Challenges Facing Class II Disposal Well Operations in the Appalachian Basin*

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Abstract

With the continued development of the unconventional oil and natural gas resources from the Marcellus and Utica shales in the Appalachian Basin, the demand for Class II disposal of oilfield fluid wastes has seen a significant increase. Production of brine water from the Utica and Marcellus in Ohio and West Virginia in 2018 averaged 159,572 barrels of water per day. With a small number of Class II disposal wells in West Virginia and lack of primacy in Pennsylvania, only Ohio remains well situated to handle the increase in Class II saltwater disposal well activity in the Appalachian Basin area.

Currently, there are 45 active Class II disposal wells in West Virginia, 15 permitted disposal wells in Pennsylvania, and 240 permitted and 219 active disposal wells in Ohio. In West Virginia, Class II disposal well permits are issued by WV DEP, are valid for five years, and then need to be renewed every five years after initial issuance of the permit. In Pennsylvania, since the state does not have primacy, Class II disposal wells require two permits, a UIC permit from U.S. EPA Region III and a well permit from PA DEP. In Ohio, which has had primacy of its Class II program since 1983, a permit to drill a new disposal well or a permit to convert a well to disposal is issued. Once the well has been drilled or converted, a second permit is issued for authorization to inject. After a well has been authorized to inject in Ohio, the permit remains valid for the life of the well.

The challenges facing Class II disposal well applicants and operators in the Appalachian Basin can be overwhelming. These challenges include: Finding locations and properly siting disposal wells; conducting title searches and mineral rights issues; understanding the various regulatory challenges, dealing with areas of dense population; addressing public and local political activists opposed to injection well development; finding adequate geologic formations for high capacity disposal operations; developing proper well construction, cementing, and completion methodology; selecting the right option for surface facility development and pre-treatment programs; dealing with NORM/TENORM testing and solid waste disposal issues; and working with the regulatory agency on potential seismic monitoring and mitigation issues or requirements.

Proper consideration of all of these challenges can lead to the successful permitting, drilling, construction, completion, and operation of a commercial Class II saltwater disposal facility in Appalachian Basin. This presentation will explore the challenges faced by a Class II disposal well applicant or operator and provide solutions to addressing the issues.

Challenges Facing Class II Disposal Well Operations in the Appalachian Basin

Prepared by Thomas E. Tomastik, CPG and J. Daniel Arthur, P.E., SPEC, ALL Consulting

Presented at the 2019 American Association of Petroleum Geologists Eastern Section Meeting, October 12-16, 2019, Worthington, Ohio

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Class II Development in the Appalachian Basin

- Water Management continues to be one of the biggest expenses for Marcellus and Utica shale operators, which has led to the demand for increased Class II disposal capacity.
- With a small number of commercial disposal wells in West Virginia and lack of primacy in Pennsylvania, only Ohio remains well situated to handle the increase in Class II disposal well activity.

