On behalf of the Real Property Institute of Canada (RPIC) and the Workshop Organizing Committee, we are really pleased to welcome all delegates, exhibitors and event partners to the fourth RPIC Federal Contaminated Sites National Workshop being held at the Allstream Center in Toronto. Through the hard work and dedication of the Organizing Committee and The Willow Group, we have again assembled a high quality program that we hope you will find stimulating and informative.

Since the early 1990’s, federal environmental specialists have worked to develop a nation-wide strategy to address federal contaminated sites. The combination of the government’s 2004 commitment of long-term funding and the establishment of the Federal Contaminated Sites Action Plan (FCSAP) program has made it possible for federal custodians and the environmental industry to undertake a collaborative effort for effective and responsible management of federal contaminated sites.

The first three National Workshops, held in Ottawa in March 2006, in Vancouver in April 2008 and in Montreal in May 2010, provided a unique forum for federal public servants engaged in environmental management and remediation, industry representatives and academics to share experiences and learn from one another. Building on this foundation, the 2012 plenary sessions, poster displays, trade show and numerous networking opportunities provide a venue to discuss technical, scientific and management strategies for addressing federal sites with colleagues from across the country, and allow for the building of partnerships that are critical to our collective success.

Our program begins with the popular pre-workshop professional development day which offers intensive sessions for those seeking a more in-depth look at environmental due diligence, environmental statistics, ecological risk assessment guidance, cost estimation and cost management, managing aquatic contaminated sites, selection of environmental quality guidelines, assessment validation and site closure or at stakeholder engagement including aboriginal cultural awareness and social media. A site tour is also offered that day to visit a major project dealing with contaminated radioactive material.

The next two days of the Workshop will feature concurrent streams covering the topics of managing environmental projects, remediation case studies, sustainable remediation, human and ecological risk assessment, risk management, site management objectives and guidance, innovative assessment, and innovative remediation. This will be followed by a plenary session on Thursday morning showcasing the achievements of the FCSAP program and a site tour in the afternoon providing delegates with an opportunity to see remedial technologies and site management strategies in action in the Toronto area.

Our technical program will be complemented by a keynote presenter roster that includes: Dr. Leonard Ritter, University of Guelph; David Cushman, Conestoga-Rovers and Associates; Ronald W. Brecher, MTE Consultants Inc., and Trevor Smith Diggins, SmithDiggins.com; and, Jeff Westeinde, Windmill Development Group.

Our special thanks go out to the 2012 Organizing and Technical Review Committees for the time and effort taken to review and select papers and to the staff of The Willow Group, without whom it would have been impossible to hold a Workshop of this size and scope.

We look forward to meeting you at the Workshop and hope that our program will provide you with the tools and information you require as you undertake the challenges of addressing federal contaminated sites.

Sébastien Yelle
Public Works and Government Services Canada
Workshop Chair

Caroline Béland-Pelletier
Department of National Defence
Technical Chair
2012 Workshop Organizing Committee

Sébastien Yelle
Workshop Chair
Public Works and Government Services Canada

Caroline Béland-Pelletier
Technical Chair
Department of National Defence

Planning Committee
• Deniz Baykal,
  Environment Canada
• Ian Chatwell,
  Transport Canada
• Tracy Dannell,
  Department of National Defence
• Lina Letiecq,
  Public Works and Government Services Canada
• Stephan Moushian,
  Public Works and Government Services Canada
• Debbie Nicholls,
  Department of National Defence
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• Brenda Pichette,
  Health Canada
• Jean-Claude Prévost,
  Parks Canada
• Brad Simpson,
  Public Works and Government Services Canada
• Meggan Sine,
  Environment Canada
• Clayton Truax,
  Public Works and Government Services Canada
• Xing Wu,
  Environment Canada

Technical Review Committee
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  Department of National Defence
• Ian Chatwell,
  Transport Canada
• Tracy Dannell,
  Department of National Defence
• Lina Letiecq,
  Public Works and Government Services Canada
• Debbie Nicholls,
  Department of National Defence
• Sarah Orovan,
  Treasury Board of Canada, Secretariat
• Jean-Claude Prévost,
  Parks Canada
• Clayton Truax,
  Public Works and Government Services Canada
• Sébastien Yelle,
  Public Works and Government Services Canada

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Monday, April 30, 2012

PROFESSIONAL DEVELOPMENT DAY

7:30 am - 4:30 pm  | Registration
                    Foyer

8:30 am - 4:00 pm  | Port Hope Site Tour

8:30 am - 12:00 pm | Training Sessions

An Introduction to the Selection of Appropriate Environmental Quality Guidelines in Canada - Overview of Environmental Quality Guidelines in Canada
Chris Allaway, National Guidelines and Standards Office, Environment Canada
Location: Room 200A

Environmental Statistics in Support of Risk Assessment of Contaminated Sites: Making Sense of Nondetects
Dennis Helsel, Ph.D., Practical Stats
Location: Room 200B

Environmental Due Diligence and Reasonable Care in the Context of Federal Contaminated Sites
Heather Goudreau, Public Works and Government Services Canada
Donna S.K. Shier, Willms & Shier Environmental Lawyers LLP
Nick Monteiro, Aboriginal Affairs and Northern Development Canada
Chris Ludwig, Franz Environmental Inc.
Jean Rheoume, Department of National Defence
Clayton Truax, Public Works and Government Services Canada
Location: Room 200C

10:30 am - 10:50 am | Refreshment Break
                      Ballroom B

12:00 pm - 1:00 pm  | Lunch Break
                     Ballroom B

1:00 pm - 4:30 pm  | Training Sessions

An Introduction to the Selection of Appropriate Environmental Quality Guidelines in Canada - Selection of Applicable Environmental Quality Guidelines for Managing Federal Contaminated Sites in Canada
Jane Yaraskavitch, Stantec Consulting Ltd.
G. Mark Richardson, Ph.D., Stantec Consulting Ltd.
Location: Room 200A

Environmental Statistics in Support of Risk Assessment of Contaminated Sites: Making Sense of Nondetects
Dennis Helsel, Ph.D., Practical Stats
Location: Room 200B

Tool for Risk Assessment Validation and Site Closure Tool
Chris Ludwig, Franz Environmental Inc.
Location: Room 200C

2:30 pm - 2:50 pm  | Refreshment Break
                     Ballroom B

6:00 pm - 9:00 pm  | Welcome Reception
                     Fairmont Royal York Hotel, Imperial Room
### Monday, April 30, 2012

**PROFESSIONAL DEVELOPMENT DAY**

<table>
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<tr>
<th>Time</th>
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<td>7:30 am - 4:30 pm</td>
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<td>8:30 am - 4:00 pm</td>
<td>Port Hope Site Tour</td>
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<td>Ecological Risk Assessment Guidance for Federal Contaminated Sites</td>
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<td>Location: Room 201A</td>
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<td>Project Cost Estimation and Cost Management</td>
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<td>Gino Dalla Coletta, Golder Associates Ltd.</td>
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<td>Tim F. Whalen, Golder Associates Ltd.</td>
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<td>Eric Wilson, Golder Associates Ltd.</td>
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<td>Aboriginal Cultural Awareness from the Contaminated Site Perspective</td>
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<td>Terry Bernhardt, Golder Associates Ltd.</td>
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<td>Location: Room 201B</td>
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<td>Framework for Addressing and Managing Aquatic Contaminated Sites</td>
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<td>Under the Federal Contaminated Sites Action Plan</td>
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<td>Lee Nikl, Golder Associates Ltd.</td>
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<td>Gary Lawrence, Golder Associates Ltd.</td>
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<td>Location: Room 201C</td>
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<td>6:00 pm - 9:00 pm</td>
<td>Welcome Reception</td>
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<td>Fairmont Royal York Hotel, Imperial Room</td>
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Tuesday, May 1, 2012

