U.S. EPA Region 8

Underground Injection Control Program

DRAFT AQUIFER EXEMPTION RECORD OF DECISION

This Draft Record of Decision provides EPA's aquifer exemption (AE) decision, background information concerning the AE request, and the basis for the AE decision.

Regulatory Agency: U.S. EPA Region 8

Date of Aquifer Exemption Application Request: August 26, 2019

Operator: Slawson Exploration Company, Inc.

Well Class/Type: Class II Salt Water Disposal (SWD)

Well/Project Name: Howie 1 SWD

Well/Project Permit/Docket Number: ND22386-11597

Well API number: 3306190449

Field: Big Bend Field

Tribal Reservation: Ft. Berthold Reservation

Well/Project Surface Location: Qtr: NWNW Section: 21 Township: 151 N Range: 92 W

Footage Calls: 2,465 feet from S line; 650 feet from W line

County: Mountrail **State**: North Dakota

Latitude: 47.883329º **Longitude:** -102.469074º

Substantial or Non-Substantial Exemption:

The action before the EPA is not a state program revision, but rather an approval of an AE in a federally-administered program. The process is treated similarly and requires the EPA to determine whether the proposed AE is a major or minor (i.e., substantial or non-substantial) exemption. The process is discussed in a Federal Register Notice Preamble at 48 Fed. Reg. 40098, 40108 (September 2, 1983); see also 49 Fed. Reg. 20138, 20143 (May 11, 1984). The EPA has determined this proposed AE is a minor exemption because it is associated with the issuance of a site-specific UIC Class II permit action, not a state-wide programmatic change or a revision with implications for the state-wide or

national UIC program. The decision to treat this AE as a minor exemption is also consistent with the corresponding state program revision process detailed in EPA Guidance 34: Guidance for Review and Approval of State Underground Injection Control (UIC) Programs and Revisions to Approved State Programs. Guidance 34 explains that the determination as to whether an exemption is substantial or non-substantial is made on a case-by-case basis, and with the exception of AEs associated with certain Class I wells or exemptions not related to action on a permit, AE requests are typically treated as minor actions/non-substantial decisions.

PROJECT BACKGROUND INFORMATION

The Howie 1 SWD well will dispose of produced Bakken and Three Forks Formation waters from the New Town peninsula area which is located south of New Town, North Dakota. Most of the water will be pipelined to the well, with the remaining water trucked in. Slawson stated on the application that the Howie 1 SWD well will reduce truck traffic on the roads to prevent air pollution and simultaneously increase road safety. Slawson's goal is to pipe as much water as possible to the Howie 1 SWD well, minimizing water truck and hauling traffic. This well construction has a deviated wellbore between 75 and 85 degrees from vertical. Slawson submitted the total dissolved solids (TDS) analyses for EPA review on August 26, 2019.

DESCRIPTION OF PROPOSED AQUIFER EXEMPTION

(depths are approximate values at the well bore):

The requested aquifer exemption is for the Inyan Kara Formation (also referred to as the Dakota or Dakota Sandstone). The lnyan Kara is commonly utilized in North Dakota as an injection interval for Class II fluids.

Aquifer(s) to be Exempted

Formation: Inyan Kara Formation (Dakota Group) *Top:* 4,931 feet true vertical depth (TVD) *Bottom:* 5,306 feet TVD

