From: Saxton, John
Sent: Thursday, February 10, 2011 4:55 PM
To: Garrett, Betty
Subject: FW: Ross ISR Correspondence from WDEQ/LQD to USEPA Regarding Class I Disposal Wells (LQD #10-263)
Attachments: wdeqlettertousepa20110209150156.pdf; deqsuppinfoinjectwells20110209150248.pdf

Betty, can you put these attachments into ADAMS
Docket No. 040 09091

Thanks

John

Received: from HQCLSTR02.nrc.gov ([148.184.44.77]) by TWMS01.nrc.gov ([148.184.200.145]) with mapi; Thu, 10 Feb 2011 16:54:38 -0500
Content-Type: application/ms-tnef; name="winmail.dat"
Content-Transfer-Encoding: binary
From: "Saxton, John" <John.Saxton@nrc.gov>
To: "Garrett, Betty" <Betty.Garrett@nrc.gov>
Date: Thu, 10 Feb 2011 16:54:35 -0500
Subject: FW: Ross ISR Correspondence from WDEQ/LQD to USEPA Regarding Class I Disposal Wells (LQD #10-263)
Thread-Topic: Ross ISR Correspondence from WDEQ/LQD to USEPA Regarding Class I Disposal Wells (LQD #10-263)
Thread-Index: AcvJZ8hhjq+tuqgBQrmef/Pdrh/viwABSumA
Message-ID: <36CF286628C20846A68047F24632330937C6084CEE@HQCLSTR02.nrc.gov>
Accept-Language: en-US
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X-MS-Has-Attach: yes
X-MS-Exchange-Organization-SCL: -1
X-MS-TNEF-Correlator: <36CF286628C20846A68047F24632330937C6084CEE@HQCLSTR02.nrc.gov>
MIME-Version: 1.0

CERTIFIED MAIL

February 7, 2011

Wendy Cheung
USEPA, Region VIII
1595 Wynkoop Street
Denver, Colorado 80202-1129

RE: Ross Disposal Wellfield, UIC Class I Application 10-263
Crook County, Wyoming

Dear Ms. Cheung:

In accordance with the Memorandum of Agreement (MoA) between the Wyoming Department of Environmental Quality (WDEQ) and the United States Environmental Protection Agency (USEPA), please be informed that WDEQ has determined that application 10-263 from Strata Energy, Inc., for an Underground Injection Control (UIC) Class I area permit is complete and technically adequate. Draft permit 10-263 is for five proposed wells: Ross DW No. 1, Ross DW No. 2, Ross DW No. 3, Ross DW No. 4, and Ross DW No. 5.

WDEQ is classifying waters in the Deadwood and Flathead aquifers within the areas of review for each disposal well as Class VI because the wells are "located in such a way, including depth below the surface, so as to make use economically and technologically impractical" [Water Quality Rules and Regulations, Chapter 8, Section 4(d)(ix)(C), 40 CFR 147.2550(a)(3)]. There are no aquifers below the proposed discharge zones.

WDEQ has determined that its groundwater classifications in this case conform to USEPA exemption of said portions of these aquifers under 40 CFR 146.4(a) and 146.4(b)(2). The designated Class VI waters also meet exemption criterion 146.4(c). The basis for WDEQ's groundwater classifications is described under the heading "Basis for Class VI Classification" in the attached 'Supplemental Information.' In accordance with the MoA and Wyoming's UIC program description as accepted for delegation by USEPA, please review these materials for consistency with Wyoming's groundwater classification criteria and USEPA's aquifer exemption criteria at 40 CFR 146.4 and respond to WDEQ in writing.

The application material and draft permit are available for USEPA review on the GEM web site (https://gem.trihydro.com). The draft permit, public notice, and 'Supplemental Information' attachment will be released for public comment approximately 20 days after your receipt of this letter and will be available on the WDEQ web site (http://deq.state.wy.us/wqd/events/index.asp).

Herschler Building · 122 West 25th Street · Cheyenne, WY 82002 · http://deq.state.wy.us

ADMIN/OUTREACH (307) 777-7758 | ABANDONED MINES (307) 777-6145 | AIR QUALITY (307) 777-7391 | INDUSTRIAL SITING (307) 777-7369 | LAND QUALITY (307) 777-7756 | SOLID & HAZ. WASTE (307) 777-7752 | WATER QUALITY (307) 777-7781

The public comment period is 30 days and comments will be forwarded to USEPA as they become available. Please send your interim response within 45 days to John Passehl at the return address above.

