Greenwich Mohawk Brownfield Remediation Project – Remedial Technologies Employed and How the Project Adapted
Brantford, ON

Milestone Environmental Contracting Inc.

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Overview of Presentation

- Project Setting and Remedial Design
- Concrete Removal & Recycling
- Overburden Excavation Approach
- PHC Excavation Approach
- Soil Treatment Approach
- LNAPL Recovery and Water Treatment Approach
- Soil Backfilling Approach
- Adapting to Changing Conditions and Modifying Approaches
- Design and Implementation of Groundwater Cutoff Walls
- Closing Remarks and Question Period

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Project Setting and Remedial Design

- 20.6 hectare (51 acre) Brownfield
- Once considered the heart of Canada's farm manufacturing industry, the brownfield area boasted thriving industries such as Massey-Harris, Massey-Ferguson, Cockshutt-Plow Company, and the Adams Wagon Factories
- Site is comprised of three properties all owned by the City of Brantford.

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Project Setting and Remedial Design

- The City previously completed demolition of existing vacant buildings on the site, with the exception of the Timekeepers Office Building and Timekeepers portico, and the Canadian Military Heritage Museum. Museum remains on site and is currently open and accessible to the public.
- Milestone was selected by the City of Brantford through a 3-step RFP Process
- Remediation commenced March 2015 with majority of Work Completed July, 2016
- Site Remediation complete by December, 2016
- Design and Contract Administration by CH2M

Project Setting and Remedial Design

- Residential – north, west, & south of Site
- Site is bisected by the Toronto, Hamilton, and Buffalo (TH & B) Railway Spur line.
- Historical Canal to the north
- Industrial to the east

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Project Setting and Remedial Design

- Site impacted by PHCs, lead, PAHs, and VOCs (40% of the properties all together)
- Remediation was to achieve Property Specific Standards (PSSs) developed within a Risk Assessment (RA) approach

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Project Setting and Remedial Design

- The remedial strategy design included:
  - lead in soil to be addressed by excavation and offsite disposal;
  - Fuel related PHCs and xylenes in soil to be treated by excavation, screening to segregate fine-grained soil and coarse material, biopile treatment of the fine-grained soil, washing of the coarse material, and subsequent placement of treated soil and washed coarse material into the excavated areas;
  - Project milestone requiring 105,780 m3 of PHC impacted material treated on-site by March 2016
  - Heavy organic PHCs (F4) in soil to be addressed by excavation and offsite disposal

Project Setting and Remedial Design

- Develop and Implement:
  - Detailed H&S Plan
  - Environmental Protection Plan
  - Dust and Odour Control Plan
  - Excavation Plan
  - BioPile Remediation Work Plan
  - Coarse Grain Washing Plan
  - Traffic Plan
  - UST Removal Plan
  - LNAPL Recovery and Water Treatment Plan
- Participate in Public Meeting organized by City

FIGURE 1 – PROPOSED GREENWICH SITE LAYOUT

FIGURE 2 – PROPOSED MOHAWK SITE LAYOUT

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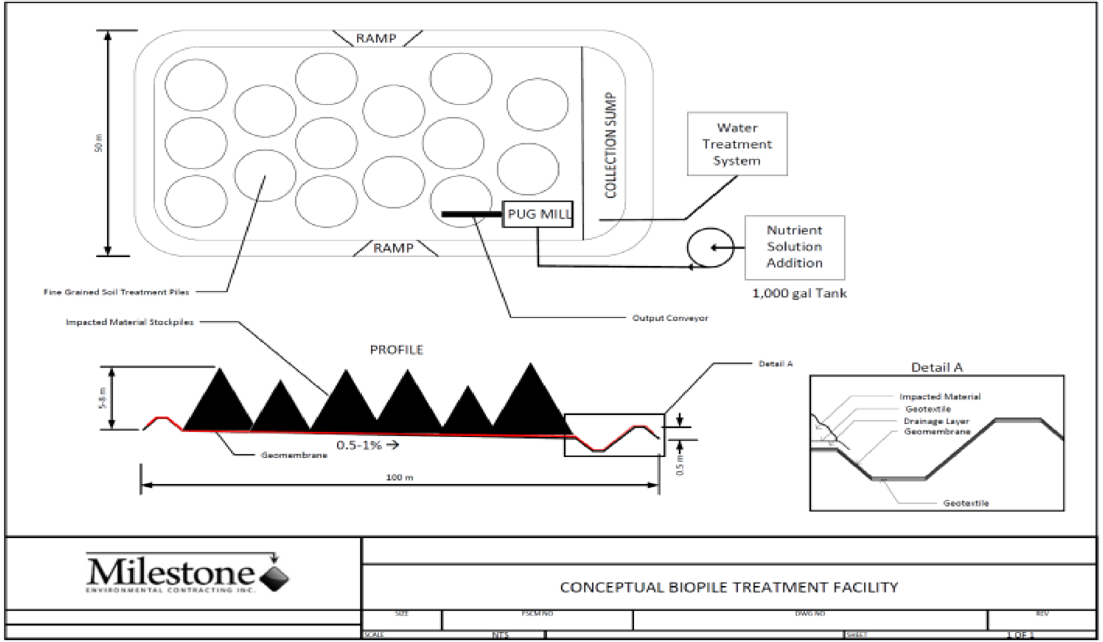
Project Setting and Remedial Design



