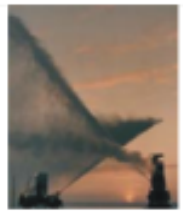
www.eba.ca

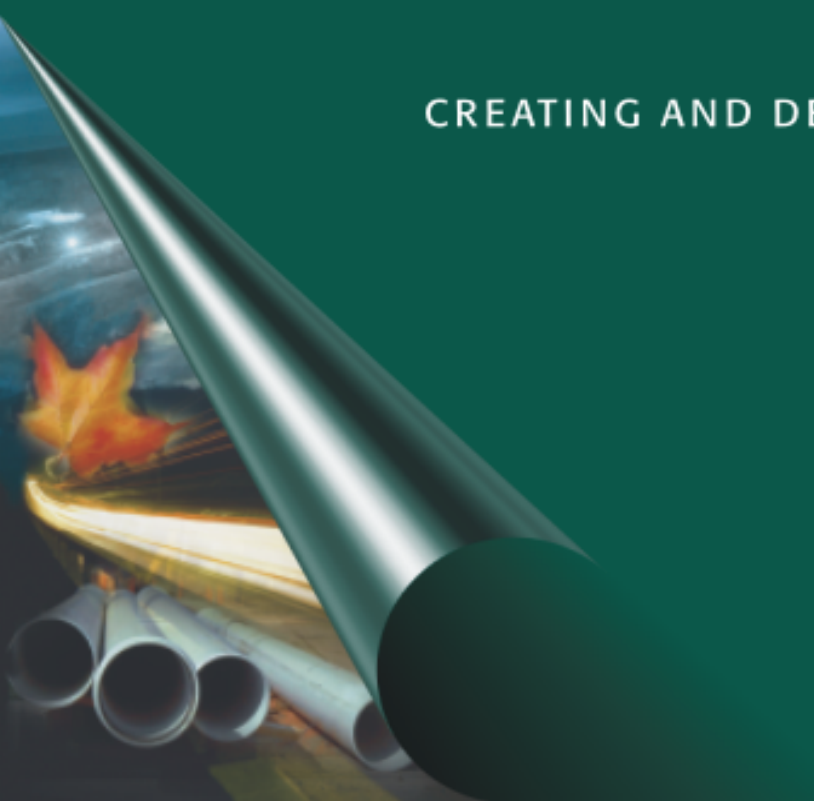









CREATING AND DELIVERING BETTER SOLUTIONS



eba

Assessment and Remediation of a Historical Pipeline Release: Tools, Techniques and Technologies applied to In-situ/Ex-situ Soil and Groundwater Remediation

Neil Reid
EBA Engineering Consultants Ltd.
and
Brad Kohlsmith
Kinder Morgan Canada Inc.

OUTLINE

- Initial Assessment
- Remediation of Hydrophobic Soils
- Re-assessment
- Site Specific Criteria
- Remediation Trial (bioventing/chemical oxidation)
- Full Scale Remediation

Site Background

- Pipeline release in summer 1977.
- Surface remediation was reported complete with a significant amount of topsoil being removed and replaced.
- In 2004 the landowner registered a complaint of poor crop growth in 4 patches near the area of the historical release.
- Initial assessment was undertaken.

