Obtaining a Remediation Certificate using a Multifaceted Approach to Site Cleanup

GeoTactical Remediation

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Heather Sturm, P.Eng.
Geo Tactical Remediation Ltd.

Outline

1. Background & Objectives
2. Remedial Approach
3. Project Implementation
4. Lessons Learned

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Background

- Site operated as a manufacturing facility since the early 1980's
- Gasoline underground storage tank (UST) onsite
- In 1999 UST was decommissioned
- Determined that the tank had been leaking
- COCs are refined PHCs
- Soils onsite are fine grained

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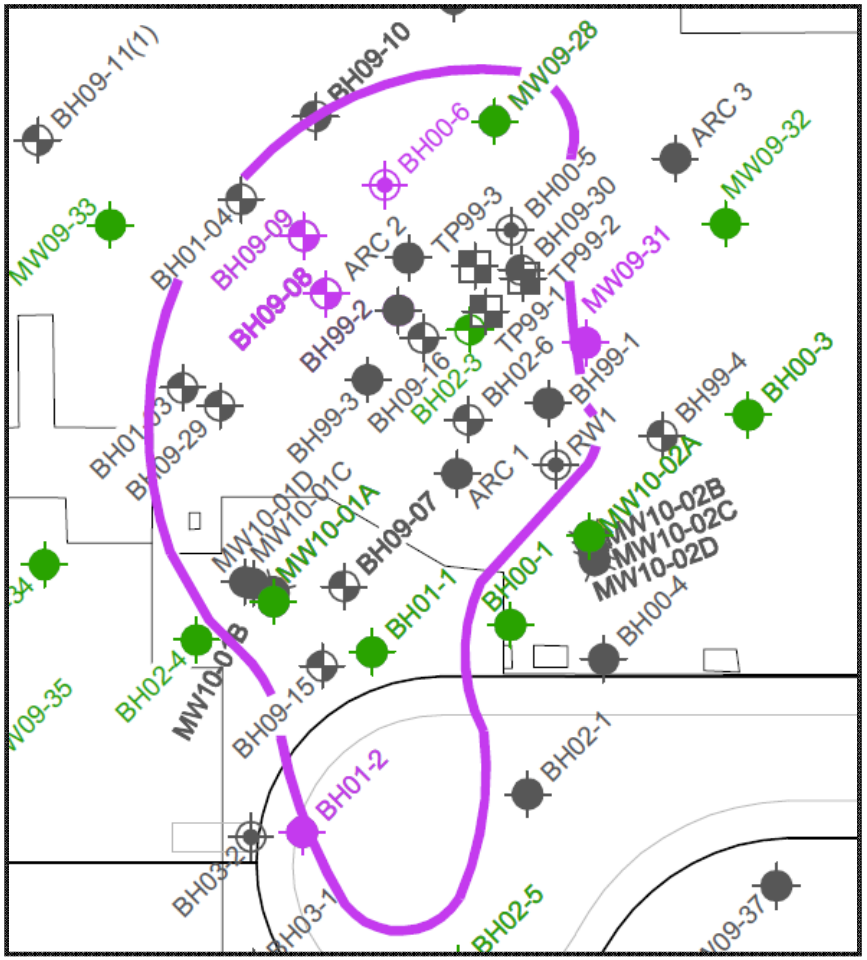
Previous Environmental Work



- A MPE system operated 2000 – 2005
- Site specific AESRD Tier 2 Criteria values approved in August 2010
- Tier 2 delineation prior to remediation
  - Soil plume 5,530 m^3 over an area of 1,725m^2
  - Groundwater plume 2,900 m^2

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Objectives

- Remediate the PHC plume to Tier 2 guidelines in a one to two year timeframe
- Conduct the work while maintaining ability for site operations to continue
- Use technologies other than excavation for the remediation work
- Obtain a remediation certificate for the client, so they could sell the property

