UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

In the Matter of CROW BUTTE RESOURCES, INC. (Marsland Expansion Area)	Docket No. 40-8943-MLA-2 ASLBP No. 13-926-01-MLA-BD01

Hearing Exhibit

Exhibit Number: OST004-R

Exhibit Title: Mike Wireman August 16, 2018 Opinion

Revised October 3, 2018

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NUCLEAR REGULATORY COMMISSION

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CROW BUTTE RESOURCES, INC. ,	)	Docket No. 40-8943 – MLA - 2
	)	ASLBP No. 13-926-01-MLA-BD01
(Marsland Expansion Area)	)	
	)	August 16, 2018 (Revised 10/3/18)

EXPERT OPINION TESTIMONY OF MICKEL WIREMAN

I, Mickel Wireman, do hereby swear that the following written testimony is true to the best of my knowledge:

I. Basis for Testimony as Expert in Field.

I have been professionally engaged in hydrogeology and ground-water management issues for more than 35 years. I am recently retired from the US EPA where I served as a National Ground-Water Expert for US EPA Region VIII in Denver, CO. In this position I provided scientific and technical support to EPA programs, other Federal agencies, International programs and ground-water protection / management programs in several western states. I have extensive experience in hydrogeology and remediation of hardrock mine sites (fractured rock settings) hydrology of mountain watersheds, DNAPL sites, ground-water monitoring, and ground-water vulnerability assessments. My position involved working closely with policy makers, decision makers and attorneys. I have taught classes for the National Ground -Water Association and Geological Society of America and have developed and taught workshops in Eastern Europe and the Middle East. I serve as a consultant to the World Bank and have significant international experience. I have served as an expert witness in federal court, state court, State Water Quality Control Commission and State Water court. I am currently President of Granite Ridge Groundwater, a small consulting firm. I provide consulting services related to hydrology and geology

II. Expert Opinions and Testimony Concerning OST Contention 2,

Opinion 1:
Characterization of the local / regional hydrogeology and groundwater flow at the Marsland Expansion Area is inadequate for demonstrating the ability to contain unwanted fluid migration from excursions and to adequately conduct groundwater restoration.

Basis:
There is still too much uncertainty regarding groundwater flow in the Basal Chadron aquifer. While hydraulic characteristics have been quantified via an aquifer test to provide data necessary for ISR operation, there are no data and an inadequate discussion regarding:

(1) recharge and discharge to the Basal Chadron – The Technical Report ("TR") contains no information on sources of recharge or the primary pathways which deliver recharge to the deep, confined aquifer. ~~The TR should discuss the relationship between annual recharge to the Basal Chadron aquifer and the annual consumptive used estimated by CBR for MEA operations (maximum of about 500 acre-feet per year).~~ On page 2-88 of the TR [CBR006 at 137] CBR reports that the potentiometric surface fluctuates about 7 ft annually. How does this relate to recharge? The only reference in the TR to discharge from the Basal Chadron aquifer on page 2-86 [CBR006 at 135] is that it occurs at a point east of Crawford where the unit is exposed. CBR should conduct hydrogeologic mapping to locate and characterize the suggested discharge areas.

(2) groundwater flow downgradient of the MEA pumping center – There is significant uncertainty about groundwater flow in the Basal Chadron downgradient of the MEA. The Environmental Assessment ("EA") states in Section 3.3.2.1 [NRC006 at 66] that groundwater flow in the Basal Chadron aquifer is not affected by the Pine Ridge escarpment -even though this escarpment functions as a groundwater divide in the Arikaree and Brule aquifers. There is no discussion to support this statement. ~~The TR indicates that ISR operations at the main CPF mine units resulted in a 60 ft decline in the Basal Chadron aquifer potentiometric surface. The TR further estimates a maximum of about 500 acre-feet per year of consumptive use and a 30 ft decline at the Marsland site. Continuous pumping associated with mining and groundwater restoration will cause some drawdown of the Basal Chadron aquifer miles from the pumping center(s).~~

(3) CBR has not installed any Basal Chadron monitoring wells upgradient or downgradient of the license area. These wells are necessary to provide the data required to fully evaluate downgradient impacts to the Basal Chadron aquifer. These impacts include potential perturbation of the potentiometric surface downgradient of

the mine units and potential contamination of downgradient groundwater that may result from groundwater restoration operations.

