



DEPARTMENT OF NATURAL RESOURCES
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June 13, 2011

J. Craig Creel
TC Operating LLC
138 South Park Square, Suite 201
Fruita, CO 81521

RE: TC Operating, LLC
Application for Deer Creek Disposal Facility
Deer Creek SWD #1 Underground Injection Control Well
NE $\frac{1}{4}$ NE $\frac{1}{4}$, Section 2, Township 14 South, Range 98 West, 6th P.M., Mesa County, CO

Dear Mr. Creel:

The Colorado Oil and Gas Conservation Commission (COGCC) has reviewed the above referenced application for an underground injection control (UIC) well submitted pursuant section 34-60-106(9) C.R.S., COGCC Rule 325, and 42 U.S.C. § 300f. *et seq.* (and regulations thereunder).

Application Summary

The proposal consists of an application for a commercial Class II UIC well. The initial application for this well (both the drilling permit application and the UIC application), submitted April 30, 2010, was to inject into the Entrada Formation at 1550 feet depth and the Chinle Formation at 2150 feet depth.

Chronology of Events

A meeting was held with TC Operating, COGCC staff, and Michael Schaub, senior geologist with the Colorado Division of Water Resources (DWR). DWR stated concerns about injection in any formation in hydraulic connection with the Gunnison River or its tributaries. Therefore, permission for injection into the Entrada Formation was denied by COGCC staff because the Entrada outcrops 2.5 miles away in a tributary drainage to the Gunnison River. COGCC staff explained to TC Operating that it would not consider an injection well less than 2000 feet depth due to concerns with protecting underground sources of drinking water (USDWs). TC Operating agreed to amend the application to include only the Chinle Formation.

The permit to drill was issued April 30, 2010. Approved target formations were the Chinle and the Entrada. The well was not drilled before the expiration of the original UIC application, January 30, 2011. The UIC application was resubmitted January 26, 2011. The requested target

formations on the second UIC application were the Chinle Formation at 2100 feet depth and the Granite Wash Formation at 2400 feet depth.

The proposed Deer Creek SWD #1 well was drilled February 21, 2011, to 1955 feet depth. In an email to Mark Weems, COGCC Southwest Area Engineer, TC Operating informed COGCC staff that the top of the Chinle Formation was reached at 1735 feet depth. TC Operating communicated to COGCC staff its intent to inject in the Chinle and any lower formation found in the open hole interval. Mr. Weems informed TC Operating that the burden of proof is on the operator that no useable ground water will be contaminated by injecting E&P waste waters into the Chinle. TC Operating set casing March 9, 2011, with knowledge that COGCC staff had concerns about safety of the USDW.

Well logs were run on March 8, 2011, and submitted to COGCC. In reviewing the application, COGCC staff considered the well logs, a published Department of Energy report called “Remedial Action Plan and Site Design for Stabilization of the Inactive Uranium Mill Tailings Site at Grand Junction, Colorado” (UMTRA report), a report titled “Subsurface Exploration Program – Geotechnical Recommendations – Deer Creek Evaporation Ponds” by Ground Engineering Consultants, Inc., water well records from the State Engineer’s office, and interagency consultations with DWR.

COGCC staff examined the geophysical logs and determined that the perforated zone is actually the unpermitted Wingate Formation, not the Chinle Formation. By geophysical log data, the Wingate is present from 1533 to 1766 feet depth. Water analyses from the perforated zone of the drilled formation reported total dissolved solids concentrations of 63,000 mg/L.

A meeting with TC Operating was held on May 26, 2011, to discuss reservoir modeling done by Stan Kleinsteiber of MHA Petroleum Consultants LLC. The modeling was intended to address COGCC and DWR staff concerns that the Wingate Sandstone may have a hydraulic connection with the Gunnison River. A follow-up email from Mr. Kleinsteiber dated June 2, 2011, also addressed COGCC and DWR staff concerns about protecting the Dakota USDW.

Staff Concerns

COGCC staff has the following concerns with the proposed injection well:

Shallow Depth. The proposed Injection Zone is within the unpermitted Wingate Sandstone at a depth between 1553 and 1766 feet below land surface (fbls). A Wingate injection zone has 691 feet of separation below the base of the Dakota Sandstone, which is used for domestic water supply in the area (see Figure 1). UIC Class II Wells in the State generally have thousands of feet of separation with multiple confining layers between the injection zone and overlying aquifers. In this case, the 691 feet of separation contains 2 other water-bearing sandstones: the Entrada (1426-1520 fbls) and Morrison Salt Wash (1220-1292 fbls) Sandstones. These sandstones present a problem because they provide a potential vertical permeability and fluid migration through the 691 foot “safety zone.”