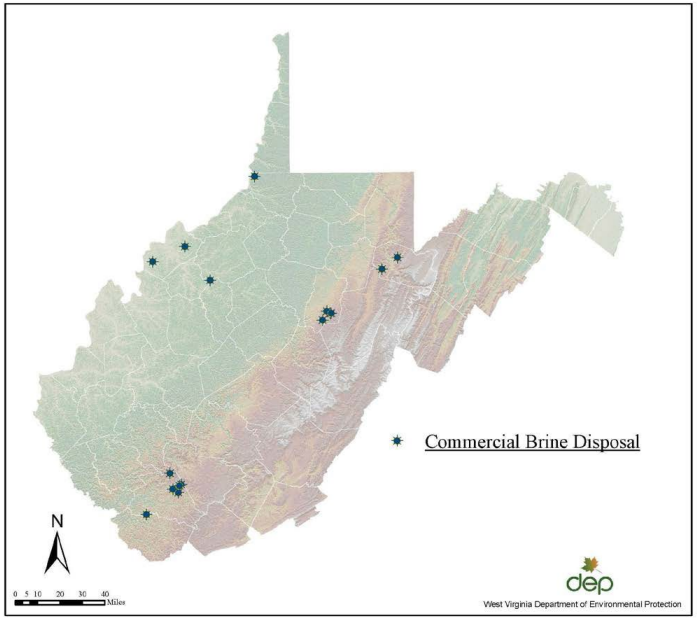
Source: ALL Consulting, 2018

Current Disposal Well Activity in the Appalachian Basin

- Currently, there are 45 Class II disposal wells permitted in West Virginia , 15 permitted in Pennsylvania, and 240 permitted in Ohio.
- Of the 45 Class II wells permitted in West Virginia, 44 are active and only 13 are considered commercial disposal wells.
- In Pennsylvania, currently only 12 Class II disposal wells are active and in operation.
- In Ohio, there are 242 permitted and 223 active Class II disposal wells.

West Virginia Class II Disposal Well Regulations

- Must submit two complete permit packages – UIC permit application and well work permit.
- Commercial disposal wells require increased security and fluid sampling of third-party haulers.
- Class II disposal wells permits must be renewed every five years and application must be submitted six months in advance of permit expiration.



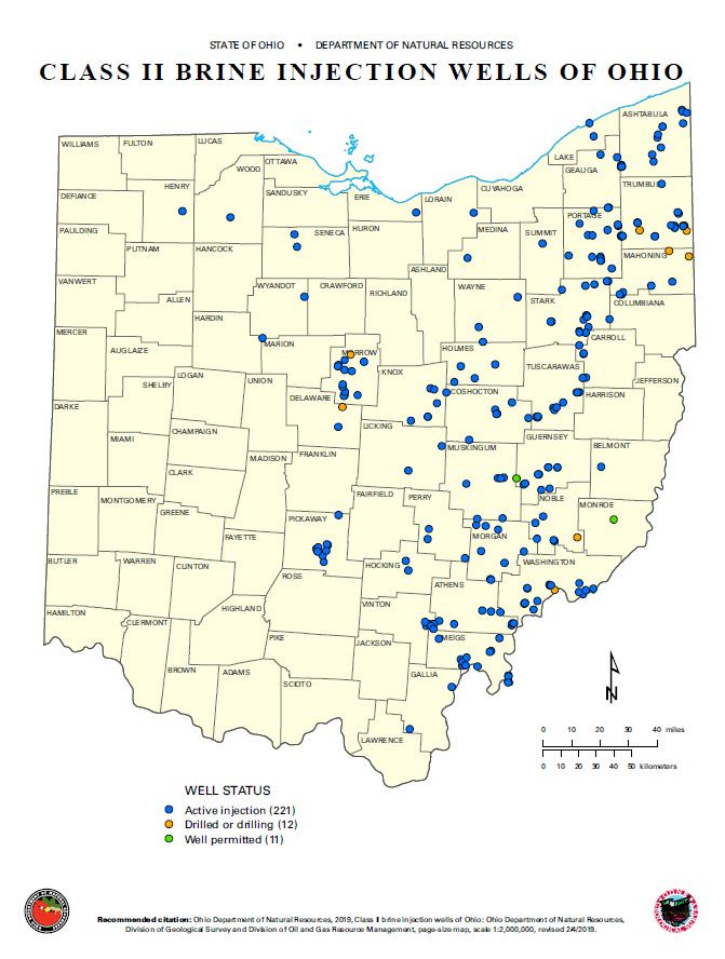
Source: WV DEP, 2013

Pennsylvania Class II Disposal Well Regulations

- Pennsylvania does not have primacy of its Class II program, so the initial permit goes through US EPA Region III.
- A second permit is required by PA DEP.
- There is strong opposition to Class II disposal in PA and appeals to the US EPA EAB and PA Hearing Board are common.
- Typically, it can take from three to five years to get these permits based on appeals and litigation.
- Injection volumes are limited to monthly volumes that range from 4,200 to 45,000 barrels per month.
- Seismic monitoring is now required for all Class IID injection wells.

