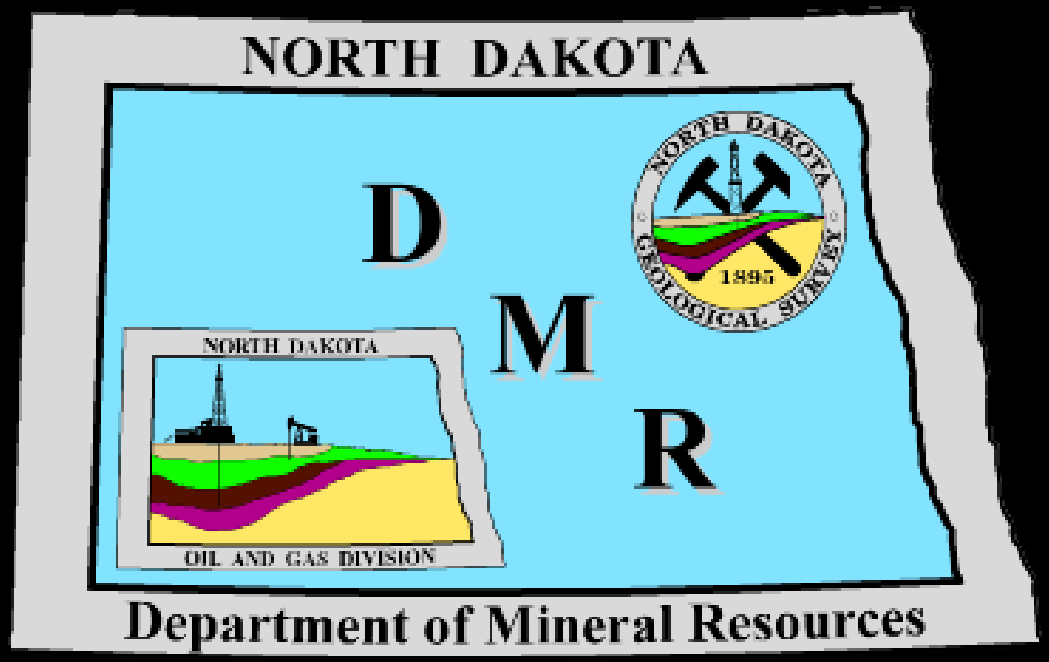
North Dakota Department of Mineral Resources



