North Dakota Update

February 04, 2021

House Energy and Natural Resources Committee HB 1401

- Legacy Brine Pit Sites
- Background
- 2020 Update
- Budget

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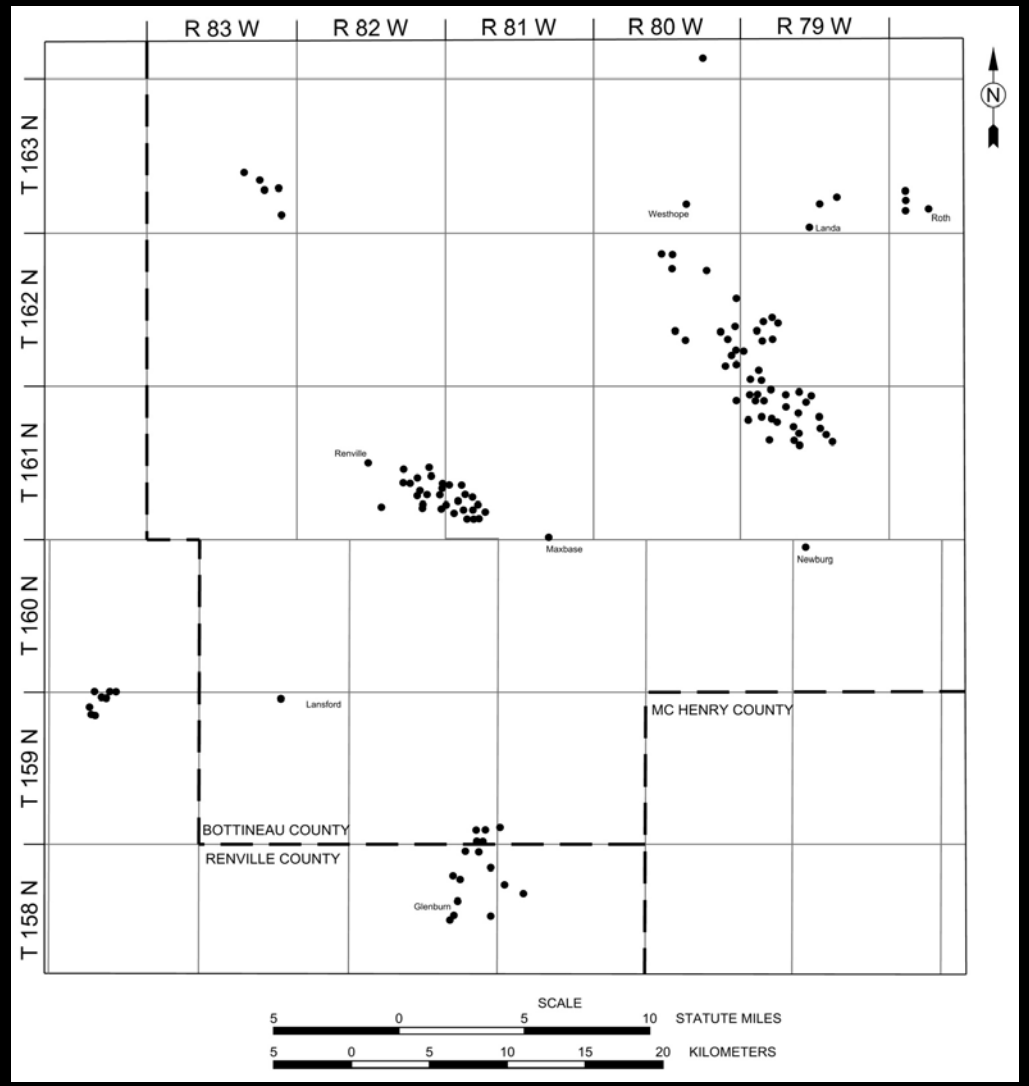
NDSU SOILS DEPT 1984 STUDY

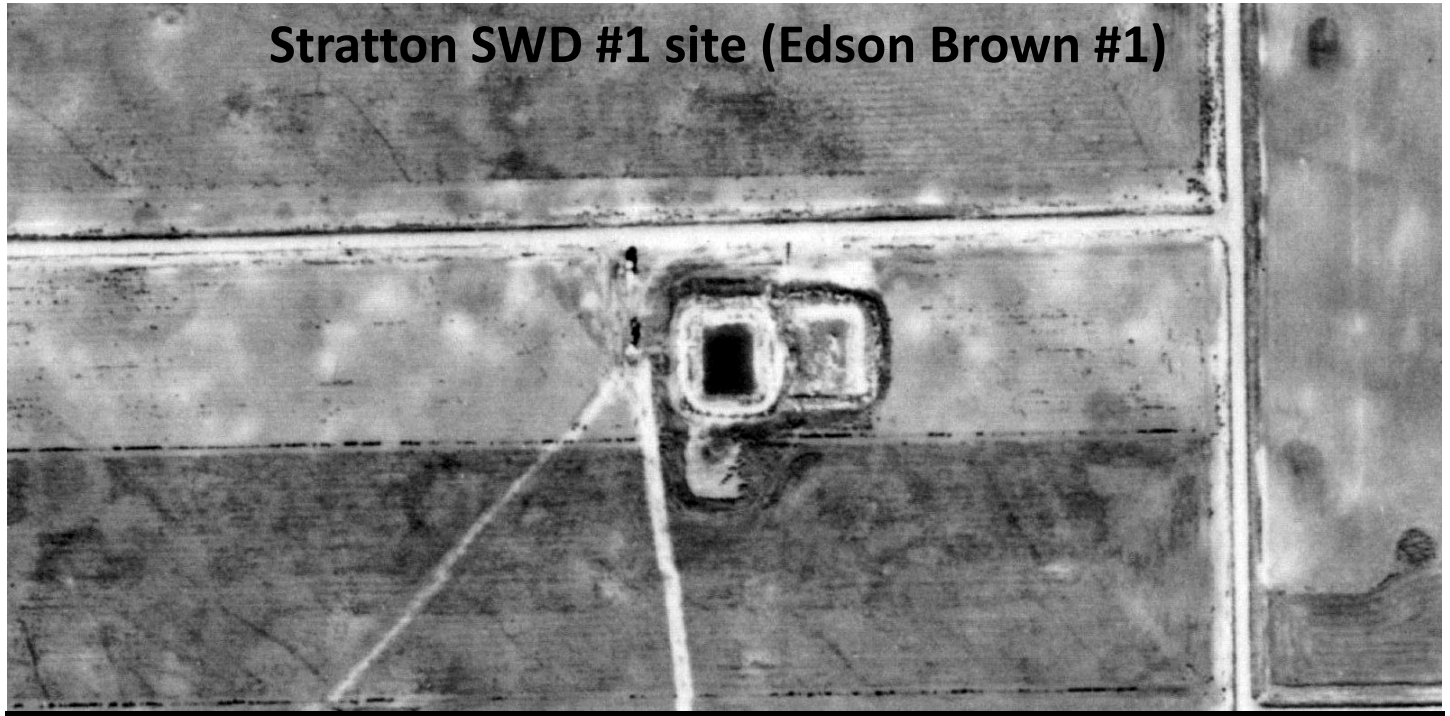
Identified 121 old brine pond sites in Bottineau and Renville Counties.