WORKSHOP

8:00 am - 2:30 pm  I  Registration
                   Foyer

8:00 am - 9:00 am  I  Continental Breakfast
                   Pre-Function C

9:00 am - 9:30 am  I  Welcoming Remarks
                   Workshop Chairs
                   Ballroom B

9:30 am - 10:00 am I  Opening Keynote: Building Research Partnerships – Closing the Knowledge Gap
                   Through Collaboration
                   Dr. Leonard Ritter, University of Guelph

10:00 am - 10:30 am I  Refreshment Break in Tradeshow/Posters Areas
                      Pre-Function C

10:30 am - 12:00 pm I  Concurrent Presentations

STREAM A: Room 200ABC
10:30 am - 11:00 am
  Work In Progress – An Update on the Goose Bay Remediation Project
  Craig Wells, Department of National Defence

11:00 am – 11:30 am
  Key Lessons Learned – DND DEW Line Clean Up
  David Eagles, Department of National Defence

11:30 am – 12:00 pm
  10 Years of Planning, Design and Reclamation: CBDC Mine Site Closure Program
  Eric Parsons, Public Works and Government Services Canada

STREAM B: Room 201ABC
10:30 am – 11:00 am
  Development and Field Trials of a New 100% Soluble Carbon-Iron Product for In-situ Remediation of Groundwater
  Kerry Bolanos-Shaw, The Adventus Group

11:00 am – 11:30 am
  Case Study: Innovative Use of the Membrane Interface Probe and Laser Induced Fluorescence to Direct In-situ Remediation
  Bruce Tunnicliffe, Vertex Environmental Inc.

11:30 am – 12:00 pm
  Ex-situ Soil Washing – Achieving Effective Mass Reduction for Organic and Recalcitrant Contaminant in Soil Via the Use of a Mobile Co-solvent/Surfactant Process
  Jean Paré, Chemco Inc.

12:00 pm - 1:00 pm  I  Lunch
                    Ballroom B

1:00 pm - 1:30 pm  I  Dessert in the Tradeshow/Poster Areas
                    Pre-Function C
Tuesday, May 1, 2012

WORKSHOP

8:00 am - 2:30 pm  I  Registration
                    Foyer

8:00 am - 9:00 am  I  Continental Breakfast
                    Pre-Function C

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10:00 am - 10:30 am I  Refreshment Break in Tradeshow/Posters Areas
                    Pre-Function C

10:30 am - 12:00 pm I  Concurrent Presentations

  STREAM C: Room 202AB

  10:30 am - 11:00 am
  Jason Wilkins, Hemmera

  11:00 am – 11:30 am
  Implications of Risk Assessment Methodology Changes on Contaminated Site Remediation Management Strategy
  Dr. Janice Paslawski, SNC-Lavalin Inc.

  11:30 am – 12:00 pm
  Odour Management for a Large Scale Sediment Remediation Project in an Urban Setting – Sydney Tar Ponds, Sydney, Nova Scotia
  Stephen Pinto, AECOM

  STREAM D: Room 203AB

  10:30 am – 11:00 am
  Health Canada Interim Position on Human Health Risk Assessment for Short-Term Exposure to Carcinogens at Contaminated Sites
  Angela Li-Muller, Health Canada

  11:00 am – 11:30 am
  Proposed Toxicological Reference Values and Risk Management Concentrations for Protection of Human Health from Lead (Pb) at Federal Contaminated Sites
  Ross Wilson, SNC-Lavalin Inc.

  11:30 am – 12:00 pm
  Interim Guidance for Evaluating Human Health Risks Associated with Direct Exposure to Contaminated Sediments at Federal Contaminated Sites in Canada
  Adam Safruk, Intrinsic Environmental Sciences Inc.

12:00 pm - 1:00 pm  I  Lunch
                    Ballroom B

1:00 pm - 1:30 pm  I  Dessert in the Tradeshow/Poster Areas
                    Pre-Function C
Tuesday, May 1, 2012

WORKSHOP

1:30 pm - 3:00 pm | Concurrent Presentations

STREAM A: Room 200ABC
1:30 pm – 2:00 pm
The Colomac Mine Remediation Project – Final Remediation to Post-Closure
Ron Breadmore, Aboriginal Affairs and Northern Development Canada

2:00 pm – 2:30 pm
Project Status of the Port Hope Area Initiative - Port Hope Project: Canada’s Largest Low-Level Radioactive Waste Clean-up Project – 2011-2021
Walter van Veen, Atomic Energy of Canada Limited

2:30 pm – 3:00 pm
Challenges of Phased Sediment Remediation at Esquimalt Graving Dock, Vancouver Island, British Columbia
Tom Wang, Anchor QEA, LLC

STREAM B: Room 201ABC
1:30 pm – 2:00 pm
Remedial Alternatives for RDX and Other Explosives in Soil and Groundwater
Dr. Ronnie Britto, Tetra Tech Inc.

2:00 pm – 2:30 pm
Combination of Electrokinetic and Enhanced Bioremediation in a Low Permeability Soil Matrix
Marianne Brien, Golder Associates Ltd.

2:30 pm – 3:00 pm
Pilot Scale Study – Removal of Uranium, Radium-226 and Arsenic from Impacted Leachate by Reverse Osmosis
Allan McMurray, Conestoga-Rovers and Associates

3:00 pm - 3:30 pm | Refreshment Break in Tradeshow/Poster Areas
Pre-Function C

3:30 pm - 5:00 pm | Concurrent Presentations

STREAM A: Room 200ABC
3:30 pm – 4:00 pm
Phase I Environmental Site Assessment at Canadian Forces Base Esquimalt, Victoria, British Columbia
Corey G. Miller, SNC-Lavalin Inc.

4:00 pm – 4:30 pm
Managing Program and Project Requirements During Sediment Stabilization at the Sydney Tar Ponds
Shouvik Gangopadhyay, Nordlys LLP

4:30 pm – 5:00 pm
Development of Risk-Based Sediment Remedial Objectives for Petroleum Hydrocarbon Contaminated Sediments at Coastal Marine Sites in Canada
Scott Moseley, Fisheries and Oceans Canada

STREAM B: Room 201ABC
3:30 pm – 4:00 pm
Practical Methods for the Discrimination of PAH Sources to Sediments at Fisheries and Oceans Small Craft Harbours – Creosote Inputs Versus Petroleum or Combustion Based Releases
Doug Bright, Hemmera

4:00 pm – 4:30 pm
Microbial Community Sequencing as an Approach to Addressing Bioremediation Challenges in the Canadian Arctic
Charles W. Greer, National Research Council Canada