In the current state of equilibrium, the brine water that occurs in the Wingate at the injection well location is apparently contained; however, there is no guarantee that new injection pressures applied to this zone will not start the brine moving upward through the stratigraphic section. This is further compounded with a concern of known fracturing and faulting in the area. The potential for vertical migration along failure planes is possible (next section).

Fractures. The Deer Creek SWD #1 well is located in an area that has undergone significant tectonic activity in the geologic past. The Uncomprahgre Uplift occurs just to the southwest of the Gunnison River (see Figure 1). It is therefore not surprising that a number of faults and fractures would be present in this area. A detailed geologic report for the UMTRA site in Section 14, Township 3South, Range 2 East indicates that fractures are prevalent in the area, even near the surface in the Mancos Shale (UMTRA report, September 1981). The report also indicates that new seismic activity, in the form of earthquakes, are possible in this area.

On May 31, 2011, COGCC Staff inspected the outcrops along the Gunnison River, near Bridgeport, at a location approximately 4.5 miles southwest of the Deer Creek SWD #1 well. A known fault exists at that location (see Figure 1). Several fractures and joints in the rock were observed in the Wingate and overlying sandstones. Figure 2a shows a large vertical fracture in the Wingate and Figure 2b shows a series of smaller fractures or joints in a sandstone unit that occurs above the Wingate (possibly the Entrada or Salt Wash).

Without any detailed understanding or mapping of subsurface fractures and faults in the immediate vicinity of the Deer Creek SWD #1 well, staff cannot be certain that injected E&P waste will not migrate further vertically or horizontally than predicted by simple homogeneous and isotropic assumptions for the Wingate. Again, referring to the previous section, the subsurface fractures and faults limit the margin of safety provided by the 691 feet of separation between the injection zone and known domestic water supply.

Water Quality and Recharge Areas. The aquifer systems outcrop along the Gunnison River and dip at an angle of about 2-3 degrees toward the northeast. It is likely that the sandstones of concern (Dakota, Salt Wash, Entrada, and Wingate) have been recharged at up-dip locations by fresh water in the vicinity of the outcrops and river. We know the Dakota has fresh water at a distance of at least two miles from the Dakota outcrop as evidenced by the presence of five Dakota water wells (blue dots on Figure 1). The Wingate water quality has been tested at three locations: the Moore Wingate Domestic Well; the MK Ferguson UMTRA Project Temporary Water Well; and the Deer Creek SWD #1 well (see red dots on Figure 1). The water quality in this zone appears to be highly variable as the Moore well is assumed to be fresh, the MK Ferguson UMTRA Well water had a specific conductance of about 9800 micromhos/cm (estimated TDS of 5000 ppm), and the Deer Creek SWD #1 well had a TDS of 63,000 ppm. The reasons for this variability are unknown; perhaps there are permeability barriers or a fresh water/salt water interface within the Wingate. If there are permeability barriers, we do not know where the permeability barriers are and how they might impact injection water flow patterns within the Wingate. If there is a fresh water/salt water interface, we have no idea where the interface is, and whether injection into the Deer Creek SWD #1 well will move the brine into fresh water areas.

Groundwater Model. COGCC staff does not believe these concerns have been adequately addressed by the groundwater model presented by MHA on May 26, 2011 or by the follow-on email from Mr. Kleinsteiber. A groundwater model performs best if it has been calibrated to real observed conditions away from the injection point. In lieu of that, a good understanding of the subsurface conditions (i.e. porosity, hydraulic conductivity, storage, and static water levels) in the model area is critical. Many times, other nearby wells or test holes can provide some of the required data. This model has no other Wingate data to rely on and appears to ignore the only other Wingate well in the area, the MK Ferguson UMTRA temporary well, located approximately 2.5 miles to the northwest.

The MHA model is not calibrated, and it is based on many questionable assumptions. The model assumes that faults and fractures are not present, that there is no communication vertically between the Wingate and overlying formations, and that the horizontal rock and water properties in the Wingate are generally uniform over a 120 square mile area. As discussed in the previous section, there is evidence that the Wingate is not uniform, and may be broken up into compartments by permeability barriers or unmapped faults. The simple MHA model relies heavily on limited data from the injection well itself, and has no way to account for unknowns at any distance away from the well. Without adequate data, predictions from this model are unreliable, and any “injection favorable” inferences are uncertain at best.

Division of Water Resources Concerns

In a memo dated April 7, 2011, DWR stated it also had concerns regarding the proposed injection well with regard to the shallowness of the proposed injection. It has been well documented in the geologic literature that fracture permeability increases with decreasing depth. DWR is concerned that potential presence of unmapped minor fault structures and/or fracture zones will provide conduits for transmitting these brines up to overlying aquifers such as the Dakota aquifer, or to the surface. DWR states they are not in support of the Wingate as a formation for injections.

