

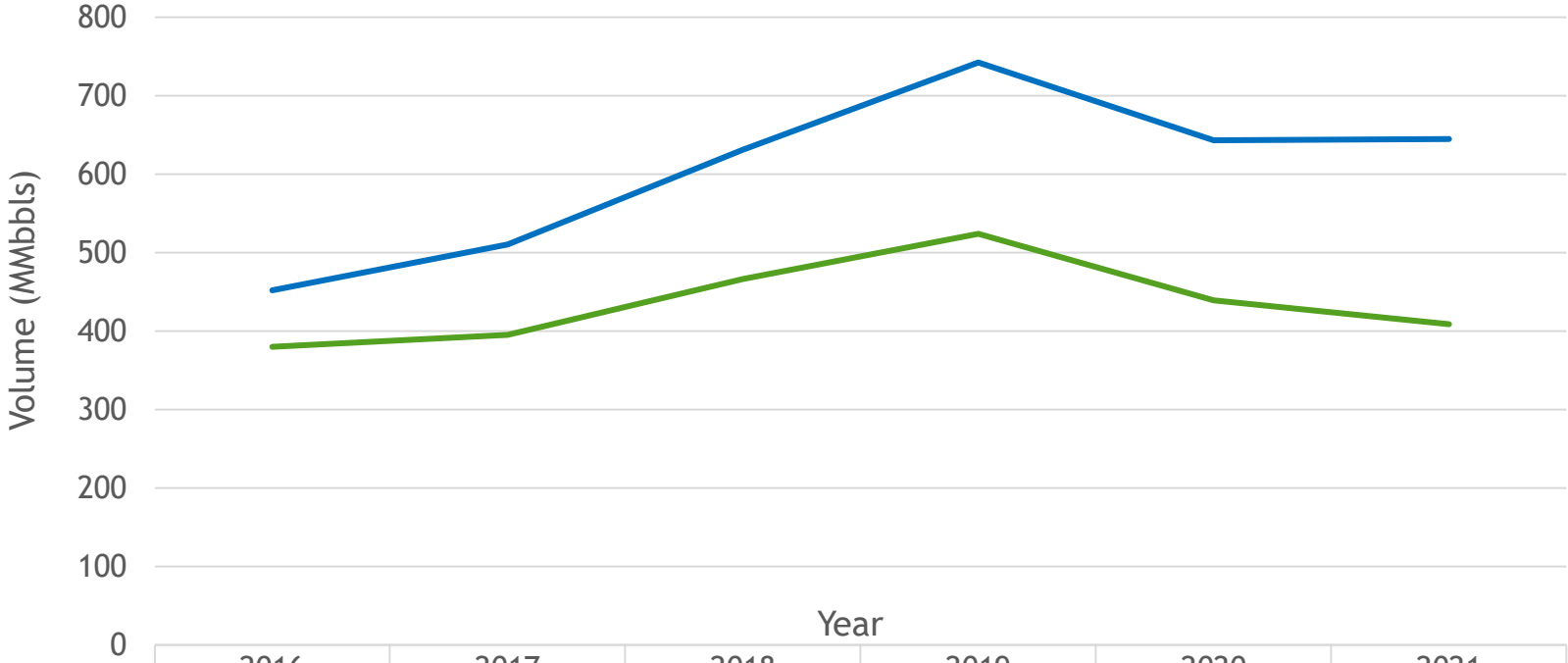
NDIC UIC Class II Program Update

March 8, 2022 Technical Solutions Group Meeting

Ashleigh Day - UIC Supervisor
NDIC Oil & Gas Division

North Dakota Historical Production

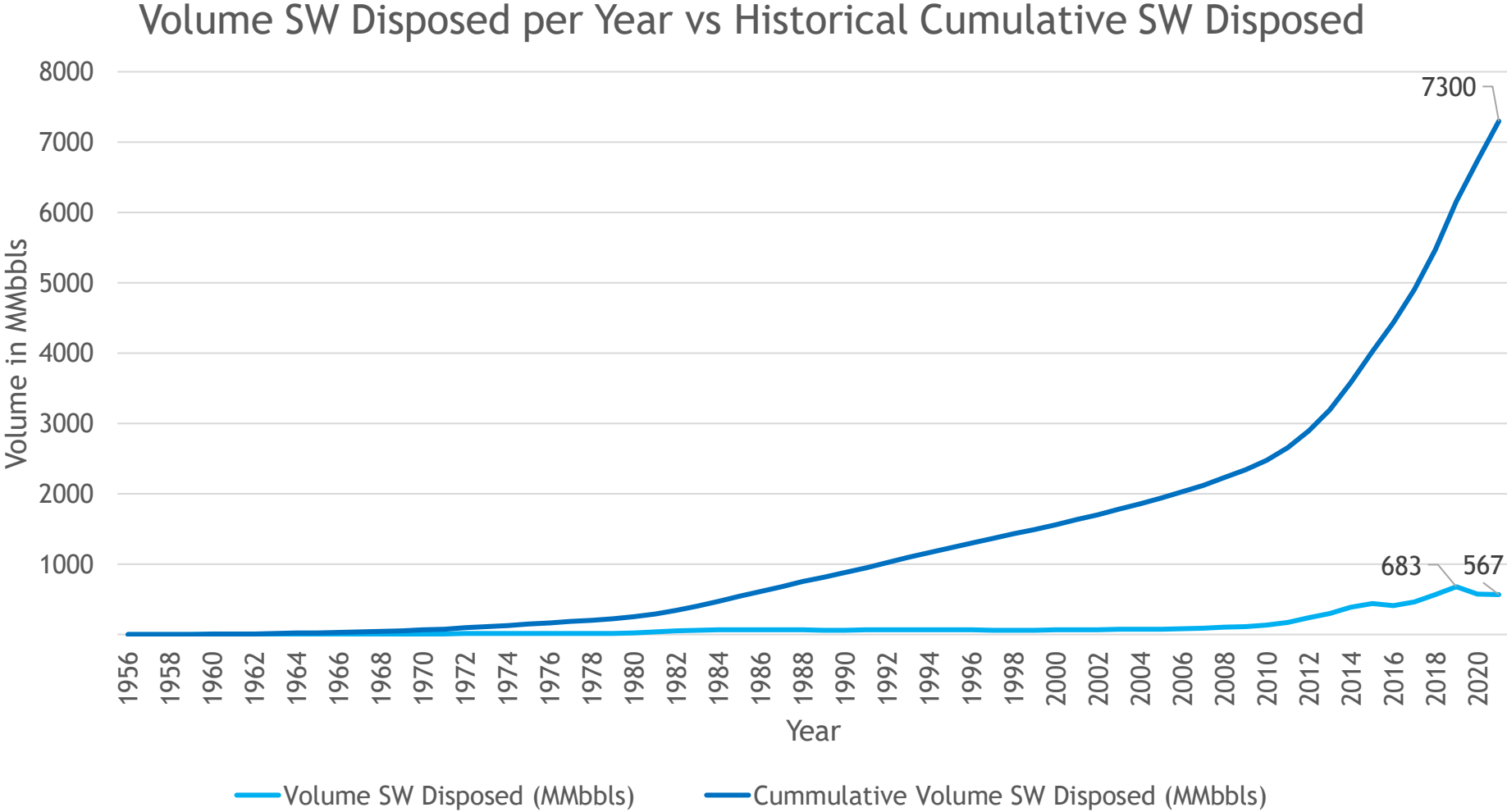
Historical Saltwater and Oil Production in North Dakota (2016-2021)

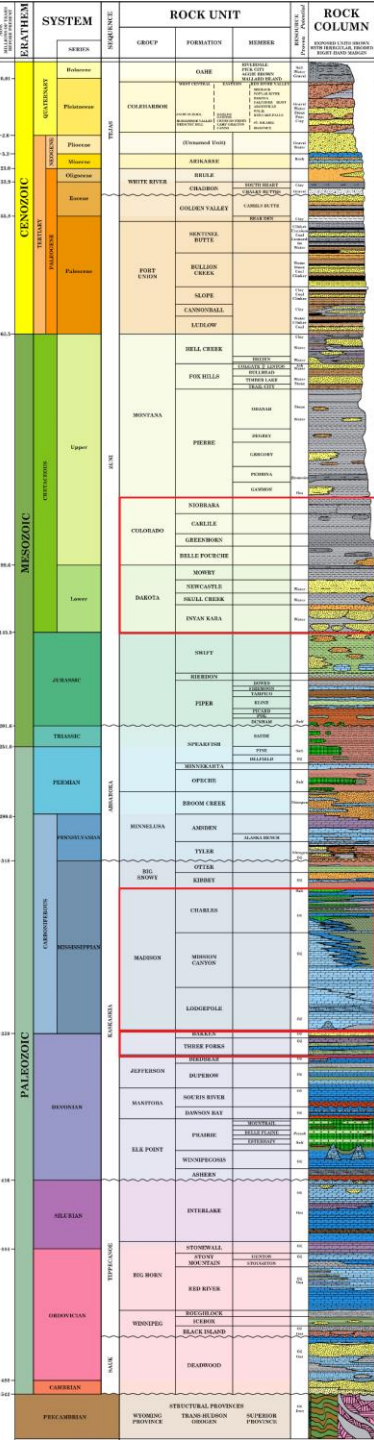


	2016	2017	2018	2019	2020	2021
Volume of SW (MMbbls)	452	510	631	742	643	645
Volume of Oil (MMbbls)	380	395	466	524	439	409

— Volume of SW (MMbbls) — Volume of Oil (MMbbls)

North Dakota Historical Saltwater Disposal Trends





NDIC Field Inspector Observed Drilling Issues Related to Dakota Pressure

Overall Issues:

- ▶ High pressure in the Dakota
 - ▶ Mud weights required to hold back the Dakota have ranged from 11.7 ppg to 13.7 ppg
- ▶ Greenhorn breaks down at a mud weight needed to drill through Dakota
- ▶ High mud weight used to hold back Dakota pressure breaks down the Mission Canyon.