4:30 pm – 5:00 pm
Investigating Background Groundwater Quality at Contaminated Sites – A Hydrogeochemical Approach
Tyler Wilen, Hemmera
<table>
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<th>Time</th>
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| 1:30 pm - 3:00 pm | **STREAM C: Room 202AB**  
**Determination of LNAPL Mobility for Establishing Remediation Goals**  
Thomas Franz, Franz Environmental Inc.  
2:00 pm – 2:30 pm  
**Habitat Equivalency Analysis as a Method of Determining Fish Habitat Compensation Requirements for Temporary Disruption Related to a Large Remediation Project**  
Lee Nold, Golder Associates Ltd.  
2:30 pm – 3:00 pm  
**Decontamination of Remote Properties by Risk Management – Use of Biological Data and Risk Analysis to Determine the Scope of Work for the Former Lighthouse at Grande-Île Project**  
Jean Pineault, Fisheries and Oceans Canada |
| 3:00 pm - 3:30 pm | **Refreshment Break in Tradeshow/Poster Areas**  
Pre-Function C |
| 3:30 - 5:00 pm | **STREAM C: Room 202AB**  
**Thin Layer Capping and Long-Term Environmental Monitoring – A Design Plan, Marathon Environmental Remediation, Marathon, Ontario**  
David G. Wilson, AECOM  
4:00 pm – 4:30 pm  
**Sustainable and Innovative Remediation of the Remote and Historic Hay Camp Abattoir and Warden Station Within Wood Buffalo National Park**  
Brent O’Rae, Parks Canada  
4:30 pm – 5:00 pm  
**Assessment and Remediation of a Former Unofficial Dumpsite in a National Wildlife Area**  
Holly Kelly, SLR Consulting (Canada) Ltd. |
| 3:30 pm – 2:00 pm | **STREAM D: Room 203AB**  
**Risk Communication in Children’s Environmental Health: Partnering with Frontline Service Providers**  
Ronald W. Brecher, MTE Consultants Inc.  
2:00 pm – 2:30 pm  
**The Use of Bioaccessibility in Risk Assessment**  
Ken Reimer, Royal Military College of Canada  
2:30 pm – 3:00 pm  
**5 Wing Goose Bay: Risk Based Criteria as a Site Management Tool**  
David Rae, AEC Environment & Infrastructure |
| 3:30 pm – 4:00 pm | **STREAM D: Room 203AB**  
**Assessment of Contaminated Sediments to Support the Derivation of Site Management Decisions: What Could Possibly go Wrong?**  
Tony Windsor, Dillon Consulting Limited  
4:00 pm – 4:30 pm  
**The Development of Site-Specific Sediment Quality Objectives as Part of a Risk-based Approach for Managing Human Health and Ecological Risks in the Kingston Inner Harbour**  
Viviane Paquin, Royal Military College of Canada  
4:30 pm – 5:00 pm  
**Natural Recovery Studies, Victoria Harbour, Victoria, British Columbia**  
David Kettlewell, SNC-Lavalin Inc. |
Wednesday, May 2, 2012

WORKSHOP

7:30 am - 2:30 pm  I  Registration  
Foyer

7:30 am - 8:30 am  I  Continental Breakfast  
Pre-Function C

8:20 am - 8:30 am  I  Welcoming Remarks  
Workshop Chairs  
Ballroom B

8:30 am - 10:00 am  I  Concurrent Presentations

STREAM E1: Room 200ABC
8:30 am – 9:00 am  
Overview of FCSAP Guidance for Ecological Risk Assessments at Federal Contaminated Sites  
Ute Pott, Environment Canada

9:00 am – 9:30 am  
Finding the Lethal Needle in the Haystack: A Case Example of Using Toxicity Identification Evaluation in Aquatic Ecological Risk Assessment to Establish Causality and Focus Risk Management Actions at a Federal Contaminated Site  
Norm Healey, Azimuth Consulting Group Inc.

9:30 am – 10:00 am  
Improving Wildlife Risk Assessment by Using Dose-response Data: an Example with PCBs  
Ryan Hill, Azimuth Consulting Group Inc.

STREAM F: Room 201ABC
8:30 am – 9:00 am  
MOE’s Pottersburg Site Decommissioning: Site Specific Remediation Challenges in an Urban Setting  
Meggen Janes, CH2M HILL Canada Limited

9:00 am – 9:30 am  
It Takes a Community to Clean-up a Remote Site – Training Initiatives and Economic Development During the Remediation of the Former Mid-Canada Line Site 500  
Wayne Ingham, WESA Group Inc.

9:30 am – 10:00 am  
Remediation of Contaminated Sites on Reserve Lands – A Partnership from Clean Up to Prevention  
Eugenia Escamilla-Duarte, Aboriginal Affairs and Northern Development Canada

10:00 am - 10:30 am  I  Refreshment Break in Tradeshow/Poster Areas  
Pre-Function C

10:30 am - 12:00 pm  I  Concurrent Presentations

STREAM E1: Room 200ABC
10:30 am – 11:00 am  
Screening Level Ecological Risk Assessment Implications of Elevated Background Metal Concentrations in Newfoundland Soil  
Adele Houston, SNC-Lavalin Inc.

STREAM F: Room 201ABC
10:30 am – 11:00 am  
Developing a Good Conceptual Site Model for Federal Contaminated Sites – Common Shortfalls and Data Needs  
Pierre Moheux, Stantec Consulting Ltd.
Wednesday, May 2, 2012

WORKSHOP

7:30 am - 2:30 pm | Registration
Foyer

7:30 am - 8:30 am | Continental Breakfast
Pre-Function C

8:20 am - 8:30 am | Welcoming Remarks
Workshop Chairs
Ballroom B

8:30 am - 10:00 am | Concurrent Presentations

STREAM G: Room 202AB
8:30 am – 9:00 am
Introducing the Draft CCME Protocols for the Derivation of Groundwater and Soil Vapour Quality Guidelines
Ian Mitchell, Meridian Environmental Inc.
9:00 am – 9:30 am
Background Soils Database in Atlantic Canada
Rita Mroz, Environment Canada
9:30 am – 10:00 am
Use of Remote Sensing Hyperspectral Analysis in Remediation Design at the Former North Rankin Nickel Mine
Paul Bandler, WESA Group Inc.

STREAM H: Room 203AB
8:30 am – 9:00 am
HOlistic Management of Brownfield REgeneration (HOMBRE)
Hans van Duijne, Deltares
9:00 am – 9:30 am
Evaluation of Groundwater Transport of Perfluorinated Chemicals at a Former Fire-Fighting Training Area
Lindsay Paterson, SLR Consulting (Canada) Ltd.
9:30 am – 10:00 am
Toxicity Review of Perfluorocarboxylates
Tara Siemens Kennedy, SNC-Lavalin Inc.

10:00 am - 10:30 am | Refreshment Break in Tradeshow/Poster Areas
Pre-Function C

10:30 am - 12:00 pm | Concurrent Presentations

STREAM G: Room 202AB
10:30 am – 11:00 am
Comparison of Observed Vapour Attenuation versus Model Predicted for Sites Contaminated with Chlorinated Solvents
Lindsay Smith-Munoz, Health Canada

STREAM H: Room 203AB
10:30 am – 11:00 am
Assessing Carbon 14 as a Potential Contaminant of Concern at a Research Laboratory
Phyllis Gregoire, Golder Associates Ltd.
Wednesday, May 2, 2012

WORKSHOP

10:30 am - 12:00 pm | Concurrent Presentations Continued

STREAM E1: Room 200ABC
11:00 am – 11:30 am  Development of Soil-to-Terrestrial Invertebrate Uptake Factors to Improve Estimation of Ecological Risk on DFO Lightstation Sites in Atlantic Canada
Malcolm Stephenson, Stantec Consulting Ltd.
11:30 am – 12:00 pm  Ecological Risk Assessment From a Property Management Perspective
Heather McCleave, Public Works and Government Services Canada

STREAM F: Room 201ABC
11:00 am – 11:30 am  Proposed Scientific Approach for Achieving Site Closure of Aquatic Contaminated Sites
Dr. Tamsin Laing, Royal Military College of Canada
11:30 am – 12:00 pm  Natural Attenuation and Risk Based Groundwater Monitoring Strategy
Stephen Livingstone, Franz Environmental Inc.