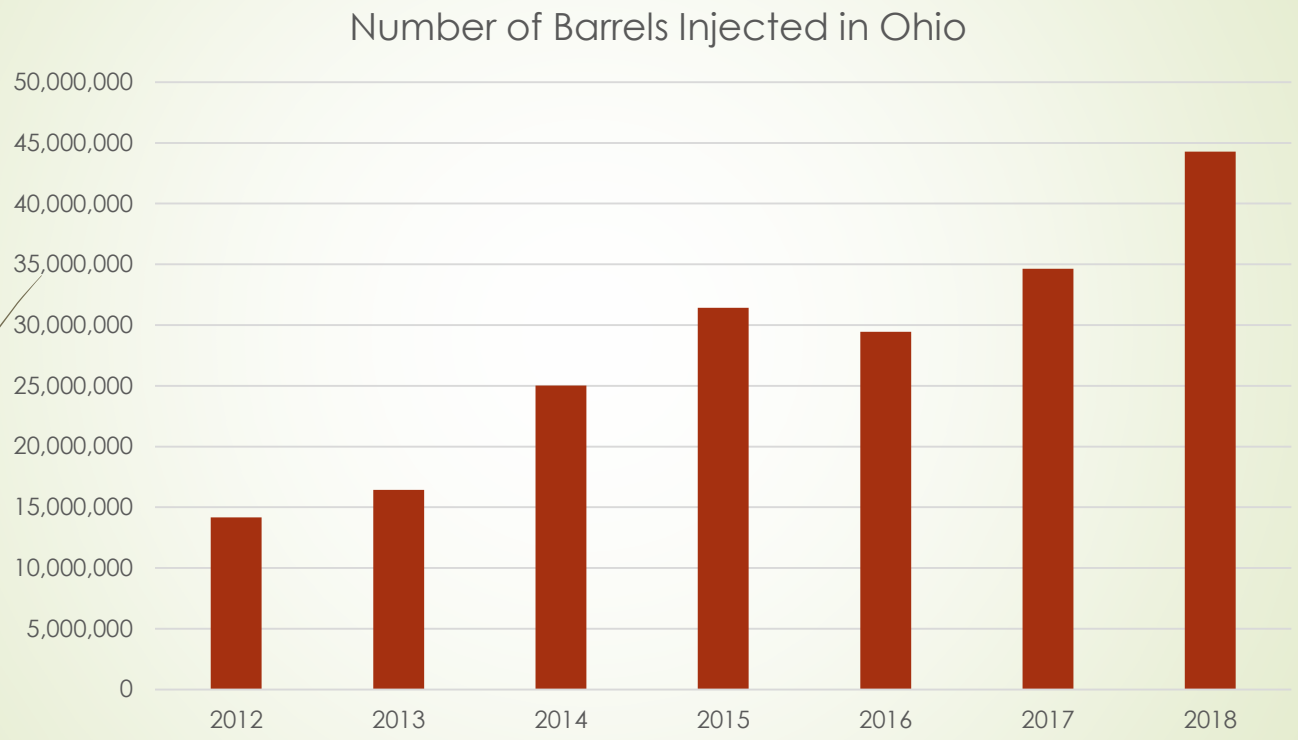
Ohio Class II Disposal Well Regulations

- Once a Class II disposal well is drilled or converted, a second permit to inject is issued.
- After the well has been authorized to inject, the permit remains valid for the life of the well.
- Seismic monitoring can be required.



Source: DOGRM, 2019

Ohio Class II Disposal Volumes



Recycling Efforts in the Appalachian Basin

- In 2017, approximately 94% of all produced fluids from the Marcellus were recycled and/or reused in Pennsylvania.
- In Ohio, there is recycling and reuse taking place in the Utica, but it is not being tracked as to how much volume is being reused and recycled.
- In West Virginia, Antero Midstream's Clearwater Facility is now fully operational and supposedly recycles about 48,000 barrels per day of Marcellus water.

Antero's Clearwater Facility

- Built to handle up to 60,000 barrels of water per day.
- $300 million-dollar project in partnership with Veolia Water Technologies.
- Located in Doddridge County, West Virginia and has onsite landfill for the salt that is produced as a waste.

