



CREATING AND DELIVERING BETTER SOLUTIONS



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

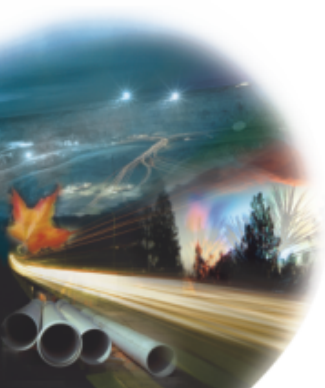
Neil Reid

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

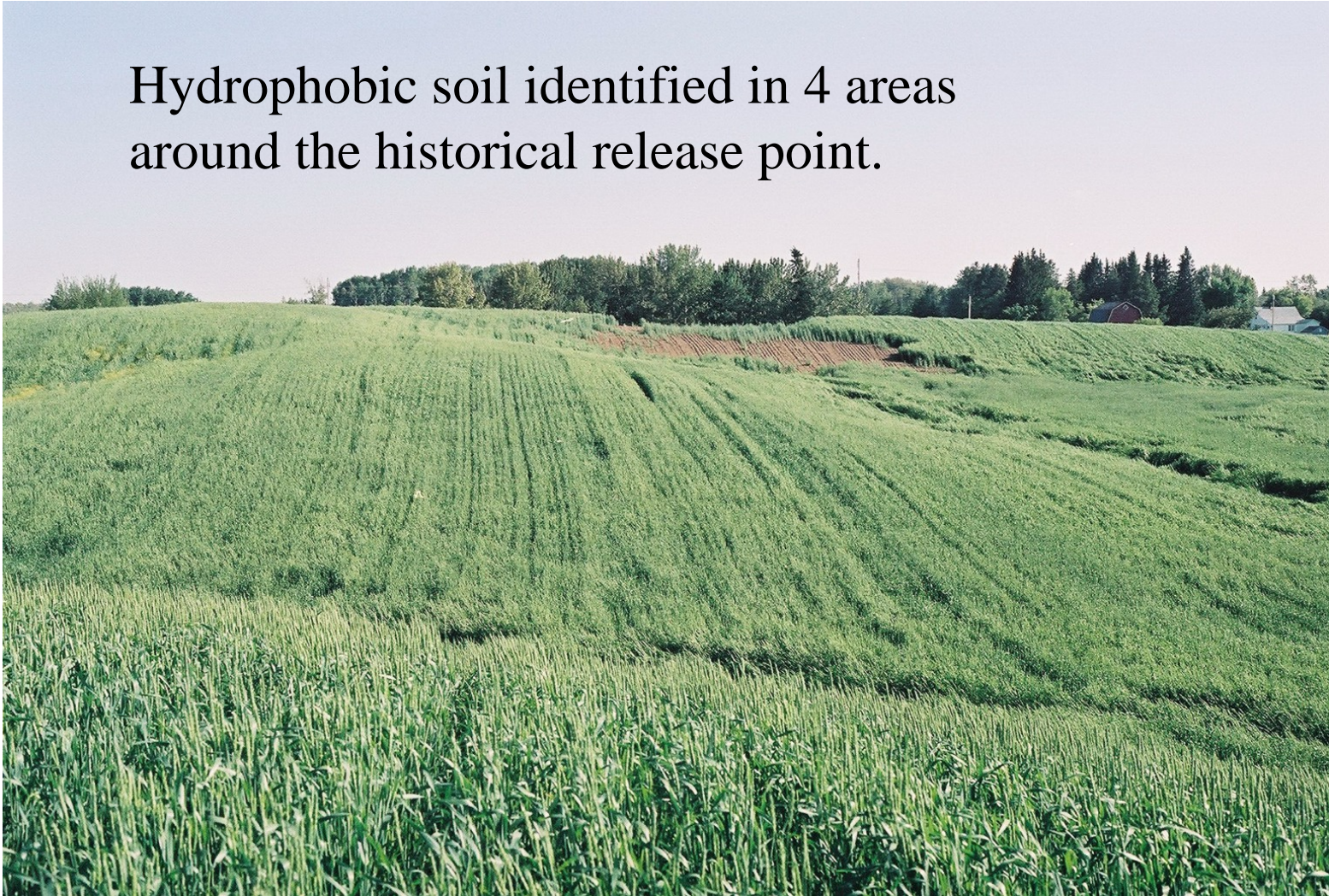


Initial Assessment



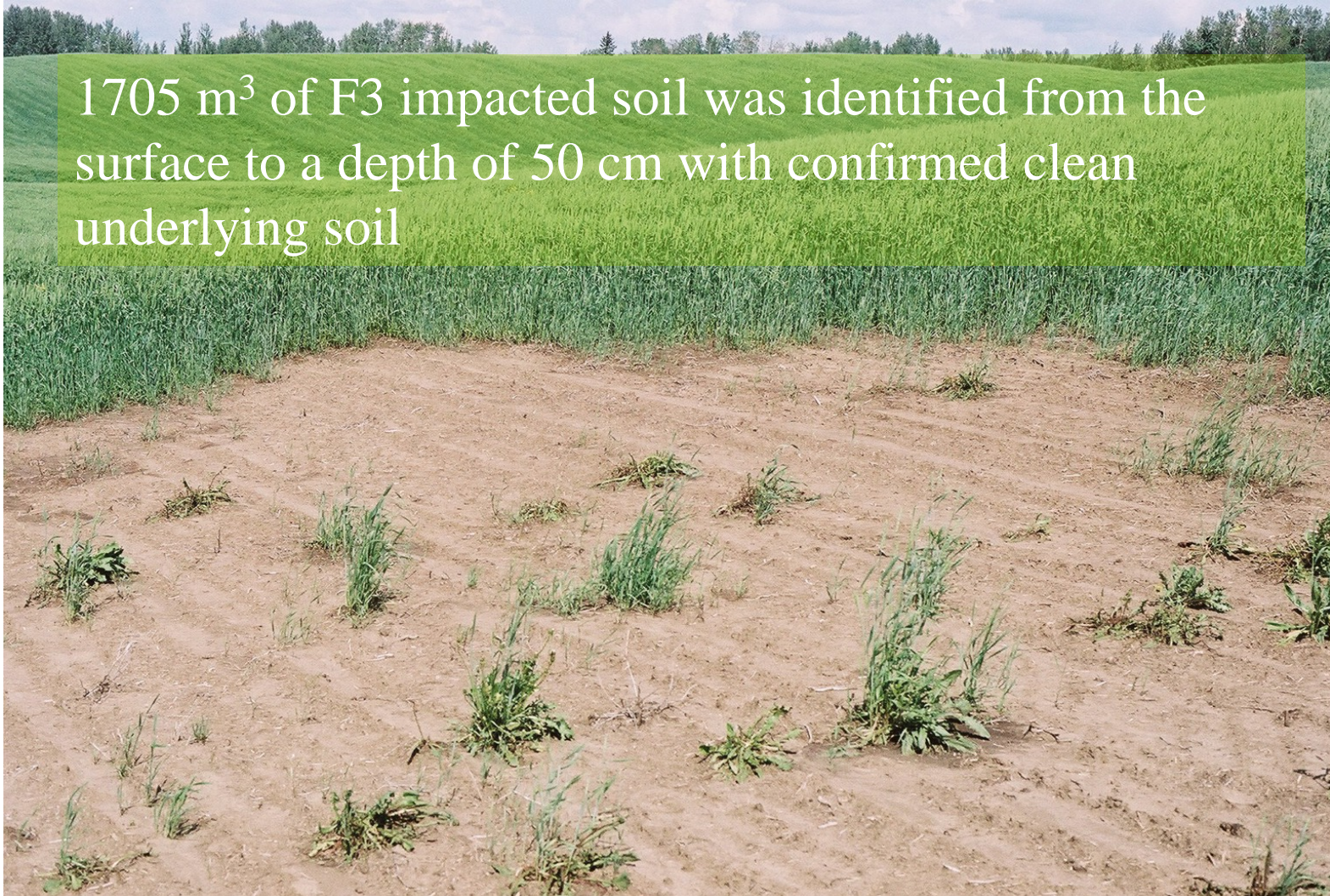
Initial Assessment

Hydrophobic soil identified in 4 areas around the historical release point.



Initial Assessment

1705 m³ of F3 impacted soil was identified from the surface to a depth of 50 cm with confirmed clean underlying soil



Remediation of Hydrophobic Soil