Estimated the area contaminated by old brine ponds at 1,450 acres (average of 12 acres per site).

Interpreted aerial photographs from various years and scales.


R 83 W
R 82 W
R 81 W
R 80 W
R 79 W
T 163 N
T 162 N
T 161 N
T 160 N
T 159 N
T 158 N
N
Westhope
Landa
Roth
Renville
Maxbase
Newburg
Lansford
MC HENRY COUNTY
BOTTINEAU COUNTY
RENVILLE COUNTY
Glenburn
SCALE
5 0 5 10 STATUTE MILES
5 0 5 10 15 20 KILOMETERS

Stratton SWD #1 site (Edson Brown #1)



1984

Drilled in 1959 by Cardinal Petroleum (Edson Brown #1).
Produced oil from 1959-1970.
Converted to a saltwater disposal well by Phillips Petroleum in 1978 (Stratton SWD #1).
The site contained two brine holding ponds from 1959 to at least 1970 (5 feet deep and 100 x 90 ft & 60 x 100 ft = 0.7 acres).
Produced 178,000 barrels of saltwater.

2005

A high salinity plume extends laterally around the site over an area of about 3 acres.
Plume restricted to till and not impacting any useable water supply (ND Health Dept. concurred in 2006).
High chloride levels at 160 feet (500 - 750 mg/l) appear to be coming from the underlying Fox Hills Formation (hydraulic heads).

Energy & Environmental Research Center

LEGACY BRINE PIT PROJECT

Wednesday, March 15, 2017

Presentation to the North Dakota Industrial Commission
Bismarck, North Dakota

Bethany Kurz
Principal Hydrogeologist

Critical Challenges. Practical Solutions.