Lithology: Sandstone

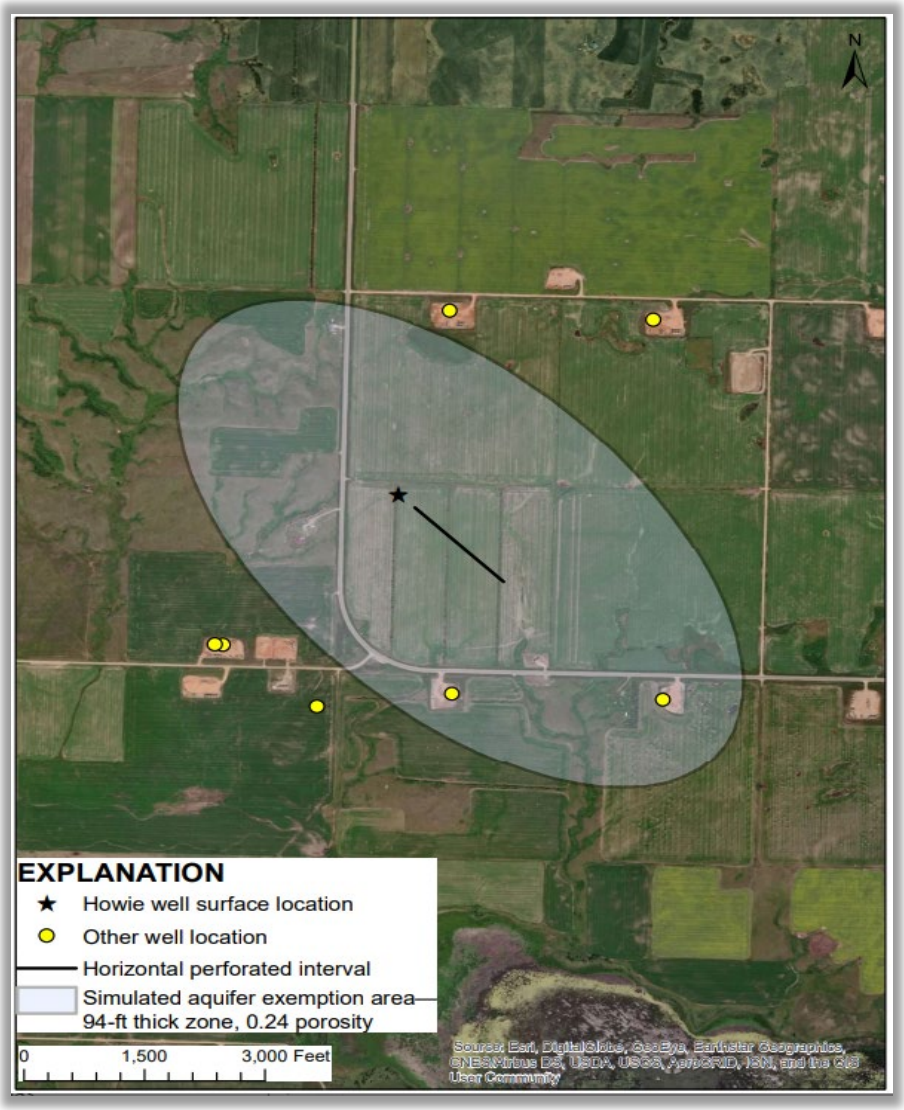

Figure 1 – Areal Extent of Aquifer Proposed for Exemption

Total Surface Area of Aquifer to be Exempted: about 710 acres (ac) (1.11 Square Miles)

The areal extent of injectate fluids was determined through numerical groundwater-flow modeling and particle tracking. Figure 1 represents the simulated extent of fluids for the aquifer exemption based on the length of the well's horizontal perforated interval, an injection volume of 696,770,000 cubic feet (proposed life-span injection volume of 20 years), net injection-zone thickness of 94 feet, and porosity of 0.24.

DEMONSTRATION THAT THE INJECTATE WILL REMAIN IN THE EXEMPTED PORTION OF THE AQUIFER

The net sand thickness was estimated as 94 feet of clean sands within the Inyan Kara at this location. Because the wellbore is highly deviated, geophysical logging could not be performed through the injection zone at the well. The average porosity value for the clean sands in the injection zone was estimated by the operator as 24 % on the basis of nearby wells neutron- and density-porosity logs, which indicate the Inyan Kara in the vicinity of the subject well generally has a porosity value between 20% and 25%.

Based on the estimates above, the Howie 1 SWD can inject no more than 124,100,000 bbls of produced water (to fill the pore space) into the Inyan Kara Formation to ensure that fluids remain within the area proposed for exemption. Additionally, upper and lower confining zones have been identified and verified by analyzing the gamma-ray logs associated with the cement bond logs to confine the fluids within the injection zone. Should this aquifer exemption be approved, the permit will be modified to enforce a limit on the volume of injected fluids noted above.