Removal of the top 50 cm of soil from 4 identified areas

Remediation of Hydrophobic Soil

Impacted soil excavated and
landfilled



Remediation of Hydrophobic Soil



Confirmatory sampling showed impacts remediated

Remediation of Hydrophobic Soil

www.eba.ca



During final confirmatory sampling impacted soil uncharacteristic of the identified hydrophobic soil was encountered. A testpit uncovered 10,000 m³ of impacted soil.

Re-assessment



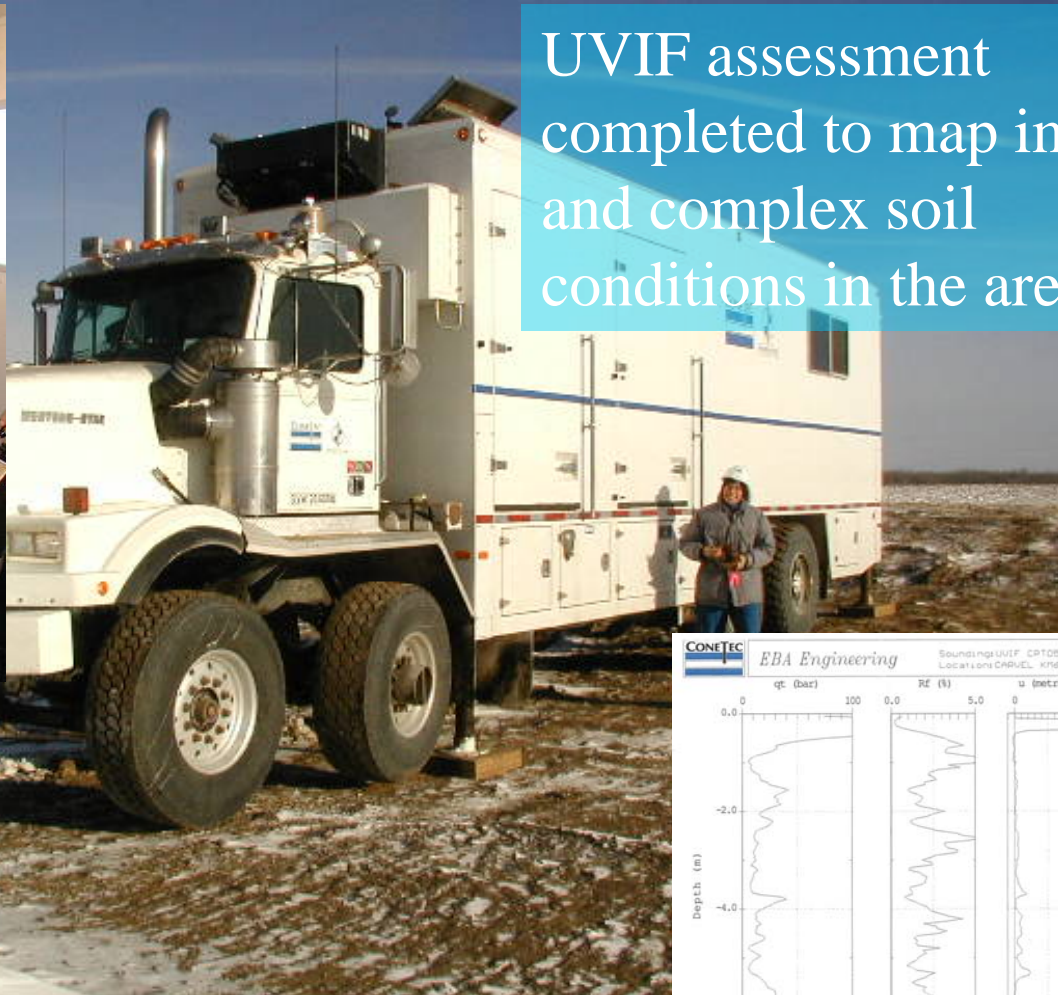
Based on the nature of the contaminants discovered it was feared the pipe might be leaking.

