



# Produced Water Overview

North Dakota Department of Environmental Quality  
2019 Region VIII Industrial Pretreatment Conference  
Bismarck, North Dakota  
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# Discussion

- **Underground Injection Control Program**
- **Use of Class II Wells in US and ND**
- **Well Construction/Location**
- **Class II Well Reporting Requirements**
- **Program Primacy/Regulation**
- **Reuse/Recycle Options**
- **Produced Water Mishaps**
- **Other Produced Water Topics**

# Produced Water

- Natural groundwater extracted along with oil and gas
- Salty and mixed with oil residues
- Produced water is considered an Industrial Waste (NDIC, 2015)
- Must be either disposed of or treated and reused.



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# Underground Injection Control (UIC) Background

- In the U.S., major use of injection wells started in the 1930s
- Nationwide program pursuant to the Safe Drinking Water Act (SDWA)
  - Overseen by the EPA – Primacy delegated to North Dakota - ~1983 (NDIC,2015)
  - Est. to protect underground sources of drinking water (USDW)
  - Six classes of UIC wells: (EPA, 2019)
    - Class I: wells used to inject hazardous waste or industrial waste below an USDW
    - **Class II: wells used to dispose of exempt oil or gas waste fluids or wells used for enhanced oil recovery**
    - Class III: wells used for solution mining
    - Class IV: wells used to inject hazardous waste or industrial waste above a USDW (banned except for those which are part of an EPA or state approved CERCLA or RCRA project)
    - Class V: all others or wells used to inject nonhazardous fluid into a USDW
    - Proposed Class VI: wells used for underground injection of carbon dioxide for sequestration

# What to do with Produced Water in North Dakota?

## The “No” Disposal Options:

- **POTW Disposal in North Dakota**
  - **CWT Facility**
  - **NDPDES**

## The “Available” Disposal Option:

- **UIC**

## “Other” Discussion

- **Reuse/Recycle Options**

# Use of Class II Wells in U.S (EPA, 2019)

- **Approximately 180,000 Class II wells in the United States**
- **~2,000,000,000 gallons of fluids injected every day**
- **Most oil and gas injection wells located in TX, CA, OK, and KS**

# Use of Class II Wells in North Dakota

- North Dakota's 1<sup>st</sup> Class II Disposal Well started operation in 1953 (Bader, 2016)
- Fracking technology increased need for disposal wells
  - 185 SWD Wells operating in 2005 in ND
  - 435 SWD Well operating in 2015 in ND
- ~13,000 producing oil wells in North Dakota (NDIC, 2015) generate ~1,000,000 barrels of Produced Water daily (Bader, 2016)

Produced Water Major Components (Bader, 2016):

- Hydrocarbons
- Salts
- Metals
- Radionuclides
- Production chemicals

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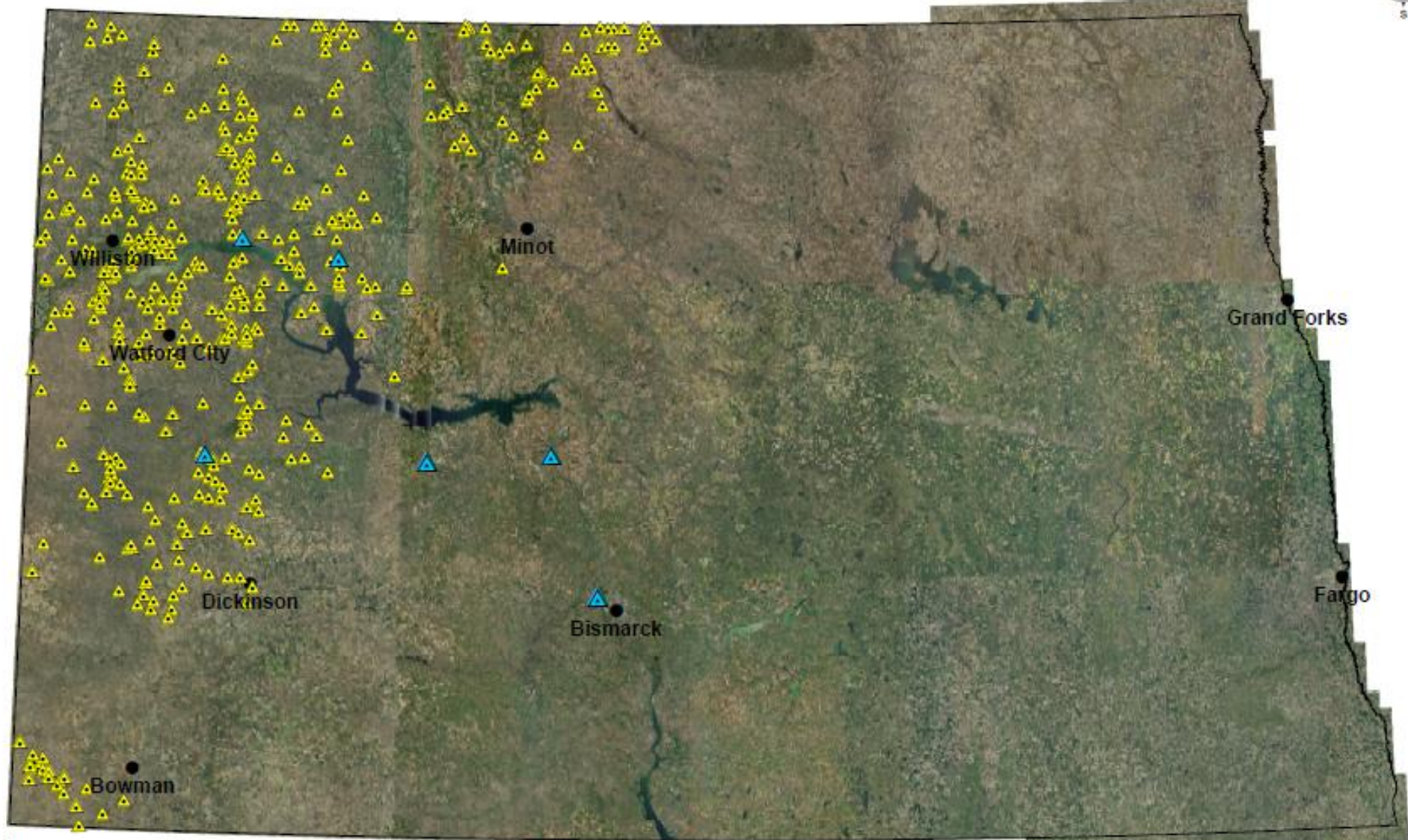
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# Well Location Factors