12:00 pm - 1:00 pm | Lunch
Ballroom B

12:30 pm - 1:00 pm | Lunch Keynote: Free Product in a Well – Debunking the Alarmist Attitude/Stigma Pertaining to Environmental Risk
David Cushman, Conestoga-Rovers and Associates

1:00 pm - 1:30 pm | Dessert in Tradeshow/Poster Areas
Pre-Function C

1:30 pm - 3:00 pm | Concurrent Presentations

STREAM E2: Room 200ABC
1:30 pm – 2:00 pm  SURF the Globe: Green and Sustainable Remediation and its Evolution Around the World
Justin Kelley, AECOM
2:00 pm – 2:30 pm  Remediation of Remote Site Under Consideration of Carbon Intensity, Social and Economic Benefits
Ingo Lambrecht, Franz Environmental Inc.
2:30 pm – 3:00 pm  Life Cycle Assessment of Remediation Approaches for a Remote Diesel-contaminated Site in Hopedale, Labrador
David Sanscartier, University of Saskatchewan

STREAM F: Room 201ABC
1:30 pm – 2:00 pm  Techniques for Obtaining Accelerated Environmental Approvals and Acceptance
Krista Barfoot, CH2M HILL Canada Limited
2:00 pm – 2:30 pm  A New Tool for Managing Large Portfolios of Phase I Environmental Site Assessments
Paul Hurst, Golder Associates Ltd.
2:30 pm – 3:00 pm  Overview of ITRC’s New Guidance on S/S Performance Standards
Matt Geary, CETCO
Wednesday, May 2, 2012

WORKSHOP

10:30 am - 12:00 pm | Concurrent Presentations Continued

STREAM G: Room 202AB
11:00 am – 11:30 am
On-site Environmental Analysis at Remote Sites in Northern Ontario and Nunavut
Allison Rutter, Queen’s University
11:30 am – 12:00 pm
Integrated Approach to the Remediation of Chlorinated Organic Compounds in Low Permeability Soils – A Field Study
Christopher Peace, CH2M HILL Canada Limited

STREAM H: Room 203AB
11:00 am – 11:30 am
Development of a Remedial Action Objective for Tributyltin
Rachael Jones, Golder Associates Ltd.
11:30 am – 12:00 pm
Comparison of Sand Separation and Mechanical Dewatering Technology on Three Major Dredging Projects, Including Beneficial Use
Bastiaan Lammers, Boskalis Environmental

12:00 pm - 1:00 pm | Lunch
Ballroom B

12:30 pm - 1:00 pm | Lunch Keynote: Free Product in a Well – Debunking the Alarmist Attitude/Stigma Pertaining to Environmental Risk
David Cushman, Conestoga-Rovers and Associates

1:00 pm - 1:30 pm | Dessert in Tradeshow/Poster Areas
Pre-Function C

1:30 pm - 3:00 pm | Concurrent Presentations

STREAM G: Room 202AB
1:30 pm – 2:00 pm
McNabs Petroleum Handling and Storage Area Remediation Project as a Driver of Provincial-Federal Partnerships
Mabaye Dia, Parks Canada
2:00 pm – 2:30 pm
Case History and Site Remediation at the Top of the World – Rogers Pass West
Darlene Atkinson, Golder Associates Ltd.
2:30 pm – 3:00 pm
Assisted Revegetation Following Contaminated Site Remediation in the Arctic: Case Study at Cape Dyer (DYE-M) Baffin Island, Nunavut
Dr. Barbara Zeeb, Royal Military College of Canada

STREAM H: Room 203AB
1:30 pm – 2:00 pm
The Link Between Tailings Pond Gas Generation and Unstable Ice Conditions: Colomac Mine Remediation Project, Northwest Territories
Rebecca Vanderspiegel, Aboriginal Affairs and Northern Development Canada
2:00 pm – 2:30 pm
Enhanced In-situ Bioremediation of Chlorinated Ethenes – A Canadian Perspective
Phil Dennis, SiREM
2:30 pm – 3:00 pm
Remedial Measures at the Former Drumheller Institution Landfill, Drumheller, Alberta
Mike Grinnell, Franz Environmental Inc.
Wednesday, May 2, 2012

**WORKSHOP**

3:00 pm - 3:30 pm  | Refreshment Break in Tradeshow/Poster Areas  
Pre-Function C

3:30 pm - 5:00 pm  | Concurrent Presentations

**STREAM E2: Room 200ABC**

3:30 pm – 4:00 pm  
*Bear Island: Northern and Sustainable Remediation, Keys to Success*  
Matthew McElwaine, Public Works and Government Services Canada

4:00 pm – 4:30 pm  
*Incorporating Sustainability into Site Closure – A Field Example*  
Leanne Murdie Austrins, CH2M HILL Canada Limited

4:30 pm – 5:00 pm  
*Development of a New Methodology Framework for the Integration of Sustainable Principles in the Selection of a Remedial Option Process: A Case Study in the Gas Sector*  
Guillaume Carle, Golder Associates Ltd.

**STREAM F: Room 201ABC**

3:30 pm – 4:00 pm  
*Application of Treasury Board’s New Policies on the Management of Projects to Federal Contaminated Site Projects*  
Monique Punt, Bronson Consulting Group

4:00 pm – 4:30 pm  
*Use of Earned Value Management in Monitoring and Controlling the $85M Mid-Canada Line Clean-up Project*  
Chris Ludwig, Franz Environmental Inc.

4:30 pm – 5:00 pm  
*Adopting Performance Specifications for Site Remediation: A Tool for Project Managers*  
Brian Whiffin, CH2M HILL Canada Limited

6:00 pm - 7:00 pm  | Gala Reception  
Fairmont Royal York Hotel - Canadian Room Foyer

7:00 pm - 10:00 pm  | Gala Dinner and Awards Ceremony  
Fairmont Royal York Hotel - Canadian Room  
**Keynote: Making the Science Make Sense**  
Ronald W. Brecher, Ph.D., DABT, C.Chem., Vice President, MTE Consultants Inc.  
Trevor Smith Diggins, Risk Communication Specialist, Smithdiggins.com
Wednesday, May 2, 2012

WORKSHOP

3:00 pm - 3:30 pm  I  Refreshment Break in Tradeshow/Poster Areas
Pre-Function C

3:30 pm - 5:00 pm  I  Concurrent Presentations

STREAM G: Room 202AB
3:30 pm – 4:00 pm
Use of Bioengineering Techniques for Re-vegetation of Riparian Areas at the Colomac Mine Remediation Project, Northwest Territories
Morag McPherson, Fisheries and Oceans Canada

4:00 pm – 4:30 pm
Development of a Soil Washing and Value Added Production Process for the 2010 Soil Treatment Program at the Liard Maintenance Yard KM 762.5, Alaska Highway
Ivy YuXia Liu, Franz Environmental Inc.

4:30 pm – 5:00 pm
Port Hope Project — The Unique Challenges of Site Remediation within Urban Port Hope
Andrea Ferguson Jones, MMM Group Limited

STREAM H: Room 203AB
3:30 pm – 4:00 pm
Assessing the Risk of Organic Contaminants to Groundwater and Vapour Intrusion at the Community Scale
Nizar Mustafa, University of Western Ontario

4:00 pm – 4:30 pm
Intricacies Associated with Risk Assessments for Four Marine Navigation Light Sites in Southern Ontario
Erik J. Martin, CH2M HILL Canada Limited

4:30 pm – 5:00 pm
Not All “Contaminated Sites” are Contaminated: A Wetland Example
Melanie Siewert, SNC-Lavalin Inc.