Thank you.

Sincerely,

Jane Francis
for

George D. Langstaff
UIC Program, Water Quality Division

GDL/bb/11-0139

Attachment: Supplemental Information

cc: Tony Simpson, 406 W. 4th Street, Gillette, WY 82716
Hal Demuth, Petrotek, 10288 W. Chatfield Ave., Suite. 201, Littleton, CO 80127
John Wagner, Administrator, Water Quality Division
Kevin Frederick, Manager, WQD Groundwater Section
John Passehl, UIC Program Geological Supervisor, WQD Groundwater Section

SUPPLEMENTAL INFORMATION
CLASS I INJECTION WELL, NON-HAZARDOUS

GROUNDWATER CLASSIFICATION
Ross Disposal Well Field, Permit 10-263

General Information

Description of the Discharge Zone: The discharge zone comprises the Deadwood and Flathead formations. Perforations for the proposed wells will be allowed in the depth range of 8,163-8,755 feet.

The area of review for each well is based on the minimum radius for the area of review as this is larger than the radius of the cone of influence and the radius of emplaced waste (Water Quality Rules and Regulations-WQRR, Chapter 13, Section 5(b)(iv)(C)) (Table 1).

Table 1. Areas of Review for the Disposal Wells

	Minimum Radius	Radius of Emplaced Waste	Radius of Influence
Ross DW No. 1	1,320 ft	1,037	4
Ross DW No. 2	1,320 ft	1,037	4
Ross DW No. 3	1,320 ft	1,037	4
Ross DW No. 4	1,320 ft	1,037	4
Ross DW No. 5	1,320 ft	1,037	4

Water Quality of the Discharge Zone: No water samples have been collected from the discharge zone near the Ross Disposal Wellfield. Log analysis indicates NaCl salinity of 1,450-21,000 ppm at depths of 3,760-4,280 feet in a well about 29 miles northeast of the Ross project, 85,000 ppm at depths of 4,053-4,082 feet about 14 miles to the north, and 8,500-37,000 ppm at depths of 10,480-11,000 feet about 22 miles to the west (Petrotek, 2010, Table 5). The U.S. Geological Survey's produced waters database has no analyses of Deadwood or Flathead water in the Powder River Basin.

Confining Zone: The discharge zone is confined above by marine shale of the Icebox Member of the Winnipeg Formation and by marine dolostone of the Red River Formation (Petrotek, 2010, p. 15-16). Published isopach maps indicate thicknesses of 30-40 feet for the Icebox Member and 280-320 feet for the Red River Formation at the Ross project but log correlations by Petrotek (2010) suggest thicknesses of about 50 feet and 360 feet, respectively.

Underlying Aquifers: There are no underlying aquifers as the Flathead Formation rests directly on crystalline Precambrian rocks.

Current Use of the Affected Aquifer as a Drinking Water Source

Drinking Water Use: In the four townships (approximately 12 miles x 12 miles or an area of 144 square miles) nearest the Ross disposal wells, the State Engineer's Office (SEO) water rights database (current through 2009) lists 40 wells for domestic or domestic and other (e.g., stock watering) purposes (Table 2). Of the 38 with well depths, the deepest is 750 feet, or

approximately 7,400 feet shallower than the top of the discharge zone. The SEO database does not list any municipal wells in this area.

Table 2. Water Use in the Ross Project Area Based on the State Engineer's Office Water Rights Database

Uses	Number of Permits	Number of Permits with Depths	Maximum Depth
Domestic and other	41	38	750
Stock and other, except domestic	93	85	1,575
Miscellaneous, industrial, and other, except domestic or stock	51	28	7,310
Monitor	37	0	unknown

Because the Madison aquifer is shallower than the aquifers in the proposed discharge zone and can produce higher yields, few water wells are drilled to the Deadwood or Flathead. Areas where the Deadwood or Flathead are present but not the Madison are limited to a relatively narrow ring in South Dakota around the core of the Black Hills Uplift and around small intrusion-caused domes near Sundance and south of Beulah (Hodson and others, 1973). The Reuter Canyon No. 2 test well for the Vista West subdivision outside of Sundance penetrated about 400 feet of steeply dipping Deadwood Formation but yielded only about 10 gal/min by air-lifting (Weston Engineering, 1994). One of the water quality samples on the map by Hodson and others (1973) was from a 6,227 feet deep well in the Deadwood Formation near Newcastle, about 60 miles southeast of the mine site.

