

SOIL STERILANTS PROGRAM (SSP) –

ADDRESSING CHALLENGES MANAGING STERILANT IMPACTED SITES IN ALBERTA

SSP 
Soil Sterilants Program

 **TC Energy**

ATCO

ALBERTA 
INNOVATES

 **InnoTech ALBERTA**
A SUBSIDIARY OF ALBERTA INNOVATES

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REMTECH OCTOBER 18, 2024

OUTLINE



Background, Solutioning Approach and
Stakeholder Feedback/ Literature Findings



Program Overview and Select Learnings

SOIL STERILANTS – WHAT’S THE PROBLEM?



Non-selective, persistent, residual herbicides that render treated soil unfit for plant growth

- Applied historically at wellsites, transmission lines, oil and gas distribution and industrial facilities, pipelines and electric substations, railways
- Use halted in 1990’s based on **persistence** and **mobility**
- **Secondary impacts** through leaching, runoff or wind dispersion
- Best estimate - **>60,000** sites in Alberta



PHASED SOLUTIONING APPROACH



Literature Review

Stakeholder Consultation

Program Development

OBJECTIVE:

To establish **proven, technical** and **cost-effective** strategies and best practices for management of sites impacted by residual soil sterilants, with the goal of supporting regulatory site closure.



What did we learn from stakeholders and literature?

- Majority of sterilant impacts in Alberta are associated with **bromacil** and **tebuthiuron**
- Sites are **primarily** located in **central** and **southern Alberta**
- Alberta **Tier 1** Soil and Groundwater Remediation Guidelines (EPA 2023) are **conservative** and based on data generated outside Alberta
- Lack of available information for use in **risk assessment models**
- **Remediation technologies** have been **successfully** used to reduce or eliminate sterilant impacts – **more research required** for Alberta conditions and larger scales



Drozdowski, B., C.B. Powter, S. Levy, 2018. Management of Sterilant Impacted Sites: Literature Synthesis. InnoTech Alberta, Edmonton, Alberta. 49 pp.

Drozdowski, B., S. Levy and C.B. Powter, 2018. Remediating Soil Sterilant-Affected Lands: Summary of Stakeholder Discussions. InnoTech Alberta, Edmonton, Alberta. 42 pp.

STERILANT IMPACTED SITES AND CHALLENGES



Site Summary Information

- | | |
|---|--|
| <ul style="list-style-type: none">• Bromacil is the more prevalent sterilant.• Co-contaminants are found at most sterilant-impacted sites.• Sites often have both fine- and coarse-grained soils, with majority dominated by fine-grained.• Vegetation impacts cannot always be used to identify sterilant impacts due to mobility and surface treatments.• Small soil 'hot spots' are often found across a site. | <ul style="list-style-type: none">• Majority of sites have sterilant impacts below surface and into shallow groundwater.• Vertical and horizontal sterilant delineation is challenging and only achieved ~50% of the time.• Inactive and dormant sites may not be regularly monitored. |
|---|--|

High Priority Risk Management and/or Remediation Challenges

Sterilants within surface soil (≤ 0.5 m bgs)

Sterilants at depths > 0.5 mbgs in unsaturated soil

Soil treatment requirements where sterilant destruction is required, and immobilization is not considered an acceptable option

Saturated fine-grained till soils and groundwater impacted by sterilants

Groundwater impacted by sterilants

KNOWLEDGE GAPS AND INTENDED SSP OUTCOMES



Identification and Delineation

- Reduced uncertainty associated with sterilant delineation
- More accurate and cost-effective technologies, best practices, and analytical methods are developed