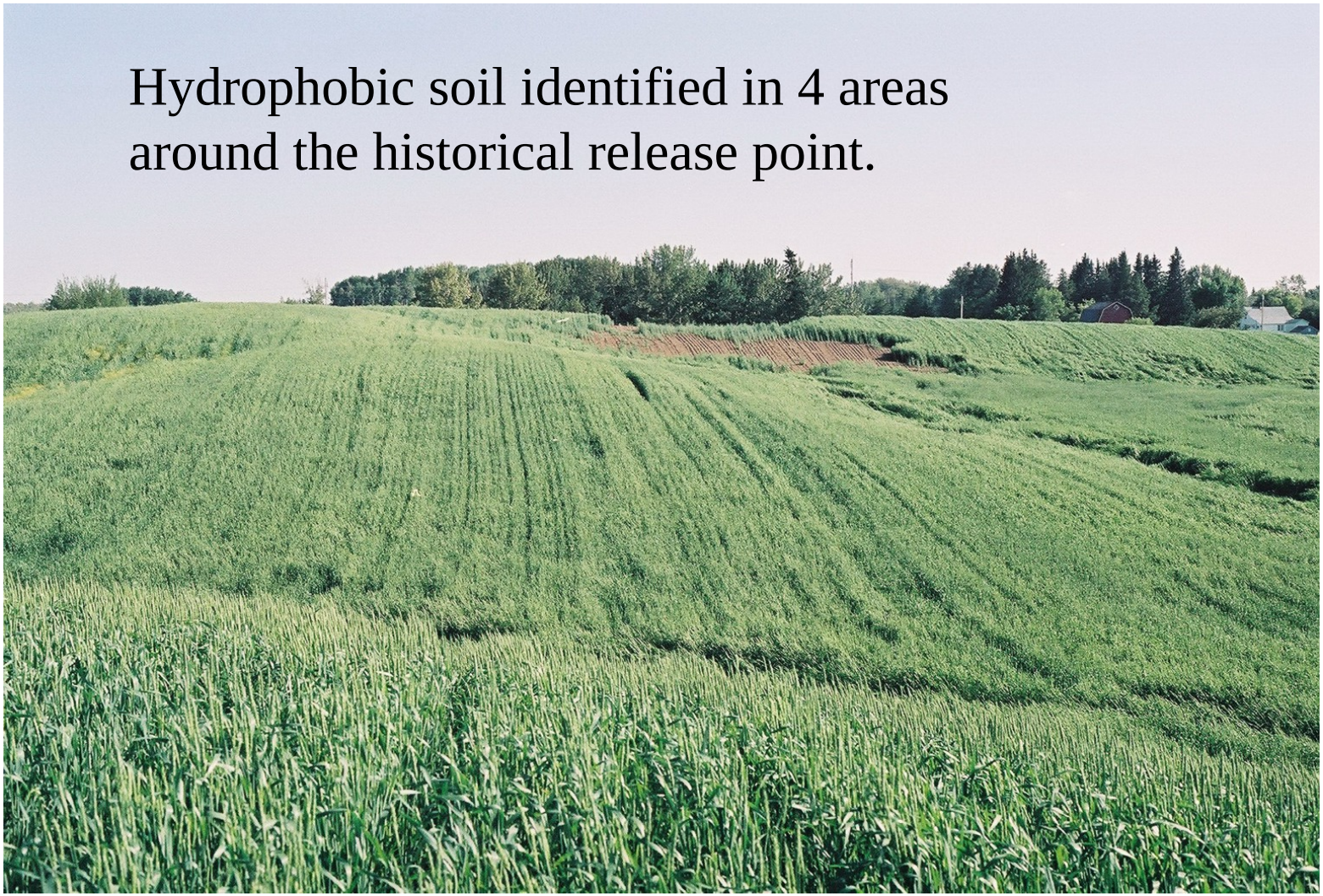
Site Background

1977 Pipeline Release

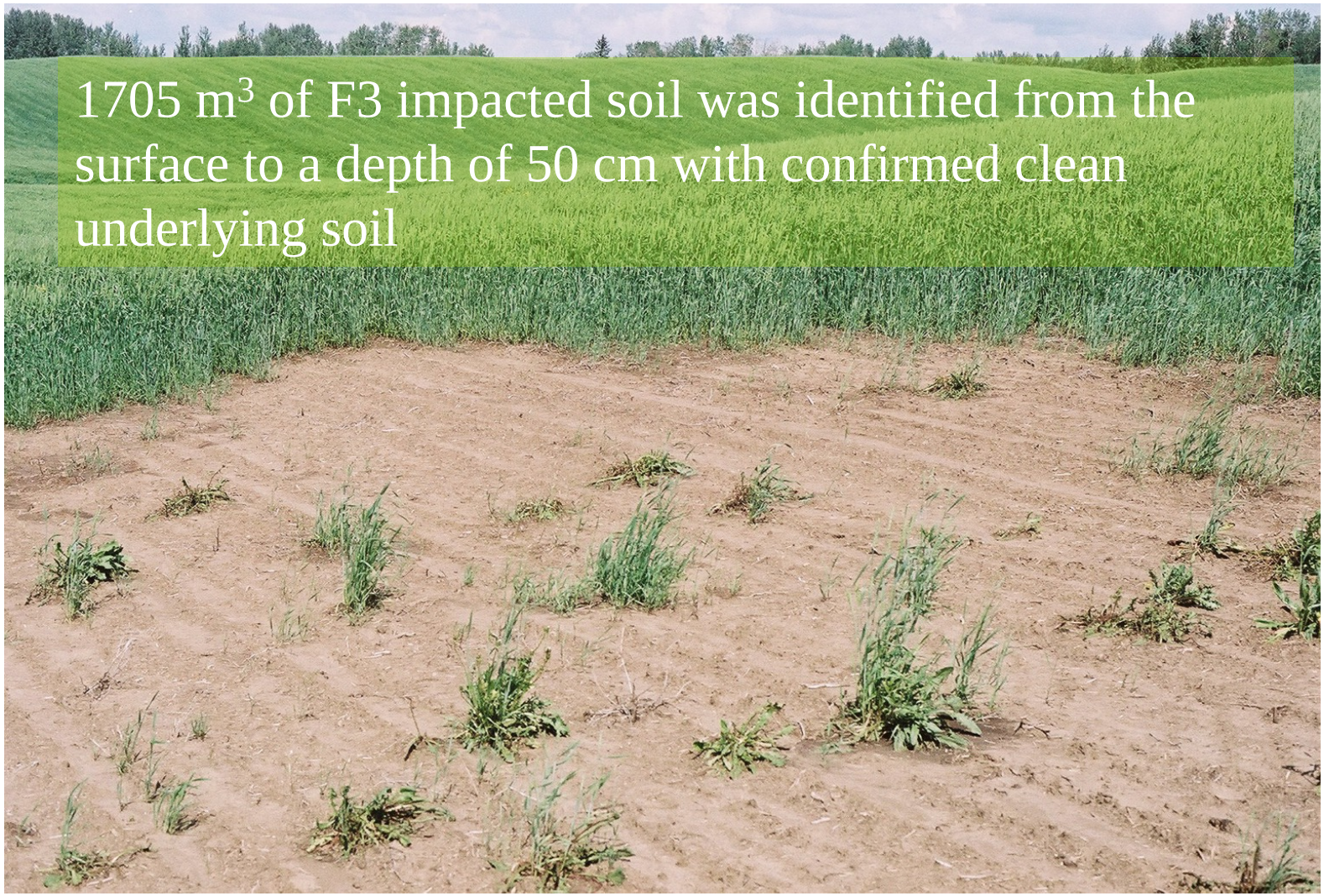
Initial Assessment

Initial Assessment

Initial Assessment



Initial Assessment



Remediation of Hydrophobic Soil

Remediation of Hydrophobic Soil

Remediation of Hydrophobic Soil

Remediation of Hydrophobic Soil

During final confirmatory sampling impacted soil uncharacteristic of the identified hydrophobic soil was encountered. A testpit uncovered 10,000 m^3 of impacted soil.