WATER QUALITY DATA OF THE AQUIFER PROPOSED FOR EXEMPTION

Aquifer Water Quality – TDS (mg/L): 26,113, 3,977 and 4,137

Source of WQ Data: On August 15, 2019, Slawson collected water samples from the Inyan Kara Formation (Dakota Group) perforations between 4,996 feet - 5,355 feet in the Howie 1 SWD well. The samples were analyzed by Astro-Chem Lab, Inc. The results of those analyses are summarized in Figure 2.

Sample Source	Total Dissolved Solids (mg/l)	Analyst	Detection Limit	Method Reference
Formation Water 100 BBLS	26,113	C. Jungels	2 mg/l	SM 2540 C
Formation Water 200 BBLS	3,977	C. Jungels	2 mg/l	SM 2540 C
Formation Water 300 BBLS	4,137	C. Jungels	2 mg/l	SM 2540 C

Figure 2– Astro-Chem Lab, Inc. Water Samples

Confining Zones

Upper: Skull Creek, Mowry, Belle Fourche, Greenhorn, Carlile, Niobrara, and Pierre Shales

Lithology: Shale

Top: 1,754 feet TVD *Bottom:* 4,931 feet TVD *Thickness:* 3,177 feet

Lower: Jurassic Swift *Lithology:* Shale

Top: 5,306 feet TVD *Bottom:* 5,736 feet TVD *Thickness:* 430 feet

Immediately above the injection zone and within the Dakota Group are the Skull Creek Shale (248 feet) and Mowry Shale (97 feet) for a total thickness of 345 feet. Above the Dakota Group is the Colorado Group which is 2,832 feet thick, consisting of the Belle Fourche Shale (242 feet), Greenhorn Shale (163 feet), Carlile Shale (245feet) and Niobrara Shale (265 feet). Also, above the Colorado Group is the Montana Group consisting of the Pierre Shale, which is 1,917 feet thick at the Howie 1 SWD well. Any USDW intersecting the Howie 1 SWD wellbore above the injection zone is protected by approximately 3,177 feet of predominantly impermeable shale as listed above.

Below the injection zone, the lower confining zone consists of the Jurassic Swift Formation, which is approximately 430 feet thick at the Howie 1 SWD well. This lower confining unit consists primarily of impermeable shales.

IDENTIFICATION OF OTHER USDWS IN THE AREA

The principal sources of drinking water in the area of the proposed aquifer exemption are the New Town aquifer and the Sanish/White Shield aquifer which are USDWs that are between 0 and 237 feet below the ground surface. Additionally, other USDWs within the region include the Fort Union Group (which is also used to supply domestic water wells), the Sentinel Butte, Hell Creek and Fox Hill aquifers. These units are found between 237 feet and 1,688 feet below the ground surface.

Water resources of the New Town peninsula and Fort Berthold Indian Reservation occur as readily-available ground water in bedrock and buried-valley aquifers and as surface water in Lake Sakakawea. Figure 3 shows the water resources for the peninsula.

Resource	Mean TDS (mg/L)	Approximate peninsula (Volume Ac-Ft)
Sentinel Butte Formation	1,300	1,250,500
Tongue River Formation	2,110	1,925,500
Fox Hills/Hell Creek Formation	1,530	4,091,600
New Town Aquifer	1,390	127,500
Sanish Aquifer	1,350	240,000
Total New Town peninsula water available (Ac-Ft) 7,635,100 (Reference USGS Report 98-4098 pgs. 1, 10, 18, 23, 37, 39).		