Re-assessment

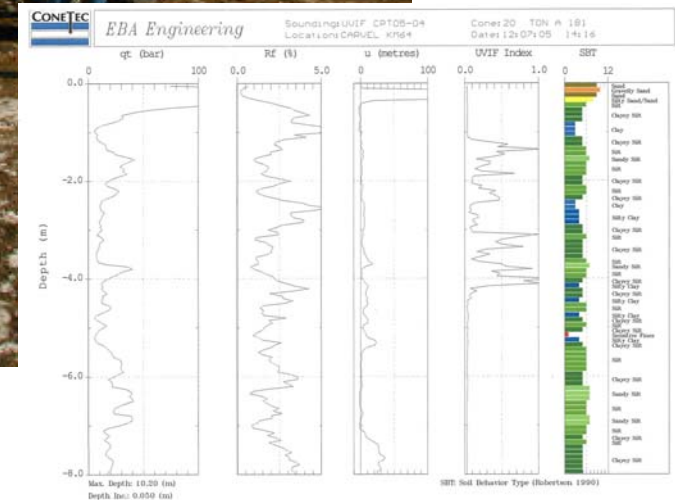


Drilling assessment completed. Buried organics discovered at 7 m.

Re-assessment



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



- 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



Installed 12 groundwater monitoring wells and completed several seasonal monitoring events.