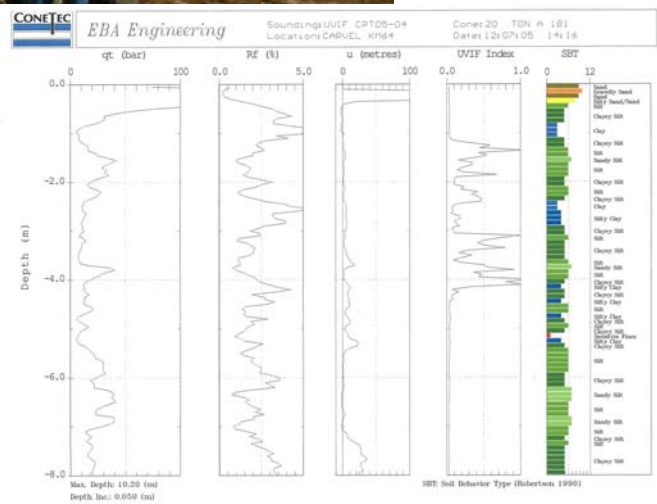
Re-assessment

Based on the nature of the contaminants discovered it was feared the pipe might be leaking.

Re-assessment

Re-assessment

UVIF assessment completed to map impacts and complex soil conditions in the area.



Re-assessment

- Pipeline was not leaking, although a vent which had been installed in 1977 and replaced in the early 90's may have leaked and caused the subsurface impacts.
- Buried organic soils found across the site.
- Soil highly stratified with many thin sorted layered of various texture (fluvial outwash area).
- Impacts intersected groundwater.