Source: ohvec.org

Challenges Facing Class II Operators

- Properly sited location;
- Title searches and mineral rights issues;
- Regulatory challenges;
- Adequate geologic conditions for high capacity disposal;
- Proper well construction and completion;
- Addressing public and local opposition;
- Right option for surface facility;
- Proper pre-treatment program;
- Solid waste disposal – NORM/TENORM; and
- Seismic monitoring and mitigation.

Well Siting Criteria

- Assessment of the area of review;
- Favorable geologic conditions;
- Away from populated areas;
- Good road network and access; and
- Proximity to shale play development.

Source: Google Earth, 2018

Title Searches and Mineral Rights

- A title search is critical to establishing if the property has been leased and if the rights to inject are with the lessor or with the lessee.
- Rights to inject may remain with the surface owner.

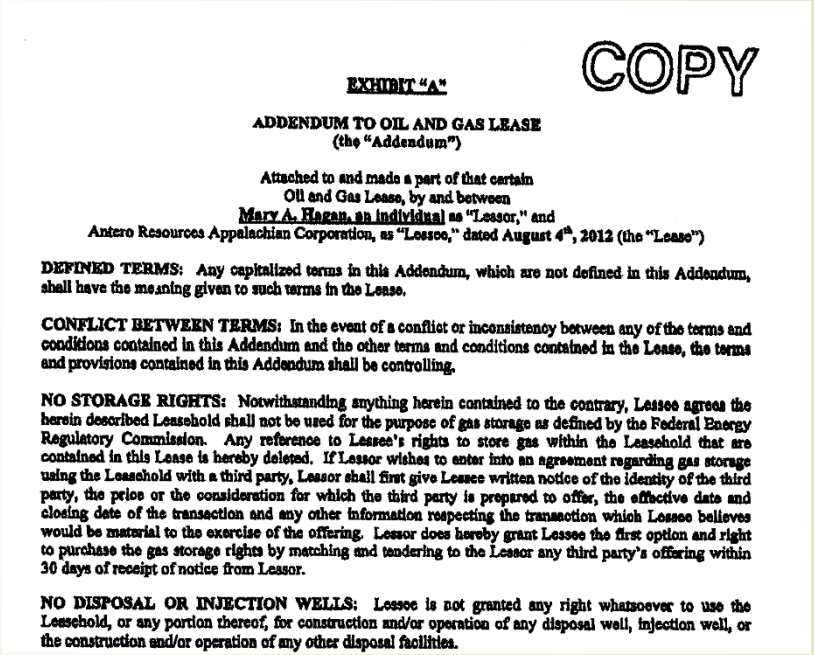


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EXHIBIT "A"

ADDENDUM TO OIL AND GAS LEASE
(the "Addendum")

Attached to and made a part of that certain
Oil and Gas Lease, by and between
Mary A. Hagan, an individual as "Lessor," and
Antero Resources Appalachian Corporation, as "Lessee," dated August 4th, 2012 (the "Lease")

DEFINED TERMS: Any capitalized terms in this Addendum, which are not defined in this Addendum, shall have the meaning given to such terms in the Lease.

CONFLICT BETWEEN TERMS: In the event of a conflict or inconsistency between any of the terms and conditions contained in this Addendum and the other terms and conditions contained in the Lease, the terms and provisions contained in this Addendum shall be controlling.

NO STORAGE RIGHTS: Notwithstanding anything herein contained to the contrary, Lessee agrees the herein described Leasehold shall not be used for the purpose of gas storage as defined by the Federal Energy Regulatory Commission. Any reference to Lessee's rights to store gas within the Leasehold that are contained in this Lease is hereby deleted. If Lessor wishes to enter into an agreement regarding gas storage using the Leasehold with a third party, Lessor shall first give Lessee written notice of the identity of the third party, the price or the consideration for which the third party is prepared to offer, the effective date and closing date of the transaction and any other information respecting the transaction which Lessee believes would be material to the exercise of the offering. Lessor does hereby grant Lessee the first option and right to purchase the gas storage rights by matching and tendering to the Lessor any third party's offering within 30 days of receipt of notice from Lessor.