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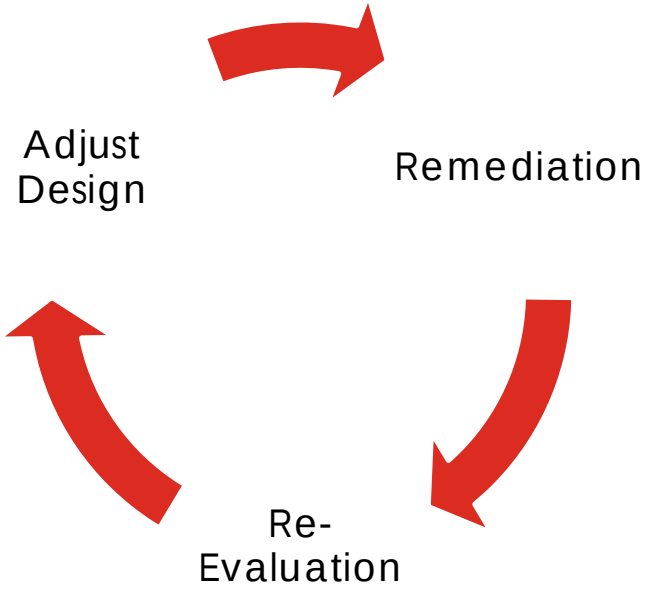
Remedial Approach

- Used an iterative process to design, with the following steps:
  - Conduct remediation work ,
  - Re-evaluate the site conditions and results obtained, and
  - Adjust and optimize the remedial technologies used and where they were applied (Multifaceted approach)



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Initial Remedial Program

- Environmental fracturing to enhance bulk permeability of fine grained soils
- Incorporate surfactant into frac slurry to increase the availability of trapped PHCs
- Install dedicated injection wells
- Inject chemical oxidants to oxidize PHCs

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Initial Remedial Treatment

In the first six months the following was emplaced in the subsurface:

- Onsite
  - 97,500 kg sand proppant
  - 500 L surfactant
  - 9,000 kg of sodium persulfate (20 – 30%)
  - 9,800 kg of 50% hydrogen peroxide (10%)
- Offsite
  - 1,200 kg of 50% hydrogen peroxide (10%)
  - 1,500 kg of calcium peroxide (30%)

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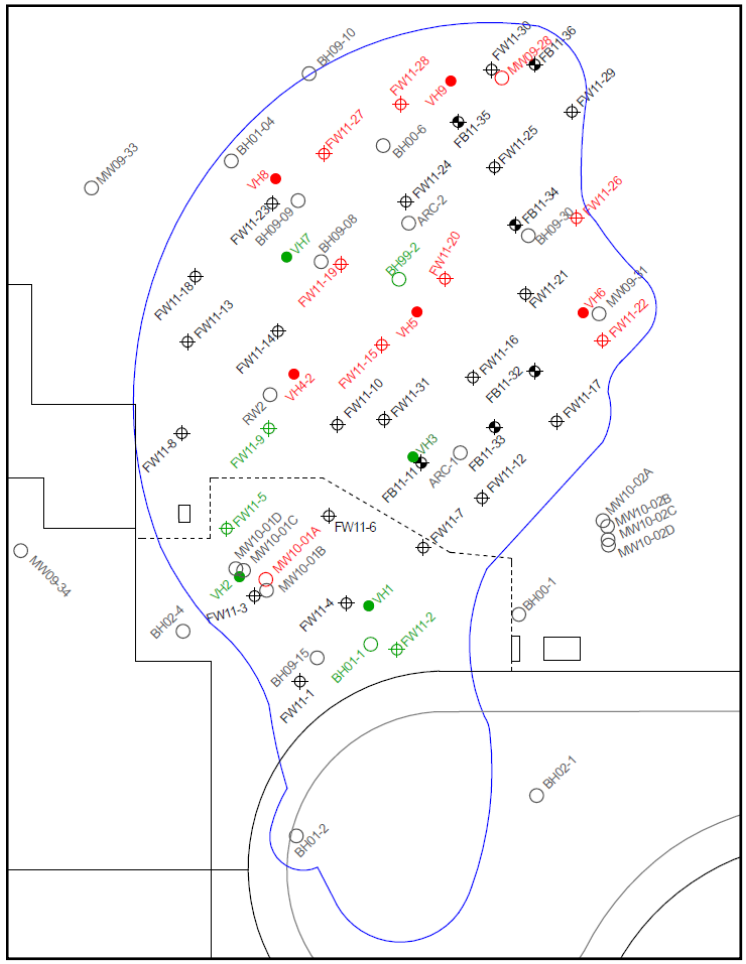
Initial Evaluation