- Geology is the most important factor.
- Williston Basin has ideal sequence of geologic units at the optimal depth for produced water disposal.
- Other factors:
  - Producing wells and fields locations
  - Road access – minimize transportation distances (Bader, 2016)



# Active UIC wells in North Dakota as of February 2019



## Legend

-  Class I UIC Well
-  Class II UIC Well

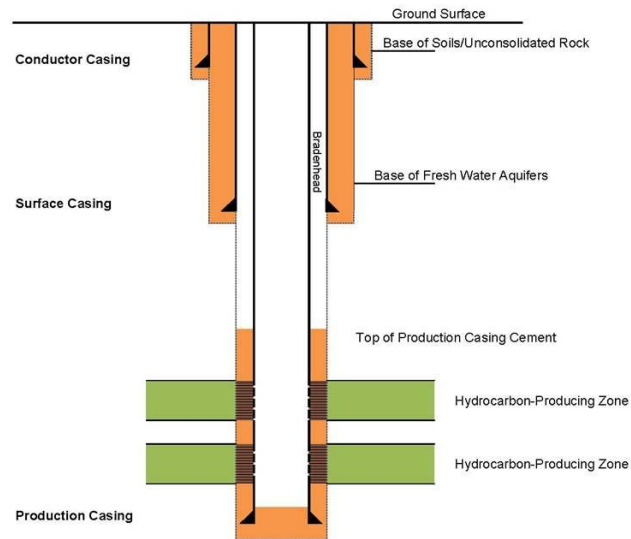
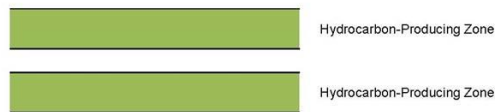
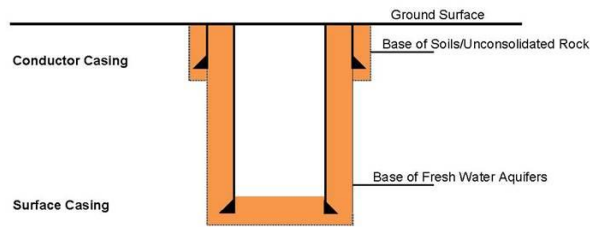
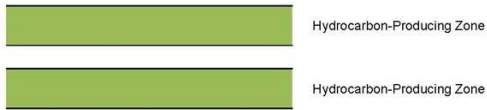
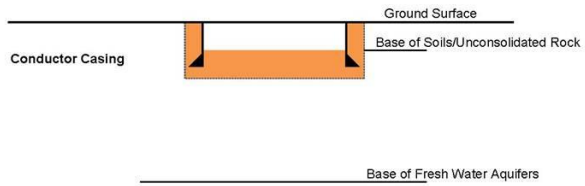


Aerial photography courtesy of NASP 2017 SS NDDH 2019

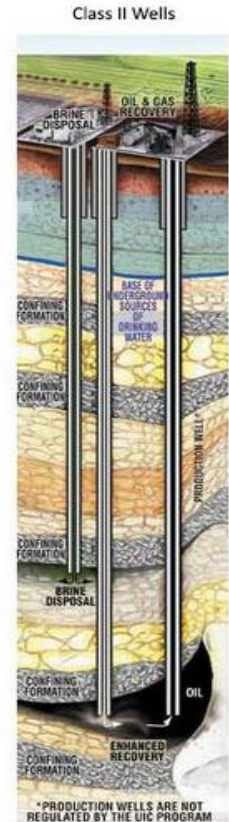
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# Class II Well Construction