http://www.oilgas.nd.gov

http://www.state.nd.us/ndgs

600 East Boulevard Ave. - Dept 405
Bismarck, ND 58505-0840
(701) 328-8020 (701) 328-8000

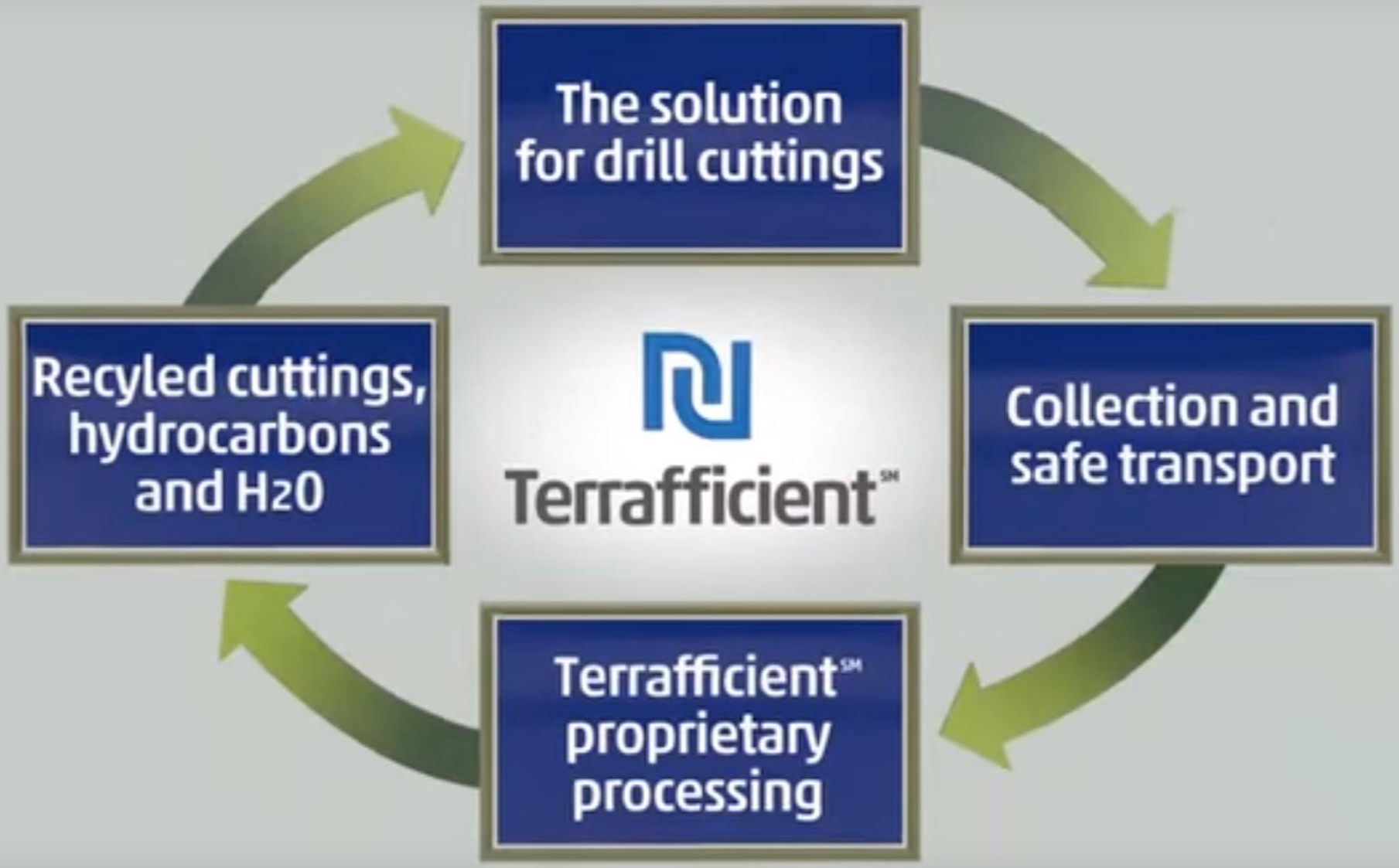

The solution for drill cuttings
Collection and safe transport
Terrafficient proprietary processing
Recyled cuttings, hydrocarbons and H2O
Terrafficient℠

Figure A-1. The locations of the proposed demonstration projects.

Based on the results of this effort, several potential areas of future work may benefit industry and the state. These include the following:

- Tracking produced water treatment technology developments that have application to the high-salinity produced water associated with the Bakken play and compiling a produced water treatment technology database of vendors, technologies, and demonstrated capabilities.

- A detailed assessment of opportunities for utilizing nonpotable groundwater resources like the Dakota aquifer and others for use in both hydraulic fracturing and well maintenance applications.

- A hydrogeologic assessment of the Dakota Formation and the associated long-term impacts of underground injection as a produced water disposal reservoir.

- An assessment of produced water storage options that provide cost-effective alternatives and would promote the utilization of produced water for hydraulic fracturing.

- Investigation of alternative uses for produced water – kill fluids, constituent/resource recovery, feedstock for chemical production strategies, dust control applications, deicing.

PILOT PROJECT BACKGROUND

Site Description

This project was conducted near Tioga, North Dakota, at an existing site where a groundwater well site is screened in the Dakota Formation (Dakota) at a depth of approximately 5500 feet. The Dakota is part of the Lower Cretaceous aquifer system and is one of the most widespread aquifers in North America. It is present in most states of the Great Plains, from western Iowa to Montana and from the Arctic Circle to New Mexico (Kansas Geological Survey, 1996). In eastern North Dakota, groundwater from the Dakota has been used as a water source for livestock since the beginning of the 20th century, but because of its marginal quality and increased costs associated with treatment and pumping, it has been marginalized as a municipal or industrial water source. However, recent developments in water treatment technologies, coupled with the current water acquisition costs of water for Bakken fracturing, made the economic and technical evaluation of the Dakota's potential as a water supply source for the oil industry a logical endeavor.

