Assess Design Implement

Remediation Technologies Symposium 2006
Banff, Alberta

Site Remediation Solutions

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Remediation of 20,000 m^3 of Hydrocarbon-Impacted Soil at a Former Well Site Using the Biopile Process

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Site History

- Former well site
- Lease established in the late 1960’s
- A flare pit, mud pit, and aboveground storage tanks were present on site
- Abandoned site located southwest from Red Deer in an agricultural area

Additional Site Assessment

Objectives:

- Additional site assessment to complete the delineation of the hydrocarbon plume
- Confirm the depth of impact identified in a previous environmental assessment
- Select the most efficient remediation strategy

Remediation Objectives

- Land use in the area is agricultural
- Soil defined as fine-grained

Contaminants	Surface Soil Criteria (mg/kg)	Exposure Pathway
Benzene[1]	0.073	Protection of Potable Groundwater
Toluene[1]	0.86	Protection of Potable Groundwater
Ethylbenzene[1]	0.19	Protection of Potable Groundwater
Xylenes[1]	25	Protection of Potable Groundwater
Benzo (a) pyrene[1]	4.3	Human Dermal Contact
PHC F1 (C_6-C_{10})[1]	260	Soil Contact (plants and invertebrates)
PHC F2 (C_{10}-C_{16})[1]	900	Soil Contact (plants and invertebrates)
PHC F3 (C_{16}-C_{34})[1]	800	Soil Contact (plants and invertebrates)
PHC F4 (C_{34}-C_{50+})[1]	4,000	Soil Ingestion (livestock)

[1]: *Alberta Soil and Water Quality Guidelines for Hydrocarbons at Upstream Oil & Gas Facilities* (AENV, September 2001)

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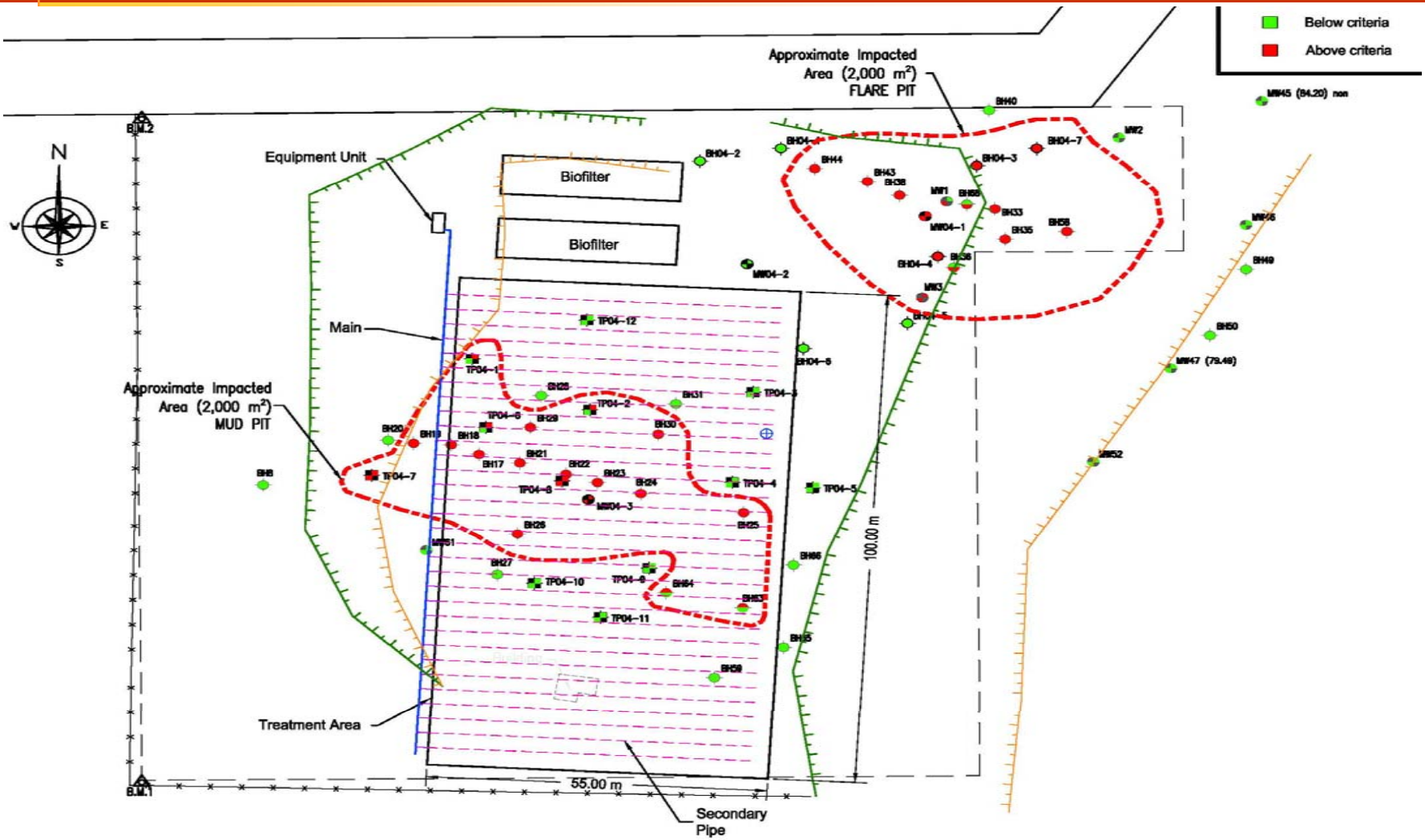
Findings of the ESA

