Please define all aquifers.	*This comment is addressed in the context of the response to Section 3 #3.*	Acknowledged. **Section 4.2.1, Groundwater Occurrence and Flow Direction, Paragraph 1, Page 4-2:** In the last sentence of this paragraph, CBR indicates that the Arikaree should not be considered a source of "reliable water." However, the presence of domestic and livestock wells completed in the Arikaree indicates that the Arikaree Group, in the vicinity of the MEA, meets the definition of an aquifer, according to Title 122, and should be treated as such in this application. If CBR has information indicating that certain areas of the Arikaree Formation, in the vicinity of the MEA, do not meet this requirement, please consider revising the application accordingly.

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64. **Section 4 #12. Section 4.2.1, Groundwater Occurrence and Flow Direction, Page 4-1 Paragraph 1, Line 1:** CBR also lists the Brule FM a water bearing interval. Please see comment 3 for section 3. Please define all aquifers.	*This comment is addressed in the context of the response to Section 3 #3.*	Acknowledged.
65. **Section 4 #13. Section 4.2.1, Groundwater Occurrence and Flow Direction, Page 4-2:** According to this section the Brule FM has historically been considered the shallowest aquifer above the basal sandstone of the Chadron. There are domestic and livestock wells in the area screened in the Arikaree FM. Please clarify.	*Revisions were made to the text of Section 4.2.1 to correct this statement.*	Acknowledged.
66. **Section 4 #14. Section 4.2.1, Groundwater Occurrence and Flow Direction, Page 4-2, Paragraph 1:** It is insufficient to simply state that particular units are "water-bearing intervals", and then describe them as "discontinuous" or "not typically reliable water sources". Title 122, Chapter 1,006, defines "aquifer" as "a geological formation, group of formations, or part of a formation that is Capable of yielding a useable amount of water to a well, spring, or other point of discharge". CBR must define the specific areal extent of each of these units that that "is capable of yielding a useable amount of water", defining not only the map-	*This comment is addressed in the context of the response to Section 3 #3.*	Acknowledged.

NDEQ RAI	*Cameco Response*	NDEQ Response
able boundary or perimeter, but also its thickness, and reservoir properties. This is very feasible, given the information cited in Section 3.2.1, Page 3-4.		
67. **Section 4 #15. Section 4.2.1Groundwater Occurrence and Flow Direction, Page 4-2:** CBR notes piezometric maps (Figures 4-2 and 4- 3) based upon the February 2011, groundwater monitoring (GWM) data, but apparently no such maps were constructed based upon the August 2011, data. Please include these as additional figures.	*CBR has determined that the potentiometric data collected during August 2011 was not valid due to inconsistencies with established methods for sampling. Instead, CBR has included new potentiometric maps for the Arikaree Group, Brule Formation, and basal sandstone of the Chadron Formation based upon water levels taken during October (fall) of 2013. These maps include newly drilled wells and are the first of a cohesive quarterly monitoring program that will evaluate seasonal water level changes across the MEA. The fourth Consecutive quarterly monitoring event will be completed in the summer of 2014.*	Acknowledged.
68. **Section 4 #16A, Section 4.2.1, Groundwater Occurrence and Flow Direction, Pages 4-2, 4-3:** Static water levels were collected in February 2011 and August 2011, but only the February data are discussed when describing the groundwater flow direction and differences in the head between the Brule and basal Chadron sandstone aquifers. The statement is made that a minor variation in flow direction in February 2011 indicated localized westward flow in the vicinity of Monitor-10. Please expand and	*CBR has determined that the potentiometric data collected during August 2011 were not valid due to inconsistencies with established methods for sampling; therefore, the interpreted potentiometric surface based on August 2011 groundwater elevation data is invalid and not included in the revised document. Cameco has included new potentiometric maps for the Arikaree Group, Brule Formation, and basal sandstone of the Chadron Formation based on water level measurements taken during October (fall) of 2013. These maps include newly drilled wells and are the first of a cohesive*	Acknowledged. **Figures 4-5a, Potentiometric Surface of the Basal Sandstone of the Chadron Formation 10/17/2013, and Figure 4-5b, Potentiometric Surface of the Basal Sandstone of the Chadron Formation, 2/22/2011:** CBR depicts unusual groundwater flow patterns in both of these figures. Is there a potential for seasonal or annual changes in the groundwater flow conditions in this aquifer? Please address.