COLORADO	NIORBARA			
	CARLILE			
	GREENHORN			
	BELLE FOURCHE			
DAKOTA	MOWBY			
	NEWCASTLE			Water
	SKULL CREEK			Water
	INYAN KARA			Water

MADISON	CHARLES			
	MISSION CANYON			
	LODGEPOLE			
BAKKEN	BAKKEN			
	THREE FORKS			

NDIC Field Inspector Observed Drilling Issues by County

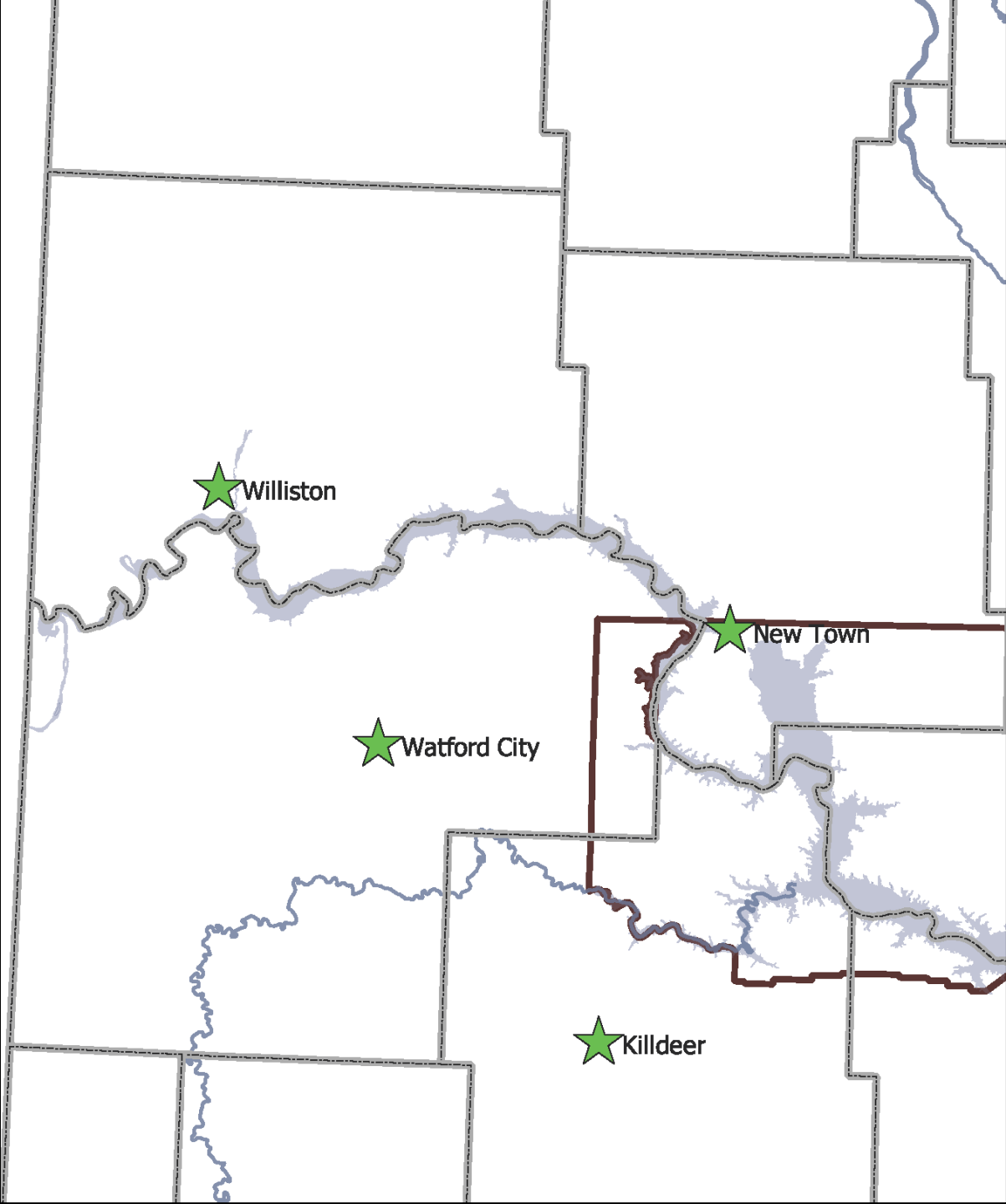
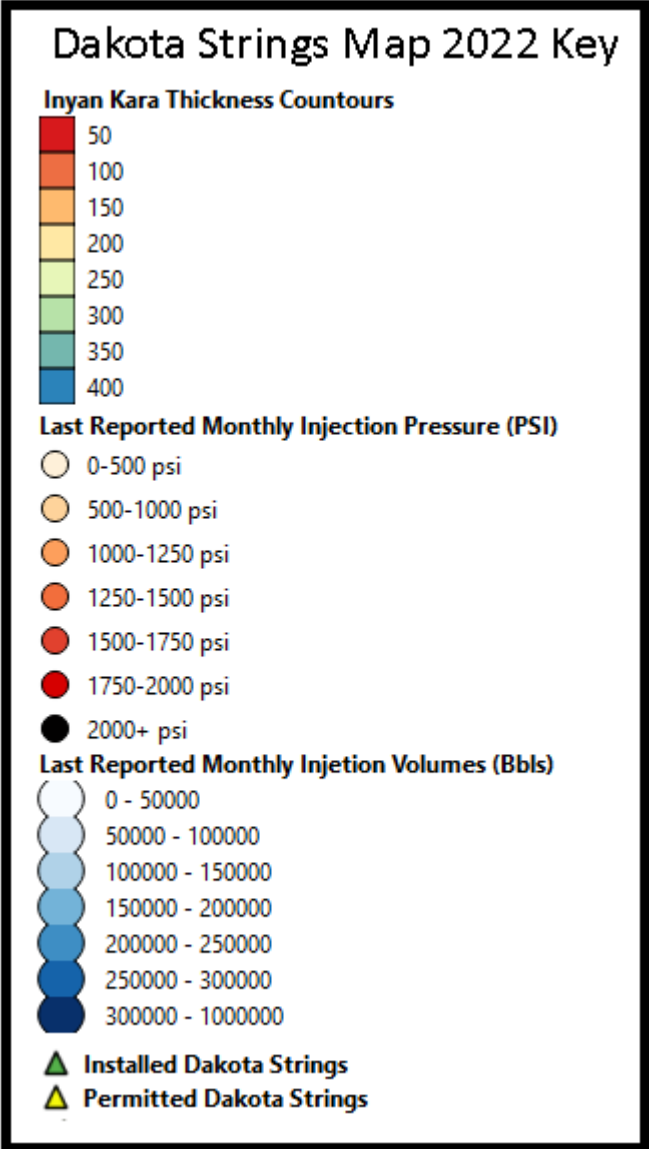
Williams County

- ▶ High Pressure Dakota - Stronger Greenhorn
 - ▶ Greenhorn breaks down between 12.7 ppg - 13.0 ppg
- ▶ Areas of Concern:
 - ▶ Around Williston
 - ▶ Closer proximity to high injection rate and pressure SWDs
 - ▶ Thinner Inyan Kara sands

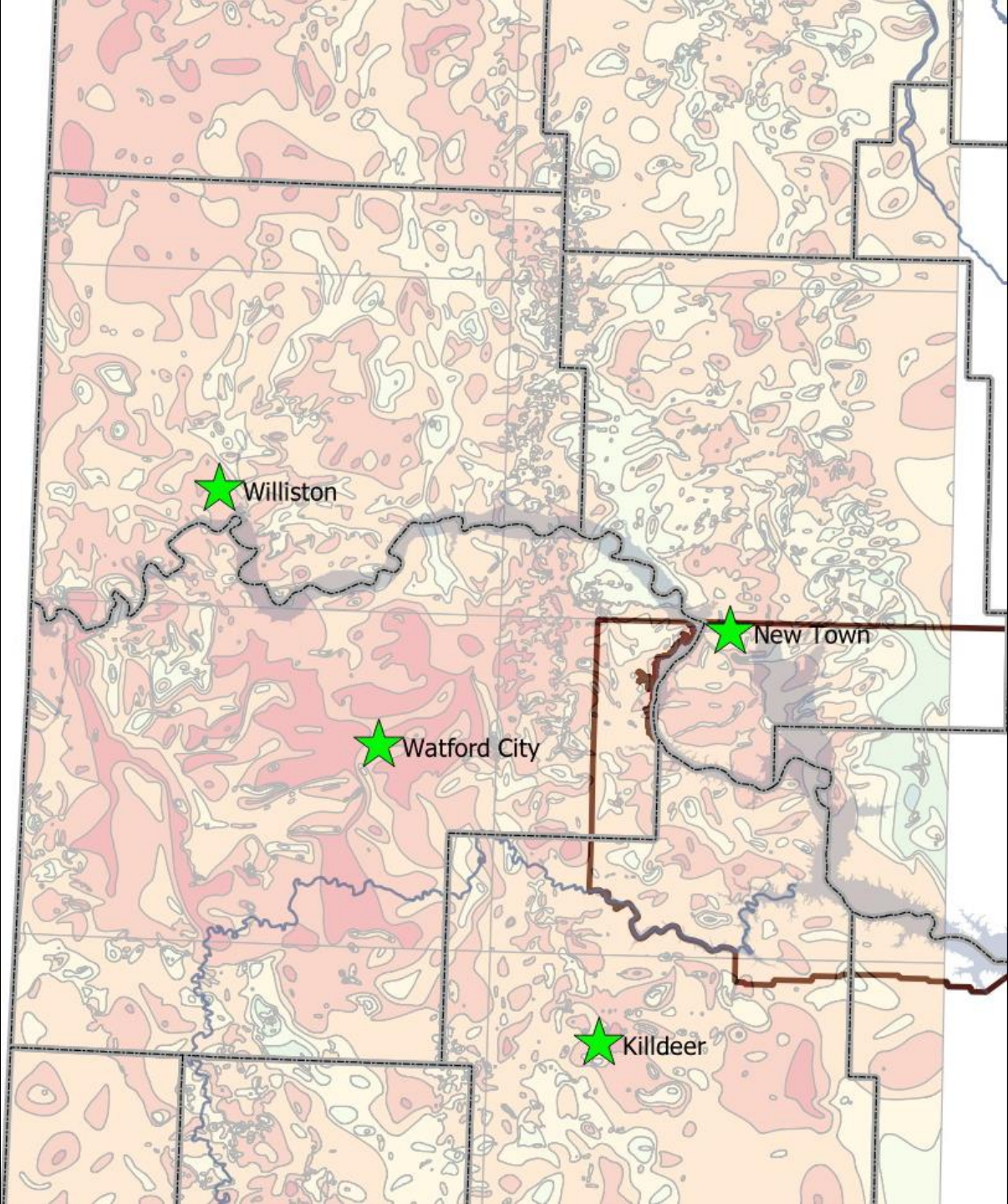
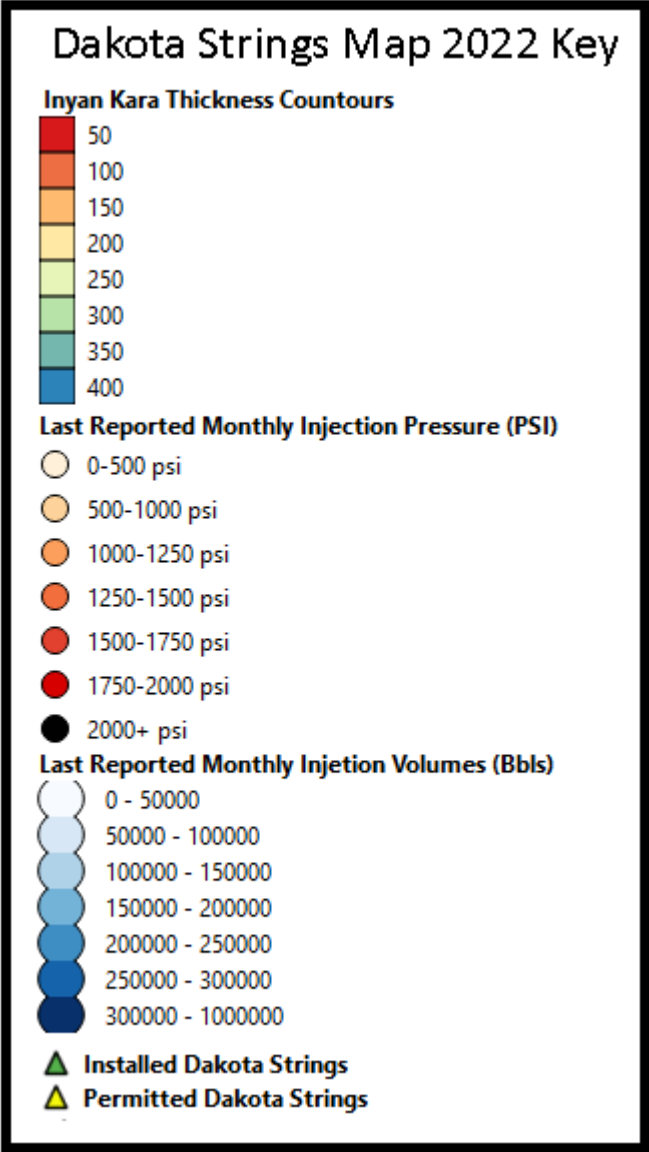
McKenzie County