6:00 pm - 7:00 pm  I  Gala Reception
Fairmont Royal York Hotel - Canadian Room Foyer

7:00 pm - 10:00 pm  I  Gala Dinner and Awards Ceremony
Fairmont Royal York Hotel - Canadian Room
Keynote: Making the Science Make Sense
Ronald W. Brecher, Ph.D., DABT, C.Chem., Vice President, MTE Consultants Inc.
Trevor Smith Diggins, Risk Communication Specialist, Smithdiggins.com
### Thursday, May 3, 2012

**WORKSHOP**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tr>
<td>7:30 am - 10:30 am</td>
<td><strong>Registration</strong></td>
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<tr>
<td>8:00 am - 9:00 am</td>
<td><strong>Continental Breakfast</strong></td>
<td>Ballroom B</td>
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<tr>
<td>9:00 am - 9:15 am</td>
<td><strong>Welcoming Remarks</strong></td>
<td>Workshop Chairs</td>
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<td>Ballroom B</td>
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<tr>
<td>9:15 am - 10:00 am</td>
<td><strong>The FCSAP Program: An Update on Progress and What’s Ahead</strong></td>
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<td>Susan O’Connor, Contaminated Sites Division, Environment Canada</td>
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<td>Clayton Truax, Public Works and Government Services Canada</td>
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<td>10:00 am - 10:30 am</td>
<td><strong>Refreshment Break</strong></td>
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<tr>
<td>10:30 am - 11:00 am</td>
<td><strong>Innovative, Sustainable and Green Remediation Technologies, Approaches and Best Practices</strong></td>
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<td>Anne Thompson, Public Works and Government Services Canada</td>
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<td>11:00 am - 11:45 am</td>
<td><strong>Auditing Environmental Liabilities</strong></td>
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<td>Louise Bertrand, Office of the Auditor General of Canada</td>
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<td>11:45 am - 12:45 pm</td>
<td><strong>Lunch</strong></td>
<td>Ballroom B</td>
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<td>12:15 am - 1:00 pm</td>
<td><strong>Closing Keynote: Moving Mountains – Leadership and Innovation in the Canadian Environmental Industry</strong></td>
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<td>Jeff Westeinde, Windmill Development Group</td>
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<td>1:00 pm - 1:15 pm</td>
<td><strong>Closing Remarks</strong></td>
<td>Ballroom B</td>
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<tr>
<td>2:00 pm - 5:00 pm</td>
<td><strong>Site Tour</strong></td>
<td>Toronto Waterfront Walking Tour</td>
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These sessions will be presented in English with Simultaneous interpretation.

Full Day Sessions: 8:30 am - 4:30 pm

**Environmental Statistics in Support of Risk Assessment of Contaminated Sites: Making Sense of Nondetects**
Dennis Helsel, Ph.D., Practical Stats
Location: Room 200B

Measurements of trace chemicals in environmental media (water, air, soils, biota) frequently result in values reported only as less than the laboratory's reporting limit ("less-thans", "nondetects", and "qualified values"). The most commonly-used method for statistical analysis of data with nondetects is to substitute one-half the reporting limit and continue as usual. Substitution obscures patterns and trends that are present, or creates those that are alien to the original data. Several examples will illustrate the potential errors.

Two alternate and fairly familiar methods that avoid the problems with substitution will be discussed in detail. The objective is to produce descriptive statistics, perform hypothesis tests, and compute regression models for data with nondetects. More complex procedures from the field of survival analysis will also be introduced. These procedures explicitly handle data with multiple detection limits and 'qualified values' between detection and quantitation limits, without substitution. This workshop is based on the forthcoming second edition of Dennis Helsel’s textbook "Statistics for Censored Environmental Data" (formerly called "Nondetects and Data Analysis"), published by Wiley.

**Ecological Risk Assessment Guidance for Federal Contaminated Sites**
Ute Pott, Senior Program Scientist, P&Y Environmental Protection Operations Directorate, Environmental Stewardship Branch, Environment Canada
Al Hodaly, Senior Program Scientist, P&Y Environmental Protection Operations Directorate, Environmental Stewardship Branch, Environment Canada
Location: Room 201A

This course will provide participants with detailed information on how to conduct ecological risk assessments on federal contaminated sites that meet the requirements of Expert Support and the Tool for Risk Assessment Validation. Participants should have a basic understanding of ecological risk assessments.

The Federal Contaminated Sites Action Plan (FCSAP) provides funding to federal custodians to assist with the management of human health and ecological risks associated with contaminated sites under their control. Ecological risk assessments (ERAs) are often relied on in the management of FCSAP-funded contaminated sites. The FCSAP Ecological Risk Assessment Focus Group is developing comprehensive ERA guidance to support federal custodians and their consultants when conducting ERAs on federal contaminated sites.

This training course highlights FCSAP risk assessment guidance for the four main elements of risk assessment: problem formulation, exposure assessment, effects assessment and risk characterization. Emphasis is on planning the ERA and characterizing risk using a weight of evidence approach. This course is intended to build on the participants’ basic understanding of ERAs by outlining FCSAP Expert Support expectations and requirements for ERAs on federal contaminated sites. ERA practices that are recommended to meet the requirements of the new Tool for Risk Assessment Validation (TRAV) are also discussed. Participants have an opportunity to apply the FCSAP ERA guidance to several case study scenarios.

**Port Hope Site Tour**
The Port Hope Area contains approximately 1.6 million cubic metres of Canada's historic low level radiation waste (LLRW) consisting primarily of soil contaminated with early waste material dating back to the 1930s. The LLRW was generated from a radium refinery located in Port Hope which extracted radium from pitchblende ores for medical and industrial applications. Consolidated LLRW is stored in several licensed and unlicensed interim storage locations in the area, pending the long-term management solution. This guided tour will start in Toronto and head to the Port Hope Area Initiative (PHAI) Management Office in Port Hope where an overview of the project will be presented. From there, the group will start on a tour of the Port Hope waste sites starting at the Harbour and ending at the Welcome Waste Management facility, the site of its long term resting place. After lunch, the group will head to Port Granby to visit the Port Granby Waste Management Facility.
An Introduction to the Selection of Appropriate Environmental Quality Guidelines in Canada - Overview of Environmental Quality Guidelines in Canada
Chris Allaway, National Guidelines and Standards Office, Environment Canada
Location: Room 200A

The selection of the “right” environmental quality guidelines (EQGs) can have a significant impact on the management of federal contaminated sites. It will directly affect the overall remedial approach/technology and more importantly the cost associated with future work, divestiture considerations, or due diligent management responsibilities.

The purpose of this session will be to briefly present an overview of the federal framework surrounding the creation and applicability of EQGs for both soils and water (surface and groundwater) for all land uses. There will be an emphasis on the derivation of the three typical tiers (Tier I, II, and III) for the various guidelines and standards, their use and restrictions, their applicability and recent trends/updates. The workshop will also briefly discuss provincial guidelines and their application/use on federal lands in comparison to the suite of federal EQGs, legal implications, and challenges faced by federal custodians and their consultants in working under both jurisdictions.

- Guidelines, Standards, Criteria – What are they? Where do they come from?
- The authors and mandate of the various applicable guidelines, standards and criteria.
- An overview of the key guidelines (Federal and an overview of available provincial/territorial).