Conclusion

COGCC staff concludes there is reasonable cause to believe that the proposed disposal well could result in a significant adverse impact on the environment or public health, safety or welfare, and that approval of the disposal well permit should be withheld. COGCC staff does not believe that protection of USDWs in the Dakota formation can be adequately assured. Therefore, COGCC staff cannot support approval of the injection of exploration and production Class II waste into the Wingate Formation at the proposed location.

Pursuant to COGCC Rule 325.b., this matter will be noticed for hearing by the Commission at the next available meeting, unless you decide not to pursue an appeal of this staff decision.

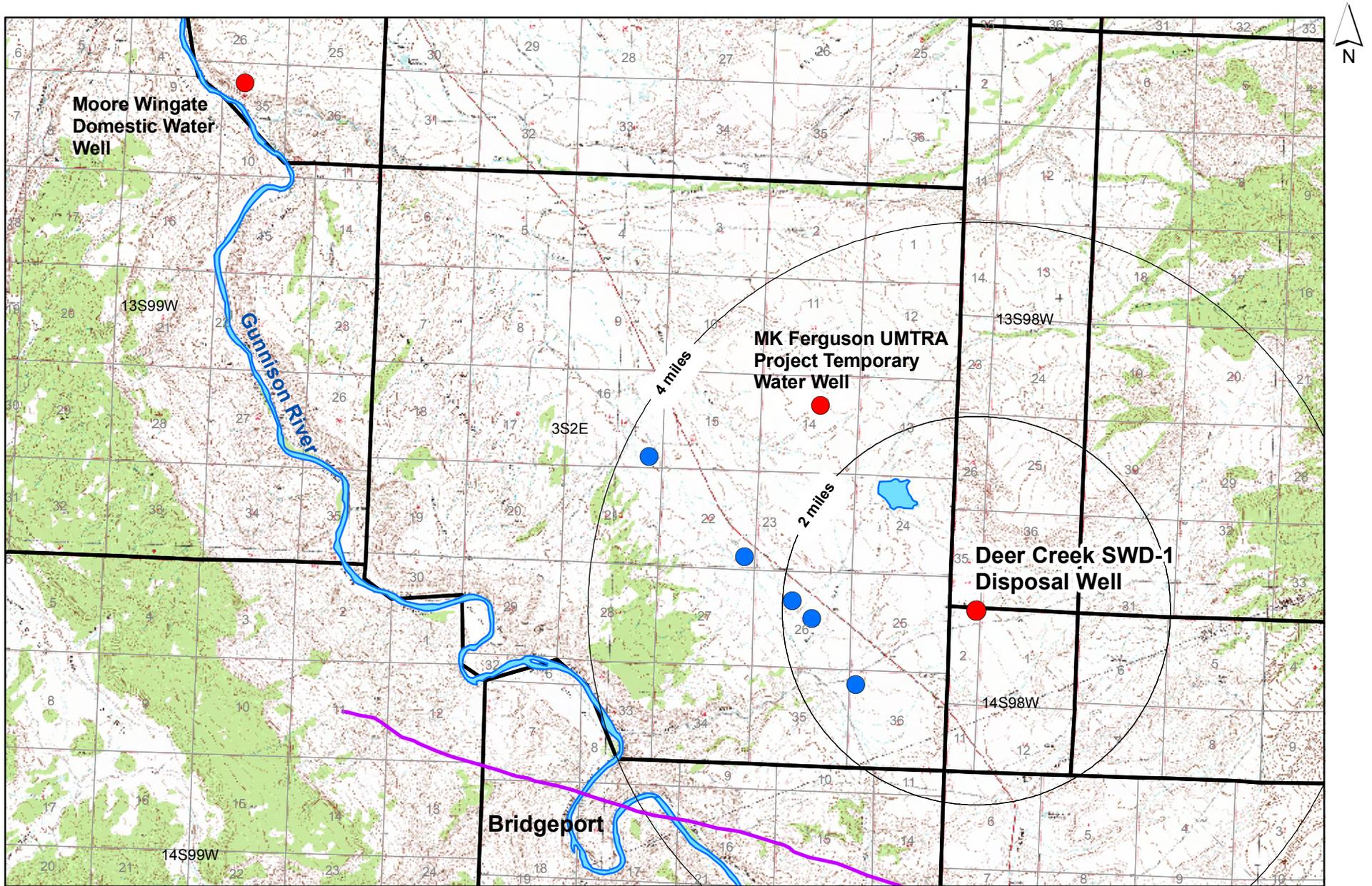
Please feel free to call me at 303-894-2100 ext. 5122, Stuart Ellsworth at ext. 5108, or Denise Onyskiw at ext. 5104.

