

# ROAD SALT: RISKS, REMEDIES, AND RESPONSIBLE MANAGEMENT



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# PRESENTATION OUTLINE

- Background
- Assessments
- Operational Improvements
- Risk Management Plan
- Results and Challenges
- Future Planning and Take Aways
- Acknowledgements

# **CASE STUDY BACKGROUND**

## **TOWN OF SLAVE LAKE PUBLIC WORKS YARD**

# Contaminant of Concern - Salt



- Commonly NaCl, CaCl<sub>2</sub>, MgCl<sub>2</sub>, KCl.
- Potential environmental impacts from salt (SCARG, 2001):
  - Degradation of soil chemical properties and impaired vegetative growth
  - Degradation of soil physical properties caused by excess sodium concentrations
  - Degraded surface water or groundwater quality.
- Impacts to transportation infrastructure

# Sources of Salt in the Prairies



- Highway maintenance yards
- Municipal public works yards
- Road salt application
- Mining
- Oil and gas exploration and production
- Naturally occurring salt deposits

# Project Information



- Active town maintenance yard that managed winter salt and sand (pickled sand).
- Pickled sand originally stored and handled directly on the gravel yard resulted in salt infiltration into the soil and groundwater.
- Site assessments by previous consultants between 2004 and 2009.
- Alberta Environment and Protected Areas recommended additional assessments and requested a RAP and RMP for the site in 2009.

# Our Remediation Philosophy

First, quantify the problem.

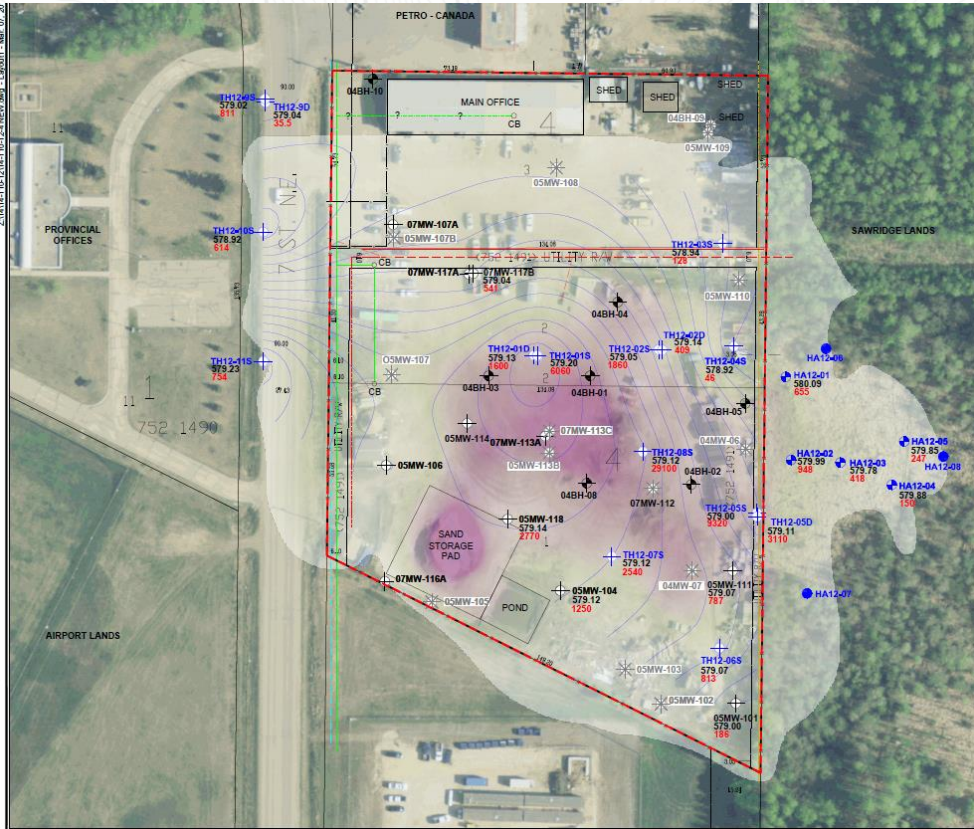
What if we did nothing?

What if we did everything?