- Mobile C. of A. (Air) for Screening & Pugmill Mixing
- Mobile ECA for treating solid non-hazardous contaminated soil waste using ex-situ biological and chemical remediation technologies
- Screening and Soil Washing Facility Construction
- Odour and Dust managed by tarping, wetting and use of Ecosorb® Odour Units surrounding processing facilities

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Project Setting and Remedial Design

Setup and Scope Included:

- Water Treatment Plants – 100 GPM, 150 GPM, 1,000 GPM
- Concrete Slab and Subsurface Structure Demolition/Crushing
- Surveying and GPS Control
- UST Investigation and Removal
- Temporary Shoring
- Overburden Removal and Temporary Stockpiling
- Source Area Excavations & Off-Site Disposal (lead, PHC F4)
- Screening/Coarse Material Washing of PHC Impacted Material
- Fine Material Bioremediation
- LNAPL Collection and Groundwater Treatment
- Soil Backfilling – Sequenced Approach, Booms, Oil Control

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Project Setting and Remedial Approach

- shallow groundwater table and the coarse grain nature of the soil allowing LNAPL to drain freely from the soil pore space
- high water table allows for the use of groundwater within the excavation to act as the medium to collect and agglomerate the released LNAPL to allow for skimming and removal

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Concrete Removal and Recycling

- Former demolition left all surface slabs, footings, & foundations remaining and basements filled/levelled with demo block & rubble debris

- Crush for Reuse as Backfill – produced a 50mm crushed product

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Concrete Removal and Recycling


- Crushing and Reuse of 40,000 m3 concrete debris

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Overburden Excavation Approach

- Segregation at OB/PHC Interface
  - Excavate to PHC surface (+0.3m)
  - Sampling & Analytical
  - Excavate in incremental horizons to PHC surface

- Excavation and Stockpiling for reuse – 280,000 m3 of material

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Overburden Excavation Approach

- Segregate lead (hazardous levels)
- Shallow excavations, off-site disposal – 2,100 tonnes
- paint debris source

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PHC Excavation Approach

- Stage at excavation face for draining back to excavation
- Transport to processing pad for treatment

- Excavation in the "wet" GPS Controlled
- Promoted LNAPL removal

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Soil Treatment Approach

- Screen material (19mm screen) to separate coarse from fines
- Use of Powerscreen Cheiftan 1700 Screening Plants

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Soil Treatment Approach

Fines conveyed to a Pugmill for:

- Mechanical mixing/aeration
- nutrient amendment
- Sampling and analysis of impacted soil to determine the rate of bioremediation, nutrient levels and C:N:P ratios, pH and moisture.

