M. Jillian Mitton, P.Eng

Brian Pimblett, P.Eng

Delineation and Remediation of Wabamun Derailment Site

Outline

- Initial Remediation Plan
- Short Term Monitoring Plan
- Soil Excavation
- Delineation Plan
- VER Design and Installation
- VER Performance and Monitoring

Derailment Area - Initial Remediation

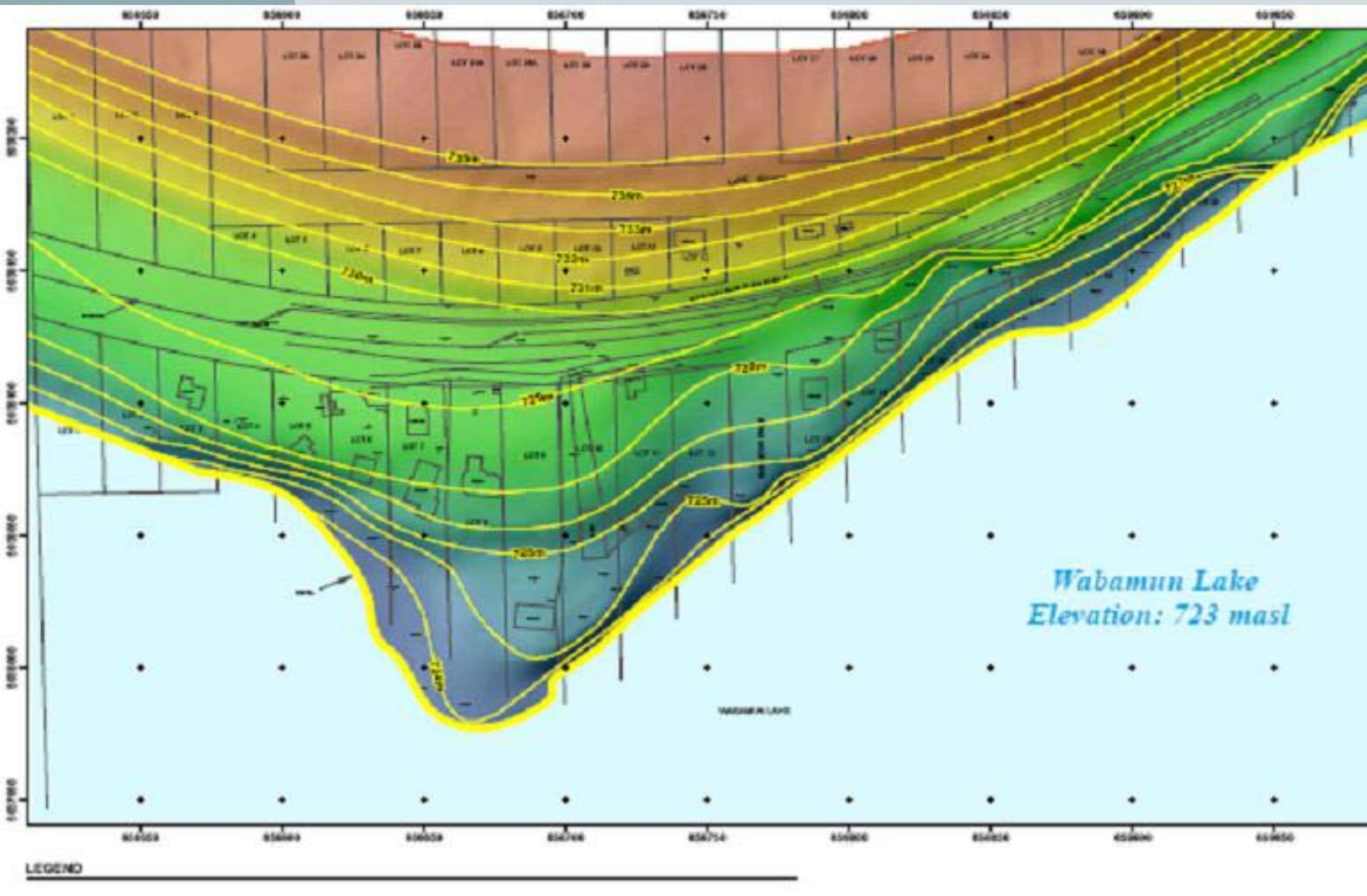
- 712,500 litres of Bucker C and 88,000 litres of Imperial Pole oil were released
- Initial response activities included recovering fluids, cutting and removing cars, repairing track starting August 3, 2005
- August 5th PTO observed seep from spring near lake
- Damaged water well where Bunker C flowed, discovered on August 16th

Stage Excavation Areas

- Area I – CN right of way (Bunker C)
- Area II – Private Property (Bunker C)
- Area III – PTO (CN Land)
- Area VI – Beach Areas
- Area V - Background