3 layers of steel casing/tubing and 2 layers of cement  
 (Diagrams: CO Oil & Gas, 2010; US EPA, 2019)



Cross-sectional diagram showing UIC Class II wells

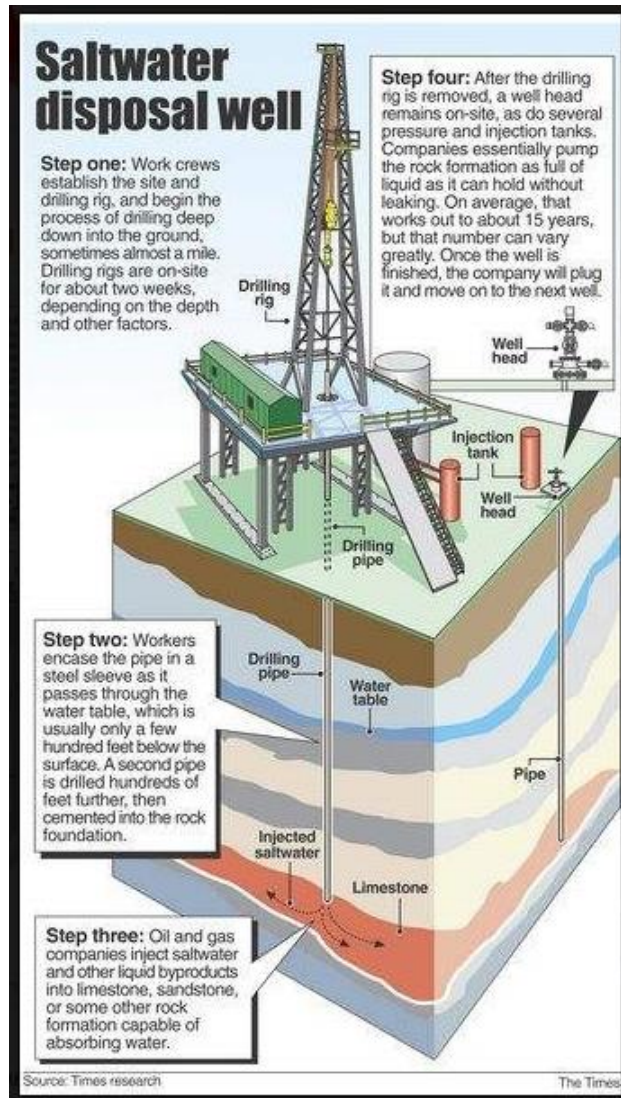


Class II wells are used to inject fluids associated with oil and gas production. Injection of fluids is typically thousands of feet below the surface into rock formations isolated from underground sources of drinking water.