Table 21. Total Cost Summary – 1.5-MGD RO Plant with Truck Transportation Disposal

	Cost	Cost per bbl
Capital Costs		
Land Acquisition	$240,000	$0.01
Groundwater Extraction Well Field	$8,250,000	$0.25
RO Plant	$15,750,000	$0.47
Permeate and Concentrate Storage	$1,021,875	$0.03
Total Capital Cost	**$24,853,600**	**$0.76**
Annual O&M Costs		
Groundwater Extraction	$95,000/yr	$0.01
RO Plant Operation	$1,000,000/yr	$0.09
RO Concentrate Disposal	$20,700,000/yr	$1.77
Total Annual O&M Cost	**$21,795,000/yr**	**$1.87**

Table 22. Total Cost Summary – 1.5-MGD RO Plant with Dedicated Pipeline Disposal

	Cost	Cost per bbl
Capital Costs		
Land Acquisition	$240,000	$0.01
Groundwater Extraction	$8,250,000	$0.25
RO Plant	$15,341,725	$0.47
Permeate and Concentrate Storage	$1,021,875	$0.03
RO Concentrate Disposal Well Field	$13,300.000	$0.41
Total Capital Cost	**$38,153,600**	**$1.17**
Annual O&M Costs		
Groundwater Extraction	$95,000/yr	$0.01
RO Plant Operation	$1,000,000/yr	$0.09
RO Concentrate Disposal	$75,000/yr	$0.01
Total Annual O&M Cost	**$1,170,000/yr**	**$0.11**

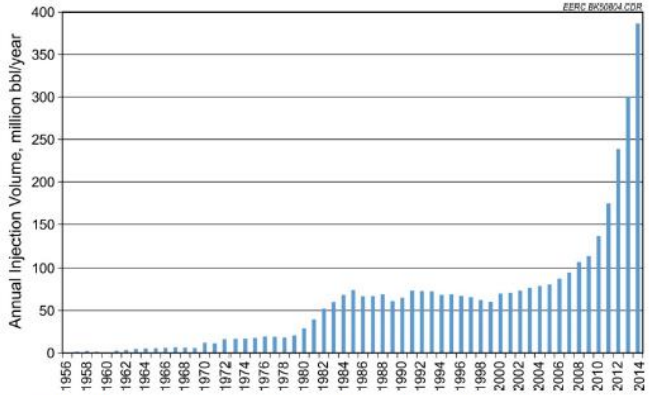


Figure 18. Volumes of water injected into all SWD wells since 1956 (data source: NDIC).

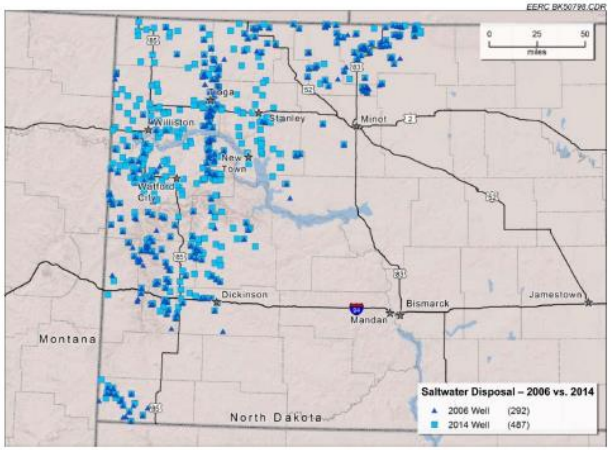


Figure 19. Comparison of active SWD well locations between 2006 and 2014 (data source: NDSWC).

Table 6. Projected Water Generation in the Bakken*

Year	Estimated Number of Bakken Wells	Estimated Annual Bakken Produced Water Generation, million bbl	Estimated Number of SWD Wells at an Average Annual Injection Rate of 793,000 bbl	Additional SWD Wells Needed Beyond Those Existing in 2014
2020	21,183	624	787	300
2025	31,183	918	1158	671
2030	39,290	1157	1459	972
2035	40,000	1178	1485	998