What are the drivers forcing us to do **something** and what are the constraints preventing us from doing **everything**?

# ASSESSMENTS: QUANTIFY THE PROBLEM

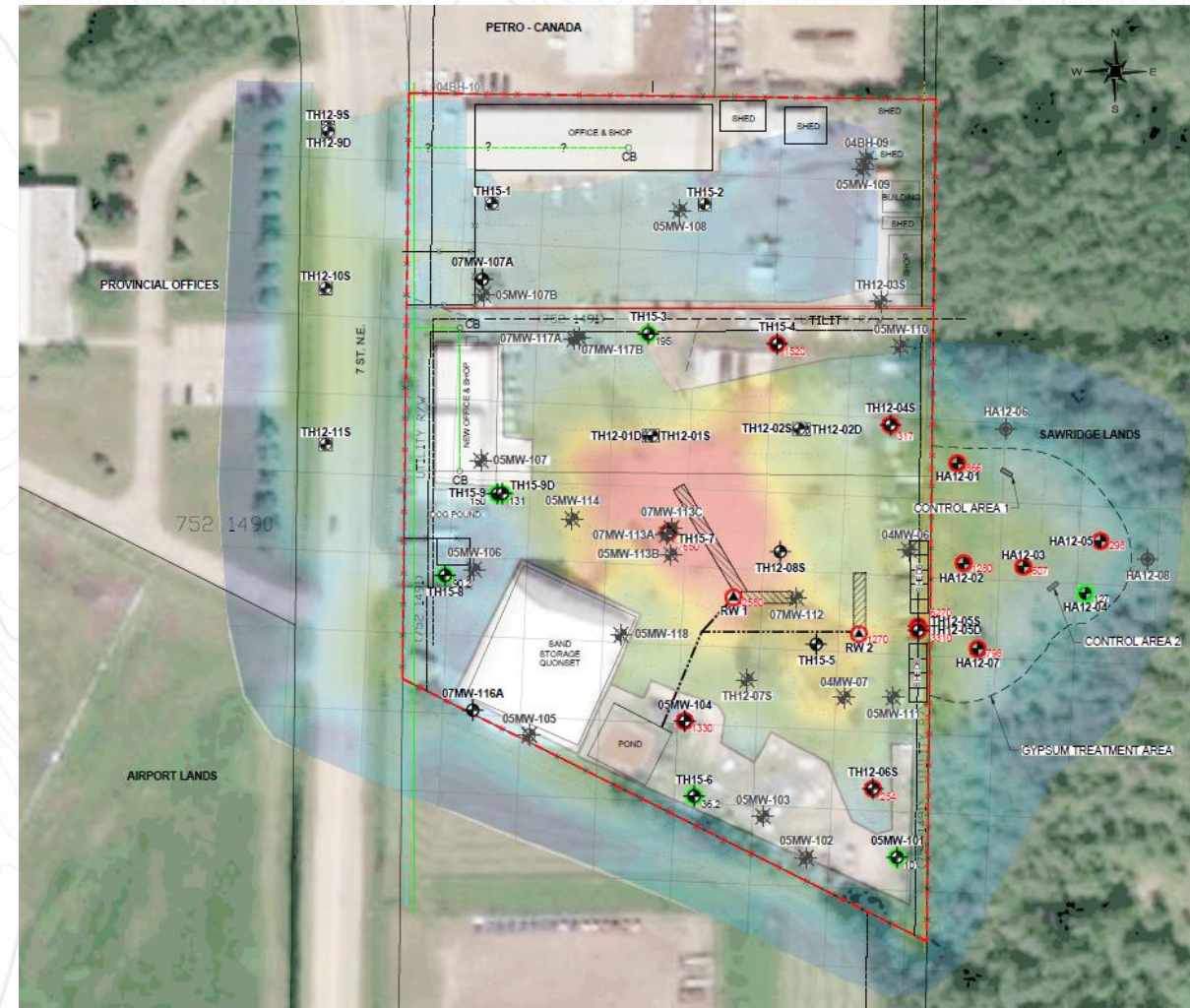
# Electromagnetic Survey and Conductivity Profiles



- Electromagnetic (EM) survey completed in 2012 to evaluate the terrain conductivity.
- Vertical conductivity profiles completed during direct-push drilling investigations.
- EM survey identified areas of elevated terrain conductivity:
  - Central area where pickled sand was historically stored.
  - Current (2012) pickled sand storage pad.