Figure 3 – Total New Town Peninsula Water Available

DISTANCE FROM THE PROPOSED EXEMPTED AQUIFER TO PUBLIC WATER SUPPLIES

A survey was conducted using a one-fourth (¼) mile buffer zone outside the exempted area, and no water wells that tap the aquifer to be exempted are within the area. The proposed aquifer exemption is approximately 3.5 miles south of the nearest public water supply for the city of New Town, ND and approximately two (2) miles from Lake Sakakawea's closest shore, a source for the Fort Berthold Indian Reservation farther downstream. The New Town city water supply consists of three (3) groundwater wells penetrating the New Town Aquifer. Figure 4 provides additional information about New Town's groundwater sources:

Well ID	Aquifer	Depth
152-092-19AA	New Town	175'
152-092-19AAA	New Town	173'
152-092-20BBb	New Town	184'

Figure 4 – New Town City Groundwater Supply Wells

INJECTATE INFORMATION

The injectate is water produced from oil-gas wells proximate to the Howie 1 SWD injection well. Both the Bakken and Three Forks Formation waters contain high concentrations of chlorides, sodium and some calcium, making the physical characteristics of the two waters very similar with total dissolved solids (TDS) up to 344,000 PPM as published in the Catalog of North Dakota Water Chemistries. Figure

6 shows grab sample analyses of each formation, and the results are well within the range of the Catalog. These waters have no secondary use and therefore are disposed of in Class II SWD wells.

Source	Location	Formation	Sample Date	TDS (mg/L)
Diamondback 3-21H	S16-151-92	Bakken	10/25/17	181,000
Water Moccasin 4-34TFH	S27-151-92	Three Forks	10/25/17	198,000

Figure 6 - Water Quality Analysis from The Proposed Injection Water

ESTIMATED COSTS TO DEVELOP THE PROPOSED EXEMPTED AQUIFER AS A WATER SUPPLY

The primary factor controlling the cost of developing the proposed exempted aquifer as a water supply source is depth and water quality. The top of the Inyan Kara at the proposed location is approximately 4,931' below land surface with the base of the formation at approximately 5,306' below land surface. In contrast, the better-quality Fox Hills and Hell Creek Formations are available between approximately 1,000 and 1,635' below land surface with several other acceptable formations at shallower depths.

Slawson recently drilled, cased, and partially perforated the Big Bend 1-5 SWD for a cost of $1,085,900 shown in Figure 7. A verbal estimate[1] provided by Backman Drilling (701-734-6667) located in Wilton, ND indicated a cost for 5" cased domestic wells as $31.00/foot. Agri Industries Inc. (Williston, ND) also provided verbal information for 10” cased industrial wells producing 100-200 gallon per minute. A 200' well was approximately $40,000, a 900' Ft. Union well was around $60,000 and a 1600' Fox Hills well was approximately $150,000. Dennis Water Well Service located in New Town, ND (701.627.2390) provided a verbal quote of $280,000 to drill a Fox Hills well. These costs do not include location construction or surface equipment, and it is assumed that these additional costs would be the same for each formation.

Aquifer	Depth (TD)	Estimated TD well cost
Unnamed	200'	$ 6,200[1]
New Town	200'	$ 40,000
Ft. Union	900'	$ 60,000
Fox Hills	1,805'	$280,000
Inyan Kara	5,444'	$1,085,900

Figure 7 – Estimated Well Cost Depth Comparison

Drilling costs varies by depth, size of hole, and contractor. The estimated total depth and cost to drill an Inyan Kara water-supply well exceeds the cost of drilling a Fox Hills water-supply well by an estimated $805,900, with additional savings and shallower depths. Therefore, based on cost, the quantity and quality of the water available in the Fox Hills/Hell Creek aquifers and other supplies located at shallower depths, the proposed exempted aquifer is situated at a depth which makes recovery of water for drinking water purposes economically or technologically impractical.

[1] Domestic well only, other wells are commercial with larger casing sizes for larger production volumes. Conversations held February 2014.

BASIS FOR PROPOSED DECISION

Regulatory Criteria under which the aquifer exemption is requested.

1. **146.4 (a)** The exempted aquifer does not currently serve as a source of drinking water.

2. **146.4 (b) (2)** It is situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical.

PROPOSED CONCLUSION AND DECISION

Based on review of the entire record, the EPA finds that exemption criteria 40 CFR §§ 146.4(a) and 146.4(b)(2) have been met, and the EPA proposes to approve exemption of portions of the Inyan Kara Formation as a minor aquifer exemption.

DRAFT	**DRAFT**
Sarah Bahrman, Chief	Date
Safe Drinking Water Branch	