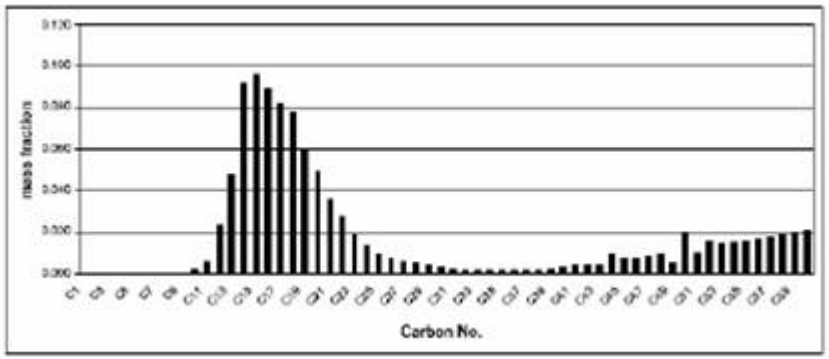
Conceptual Spill Model

Derailment Topography

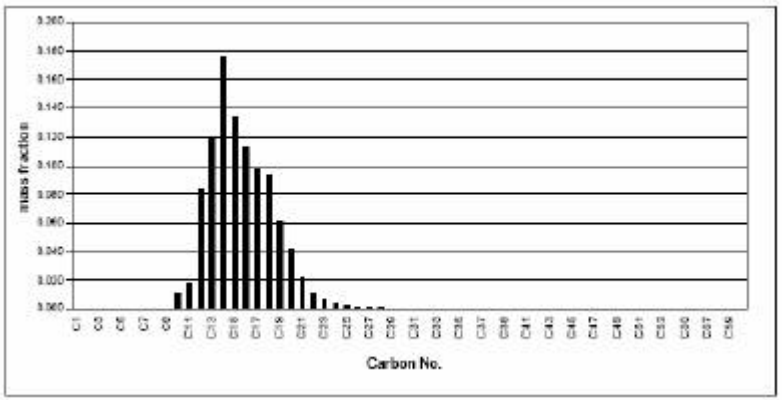



HAZCO

The Fuels and Fingerprinting

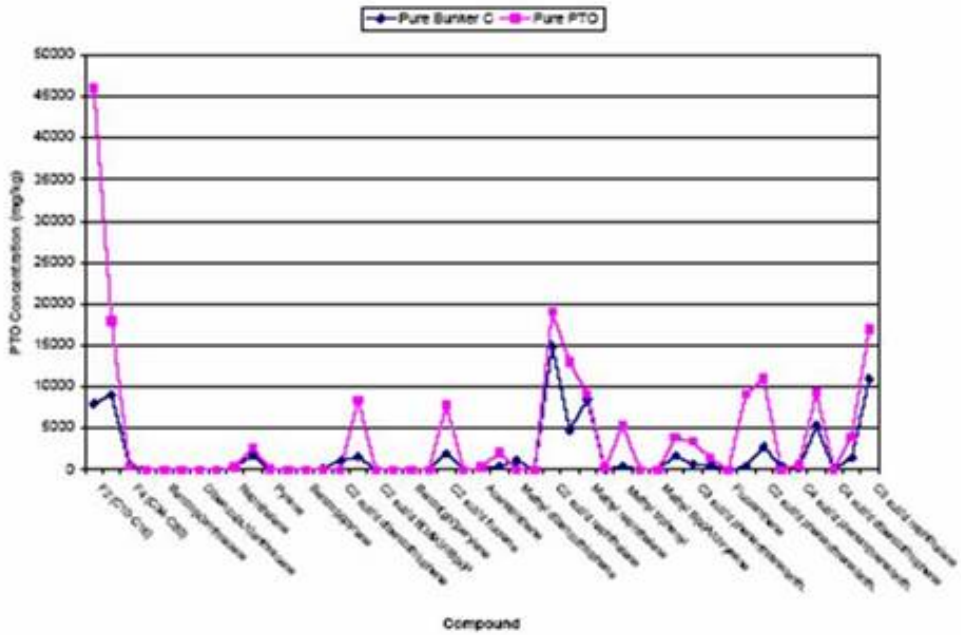


Bunker C histogram



PTO histogram

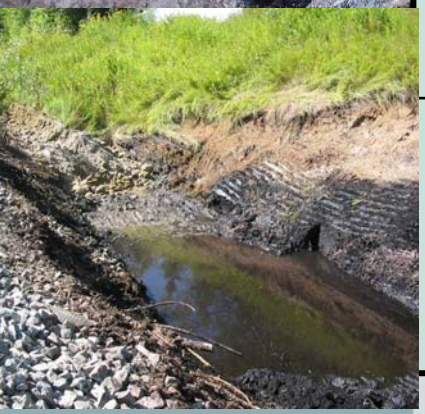
Similar chemical constituents, different fate and transport characteristics, natural sources in the area (coal and peat)



Comparison of Bunker C and PTO

Golder Associates

Fuel Characterization



Property	Bunker C	PTO
Density (kg/m^3 @ 15 ºC)	986.4	939.6
API Gravity (15.6 ºC)	11.9	19.0
Viscosity (cSt @ 20 º C)	6756	5.411
Description	Aliphatic, olefinic, naphtenic and aromatic hydrocarbon	Aliphatic and aromatic hydrocarbons (diesel like fuel)

Golder Associates

Pre-Excavation Activities

- Health and Safety
- Utility Clearance and Management
- Legal Survey
- Removal of Vegetation and Infrastructure

Soil Excavation

- Bunker C oil recovery using vacuum trucks from rail cars, pools of oil within ditches and bell holes.
- Removal and offsite disposal of impacted soil was stage due to restricted assess
- All impacted soil disposed of at Hazco Tower Road Class II Industrial land fill
- 5059 tonnes of PTO impacted soil (11,000 litres of PTO)
- 17,472 tonnes of Bucker C impacted soil (231,000 litres of Bunker C)