Other Uses: The SEO water rights database lists 51 wells with industrial, miscellaneous, or miscellaneous and some other use (except stock or domestic) in the four townships nearest the disposal wells. 27 of the permits have been cancelled. Although use of these wells might include drinking water, most are owned by mining or petroleum companies. For the 28 wells with reported depths, five have depths of 6,900-7,300 feet (probably the Madison aquifer; all but one of these permits have been cancelled), one has a depth of 3,708 feet, twelve have depths of 1,000-1,730 feet, and 10 have depths of 750 feet or less.

The four township area includes 93 permits for stock watering use with or without irrigation use. The maximum depth of the 85 wells with known depths is 1,575 feet.

Criteria for the Proposed Class VI Classification

Groundwater Classification of the Discharge Zone: WDEQ is classifying waters in the Deadwood and Flathead aquifers within the areas of review for each disposal well as Class VI because the wells are "located in such a way, including depth below the surface, so as to make use economically and technologically impractical" (WQRR, Chapter 8, Section 4(d)(ix)(C)). The basis for WDEQ's classification and justification for aquifer exemption under 146.4(b)(2) are described in "Basis for Class VI Classification" below.

Basis for the Class VI Classification

Distance from Population Centers: The Ross Disposal Wellfield is located in a sparsely populated, rural part of the Powder River Basin where the major land use activities are ranching and petroleum production. The nearest population centers are listed in Table 3. Because of the distances in Table 3, it would be uneconomic to develop water supplies in the Moore Ranch area for off-site communities unless the water supply potential were outstanding. It is not (see below).

Table 3. Population Centers Nearest Disposal Wells

Community	2009 Population	Distance from Ross	Direction from Ross
Oshoto	not in census	1 miles	northeast
Pine Haven	398	16 miles	southeast
Weston	not in census	18 miles	west
Hulett	518	18.5 miles	northeast
Moorcroft	926	21 miles	south
Sundance	1,339	30 miles	southeast
Gillette	28,728	32 miles	southwest

2009 population is an estimate by the Wyoming Economic Analysis Division (http://eadiv.state.wy.us/pop/SUB-09EST.htm).

Water Supply Potential: Based on recharge/sustainability, water quality, and yield, aquifers in the discharge zone have minimal water supply potential. Average annual precipitation over the South Dakota portion of the Black Hills is 18.6 inch/yr and is locally up to 28 inch/yr (Driscoll and Carter, 2001). However, only a small portion of this is captured by the Deadwood and Flathead aquifers. Except for limited outcrop around Tertiary intrusions near Sundance and Deadwood, recharge to the Deadwood and Flathead aquifers occurs primarily in South Dakota more than 50 miles southeast of the Ross Project. Driscoll and Carter (2001, Figure 35) calculated that net groundwater outflow from the Deadwood aquifer (they did not differentiate the Flathead Formation) in South Dakota is 6 ft^3/s, or 2,693 gal/min. A small fraction of this outflow could flow northwestward toward the Ross Project (Driscoll and others, 2002, Figure 84). At a distance of 60 miles, an arc of 1° would be about 1 mile across. Assuming homogeneous radial flow away from the Black Hills, the recharge flowing through a 1 mile width of the Deadwood-Flathead aquifers would be about 7.5 gal/min. Downward leakage from the Madison aquifer into the Deadwood is unlikely because the high elevations of the recharge areas in the Black Hills results in upward hydraulic gradients in the adjacent basin. Consequently, the sustainability of the Deadwood and Flathead aquifers at the Ross Project is poor.

Total dissolved solids (TDS) concentrations in the Deadwood and Flathead aquifers at the Ross site are almost certainly greater than 5,000 mg/L and could be well above 10,000 mg/L. Use of these aquifers as drinking water supplies is not plausible. The sensitivity of drinking water supplies to water quality is illustrated by the development of Gillette's water supply. Rather than drill Madison wells near the city, Gillette chose to drill the wells far to the northeast and install a 42 mile pipeline to convey the water to the users. The expectation of "highly mineralized" water in the Madison below Gillette, in addition to the high cost of a deep well, played a major role in the decision to locate the wells far from town (State Engineer's Office, 1977, p. 37). Considering water quality alone, future water demand at the Ross site would be met by shallower aquifers or by Deadwood - Flathead wells closer to the recharge areas.

