COMBINING SOIL GAS SAMPLING AND MIP INVESTIGATION TO OPTIMIZE A DNAPL SOURCE ZONE CHARACTERIZATION

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Area Layout & Project Goals

- Project Goals:
  - Characterizing Source Zones
  - Plume Delineation
  - Risk Assessment
  - Remedial Cost Estimate

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Geology and Groundwater Flow

- Geology
  - 0-2m: Fill layer (variable composition)
  - 2-30m: Fine to medium sand with clay
  - >30m: Clay (1st aquitard)
- Very irregular topography
- Depth to groundwater circa 2 m-bgs
- Groundwater Flow SE-NW
- Fairly permeable aquifer but very low gradient
Historical Overview

Investigated areas:

Timeline

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Original Investigation Approach

Borings and existing monitoring wells from previous investigations:

- Red: Soil Borings
- Yellow: Wells until 5 m-bgl
- Orange: Wells 6-10 m-bgl
- Brown: Wells 11-15 m-bgl
- Purple: Wells 16-20 m-bgl
- Dark purple: Wells >20 m-bgl

Proposed Next Steps:

- More wells…

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## Proposed New Phased Approach

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<th>Phase</th>
<th>Action</th>
<th>Goal</th>
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<tr>
<td>1A</td>
<td>Passive Soil Gas Screening <em>(GORE™ Sorber Survey)</em></td>
<td>Identify and delineate source zones; Investigate potential for VI risks</td>
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<tr>
<td>1B</td>
<td>MIP Investigation <em>(Membrane Interface Probe)</em></td>
<td>Characterize the vertical distribution and extent of the contaminants</td>
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<tr>
<td>1C</td>
<td>Installation of wells and analyses</td>
<td>Collecting analytical data</td>
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<td>2</td>
<td>Groundwater modeling and risk assessment</td>
<td>Understanding plume migration and assessing potential risks</td>
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<td>3</td>
<td>Data evaluation and reporting</td>
<td>Presenting results to Local Environmental Authorities</td>
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<td>4</td>
<td>Communication with Stakeholders</td>
<td>Presenting results to other stakeholders</td>
</tr>
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</table>

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Phase 1A: Passive Soil Gas Survey

- Screening technique
- Rapid & unobtrusive installation minimizing disturbance to site owners

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Why Passive Sampling?

Time-integrated: Sensitive to a broader range of compounds, present in lower concentrations, in virtually any soil condition.

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Phase 1A: Passive Soil Gas Survey

- 250 GORE™ modules installed (2 phases)
  - 172 in industrial zone (~20 different companies)
  - 38 in nature park (other sources? plume migration?)
  - 40 in streets (VI impacts?)
- Average installation depth ~1.5 m
- Average residence time ~15 days
- Analyses on VOCs, BTEX and TPH
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Groundwater Flow

Total Target VOCs [μg/L]

1288.250
830.520
535.427
345.183
222.536
143.466
92.491
59.628
38.441
24.783
15.977
10.300
6.640
4.281
2.760
1.779
1.147
0.740
0.477
0.307
0.198
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Phase 1B: MIP Investigation
Why perform MIPs before wells?

Surface level

Soil

Groundwater

Aquifer

Chlorinated solvents DNAPL

Clay lens

Chlorinated solvents DNAPL

Clay

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Phase 1B: MIP Investigation

- Initially 12 MIP’s carried out
- Average depth ~34.5 m
- In situ measurements:
  - Geology (CPT)
  - Specific Conductance
  - VOCs (DELCD detector) en TPH (PID en FID detectors)
MIP Detectors

- FID (Flame Ionization Detector)
  Corg.

- PID (Photo Ionization Detector)
  Ionization Potential < 10.6 eV

- DELCD (Dry Electrolytic Conductivity Detector)
  Organic Bonded Chlorine (VOCL)
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Source Areas

Clay

DNAPL?
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Consolidating Site Conceptual Model…

- Additional MIPs
- Tap Water Sampling
- Vapor Intrusion?
- Well Installation
- Traditional Sampling
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Summary

- Known source zones of chlorinated solvents and petroleum hydrocarbons confirmed and delineated
- New source zones of chlorinated solvents and petroleum hydrocarbons detected (on- and off-site)
- Extent of impacts in the source zones bigger than initially expected
- Plume width and length bigger than initially expected
- Potential for free phase product (DNAPL) identified
- Plume migration is fairly complex and driven by preferential flow channels
Muito Obrigado!

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