- ▶ High Pressure Dakota - Weaker Greenhorn
 - ▶ Greenhorn breaks down around 11.5 ppg
- ▶ Areas of Concern:
 - ▶ Around Watford City
 - ▶ North from Watford City towards the lake along Highway 1806

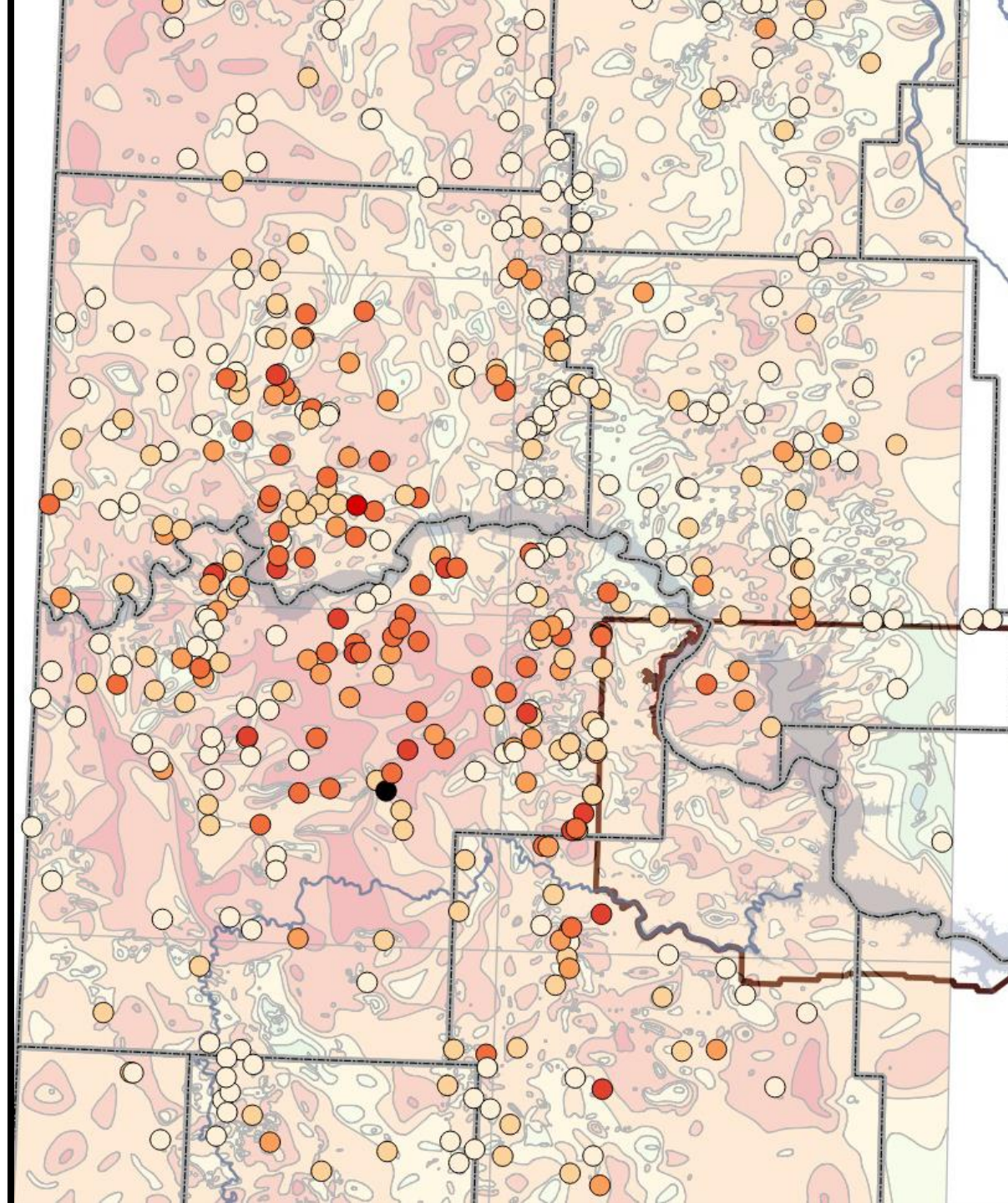
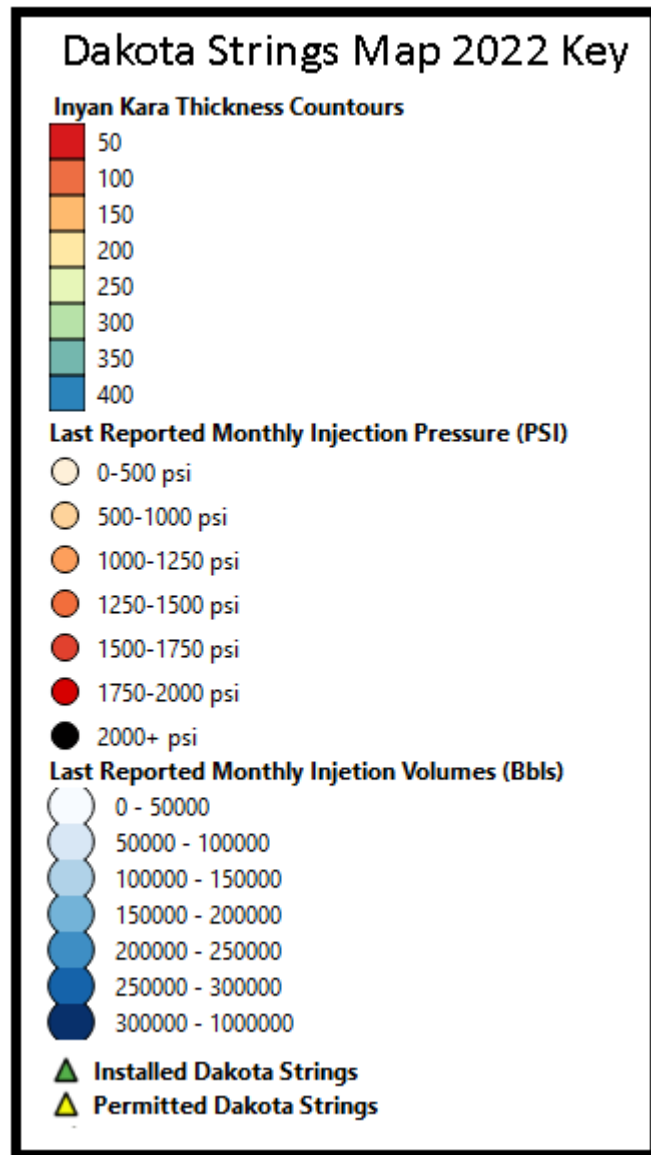
2022 Dakota Strings Map