The Ross uranium mine is located on the eastern margin of the Powder River Basin. It is west, and down dip of, the Black Hills monocline (Petrotek, 2010, Figures 11 and 12). Although fracturing at Ross could be enhanced due to proximity to the monocline, the crest of the monocline would be a more favorable location for secondary permeability. There are no existing high-yield water wells in the Deadwood and Flathead anywhere near the Ross Project to demonstrate the possibility of high yields. It would be very risky to target the Deadwood and Flathead aquifers at the Ross site as a source of water.

Gillette's decision (State Engineer's Office, 1977) to locate a new water supply illustrates the trade offs in well siting. Gillette, like the Ross project, is located west of the Black Hills monocline. The new well field was sited east of Gillette on the Black Hills monocline to take advantage of fracturing and karst development in the Madison aquifer. The location is also closer to the Madison recharge area so the aquifer is at a shallower depth and has better water quality than under Gillette. However, the location required a 42-mile pipeline to deliver the water to Gillette. The ten current wells have depths of 3,010 feet or less and pumping rates of 500-1,500 gal/min (HDR, 2009). 200-250 horsepower pumps are set at depths of 500-1,100 feet. Total dissolved solids concentrations of the Madison water are 580-730 mg/L (HDR, 2009, Table 7.3). From 1978 through 2007, the Madison well field has supplied 65% of Gillette's water needs (HDR, 2009, Table 7.2). This success has convinced Gillette to drill eleven more Madison wells near the first ten and to build a second parallel pipeline (HDR, 2009). Future water demands in the region which cannot be met by shallow, low-yield wells on site could be met by Madison wells on, or east of, the Black Hills monocline. The Deadwood and Flathead aquifers west of the Black Hills monocline are not prospective water supply targets. Significantly, the 2002 Northeast Wyoming River Basin Plan does not even mention the Deadwood and Flathead aquifers for development potential (HKM Engineering, 2002, Table 4.0).

Aquifers in the discharge zone at the Ross site are unfavorable for sustainability, unfavorable for water quality, and unfavorable for high yield. Developing unsustainable, poor quality water with low yield wells is not economical.

Remoteness: Access to the Ross Project area is adequate. County roads provide access from US Highway 14, about 12 miles to the southeast, and from I-90/US 16, about 21 miles to the south. However, the area is relatively distant from population centers. Suburban sprawl peripheral to Gillette has been primarily along I-90 and along highways US 50 and US 59 south of Gillette. This development pattern is expected to continue in the near future (HDR, 2009).

Land Ownership: Surface ownership at the Ross site is almost entirely private. The State has approximately two sections per township and there is less than a section of federal land within a three mile radius of the mine permit boundary. Federal and state ownership are not obstacles to settlement or development at Ross. The possibility for rural development would consequently depend on the needs and desires of current and future owners.

Well Costs: A regression of Wyoming Water Development Commission (WWDC) cost data for public water supply wells with depths of 200-4,250 feet indicates that it would cost approximately $442,000 (in 2009 dollars) to drill and complete a 700 feet deep well in the Lance

- Fox Hills aquifer system and $3,461,000 (in 2009 dollars) to drill and complete a 8,800 feet deep well to the bottom of the Flathead aquifer. The Newcastle (Muddy) Sandstone is too thin to be a viable water supply target but a well to the Fall River - Lakota (Dakota) aquifer system at 5,100 feet would cost about $1,352,000. A Madison well to 8,000 feet would cost $2,825,000. Per gallon operating costs are likely to increase with depth as yields are probably lower in deeper aquifers. The Deadwood and Flathead aquifers are consequently not economically viable sources of water.

Treatment Costs: Water in the Deadwood and Flathead aquifers almost certainly has TDS greater than 5,000 mg/L and may have other constituents which would need to be treated. Depths and lack of water supply potential are the primary factors in the economic impracticality of water wells to the Deadwood or Flathead aquifers, but treatment would substantially increase capital and operating costs. HDR (2000) estimated capital costs of $1.52 million and annual operating costs of $112,000 for reverse osmosis treatment of brackish water (1,000-3,000 mg/L) needing minimal pre-treatment to produce a 347 gal/min water supply. Decreases in treatment costs since 2000 due to improved technology may be more than compensated by the higher TDS of the Deadwood - Flathead water. Compared to a $442,000 well and no treatment, such costs are prohibitive.