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provide a discussion and possible explanation for this statement.	*quarterly monitoring program that will evaluate seasonal water level changes across the MEA. The fourth consecutive quarterly monitoring event will be completed in the summer of 2014. The groundwater flow patterns shown on the February 2011 Potentiometric Surface of the basal sandstone of the Chadron Formation Map (Figure 4-3 of the original submittal) depicts a very flat potentiometric surface. The unusual flow pattern around Monitor-10 indicates an area of relatively low water level (i.e., depressed potentiometric surface) around that well. CBR has identified and examined the following potential causes for this unusual flow: formational variations within the basal sandstone of the Chadron Formation; well screen and well development problems; error in ground level elevation survey; and error in water level measurements taken in February 2011. CBR has reviewed the geologic and well development data for Monitor-10 and found no reason to explain the anomaly. Likewise, the well has been re-surveyed for elevation and was found to be accurate to within 0.05 foot. Subsequent water level measurements completed during October 2013 and presented in Figure 4-5 did not show the same potentiometric low at Monitor 10. Whether the unusual flow shown near Monitor 10 in February 2011 was authentic or the result of error, the October 2013 data did not show a similar pattern at Monitor-10. No additional wells have been installed within the basal sandstone of the Chadron Formation at this time, as CBR feels that the*	

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	present monitoring network of wells is sufficient to characterize groundwater flow within the project area.	
69. **Section 4 #16B. Section 4.2.1, Groundwater Occurrence and Flow Direction, Pages 4-2, 4-3:** The August readings indicate that there are some anomalies. The groundwater elevations for five of the monitoring wells screened in the basal sandstone went down between 0.24 to 3.85 feet, but the groundwater in two wells screened in the sandstone, Monitor 3 and CPW-2010-1went up 1.54 and 6.44 feet respectively. A quick review of the August groundwater elevations shows no distinct flow direction in the basal sandstone aquifer. There is no explanation provided in the text and no discussion of the groundwater elevation differences between February and August. Please provide additional groundwater level data for our review and include a discussion on the August data in your revision.	*CBR has determined that the potentiometric data collected during August 2011 were not valid due to inconsistencies with established methods for sampling; therefore, the interpreted potentiometric surface based on August 2011 groundwater elevation data is invalid and not included in the revised document. CBR has included new potentiometric maps for the Arikaree Group, Brule Formation, and basal sandstone of the Chadron Formation based on water level measurements taken during October (fall) of 2013. These maps include newly drilled wells and are the first of a cohesive quarterly monitoring program that will evaluate seasonal water level changes across the MEA. The fourth consecutive quarterly monitoring event will be completed in the summer of 2014.*	Acknowledged.
70. **Section 4 #16C. Section 4.2.1, Groundwater Occurrence and Flow Direction, Pages 4-2, 4-3:** Some of the monitoring wells screened in the Brule FM are not depicted on the map (Figure 4-2). Please provide a groundwater contour map for the August 2011 data, on a revised map	*Figures 4-4a and 4-4b depict all of the Brule Formation monitoring wells sampled to produce the interpreted potentiometric surfaces. A revised map of the August 2011data has not been included as CBR has determined that the potentiometric data collected during August 2011were not valid due to inconsistencies with established*	Acknowledged.