# Class II Well Types

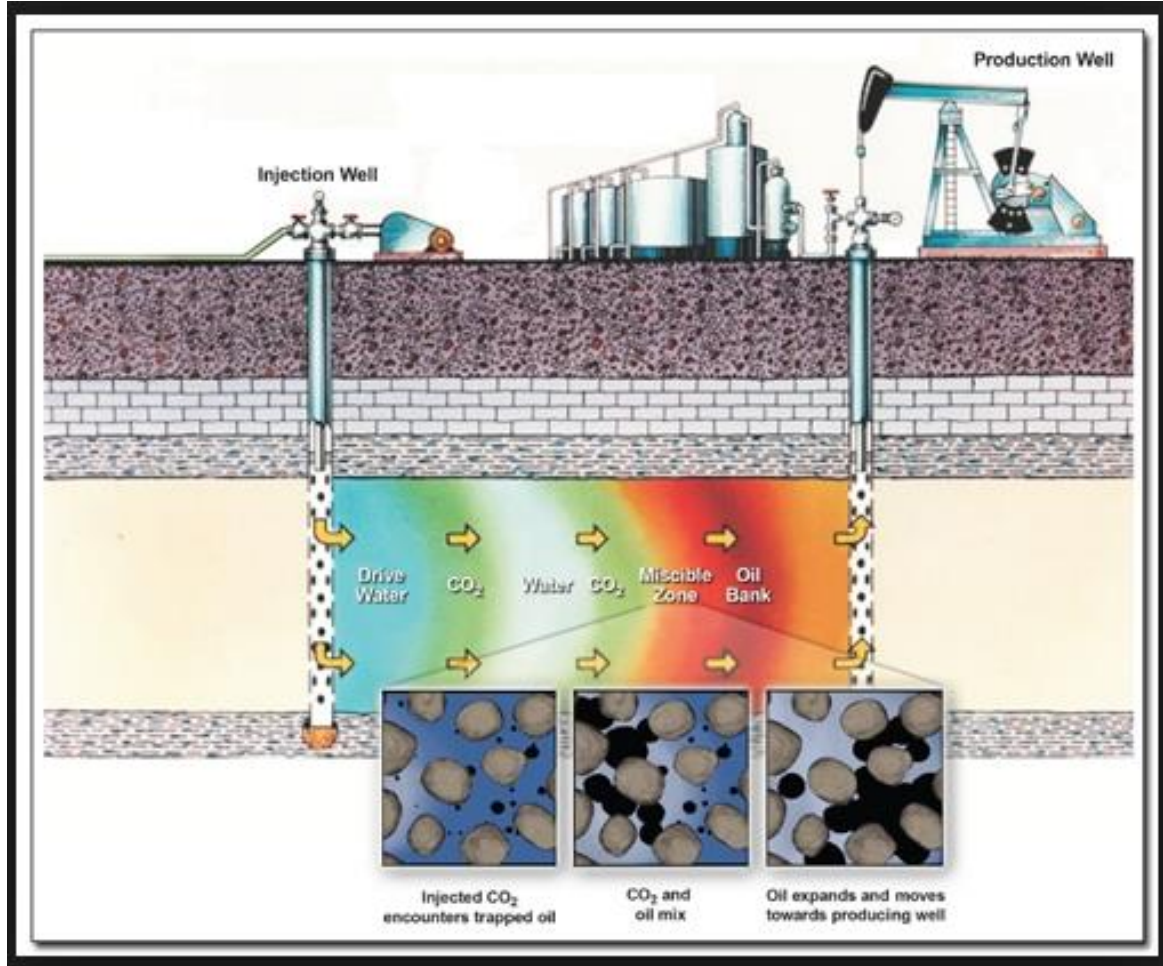
- **Saltwater Disposal Wells**
- **Enhanced Oil Recovery Wells (EOR)**
- **Hydrocarbon Storage Wells**

# Saltwater Disposal Wells (SWD)



- Brines and hydrocarbons separated after extraction – brines reinjected
- SWD well only approved method for produced/salt water disposal in North Dakota (NDIC, 2015)
- Represent ~20% of all Class II Wells in the US (EPA, 2019)

# Enhanced Oil Recovery Wells



Source: Department of Energy - 2019

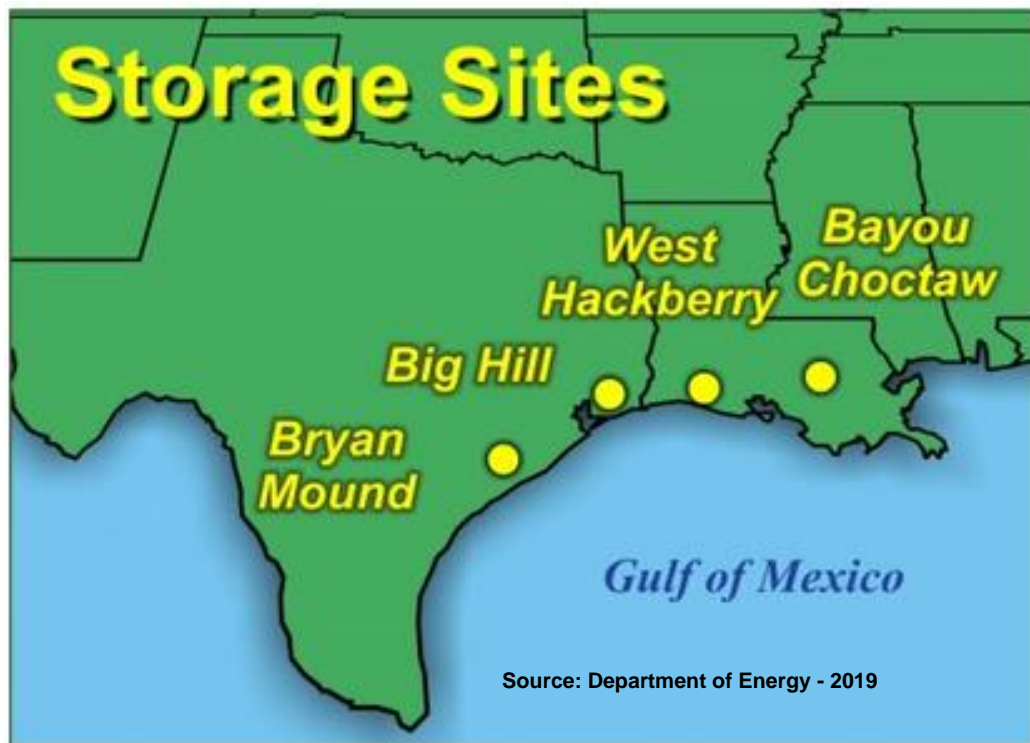
- Fluids injected into oil-bearing formations for oil and natural gas recovery
- Hydraulic fracking is considered an enhanced recovery process
- Not typically under the UIC program - can regulate when diesel fuel is used in fluids or propping agents
- Represent ~80% of all Class II wells in US (EPA, 2019)