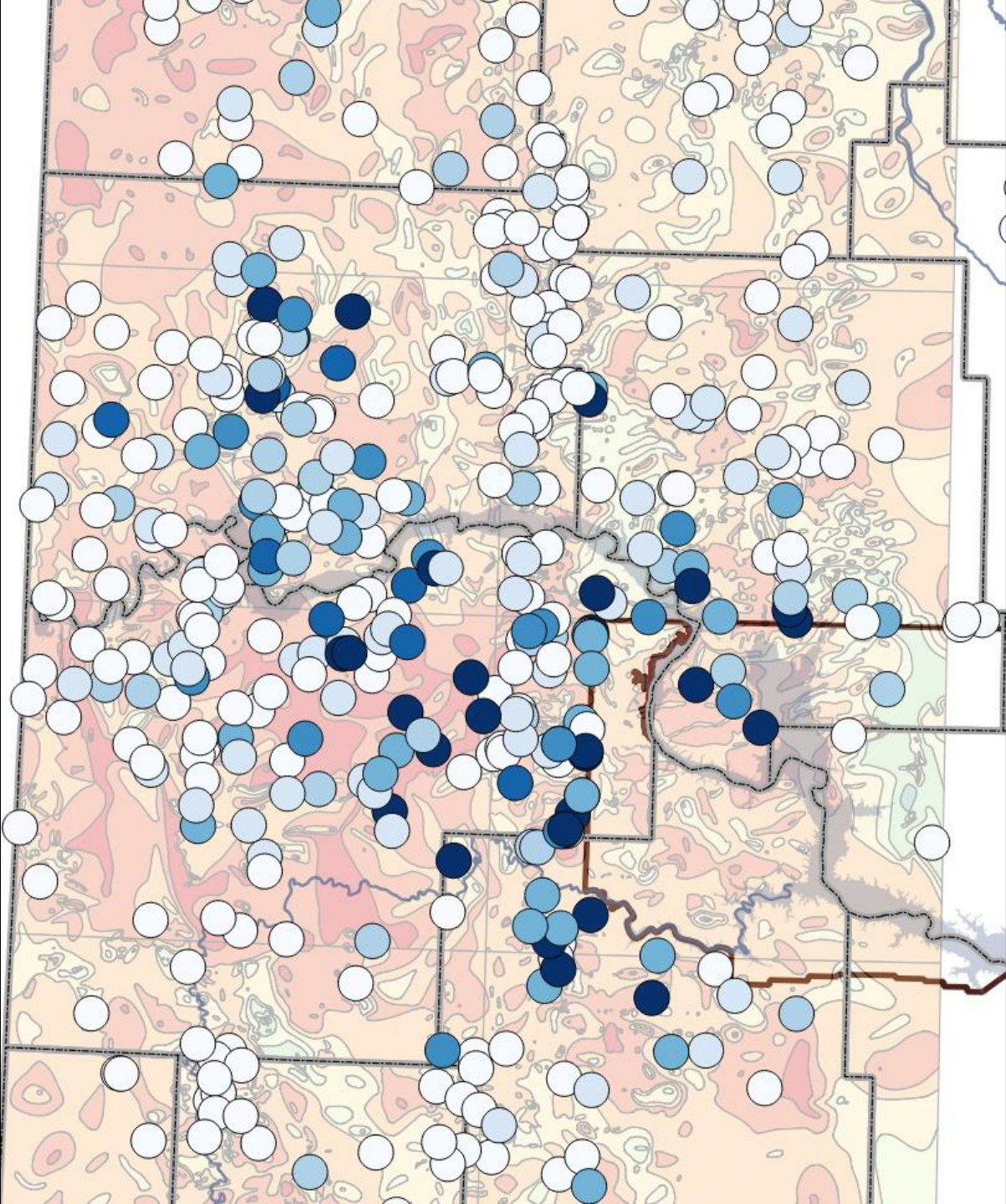
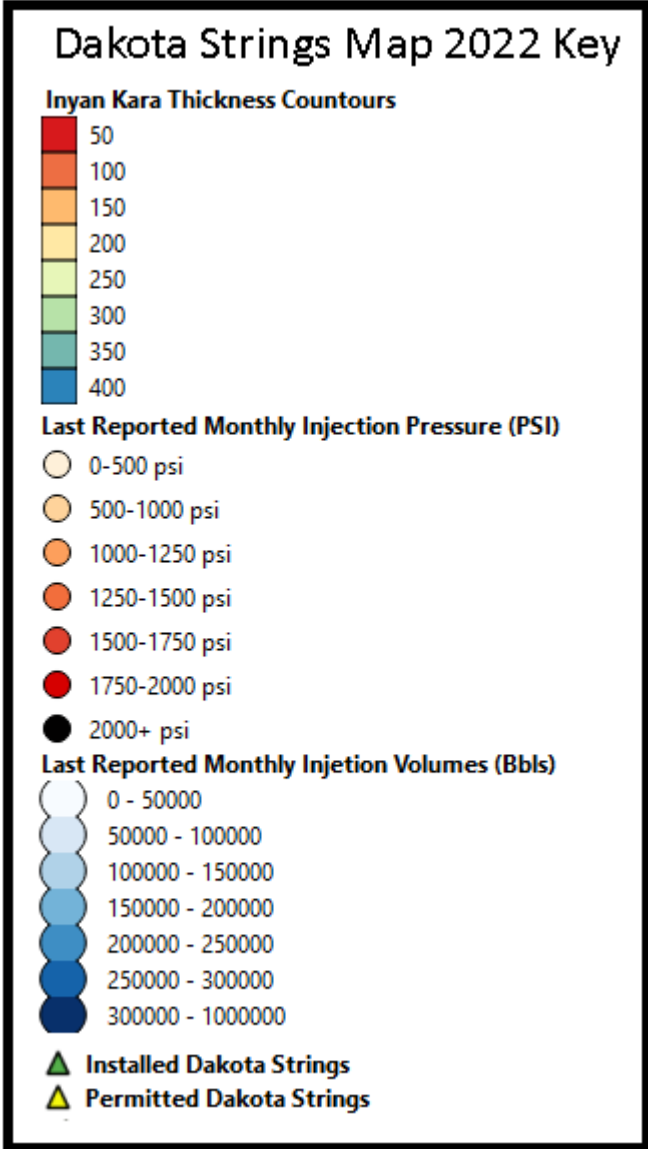
2022 Dakota Strings Map



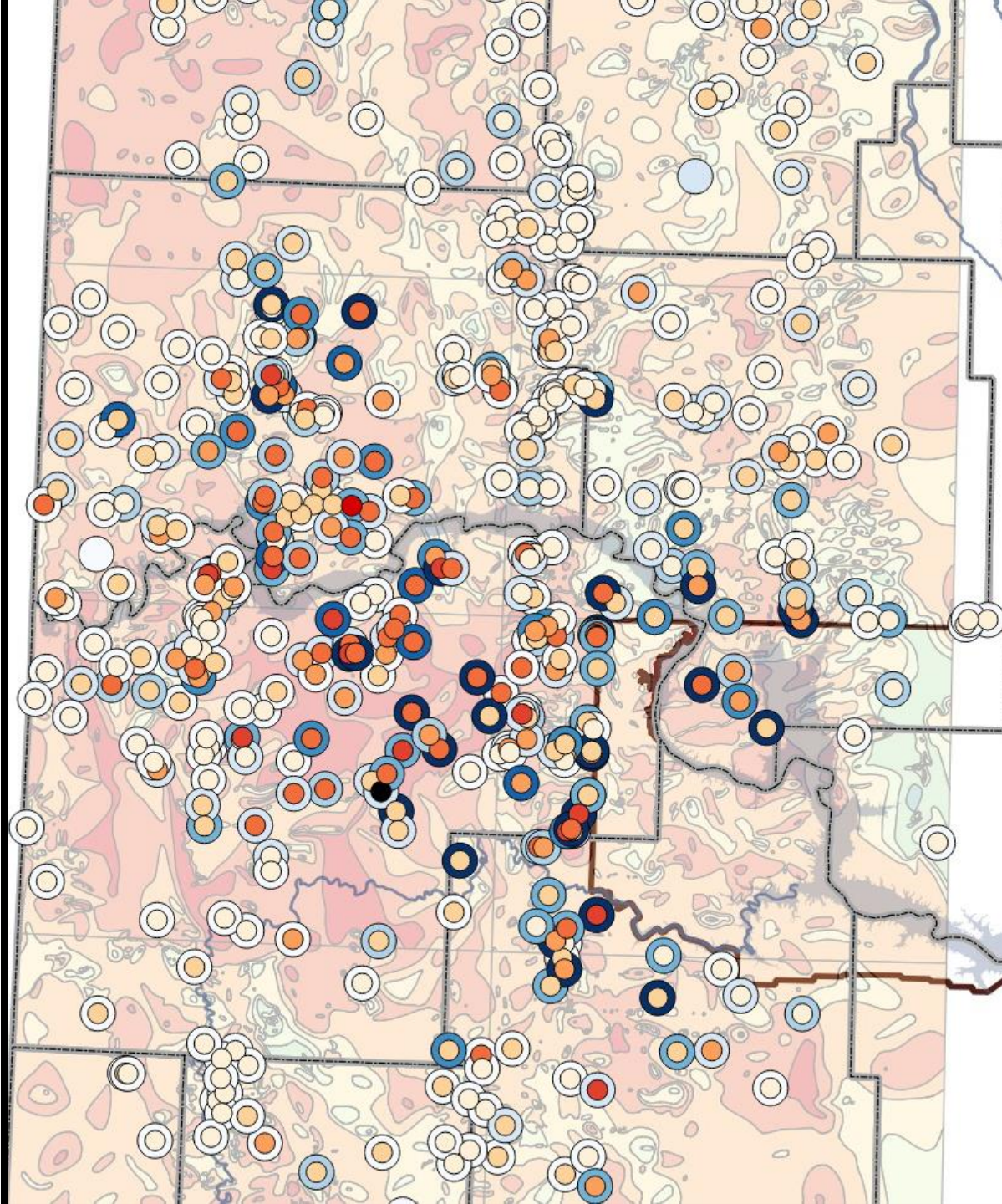
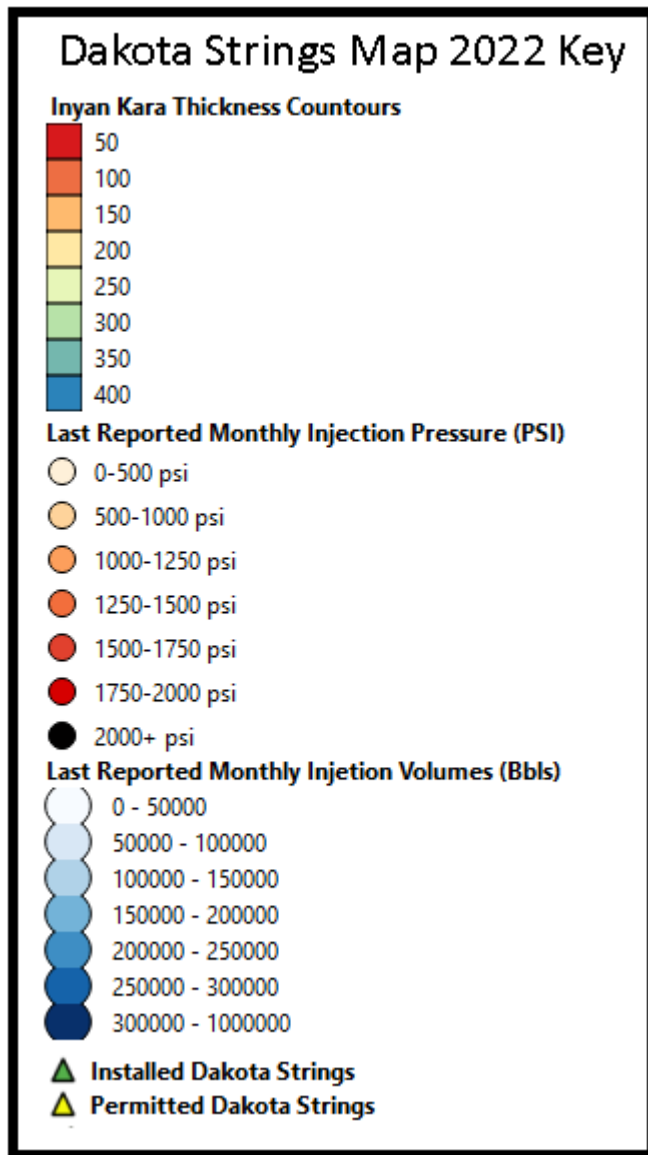
2022 Dakota Strings Map