Re-assessment

Re-assessment

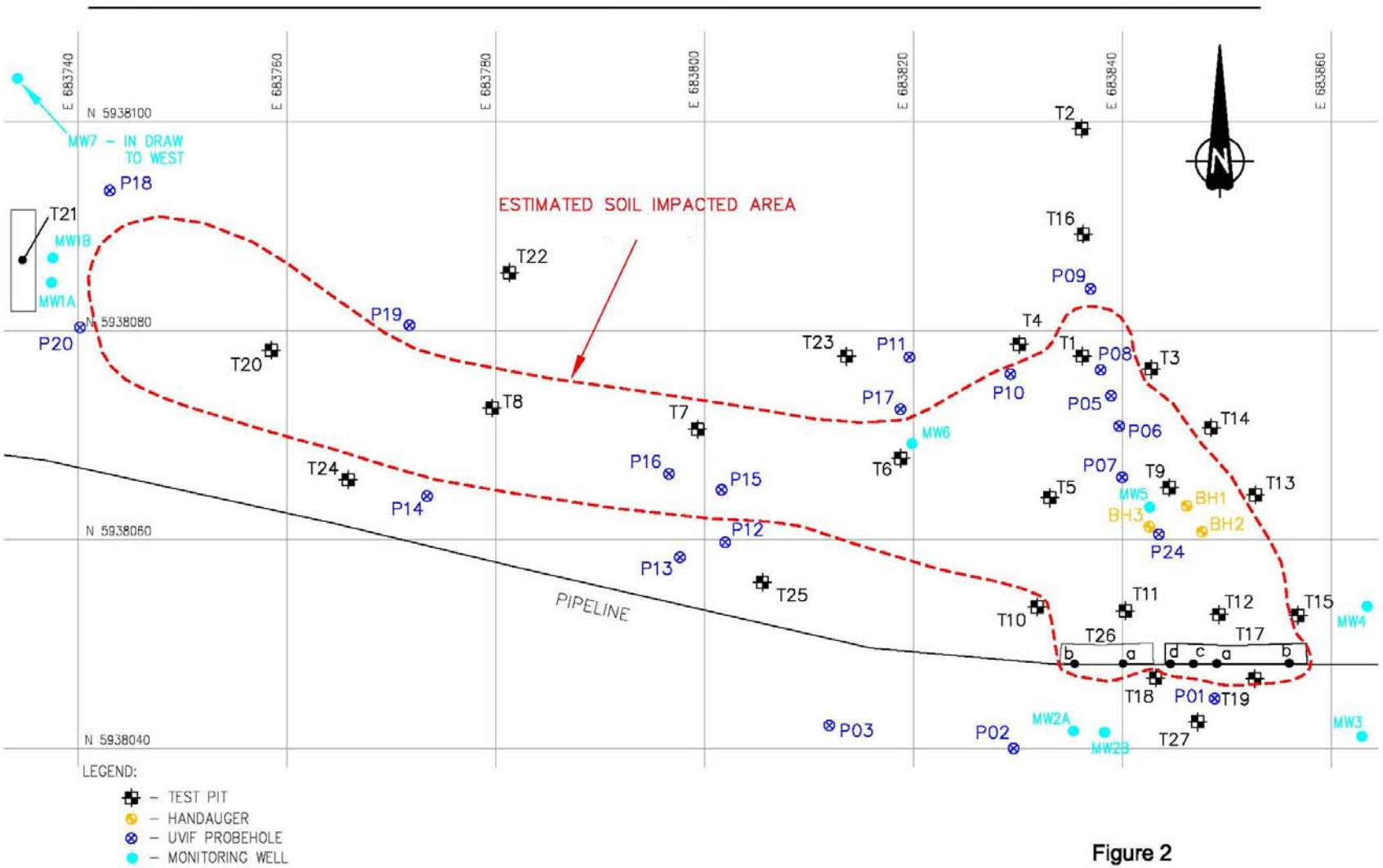
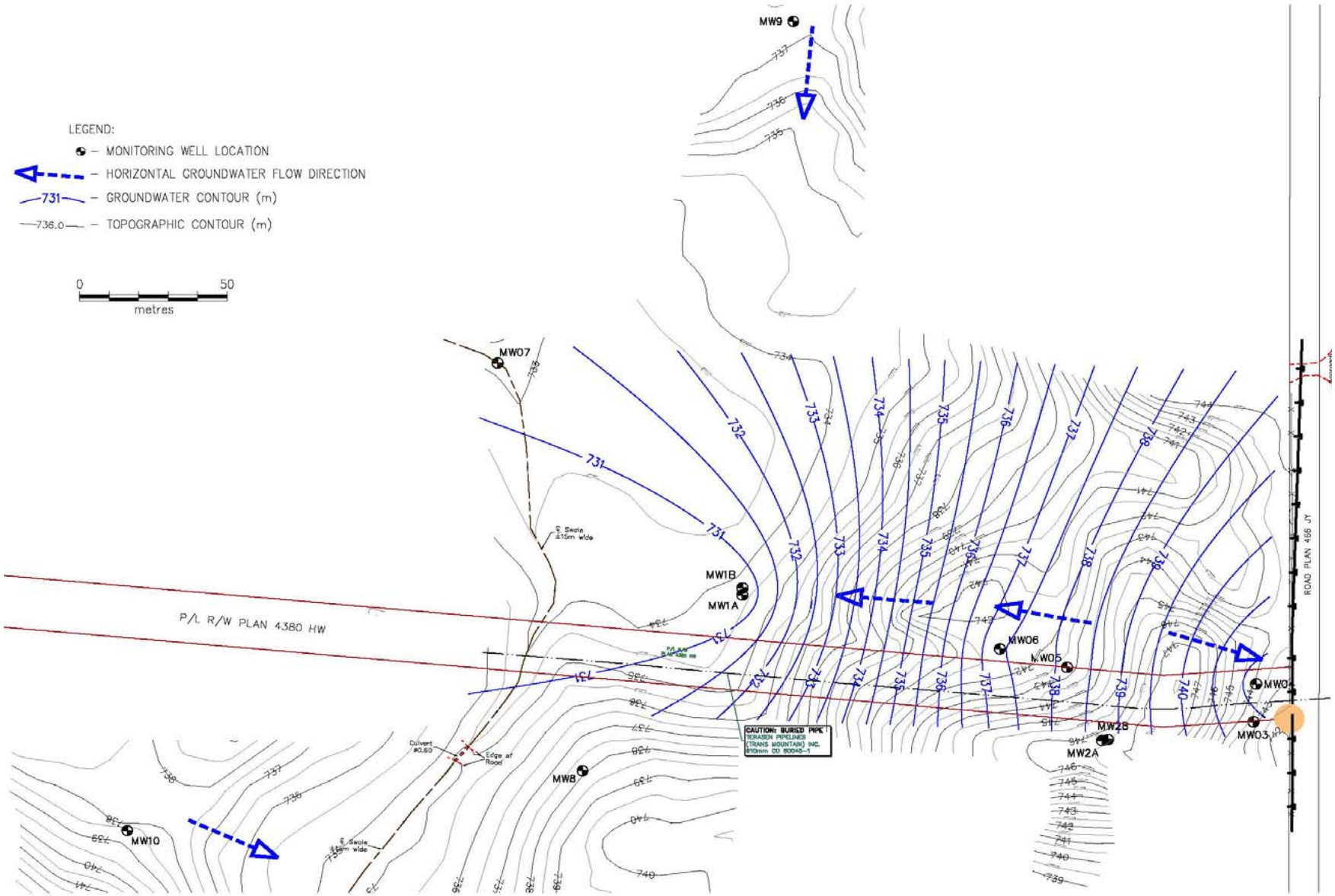


Figure 2

Re-assessment

- 10,000 m^3 of BTEX, F1, F3 and F4 impacted soil was identified to a depth of 5 m.
- Groundwater impacted with BTEX, F1 and F2 hydrocarbons and phenols.
- Groundwater impacts contained within the limits of soil impacts with the exception of total phenols.
- Phenol impacts observed in all 12 wells including hydraulically isolated control wells.