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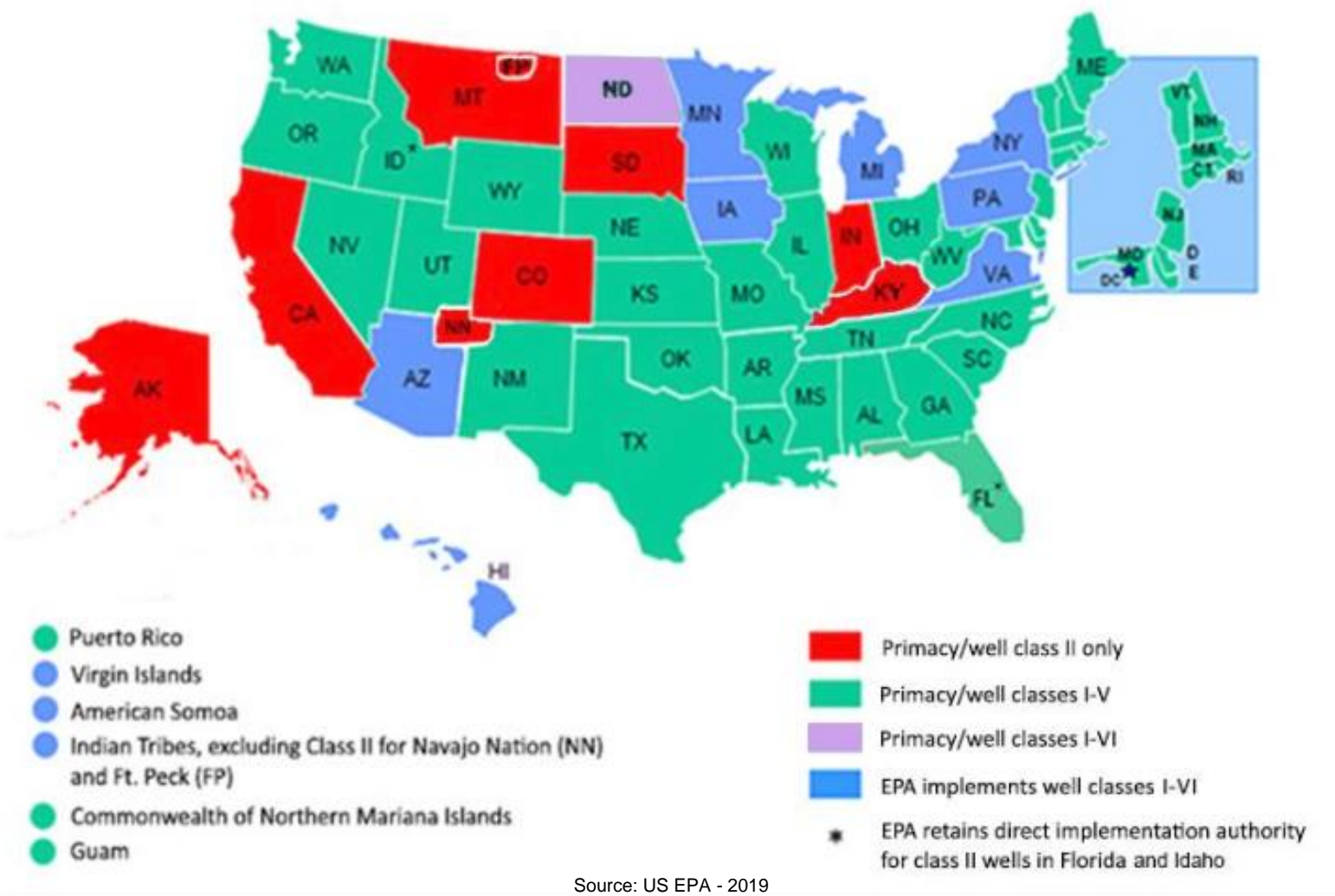
# Hydrocarbon Storage Wells (EPA, 2019)

- Liquid Hydrocarbons injected into underground formations (Salt Caverns)
- Part of Strategic Petroleum Reserve (SPR) - 4 majors (DOE, 2019)
- Over 100 operating in US (EPA, 2019)



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# UIC Primacy



- Developed by EPA (EPA, 2015)
- Designed to be adopted by:
  - States
  - Territories
  - Tribes