Re-assessment

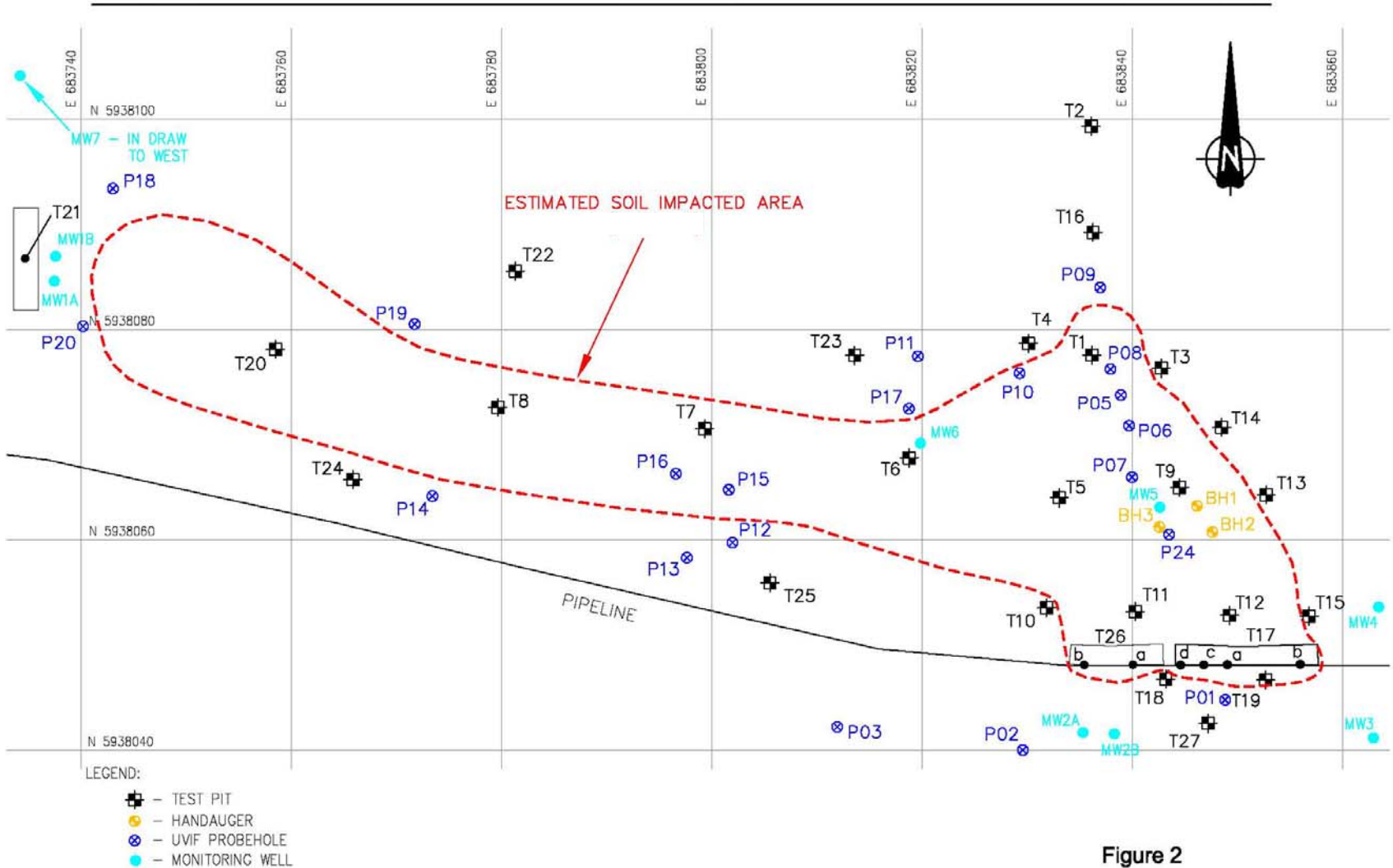
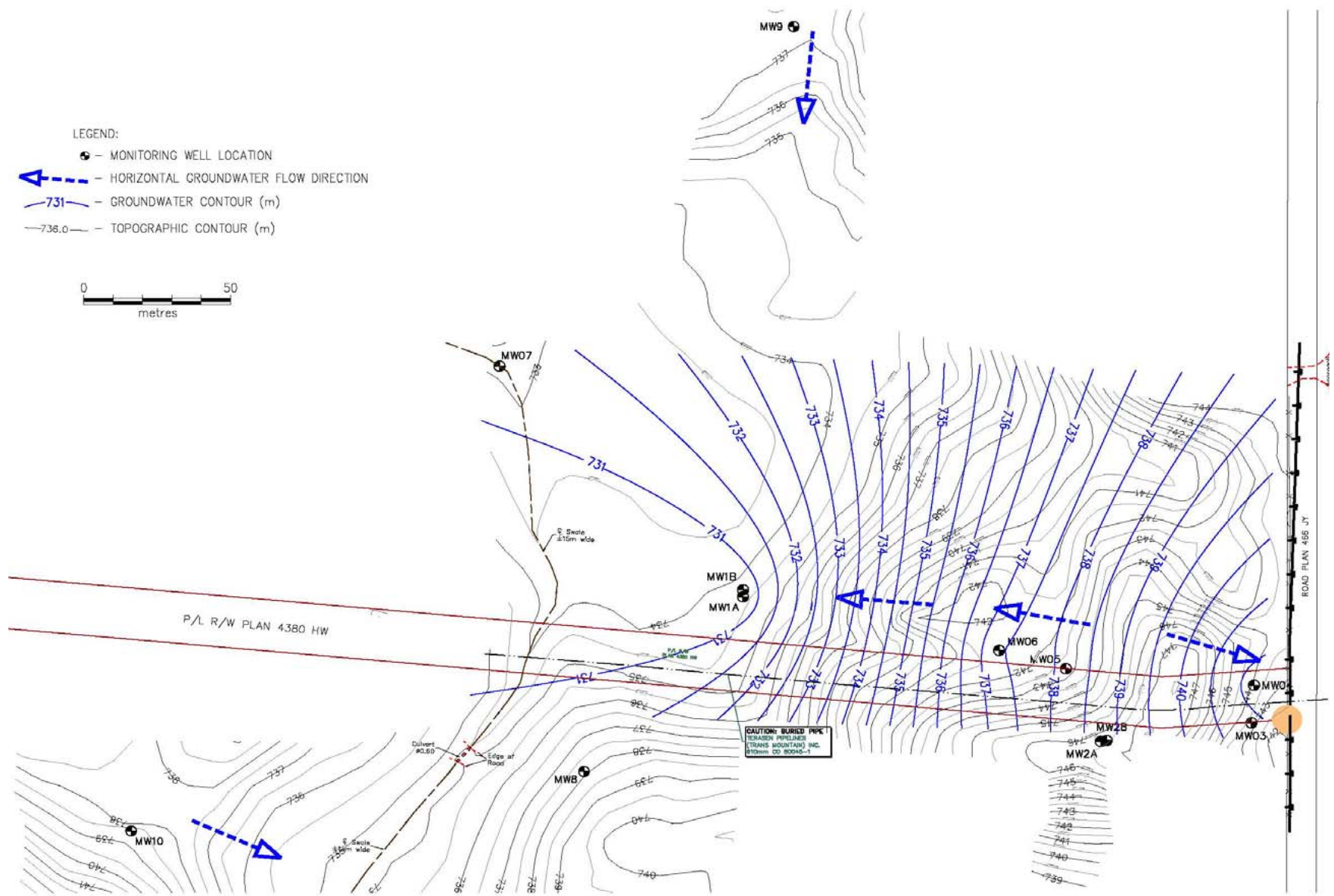