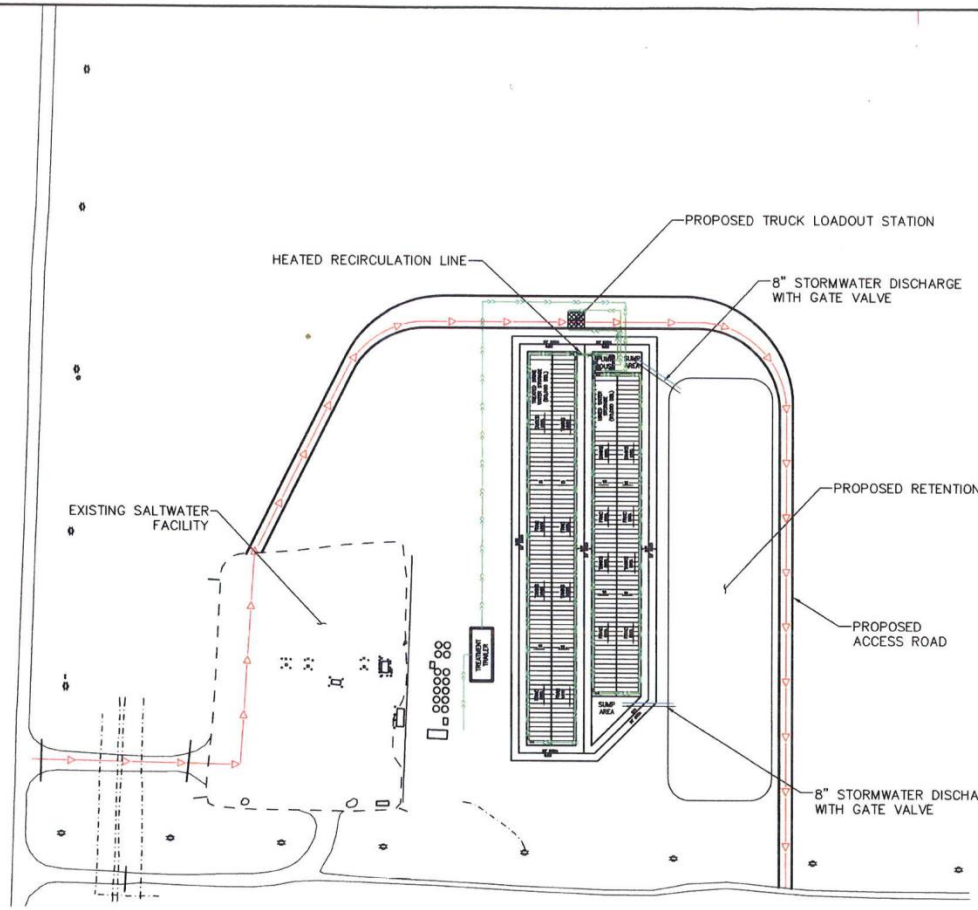
* Assumes a well lifetime of 20 years.

Table 12. Water Storage Alternatives and Space Requirements

Storage Receptacle	Volume, bbl	Number of Tanks Required		Approximate Footprint, acres	
		80,000 bbl Storage	240,000 bbl Storage	80,000 bbl Storage	240,000 bbl Storage
Standard Frac Tank	500	160	480	1.4	4.2
Water Corral*	42,000	2	6	1.2	3.5
Lined Pit*		1	1	0.9	2.7
Closed-Top Tank	1000	80	240	0.4	1.3
Bladder Tank	5000	16	48	2.0	6.0

* Open top receptacles for comparison purposes.

Figure 23. Potential produced water storage options.



N

200 0 100 200

GRAPHIC SCALE IN FEET

LEGEND

- 2320 EXISTING CONTOURS
- EXISTING ROAD
- EXISTING FENCE
- EDGE OF WATER
- EXISTING PAD
- EXISTING UNDERGROUND UTILITY
- EXISTING CULVERT
- EXISTING BUILDING/TRAILER
- EXISTING STORAGE TANK
- EXISTING BOLLARD
- EXISTING LIGHT POLE
- EXISTING POWER POLE
- EXISTING TERMINAL
- EXISTING SOIL PILES
- FLOW ARROWS
- PROPOSED FORCEMAIN
- TRAFFIC FLOW

REV	REVISION DESCRIPTION	DWN	APP	REV DATE

SEAL

PRIME CONSULTANT: Wenck

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3301 Fieldview Drive, Suite 100, Fargo, North Dakota 58103 (701)237-9620 (701)237-9621
Web Site: www.wenck.com