Risk Assessment and Management

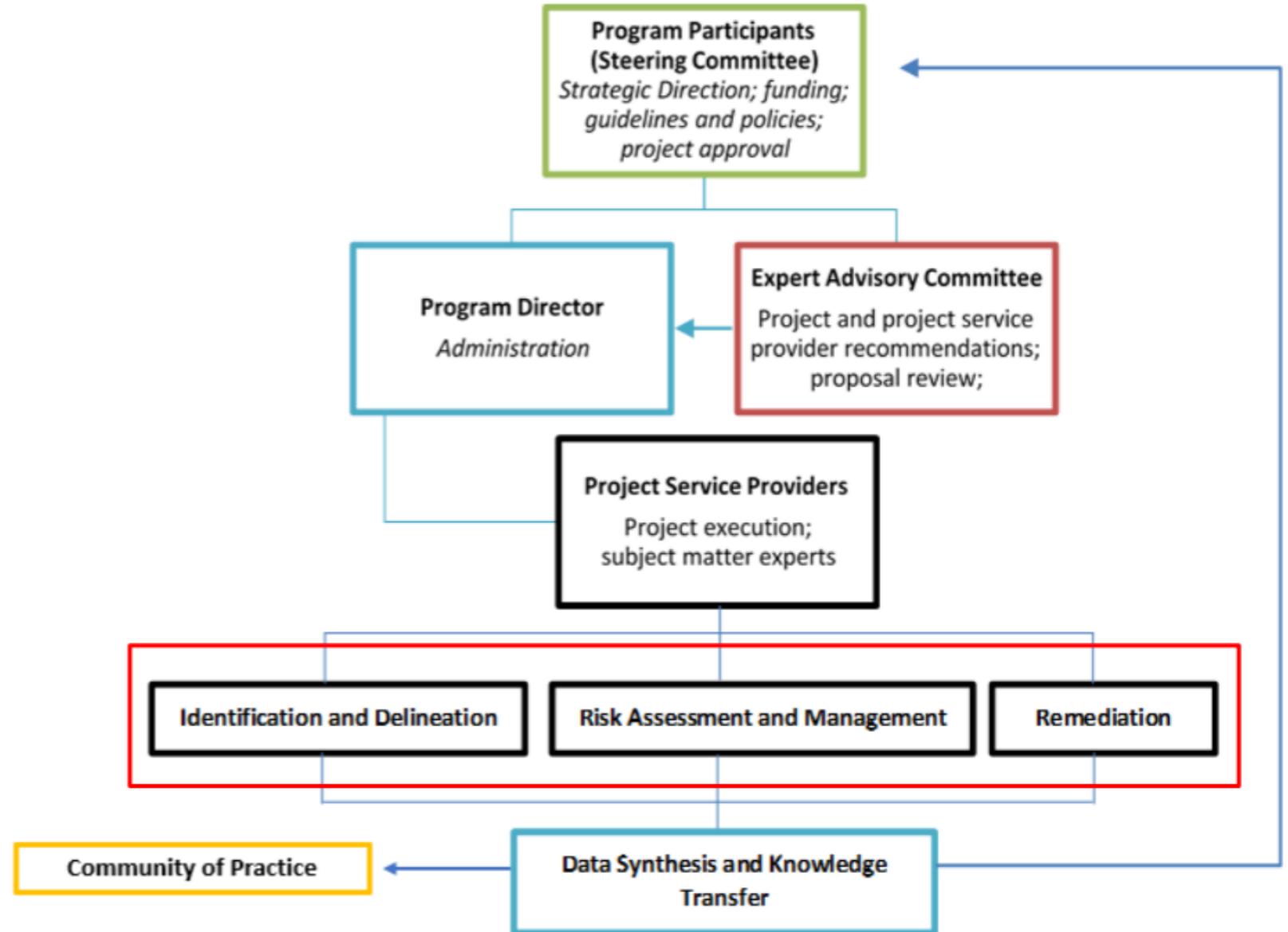
- Reduced uncertainty associated with empirical data inputs to risk assessment models
- Confirmed long-term effectiveness of immobilization technologies

Remediation

- Optimal, state-of-the-art technologies and/or processes are evaluated, validated and demonstrated under Alberta conditions

PROGRAM DELIVERY

- 5 year program
 - Initiated in 2019
- Scope
 - Address challenges specific to AB
 - *Applied* research
 - Bromacil and Tebuthiuron focus