NO DISPOSAL OR INJECTION WELLS: Lessee is not granted any right whatsoever to use the Leasehold, or any portion thereof, for construction and/or operation of any disposal well, injection well, or the construction and/or operation of any other disposal facilities.

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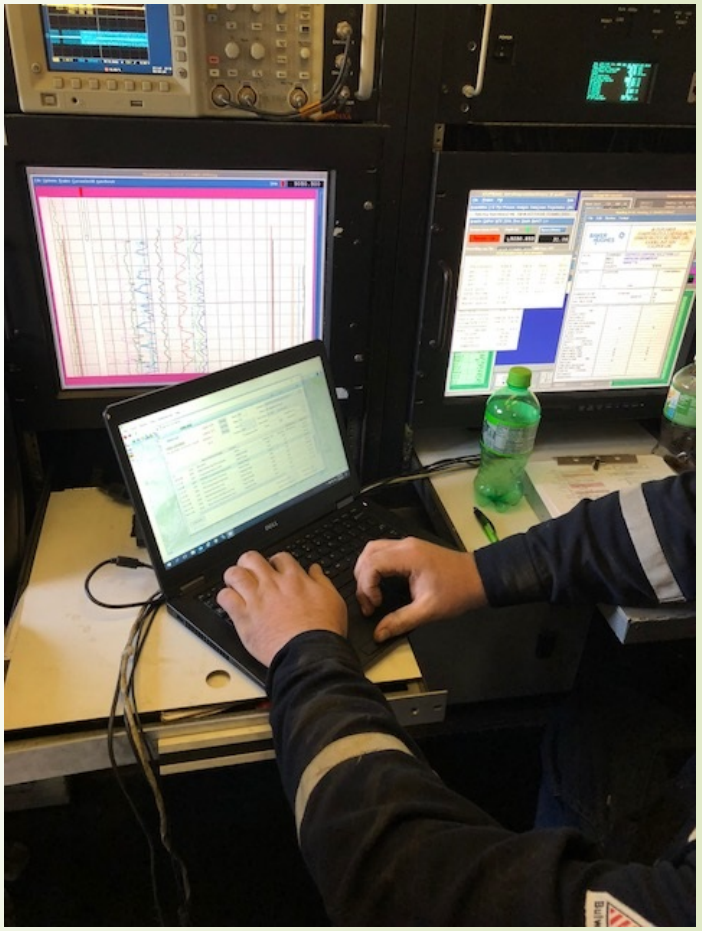
Regulatory Challenges

- Continuing changes to the regulatory environment can present new challenges to the Class II disposal well operator.
- Seismic monitoring and mitigation is now required on all new Class II disposal wells in Pennsylvania and for deep injection wells in Ohio with the potential for monitoring on other Class II disposal wells based on regulatory discretion.
- West Virginia requires detailed seismic activity assessment and fault delineation and evaluation on new and renewal Class II disposal well applications.

