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Air Sparging and Soil Vapour Extraction Systems for the Remediation of Volatile Organic Compounds in Groundwater and Soil Vapour: A Contractor's Perspective

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Presentation Outline

- Who we are?
- VOCs and environmental impact
- Overview of AS/SVE technology
- The role of an environmental remediation contractor
- Principles of AS/SVE system operation
- Case Study
- Benefits and limitations of AS/SVE technology
- Closing Remarks

Green Infrastructure Partners (GIP)

- One of Canada's largest and most diversified companies.
- Offer vertically integrated infrastructure solutions for public and private projects of every scale.
- Projects are becoming complex, and we have the unique ability to complete an entire project without the need for subcontractors.
- Specialized Services:
  - **Remediation Technologies**
  - Excavations and Demolition
  - Shoring & Foundations
  - Paving & Production of Materials

GIP – Remediation Division

In-Situ/Ex-Situ Remediation Services (Including Drilling)

Water/Wastewater Treatment Systems

Sub-Slab Vapour Intrusion Mitigation Systems

Bulk Excavation, Remediation & Restoration

Mass Excavation & Shoring

Fuel Station Decommissioning

Underground Storage Tank Removals

Cutoff walls, slurry walls & Permeable Reactive Barriers

Facility Demolition & Decommissioning

Stormwater Management Pond Cleanouts & Creek

Restoration Bulk Materials Screening, Grinding & Crushes

Interior/Industrial Site Remediation

VOCs & Environmental Impact

- Volatile organic compounds (VOCs) - A class of hazardous chemicals commonly found in industrial sites, dry cleaners, and fuel storage facilities.
- VOCs such as trichloroethylene (TCE) and perchloroethylene (PCE), are known to contaminate groundwater and soil vapour.
- Poses significant risks to human health and the environment and exposure to VOCs can lead to respiratory problems, liver damage, and even cancer.

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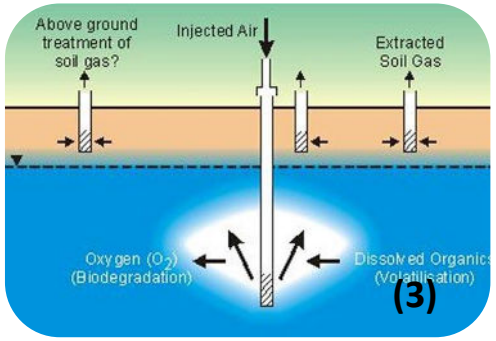
The Role of an Environmental Remediation Contractor