STEERING COMMITTEE

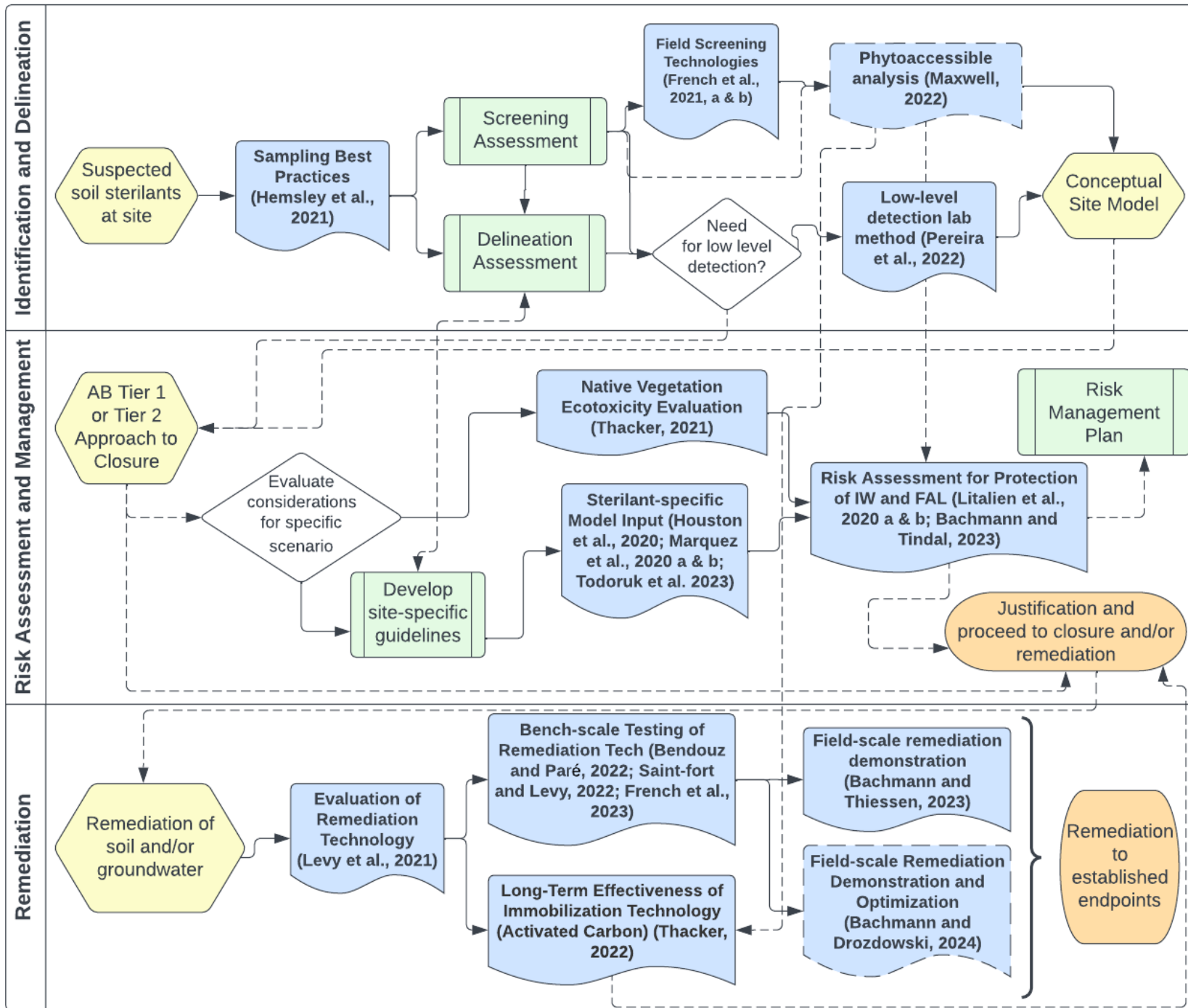
- Monica Brightwell, ATCO Pipelines
- Darcy Bye, TC Energy
- Larry D'Silva, TC Energy
- Dallas Johnson, Alberta Innovates
- Jason Pentland, ATCO Electric
- Bonnie Drozdowski, InnoTech Alberta



EXPERT ADVISORY COMMITTEE



- Kathryn Bessie, Retired (Formerly TetraTech)
- Alfred Burk, Verdant Environmental
- Gordon Dinwoodie, Retired (Formerly AEPA)
- Catherine Evans, Alberta Energy Regulator
- Kevin French, Vertex Environmental
- Premee Mohamed, Alberta Environment and Protected Areas
- Terry Obal, (Formerly Maxxam Analytics)
- Chris Powter, Enviro Q&A Services
- Roger Saint-Fort, Mount Royal University
- Ron Sawatsky, Independent (Formerly InnoTech)
- Gladys Stephenson, Aquaterra Environmental Consulting
- Ron Thiessen, University of Calgary (Formerly Advisian)