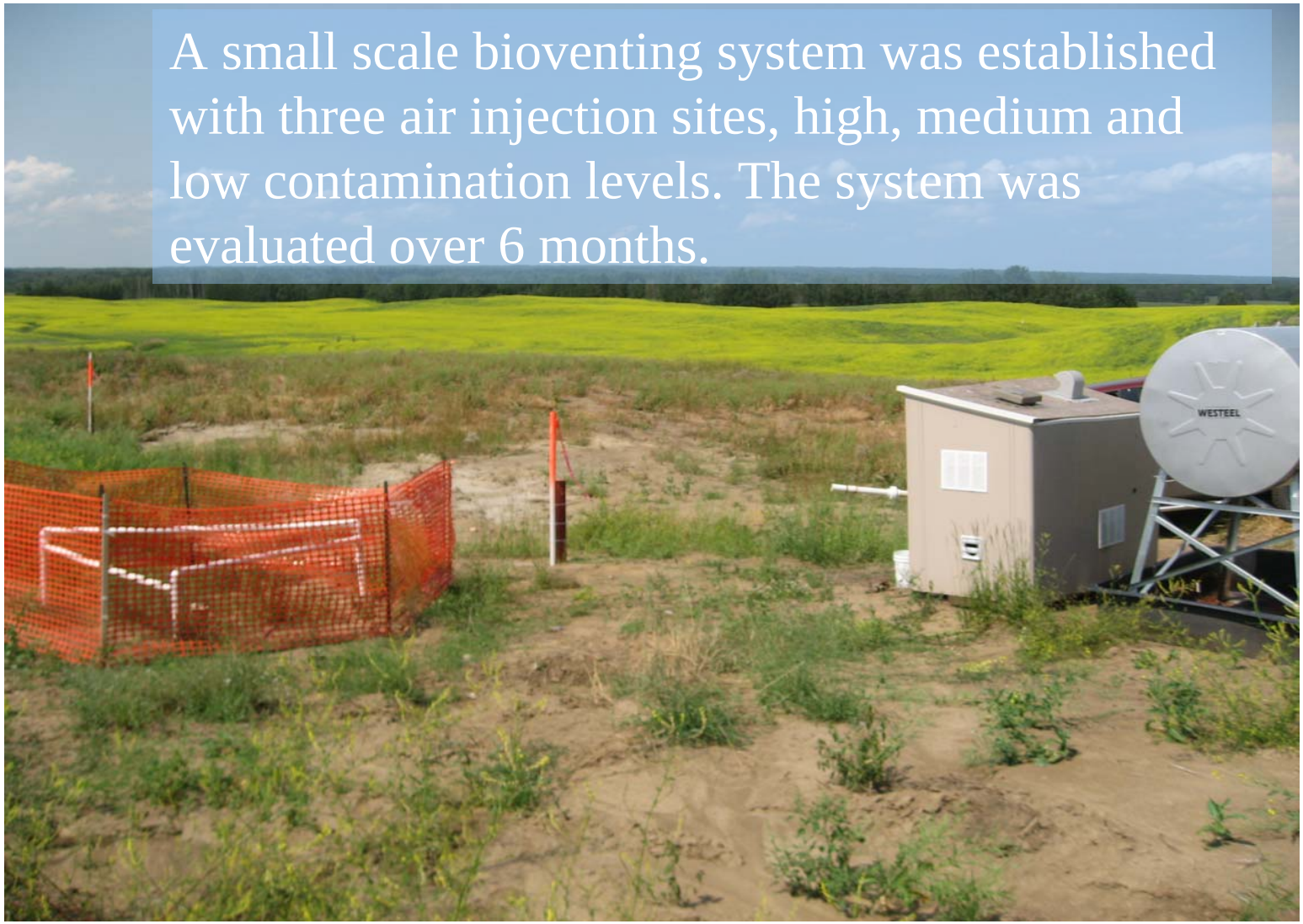
Site Specific Criteria



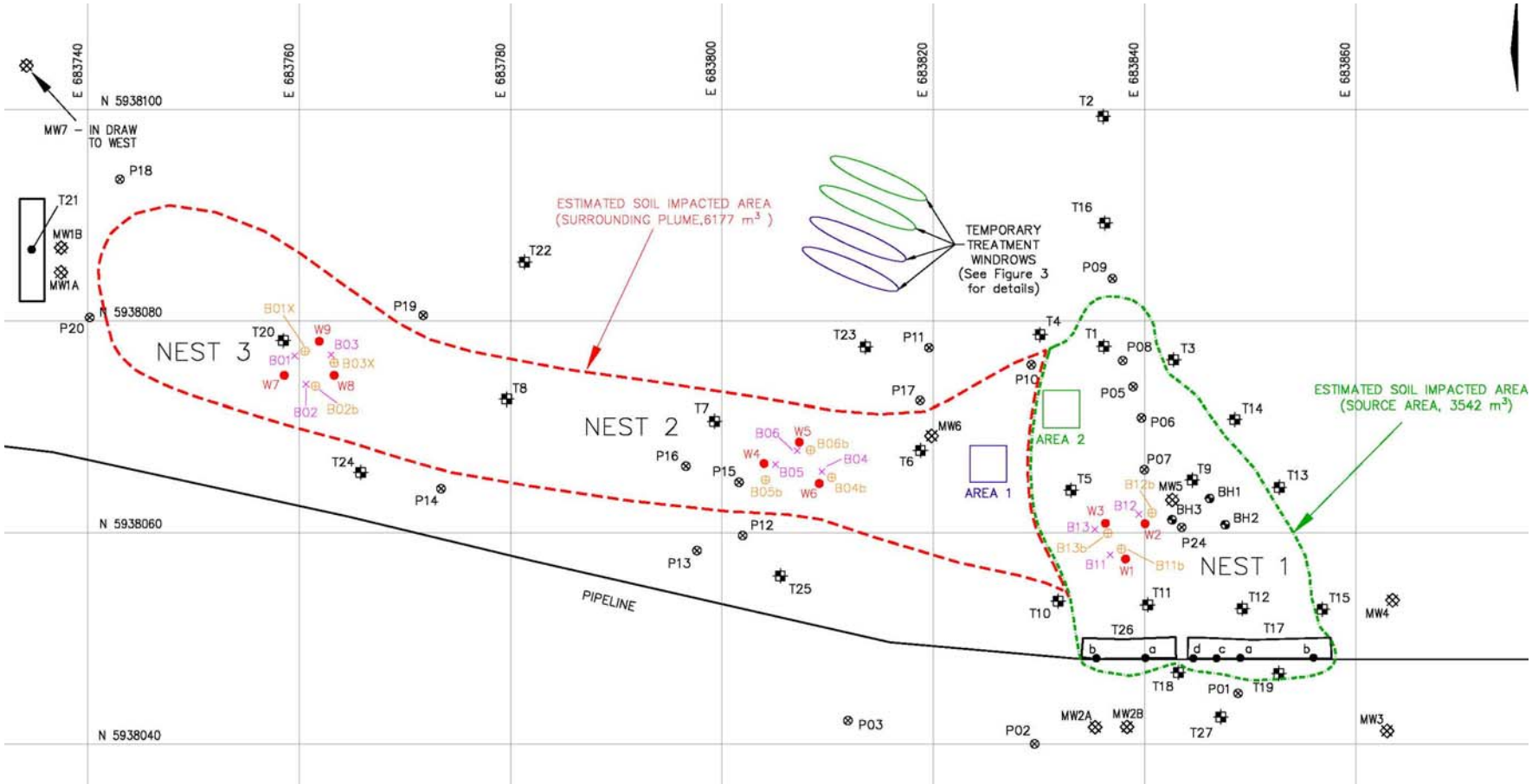
Site Specific Criteria

- Open scans were preformed on the water and soil collected from control and source areas at the site.
- Results supported the presence of natural organic material contributing to our high total phenol values.
- More specific phenol scans were completed for phenolic compounds associated with petroleum hydrocarbons and supported the natural sources as contributing to our total phenol issue.