Golder Associates

Soil Excavation

Soil Excavation

Soil Excavation

Soil Excavation

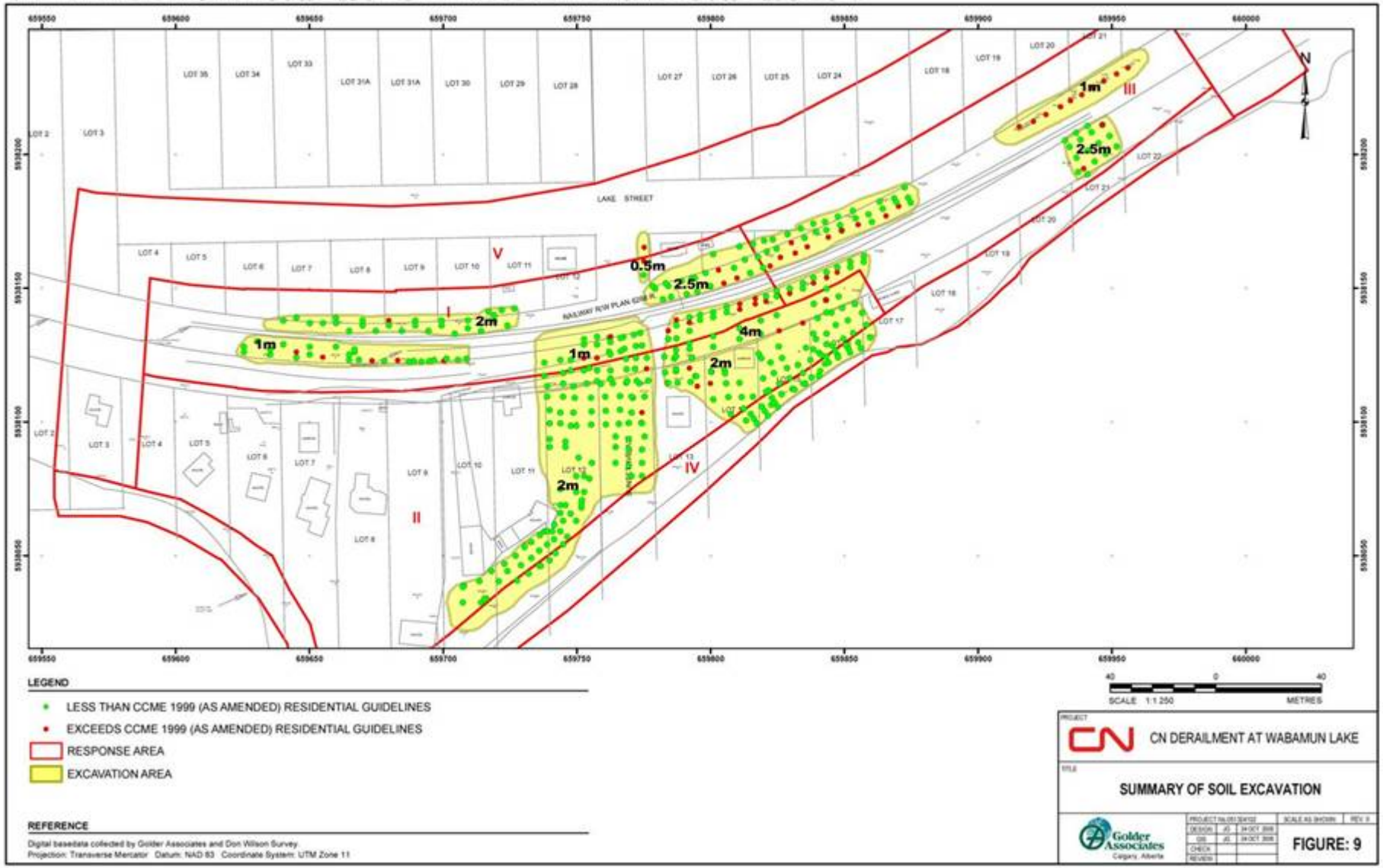
Soil Excavation

Confirmatory Soil Sampling

- The plan required soil sampling every 5 linear metres for every 3 m depth
- Collected over 500 soil samples
- Soil samples were analyzed for BTEX, PHC fractions F1-F4, and PAHs
- GIS and Information Management were essential for Sampling Plans
- Winter sampling program conducted for further validation
- Guidelines were the CCME Soil Quality Guidelines for Residential Land Use

Golder Associates

Soil Confirmatory Sampling



Damaged Water Well

Damaged Water Well

- ✓Vacuum Truck Removal
- ✓Steam Removal
- ✓Well Abandonment
- ✓Installation of 3 deep Observation Wells