- South end of the onsite plume below Tier 2 (except one MW)
- Four of nine soil sampling locations below Tier 2
- Suspected soil “Hot Spot” found on East Boundary of Plume
- F2 concentrations in groundwater
- Offsite conditions not verified

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1st Optimized Remedial Program

7 Month Remedial Program Details	Mass
Fracture Emplace Sodium Persulfate	3,025 kg
Fracture Emplace Calcium Peroxide	570 kg
Potassium Persulfate Canisters	10 Canisters

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2nd Site Evaluation

Soil Sampling (9 Months)

- 5 Locations sampled
  - 4 showed signs of decreased PHC concentrations
  - 1 location below Tier 2
  - Confirmed a shallow "hot spot" area exists on the east boundary of the plume

Water Sampling (9 Months)

- 11 wells sampled
  - All samples showed decreased concentrations
  - 3 wells below criteria
  - Wells in the "hot spot" were above criteria
  - Continued to show the south half below and north half above Tier 2

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2nd Optimized Remedial Program

- 900 tonnes of contaminated soil was disposed
- 15 x 15 m
- 1.25 to 3.5 m bgs

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2nd Optimized Remedial Program

Remedial Description	Mass
Hydrogen Peroxide Injection (12 – 20%)	400 kg
Hydrogen Peroxide Fracture Emplace (12 – 20%)	11,600 kg
Calcium Peroxide Fracture Emplace (30 – 35%)	1,270 kg

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3rd Site Evaluation

10 Month Soil Sampling

- The excavation boundaries were below Tier 2
- All other soil samples were below Tier 2
- The remaining issue on the site is a groundwater issue

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3rd Site Evaluation & Optimized Remedial Program

- Groundwater Sampling showed 4 wells above Tier 2
- Targeted injection around this area of the site
  - 30% sodium persulfate solution injected (150 kg)

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4th Evaluation & Optimized Remedial Program

- Groundwater Sampling at 15 months, showed 5 wells above Tier 2, and only F2s
- Targeted fracture emplacement around one well with very high F2s
- Targeted injection in this area
- Use Alkaline Activation because only F2s remaining

Remedial Program Details	Mass
Fracture Emplace Sodium Persulfate (12.5%)	300 kg
Injection of Sodium Persulfate (20%)	125 kg

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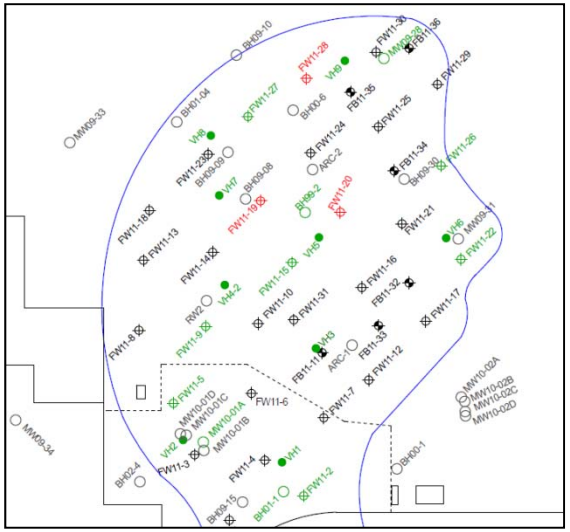
5th Site Evaluation