Environmental Due Diligence and Reasonable Care in the Context of Federal Contaminated Sites
Heather Goudreau, Counsel, Legal Services, Public Works and Government Services Canada
Donna S.K. Shier, Partner, Certified Environmental Law Specialist, Willms & Shier Environmental Lawyers LLP
Nick Monteiro, A/Program Manager, Northern Contaminated Sites Program, Aboriginal Affairs and Northern Development Canada
Chris Ludwig, M.Eng, P.Eng., PMP, Principal, Franz Environmental Inc.
Jean Rheume, Legal Advisor, Environmental Law, Department of National Defence
Clayton Truax, A/National Manager, Environmental Services Directorate, Public Works and Government Services Canada
Location: Room 200C

We see and use the term due diligence on a daily basis, but what does it really mean? Why is it important? And how does it affect each and every different sector?

The term due diligence is somewhat ambiguous, but could be defined as the steps a person or organization should be taking to protect themselves, legally. The exact description of what due diligence is required will depend on the situation, but it may include keeping records of certain actions or decisions; or gathering and analyzing certain information. In the environmental field, this may mean, for example, taking reasonable care to prevent releases of hazardous substances, and documenting the steps that have been taken towards such prevention. But how do you know what steps you should be taking? And how should these steps be documented?

This half-day professional development session will focus on the legal requirements for conducting proper environmental due diligence. The panel format will include presentations and open discussion on: what you need to be doing, what you should be doing, and what you need to be keeping, for how long, and why? The expertise from the diverse panel of experts including legal counsel and environmental advisors will combine to provide you with the tools and tips you need to make the correct decisions regarding due diligence in your day to day work.

Project Cost Estimation and Cost Management
Gino Dalla Coletta, M.Sc., MPM, P.Geo., Hydrogeologist-Project Manager and Associate, Golder Associates Ltd.
Tim F. Whalen, M.A.Sc., P.Eng., Senior Environmental Engineer and Principal, Golder Associates Ltd.
Eric Wilson, P.Eng., PMP, Senior Environmental Engineer and Project Manager, Golder Associates Ltd.
Location: Room 201C

This half-day workshop delivered by Public Works and Government Services Canada (PWGSC) will address the related topic of project cost estimation. PWGSC has developed several project management (PM) tools applicable to federal contaminated site management, including Project Cost Management Guidance for Federal Contaminated Site Remediation/Risk Management Projects, based on the Project Management Institute’s Project Management Body of Knowledge (PMBoK). During the course of this training session, project managers will enhance their understanding of the Cost Knowledge Area as defined by the PMBoK (including Earned Value Management) and develop a consolidated understanding of remediation project cost management within the federal context.
Half Day Sessions (Afternoon): 1:00 pm – 4:30 pm

An Introduction to the Selection of Appropriate Environmental Quality Guidelines in Canada - Selection of Applicable Environmental Quality Guidelines for Managing Federal Contaminated Sites in Canada
Jane Yaraskavitch, M.Eng., P.Eng., Senior Associate, Stantec Consulting Ltd.
G. Mark Richardson, Ph.D., Senior Risk Assessment Specialist, Stantec Consulting Ltd.
Location: Room 200A

The selection of the “right” environmental quality guidelines (EQGs) can have a significant impact on the management of federal contaminated sites. It will directly affect the overall remedial approach/technology and more importantly the cost associated with future work, divestiture considerations, or due diligent management responsibilities.

The purpose of this session will be to review the most common considerations related to the selection of EQGs including:

- TB Policies
- Human and Ecological Health Risk
- Real Property
- Stakeholders
- Federal 10-steps process

This session will also contain group exercises evolving different role playing as various stakeholders in contaminated sites projects (contaminated site manager, federal regulators, provincial regulator, property owner, potential buyer, consultants and communities).

Tool for Risk Assessment Validation and Site Closure Tool
Chris Ludwig, M.Eng., P.Eng., PMP, Principal, Franz Environmental Inc.
Location: Room 200C

Public Works and Government Services Canada and the Federal Contaminated Sites Action Plan (FCSAP) Secretariat at Environment Canada, supported by the science-based Expert Support Departments (Health Canada, Environment Canada, and Fisheries and Oceans Canada), have developed a tool for site closure to provide a consistent federal approach. Environment Canada, in its Expert Support role, has developed a supporting tool to validate risk assessments conducted at federal contaminated sites where remediation and/or risk management activities are being undertaken. The intent of these spreadsheet based tools and associated guidance will be to assist federal custodians in providing quality assurance as the project progresses, ultimately culminating in the demonstration and the documentation that no further action is required at a federal site. This professional development session will provide delegates with a detailed understanding of the Tool for Risk Assessment Validation (TRAV) and the Site Closure Tool (SCT) within FCSAP.

Framework for Addressing and Managing Aquatic Contaminated Sites Under the Federal Contaminated Sites Action Plan
Lee Nikl, Golder Associates Ltd.
Gary Lawrence, Golder Associates Ltd.
Location: Room 201C

Contaminated site management in the Federal Contaminated Sites Action Plan (FCSAP) program has historically followed the guidance provided in the Contaminated Sites Management Working Group (CSMWG) ‘Federal approach to contaminated sites’. Although the ‘Approach’ has proven to be an effective management tool for terrestrial contaminated sites, it lacked specific guidance on addressing contaminated aquatic sites and sediments. In order to address some of these guidance gaps, a risk-based framework for the adaptive management of contaminated aquatic sites was developed by the Aquatic Site Working Group (ASWG) for use by FCSAP practitioners. The ‘Framework for Addressing and Managing Aquatic Contaminated Sites’ reflects the 10 steps employed by the ‘Approach’ and incorporates weight-of-evidence (WOE) guidance for assessing contaminated sediment. The Framework is designed to be sufficiently prescriptive to standardize the decision-making process of aquatic sites while still allowing for necessary site-specific flexibility.

This half-day professional development course will present an overview of the Aquatic Sites Framework document and provide participants with the opportunity to complete a practical exercise in weight-of-evidence based decision-making using a contaminated aquatic site case study.
Aboriginal Cultural Awareness from the Contaminated Site Perspective
Terry Bernhardt, Senior Manager of Aboriginal Business, Golder Associates Ltd.
Location: Room 201B

This professional development session on Aboriginal Cultural Awareness is targeted at managers whose projects include Aboriginal stakeholders. It will start with a background to enable the participant to understand how impacts of disease, residential schools, 60’s scoops and other events in the recent past have shaped the Aboriginal people’s perspective. It will describe the significance of land and water in the indigenous worldview and the impact of contaminated sites on Aboriginals and their use of the land and water.

Aboriginal approaches for conflict resolution, consensus building and understanding will be shared with the participants. Suggestions on how to engage First Nations communities at key phases and aspects of Contaminated Site work such as Remedial Options Selection, Activity Planning and Implementation will be made. If space and numbers permit, the trainees will have the opportunity to participate in the Circle Process for sharing insight, and information.
Tuesday, May 1, 2012

OPENING KEYNOTE

9:30 am – 10:00 am
Building Research Partnerships – Closing the Knowledge Gap Through Collaboration
Ballroom B

Informed risk assessment is based on the identification and resolution of knowledge gaps that create uncertainty and undermine confidence in science-based public policy. In Canada, significant research initiatives have evolved in order to address the generation of new knowledge, including the national Centres of Excellence program and the NSERC Research Partnerships Program, to name just two. Successful research partnerships depend on an effective and efficient governance structure, a spirit of collaboration between government regulatory authorities and those who are the subject of regulation, development of a transparent approach to identification and agreement of high priority knowledge gaps and sustained scientific excellence to support the evolution of science-based public policy. The (Human) Metals in the Environment Strategic Network, a NSERC supported national research network that operated between 1999 and 2010, is an excellent example of one of Canada’s most visible and effective research partnerships. Its mandate, approach, governance and successes and failures will be presented.