IDENTIFICATION AND DELINEATION

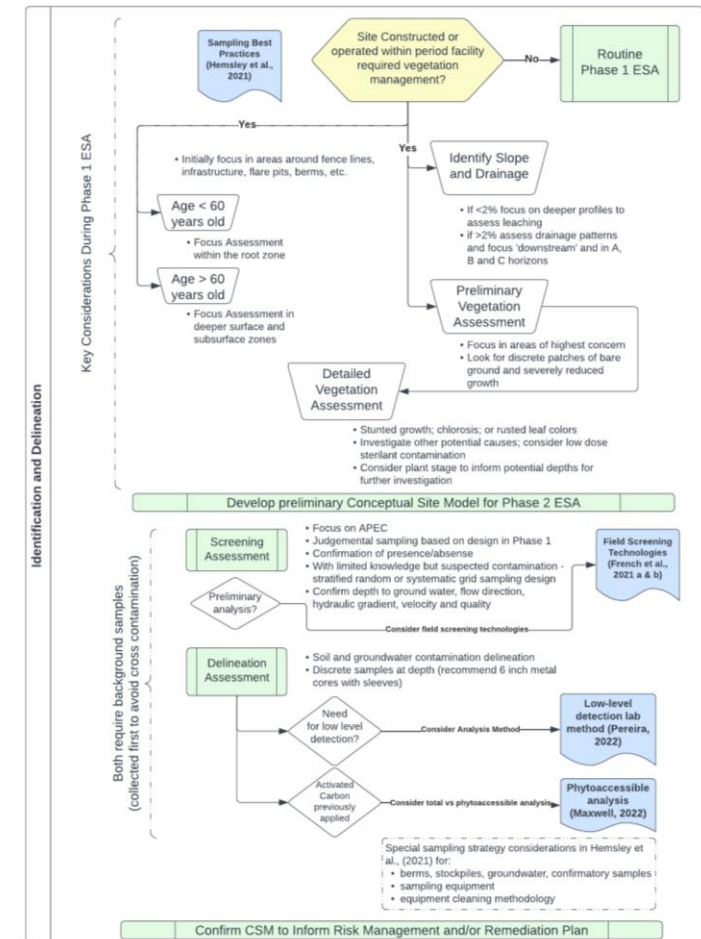


Project	Project Description	Project Service Provider(s)
Sampling Best Management Practices	Develop best management practices for sampling methodologies to ensure quality analytical results are available to inform management decisions.	TetraTech
Laboratory Method Investigation	Develop a method to increase effectiveness and/or efficiency in laboratory analysis for detection of total bromacil and tebuthiuron in soil and water.	InnoTech Alberta
Detection of Bioavailable Sterilants	Develop and validate laboratory analytical method(s) for detection of bioaccessible bromacil and tebuthiuron, required for evaluating effectiveness of immobilization technologies and for supporting risk assessment.	University of Alberta InnoTech Alberta
Field Screening Technologies	Investigate the potential to develop field screening or proxy lab analytical methods to minimize costs associated with delineation of bromacil and/or tebuthiuron.	Vertex Environmental Inc.

- Kathryn Bessie, Tyrel Hemsley, and Aziz Shiakh
- Victor Bachmann, Graham Knox, Simone Levy, Alberto Pereira, Julius Petrolius, Eric Ruan, Sarah Thacker, Ron Thiessen, and Xinghuo Mo
- Eric Cowan, Kevin French, Emily Terpstra, and Alyson Neufeld
- Jackie Maxwell and Sylvie Quideau
- Chris Powter