PROJECT TITLE: Nuverra Salt Water Recycling Facility, Foss Site (Williams County) CASE # 20886, S4, T156N, R96W

Nuverra Environmental Solutions

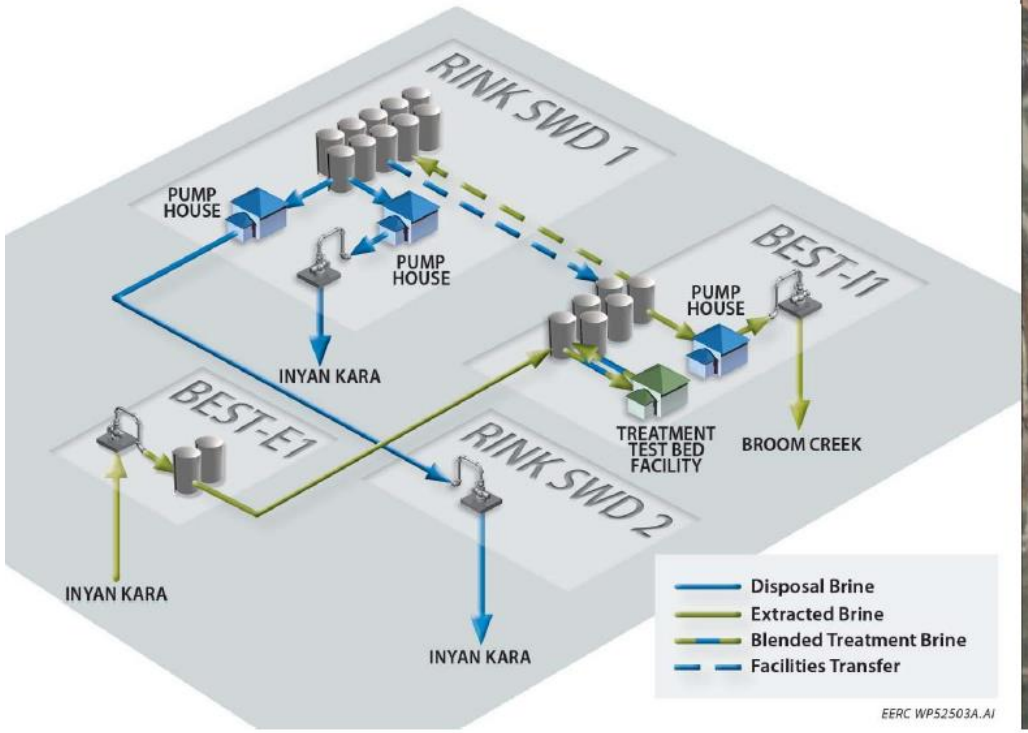
SHEET TITLE: SITE DETAIL MAP

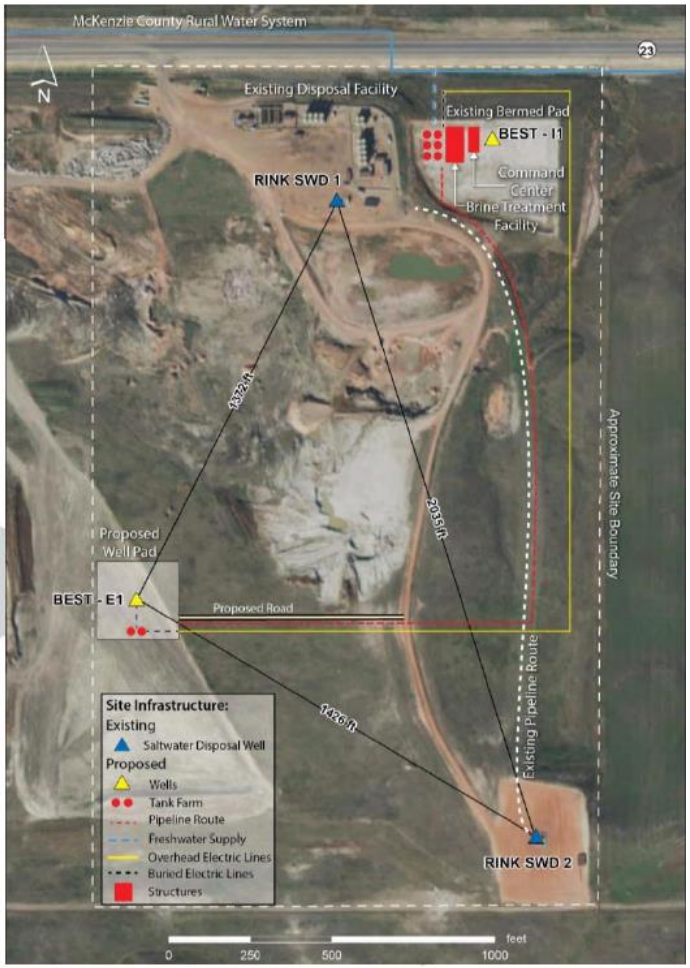
PAGE 2 OF 2

DWN BY	CHK'D	APP'D	DWG DATE	SEPT 2013
JCS	MPM		SCALE	AS SHOWN

PROJECT NO.	SHEET NO.	REV NO.
3110-03	EXHIBIT 3	1

Infrastructure

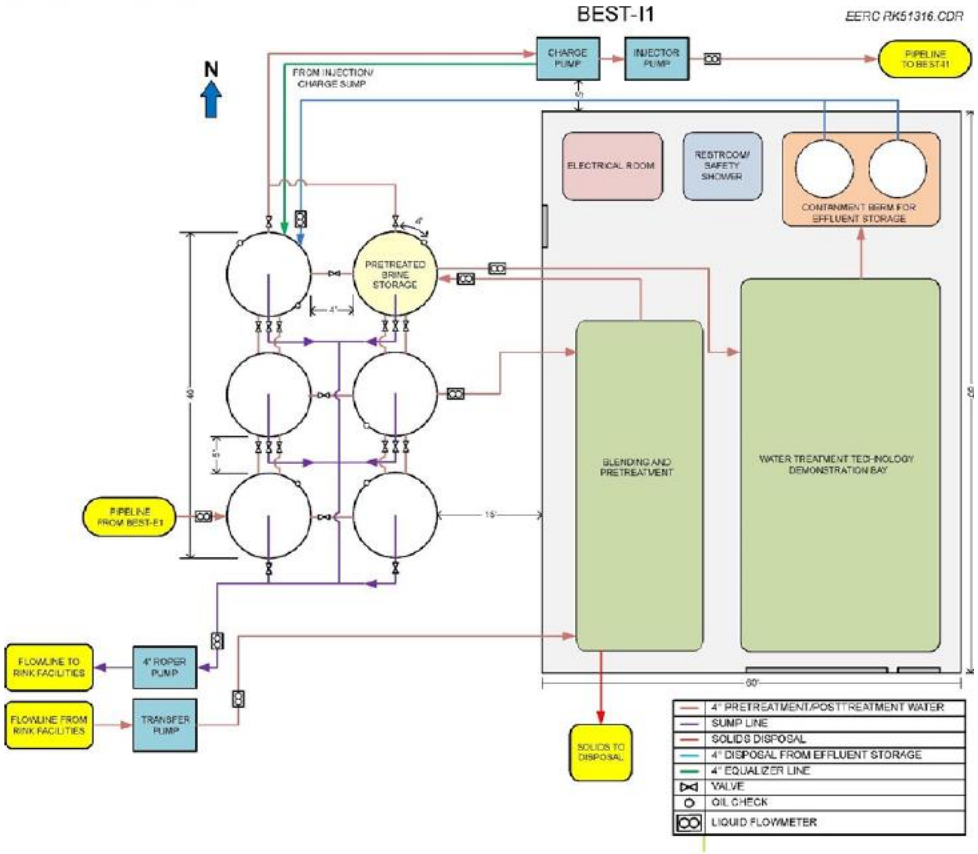




Brine Treatment Test Bed

- Environmentally enclosed facility
  - 24/7, 365 operational capable
- Tailored brine compositions
  - ~4500–300,000 mg/L TDS
- Tailored rates
  - 5–25 gpm
- 30–60-day extended-duration tests
- Pretreatment provided
- Monitoring
  - Energy, flow rates, pressure, temperature, chemicals, etc.
- Waste management

<u>Technologies Selected in Phase 2</u>



EERC

BE IT ENACTED BY THE LEGISLATIVE ASSEMBLY OF NORTH DAKOTA:

SECTION 1. Section 23-29-04.2 of the North Dakota Century Code is created and enacted as follows:

23 - 29 - 04.2. Commercial oilfield special waste recycling facilities - Action against well operators restricted.