- Delineation of areas of concern for BTEX and PHC (F1 to F4) completed:
  - Former Flare Pit (14,000 m^3 *in situ*)
  - Mud Pit (6,000 m^3 *in situ*)
- Depth of impact was confirmed at 4 m in the Mud Pit and 9 m in the Flare Pit area
- Groundwater exceedances for hydrocarbons

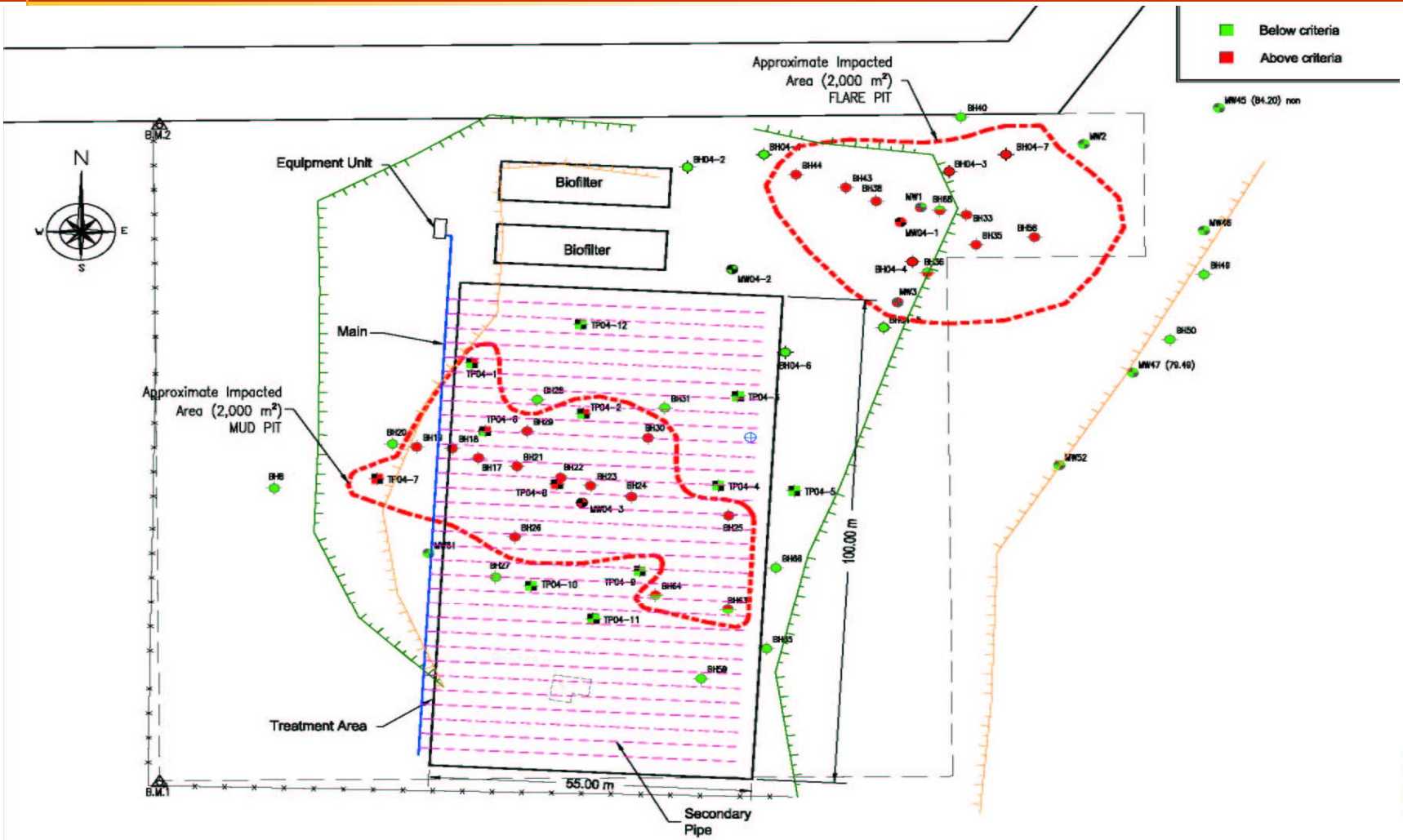
ESA Results – July 2004



Site Specific Challenges

- Proximity of land owners (noise, dust, and air quality)
- Lease slopes to a nearby river
- Large volume of impacted material
- Depth of impact (down to 9 m in Flare Pit)
- Limited space available on-site
- High concentrations of PHC
- Segregation of impacted soil
- Winter installation and start-up

Proposed Strategy



Advantages

1. Soil treatment to Tier 1 criteria – unconditional closure
2. Improved groundwater quality
3. Maximize space available
4. Minimize soil handling
5. Minimize use of landfill and backfill
6. Increased safety by decreasing truck traffic in the vicinity
7. Management and treatment of air issues (reduced VOC emissions to a minimum)
8. Proven technology (biopile)
9. Contract (pay for performance)