NDEQ RAI	*Cameco Response*	NDEQ Response
which depicts all monitoring well locations.	*methods for sampling. CBR has included new potentiometric maps for the Arikaree Group, Brule Formation, and basal sandstone of the Chadron Formation based on water level measurements taken during October (fall) of 2013. These maps include newly drilled wells and are the first of a cohesive quarterly monitoring program that will evaluate seasonal water level changes across the MEA. The fourth consecutive quarterly monitoring event will be completed in the summer of 2014.*	
71. **Section 4 #17. Section 4.2.2, Groundwater Quality Data:** The first paragraph states that data from three water-bearing zones in the MEA, the Arikaree, Brule, and basal sandstone of the Chadron FM, are presented in Table 4-4. However, only the water quality results for the Brule and basal Chadron FM are discussed in this section. Please discuss any data from wells screened in the Arikaree FM in this section. According to Table 4-12, the wells that are screened in the Arikaree FM and were sampled to obtain background data are: 705, 727, 747, and 788.	*CBR has installed additional monitoring wells within the Arikaree Group and Brule Formations to obtain water quality data more representative of the MEA site. The 10 new Arikaree monitoring wells and the 11 Brule monitoring wells (8 existing plus 3 new wells) will be sampled for water quality data quarterly for a 12-month period, which will serve as additional "seasonal" preoperational monitoring data. The first of four quarterly sampling rounds will commence in early November, 2013, and the resulting water quality data will be submitted to the NDEQ following completion of quality assurance/quality control tasks to ensure that the data are valid and representative of the sampled wells. Submittal of the first quarter data is expected to occur in early 2014.*	Acknowledged.
72. **Section 4 #18. Section 4.3, Aquifer Testing and Hydraulic Parameter Identification Information, Page 4-6,**	*Section 4.3 was revised to correct the date of 1010 to 2010.*	Acknowledged.

NDEQ RAI	*Cameco Response*	NDEQ Response
Paragraph 1: Change the date year of "1010" to "2010".		
73. **Section 4 #19. Section 4.3, Aquifer Testing and Hydraulic Parameter Identification Information, Paragraph 2, Page 4-6:** Please explain how the static water level taken on November 12, 2010 is incorporated with this report.	*Water level data collected on November 12, 2010 were assessed to provide a preliminary determination of static water levels and groundwater gradients within the Brule Formation and Chadron Formation prior to the measurements taken immediately prior to the aquifer pumping test conducted in May 2011. As these data reflect pre-development baseline conditions, they also provide a basis for comparison for later observations.*	Acknowledged.
74. **Section 4 #20. Section 4.3, Aquifer Testing and Hydraulic Parameter Identification Information, Pages 4-6 -4-8 and Section 4.5, Description of the Proposed Recovery Operation and Relationship to Site Geology and Hydrology, Pages 4-12-4-14:** For the May 2011 pumping test, a 40 foot thick aquifer was used for computing the hydraulic properties. However, in Section 4.5, the report states that the average thickness of the basal sandstone is 55 feet. Please clarify. If the average thickness is 55 feet, please re-compute the hydraulic properties arid revise the report as necessary.	*The first sentence in the second paragraph of Section 3 of the Pump Test (page 5) states: "(o)re-grade uranium deposits underlying the Marsland Expansion Area are located in the Basal Chadron Sandstone, which averages SO feet in thickness (typically 40 feet net sand) and occurs at depths ranging from 900 to more than 1,100 feet below ground surface." The average stratigraphic thickness of the unit used in the application (55 feet) is based on more recent stratigraphic evaluation of MEA subsurface geology than was available at the time of the pumping test. As stated in Sections 3.3.3.2 and 4.5, the stratigraphic thickness of the Basal Sandstone of the Chadron Formation averages 55 feet at MEA. Stratigraphic thickness is a measure of the distance between the contact between the Basal Sandstone of the Chadron Formation and the underlying and overlying Pierre Shale and Middle Chadron Formation, respectively.*	Acknowledged.