Remediation Field Trial



Remediation Field Trial



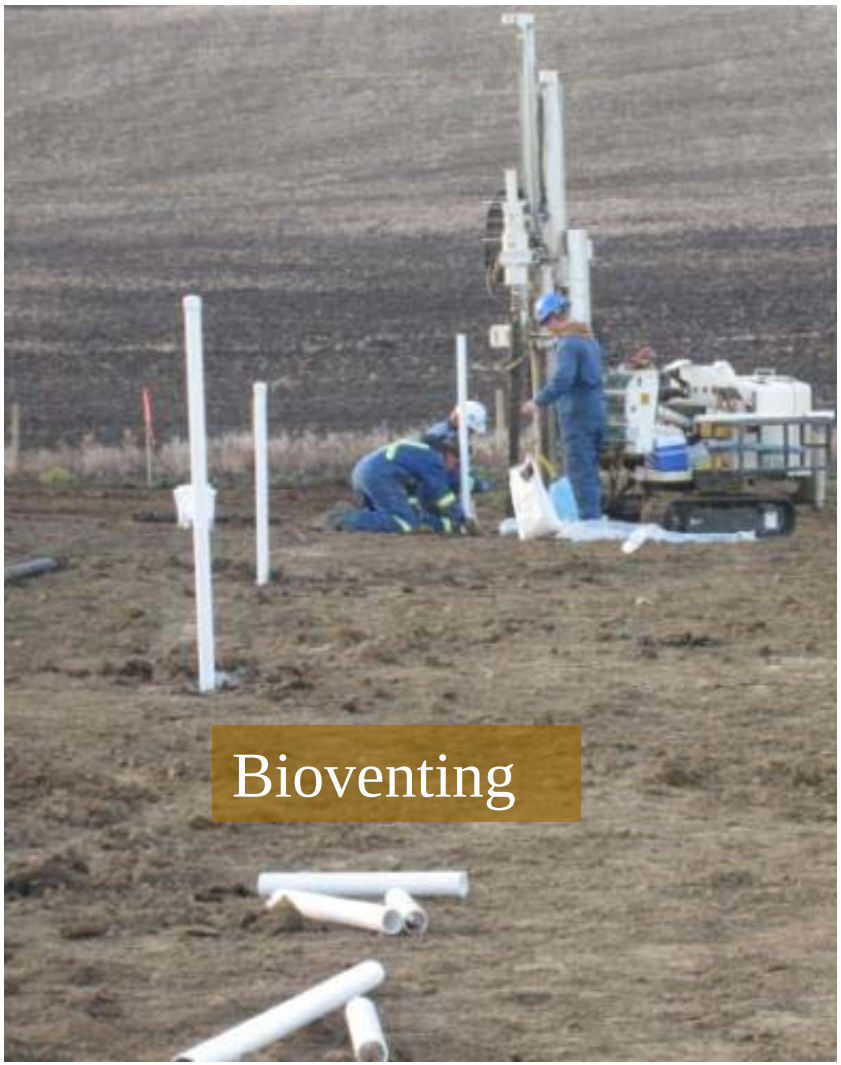
Remediation Field Trial

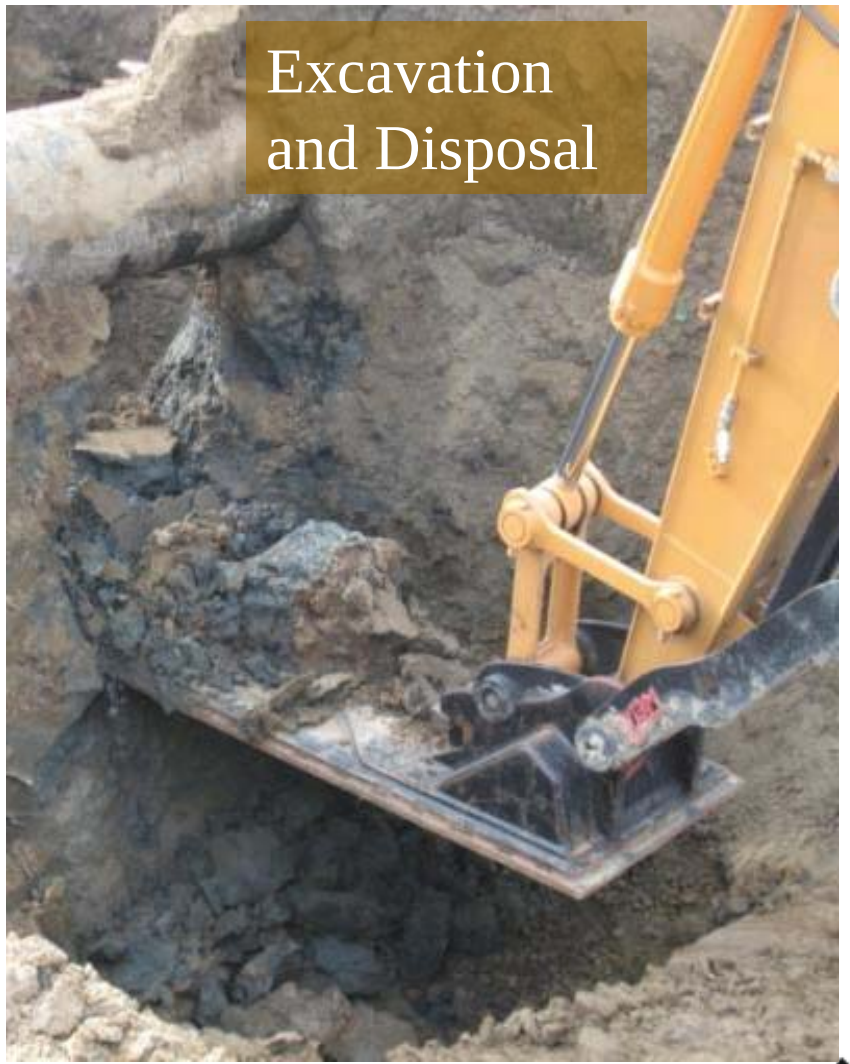
Remediation Field Trial

Remediation Field Trial

- Chemical oxidation showed limited success in reducing hydrocarbon levels in the soil and significantly increased salinity parameters above applicable criteria.