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# UIC Federal Regulations

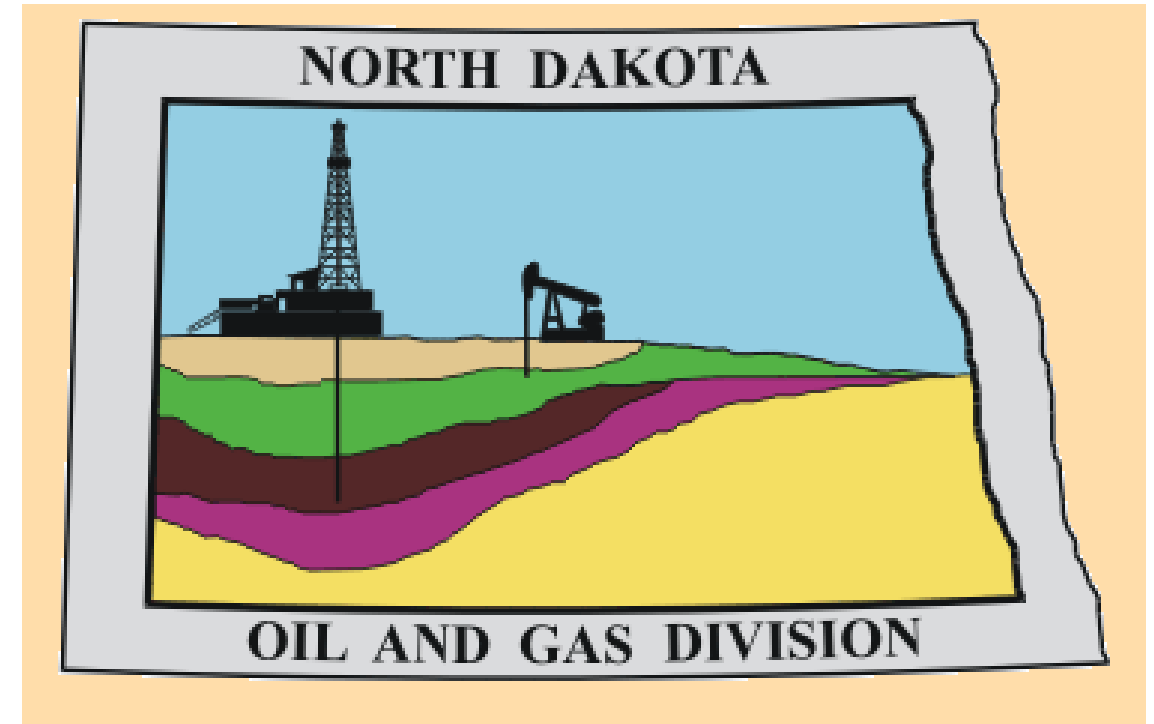
- 40 CFR 144 – Underground Injection Control Program
- 40 CFR 145 – State UIC Program Requirements
- 40 CFR 146 – Underground Injection Control Program: Criteria and Standards
- 40 CFR 147 – State, Tribal, and EPA-Administered Underground Injection Control Programs





# North Dakota Primacy and Regulatory Authority

- North Dakota received primary enforcement responsibility (primacy) for Class II injection wells under SDWA section 1425 on May 11, 1984. (NDIC, 2015)
- North Dakota Department of Mineral Resources has primacy over Class II and Class III
- Class II Wells are regulated by the Oil and Gas Division
- Class III wells are regulated by the Geological Survey – None currently in operation in North Dakota



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# Class II Well Permitting and Monitoring

- Each well requires public notice and hearing before permit issuance (not including an area permit). Other requirements:
  - Notify surface owners within  $\frac{1}{4}$  mile
  - Proposed location requires geotechnical analysis
  - No migration within the formation – injection in North Dakota is typically in the Dakota Group Formation.
- Once in operation, well pressure and wellbore integrity are monitored monthly.
- Down-hole mechanical integrity tests
  - required initially and
  - at least once every 5 years – or whenever the down-hole portion of the well has undergone any maintenance.

# Class II Well Reporting Requirements

- Monthly submittals by injection-well operator to the Oil and Gas Division:
  - Beginning and end of the month meter readings for:
    - Total volume injected
    - Average injection pressure
    - Individual sources of fluid
    - Type of fluid
    - Transportation method – piped or trucked