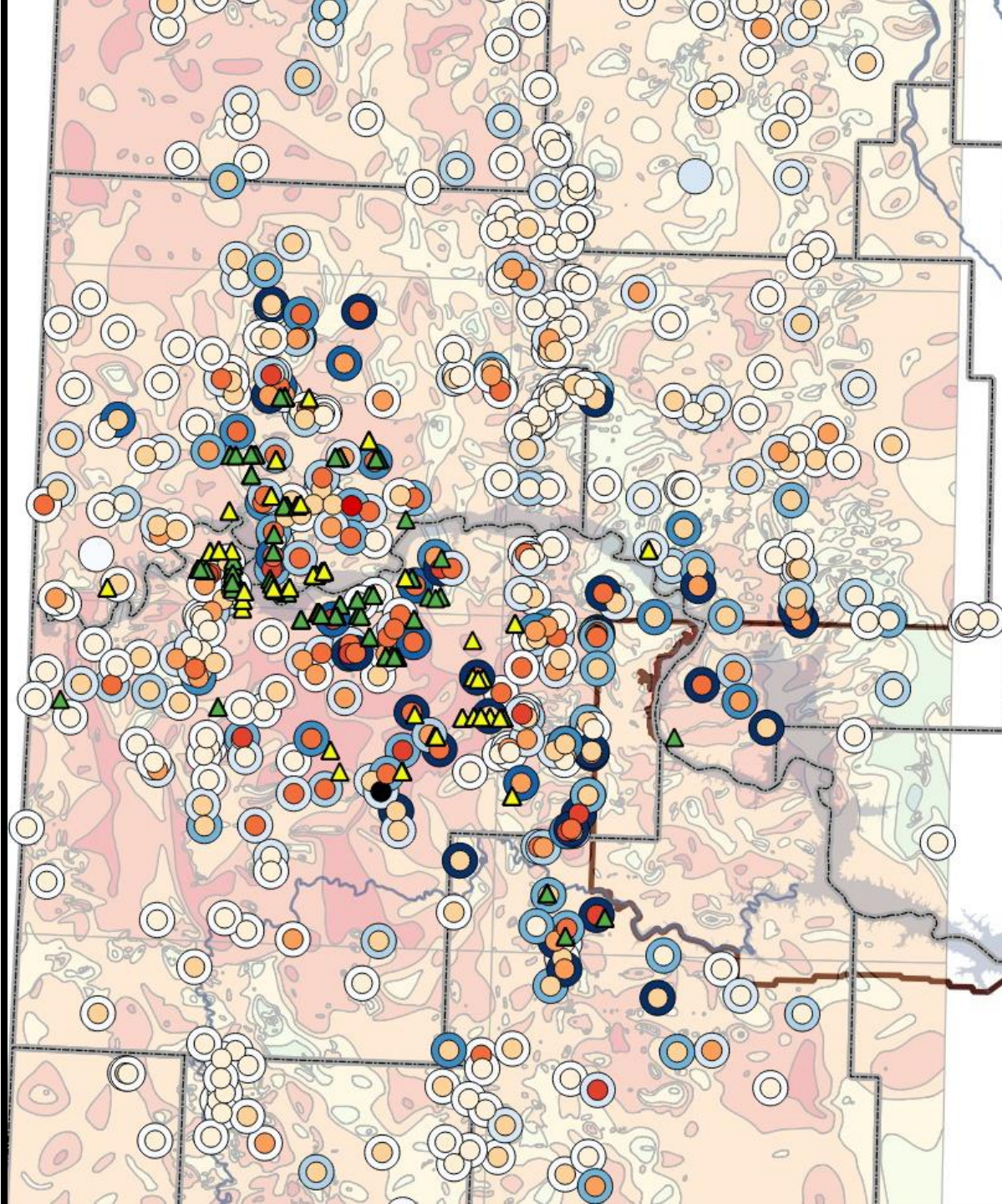
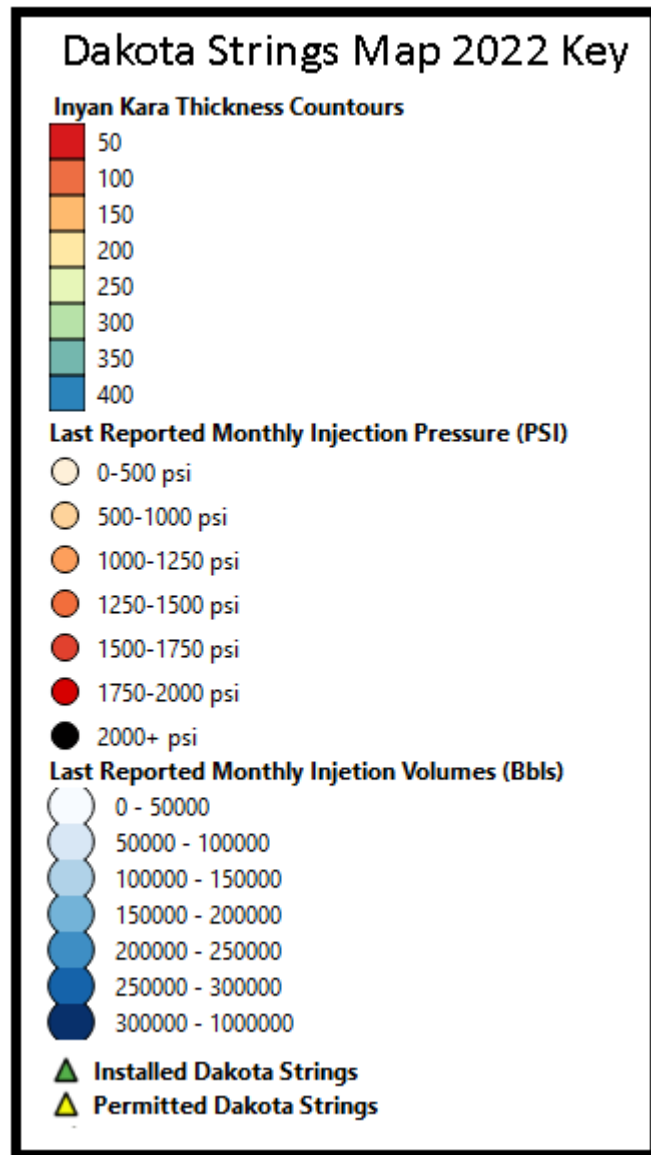
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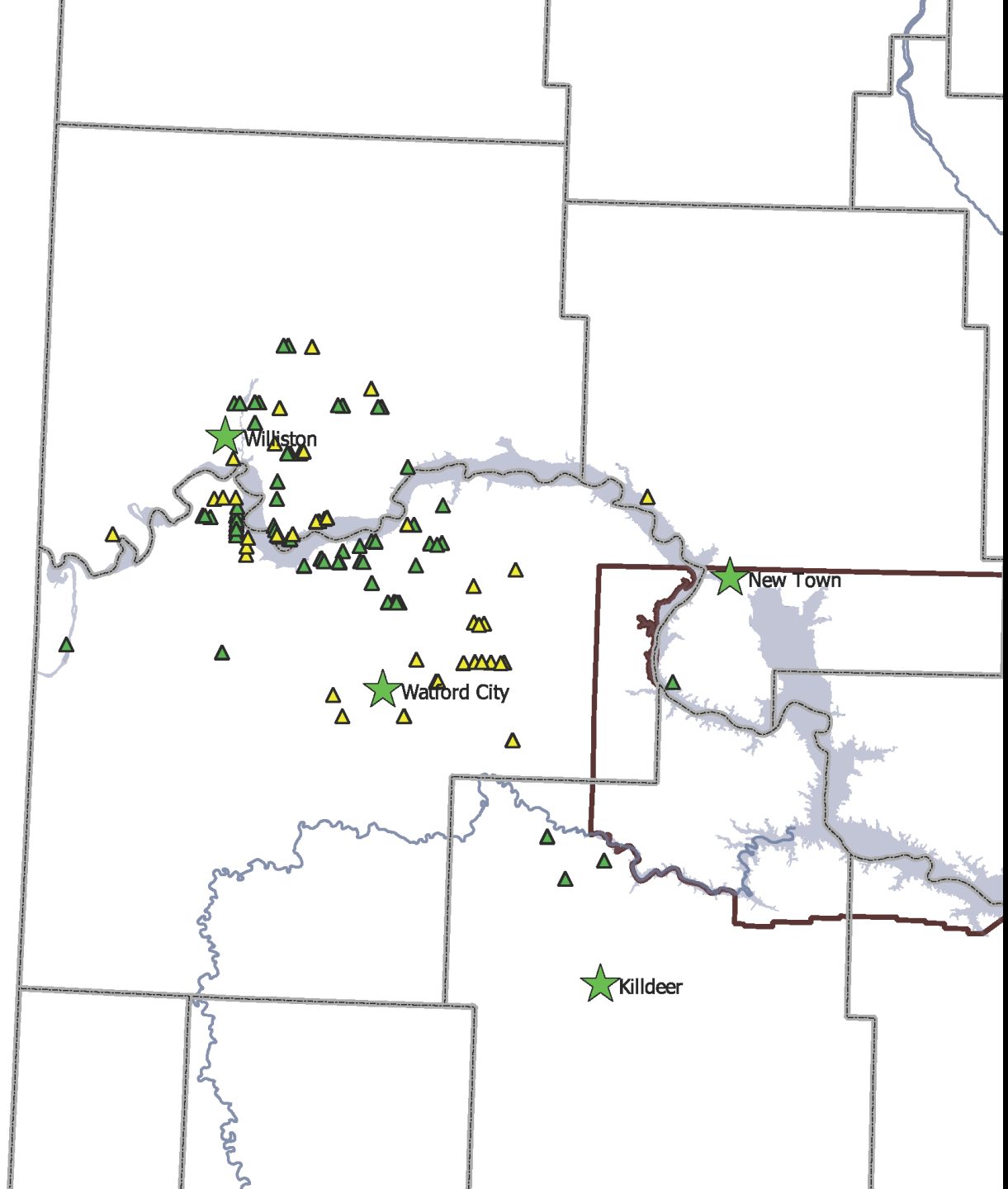
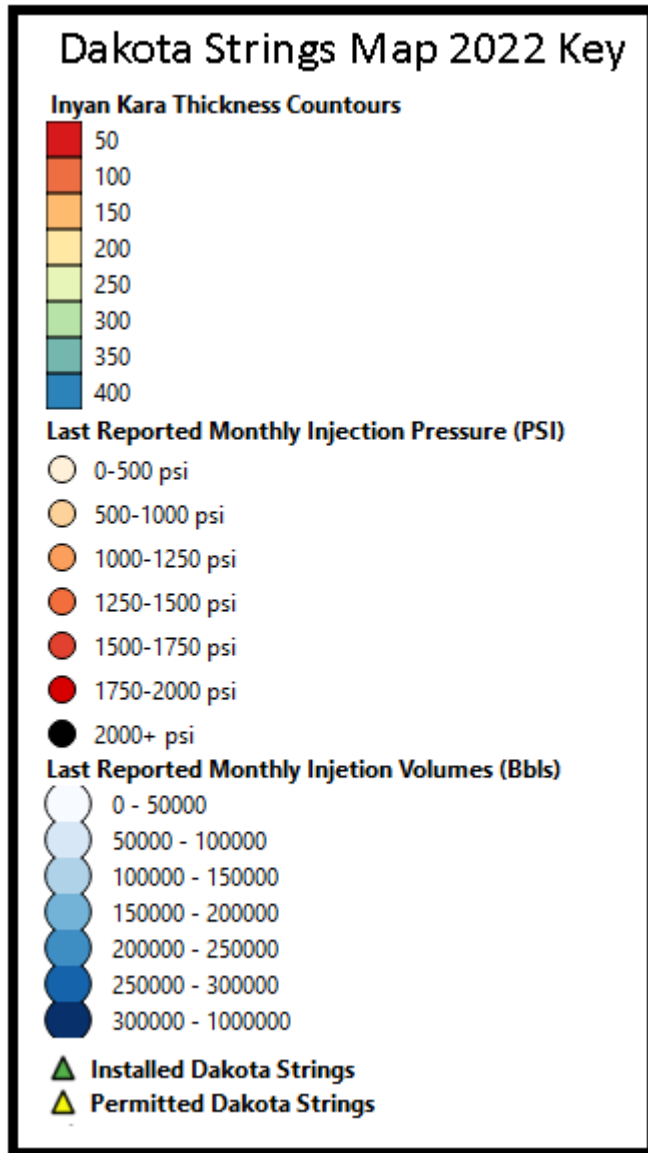
2022 Dakota Strings Map