- Bioventing was successful in reducing BTEX, and F1 hydrocarbons to levels below criteria.
- Bioventing limits of treatment for F2 (3000 mg/kg), and F3 (2000 mg/kg) were determined based on field trial.

Full Scale Remediation





Full Scale Remediation

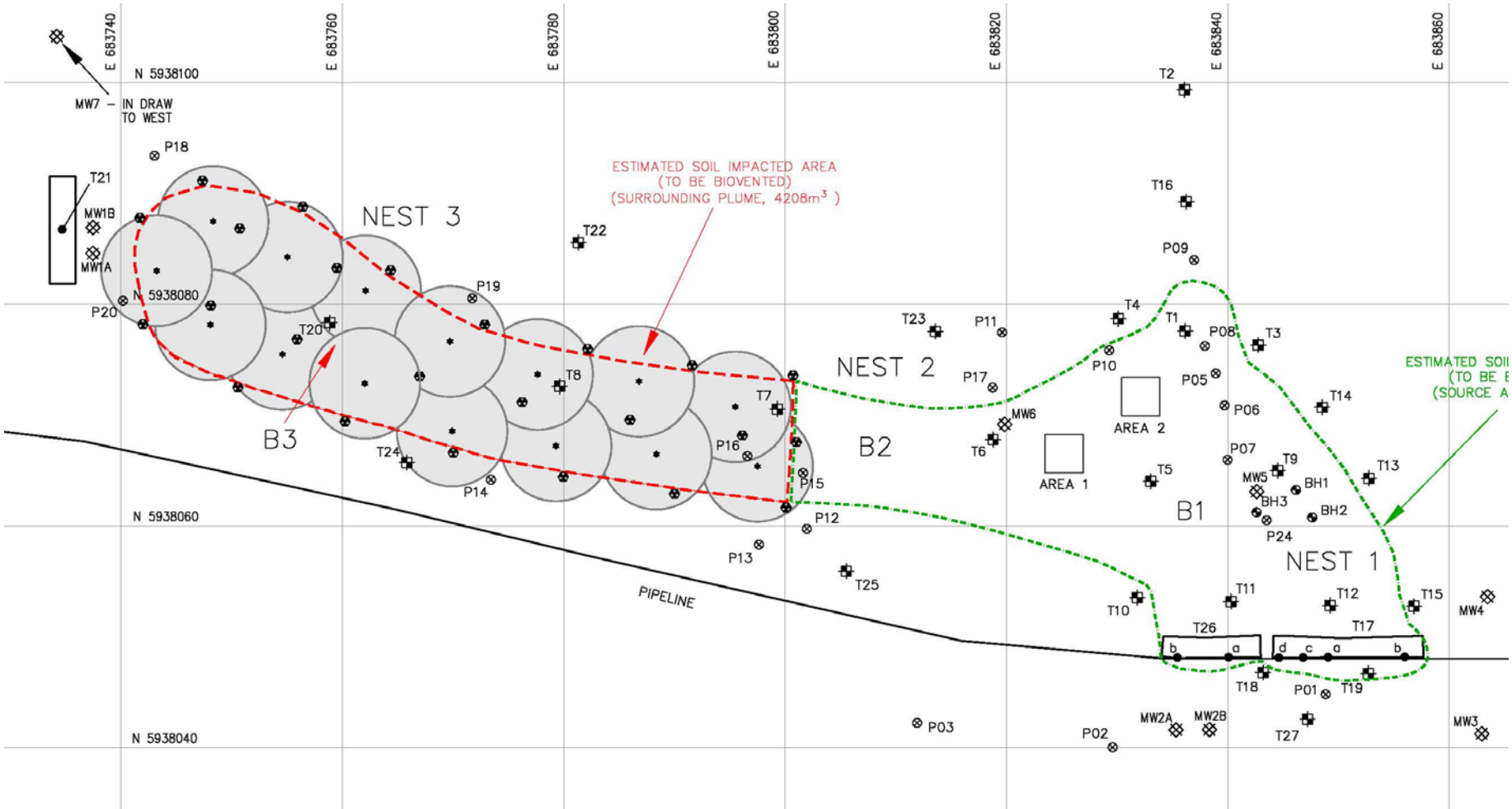
Excavated and disposed of approximately 6784 m^3 of soil