LEARNINGS AND SOLUTIONS

- Application of the sampling methods BMPs is essential for preventing cross-contamination and accurately detecting low concentrations
 - **WORTH THE INVESTMENT**
- Field screening technologies do not currently have the sensitivity required to be useful to detect presence/absence
 - **FOCUS ON HOW AND WHAT TO SAMPLE TO MANAGE DELINEATION COSTS**
- Lower detection limits and greater accuracy are possible analytically – need to assess when and why
 - **USEFUL FOR CONFIDENCE IN TIER 2**
- Total (non-soluble) and phyto-accessible (soluble) concentrations are not equivalent
 - **USEFUL FOR ASSESSING RISK THROUGH TIER 2**



RISK ASSESSMENT AND MANAGEMENT



- Sarah Thacker, Victor Bachmann, Simone Levy, and Stefan Schreiber
- Cory Kartz, Amélie Litalien, Ian Mitchell, and Miles Tindal
- Amy Grainger, Steven Hardy, Adele Houston, Gil Marquez, Aaron Tangedal, Ron Thiessen, and Tiona Todoruk
- Ryan Prosser
- Barry Loescher
- Chris Powter

Project	Project Description	Project Service Provider(s)
Sterilant-Specific Model Input Data	Develop sterilant-specific model input data relevant to Alberta (soil half-life, mobility, etc.).	Advisian, University of Guelph and BV Labs
Risk Assessment for Protection of Irrigation Water and Freshwater Aquatic Life	Determine appropriate risk model(s) and model parameters to develop screening guidelines for bromacil and tebuthiuron deemed to be protective of the irrigation watering and freshwater aquatic life pathways and better reflect the contaminant's "real-world" fate and mobility in the subsurface under Alberta field conditions.	Millennium EMS Solutions
Investigating Sterilant Fate and Mobility in Alberta	Investigate bromacil mobility in groundwater under Alberta conditions to inform guideline modification and/or acceptance for Tier 2 approaches.	Advisian
Native Species Toxicity Evaluation	Undertake Alberta native plant species toxicity evaluation.	InnoTech Alberta

LEARNINGS AND SOLUTIONS

- Determine limiting pathway based on Tier 2 - FAL and IW pathway exclusion is the first step in any risk analysis
 - Groundwater < guideline = applicable guideline will be ecological soil contact guideline
 - Groundwater > guideline = Tier 2 approach recommended
- Site-specific data collection is essential for use of the Alberta Risk Framework
 - **ESA and CSM ARE ESSENTIAL FOR QUALITY RISK ASSESSMENT**
 - **HALF- LIFE CONSIDERATION ESSENTIAL FOR SUCCESS AT TIER 2**
 - **FOCUS ON GROUNDWATER MONITORING WELLS AT THE “POINT OF CONTACT” AND K_d**



REMEDIATION

Project	Project Description	Project Service Provider(s)
Investigation of Long-term Effects of Activated Carbon	Investigate longevity of immobilized bromacil and/or tebuthiuron with activated carbon, a common historical amendment for preventing migration of soil sterilants.	InnoTech Alberta
Bench-scale Testing of Sterilant Remediation Technologies	Identify and test candidate technologies for immobilization or remediation of bromacil and/or tebuthiuron in soil and water.	Chemco Inc. Mount Royal University and InnoTech Alberta Vertex Environmental Inc. Evonik
Remediation Demonstration(s)	Undertake operational-scale demonstration of management of representative sterilant-impacted site:multiple technology approach.	InnoTech Alberta



- Victor Bachmann, Simone Levy, Sarah Thacker, Stefan Schreiber, Ryan James, Ron Thiessen, and Bonnie Drozdowski
- Chris Powter
- Eric Cowan, Kevin French, Emily Terpstra, and Alyson Neufeld
- Allan Seech
- Malika Bendouz and Jean Paré
- Roger Saint-Fort
- Oskar Pula

LEARNINGS AND SOLUTIONS

- Immobilization technologies were assessed with and without weathering to reduce phyto-accessible Bromacil and Tebuthiuron concentrations
- Bench scale testing/validation required prior to selecting an ISCO remediation technology
- Bench-scale testing demonstrated the benefit of BOS200+ with and without AC and surfactant
- ISCR Technology (Daramend®) proven to reduce bromacil concentrations - operational considerations influence practical application
- Previously proven remediation technologies (thermal desorption) still relevant