Dr. Leonard Ritter, Professor Emeritus of Toxicology, School of Environmental Sciences, University of Guelph

Dr. Leonard Ritter is Professor Emeritus of Toxicology in the School of Environmental Sciences at the University of Guelph in Ontario, Canada. In addition, Leonard also served as Executive Director of the Canadian Network of Toxicology Centres and Coordinator of the Metals in the Human Environment Strategic Network. Leonard has extensive experience in the regulatory toxicology of a broad range of environmental chemicals; domestic, agricultural and industrial use pesticides; and the safety of food residues. He serves as an expert advisor to the Joint Expert Committee on Food Additives of the World Health Organization and has participated in various boards and expert panels, including those organized by the Royal Society of Canada, Canada’s Pest Management Regulatory Agency, Health Canada, the National Cancer Institute of Canada, the U.S. National Academy of Sciences, the US EPA and the World Trade Organization. Leonard served as Chair of the Council of Canadian Academies’ Expert Panel on the Integrated Toxicity Testing of Pesticides, a member of Health Canada’s Health and Environment Experts Group of the Canadian Longitudinal Study on Aging and a member of the Organizing Committee of the Joint ICCA-LRI and Health Canada Workshop on Advancing Exposure Science to Improve Chemical Safety.

Leonard holds a B.Sc. (Hons) in Biology and Biochemistry from Sir George Williams University in Montreal, Quebec, Canada and a Ph.D. in Biochemistry from Queen’s University, Kingston, Ontario, Canada. Leonard is a Fellow of the Academy of Toxicological Sciences and, in 2006, was awarded a medal by the UN World Health Organization in recognition of his contributions. Between 1977 and 1993, Leonard served as Chief of the Pesticides Division, Chief of the Product Safety Division and as Director of the Bureau of Veterinary Drugs at Health Canada prior to taking up his responsibilities as Executive Director of the Canadian Network of Toxicology Centres and Professor of Toxicology at the University of Guelph in 1993. He has been involved in research and regulatory toxicology for almost 35 years.
10:30 am – 11:00 am  
**Work In Progress – An Update on the Goose Bay Remediation Project**  
Craig Wells, Department of National Defence

The Department of National Defence (DND) is currently managing over 100 suspected and confirmed contaminated areas at 5 Wing Goose Bay (located in central Labrador) and has undertaken a comprehensive remediation effort to reduce or eliminate the potential risks posed by the contamination.

Contamination at the Base can be attributed to several sources. Major hydrocarbon plumes can be attributed to leaking underground and aboveground tanks, leaking or ruptured pipelines, and historical management and containment practices. Heavy metals and other chemical contamination (i.e., PCBs, VOCs) are due to historical site activities and past waste disposal practices.

DND has taken a holistic management approach to develop and implement a comprehensive, multi-phase remedial action plan. Instead of independently assessing each contaminated site, DND is collectively considering all the sites to achieve an overall evaluation and to consider interrelated requirements between the sites. The overall objective is to assess and prioritize all the contaminated sites at 5 Wing Goose Bay and pursue combined remedial objectives and/or risk management strategies for all contaminated areas, through ten sub-projects. DND has worked closely with regulatory agencies to develop remedial objectives for the various sites, and to date has implemented five of the ten sub-projects. Despite numerous challenges, technical and otherwise, the project continues to follow its original scope, schedule and budget.

The Goose Bay Remediation Project has been part of the RPIC Federal Contaminated Sites National Workshop agenda since 2008. This biennial event provides a unique opportunity to document the progress of, and present an update on, this large, complex project after five years of assessment work and three years of federal approvals to implement the remedial action plan. The presentation will also look ahead to where the project is going and highlight many of the innovative approaches to managing issues and the challenges faced by DND on the planning and execution of a large-scale remediation project in a remote area.

11:00 am – 11:30 am  
**Key Lessons Learned – DND DEW Line Clean Up**  
David Eagles, Department of National Defence

The Department of National Defence (DND) started their first site visits in 1989 to determine what remediation was required for their 21 DEW Line sites that were about to be closed down in the next few years. Actual remediation and construction on site started in 1996 and the project costs have grown to the current estimate of $575M. During these many years working in the Arctic, we have captured and analysed our successes and failures and are working on producing a database of the hundreds of recorded lessons learned (LL) that will be usable for other major environmental and Arctic projects. The aim of the presentation would be to highlight the top five major LL in the categories of government programs and policy, project management, contract management, and technical.

11:30 am – 12:00 pm  
**10 Years of Planning, Design and Reclamation: CBDC Mine Site Closure Program**  
Eric Parsons¹, Belinda Campbell¹, Robert MacDonald²

¹Public Works and Government Services Canada  
²Enterprise Cape Breton Corporation

Cape Breton coal made Canadian history when the first commercial coal mines in the country opened at Port Morien in 1720. Coal mining activities continued over the years under several owners. In 1928, a new holding and operating company was formed called Dominion Coal and Steel Company (DOSCO). DOSCO operated the mines for the next 30 years. By 1966, DOSCO estimated that the mines had 15 years of life remaining. It concluded that it would cost too much money to develop any new mines so it went to Ottawa indicating that it wanted out of the coal mining business in Cape Breton. A Royal Commission recommended setting up a crown corporation to acquire and manage DOSCO’s coal operations. On July 7, 1967 Cape Breton Development Corporation (CBDC) was established to phase out coal and find new employment opportunities. In 1968 coalmines owned by DOSCO were expropriated by CBDC. Coal mining did continue with the Oil Embargo of the mid-1970’s prompting further exploration of the coal resources in the Sydney Coal Field, however in later years a drop in coal prices made it difficult to be profitable. In 2001, the last mine closed operation.
The long history of coal mining in Cape Breton resulted in a large number of closed mines requiring rehabilitation. When many of these mines operated there were no environmental regulations and guidelines associated with the development and operation of these sites. The outcome of these activities was hundreds of hectares of environmentally impacted lands. In 2001, CBDC engaged the Canadian government common service provider, Public Works and Government Services Canada (PWGSC) to aid in the planning and implementation of the CBDC Mine Site Closure Program, which involved over 700 properties in 35 communities. As of January 1, 2010 the assets and liabilities of the Cape Breton Development Corporation (CBDC) were transferred to Enterprise Cape Breton Corporation (ECBC) and CBDC dissolved as a corporation.

The former mine site closure program is on schedule and budget with major projects to be completed by March 31, 2012. To date over 150 million dollars have been spent on remediation, planning, design, construction and monitoring activities. The initial schedule for the project was 20 years; however at the request of CBDC, the schedule was reduced from 20 to 10 years. This was a significant shift in the project scope. With this type of scope change the project team had to develop program specific assessment, guidance, planning, contracting and communications tools and approaches to support the program team.

This presentation will discuss the magnitude of program; tools and approaches that were developed to manage the program including expectations of CBDC and the local community.

1:30 pm – 2:00 pm
The Colomac Mine Remediation Project – Final Remediation to Post-Closure
Ron Breadmore1 and Giselle Cotta2
1Aboriginal Affairs and Northern Development Canada
2Public Works and Government Services Canada

The Colomac Mine is a former gold mine located approximately 220 km north of Yellowknife, Northwest Territories (NWT). The mine was commissioned in 1990 with sporadic production until late 1997, when the mine’s last owner, Royal Oak Mines Inc., placed the mine into care and maintenance. In April 1999, Royal Oak went into receivership and the site reverted to Aboriginal Affairs and Northern Development Canada (AANDC). Colomac’s relatively short mine life left a significant scar on the local landscape.