Full Scale Remediation

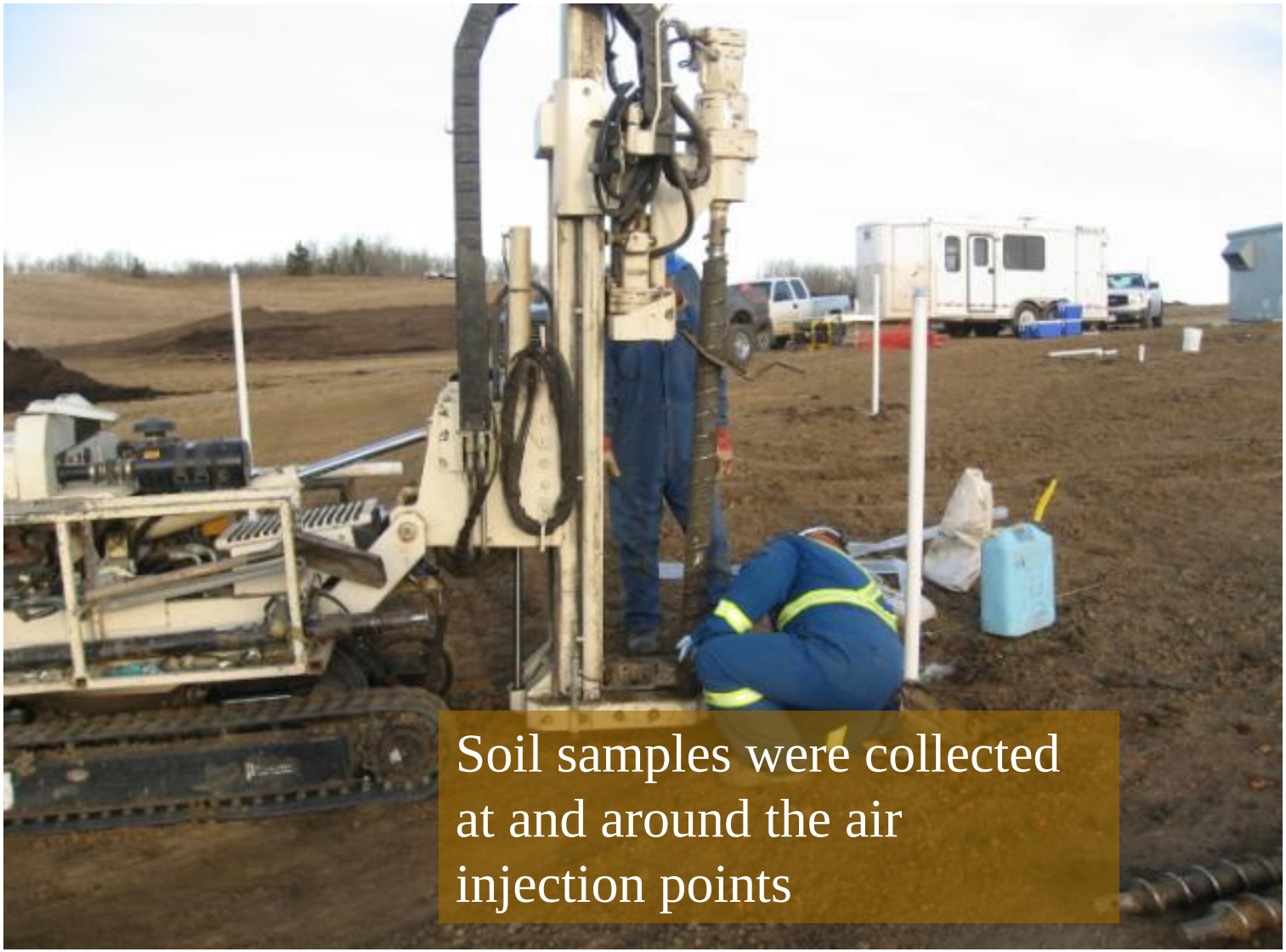
Full Scale Remediation

Excavation limits confirmed clean and western advancing wall below established bioventing levels

Full Scale Remediation



Full Scale Remediation



Full Scale Remediation

Full Scale Remediation

Installed vent monitoring wells to monitor the systems performance and to Optimize Bioventing effort.

Full Scale Remediation

- Monitored C02 and O2 levels over several weeks turning the forces air system on and off.
- Increased and decreased the pressure 70 psi to 50 psi with very little change in O2 levels.
- And determined optimal injection period was 7 days with 14 day rest.

Summary

- Comprehensive assessment set the base for a careful staged approached the remediation of this site including the establishment of site specific criteria.
- The process was made possible with high level of communication between all stakeholders.
- The most appropriate solution for the site was realized.

CREATING AND DELIVERING BETTER SOLUTIONS