DATA SYNTHESIS/KNOWLEDGE TRANSFER



Project	Project Description	Project Service Provider(s)
Technology Evaluation and Comparison	Evaluate and compare remediation technologies, including cost and benefit analysis (including treatment logistics).	InnoTech Alberta
Knowledge Synthesis and Extension	<p>Hold Annual sharing events to update project status.</p> <p>Present non-proprietary information through publications and conferences.</p> <p>Prepare a series of Program Summary reports for Sterilant Program members and, where approved, for public dissemination.</p>	<p>InnoTech Alberta</p> <p>Enviro Q&A Services</p>



- Simone Levy, Bonnie Drozdowski, Sarah Thacker, Victor Bachmann, Xinghuo Mo
- Chris Powter

PROGRAM DELIVERABLES

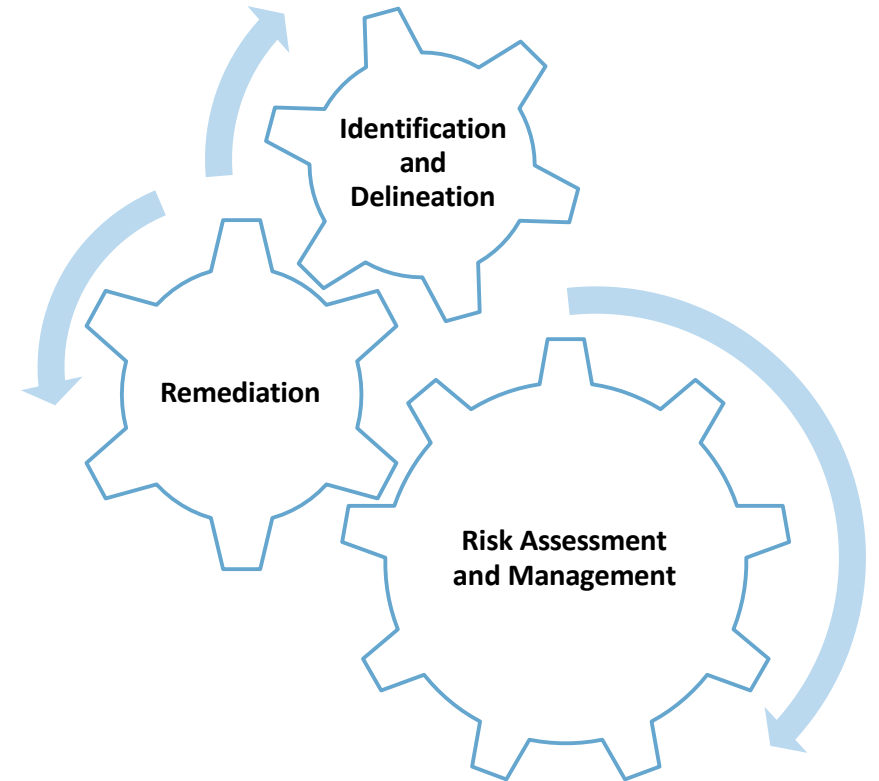


- Drozdowski, B. and C.B. Powter, 2024. Soil Sterilants Program: **Knowledge Synthesis, Recommended Practices and Gaps**. Report SSP-14B prepared by InnoTech Alberta and Enviro Q&A Services for Soil Sterilants Program, InnoTech Alberta, Edmonton, Alberta. 65 pp.
- Powter, C.B. and B. Drozdowski, 2024. Soil Sterilants Program: **Project Report Compilation**. Report SSP-14A prepared by Enviro Q&A Services and InnoTech Alberta for Soil Sterilants Program, InnoTech Alberta, Edmonton, Alberta. 46 pp. plus appendices.
- Sawchuk, S., B. Drozdowski and C.B. Powter, 2024. Soil Sterilants Program: **Steering Committee Minutes and Quarterly and Annual Reports**. Report SSP-14C prepared for InnoTech Alberta, Soil Sterilants Program, Edmonton, Alberta. 200 pp.

OVERARCHING SSP LEARNINGS:

- Challenging to fully articulate the specific problems and challenges to solve
 - End up “flying to the moon” when simple “walk” would suffice
- 5 years is a long time

Industry Applications – Jason Pentland - ATCO



ACKNOWLEDGMENTS AND QUESTIONS?



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