Site Assessment & Characterization



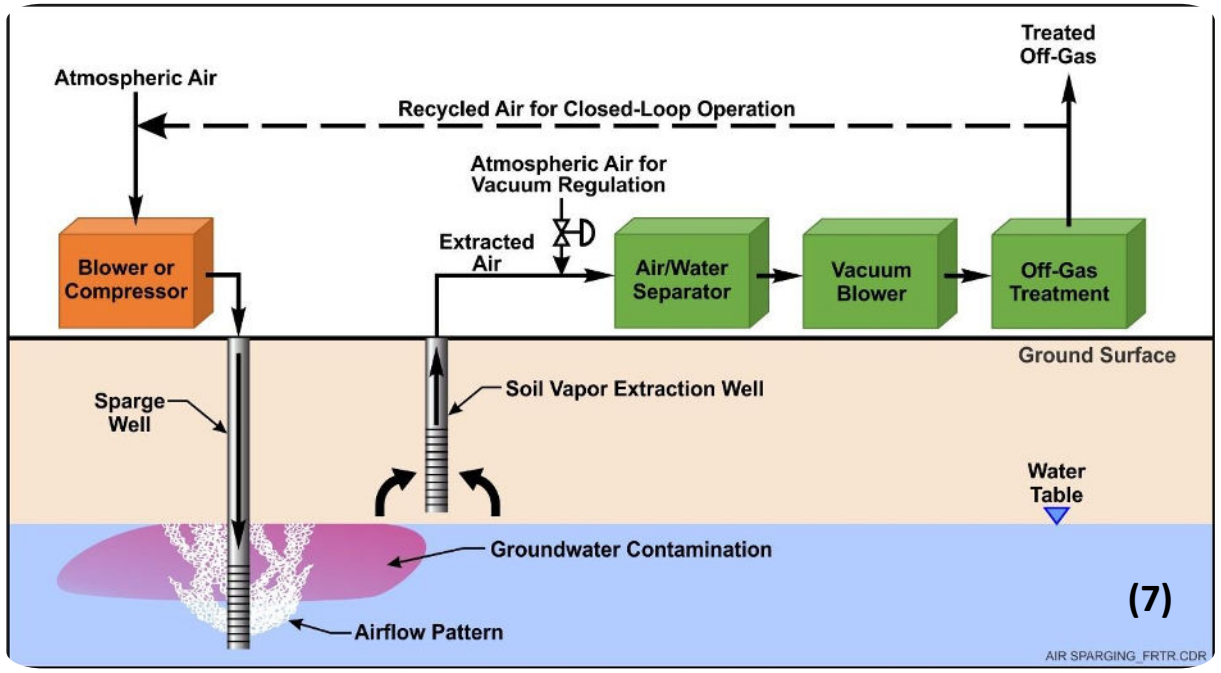
System Design & Implementation

Operation & Maintenance

Monitoring & Data Analysis

Collaboration with Stakeholders

Overview of AS/SVE Technology



- AS/SVE Technology - A combined remediation technique used to mitigate VOC contamination.
- Two main components:
  1. Air Sparging
  2. Soil Vapour Extraction

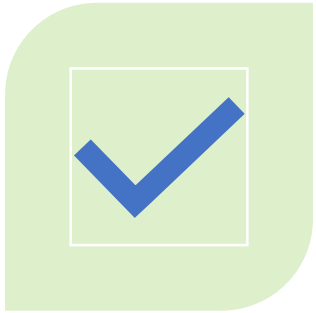
Air Sparging

- Involves injecting air or oxygen into the groundwater to promote the volatilization of VOCs.
- This process enhances the transfer of contaminants from the dissolved phase to the vapour phase.

Soil Vapour Extraction

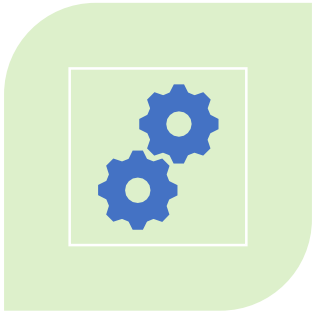
- Involves the removal of VOCs from the unsaturated zone, also known as the vadose zone.
- This is accomplished by applying a vacuum to the soil, causing the VOCs to volatilize and be captured for treatment.

Principles of AS/SVE System Operation



Site-Specific Considerations

Understanding the site's hydrogeology, including soil types, groundwater flow rates and geological heterogeneities



Engineering Design

Collaborating with engineers to design the system components, such as the number and placement of wells and monitoring points

Operational Expertise

Applying our expertise to activate the system, introduce air into the subsurface, and simultaneously extract vapors for treatment.

Treatment & Disposal

Working closely with treatment specialists to ensure proper treatment of extracted vapors and compliant disposal of the treated effluent.

Case Study – AS/SVE for Remediation of VOCs in Groundwater & Soil Vapour

Site History

- Site was formerly used for industrial purposes where electroplating activities were carried out.
- Site is located in an area of mixed industrial/commercial, institutional, and residential land use.
- Site investigations showed that VOCs, more specifically **trichloroethylene (TCE)**, are present in on-site groundwater and soil vapour at concentrations exceeding applicable:
  - Groundwater standards
  - Residential soil vapour intrusion criteria

Project Timeline

2018

Engineering consultant completed the **remedial technologies evaluation** which identified AS of the groundwater with SVE as a preferred remedial option.

2019

GIP conducted the **pilot testing of the AS/SVE system** to evaluate the effectiveness of this technology.

Winter 2020 – Spring 2021

GIP completed the **installation and commissioning of the full-scale AS/SVE system** for the subsequent operations.

Summer 2021 – Ongoing

GIP is continuing the **operations and monitoring of the full-scale AS/SVE system** for site remediation.