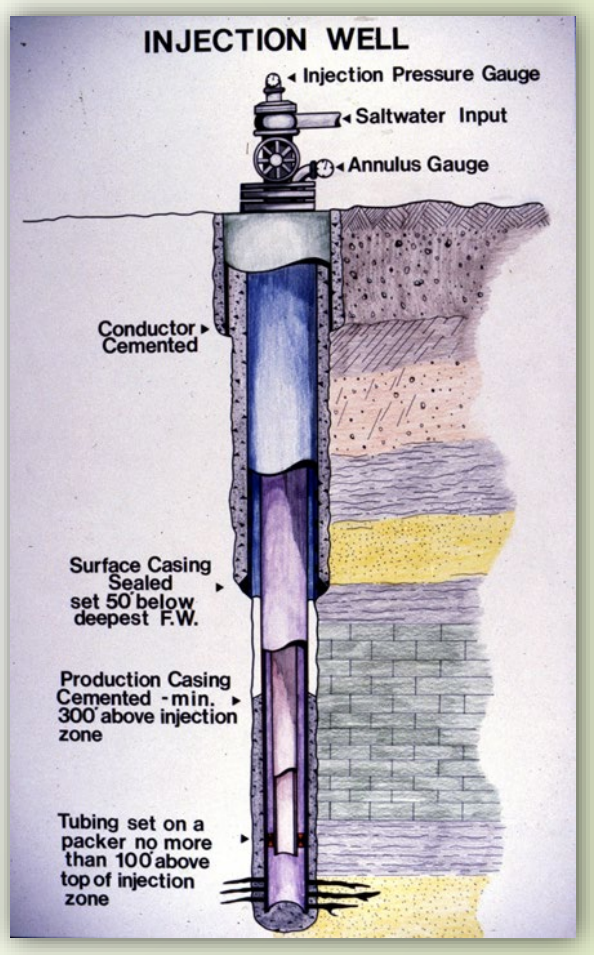
Geologic Evaluation and Assessment

- Proper geological evaluation is critical to a successful large capacity disposal well in the Appalachian Basin.
- Knowledge of geologic formations and regional variations is important in selecting appropriate disposal intervals.



Well Construction and Completion

- Understanding proper well construction design, geophysical log interpretation, cementing, and completion practices in the Appalachian Basin are essential to a successful SWD well.
- Completion methodology – Open hole versus cased hole assessment



Source: DOGRM, 2013

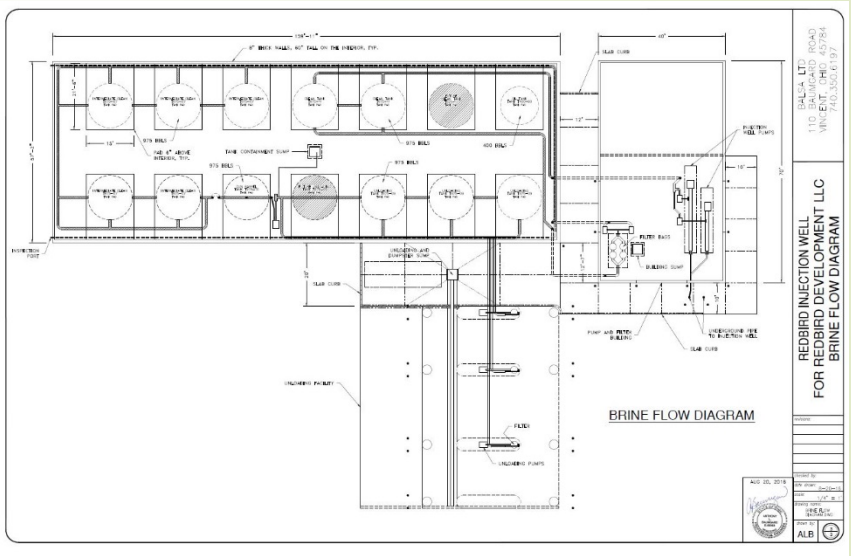
Addressing Public and Local Opposition

- Opposition to Class II disposal wells has increased dramatically in the Appalachian Basin.
- There have been objections to SWD applications and protests and demonstrations at operational sites, along with environmental appeals and litigation.
- The applicant needs to be prepared to face these challenges.

Source: Commondreams.org

Surface Facility Operations

- Surface facility design can vary within the Appalachian Basin, but typically includes:
  - Unloading bays or pad;
  - Appropriate tank storage with secondary containment;
  - Injection pump(s) with filter pods; and usually some type of chemical pre-treatment.



Source: ALL Consulting, 2016

Types of Surface Facilities

Source: ALL Consulting, 2017

Source: ALL Consulting, 2016

Pre-Treatment Program

- It is extremely important to properly filter and chemically treat the injectate prior to injection.
- Chemical treatment needs to address not only the type of fluid to be injected, but also the sensitivity of the injection formations.
- Failure to properly treat or filter injectate can lead to skin effect and formation damage.
- Poorly filtered or treated injectate leads to solids filling up wellbore, plugged tubing, and expensive well workovers.
- It is far cheaper to address on the surface then in the subsurface.