(4) No data / information on surface water hydrology at MEA is included in the TR or the EA. Two southward flowing ephemeral streams traverse the MEA. A spring (Dooly spring) is located within the MEA. The baseline sampling conducted by CBR should include sampling the two streams when ephemeral flow is occurring and investigating the spring (is it flowing?; what geologic unit is discharging at the spring?).

(5) ~~CBR has obtained site specific meteorological data for one year: Aug 2010 - Aug 2011. However, 2011 was abnormal year. Ten of the 18 inches of annual precipitation total occurred in May. Another year of meteorological data should be collected.~~

(6) Baseline monitoring – The TR reports that baseline groundwater quality is determined using data from "baseline restoration wells." CBR proposes a minimum of 6 baseline restoration wells per mine unit. Each of these wells will be sampled four times prior to mining. This data will be used to establish baseline. These wells have not been selected and no data is provided regarding background concentrations for applicable constituents.

Opinion 2:

Characterization of the structural geology is insufficient to develop an acceptable conceptual model of site hydrology that is adequately supported by site characterization data.

Basis:

The structural geologic setting in NW Nebraska is more complex than previously reported by CBR. Numerous significant structural features associated with the Black hills and Chadron uplifts occur in northwest Nebraska. The MEA is located between the Pine Ridge escarpment (Cochran arch?) to the north and an east-west trending graben south of Marsland. There is disagreement between CBR and previous researchers (Degraw, 1969, Souders, 1981) as to the existence of two major E-W trending faults - the Pine Ridge fault to the north of the Pine Ridge escarpment and the Niobrara Fault which trends parallel to the Niobrara River. CBR concludes that the faults do not exist and therefore there is no discussion of if / how these structures affect groundwater flow in the Arikaree and White River groups. The Black Hills and Chadron uplifts occurred prior to the deposition of the Chadron Fm. The Pine Ridge Escarpment is thought to be associated with the Black Hills uplift and therefore was uplifted prior to the deposition of the Basal Chadron. As discussed above CBR has concluded that groundwater flow in the Basal Chadron aquifer is not affected by the Pine Ridge escarpment. This cannot be the case if the uplift predates the Basal Chadron sandstone.

Opinion 3:
Aquifer testing conducted at the MEA is inadequate for developing an acceptable site-wide conceptual hydrologic model and does not adequately characterize the subsurface heterogeneity.

Basis:

Only one aquifer test has been conducted at the MEA. The aquifer test was conducted in May 2011. The test was focused primarily on obtaining data to assess the hydraulic properties of the Basal Chadron. These data are necessary to design and operate ISR operations. The test utilized one Basal Chadron pumping well, 8 Basal Chadron monitoring wells and 3 Brule Fm. Monitoring wells. The pumping well was pumped at 27.08 gpm for 103 hours CBR reports that the radius of influence estimated from the aquifer test data was about 8800 ft (1.6 miles). The MEA extends for more than 7.2 miles from the NW corner to the SE corner. Therefore, much of the Basal Chadron has not been tested to determine if there is hydraulic connection between the Basal Chadron aquifer and the overlying Brule aquifer.