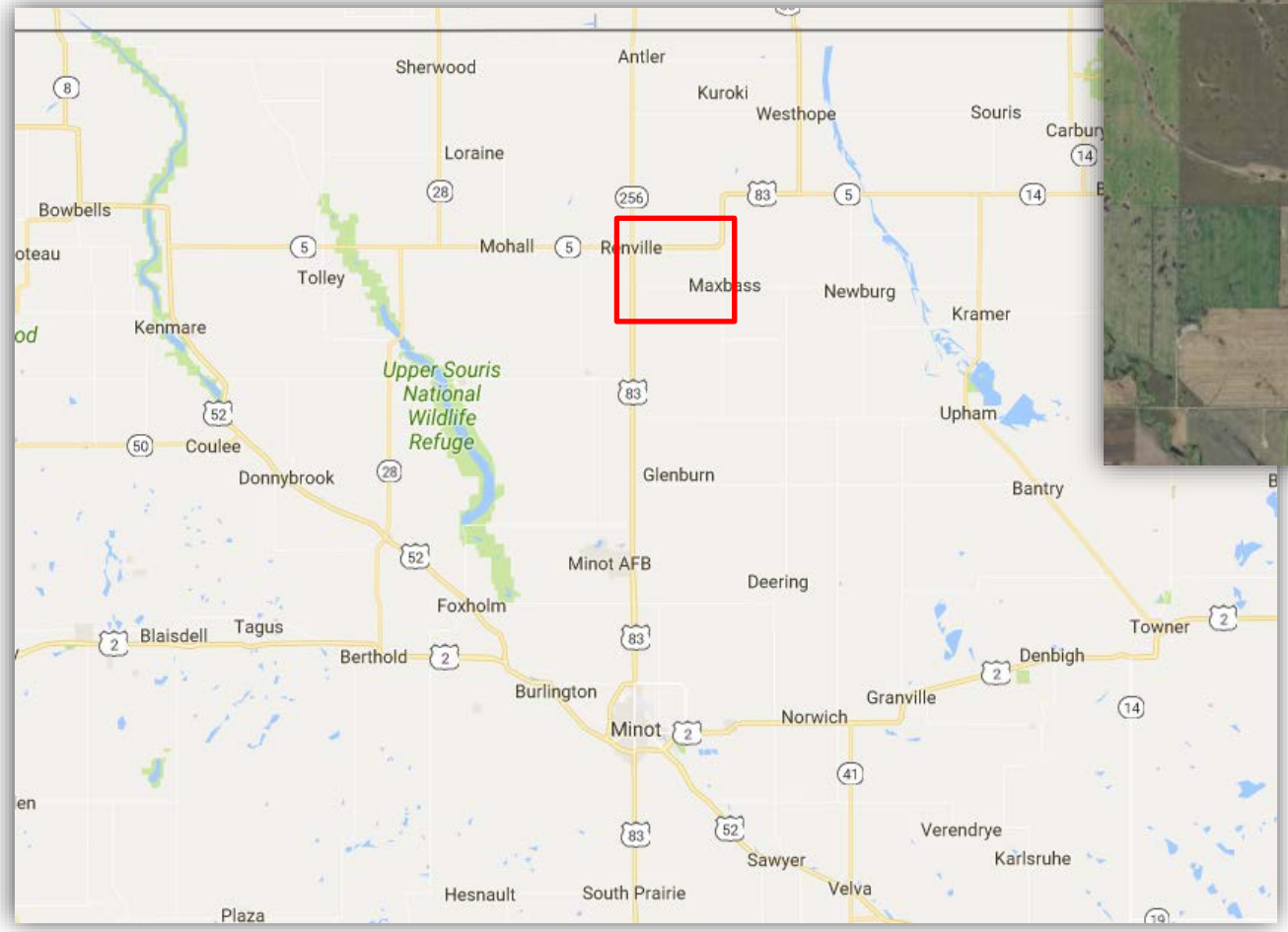
BACKGROUND

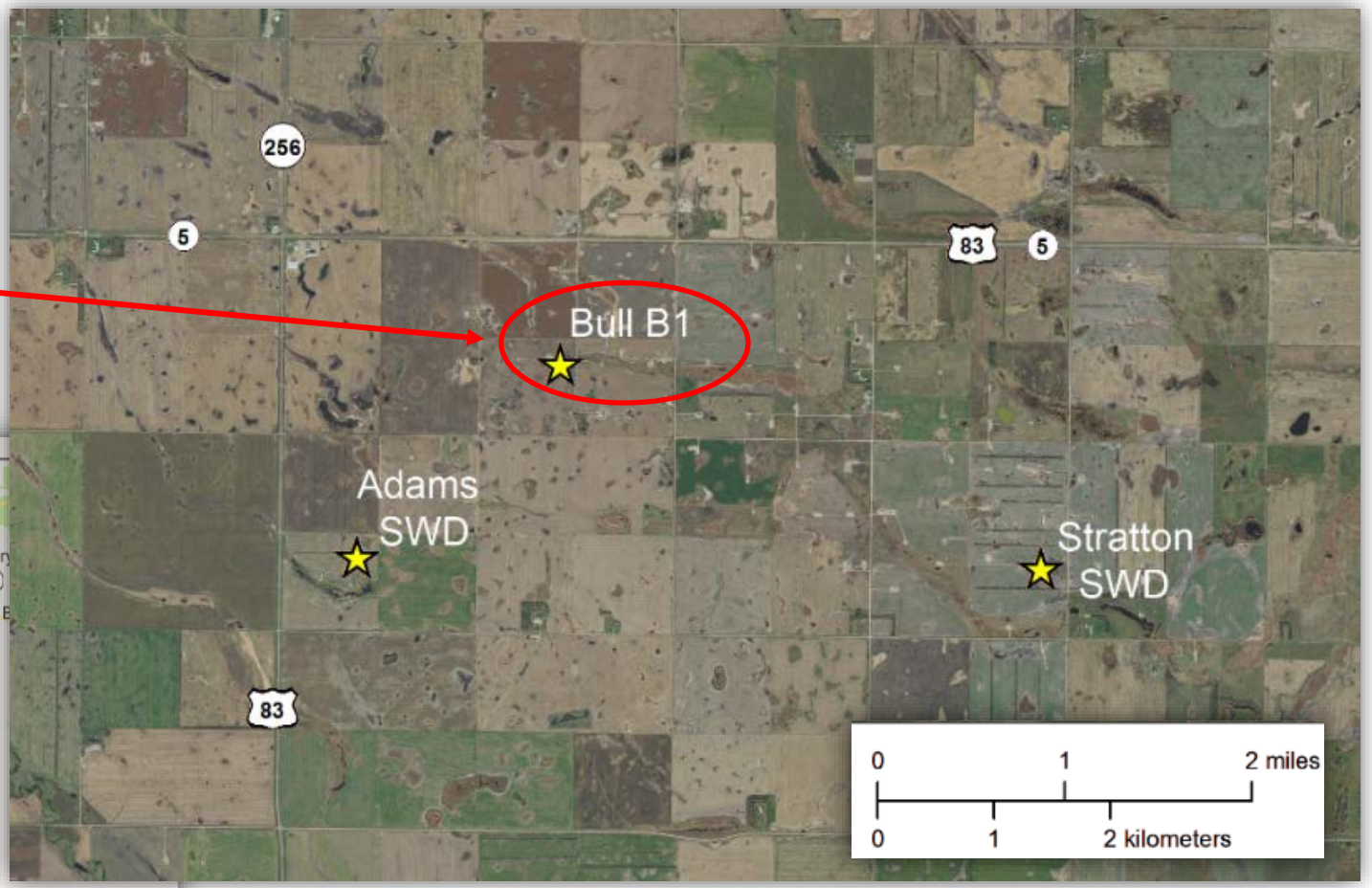
- Project goal
  - Apply a best practice, a common practice, and a novel remediation approach to a “representative” legacy brine pit site to assess the efficacy and cost of each.
- Project team
  - Energy & Environmental Research Center
  - Habitat Management, Inc.
  - Dakota Technologies, Inc.

EERC

SITE LOCATIONS

Initial Site Location





$450,000

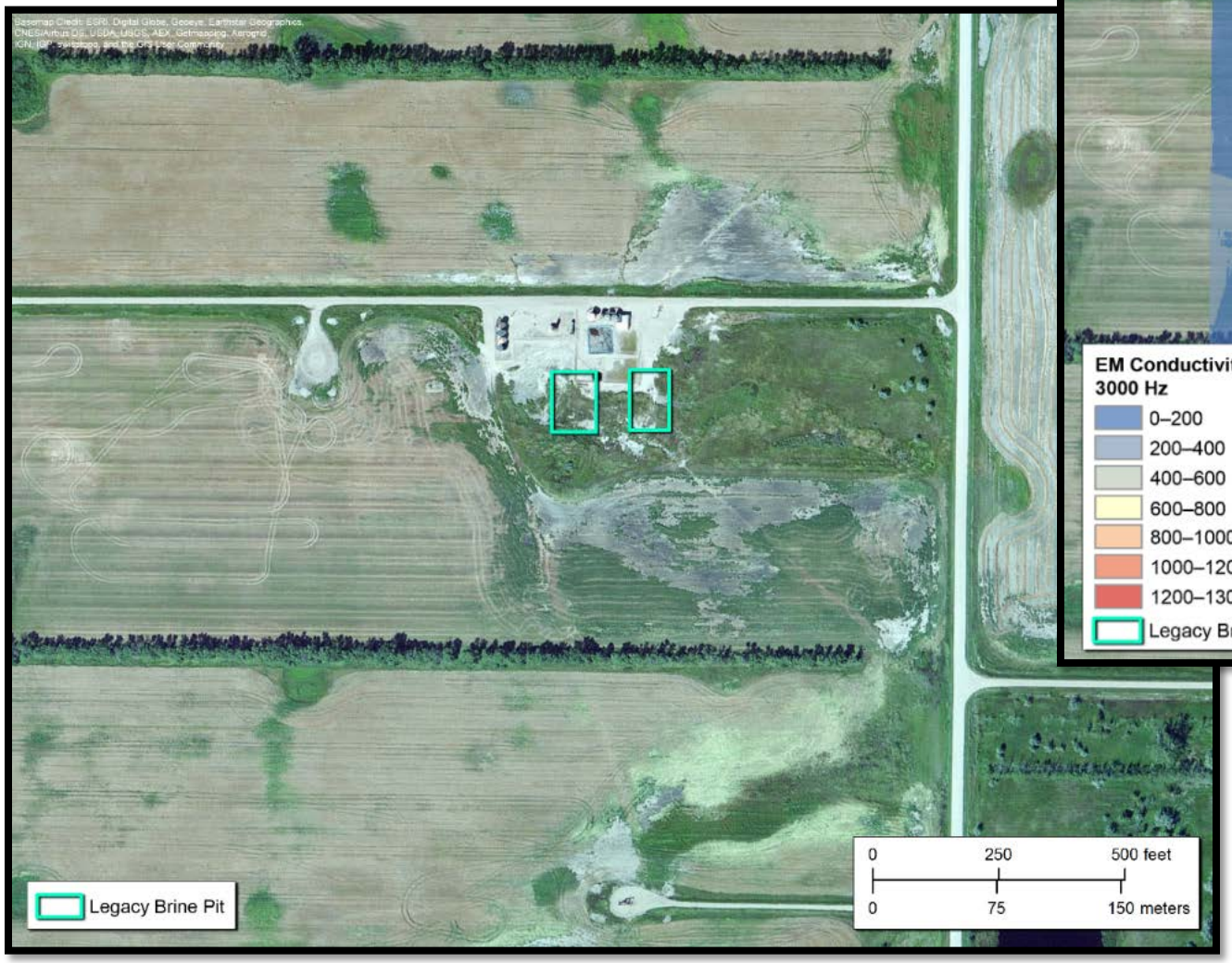
Critical Challenges. **Practical Solutions.**