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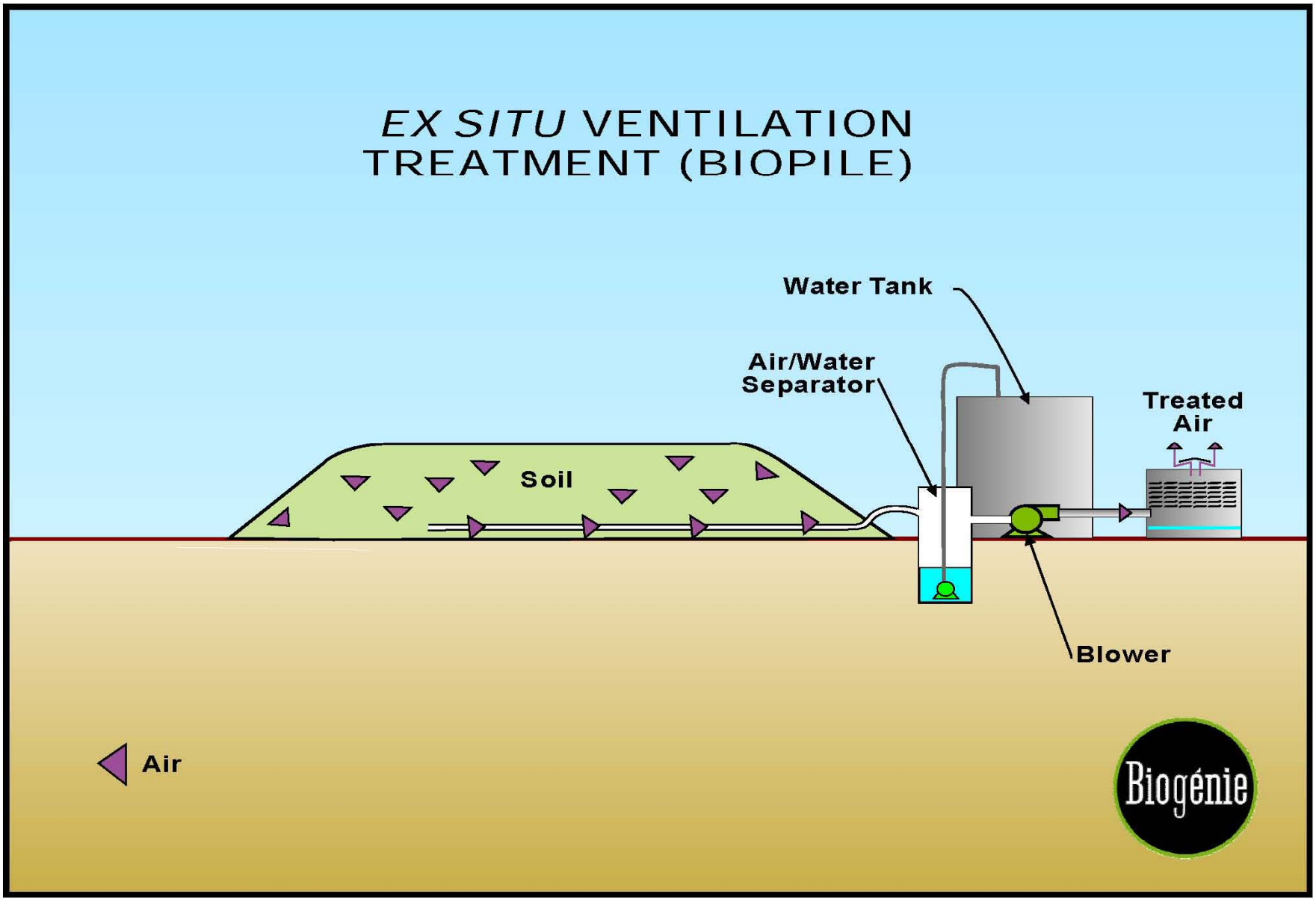
EX SITU VENTILATION
TREATMENT (BIOPILE)
Water Tank