Golder Associates

Water Well Remediation

Casing Removal

Well Excavation

Water Well Remediation

Steam Injection and Vacuum Extraction

Water Well Remediation

Well Decommissioning with Mud Rotary Rig

PTO Initial Contaminant

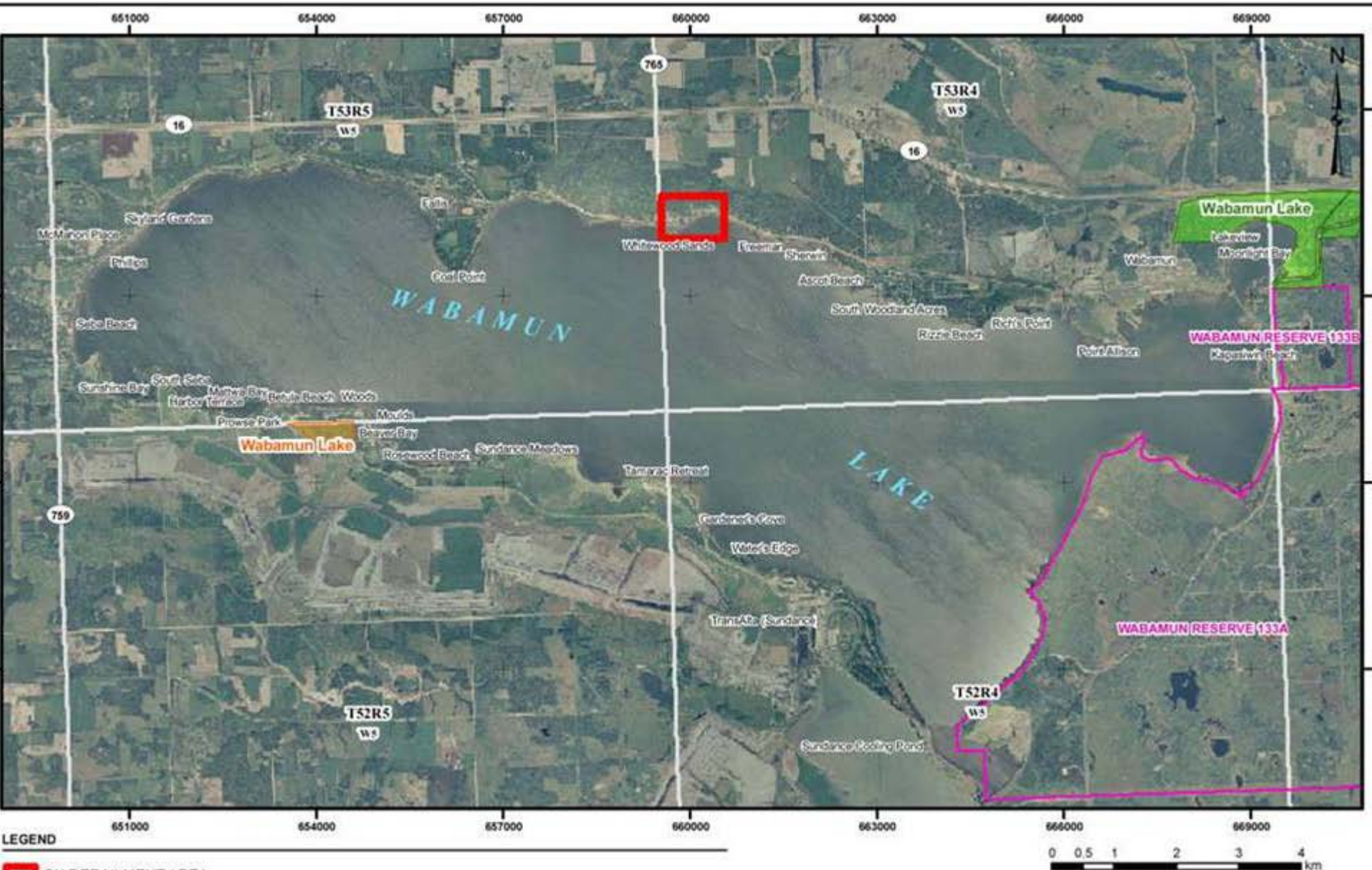
- In addition to topography, underground culverts (wooden), natural spring and wood stave pipe promoted PTO migration

PTO Initial Containment/Recovery

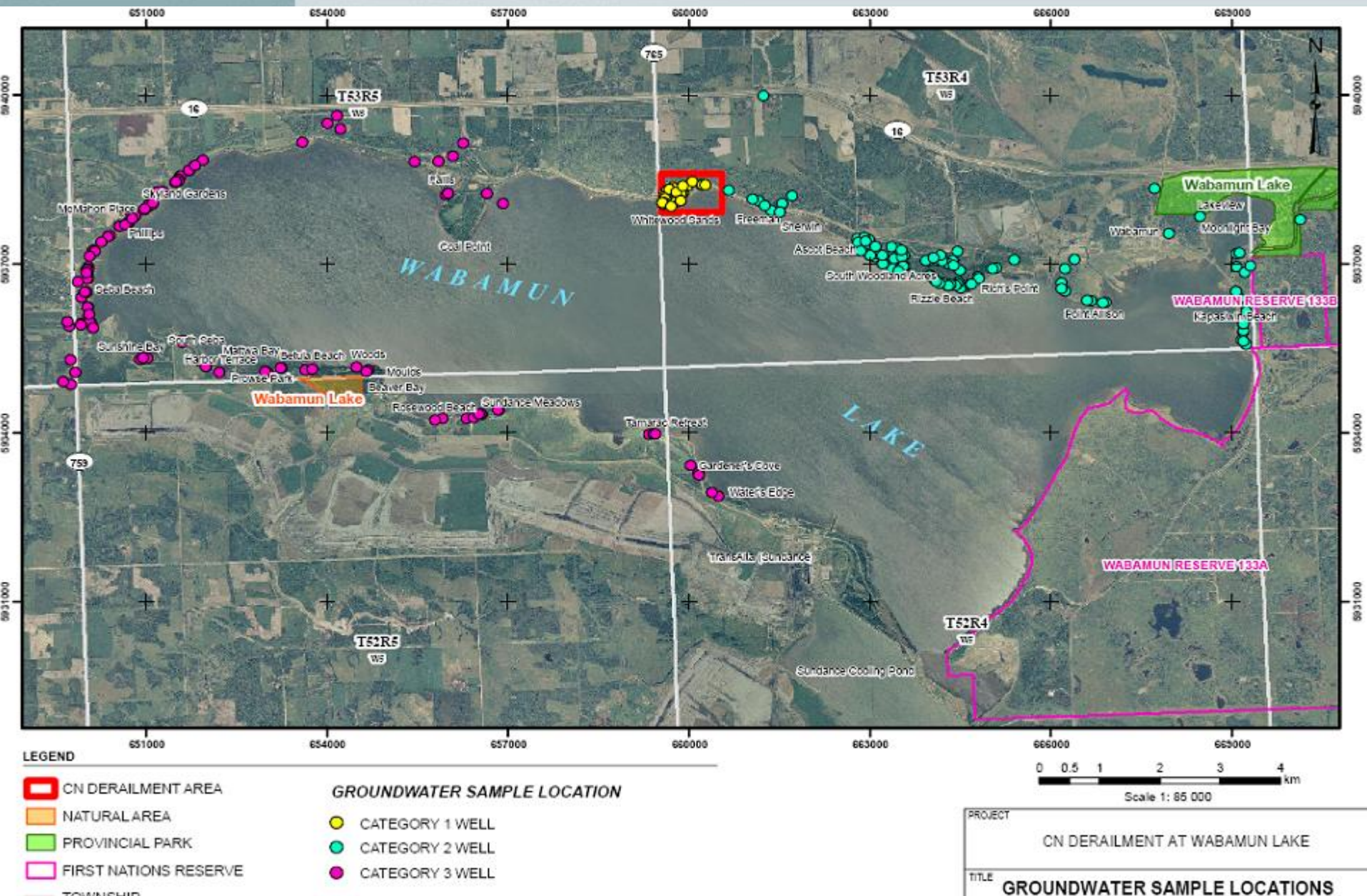
- Absorbent pads and booms initially used
- Shallow sump and vacuum truck
- Additional Bell Holes and Vacuum Trucks
- Temporary Dual Phase Vacuum System, storage tank, oil/water separator, clay/carbon filtration, clean water storage.
- Permanent Concrete Vault

