

**CAMECO RESOURCES  
CROW BUTTE OPERATION**



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April 20, 2016

**CERTIFIED MAIL  
RETURN RECEIPT REQUESTED**

Marty Link, Water Quality Division Administrator  
Nebraska Department of  
Environmental Quality  
P. O. Box 98922  
Lincoln, Nebraska 68509-8922

**Marsland Permitting Revisions**

Dear Ms. Link:

On November 20, 2015, Crow Butte Resources, Inc. (CBR), d/b/a Cameco Resources – Crow Butte Operation submitted a revised Marsland Expansion Area (MEA) Aquifer Exemption Permit (AEP) application for NDEQ approval. Nancy Harris, UIC/ME Program Coordinator, has requested clarification of changes made in that document regarding the Brule and Chadron Formation geology.

The Marsland AEP was revised by CBR after reviewing work completed by Swinehart, Souders, DeGraw and Diffendal of the Nebraska Conservation and Survey Division. Their 1985 report titled, "*Cenozoic Paleogeography of Western Nebraska*", along with others compiled in Special Paper 325 published by The Geological Society of America, entitled "*Depositional Environments, Lithostratigraphy, and Biostratigraphy of the White River and Arikaree Groups*", (1998), uses identification of lithified volcanic ash horizons (tuffs) within Tertiary sediments to assist with correlation of strata, including the Brule Formation. Because these ash zone tuffs were deposited over a wide area during a period of days or weeks, they represent chronostratigraphic markers that are useful for correlation of wide ranging data.

Geophysical logs in Figure 6, of "*Cenozoic Paleogeography of Western Nebraska*", show several ash beds in relation to accepted formational boundaries of the Arikaree, Brule and Chadron Formations. A review of geophysical logs from the MEA show similar log traces for some of these air-fall tuff horizons; in particular, the Nonpareil, upper Whitney, and lower Whitney ash zones. The tuff horizons identified on MEA drill logs



typically show increased resistivity, as well as elevated natural gamma levels, most likely due to the presence of uranium within the volcanic ash. The identified ash beds have been correlated across the MEA and their stratigraphic position in relation to the formational boundaries shown in the above paper indicates that the base of the Brule Formation is approximately 280 feet deeper than initially reported in the original AEP application.

Therefore, in the revised AEP, the base of the Brule Formation has been moved downward, below the lower Whitney Ash. Because the contact between the Brule Formation and the underlying Chadron Formation is intertonguing and difficult to distinguish on geophysical logs, the revised bottom of the Brule Formation is based on lithologic changes observed in drill hole cuttings below the lower Whitney Ash where the brown and tan siltstones of the Brule Formation show a color change towards the brown and green claystones of the Big Cottonwood Creek member of the upper Chadron Formation.

As a result of this revision, several significant changes to the Marsland area permits and supporting documents are needed. In addition, further testing at the site is planned. The revisions and additional site work are detailed below:

As the base of the Brule Formation has been revised downward, a corresponding decrease in the thickness of the upper Chadron Formation is observed. This decreases the thickness of the overlying confining layer above the mining zone to approximately 400 feet. The November 2015 AEP contains cross-sections, isopach and structural figures showing the Brule and upper Chadron Formations that have been revised to reflect the changes in stratigraphy.

As these lower portions of the Brule Formation were not monitored for water quality and water levels, CBR proposes to install additional monitoring wells to assess quarterly water quality and water levels for this portion of the Brule Formation for a period of one year to assess seasonal conditions. These monitor wells will be screened only in the newly recognized portions of the Brule Formation. This water data will be provided to NDEQ when quarterly testing has been completed. The Marsland water user survey did not identify any private wells screened in this deeper portion of the Brule Formation.

The original Marsland pump test did not assess potential impacts to this lower portion of the Brule Aquifer. Therefore, CBR proposes to perform an additional pumping test, once the above monitoring wells are completed, to assess if any hydrologic connections exist between the mining zone and the lower portion of the Brule Formation. This pump test will utilize similar wells as the previous pump test in addition to the newly constructed deep Brule Formation observation wells. The results of this test will be provided to NDEQ and included as an addendum to the AEP.

# CROW BUTTE RESOURCES, INC.



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Revisions to the Class I and Class III permits will also be revised to reflect the new data.

Should you have any questions concerning this information, or require additional data, please do not hesitate to contact me.

Sincerely,

A handwritten signature in cursive script that reads "Wade Beins". The signature is written in black ink and is positioned below the word "Sincerely,".

Wade Beins  
Senior Geologist

cc: CBO File  
Tom Lancaster – USNRC  
Dave Carlson, NDEQ Chadron Field Office  
ec: Cameco Resources – Casper Office  
Nancy Harris, NDEQ UIC/ME Program Coordinator