NDEQ RAI	*Cameco Response*	NDEQ Response
	This is also referred to as the "gross" thickness of a geologic unit. Net sand represents the total thickness of sandstone within the overall stratigraphic package (e.g., total thickness minus interbedded non-sandstone units such as mudstone and siltstone). An average of 40 feet of net sand within the Basal Sandstone of the Chadron Formation is considered to be an accurate estimate based on the current understanding of site geology. The net sand thickness of 40 feet was used by Aquiver during pumping test #8 to calculate hydraulic conductivity because the amount of coarse-grained (sand), porous material is a major control on the ability of an aquifer to transmit water.	
75. **Section 4 #21. Section 4.4.1, Confining layers, Page 4-9:** Why were only four core samples taken? Are four adequate for the size of MEA?	*Two core holes were completed in 2011 for sampling confining units overlying and underlying the production zone. In 2013, five additional core holes were completed across MEA to sample the Arikaree Group, Brule Formation, Chadron Formation, and Pierre Shale. A total of 36 core samples have been analyzed for particle size distribution and 36 samples for mineralogy by X-ray diffraction. Within the upper and middle Chadron Formation upper confining unit, 6 core samples were analyzed for particle size distribution and 6 for mineralogy by X-ray diffraction. Within the Pierre Shale lower confining unit, 7 core samples were analyzed for particle size distribution and 7 samples were analyzed for mineralogy by x-ray diffraction. Table 3-4 has been added to the document to clarify core intervals.*	Acknowledged. ***[New Table]:*** Please consider incorporating a new table that would summarize where the geologic formation that each core is from along with a summary of the grain size analysis results for each core. Please consider referring to this table in applicable portions of the application.

NDEQ RAI	*Cameco Response*	NDEQ Response
76. **Section 4 #22. Section 4.4.1, Confining layers, Page 4-9, Paragraph 1, Lines 1-3: Here, and on Page 3-15, Section 3.3.3.2, Middle Chadron FM, Paragraph 1, Lines 4-5,** CBR states that there is a confining zone, 430-940 ft. thick, averaging 690ft. thick, above the "Basal Sandstone of the Chadron FM", consisting of the "upper and middle Chadron units", but Page 3-11, Section 3.3.3.2, Upper Chadron and Upper/Middle Chadron, Paragraph 1, lines 2-3 identifies "tabular and lenticular channel sandstones" in the Upper Chadron FM. Please revise for consistency.	*Discussion of the confining unit consisting of the upper Chadron and middle Chadron has been revised to incorporate lithologic data from 2013 drilling and coring activities. Water has not been observed in the sandstones of the upper Chadron Formation; therefore, the confining properties of the upper and middle Chadron as a whole are not considered to be affected by sandstones within the upper Chadron. Clarifying revisions were made in Sections 3.3.3.2 and 4.4.1.*	Acknowledged.
77. **Section 4 #23. Section 4.4.1, Confining layers, Page 4-9, Paragraphs 2-3:** CBR discusses the permeability of the Pierre Shale. The weak points of the Pierre within the MEA AOR are fractures from late Cretaceous and later uplifts (particularly in the development of the nearby Cochran Arch), as well as well abandonments that penetrated the Pierre (Hollibaugh 1). Please address this issue.	*The Pierre Shale is marine shale that consists primarily of illite and smectite as indicated by CBR core samples collected in 2011 and 2013. The swelling nature of these clays in the presence of water makes it unlikely that any fractures or penetrations within the Pierre would provide preferential flow pathways and potential for loss of confinement through this thick unit. The upper surface of the Pierre, shown in Figure 3-13 and Figure 3-4a, depicts the gentle southeasterly sloping surface that is consistent with the surface described by DeGraw (1971). This sloping surface rises to the axial crest of the Cochran Arch located to the north of the MEA. Regional studies by Neuzil and others (1982) indicate that there is no observed transmissivity between vertical fractures in the Pierre Shale and that these fractures*	Acknowledged.