Examples of Poorly Treated Injectate

Source: ALL Consulting, 2016

Source: ChemTreat, 2019

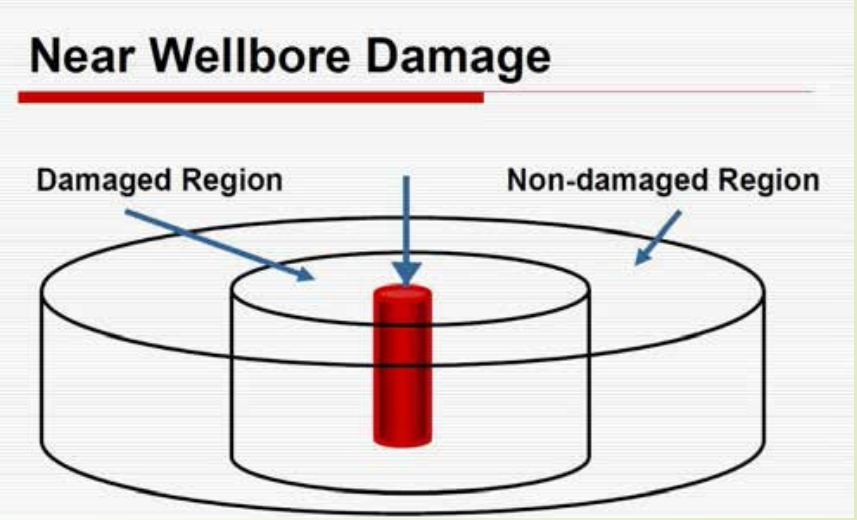
Better Solids Removal

- Use of an inline weir tank, gun barrel, DAF system, hydrocyclone, or desilter/ desander provides for better separation and removal "on the fly" of solid (silt) particles.
- Dramatically reduces the reliance on conventional filter sticks and sock filters.
- Use of these advanced technologies can lead to savings in labor and disposal costs of filtering media.

Source: DR Environmental, 2019

Formation Damage

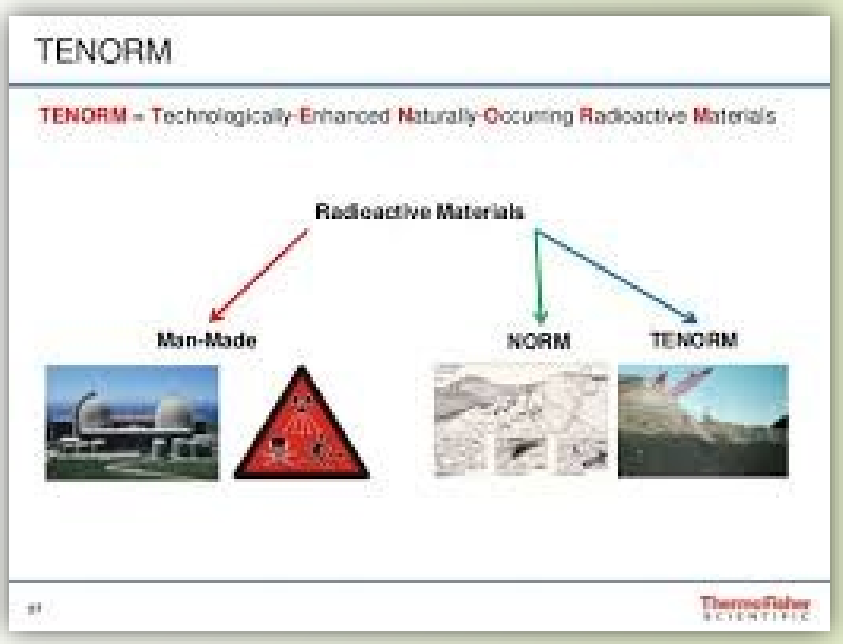
- Any unintended impedance to the flow of fluids into or out of a wellbore (reduction in permeability) is commonly referred to as formation damage.
- •Formation damage is usually caused by physico-chemical, chemical, biological, hydrodynamic, and thermal interactions of the porous geologic formation with particles, fluids, and mechanical deformation of the reservoir.
- •Well injectivity is reduced by deposition and flow modification at and around the wellbore.