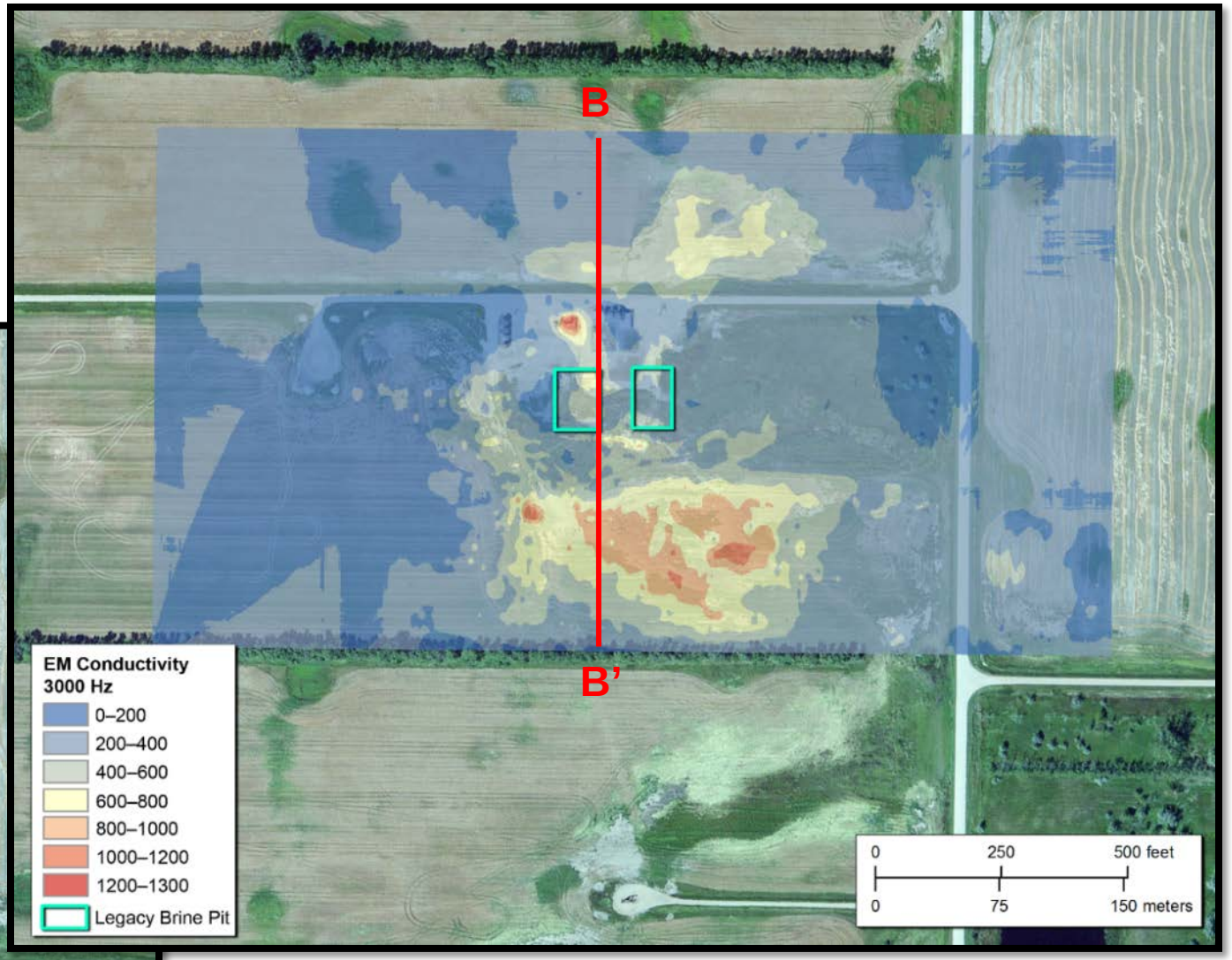
ORIGINAL PROJECT OBJECTIVES

- Site characterization to determine areal and vertical extent of brine contamination
- Site remediation system design (drain tile, sumps, wells, irrigation, deep hydraulic delivery)
- Site preparation
- Extensive site irrigation at the best practice site area
- Hydraulic delivery of amendments at the novel technique site area
- Periodic, regular soil sampling until threshold levels are met

SITE #2: STRATTON SWD

NDIC File No. 2318
48.739°N 101.216°W
Spud Date: 05/07/1959





3D Visualization of Electrical Conductivity (mS/m)
EERC - 0265.16 (Stratton)
Minot, ND
Vertical Exaggeration = 5:1