PTO Sump

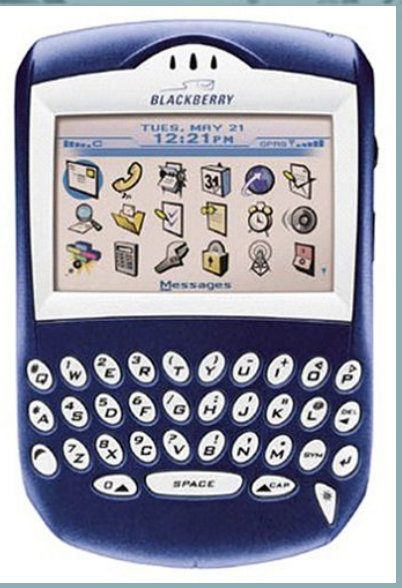
Short Term Monitoring Plan



Short Term Monitoring Plan



Short Term Monitoring Plan and Results



1 -800 Hotline

- Developed Sampling Categories
  - Category 1 - Immediate derailment area
  - Category 2 - East of derailment
  - Category 3 - Greater Wabamun Lake area
- Regional Groundwater Study
- Local Derailment Study (Delineation Plan and Water Well Survey)
- Extensive Groundwater Quality Testing Completed
- Risk Management Screening of all Water Wells in potential high risk area
- Long-Term Plan focused monitoring in the derailment area comprehensive quarterly sampling and limited monthly monitoring for first year

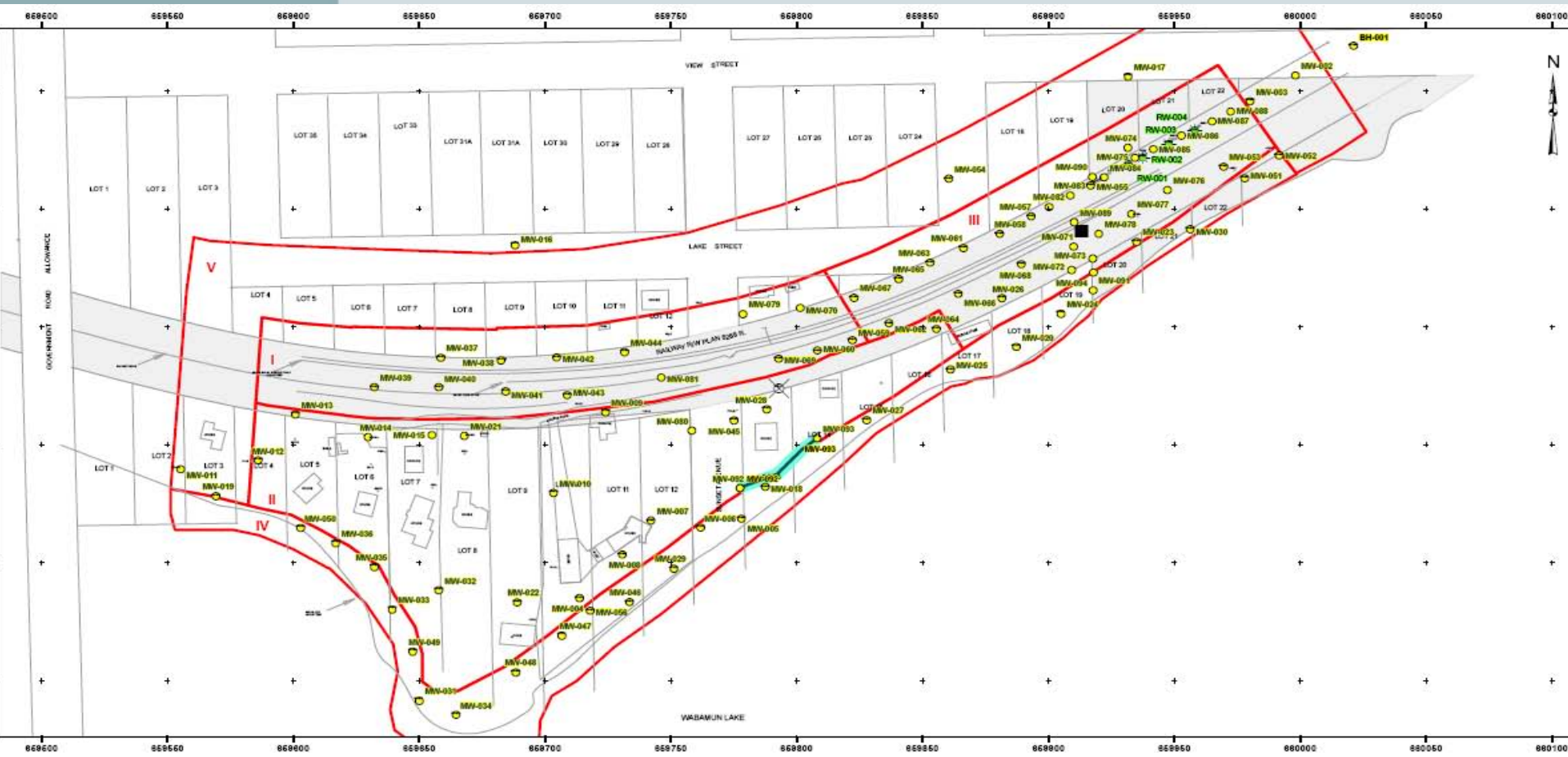
Golder Associates

Drilling Equipment

Drilling equipment selected based on:

- availability
- access restrictions
- depth
- drilling method

Delineation Program



EGEND

- MONITORING WELL
- RECOVERY WELL
- PTO RECOVERY TANK
- ABANDONED WELL
- RESPONSE AREA
- CN OWNED LAND
- INITIAL RESPONSE CONTAINMENT TRENCH

REFERENCE

igital basedata collected by Golder Associates and Don Wilson Survey.
rojection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 11

50 0 5

SCALE 1:1 600 METRES

PROJECT

CN DERAILMENT AT WABAMU

TITLE

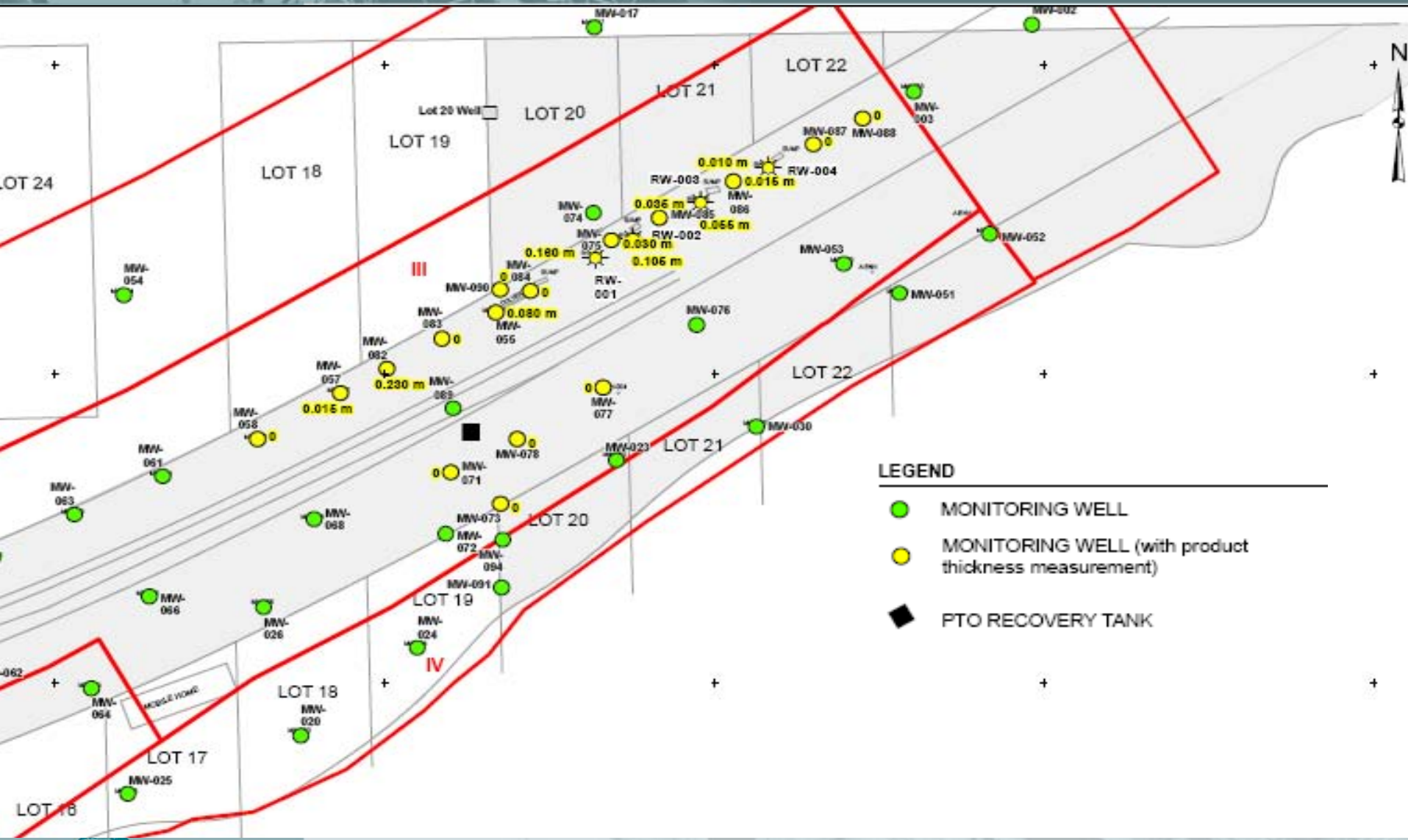
REMEDIATION AND DELINEATION PLAN

Golder Associates Calgary, Alberta

PROJECT No. 051324102			SCALE AS S
DESIGN	JG	July 20th / 05	
GIS	JG	July 20th / 05	
CHECK			

FIG

Remaining PTO Subsurface Impact



Golder Associates

Pilot Test

Pilot Test Results

TEST DESCRIPTION	Hydraulic Conductivity (m/s)	Gas Conductivity (m/s)	Air Permeability (m^2)	Air Permeability (Darcy)
VER Test I (using RW-001)	2.13×10^{-5}	1.83×10^{-6}	3.29×10^{-7}	33.29
VER Test II (using RW-003)	4.16×10^{-5}	3.58×10^{-6}	6.42×10^{-7}	65.03
Constant drawdown test I (using RW-001)	1.34×10^{-5}	1.16×10^{-6}	2.07×10^{-7}	20.95