The aquifer test data indicate that hydraulic conductivity and transmissivity of the Basal Chadron near the pumping well is an order of magnitude lower than at the outlying monitoring wells. Lithologic and hydraulic data included in the TR for the Arikaree and Brule aquifers indicate significant heterogeneity. Sediment comprising these formations was deposited in a variety of fluvial environments resulting in facies changes within formations and vertical stacking of facies. The heterogeneity is further increased by structural deformation of the sedimentary rocks that comprise the aquifers. Groundwater flow and well yields are affected by these heterogeneities. The CBR TR includes information on an irrigation wells that yields more than 800 gpm form the Arikaree immediately east of the southern part of the MEA. The yield from this well contrasts with the average yield of less than 100 gpm for all Arikaree / Brule wells. Aquifer testing, monitoring and flow modeling of these aquifers must consider the heterogeneity.

Water table elevation data from the CBR Arikaree and Brule monitoring wells indicate that these two aquifers comprise a single aquifer system. Therefore, any contaminated groundwater migrating into the Brule could be pumped from Arikaree water wells.

Opinion 4:
There is too much uncertainty regarding applicable groundwater restoration standards. This uncertainty is problematic given the inadequate site hydrogeologic characterization.

Basis:

Both the CBR 2015 TR and NRC Staff's 2018 EA are confusing regarding applicable restoration monitoring requirements and compliance standards. The EA and the TR state (EA page 2-9 [NRC006 at 37], TR page 6-4 [CBR006 at 297]) that the *"primary goal of the groundwater restoration program is to return groundwater affected by uranium recovery operations to pre-injection baseline values on a mine-unit average, as determined by the baseline water quality sampling program."* Per NRC regs (Criterion 5B (5) of 10CFR Part 40) – at the designated point of compliance concentrations of regulated constituents must not exceed (a) NRC approved background concentrations, (b) the applicable UMTRC value or, (c) an alternative concentration limit set by NRC. However, based on the discussion included in Section 6.1.3 of the TR [CBR006 at 297], it appears that CBR is assuming the restoration efforts will not achieve background concentrations for some constituents -so they are anticipating that restoration values set by NDEQ for Class III UIC permits will apply. In section 6.1.3.1 of the TR [CBR006 at 298] CBR states that they will provide Tables for each of the 11 MEA mine units that include the baseline average and range and the NDEQ restoration standards. There are two issues around this:

1. Will NDEQ standards be considered alternative concentration limits and require NRC approval with a public involvement?
2. In the TR at page 6-4 [CBR006 at 297] it states that if restoration efforts are unable to achieve baseline conditions after *"diligent application of best available technology"* CBR commits to meeting the NDEQ compliance standards. This is consistent with the rational for requesting an ACL. What criteria will be applied to determine if *"diligent application of best available technology"* has occurred?

The NRC and the NDEQ also have different regulations regarding stabilization phase monitoring. The NRC regulations require that regulated constituent concentrations be stable for four consecutive quarters before closure can occur. NDEQ regulations only require sampling for six months. There is no discussion of post closure, long term monitoring.

Opinion 5:
There is inadequate information regarding the proposed wastewater disposal.

Basis:
The TR states on page 7-22 [CBR006 at 347] that CBR plans to use one or two deep disposal wells to dispose of waste fluids comprised primarily of bleed water (up to 120 gpm / 69 million gal/yr) and groundwater restoration waste water. The disposal wells will presumably be permitted as Class I UIC wells. The TR does not include any information on the geologic formations /aquifers into which CBR proposes to inject wastefluids. These include the lower Dakota, Morrison and /or Sundance. Are any of these formations an underground source of drinking water (USDW) as defined in the Federal Safe Drinking Water Act? If so CBR will need to (1) demonstrate that there are no USDWs below the proposed injection zone and / or request an aquifer exemption. Appropriate hydrogeoloic / water quality data will be necessary to address either of these requirements and should be included in the TR and EA.

Pursuant to 10 CFR 2.304(d) and 28 USC 1746, I declare under penalty of perjury, that the foregoing is true and correct to the best of my knowledge and belief.

Signed in Toledo, ohio, on 8/16/2018, 2018.

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MICKEL WIREMAN