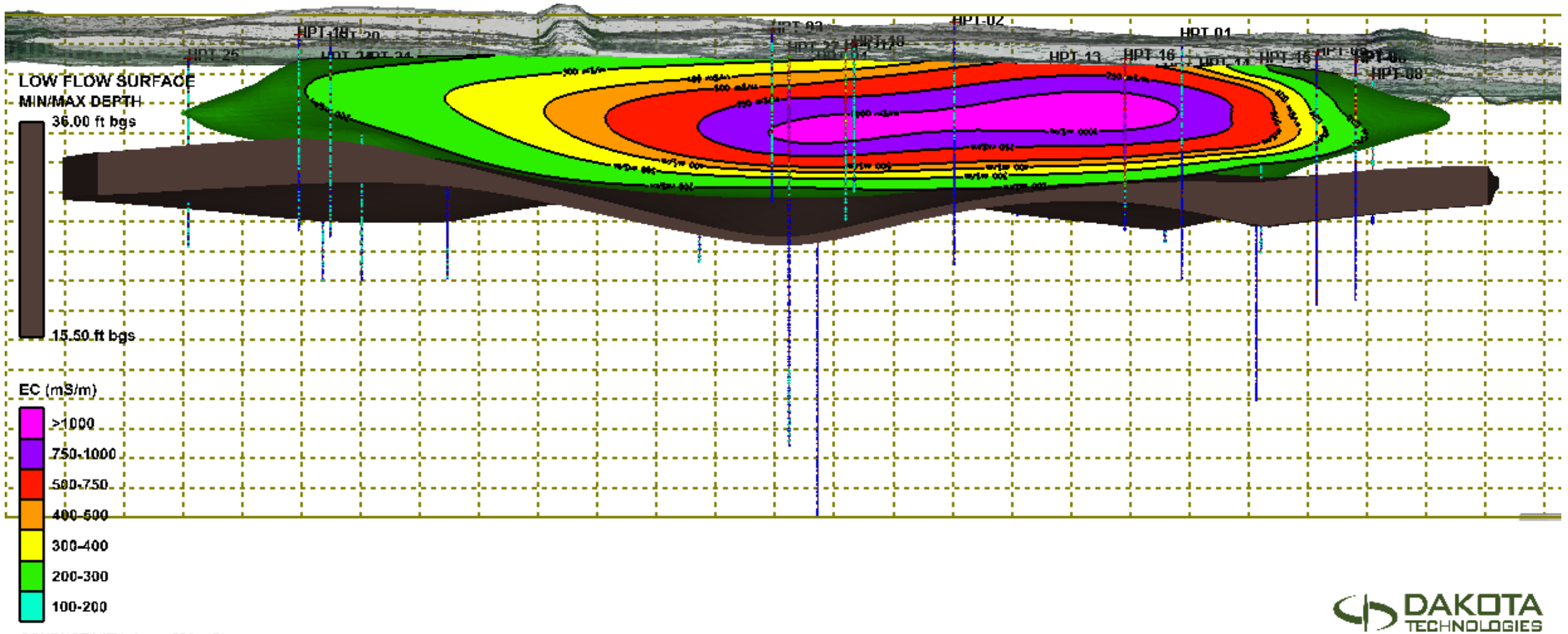
CONDUCTIVITY above 200 mS/m

Vertical Slice, Easting = 1,795,843.0 ft

Stratton SWD Site

B

B’



DAKOTA TECHNOLOGIES

October 2016 Integrated Site Visualization (ISV)

KEY CONCLUSIONS

- Salt-impacted zones extend well beyond the original pit area and may be increasing in size.
  - Contaminant migration is exacerbated by the shallow water table in the Prairie Pothole Region.
- Soil remediation (soil amendments/irrigation) coupled with drain tile may be a mechanism to remediate the near-surface soils (0–6 feet), but costs are highly dependent on availability of freshwater supplies for irrigation as well as disposal options for the drain tile effluent.
- Given the low-permeability of the soils, in situ treatment of the deeper zones will likely be challenging, and excavation of the contaminated soils is very expensive.

Reclamation Options for Legacy Brine Waste Pits in North-central North Dakota: Effects of remediation techniques on grass species

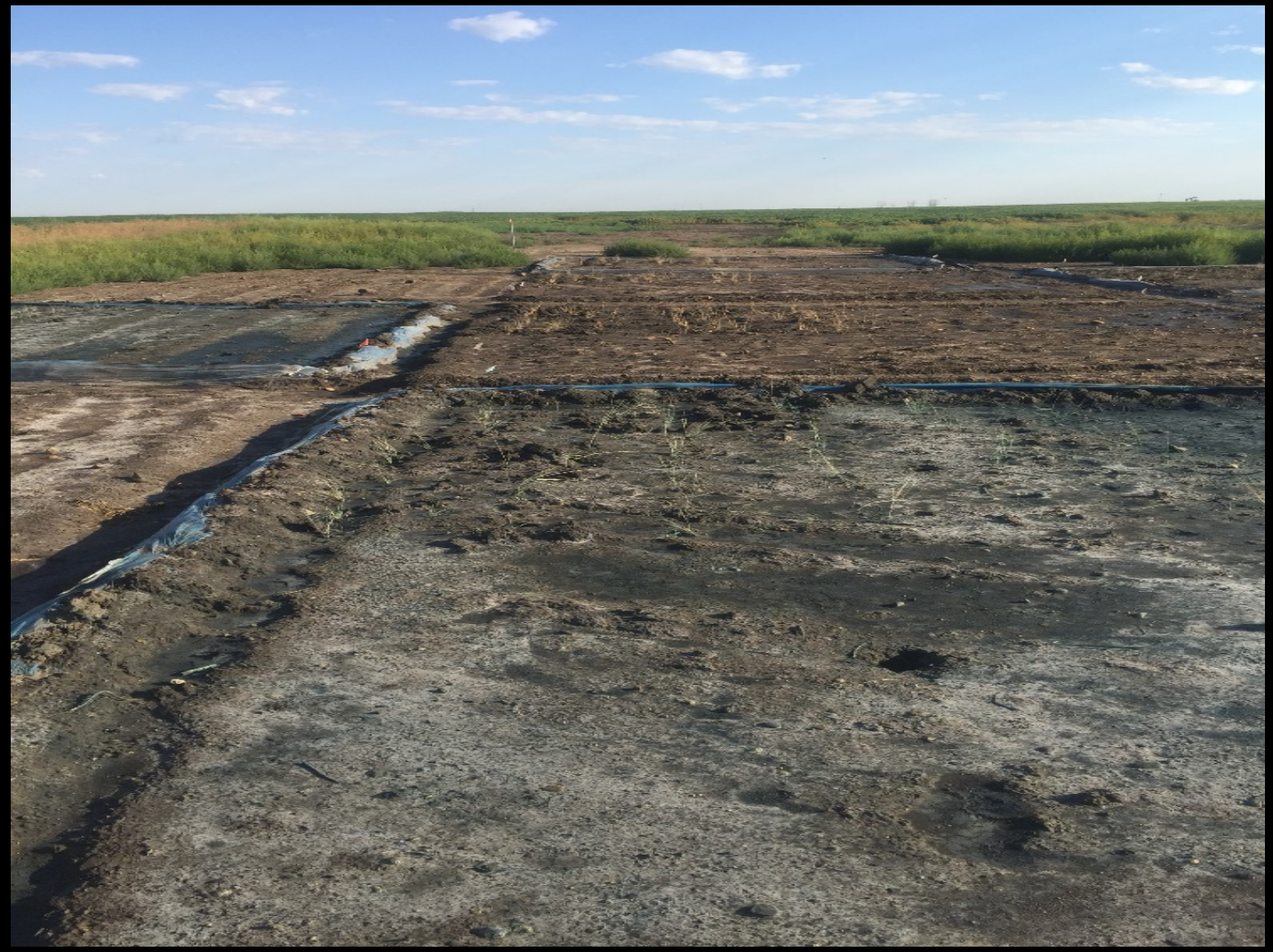
Funded by Abandoned Oil and Gas Well Reclamation Fund 405-448-15