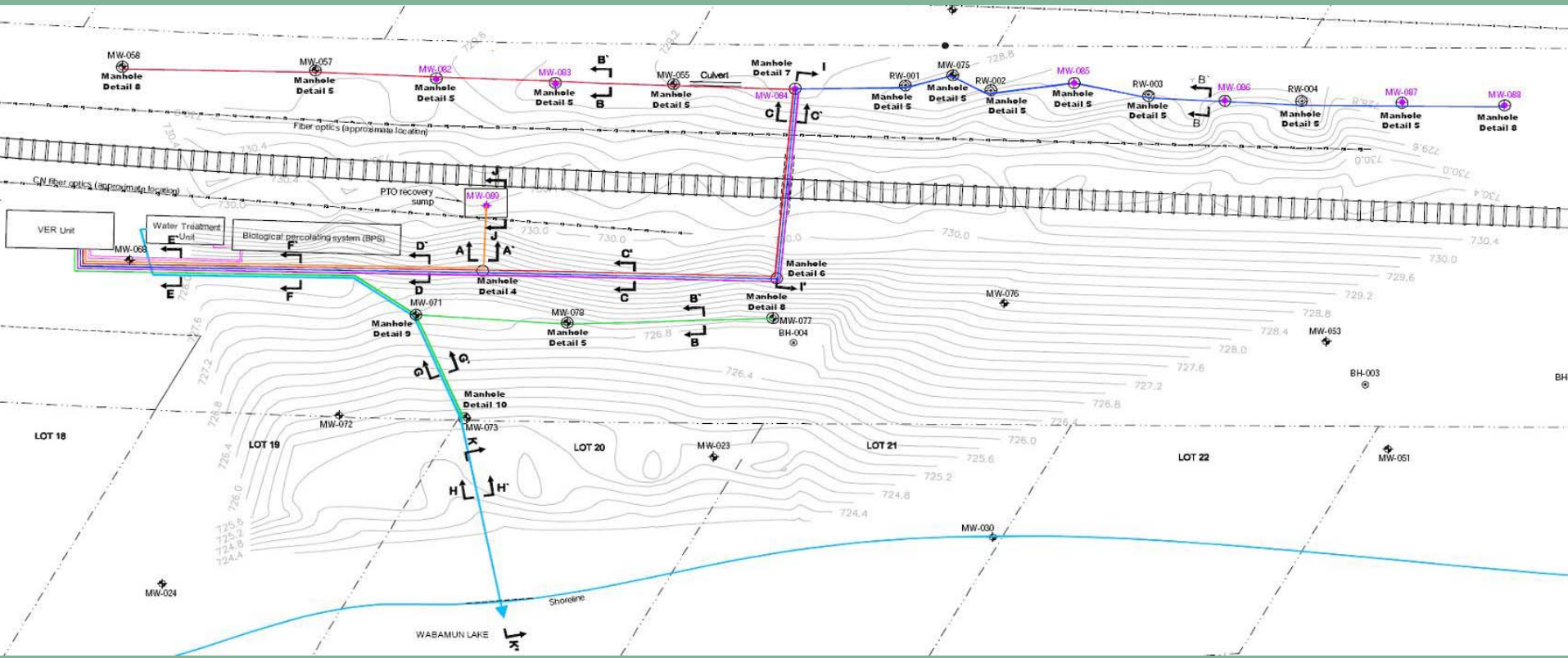
Well diameter	50 mm;
Length of screen	between 2 and 3 metres;
Drop tube diameter	1";
Vacuum at top of drop tube	between 5 and 13.5 inches of Hg;
Applied vacuum at annulus	20 to 40 inches of H_2O;
Air extraction flow rate	between 20 and 35 cfm/well;
Water extraction flow rate	between 3 and 4 litres/minute/well;
Radius of pneumatic influence	4 metres; and
Liquid radius of influence	10 to 12 metres.

PTO Recovery System

- 20 Recovery Well Network and PTO Recovery Sump
- Biological Percolating System (BPS)
- Water Treatment System (clay and carbon)
- Push Pipe
- Lake Discharge Basin
- Electrical