Figure 2

- 10,000 m³ 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

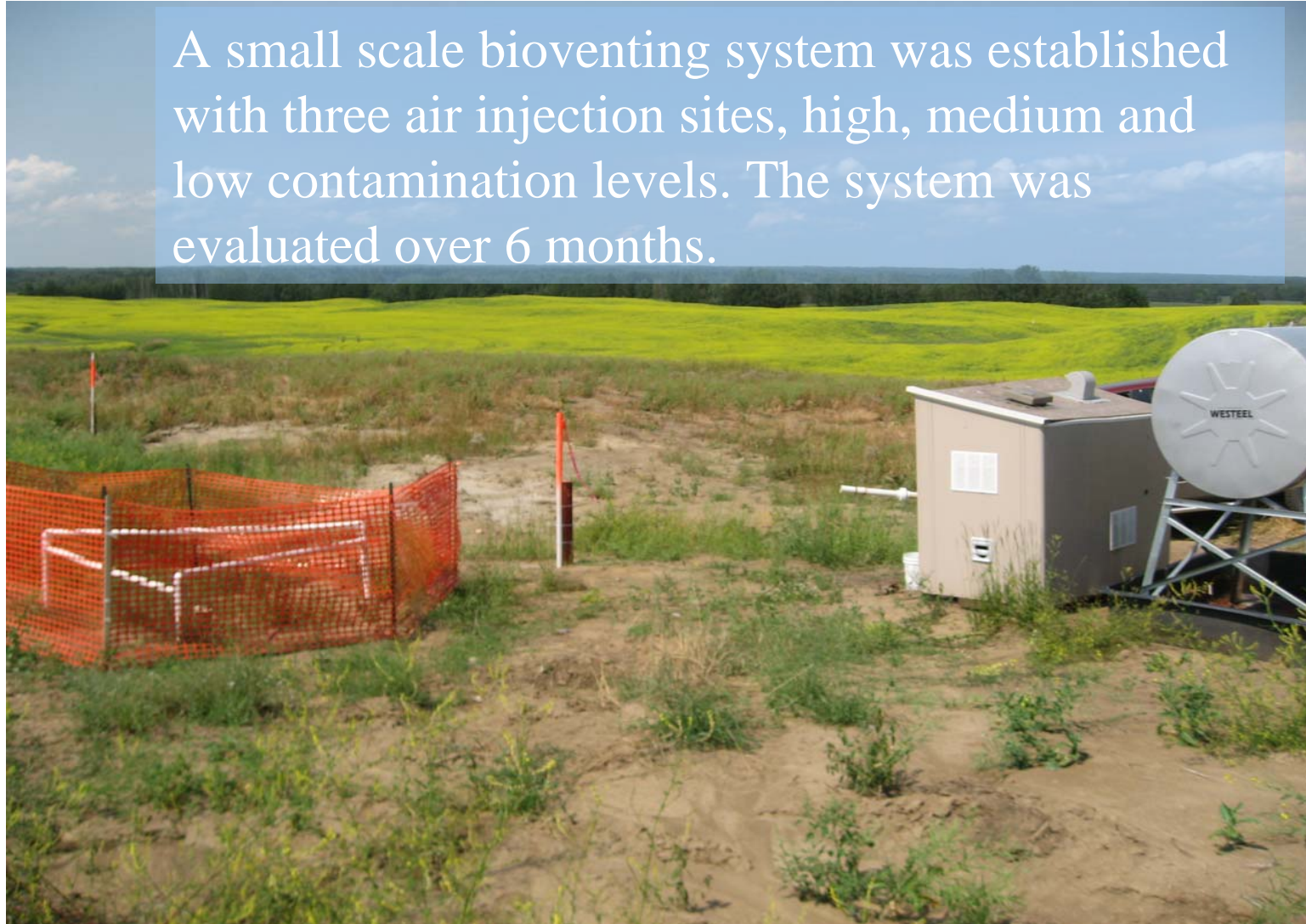


Site Specific Criteria

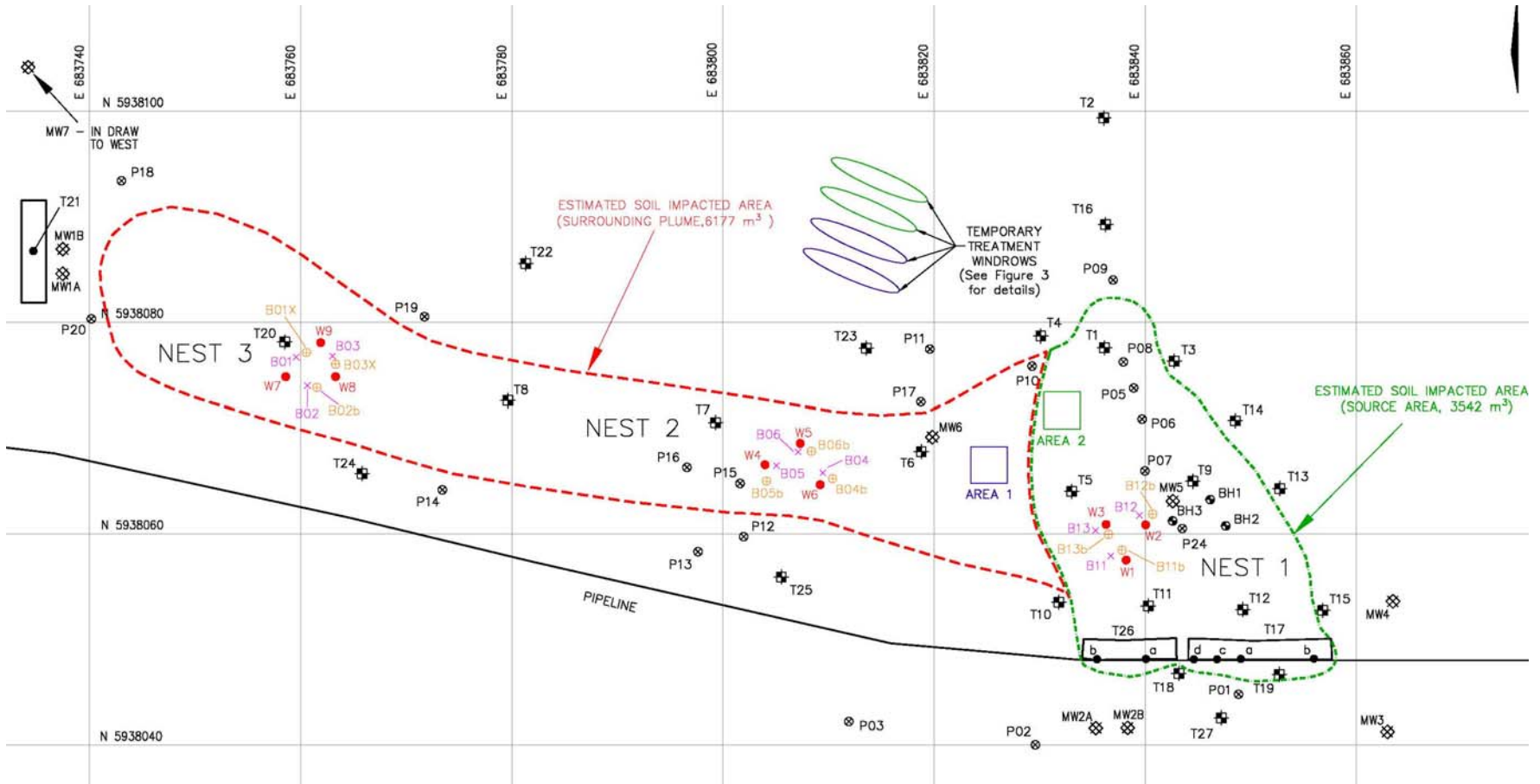
- Open scans were performed on the water and soil collected from control and source areas at the site.
- Results supported the presence of natural organic material contributing to our high total phenol values.
- More specific phenol scans were completed for phenolic compounds associated with petroleum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