Air/Water
Separator
Treated
Air
Soil
Blower
Air
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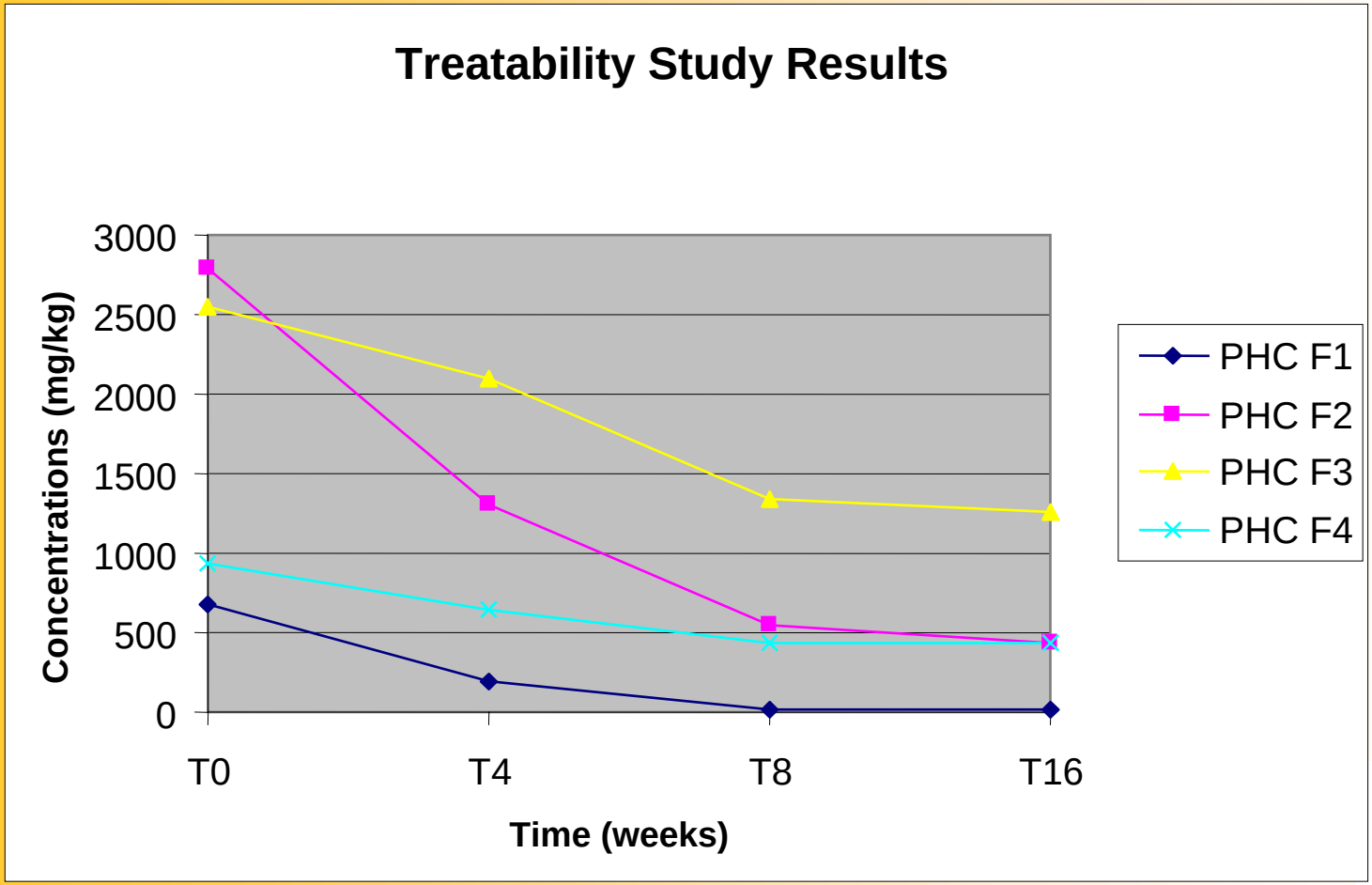
Figure 5