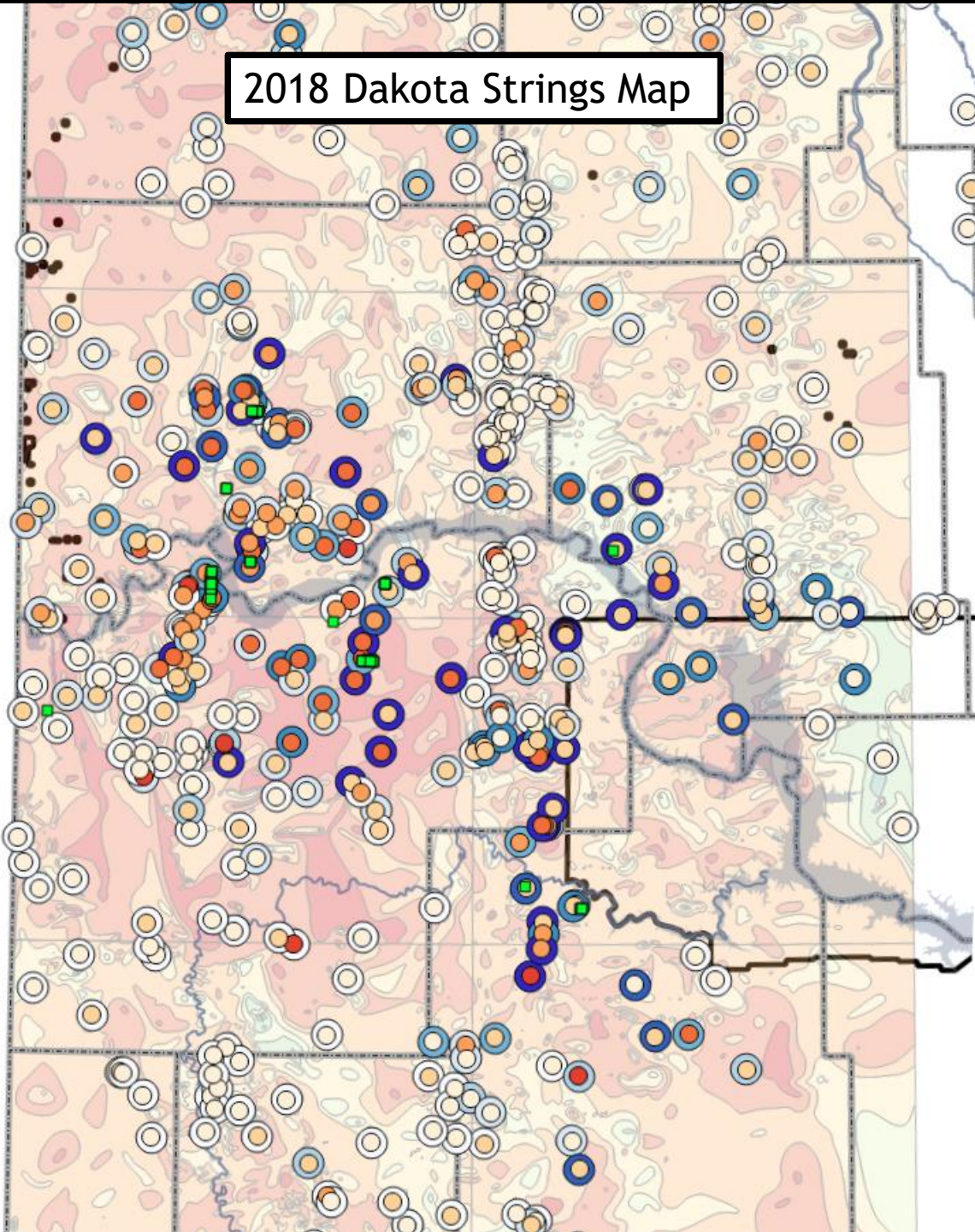
2022 Dakota Strings Map



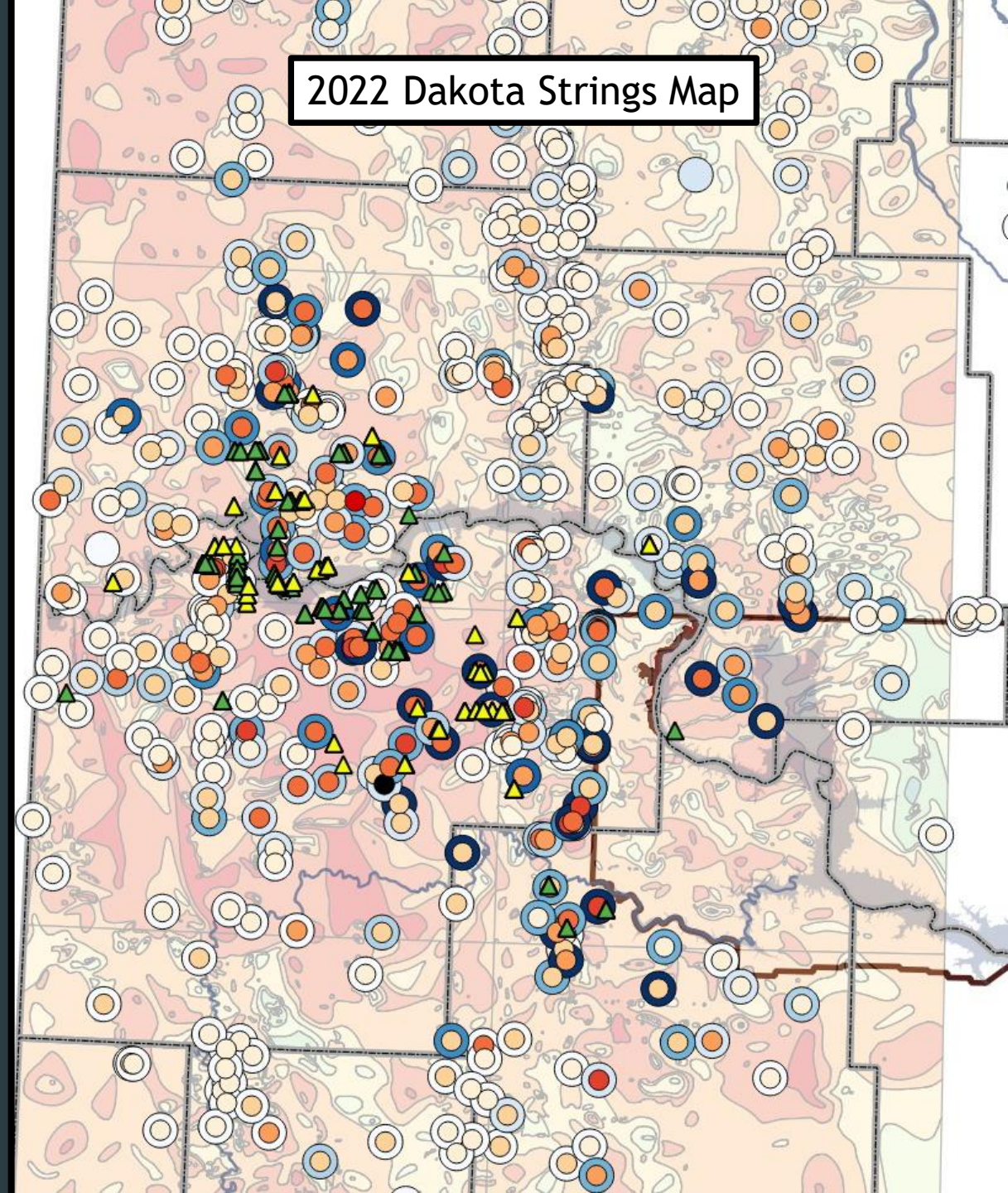
2022 Dakota Strings Map



2018 Dakota Strings Map



2022 Dakota Strings Map



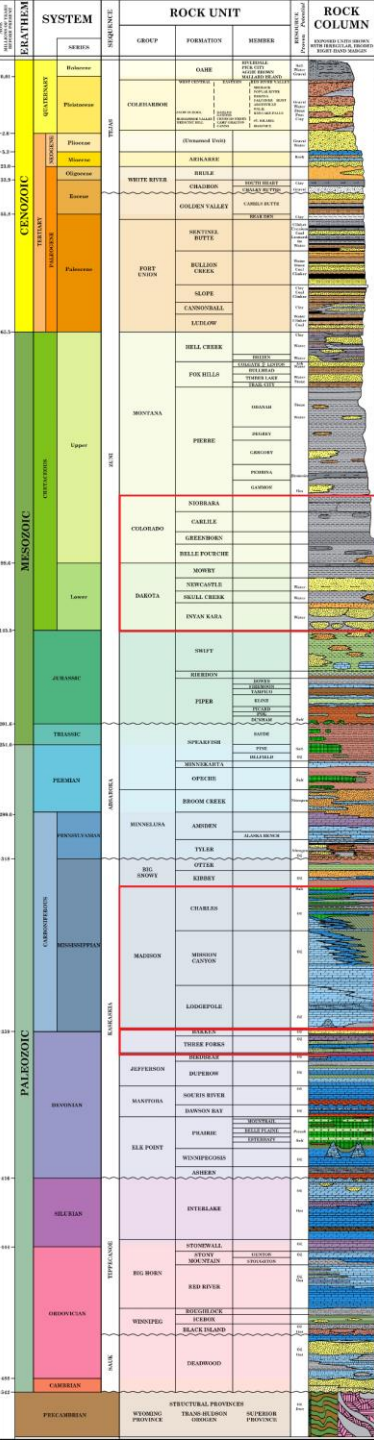
NDIC Field Inspector Observed Drilling Problems & Solutions

Problems

- ▶ Increasing mud weight too early and breaking down the Greenhorn
- ▶ Difficulty killing Dakota flow after Greenhorn has broken down.
 - ▶ 8 wells plugged
 - ▶ 18 surface holes plugged due to issues on the pad and the preset surface casing was not large enough to allow for an additional casing string.
- ▶ Using brine while drilling the vertical portion of the wellbore damaging the shales above the Inyan Kara.
 - ▶ Risk of getting BHA stuck in hole due to sluffing shales.
 - ▶ Results in cementing the BHA in hole as part of plug back.
 - ▶ Or BHA could be required to be fished out of hole depending on location to ensure proper isolation of formations during plug back.

Solutions

- ▶ Blockade Squeezes
 - ▶ Preemptive squeeze performed after drilling through Greenhorn before entering Dakota.
 - ▶ Squeeze Greenhorn with asphalt grade fluid to strengthen formation enough to increase mud weight to get through Dakota and set Dakota string.
 - ▶ Like an LCM type squeeze, creates a barrier like a mud cake.
 - ▶ Works well in Williams County but has not in McKenzie County
- ▶ Cement plugs across the Greenhorn to build strength
 - ▶ Attempted after blockade squeeze failure.
 - ▶ Balanced cement plug across Greenhorn, let cement set and come back and drill out.



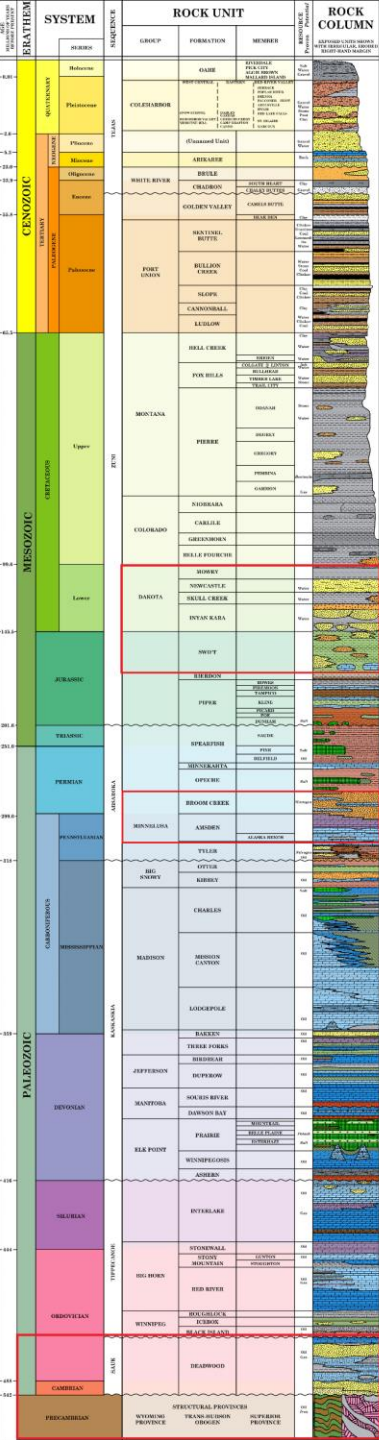
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	INYAN KARA		Water	

MADISON	CHARLES		Oil	
	MISSION CANYON		Oil	
	LODGEPOLE		Oil	
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	THREE FORKS		Oil	