Remediation Field Trial

A small scale bioventing system was established with three air injection sites, high, medium and low contamination levels. The system was evaluated over 6 months.



Remediation Field Trial



Remediation Field Trial

A microenfractionator was used to mix chemical oxidizing agents with excavated soil.



Remediation Field Trial

www.eba.ca



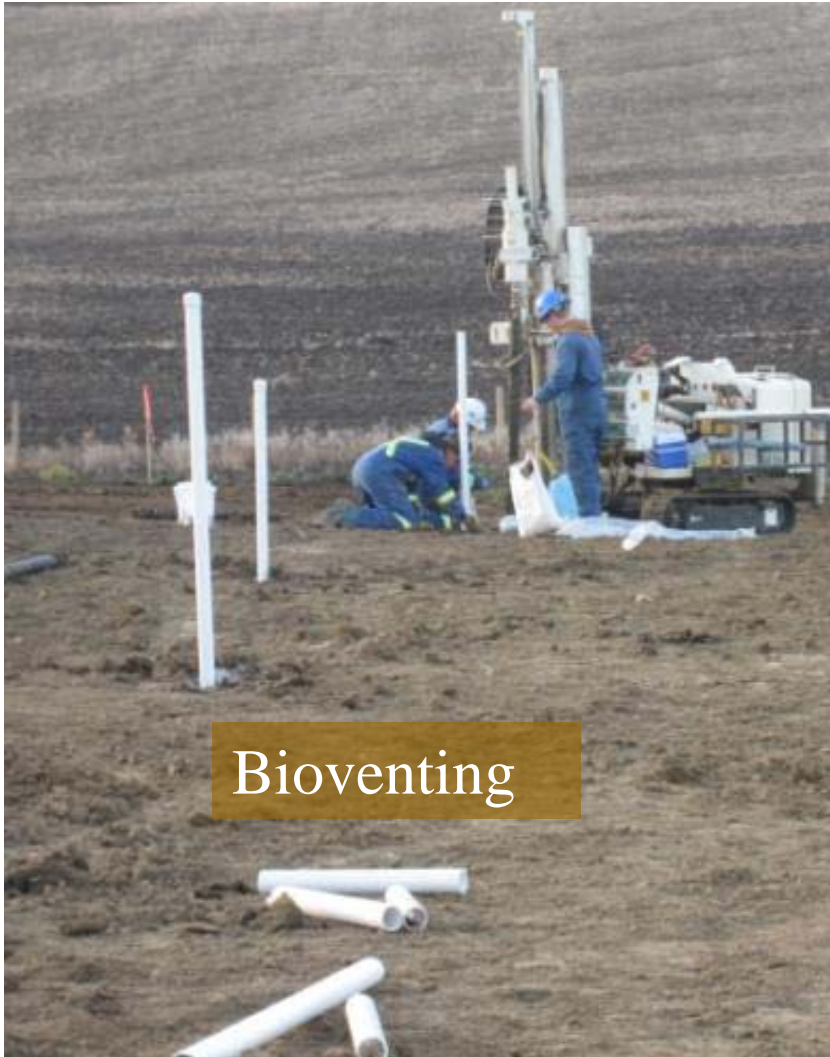
CREATING AND DELIVERING BETTER SOLUTIONS



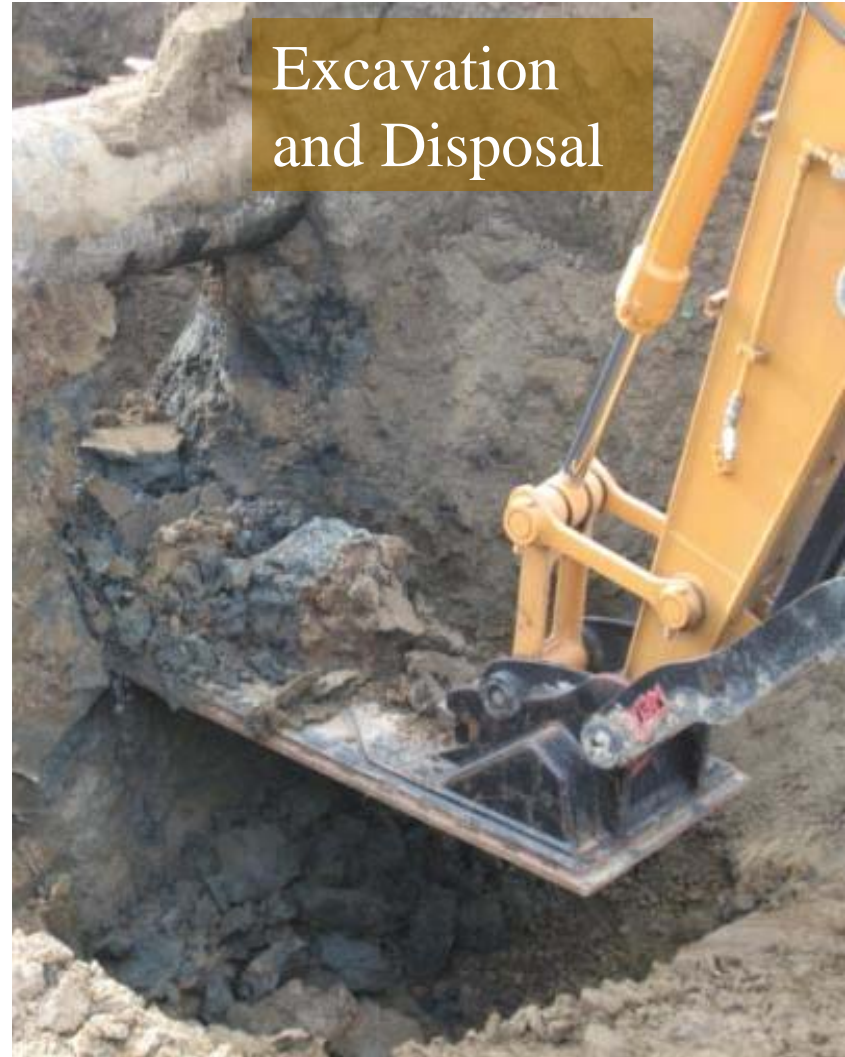
Remediation Field Trial