Treatability Study



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Treatability Study (cont.)

Parameter	Initial Mean Concentration (mg/kg)	Final Mean Concentration (mg/kg)	Reduction Rate (%)	Target Rate
PHC-F1 (C6-C10)	674	19	97	260
PHC-F2 (>C10-C16)	2,785	430	85	900
PHC-F3 (>C16-C34)	2,545	1,260	50	800
PHC-F4 (>C34)	944	438	54	4,000

Remediation Strategy

Objectives:

- Complete excavation, segregation, treatment and backfilling of 25,000 m^3 of soil within a restricted area of 12,000 m^2, while minimizing soil to be landfilled
- Treatment of air emissions and process water
- Complete the project within an 18-month timeframe

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Remediation Strategy / Methodology

- Additional site assessment
- Removal of remaining infrastructures
- Excavation and segregation of topsoil and clean overburden
- Construction of treatment area - Phase I
- Excavation, segregation, and backfilling of mud pit area
- Construction of treatment area - Phase II
- Excavation, segregation and stockpiling of flare pit area
- Segregation of highly impacted soil and pre-treatment
- Treatment start-up for top layer

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Remediation Strategy / Methodology (cont.)

- Backfilling of treated material
- Treatment start-up for bottom layer
- Backfill of treated material
- Disposal of highly impacted soil to landfill

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Treatment Monitoring

Results:

- Air emissions were treated through a biofilter
- Analytical results showed VOC reductions of nearly 80%
- Air samples collected at the site boundaries showed concentrations below the ambient air quality guidelines
- Water samples collected in the process water tank prior to release showed concentrations below applicable guidelines


DEERE

Project Results

Parameter	Initial Mean Concentration (mg/kg)	Final Mean Concentration (mg/kg)	Reduction Rate (%)	Target Rate
PHC-F1 (C6-C10)	293	27	90	260
PHC-F2 (>C10-C16)	1,336	93	93	900
PHC-F3 (>C16-C34)	1,134	256	77	800
PHC-F4 (>C34)	270	202	25	4,000

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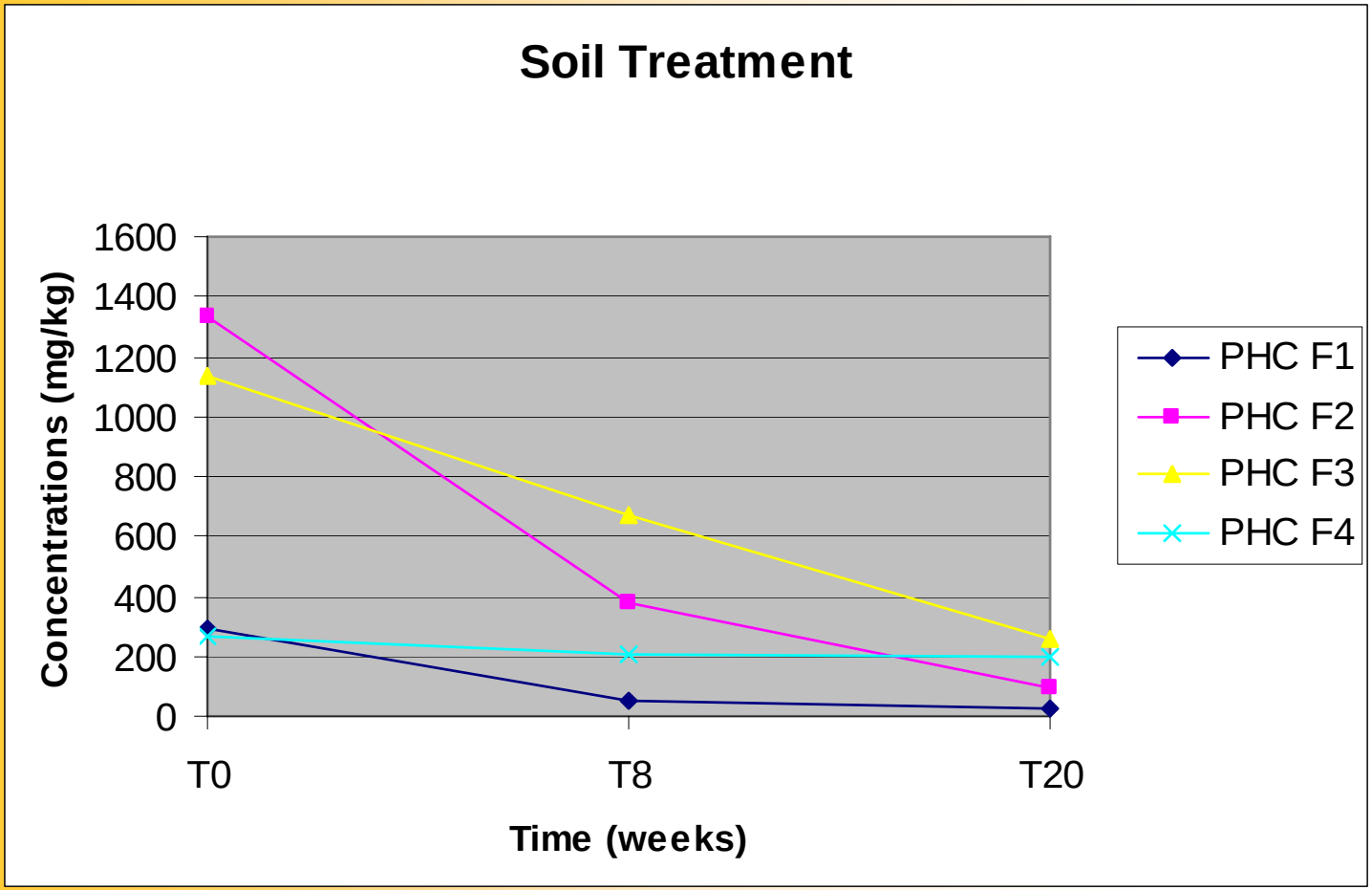
Project Results (cont.)