NDEQ RAI	*Cameco Response*	NDEQ Response
	typically are short and not connected. All oil and gas test holes in the Area of Review have been abandoned in accordance with accepted regulatory practices at that time.	
78. **Section 4 #24. Section 4.7, Local Water Supply, Page 4-15:** Revise MW ¼ to NW ¼.	*MW ¼ was corrected to NW ¼ in Section 4.7.*	Acknowledged.
79. **Section 4 #25. Section 4.7, Local Water Supply, Page 4-16:** A statement is made that water use would be expected to average about 2,800 gallons per day (gpd) for the entire area based on the presence of eight occupied residences within the 2.5 mile AOR. This water use is based on human consumption only and seems a little low. There are numerous livestock wells within this area. Please account for the agricultural water usage.	*Recent literature on water consumption was reviewed and the amount of typical water consumption for an average household was adjusted up from 2,800 gpd to 3,200 gpd. Section 4.7 was revised to reflect the updated information. Livestock consumption calculations for the MEA permit area and AOR are now discussed in Section 4.7.*	Acknowledged.
80. **Section 4 #26. Table 4-3, Water Levels, and Figure 4-2, Potentiometric Surface, Brule FM:** The Table lists groundwater monitoring (GWM) data from wells in the Brule and Basal Sandstone of the Chadron FM, while the Figure depicts the February 2011, piezometric surface. The Figure does not show well BOW 2010-4, which is noted and has data in the Table.	*Due to the inclusion of additional figures, this figure is now designated as Figure 4-4 and has been revised to show that February 2011 water level data was obtained from well BOW 2010-4, not BOW 2010-4A.*	Acknowledged.
81. **Section 4 #27. Table 4-9, 2011 Marsland Pumping Test #8:**	*Table 4-9 has been revised as suggested. Wells Walters 1 and Walters 2 were not Included*	Acknowledged.

NDEQ RAI	*Cameco Response*	NDEQ Response
Columns 5 and 6 should be exchanged. Monitor-5 is in Section 2, not 1. Column 11 (Casing Depth, bgs) cannot be less than Column 12 (Top Screen, bgs). Why are Wells Walters 1 and 2 data not listed?	*in the pumping test and are therefore not included in the table. Gaps between the bottom of well casings and the top of screened intervals represent 3-inch PVC pipe that is part of the screen assembly, but is not screen and not casing. These blank PVC intervals are used during well construction to extend the screen out of the bottom of the well. Wells were cased to the nearest 10-foot interval above the targeted horizon. After deepening the hole and logging to determine the zones to be sampled, the screen assembly was set in place. Depending on subsurface conditions during well installation, the well screen may extend upward beyond the bottom of the casing (for example, well BOW-2010-2). Similarly, if multiple zones are screened, a blank 3-inch PVC section may be placed between the screen intervals if they are separated by a significant distance or an unproductive zone. Well completion data have been reviewed and updated where applicable.*	
82. **Section 4 #28. Table 4-9, 2011Marsland Pumping Test #8:** Section numbers are listed in the Township & Range Column, and Township & Range information is listed in the Section column. Please revise.	*Table 4-9 was revised as suggested.*	Acknowledged.
83. **Section 4 #29. Table 4-9, 2011Marsland Pumping Test #8:** Monitoring well Monitor-S is located in Section 2,T29N, R51W. Please revise.	*Table 4-9 was revised as suggested.*	Acknowledged.

NDEQ RAI	*Cameco Response*	NDEQ Response
84. **Section 4 #30. Table 4-9, 2011Marsland Pumping Test #8:** The casing stickup height for CPW-2010-1is 2.05, Monitor-4A is 1.19 (1.6 on table), and Monitor 7 is 1.18. Please revise.	*Table 4-9 was revised with field-verified measurements.*	Acknowledged.
85. **Section 4 #31. Section 3.3.3.2, Basal Sandstone of the Chadron FM, Page 3-16 and Sections 3.3.4, Montana Group, Pierre Shale, Page 3-18:** Comments on these pages state that the base of the Chadron Formation and the top of the Pierre Shale dip gently to the north/northwest. Figure 3-10 indicated that the elevation of the top of the Pierre in the northernmost section of the AOR is approximately 3,240 feet while the elevation at the south is approximately 3,100 feet. This indicates that the base of the Chadron/top of the Pierre is actually dipping to the south/southeast. Please revise the text in this section.	*The text of Section 3.3.3.2 has been revised as requested.*	Acknowledged.
86. **Section 4 #32. Table 4-12 Active, Inactive, and Abandoned Water Supply Wells in MEA and AOR:** Please provide an explanation why some wells are not present on the table. Figure 4-1 depicts wells located outside the area and numbers coincide with those not present on the table. Please note that well #833 is not depicted on the map and not present on the table.	*Please see the attached response for Section 4 #32.*	Acknowledged.

