Incorporating Sustainability into Site Closure – A Field Example

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Outline

- Defining Sustainability and Sustainability Goals
- Phased Remediation Planning Model
- Sustainable Soil Management
  - Insitu
  - Exsitu
- Sustainable Water Management
  - Surface Water Management
  - Groundwater Management
- Results against Goals
- Final Site Condition
Sustainability Goals

- A remedy or a combination of remedies whose net benefit on human health and the environment is maximized through the judicious use of limited resources

Key elements for Remediation:
- Energy Intensity Reduction
- Community Acceptance;
- Environmental Protection
Site Overview

- Chemical production plant in operation for over 70 years was closed
- Site complicated by age of contamination, native glacial clay till with fractures, and permeable utility corridors
- 322 acres of property prepared for property transfer through a combination of insitu and exsitu remediation and legal negotiations
- Volatile Organics Compounds present in the subsurface for over 60 years in some locations.
Remedy Selection Process

Flow Chart Developed for Decision Making

- CVOC Contaminated Soil to be Remediated:
  - DNAPL, >TCLP criteria, or posing risk to surface water
  - Treat in Soil Treatment Area (STA)
    - CVOCs > TCLP
- Treat In Situ with Fracture and Injection
  - Volume too large to treat in STA (>10,000 cys)
  - Soil cannot be excavated (below building, below piping)
  - Longer timeframe available
Sustainable Soil Management
Where Insitu and Exsitu Remediation were Applied
Premise - Soil is not a waste
Reach target concentrations in 5 - 7 years
Must be cost effective based on volume of soil to be treated (60,000 cubic yards)
Selected amendment must be able to treat near saturation CVOC soil concentrations to <TCLP criteria
- ex 1,2 DCA from 20 mg/kg to 500 mg/kg (0.5 mg/l TCLP, 20x rule = 10 mg/kg)
Anaerobic Reductive Dechlorination in Soil Treatment Area (STA)
Mix Ratio: 3 Soil/ 0.5 manure/ 0.5 wood chips
Mixing machinery must be able to adequately mix low permeability clay soils and the treatment amendments
Exsitu Remediation – STA
Exsitu Remediation – STA
Exsitu Remediation

- Total treated: 60,000m³
- Treatment area footprint: 4.7 ac
- Operating time period: 145 days
- Daily production average: 410 yards per day
- $350/yard treatment cost if disposed as hazardous waste
- $95/yard total treatment cost in STA
- Treated soils can be used as backfill material onsite

SOIL WAS NOT A WASTE
Then and Now
Soil Mixing Area

Meteorological Station

Ambient Air Monitoring Stations

BLOCK 100 Biocell

BLOCK 150

BLOCK 120 Parcel C

BLOCK 50 Long Term Remediation

Easement
Soil Mixing Process
On Site Areas where Insitu and Exsitu Remediation were Applied
Premise - SOIL IS NOT A WASTE
Reach target concentrations in 5 - 7 years
Must be cost effective based on volume of soil to be treated (in excess of 110,000 m³)
Selected amendment must be able to treat near saturation CVOC soil concentrations to <TCLP criteria
- ex 1,2 DCA from 20 mg/kg to 500 mg/kg (0.5 mg/l TCLP, 20x rule = 10 mg/kg)
Iron and organic carbon successfully added to the subsurface.

Amendment detected throughout a 20 to 30 foot radius from the injection point and secondary fractures visible up to 12 inches vertically from the primary fractures.

Long term success throughout the vertical treatment zone is still in question.
Potential Cost Savings compared to excavation and offsite disposal – $3.7 MM
Insitu Remediation

- Total treated: 20,000m³
- Application Period: 14 days
- $350/yard treatment cost if disposed as hazardous waste
- $45/yard total treatment cost for insitu
- Success of treatment – may be seeing rebounding after 6 years post application, clay matrix diffusion extremely slow

SOIL WAS NOT A WASTE however, treatment is not complete
Sustainable Water Management
Groundwater Management – Design of Passive Hydraulic Control

- Premise - no operational features remaining.
- Need to control water levels in a French Drain system that was previously controlled by pumping and onsite carbon treatment.
- Reduce flow from 20 gpm to 1 gpm.
- Infiltration reduction necessary.
Tree Plantation Design
Challenges/Lessons Learned

- Trees require 5 years or more to reach maturity
- Tree mortality
- Finding all infiltration sources
- Precipitation during dormancy periods
- Aeration tubes allowed infiltration
- Interim water management
Surface Water Management

- Site contoured to promote surface runoff to a single discharge point.
- Site vegetated to utilize surface water and reduce TSS.
- Negotiated regulatory discharge to provincial water body after sampling to confirm clean surface water.

July 15, 2010
TSS = 1,400 mg/L

October 19, 2011
TSS = 75 mg/L

October 19, 2012
TSS = 25 mg/L
Water Management

- Regulatory permission granted for direct discharge to the provincial water body.

- Management of dormancy periods being controlled by further reduction of infiltration and installation of passive permeable reactive beds in areas of seeps.

- Goal to allow water table to be at static with no additional pumping.
Energy Intensity Reduction;
- **Achieved** - massive reduction in carbon footprint due to negotiations and remedial strategy.
- Negotiated extended timeframes for insitu remediation.
- Exsitu remediation occurred onsite, reducing transportation costs.
- No mechanized treatment remains onsite.
- Trees provide passive pumping to control groundwater gradient.
- Reduced GAC usage - formerly 70,000 to 80,000 lbs of carbon per year and costs for transportation to regeneration facility.
Community Acceptance;

- **Achieved** – aggressive community education and community support

- Development of recreational property
Environmental Protection;
- **Achieved** - land is fully available for industrial reuse
- No offsite migration potential remains
Field Site

Before

After
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Questions/ Comments?