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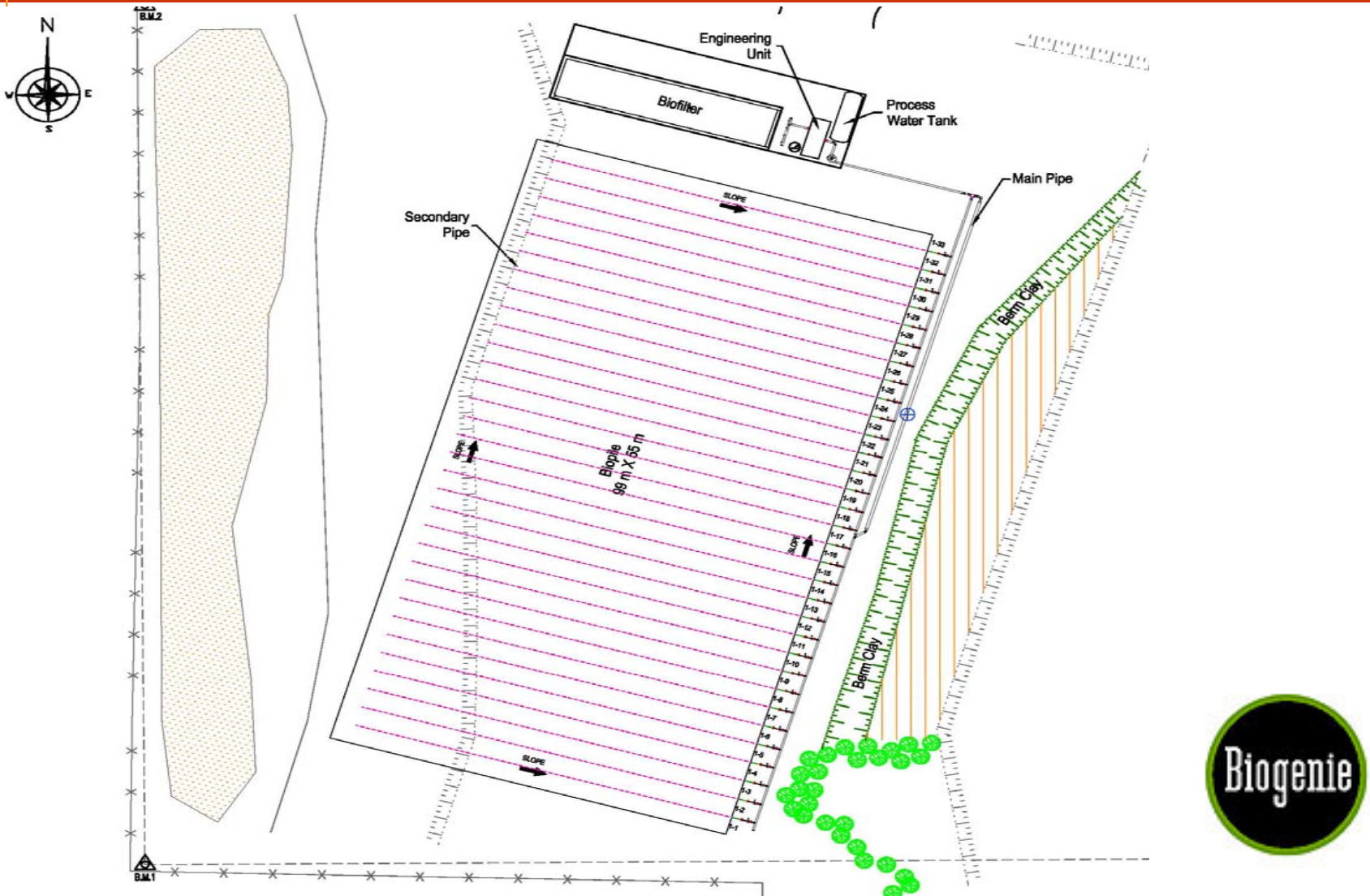
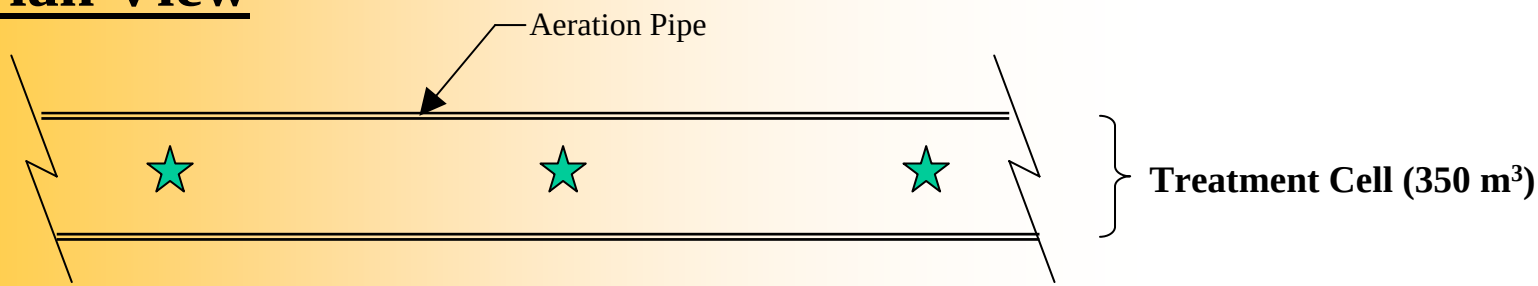
Treatment Pad as Built