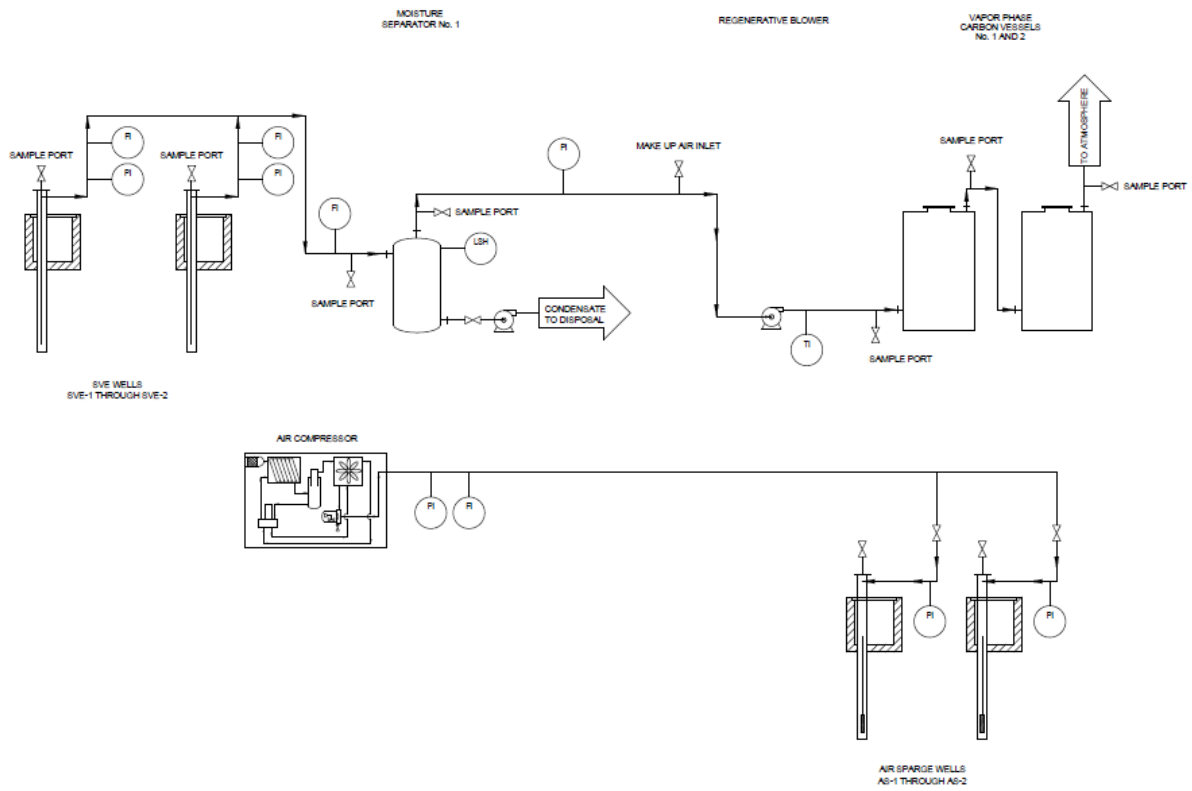
Pilot-Scale

Pilot test was conducted to:

- Evaluate the effectiveness of an AS/SVE system for the remediation of volatile organic compounds (VOCs).
- To determine the necessary design parameters for full-scale design, at the site.

Pilot Scale: System Setup

- A **rotary vane compressor** was used as the air source for the sparge wells.
- A **regenerative blower** was used to provide the vacuum to the SVE wells.
- The piping from the SVE wells connected to a **moisture separator** which then connected to the inlet side of the **blower** to remove water from the air stream.
- Vapour phase treatment was undertaken using two **carbon vessels** in series.



Full-Scale System

Type of Well	No. of Wells
Air Sparging	9
Soil Vapour Extraction	12
Observation Wells	6