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Soil Treatment Approach

- Bio Pile temperature, oxygen and carbon dioxide data monitored on a weekly basis
- Subsequent aeration and nutrient amendment
- Monthly reporting of progress
- 600 m3 biopiles created

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Soil Treatment Approach

- Coarse wash using high pressure water

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Soil Treatment Approach

Coarse wash water treated with polymer and pumped to Geotube® for filtering and reuse in process

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LNAPL Recovery and Water Treatment Approach

- Estimated to be 1.8 Million L of liquid to require skimming and onsite treatment or offsite disposal
- Removal of free-phase PHCs such that 5% free-phase PHCs to 95 percent oily water ratio is achieved (90,000 litres LNAPL)
- Intent was to minimize the collection of extraneous amounts of water and selectively remove the free-phase PHC
- Allocation to pump/treat 50,000 m3 of groundwater from open excavations

LNAPL Recovery and Water Treatment Approach

- Overall recovery and recycling of 125,000 litres of free phase PHC
- Groundwater pumping and water treatment for removal of residual sheen
- Overall Water Treatment volume 24,345 m3

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Soil Backfilling Approach

1. Washed coarse stone used to backfill excavations to above the water table
2. Geotextile placed above coarse stone
3. Treated fine material placed and packed above the geotextile
4. Overburden and crushed concrete placed and packed to surface

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Excavation Progress – July 1, 2015

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Temporary Shoring

Use of temporary sheetpile and slide rail shoring for excavation along property line sections

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Adapting to Changing Conditions and Modifying Approaches

- Increase in LNAPL volume and presence
- LNAPL and oily soil creating nuisance odours emanating into adjacent neighbourhoods
- Increase in amount of F4 impacted soil
- Increase in public complaints due to odours
- Increased involvement by MOECC and zero tolerance for off-site odours causing an adverse effect
- Increased requirement for air quality monitoring / testing
- Need to implement an additional public meeting to communicate with concerned residents

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Adapting to Changing Conditions and Modifying Approaches

- Maximized use of coarse wash capability to screen out smaller coarse size fraction (2mm to 15mm) and treat F4 soils on-site instead of transporting off-site for disposal

- Implemented use of foam suppression, Rusmar Foam Technologies™, to encapsulate and control odours

- Expedited removal of LNAPL from groundwater surface to aid in minimizing nuisance odours by:
  - Implement a vacuum truck full time on-site to skim oil, off-load into on-site tank and skim LNAPL from tank to recover oil for off-site recycling
  - Implement use of Oilstic – an oil absorbent to absorb oil quickly and to provide a surface to apply foam suppression

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Adapting to Changing Conditions and Modifying Approaches

- Use of Odor Boss units, by Dust Control Technology®, to amplify air atomization and suppression of odours

- Excavate oily soils/odour producing soils in winter to minimize odours off-site, involving;
  - Dry screening oily soil
  - Transport/off-site disposal off fine material at a licensed landfill
    - Foam encapsulation of each truck
  - Stockpile coarse fraction on-site for treatment in spring and reuse on-site

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Adapting to Changing Conditions and Modifying Approaches

Maximize coarse wash, modify screen size and implement full soil wash

On-site treatment of F4 material

Provided quicker treatment of material and produced more stone for backfilling in open water excavations

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Adapting to Changing Conditions and Modifying Approaches

Use of foam suppression on piles and excavation face to control odours overnight

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Adapting to Changing Conditions and Modifying Approaches

Use of oilstic to expedite removal of LNAPL and provide surface to use foam suppression on water surface

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Adapting to Changing Conditions and Modifying Approaches

Use of Odor Boss units to amplify air atomization and suppress odours

Mobile and operated by generators

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Adapting to Changing Conditions and Modifying Approaches

Continuing Excavation in Winter and Spring with use of Odor Boss Units, foam technology and use of oilstic

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Adapting to Changing Conditions and Modifying Approaches

Within 17 months – approximate overall project volumes:

- Breaking, removal, crushing and reuse of 40,000 m^3 of former concrete slabs & foundations
- Excavation of 283,000 m^3 of overburden and PHC impacted soil
- On-site treatment of 136,000 m^3 of PHC impacted soil
- Off-site disposal of 2,100 tonnes of hazardous lead impacted soil
- Off-site disposal of 90,000 tonnes of PHC impacted soil
- Recovery and recycling of approximately 125,000 litres of LNAPL