Deer Creek SWD #1
Mesa County, Colorado

Sincerely,

David Neslin
Director

Cc: Michael Schaubs, Colorado Division of Water Resources
Dan Jackson, Environmental Protection Agency



Legend

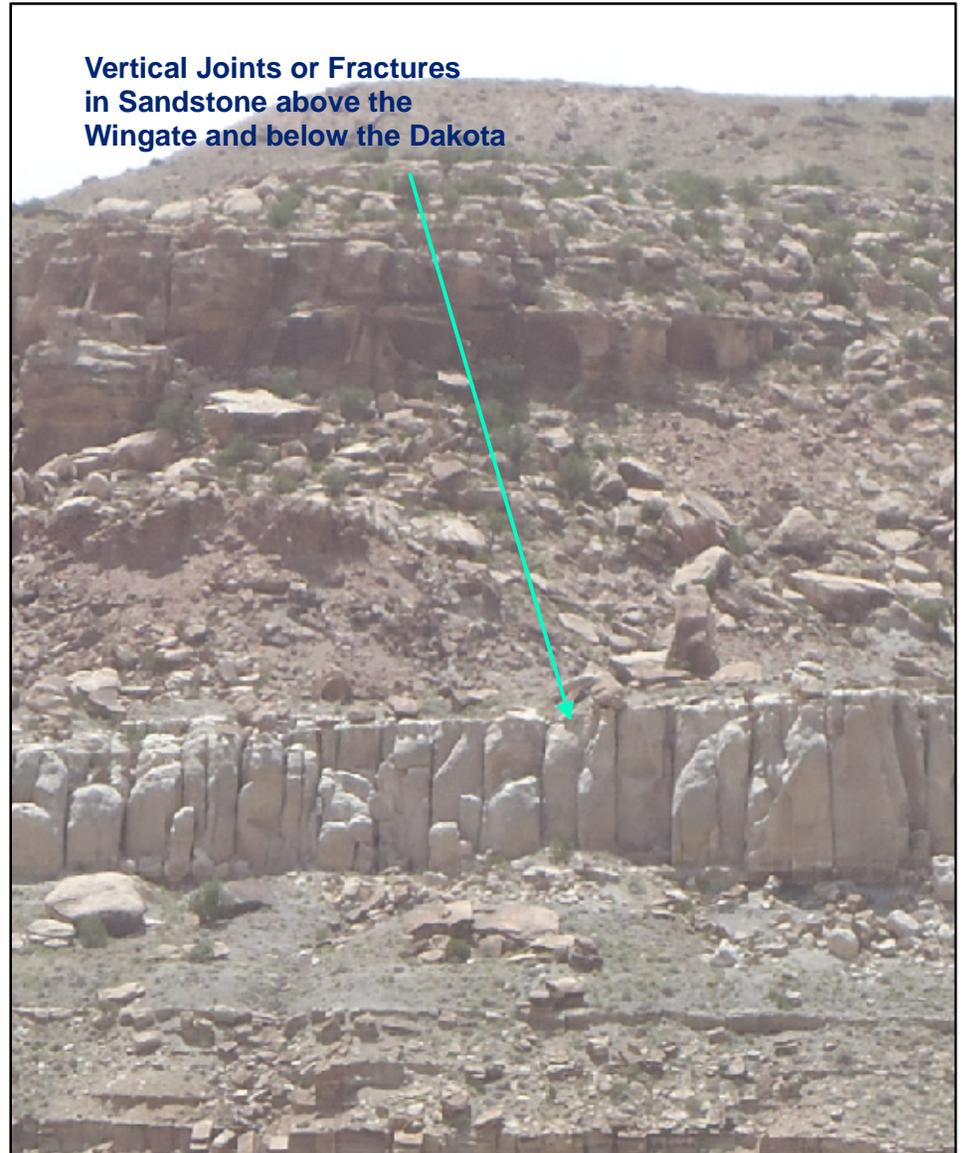
- Dakota Domestic Water Wells
- Wingate Water Wells and Wingate Deer Creek SWD-1 Disposal Well
- Mapped Fault

Figure 1 - Vicinity Map, Deer Creek SWD-1 Disposal Well Project



Vertical Fracture
in the Wingate

Figure 2a. Wingate Sandstone Outcrop Adjacent to the Gunnison River Near Bridgeport



Vertical Joints or Fractures
in Sandstone above the
Wingate and below the Dakota

Figure 2b. Fractured Sandstone Outcrop Near Bridgeport