On-Site

- 10 month soil sampling showed soil below Tier 2
- 1.5 year groundwater sampling showed one area of the site above Tier 2



Off-Site

- Soil sampling at 3 locations underlying City of Calgary property, all below Tier 2
- Sampled the three wells and groundwater levels were below Tier 2

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5th Optimized Remedial Program

- Groundwater samples (1 year 10 months) showed concentrations above Tier 2 present at only two locations in the centre of the plume

Remedial Program Details	Amount
Injection of sodium persulfate with alkaline activation	525 kg
Oxygen diffusers	3 L/day

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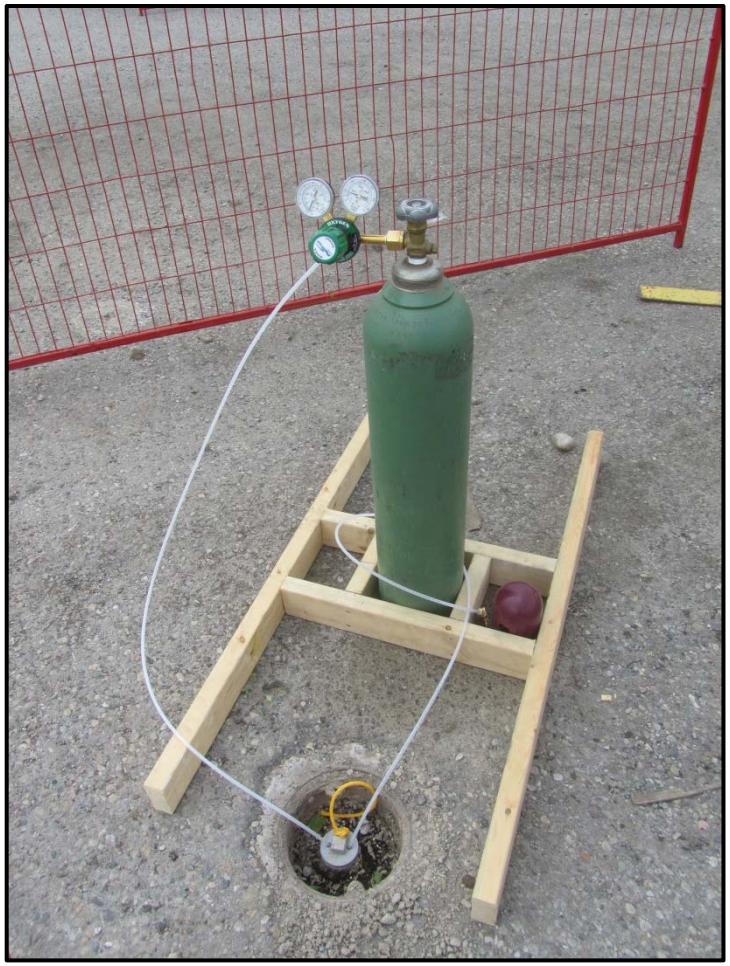
Final Remedial Results



- Groundwater sampling at 2 years still showed the 2 wells slightly above criteria
- Continued with the oxygen diffusers
- Groundwater samples one month later demonstrated Tier 2 achieved

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Remediation Certificate

- Submitted the Remediation Certificate Application 6 months after completion of remediation
- Submitted supplemental data to AESRD 9 months after application submitted
- A Remediation Certificate was issued for the site on October 9, 2014

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Lessons Learned

- Proper delineation is key to remedial success
- Continual assessment of site conditions so you can focus on necessary areas
- Broad range of technologies available so use a multi-faceted approach to help obtain best results

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Questions?

THANK YOU!

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