# Phase 3 Environmental Site Assessment

- Thurber completed Phase 3 ESAs in 2012 and 2013.
- Expanded the existing monitoring well network:
  - Road allowance area west of 7 Street
  - Sawridge First Nations land east of the site
  - Nested wells to evaluate vertical gradients
  - Sentinel wells around the site perimeter
- Delineated the salinity impacts in the soil.



# Phase 3 ESA Results

- Salinity impacts identified on site in the soil and groundwater:
  - Groundwater:
    - Peak chloride ~30,000 mg/L
    - Peak sodium ~14,000 mg/L
  - Soil:
    - Peak chloride ~15,000 mg/L
    - Peak EC ~60 dS/m
- Off-site salinity impacts in the Sawridge FN land east of the site.
- Additional off-site impacts along the road allowance NW of the site.

# OPERATIONAL IMPROVEMENTS

# Operational Improvements



- Operational Improvements:
  - Asphalt pad for the salt and sand stockpiles
  - Retention pond for leachate management
  - Quonset over the asphalt pad

# RISK MANAGEMENT PLAN

# Preliminary Risk Management Plan

- Thurber developed a Preliminary RMP with input from Alberta Environment.
- CoPCs identified:
  - Soil: pH, electrical conductivity (EC), sodium adsorption ratio (SAR), and elevated chloride
  - Groundwater: pH, sodium, chloride, and dissolved metals
- Assessment results:
  - Soil impacts spanned an area of approx. 11,000 m<sup>2</sup> (total soil volume 60,000 to 80,000 m<sup>3</sup>).
  - Full remediation costs estimated upwards of \$8 Million (in 2013).
  - Risk of plume expanding to impact surrounding environmental receptors (Lesser Slave Lake).
- Preliminary RMP proposed shallow soil treatment, vegetation assessment in Sawridge FN Lands, groundwater recovery, and further assessing and monitoring soil and groundwater conditions.

# Soil Treatment and Monitoring

- Elevated SAR in the Sawridge FN land off-site - soil treatment with gypsum was proposed.
- Elevated sodium in soil hinders plant growth and establishment.
- Gypsum,  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ , is added to soil.
  - Sodium cations that were adsorbed to soil particles are replaced by calcium cations from the gypsum amendment.
  - The sodium is then mobilized and flushed through the soil.
- Gypsum amendment was conducted during the growing season annually.
- Soil monitoring to assess the soil quality during treatment.
- Managing EC levels during soil treatment.



# Vegetation Assessment

- Evaluated vegetation species and health in the Sawridge FN Lands east of the site.
- Established a baseline for off-site conditions prior to soil treatment and groundwater remediation.

# Groundwater Recovery and Disposal



- Groundwater recovery system (GWRS) installed at a large diameter (150 mm dia.) recovery well (RW1) with a submersible pump.
- A pilot test conducted in 2014.
- RW1 and RW2 and associated infiltration trenches installed in 2015.



# Groundwater Monitoring and Subsoil Salinity Tool



GROUNDWATER TREND CHARTS - MONITORING WELL TH15-7  
2024 SOIL AND GROUNDWATER ASSESSMENT ACTIVITIES  
TOWN OF SLAVE LAKE - PUBLIC WORKS YARD  
1009 - 7 STREET NE, SLAVE LAKE, AB