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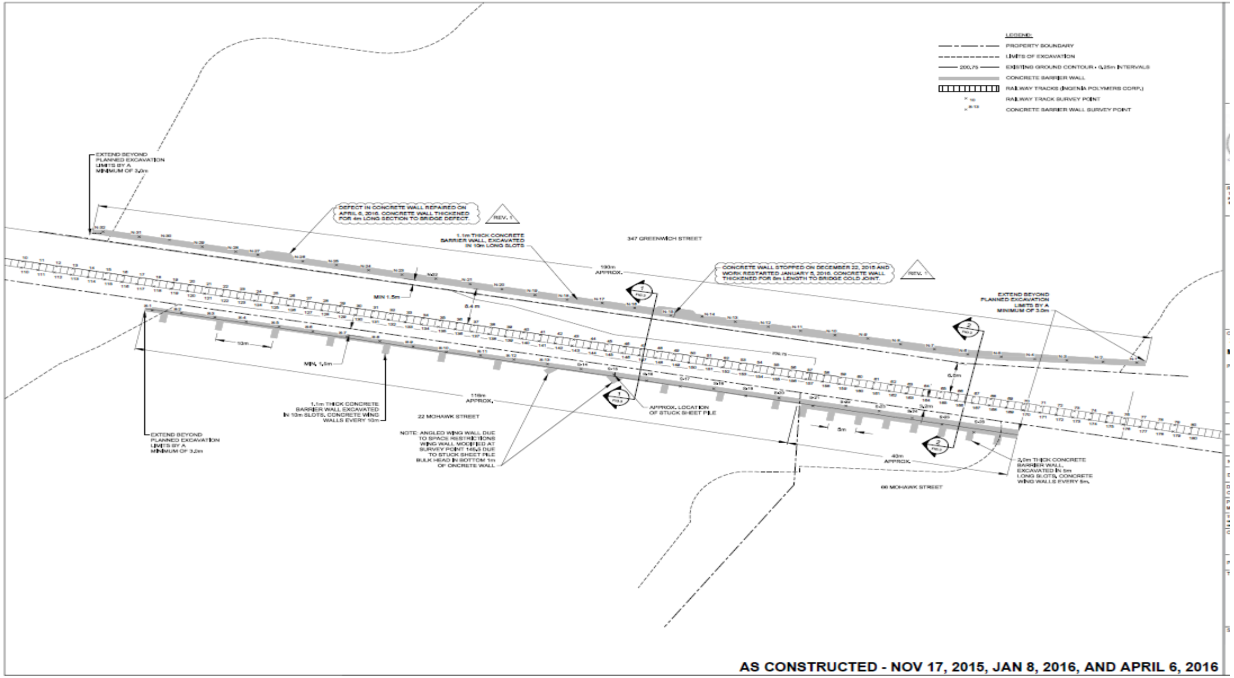
Design and Implementation of Groundwater Cutoff Walls

Design / Build:

- Using a Concrete Barrier Wall Method for the Shoring Adjacent to the existing rail line
- Installed using a bentonite slurry trench excavation method
- Provide a barrier 1×10^{-7} cm/sec to cutoff groundwater flow using 20 MPa concrete



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Design and Implementation of Groundwater Cutoff Walls

The results of the compressive strength tests show that the concrete strengths met or exceeded the required design strength of 20 MPa at 28 days.

Additional concrete cylinders were obtained for hydraulic conductivity (permeability) testing on a weekly basis (seven tests in total). These tests were carried out once the concrete had cured in our Waterloo lab curing tanks for 28 days. The results of the permeability test are attached. The measured permeability for the 6 cylinders tested to date range from 6.4×10^{-9} to 1.4×10^{-10} cm/sec, which is consistent with the expected permeability.

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Design and Implementation of Groundwater Cutoff Walls

- Installation of a vertical membrane to create a low-permeability curtain wall
- reduce the potential for future contamination of the property from existing interceptor trench
- Installed 200 m length, Layfield Enviroliner 4000 membrane, within a trench across the groundwater interval