NDEQ RAI	*Cameco Response*	NDEQ Response
Please revise the table or map to show well #833.		
87. **Section 4 #33. Table 4-13, Minimal Horizontal Distance Separating a Municipal Water Well from Potential Sources of Contamination:** This table shows minimal offsets from municipal wells to particular sources of contamination, by Nebraska Title 179. Why is this Table presented? There are no municipal wells located in the MEA. Please include a statement to this effect and omit this table.	*Table 4-13 has been removed from the document. The accompanying text of Section 4.7 was also revised for clarification.*	Acknowledged.
88. **Section 4 #34. Figures 4-2, Potentiometric Surface of Brule FM, and 4-3, Potentiometric Surface of Basal Chadron FM:** Structural maps of the tops of the Pierre Shale are given in Figure 3-10, but no other structure contour maps of the tops of the most critical units are given, the most useful of which would have been of the top of the Basal Chadron Sandstone. Spot-checking of elevations against the cross-sections indicates that this map is extremely inaccurate (off by about 200 feet). Please submit accurate structure contour maps of the tops of all of the major stratigraphic units.	*Structural contour maps for the Top of the Pierre Shale, Top of the basal sandstone of the Chadron Formation, Top of the Chadron Formation, and Top of the Brule Formation have been prepared and are presented in the revised Class III and AEP applications. Cross-sections have been corrected for inaccurate elevations. Interpreted picks for geologic units are incorporated into a geodatabase that has removed inconsistencies between cross-sections, isopach maps, and structural maps.*	Acknowledged.
89. **Section 4 #35. Figure 4-3, Potentiometric Surface of Basal Sandstone of the Chadron FM:** CBR depicts an unusual GW flow pattern	*The groundwater flow patterns shown on the February 2011 Potentiometric Surface of the basal sandstone of the Chadron Formation map (Figure 4-3 of the original submittal)*	Acknowledged. Please see NDEQ's response (above) to the comment #69.

NDEQ RAI	*Cameco Response*	NDEQ Response
near Basal Sandstone well Monitor-10 for the February GWM data. August data (see Table 4-3), is not presented in an additional piezometric map. It is also clear from Figure 4-3 that there is inadequate understanding of the flow within the Basal Chadron (see particularly the depicted confused flow within Sections 18 and 19, T29N, R50W). Additional piezometers/wells appear to be needed in Sections 17 and 20, T29N, R50W, and Section 24, T29N, R51W. Please address.	*depict a very flat potentiometric surface. The unusual flow pattern around Monitor-10 indicates an area of relatively low water level (i.e., depressed potentiometric surface) around that well. CBR has identified and examined the following potential causes for this unusual flow: formational variations within the basal sandstone of the Chadron Formation; well screen and well development problems; error in ground level elevation survey; and error in water level measurements taken in February 2011. CBR has reviewed the geologic and well development data and found no reason to explain the anomaly. Likewise, the well has been re-surveyed for elevation and was found to be accurate to within 0.05 feet. Subsequent water level measurements completed during October 2013 and presented in Figure 4-5 did not show the same potentiometric low at Monitor-10. Whether the unusual flow shown near Monitor-10 in February 2011 was authentic or the result of error, the latest water level data collected in October 2013 did not show a similar pattern at Monitor-10. No additional wells have been installed within the basal sandstone of the Chadron Formation at this time as CBR feels that the present monitoring network of wells is sufficient to characterize groundwater flow within the project area.*	-
90. **Section 4 #36. Figure 4-4, MEA Pumping Test Well locations:** The single pumping well from the well	*The location of the MEA Pumping Test pumping well was chosen at the center of the area defined for the first mining well fields.*	Acknowledged.