Alternate Sources of Water Supply: The Lance - Fox Hills aquifer system is exposed at the surface near the Ross project. It provides an economic source of good to fair quality water for current and future residents in the Ross area. Reported yields for shallow wells on the Lance - Fox Hills outcrop in the eastern Powder River Basin range up to 65 gal/min but a dozen deep wells (2,900-4,400 feet) near Gillette have reported yields of 100-625 gal/min (State Engineer's Office, 2005). Some of these reported yields may not be factual but an 8-day pumping test of Fox Hills #1 at the Dry Fork Mine demonstrated that a yield of 370 gal/min can be maintained in at least one well designed well (State Engineer's Office, 2005).

In addition, there are significant aquifers at shallower depths than the Deadwood and Flathead aquifers at the Ross mine site. Several water wells on sheet 2 of Hodson and others (1973) produce from the Fall River and/or Lakota formations of the Inyan Kara Group (part of the Dakota aquifer system of the northern Great Plains). Two southwest of Newcastle and one south of Upton have TDS less than 2,000 mg/L in spite of depths of 3,850-5,330 feet. Hodson and others (1973) reported yields up to 150 gal/min but the highest was for a well only 800 feet deep.

The induction logs (API Nos. 49-011-20844 and -20332) through the Morrison Formation, below the Dakota aquifer system at 5,100-5,250 feet at the Ross site, indicate the presence of some sandstone, which is probably fine grained. However, Hodson and others (1973) noted yields up to 10 gal/min in the Morrison near outcrop and that "most of the formation does not yield water".

The Hulett Sandstone Member of the Sundance Formation is about 200 feet thick under the disposal well field at depths of 5,390-5,590 feet (API Nos. 49-011-20844 and -20332). Hodson and others (1973) indicated yields of up to 50 gal/min are possible at shallow depths.

The upper Minnelusa Formation is hydraulically isolated from the underlying Madison in parts of the Black Hills and eastern Powder River Basin (Feathers and others, 1981) and can yield up

to 480 gal/min (Hodson and others, 1973). It is at a depth of approximately 6,265-7,000 feet at the Ross site. TDS concentrations are highly variable but generally greater than 3,000 mg/L away from outcrop and east of the Black Hills monocline (Feathers and others, 1981). Figures 31-32 of Petrotek (2010) show several oil wells south of the disposal well field have water with TDS of 3,000-10,000 mg/L and others to the west and southwest have water with TDS greater than 10,000 mg/L.

The Madison is the most prolific aquifer in northeastern Wyoming. Water quality is unlikely to be much worse than that of the Deadwood. It is not likely to be exploited near the Ross project because of its great depth, probably poor water quality, and possible absence of karst. Nonetheless, it is a more favorable water supply prospect than the Deadwood or Flathead.

Surface water sources may be available to future residents near the Ross project. The project is located in the Belle Fourche River basin but the Cheyenne River basin is nearby. The Belle Fourche River Compact of 1943 severely limits the construction of new reservoirs but available annual flow "in excess of current Wyoming water demands" is 1,100-15,600 acre-feet, depending on whether the weather is dry or wet. The annual flow "in excess of current Wyoming water demands" in the Cheyenne River basin has been estimated as 5,000-103,000 acre-feet, depending on weather, but it is not known how much of this would be available to Wyoming until a compact with South Dakota is finalized (HKM Engineering and others, 2002).

Surface water sources are not currently used for drinking water due to poor water quality. Winter flows in the Belle Fourche River near Devil's Tower, east of Ross, have TDS concentrations of 1,000-2,000 mg/L. Winter flows in Beaver Creek and the Cheyenne River near the South Dakota border have TDS concentrations greater than 2,000 mg/L (Hodson and others, 1973). These sources have better water quality than the Deadwood and Flathead aquifers.

Rural residents have another economical alternative to a deep well water supply. Several water systems around the state sell bulk water, including those for Laramie, Lander, Douglas, and Gillette. Gillette's July 2009 bulk rates were $6.00 for the first 2,000 gallons and $5.00 for each additional 1,000 gallons. If a family of three used a below-average 100 gallons per day per person, as several Wyoming communities do, their monthly water demand would be 9,132 gallons per month and it would cost them about $42.00 per month if they filled up a tank once per month. That is well within the range of monthly water costs for urban Wyoming residents although a tank, trailer, and fuel for hauling would be additional costs. In comparison, the annualized capital cost of a typical $33,000, 800 feet deep domestic well that lasts 30 years would be $1,100, or $91.67 per month. Debt service (if any), well operation, and maintenance costs would be additional.

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