Drs. Ryan Limb, Kevin Sedivec, Aaron Daigh, and Tom DeSutter

School of Natural Resource Sciences

North Dakota State University

NDSU Field Studies – 2016



Survivability of Grass Plugs and Seedlings on Legacy Brine Spills using Amendments

Amendments

- Compost
- Gypsum
- Combination of Compost and Gypsum
- Ferric hexacyanoferrate ($C_{18}F_7N_{18}$) crystallization inhibitor
- Control

Plugs and Seed Survival

- Plugs planted in August
- Seeds planted in October (dormant seeding)
  - *Western wheatgrass*
  - *Inland saltgrass*
  - *Alkali sacaton*

North of Glenburn, ND in Bottineau County(T157N, R82W, NW1/4 Section 36)

Leaching Column Results

- No difference between amendment types (commercial vs gypsum)
- There was a more than one magnitude reduction in EC (78.4 to 4.67 dS m^{-1}) for all treatments after trial termination.
  - Based on these findings, we CAN MOVE water and salt down the soil profile

Findings to Date
$435,759

- Ferric hexacyanoferrate ($C_{18}F_7N_{18}$) crystallization inhibitor DID NOT work on legacy sites
- Nuttall alkaligrass, alkali sacaton, inland saltgrass were superior grass species to plant on brine impacted soils
  - Western wheatgrass worked successfully on soils with EC levels < 20 dS m^{-1}

GOLDER

NDIC Brine Pond Study

Phase II: Site Assessments

Submitted to:

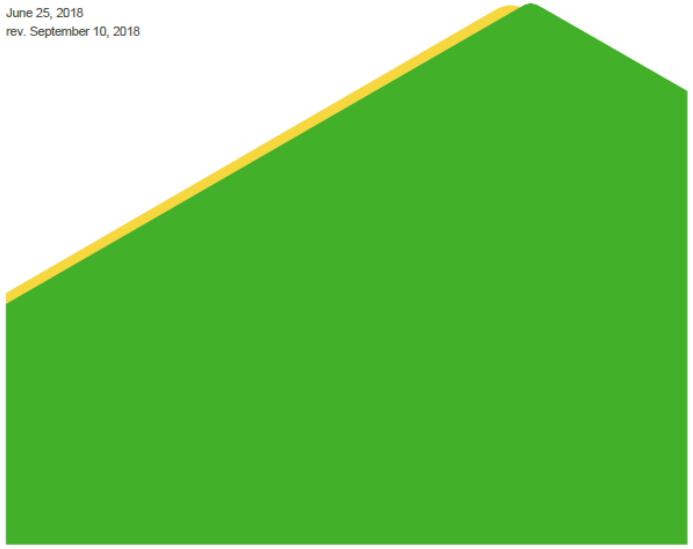
North Dakota Department of Mineral Resources - Oil and Gas Division
1016 E Calgary Ave
Bismarck, ND 58503

Submitted by:

Golder
2000 Schafer Street, Suite H, Bismarck, North Dakota 58501, USA

+1 701 258 5905

June 25, 2018
rev. September 10, 2018



$83,159

North Central Area

216 potential sites
166 sites in aerial photos (Golder)
52 no visual impacts (Golder)
114 impacted sites (Golder)
9 settlements identified (Barr)