- 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



Bioventing



Excavation
and Disposal

Full Scale Remediation



Excavated and disposed of approximately 6784 m³ of soil

Full Scale Remediation

www.eba.ca



Achieved 100% Compaction

CREATING AND DELIVERING BETTER SOLUTIONS

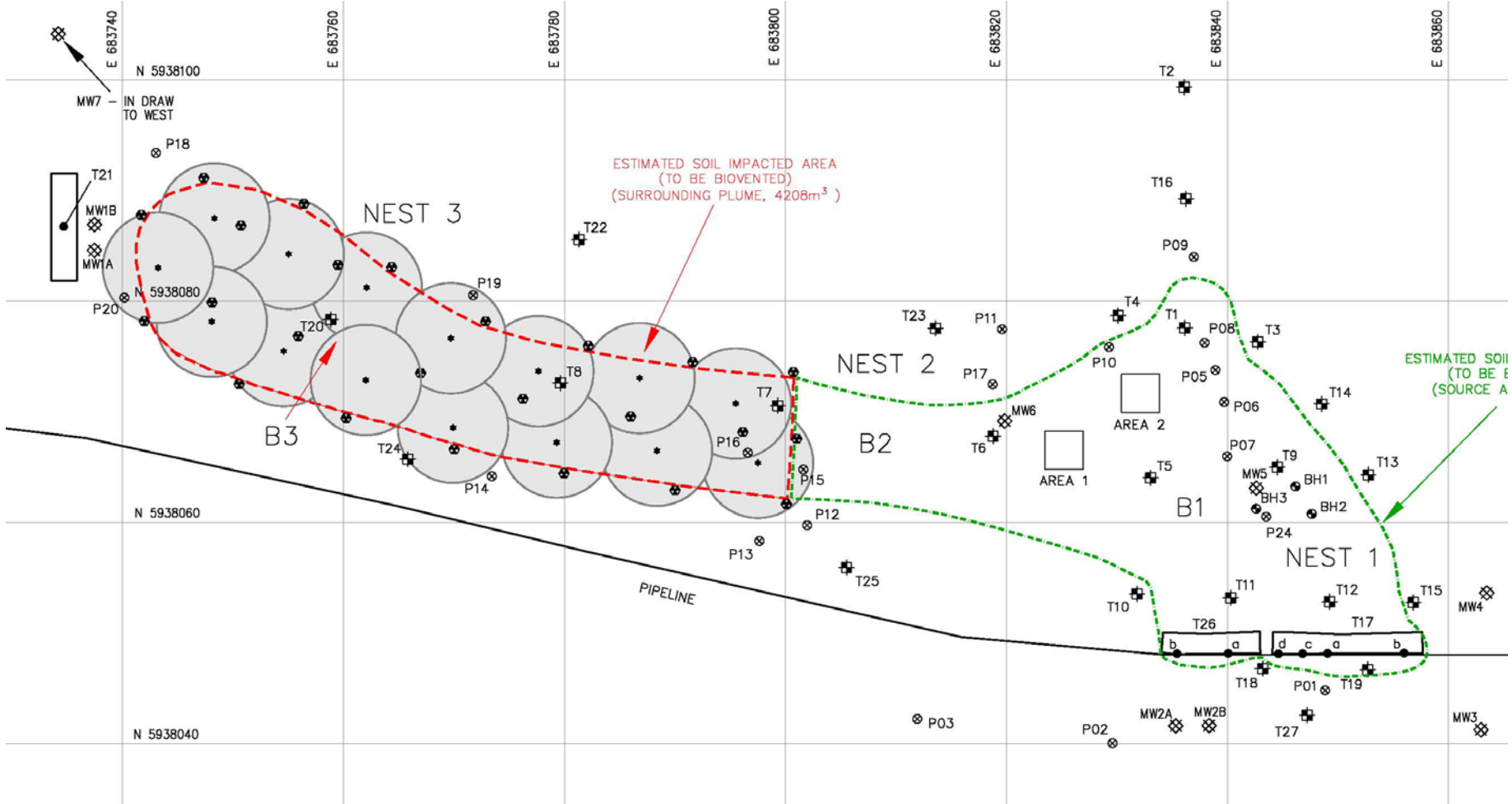


Full Scale Remediation

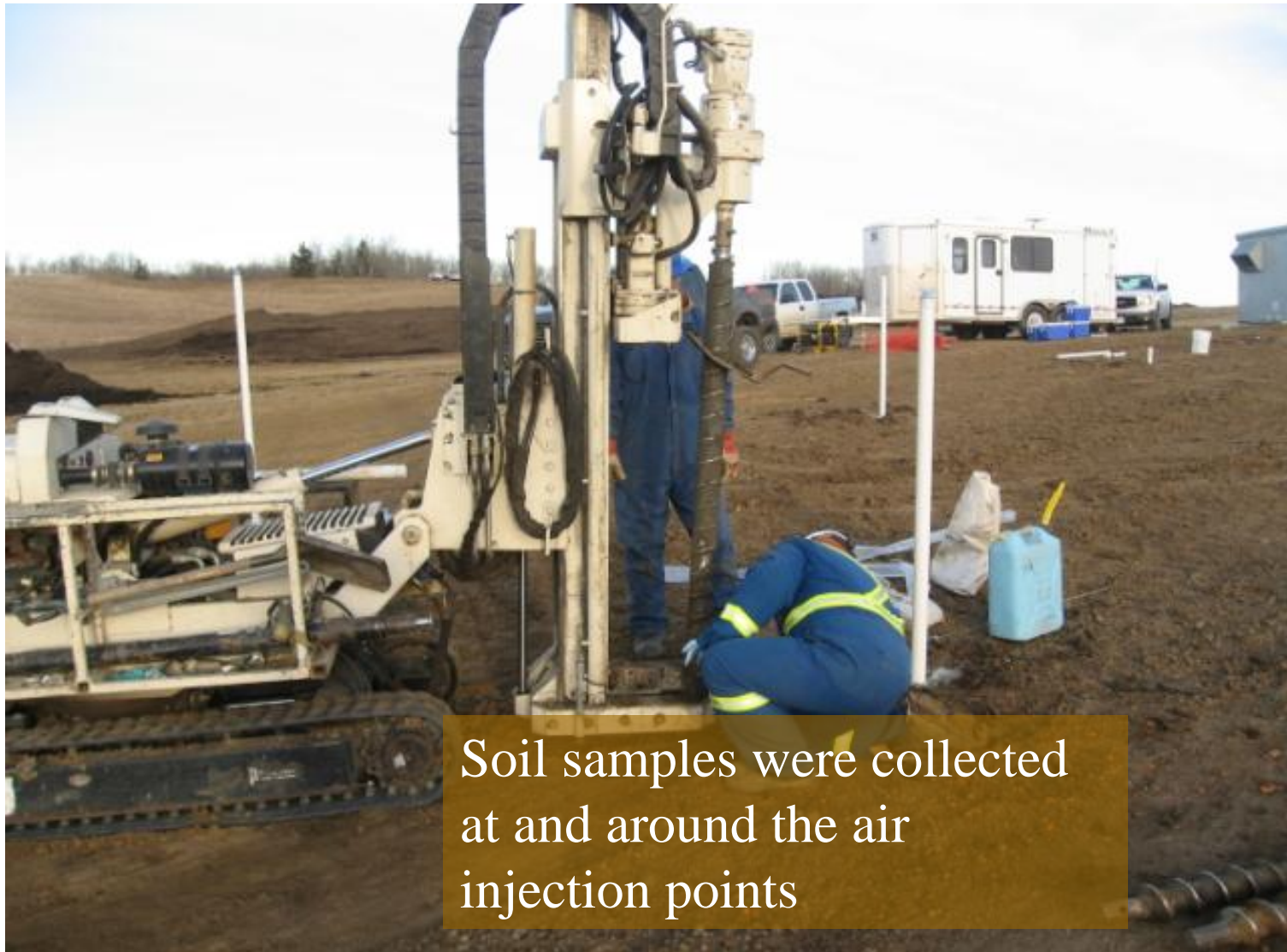


Excavation limits confirmed clean and western advancing wall below established bioventing levels

Full Scale Remediation



Full Scale Remediation



Soil samples were collected at and around the air injection points

Full Scale Remediation

www.eba.ca



CREATING AND DELIVERING BETTER SOLUTIONS



Full Scale Remediation

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



Full Scale Remediation

- Monitored CO₂ and O₂ levels over several weeks turning the forced 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.



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



CREATING AND DELIVERING BETTER SOLUTIONS