Golder Associates

Permanent PTO Remedial System



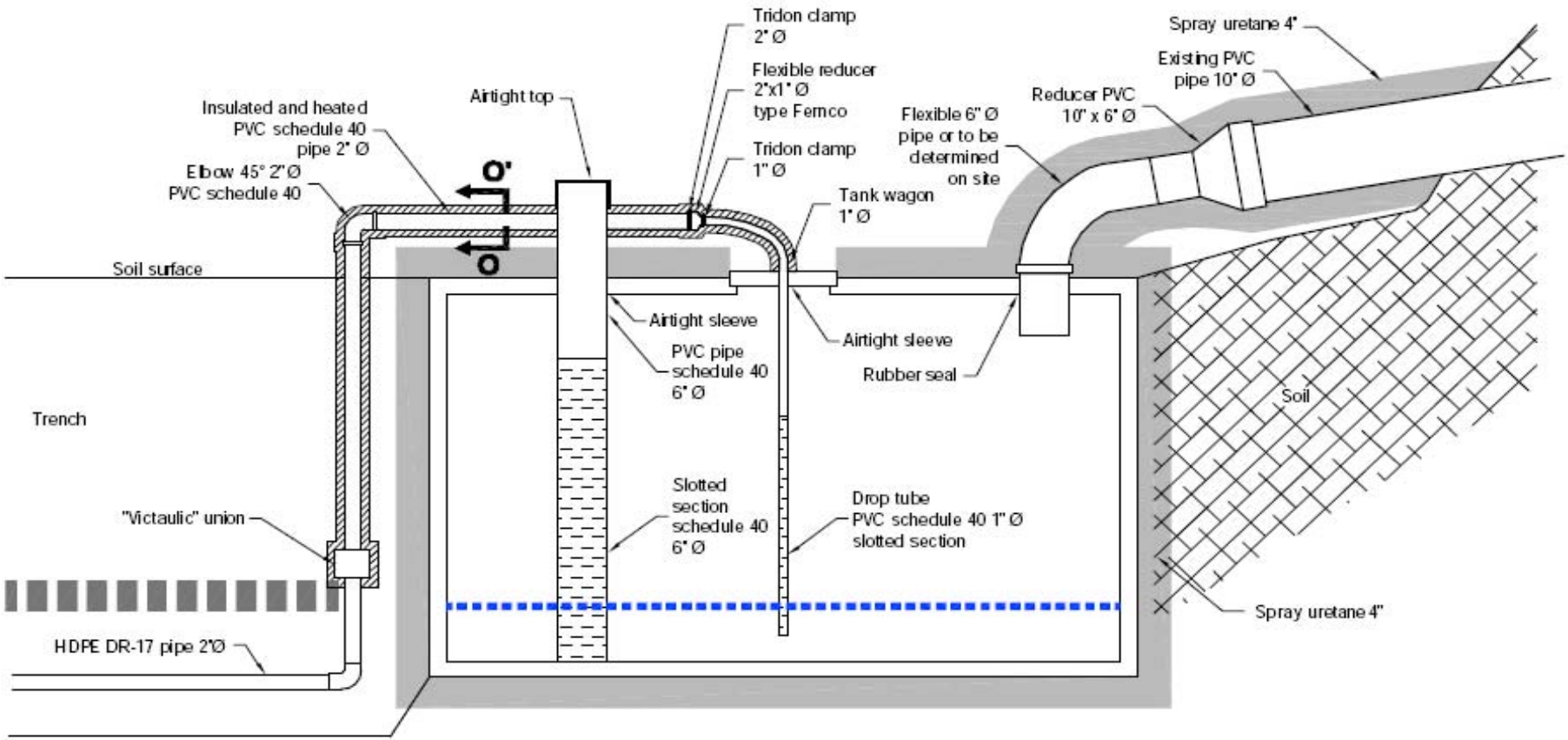
PTO Recovery System Installation

Push Pipe

Well networks

Golder Associates

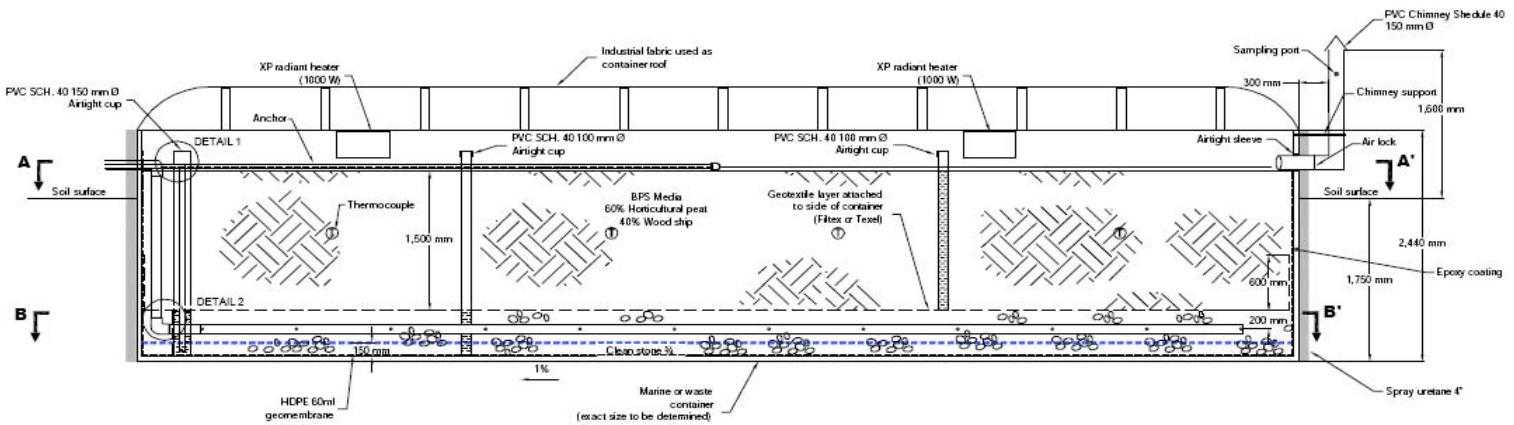
PTO Sump



CROSS-SECTION J-J'

Scale 1 : 20

Biological Percolating Filter (Primary Treatment)



SECTION VIEW
Scale 1 : 40

Golder Associates

Recovery and Water Treatment

Golder Associates

Discharge System

Golder Associates

PTO Performance

- VER recovery system has operated for a total of 5,550 hours.
- Groundwater recovery rates range from 3 L/min to 13 L/min.
- Total volume of groundwater recovered and treated during the period is 2,038,000 L.
- Total volume of PTO recovered in the dissolved phase (i.e., groundwater) is estimated to be 7,950 L.
- Removal efficiencies are generally greater than 95% BTEX, PHC and PAHs
- 48-h Daphnia magna (LC50) toxicity testing indicate greater than (>) 100 percent (%) survival for the test criteria
- Current apparent PTO thicknesses in recovery wells range from 0.010 to 0.050 m.

Golder Associates

PTO Recovery

PTO Recovered From	PTO (litres)
PTO Released During Derailment	88,000
Excavated Soil	10,675
PTO losses due to Volatilization	Unknown
PTO commingled with Bunker C	Unknown
Contaminated Fluids from Tanks	28,260
Pilot VER System	1,500
Full Scale VER System (holding tank)	600
Removed from Groundwater Phase	5578
Removed from Air Phase	268
Total Recovered	**46,881**
Amount Remaining	**<6,000**

Delineation and Remediation Results

- Work completed in this presentation contributed to 5 monitoring/delineation and remediation plans required under an environmental protection order
- All plans were successful prepared and submitted on time under challenging working conditions
- All plans submitted to date have been accepted by the agencies and successfully implemented.

Golder Associates

Landscaping

Landscaping

Current Views

Current Views

Current Views

Website Links

- Alberta Environment - Wabamun Lake
  - http://www3.gov.ab.ca/env/water/WabamunLake.html
- CN - Wabamun, AB
  - http://www.cn.ca/about/community/wabamun/en_wabamun.shtml
- Lake Wabamun Residents Committee
  - http://www.wabamunresidents.com/index.php

Golder Associates