1. By June 1, 2015, the department shall select at least one commercial oilfield special waste recycling facility having a pending beneficial use application, for authorization of operation of the facility as a pilot project and to assist the department to develop standards for recycling of oilfield special waste. **The pending beneficial use application of the pilot project facility must be supported by scientific findings** from a third - party source focused on the anticipated environmental performance of the end products of the recycled oilfield special waste and the practical utility of those end products.

2. Any pilot project facility and any commercial oilfield special waste recycling facility permitted after June 30, 2017, **must obtain a solid waste permit from the department and a treating plant permit from the industrial commission** for treatment of oilfield special waste.

3. Any **selected pilot project facility may operate as an oilfield special waste recycling facility through June 30, 2017**, and may implement beneficial use demonstration projects using processed materials under the guidance of the department. A selected pilot project facility operator shall cooperate with the department to monitor and analyze impacts to the environment.

BE IT ENACTED BY THE LEGISLATIVE ASSEMBLY OF NORTH DAKOTA:

SECTION 1. Section 23-29-04.2 of the North Dakota Century Code is created and enacted as follows:

4. By July 1, 2017, based upon the results of any pilot projects, **the department shall make recommendations either to adopt rules under chapter 28 - 32 governing operations and permitting of commercial oilfield special waste recycling facilities or to develop written guidelines on recycling and beneficial use of oilfield special waste** under the department's beneficial use approval process. The rules or guidelines must be adopted to assure compliance with federal and state laws and rules for protection of the state's water and air and public health in the handling and subsequent use of oilfield special waste.

5. Upon presentation of official credentials, **an employee authorized by the department may:**

a. Examine the premises and facilities and copy books, papers, records, memoranda, or data of a commercial oilfield special waste recycling facility.

b. Enter upon public or private property for the purpose of taking action authorized by this chapter and rules adopted under this chapter, including obtaining information from any person, conducting surveys and investigations, and taking corrective action.

6. The operator of the commercial oilfield special waste recycling facility is liable for the cost of any inspection and corrective action required by the department.

BE IT ENACTED BY THE LEGISLATIVE ASSEMBLY OF NORTH DAKOTA:

SECTION 1. Section 23-29-04.2 of the North Dakota Century Code is created and enacted as follows:

7. As a condition of permitting, **the department may require the operator of a commercial oilfield special waste recycling facility post a bond** or other financial assurance payable to the state in a sufficient amount for remediation of any release or disposal of oilfield special waste in violation of the rules of the department, on the premises or property of the facility or at a place where treated or untreated materials from the facility are taken for use or disposal.

8. As used in this section:

a. **"Commercial oilfield special waste recycling facility" means** a commercial recycling facility permitted, or a commercial recycling facility pilot project authorized, under this section for extraction of reusable solids and fluids from any or all types of oilfield special waste.

b. **"Drilling operation"** means oil and gas drilling and production operations and any associated activities that generate oilfield special waste.

c. **"Oilfield special waste"** means special waste associated with oil and gas drilling operations, exploration, development, or production and specifically includes drill cuttings, saltwater, and other solids and fluids from drilling operations.

BE IT ENACTED BY THE LEGISLATIVE ASSEMBLY OF NORTH DAKOTA:
SECTION 1. Section 23-29-04.2 of the North Dakota Century Code is created and enacted as follows:
9. Upon delivery of oilfield special waste to a commercial oilfield special waste recycling facility, which is permitted or authorized to conduct recycling operations under this section and is not affiliated with the well operator; acceptance of the oilfield special waste by the recycling facility; and after the oilfield special waste has been treated and converted to a beneficial use as a usable product or legitimate substitute for a usable product, **the well operator is not liable in any civil or criminal action for any subsequent claim or charge regarding the material converted to a beneficial use**.