NDEQ RAI	Cameco Response	NDEQ Response
test (CPW-2010-1A) is closest to Well M-1440 on Cross-Section A-A' (Figure 3-4), which appears to show an anomalously thin Basal Sandstone of the Chadron FM, the pumping target unit. Why was this location chosen?	*All mining wellfields must fall within the confines of the radius of influence of an approved and successful pumping test. As the mining area is expanded, additional pumping tests will be required to demonstrate the confinement for those areas as well. The MEA Pump Test Plan was submitted to NDEQ for review on Sept. 30, 2010 and was approved on October 4, 2010. Modifications to the plan were approved on November 16, 2010 to replace a monitoring well (Monitor 4), and on March 24, 2011 to cover the replacement of the pumping well with CPW-1A. The MEA Pumping Test began on May 16, 2011 and ended successfully on May 20, 2011. As noted in RAI 36, the basal sandstone of the Chadron Formation is thinner at this location than some other parts of the project; however aquifer properties were adequate at this location.*	
Section 7—References		
91. **Section 7 #1. Section 7, References, Page 7-5:** Typing error? 2007-2020-Low Fluid Pressure within the Pierre Shale.	*The citation is correct and has been revised in Section 7 to clarify that 2007-2020 are page numbers.*	Acknowledged.
NDEQ Comments- Other Issues		
92. **Section 3.3.2, Arikaree Group, Paragraph 2, Page 3-7:** This section refers to M-533C, Run 1, Sample 5 as being from the Arikaree Group, yet the depth interval indicated in Appendix B-2 is 1052.5-1053.0 and is composed of mostly clay. Also, Table 3-4, Marsland Expansion Area Coring Summary indicates that Run 5 is from the Pierre Shale. Please clarify. Are there any cores that show intervals of mostly mudstone from the Arikaree Group?		
93. **Section 3.3.3.1, Brule Formation, Pages 3-11—3-13:** Why are the results of the grain size analysis from the Brule cores (Appendix B-2) not discussed in this section?		

NDEQ RAI	*Cameco Response*	NDEQ Response
94. **Section 3.3.3.1, Brule Formation, Pages 3-11—3-13, and Figure 3-7, Marsland Isopach Map, Brule Formation:** There are several boreholes in the NW ¼ of Section 29, T 29N, R 50W that are less than 100 feet thick, yet the text of Section 3.3.3.1 indicates an approximate minimum thickness of 100 feet. Please clarify.		
95. **Section 4.2.1, Groundwater Occurrence and Flow Direction, Paragraph 3, Page 4-2:** In this section, CBR indicates that they calculated the hydraulic conductivity of the Brule and Arikaree using the Kozeny-Carman equation. Please include these calculations in an appropriate section, or appendix, of the application.		
96. **Section 4.2.1.1, Arikaree Group, Page 4-3, and Figure 4-3, Potentiometric Surface, Arikaree Group, 10/17/2013:** AOW-2 is not accounted for. Was this well abandoned or never completed? Where was this well located? Please address.		
97. **Figure 3-4a, Marsland Cross-Section A-A':** The vertical scales on the left and right of Figure 3-4a needs to be printed correctly. It appears that the first two digits of the elevation, and axis label on the left, were cut off in this printing. It also appears that the vertical scale showing feet below ground surface (bgs) on M-1554, on the right, was also cut off.		
98. **Figure 3-4f, Marsland Cross-Section F-F':** Why are the Arikaree Group, Brule Formation, and Basal Sandstone of the Chadron Formation shown as having predominantly sandstone lithology on this cross-section, unlike all the others. Please revise.		
99. **Figure 3-6, Marsland Isopach Map, Arikaree Group:** There is 1 borehole location in the NW ¼ of the NW ¼ of Section 1, Township 29 North, Range 51 West, that indicates a thickness of 201 feet, yet Section 3.3.2, Paragraph 3 indicates that the maximum thickness of the Arikaree Group in the MEA is approximately 160 feet. Please clarify.		
100. **Figure 4-2, Marsland Arikaree and Burle Monitor Wells:** Most of the Brule monitoring wells are labeled in the manner of "BOW-2010-5" except BOW-9 and BOW-10. Please explain this numbering difference. Also, please describe what happened to AOW-2. Was it ever constructed? Has it been abandoned? Where was it located on this map?		
101. **Figure 4-3, MEA Potentiometric Surface, Arikaree Group, 10/17/2013, AOW-7, dry hole:** What is the explanation?		