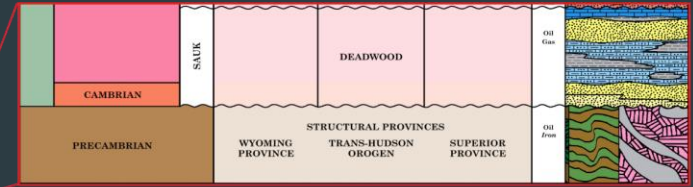
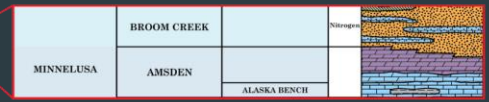
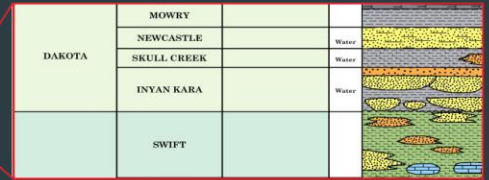
Potential Proactive Solutions

- ▶ Closely monitor mud weights and incrementally increase mud weight depending on formation entered.
- ▶ Preemptive blockade squeeze in the Greenhorn.
- ▶ Drilling into formations, setting cement plugs for strength, and coming back to drill out the plugs.
- ▶ Take note of nearby disposal wells' rates and pressures during the permitting process and prior to starting drilling of a well.
 - ▶ Work with nearby disposals for potential to stop injection during drilling operations.
- ▶ Wellbore Design Solutions
 - ▶ Additional casing strings to cover the Greenhorn and Dakota
 - ▶ Surface casing, Greenhorn string, Dakota string, Intermediate casing and liner
 - ▶ Monobore - Surface casing, Greenhorn string, Dakota string, Production Casing from surface to TD.

Alternative Disposal Zones



- ▶ **Current Disposal Zones**
 - ▶ Primary Zone - Inyan Kara - Larger sand package(s) within the Dakota Group.
 - ▶ New Castle - A less prevalent sand package in the Dakota Group above the Inyan Kara sands.
 - ▶ Swift - Sands in the upper Swift have been targeted along with the Inyan Kara sands.
 - ▶ Minnelusa Group - Sands in the Broom Creek and upper Amsden are targeted. Sand package thicknesses vary across the basin.
 - ▶ NOTE: All of these disposal zones are above the Bakken.
- ▶ **Other Potential Disposal Zones**
 - ▶ Deadwood - Upper interbedded sandstones
 - ▶ Located above the Precambrian basement rock
 - ▶ At its deepest in the basin the top of the Deadwood is ~14,500'. (The top of the Bakken is at ~10,000').
 - ▶ Not much information on the Deadwood in North Dakota. Currently coring as part of Class VI projects.