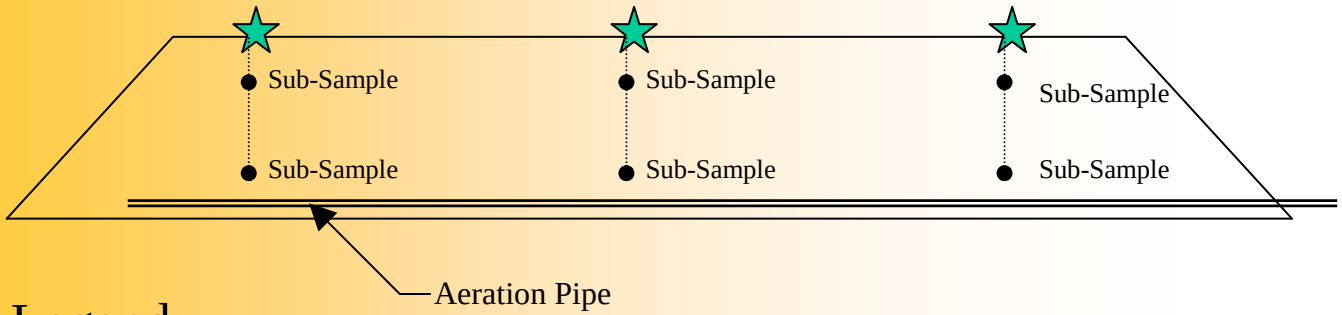


Sampling Pattern

Plan View



Cross Section



Legend:

★: Sampling Location

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Conclusion

Overall:

- Safety: no recordable incidents
- Quality: objectives for soil, water, and air treatment were achieved
- Cost: 25% less than landfill
- Time: 18 months
- Overall: 100% of the objectives were achieved

There are very limited reasons that can justify not looking into the recycling of soil, air, and water

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