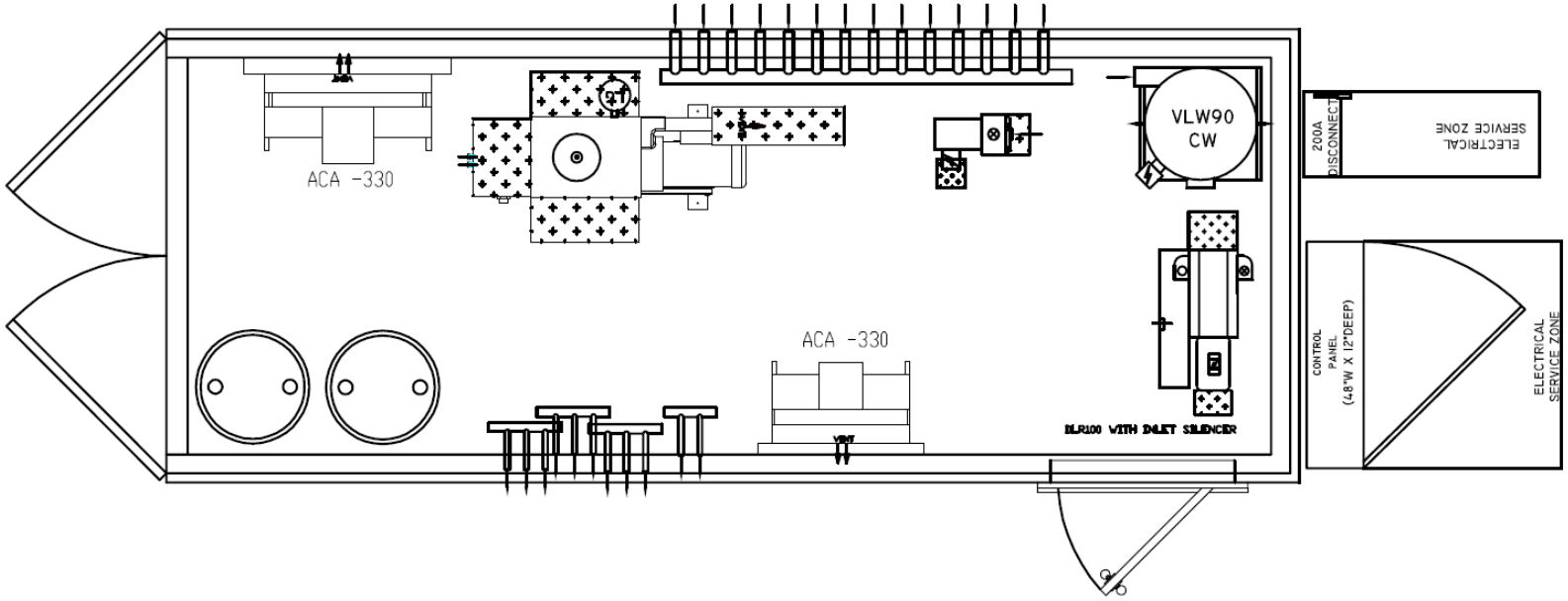
- The AS/SVE well/probe network was divided into five (5) treatment cells (Cells 1 to 5) for system operation and performance evaluation.
- Cells 2 and 3 are located in primary VOC source areas and Cells 1, 4, and 5 are located along the periphery of the primary VOC source area.
- Long term VOC mass removal by the AS/SVE system will be primarily completed in Cells 2 and 3.
- Periphery Cells 1, 4 and 5 address low concentration VOC impacts to the south, west and east of Cells 2 and 3, respectively.