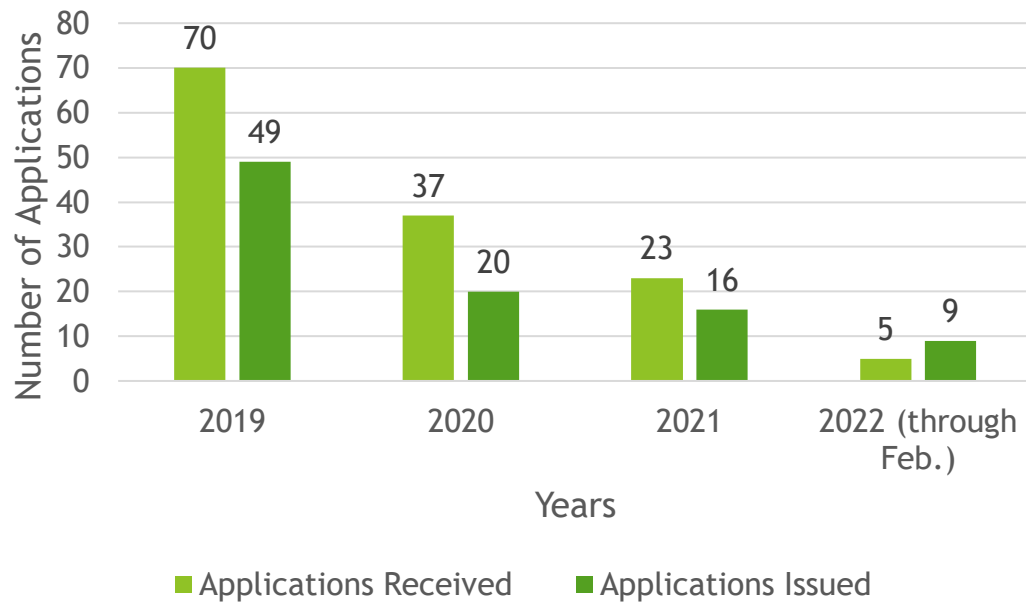


Requirements for Consideration to Dispose in Historically Productive Zones

- ▶ Operator must demonstrate that the correlative rights of all applicable owners can be protected.
 - ▶ Required Formation Evaluations Information
 - ▶ Geologic Assessment of the Proposed Formation
 - ▶ Structure map, isopach map, reservoir properties (porosity, permeability, oil or gas saturation, water saturation)
 - ▶ Presence of Hydrocarbons
 - ▶ All production records, production test, swab tests, drill stem tests, log analysis
 - ▶ List of Wells and Logs used
 - ▶ Legal description of mineral and lessee ownership within ½ mile of the proposed completion interval.
 - ▶ Notification of all mineral interest owners, including overriding royalty interest owners and working interest owners of the proposed completion interval and injection formation.
 - ▶ Detailed analysis and explanation of how correlative rights of all owners will be protected.
- ▶ **Commission is open to consider the potential of injection in historically productive zones and each is evaluated on a case-by-case basis.**

2022 SWD Permitting

SWD Application Stats



NorthStar UIC Permitting

- ▶ UIC Application submission is now in NorthStar
 - ▶ All of the same attachments are required to be uploaded as part of the NorthStar application.
- ▶ Review and Hearing process follows the same pattern as before:
 1. Initial Review - Prior to docketing for hearing.
 2. Detailed Review - After hearing is completed.
 3. Final Review - Order is drafted after application is correct and complete.
 4. Permit Approved

UIC Permitting Cont.

UIC Permitting Rule Changes

- ▶ Bonding (NDAC Section 43-02-03-15(2))
 - ▶ Non Commercial SWD - wells that dispose of some of the operator's own produced water.
 - ▶ Can be placed on existing \$100,000 blanket bond.
 - ▶ Commercial SWD - well that only receives fluids produced from wells operated by other operators
 - ▶ Must be placed on \$100,000 single well bond.
- ▶ Operator Notification (NDAC Section 43-02-05-04(1)(t))
 - ▶ 2018 policy was added to rules in 2020.
 - ▶ Operators of usable oil and gas wells within the AOR of a proposed SWD well are required to be sent a letter notifying them of the proposed SWD well and giving them an opportunity to comment on the application.
- ▶ Proof of Receipt for All Notice Letters (NDAC Section 43-02-05-04)
 - ▶ Added to rules in 2020.
 - ▶ Proof of receipt for all notice letters sent as part of a UIC application are required to be submitted. This can be in the form of copies of the returned certified mail green cards or the online equivalent showing delivery of the letter.

Permitting Resources

- ▶ Surficial Aquifer Review

Any proposed SWD within 1 mile of a mapped surficial aquifer requires soil borings at the proposed site and a geotechnical analysis.

 - ▶ ND Hub Explorer Map (<https://www.nd.gov/gis/apps/HubExplorerV2/>)
 - ▶ Layers: NDGISHub_Hydrography > Surficial Aquifers, DRASTIC, GTS_Aquifers
- ▶ Fresh Water Well Review

The nearest 2 freshwater wells within a 1-mile radius of the proposed well are required to be sampled by a state certified lab and a copy of the analyses submitted.

 - ▶ ND Dept. of Water Resources Map (<http://mapservice.swc.state.nd.us/>)
 - ▶ Layers: Water Resources > Drillers Logs
 - ▶ Google Earth - Used to locate potential residences with wells that are not registered with the DWR.
- ▶ Landowner Notification

All landowners within the ¼ mile AOR of the proposed well are required to be notified.

 - ▶ County parcel viewers
Ex. Divide County Parcel Viewer (<https://portico.mygisonline.com/html5/?viewer=dividend>)

Fracture Slurry Injection Update

Active FSI Injection

- ▶ 1 active FSI well in ND.
 - ▶ KT Enterprises 34-22 SFI well located in Johnson Corner Field in McKenzie County.
 - ▶ Injection is into the Broom Creek and Amsden sands.
 - ▶ Active since April 13, 2021.
 - ▶ Cumulative Totals Injected April 2021 through January 2022
 - ▶ Slurry Volume Injected = 92,432 bbls
 - ▶ Solids Injected = 8,222 bbls

FSI Permitting Process

- ▶ Prior to docketing any FSI project for hearing it is crucial to meet with NDIC staff.
 - ▶ Initial geographical area review
 - ▶ Initial geological review
 - ▶ Go over all current requirements and concerns
- ▶ Application requirements are outlined in the most recent FSI order (Order No. 31434).
- ▶ Hearings involve detailed review of the geology and modeling presented for the proposed well(s).
 - ▶ A case to set the bond amount and a case for any associated treating plant are heard on the same day.
- ▶ Applications go through detailed review process.
- ▶ After the order is signed and the application has completed the review process the permit can be approved.

Safety and Spills

Safety Regulation

NDAC Section 43-02-03-25

- ▶ Any rubbish or debris that might constitute a fire hazard shall be removed.
- ▶ All vegetation must be removed to a safe distance from any production or injection equipment to eliminate a fire hazard.
- ▶ Remote or automatic shutdown equipment may be required.
- ▶ No well, production or injection equipment, saltwater handling facility or treating plant may be less than five hundred feet from an occupied dwelling unless agreed to in writing by the owner of the dwelling or authorized by order of the commission.

Spill Regulations

- ▶ Spill Reporting - NDAC Section 43-02-03-30
 - ▶ Immediate notice to NDIC followed by online reporting with 24 hours using the Unified Spill Reporting System (<https://www.spill.nd.gov/>)
 - ▶ This system has been active since 2021 and is the spill reporting site for all spill types in the state.
 - ▶ Public Portal - general info center for the public and can find specific spills using location information.
 - ▶ Reporting Portal - Oil field spill reports are automatically sent to NDIC, DEQ, DES and others dependent on the location.
 - ▶ Does not cover any federal requirements which must be met by operator.
 - ▶ Offsite spills require notification of the landowner.
 - ▶ Wells spud or facilities constructed before 9/2/2020 are required to report any spill greater than 1 bbl.
 - ▶ Wells spud or facilities constructed after 9/2/2020 are required to report any spill greater than 10 bbl.
 - ▶ May impose more stringent spill reporting requirements if warranted by proximity to sensitive areas, past spill performance, or careless operating practices.
- ▶ Spill Clean up - NDAC Section 43-02-03-30.1
 - ▶ Operators should work with NDIC field inspectors during clean up.

NDIC Contact:
Cody Vanderbusch
Reclamation Specialist

Saltwater Gathering Pipelines

NDAC Section 43-02-03-29.1

NDIC Contact:
Tamara Madche
Pipeline Supervisor

- ▶ Bonding NDAC Section 43-02-03-15(8)
 - ▶ Bonding is required on produced water gathering pipeline systems.
 - ▶ This bonding is separate from well bonding.
 - ▶ The bond remains in force until all pipelines on the system have been properly abandoned and the right-of-way, including all associated above ground equipment, has been reclaimed.
 - ▶ Pipelines which are inactive (idle/deactivated) are not considered properly abandoned.
- ▶ Mapping Requirements
 - ▶ Pipeline Submissions that require GIS layer(s):
 - ▶ Proposed new construction, integrity test results, as-builts, repair, abandonment, bonding, inactive for over a year
- ▶ Operation Requirements
 - ▶ Maximum operating pressure (MOP) may not exceed the manufactures specs of the pipe or any component of the pipeline.
 - ▶ Adequate controls and protective equipment placed on the pipeline to prevent operating above the MOP
 - ▶ Operators are required to prove integrity on all new or repaired pipelines prior to use.
 - ▶ MOP may not exceed the test pressure from the most recent integrity test.
- ▶ Leak Protection, Monitoring and Spill Response
 - ▶ Pipeline system must have a form of monitoring.
 - ▶ Ex. Pressure and flow monitoring, drone flyovers, volume balancing.
 - ▶ Inactive pipelines must still be monitored.
 - ▶ Data Sharing Plans - plan must provide for real-time sharing of data between the operator of the production facility, the underground gathering pipeline owner, and the operator at the point or points of disposal.
 - ▶ A spill response plan must be maintained during the service life of the pipeline system.