# Beneficial Use/Reuse

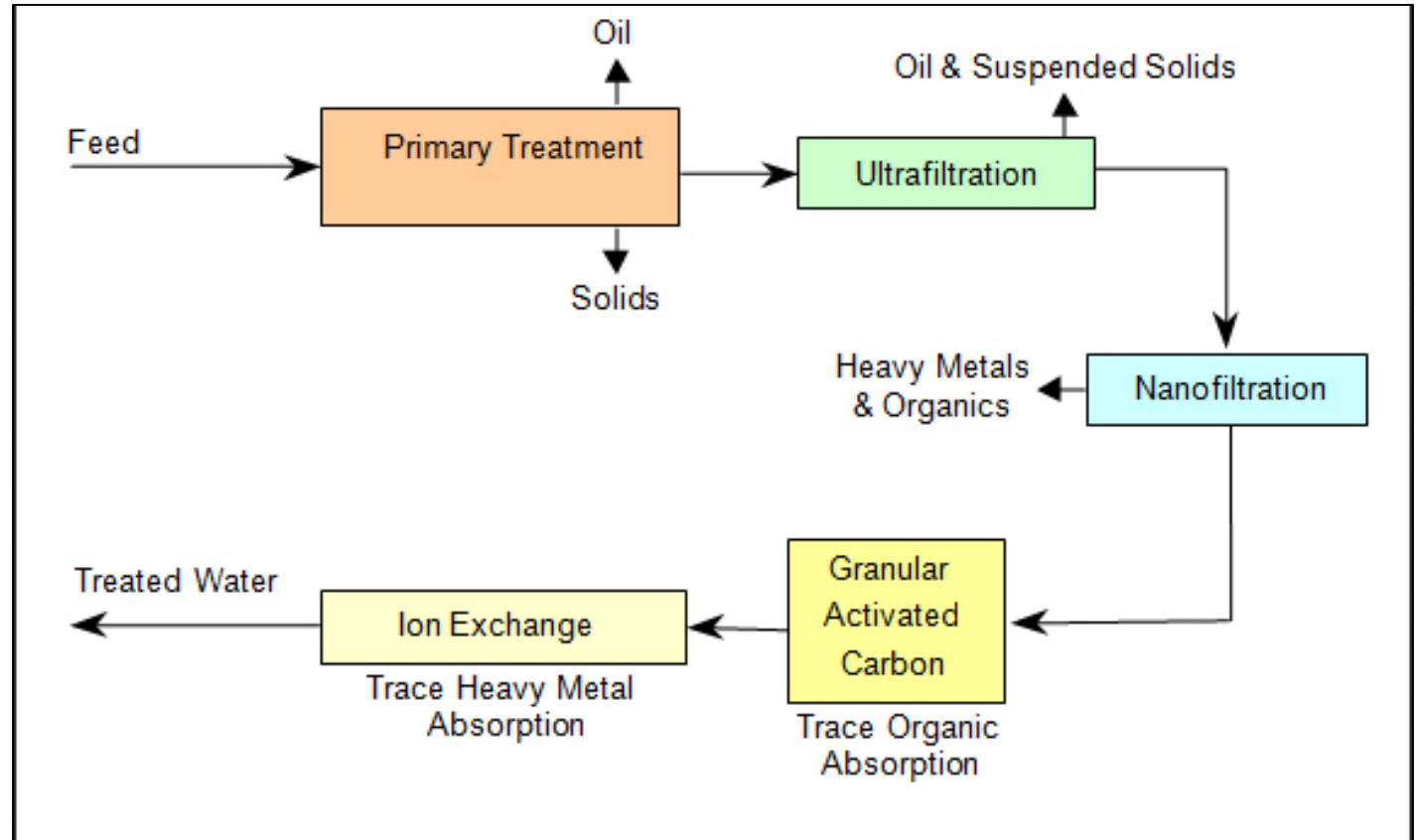
- Possible beneficial use/reuse
  - Ice and/or dust control as a substitute for commercial products (NDDH, 2019)
  - Recycle options – lower transportation-related issues and trucking costs (Kurtz, 2016)



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# Treating Plants

- Treating plants – separate oilfield wastes
  - Recovered oil is sold
  - Saltwater disposed of in Class II well
  - Other separated waste is dried and buried in special waste landfills



Source: Emsil Wastewater Treatment Website - 2019

# Produced Water Mishaps

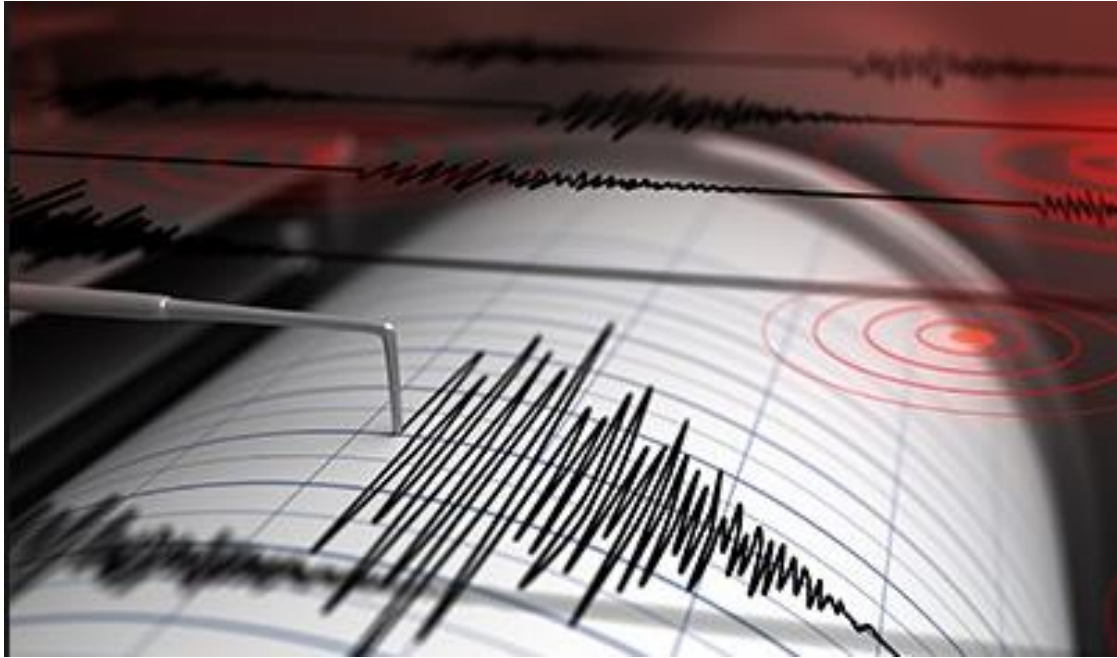
- Produced water mishaps have taken place in the past – 869 documented incidences from 1/2/2008 – 8/9/2018 (NDSS, 2018)
  - The North Dakota Department of Health responds and has increased its enforcement presence with:
    - Additional inspectors and,
    - Modified regulations to increase civil penalties and cleanup efforts and,
    - Better documentation for increased transparency
- Earthen pits or open receptacles cannot be used to store produced water.