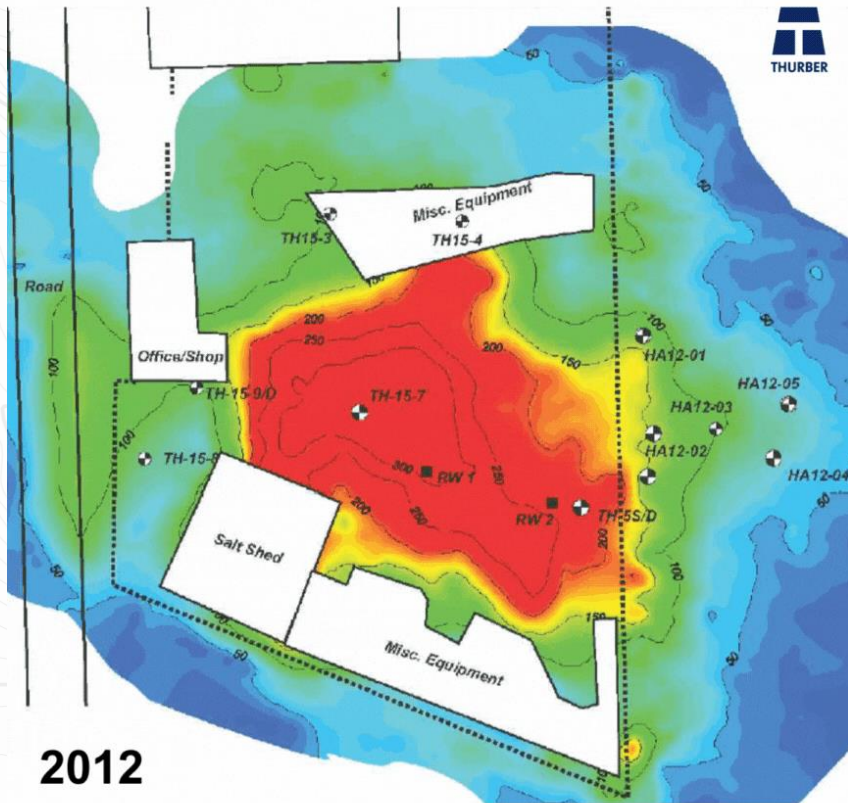


- Annual and semi-annual GWMPs.
- Decreasing chloride trends and retracting salinity plume.
- EM surveys completed at the site in 2012, 2018, and 2022.
- Results of the 2021 SST Evaluation
  - Limited reduction in the remedial excavation requirements.
  - Confirmed that the current RMP was protective of the nearest receptors.



# RESULTS AND CHALLENGES

# Results



- Original estimate for full remediation was \$8 Million (in 2013). To date, total spent on environmental efforts are less than \$1 Million.
- Since 2015, over 1,100 m<sup>3</sup> of chloride-impacted groundwater and 8,300 kg of chloride mass has been removed from site.
- Over 55 percent reduction in the contaminant plume area across the site.

# Challenges

- Including operations staff and leadership in planning the work each year.
- Staffing changes at the Town of Slave Lake.
- Thurber became the trusted source of current and historical data for the site to inform the new PMs and new councils and mayors.
- How to pay for this effort?
  - Providing estimates early of the full program costs.
  - Town of Slave Lake included the full costs as a liability on the town's balance sheet.
  - Each year's efforts reduced that liability.
- Becoming more efficient.
  - Engaging with operations staff to find ways to complete more tasks internally.

# FUTURE PLANNING AND TAKE AWAYS

# Future Planning



- Original objective: reduce/remove the salt source, manage the plume, and prevent impact to the lake and other surrounding receptors.
- Progress: improved operational processes, removed a substantial mass of chloride, and shrunk the contaminant plume.
- Next steps: long-term groundwater and soil monitoring while site is operational.

# Key Take Aways

- Continue verifying and calibrating remedial methods by collecting data (e.g. EM surveys, soil and groundwater monitoring, analytical data).
- Closed feedback loop.
- Progress is made with consistent and sustainable effort.
- Client is key.

# ACKNOWLEDGEMENTS



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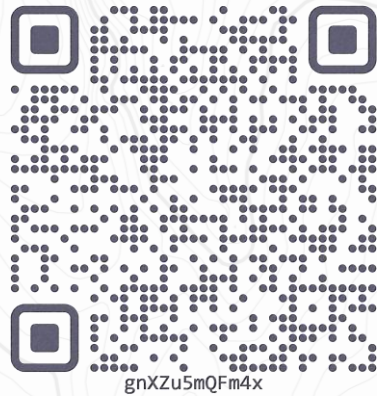


Town of  
**SLAVE LAKE**

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# THANK YOU!



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