105 potential remediation sites

100 square feet - 5.75 acres

BARR

Brine Pond Landowner Compensation Research Summary Report

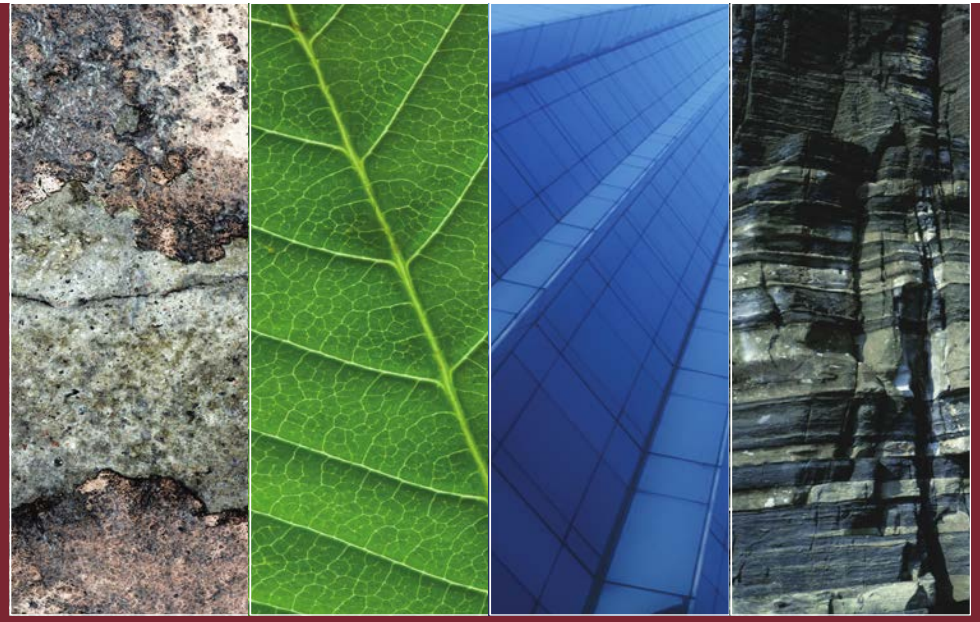
Bottineau, Renville and Ward Counties

Prepared for
North Dakota Industrial Commission

August 31, 2018

Barr Engineering Co. 234 W. Century Ave. Bismarck, ND

$35,698



Brine Pond Remediation Techniques

Project No. 405.2-17-010

$429,120

Terracon

Drone Aerial Photography

2017

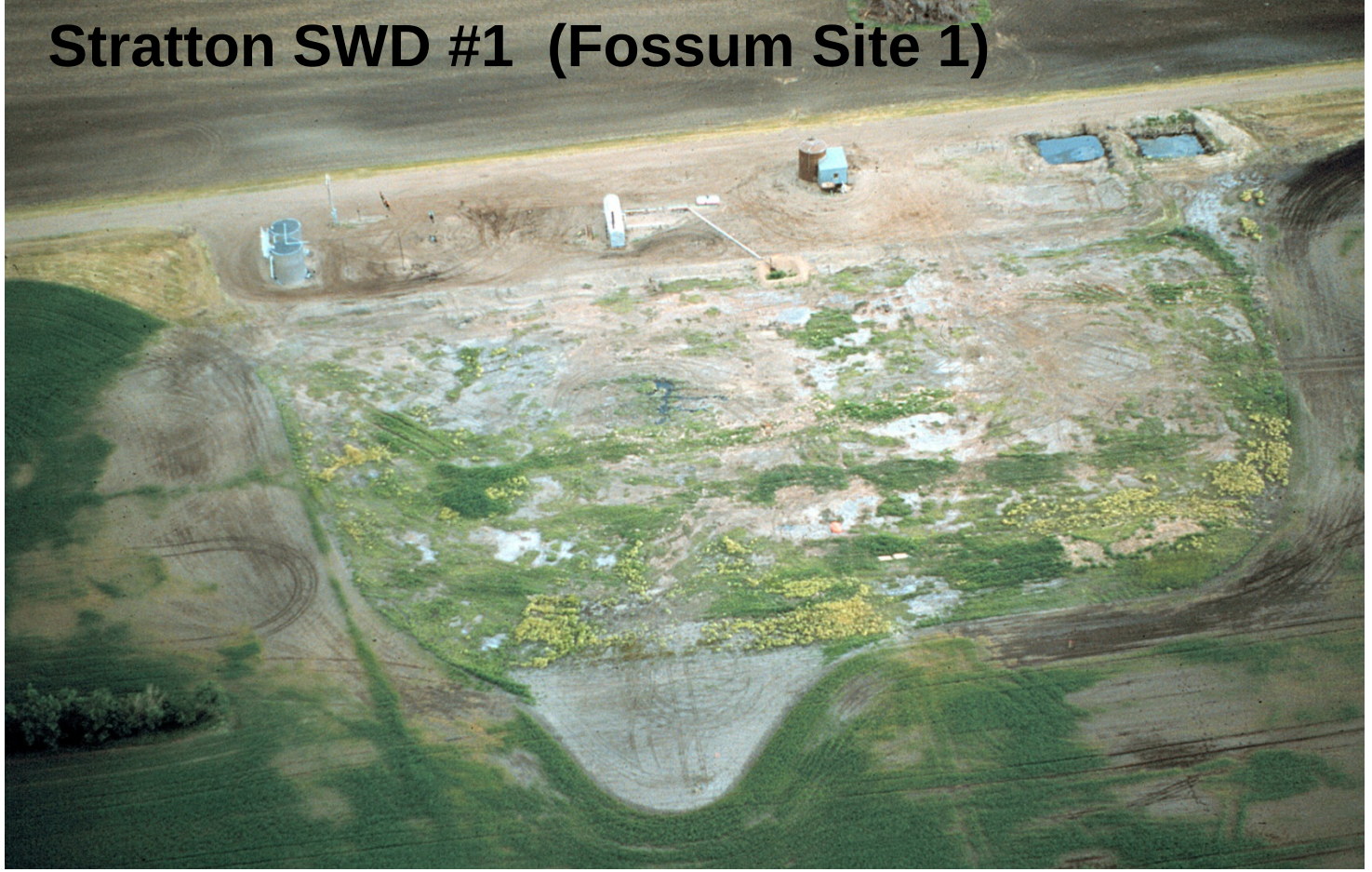
Site B21-13 **South of Site Looking North Prior to Field Work**

A high salinity plume extends laterally around the site over an area of 250,000 ft2 (about 6 acres).

Plume extends to a depth of over 80 feet (highest concentrations in top 40 feet).

Plume restricted to till and not impacting any useable water supply (ND Health Dept. concurred in 2006).

High chloride levels at 160 feet (500 - 750 mg/l) appear to be coming from the underlying Fox Hills Formation (hydraulic heads).



1985

A high salinity plume extends laterally around the site over an area of 250,000 ft2 (about 6 acres).

Plume extends to a depth of over 80 feet (highest concentrations in top 40 feet).

Plume restricted to till and not impacting any useable water supply (ND Health Dept. concurred in 2006).

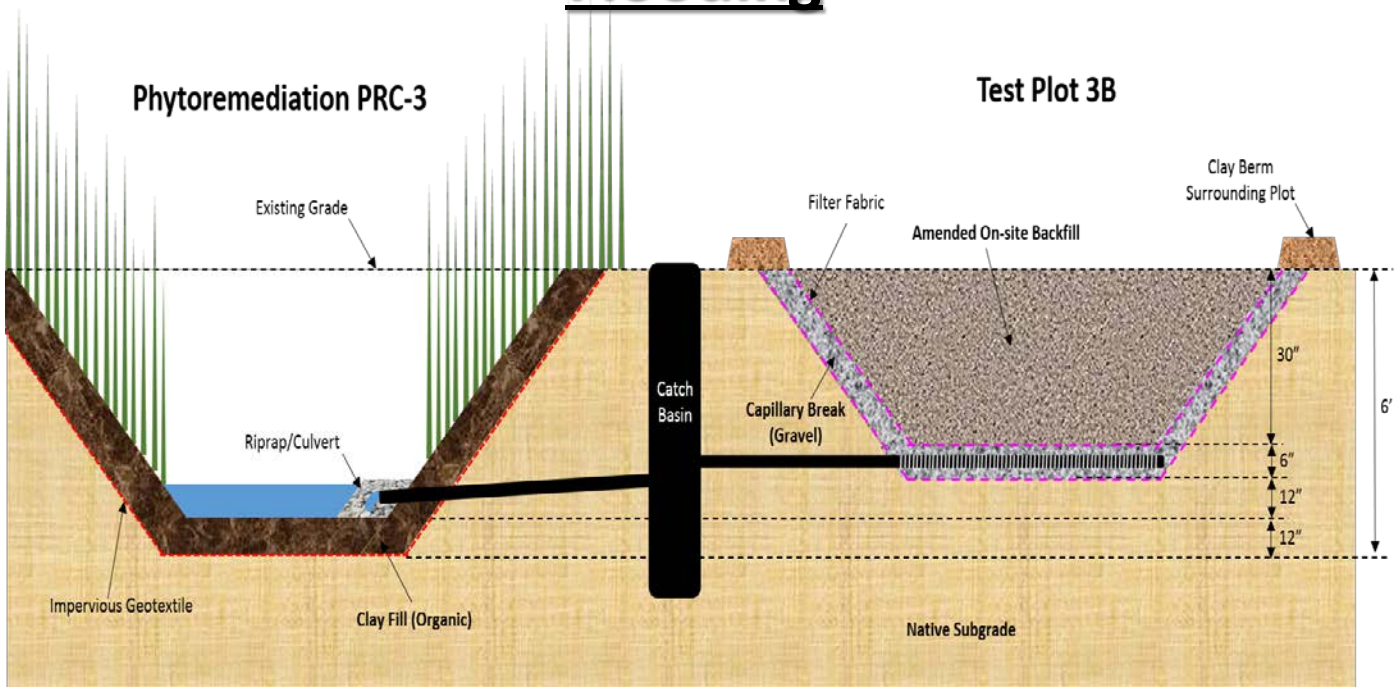
High chloride levels at 160 feet (500 - 750 mg/l) appear to be coming from the underlying Fox Hills Formation (hydraulic heads).