Daryl Peterson stands in his field on a site where the soil has been evacuated because of a saltwater spill.

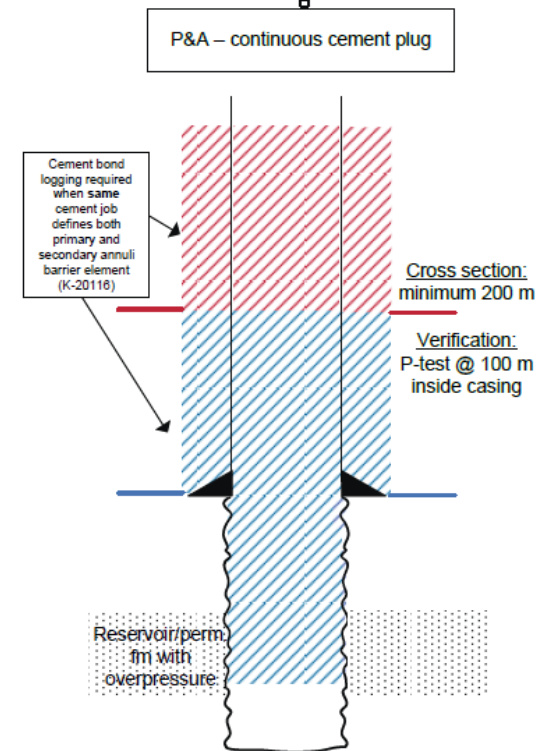
Courtesy Daryl Peterson

# Other Topics



## Seismic Activity

North Dakota has a very low threat (NDIC, 2015)



Source: Natural Gas Investing. Com - 2019

## Well Plugging

Operation witnessed by State inspectors

# References

Bader, J.W., 2016, The Dakota Group of the Williston Basin, GEO News, January.

Kurtz, B.A., Stepan, D.J., Glazewski, K.A., Stevens, B.G., Doll, T.E., Kovacevich, J.T., Wocken, C.A., 2016, A Review of Bakken Water Management Practices and Potential Outlook: Final report prepared for Members of the Bakken Production Optimization Program, EERC Publication 2016-EERC-03-11, Grand Forks, North Dakota, Energy & Environmental Research Center, March.

Environmental Protection Agency (EPA), 2015, Basic information about injection wells:, <http://water.epa.gov/type/groundwater/uic/basicinformation.cfm>, (retrieved 3/27/2019).

Environmental Protection Agency (EPA), 2019, Class II Oil and Gas Related Injection Wells:, [https://www.epa.gov/uic/class-ii-oil-and-gas-related-injection-wells#addit\\_info](https://www.epa.gov/uic/class-ii-oil-and-gas-related-injection-wells#addit_info) (retrieved 2/27/2019).

North Dakota Department of Health (NDDH), 2019, Draft produced water beneficial use/reuse guideline document, 20190227\_Final-Draft-7\_Brine-Guidelines\_(002).docx.

North Dakota Saltwater Spills: January 2008 - August 2018, (NDSS), 2018:, <https://docs.google.com/spreadsheets/d/14C8bUQeMwKn4RCSU-MJye1WI1SUEf2y5nA21Z54EH-M/edit#gid=441336115>, (retrieved March 27, 2019 from CNBC News Article By: Likhitha Butchireddygari, 2018)

North Dakota Industrial Commission (NDIC), 2015, <https://www.dmr.nd.gov/oilgas/>, (retrieved February 27, 2019).

United States Department of Energy (DOE), (2019) Strategic petroleum reserve storage sites:, <https://www.energy.gov/fe/services/petroleum-reserves/strategic-petroleum-reserve/spr-storage-sites>, (retrieved March 27, 21019).





Questions

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