Source: Civan, 2006

TENORM Disposal Issues in the Appalachian Basin

- TENORM in Ohio and West Virginia is regulated by the State's Health Departments and under Chapter 78a by the PA DEP.
- Oil and gas regulations also address requirements for testing or manifesting of TENORM solid wastes.
- Radium-226 and Radium-228 are the predominant TENORM issues with oil and gas.
- At Ohio Class II SWD facilities, solids required to be tested for TENORM will be tank bottoms, pipe scale, and filter media.
- These solids can also be manifested for shipment out of state without conducting testing.



Source: Slideshare.net, 2015

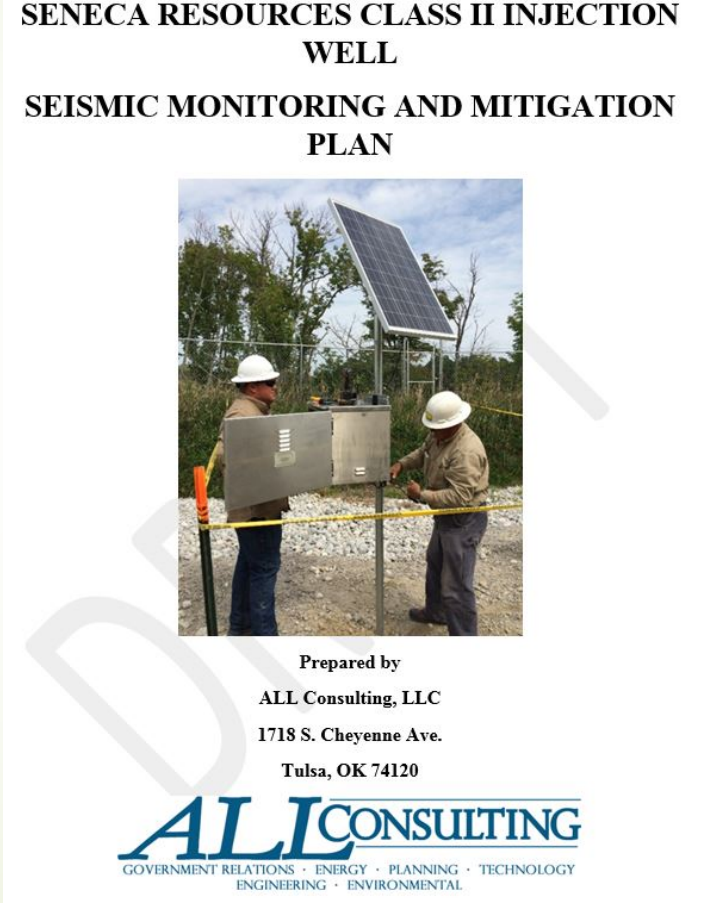
Seismic Monitoring and Mitigation

- Development of a monitoring and mitigation plan is becoming a critical consideration for Class II disposal operations.
- This is a proactive approach that can effectively manage and mitigate injection-induced seismicity.
- PA DEP and Ohio have developed seismic monitoring and mitigation requirements.

Source: ALL Consulting, 2018

The Plan

- A plan, which includes both monitoring and mitigation elements, should be built upon hazard identification, risk assessment, and data evaluation that provides for a technology-based process for accessing and addressing actual and perceived risks.



Hazard Identification and Risk Assessment

- **Involves evaluation and determination of:**
  - Site specific subsurface geology and geophysical data;
  - Identification of pre-existing, favorably-oriented faults in the vicinity of injection operations;
  - Hydrologic conditions;
  - Existing seismic networks and their effectiveness;
  - Injection reservoir analysis;
  - Injection history; and
  - Assessment of historical seismicity in the area.
- **Additional risk considerations:**
  - Assessment of population density;
  - Structures;
  - Infrastructure; and
  - Human health, safety, and the environment.

Summary

- Proper consideration of these challenges can lead to success in SWD environment in the Appalachian Basin.
- ALL is actively engaged in assisting oil and gas and injection well clients in this area and understands how to maneuver in the disposal well landscape and how to address these challenges.

Source: ALL Consulting, 2018

Questions

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Source: ALL Consulting, 2018

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