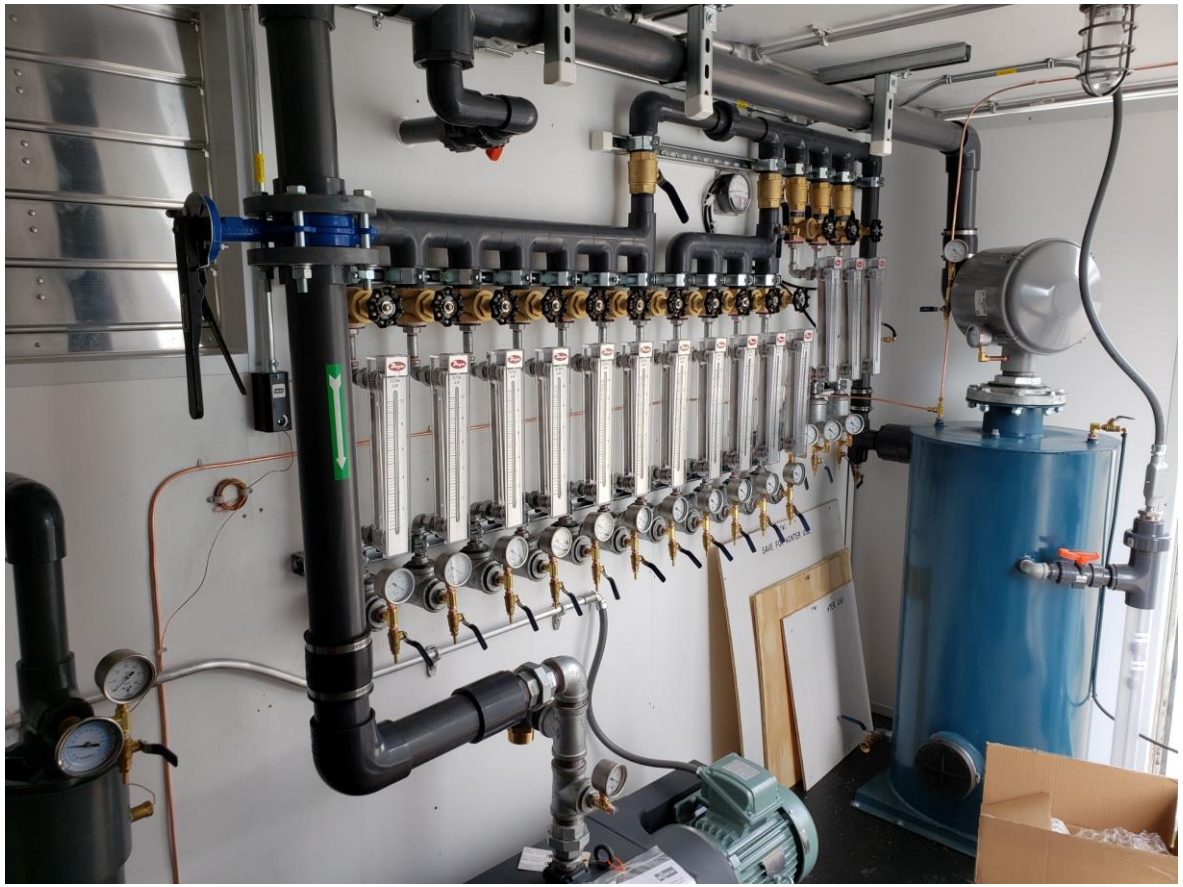
Full-Scale System

Partnered with **Newterra** to design and build a full-scale system that meets the client's specification and consists of following components:

- Air sparge compressor and heat exchanger
- Air sparge manifold.
- Soil vapour extraction blower and heat exchanger
- Vacuum extraction manifold.
- Vapour liquid separators.
- Specialty media filtration.
- Vapour phase carbon filtration.

Parameter	Design Value
Site power	Single-phase, 208V, 60Hz Maximum Available Fault Current: 10,000 Symmetrical RMS Amps
System Area Classification	Hazardous CL 1 DIV 2 location for equipment Non-hazardous location for control panel
Site Noise Constraints	n/a
Contaminants	Various BTEX and VOC compounds
Ambient temperatures	max: 100 F min: 25 F
Elevation	700 ft
Process Flow Rate (Design)	SVE: 50 SCFM (55 ACFM) @ 2.94"Hg (60"WC) vacuum SPG: 40 SCFM @ 20 PSI





Challenges

- System installation
- Site-specific complexities
- Equipment selection and calibration
- Monitoring and data interpretation
- Regulatory compliance

Operation and Maintenance

- Monitoring air and water flows
- Maintaining proper vacuum levels
- Conducting routine inspections

Benefits and Limitations

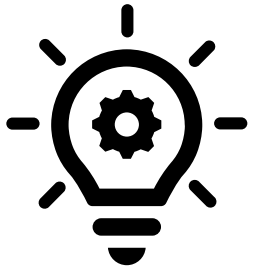
Benefits

- Effective Remediation
- Versatility
- Cost-Effectiveness

Limitations

- Slow Treatment Rates
- Limited Applicability

Closing Remarks



- AS/SVE systems offer a viable and effective solution for remediating groundwater and soil vapor contaminated with VOCs.

- Pre-qualify your contractor
  - Limit your risk.
  - Work with experienced contractors to level playing field.
  - Less potential for unexpected change orders.

- Technical engagement at the early stage
  - Understand site-specific conditions.
  - Management of residuals from remediation activities.

Closing Remarks

- Work with sub-trades. i.e., Plumber, electrical, granular, concrete:
  - To ensure utilities are identified and supply is accessible.
  - To ensure fittings and materials that meets the specifications and guidelines are used.

- On-site testing is key and only trained and experienced field professionals can carry out this.

- Communicate impacts of the project with existing tenants.
- Strategic planning to deal with unexpected delays and supply chain issues.

Resources

1) https://www.culligannation.com/vocs-impact-drinking-water
2) https://frtr.gov/matrix/Air-Sparging/
3) https://www.trihydro.com/services/environmental-site-assessment-characterization-and-modeling
4) http://108.128.142.250/en/products/remediation-systems
5) https://www.shutterstock.com/image-illustration/3d-work-tool-threedimensional-shape-people-263969129
6) https://dewesoft.com/blog/how-to-interpret-condition-monitoring-data
7) https://www.istockphoto.com/photo/people-hands-connecting-jigsaw-pieces-gm508408868-85249075

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Questions?

For more information, Please contact:

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