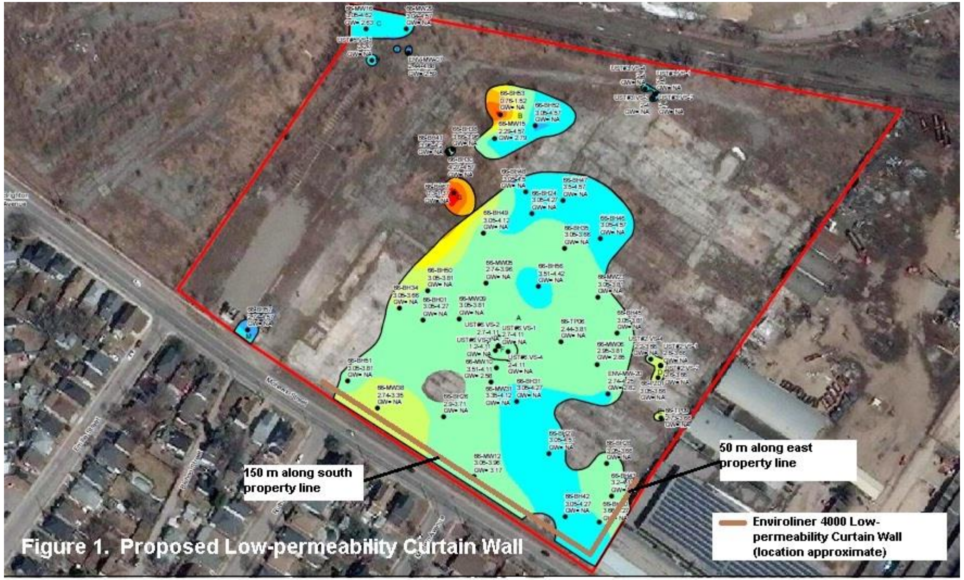

Figure 1. Proposed Low-permeability Curtain Wall

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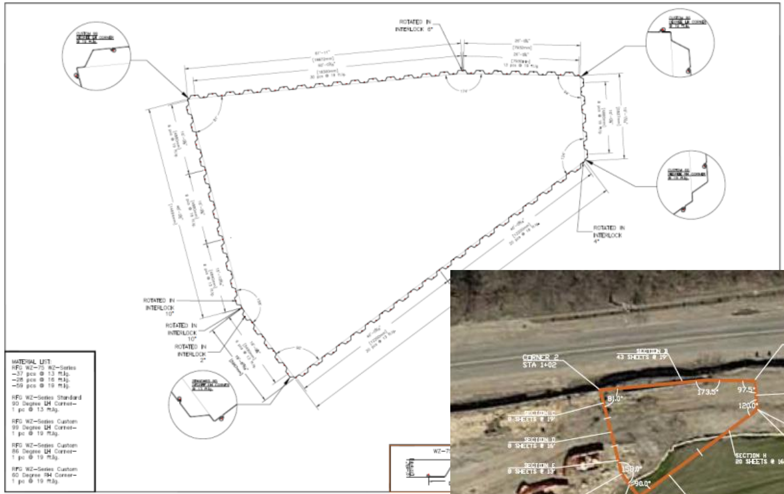
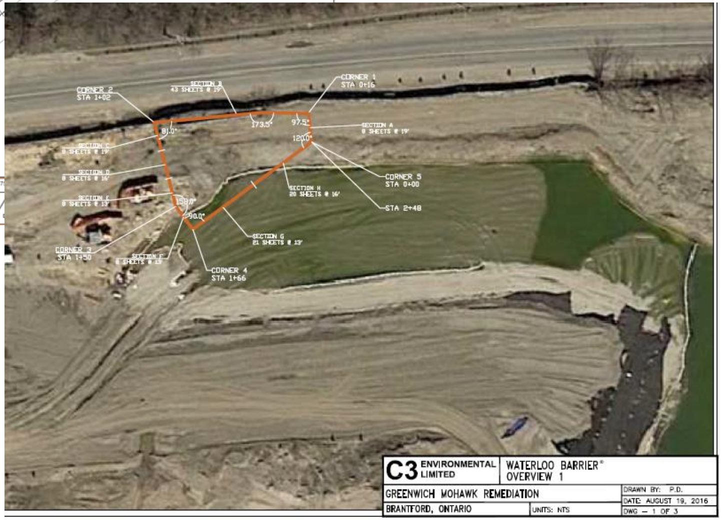
Design and Implementation of Groundwater Cutoff Walls





Installation of a Waterloo Barrier® as a risk management measure to avoid excavation work that is known to create significant odours

- to be completed October/November 2016

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Proud Project Team

THE CORPORATION OF THE CITY OF
BRANTFORD

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Thank You For Your Time and Attention

Questions???

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