Tested 9 different techniques 2017-2018

$655,396

3B performed best

Test Plot 3B – Amended Soil with Water Flooding



3B Diagram
Test 3B on a typical 1-2 acre site in 2020

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2019

Photo #1 View of remediation area prior to commencing work.

2019

Photo #2 Initial earthwork and removal of topsoil.

2019

Photo #3 Stockpiling topsoil and excavated contaminated soil.

2019

Photo #4 Soil Excavation.

2019

Photo #5 Excavation of phytoremediation cell.

2019

Photo #6 Installation of capillary break.

2019

Photo #7 Installation of PVC drain tile in the capillary break with filter fabric.

2019

Photo #8 Placing gypsum and straw amended soil over capillary break.

2019

Photo #9 Remediation area with hoses and sprinklers laid out.

$342,602

2020

Photo #11 Wheat growth in the remediation cell compared to the surrounding wheat fields.

The phytoremediation approach to remediating this site required less time, equipment, soil disposal and soil delivery ultimately leading to significantly reduced costs for remedial actions. As presented in the Limited Site Investigation (LSI) with Corrective Action Plan (CAP) dated September 3, 2019 and this report, based on the progression of field and analytical data collected between August 2019 and July 2020, this technique appears to meet the hypothesis and goal of this brine remediation study.

It was observed that limited areas along the developed berm of the remediation zone have spots that are currently bare ground and not maintaining the desired vegetation growth. This is believed to be due to the steep outer perimeter slope to the east north, east and south being constructed of the same amended soil, yet not receiving the flooding procedure that the central area did. It should be noted that there may be a thinner crop growth this year due to the volume of water stripping the soil of nutrients. Terracon recommends utilizing a bioremediation fluid surface treatment in these areas to assist in the revegetation process. Additionally, Terracon recommends continued monitoring for the 2021 crop season with spray applications as needed based on field observations.

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Budget with Brine Pond Remediation

Fiscal Year	Wells	Well Plug & Reclaim	Illegal Dumping	Legacy Sites	Brine Ponds	Total	Fund Balance		
2007	4,603	$231,911				$7,500,000	Revenue/year		
2008	5,483	$26,750							
2009	5,547	$141,089							
2010	6,409	$0							
2011	7,746	$142,729							
2012	9,760	$87,026							
2013	11,945	$0	$283,389						
2014	14,377	$0	$1,387,223						
2015	15,853	$49,749	$127,058	$102,201		$279,008	$11,500,000		
2016	16,513	$1,800,000	$19,407	$1,200,000	$450,000	$3,469,407	$14,030,593		
2017	17,527	$82,075	$6,665	$340,716	$435,759	$865,215	$15,190,378		
2018	18,749	$87,794	$187,577	$1,694,700	$429,120	$2,399,191	$14,791,187		
2019	19,999	$93,648	$124,819	$1,694,700	$118,857	$2,032,024	$22,139,680	0	
2020	20,380	$73,502	$124,819	$1,335,413	$261,501	$4,256,530	$25,654,211	1	$1,695,237
2021	21,276	$10,000,000	$124,819	$1,000,000	$81,101	$13,944,626	$16,517,736	0	
2022	22,172	$2,500,000	$124,819	$500,000	$1,000,000	$4,124,819	$19,892,917	13	
2023	23,068	$3,500,000	$124,819	$500,000	$1,000,000	$5,124,819	$22,268,098	13	
2024	24,348	$3,500,000	$124,819	$500,000	$1,000,000	$5,124,819	$24,643,278	13	
2025	25,628	$1,000,000	$124,819	$1,694,700	$2,305,300	$5,124,819	$27,018,459	31	
2026	26,908	$750,000	$124,819	$1,694,700	$2,555,300	$5,124,819	$29,393,640	34	$7,941,701
	Total	$24,066,274	$3,009,874	$12,257,130	$9,636,938	$59,370,098	$243,040,177	105	

The Public Trust Doctrine in North Dakota

Don Negaard

2. *Resources Attached With the Public Trust*

Historically, the public trust has attached to such resources as tidelands, lands beneath lakes, land beneath a state's navigable waters, water in whatever form, and parklands.

Purposes protected by the Public Trust Doctrine include navigation, fishing, and hunting.

North Dakota has developed a trust concept in relation to an easement held for the public in the congressional section lines of the state for transportation purposes. North Dakota is not alone in applying the trust to these easements.

Water appears to be the resource most affected by Public Trust Doctrine.

> The idea of the navigable stream beds being held in trust is consonant with the public's right to travel upon the waters. Riparian landowners and appropriators do not own the streams from which they receive their water but merely have a usufructuary right.
>
> 61-01-01. Waters of the state - Public waters. All waters within the limits of the state from the following sources of water supply belong to the public and are subject to appropriation for beneficial use and the right to the use of these waters for such use must be acquired pursuant to chapter 61-04:
> 1. Waters on the surface of the earth, excluding diffused surface waters but including surface waters whether flowing in well-defined channels or flowing through lakes, ponds, or marshes which constitute integral parts of a stream system, or waters in lakes;
> 2. Waters under the surface of the earth whether such waters flow in defined subterranean channels or are diffused percolating underground water;
> 3. All residual waters resulting from beneficial use, and all waters artificially drained; and
> 4. All waters, excluding privately owned waters, in areas determined by the state engineer to be noncontributing drainage areas. A noncontributing drainage area is any area that does not contribute natural flowing surface water to a natural stream or watercourse at an average frequency more often than once in three years over the latest thirty-year period.

IV. CONCLUSION

The common law Public Trust Doctrine is not and should not be a substitute for careful planning by legislative and administrative officials charged with co'ordinating allocation and disposition of the publicly owned resources of North Dakota. Beneficial industrial development planning requires a much higher degree of social responsibility than is presently required by the minimal safeguards provided by the Public Trust Doctrine.

What the Public Trust Doctrine does provide for the citizens of North Dakota is a judicially developed safeguard with procedural and substantive limitations applied to dispositions of resources which are allocated by the public to the private sector. The Public Trust Doctrine accomplishes this by providing standing in the courts for concerned citizens who wish to challenge an allocation of resources that they feel is not in the public interest. The Public Trust Doctrine serves the interests of the public when a governmental body which is required to represent the public ignores or reacts arbitrarily with regard to the terms of the trusteeship with which the public has been vested with property rights. As a short term concept it can and will provide a minimum standard for review of governmental action but is no substitute for careful, detailed planning and mandatory legislative guidelines for wise energy related development.

North Dakota
Department of Mineral Resources

www.dmr.nd.gov

Phone: 701.328.8020 **Email: oilandgasinfo@nd.gov**
Mailing Address: 600 East Boulevard Ave. Dept 405; Bismarck, ND 58505