At abandonment, the site presented significant legacy issues including: cyanide contaminated tailings water and solids; hydrocarbon impacted soil, bedrock and lake sediments; extensive inventories of waste; petroleum, oils, and lubricants (POL) and hazardous chemicals; abandoned mine infrastructure; open pits; waste rock dumps; and, quarries. The most pressing issue was the management of contaminated tailings water which, by the end of 1998, was threatening to overtop the main water retention structure, Dam 1. Due to poor construction and absence of asbuilt drawings the effective elevation of the dam was confirmed at mine closure to be one metre less than the freeboard limit specified in the water licence. This coupled with the rapid rise in Tailings Lake water levels in 1998, made water management critical and emergency measures were invoked under the NWT Waters Act. The measures allowed for the transfer of millions of cubic metres of contaminated tailings from Tailings Lake to the Zone 2.0 Pit for storage and treatment. Added to this was the fact that Dam 1 had been constructed on a major fault and seepage rates began to increase dramatically towards mine closure, to approximately 250 US GPM. The seepage contained elevated concentrations of cyanide and ammonia which required continuous pump back to Tailings Lake to prevent adverse impacts to downstream environments. Following the successful water management effort, remedial efforts shifted to the treatment of the highly toxic tailings water in Tailings Lake and the Zone 2.0 Pit. Through the enhanced natural removal process (simple addition of phosphorus via fertilizer) water treatment in Tailings Lake and the Zone 2.0 Pit was completed by 2007. With water management and treatment under control, the remedial focus shifted to hydrocarbon remediation in 2005, with the demolition of the bulk tank farm, excavation and treatment of contaminated soils, construction of a bio-remediation facility and recovery of free product from bedrock. Final remediation of the site commenced in 2010 and included a major demolition and decontamination program for mine infrastructure and major civil works for the remediation of Steeves Lake shoreline and restoration of original drainage and fish passage.

This presentation provides a brief overview of AANDC’s management of the Colomac site over approximately twelve years; from emergency care and maintenance to remediation planning and execution. The primary focus of the presentation will be on the final remediation program completed over the past two years and the transitioning from a remedial to sustainable post-closure phase. The strong partnership between AANDC and the Tlicho people, as well as the application of traditional knowledge, good science and sound engineering throughout all phases of the project, will also be highlighted.
2:00 pm – 2:30 pm

Project Status of the Port Hope Area Initiative - Port Hope Project: Canada’s Largest Low-Level Radioactive Waste Clean-up Project – 2011-2021

Walter van Veen¹, Glenn Case¹ and Tim Palmeter²
¹Atomic Energy of Canada Limited
²Public Works and Government Services Canada

The Port Hope Area Initiative (PHAI) involves the cleanup of the by-product of uranium and radium ore processing activities of the former crown corporation Eldorado Nuclear Limited between 1932 and 1988. It is the largest clean up of low-level radioactive waste (LLRW) ever undertaken in Canada. The project is located in Port Hope and Clarington, two adjacent Ontario communities. The project scope includes the removal and management of an estimated 1.7 million cubic metres of contaminated material and its consolidation within two new waste management facilities, one in each community, in the form of above-ground, engineered containment mounds.

The project will include:
• Excavation of soil and debris from a number of well characterized storage sites and treatment of locally contaminated groundwater;
• Excavation and dewatering of sediment from Port Hope Harbour;
• Resurveying and excavation of soil from the alignment of a former wastewater discharge line from a waste storage site;
• Resurveying of 4,500 private properties, mostly family dwellings, and, if necessary, removal of materials from properties not meeting radiological clean-up criteria;
• Construction of two long-term waste management facilities (LTWMFs) with multi-layered engineered base liners and caps, and two waste water treatment plants (WWTPs), in each of Port Hope and Port Granby; and,
• Operation of the LTWMFs and WWTPs in perpetuity.

The PHAI is sponsored by the Government of Canada, under the federal historic liabilities management program which is the responsibility of Natural Resources Canada (NRCan). The PHAI Management Office, consisting of Atomic Energy of Canada Limited, Public Works and Government Services Canada and NRCan staff, was established to perform the majority of Canada’s obligations for the clean up.

The terms of reference for the PHAI are set out in a legal agreement signed in 2001 between the Government of Canada and the host municipalities. The legal agreement outlines a three-phased approach for the implementation of the PHAI:
• Phase 1 - planning and regulatory approvals;
• Phase 2 - remediation and construction; and,
• Phase 3 - long-term monitoring and maintenance.

Within the new project execution framework established in 2008 was the introduction of Phase 1A. This phase was initiated to transition the PHAI from planning to the execution stage, within which final regulatory approvals will be sought and detailed designs and cost estimates for Phase 2 activities completed. The Project is currently completing Phase 1A and will begin Phase 2 activities starting 2012.

This presentation will illustrate the status of the Port Hope project (which comprises approximately 70% of the Port Hope Area Initiative) to date in terms of designs completed and regulatory approvals received or in progress and set out the scope and schedule for the remediation and construction work scheduled to begin in early 2012.

2:30 pm – 3:00 pm

Challenges of Phased Sediment Remediation at Esquimalt Graving Dock, Vancouver Island, British Columbia

Tom Wang¹, Andrew Mylly² and Dan Berlin¹
¹Anchor QEA, LLC
²Public Works and Government Services Canada

The Esquimalt Graving Dock (EGD) is located on federal Crown-owned property in Esquimalt Harbour on Vancouver Island, British Columbia, and is managed by the federal custodian Public Works and Government Services Canada (PWGSC). The EGD facility and Esquimalt Harbour have a long history of naval and industrial activity both within the Harbour and in the uplands along the shoreline. Industrial activities have existed since the 1850’s and include sawmills, log storage, shipbuilding, and ship repair. The EGD facility has been operating for the repair and maintenance of military and civilian ships since July 1, 1927, and is the largest solid-bottom commercial drydock on the West Coast of the Americas, measuring 357 meters long by 38 meters wide. Historic contamination includes a broad range of chemicals, such as metals, PCBs, TBT, PAHs.

PWGSC has contemplated a governance change of the EGD waterlot and property. In support of a potential governance change, PWGSC initiated remedial investigation of contaminated sediment within the waterlot, and developed an updated remedial action plan/risk management plan for the site. EGD waterlot remediation faces many challenges, including policy, technical, operational, timing, and procurement strategy issues.
The wetland remediation is considered an early action, because the Esquimalt Harbour-wide risk assessment and establishment of cleanup levels has not been completed. In addition, significant sediment contamination is located under an existing South Jetty, a structure that PWGSC has identified as needing replacement, but there is currently no funding confirmed. Therefore, early action cleanup of accessible open water areas will occur in a first phase of cleanup, plus installation of a sheetpile wall barrier around the perimeter of the South Jetty to prevent future recontamination of cleaned up areas in the wetland between cleanup phases. A second phase of cleanup to address the contaminated sediments underneath the South Jetty would take place in combination with the South Jetty replacement project, which may not occur for many years. The uncertainty of the timing for implementing the second phase of cleanup affects many aspects of the project including remedial action planning, design, regulatory, operational, and project management.

This presentation will discuss many of the critical challenges that have been addressed by PWGSC and the EGD Design Team during remedial design, including: PWGSC risk management of residual contaminants, PWGSC and Department of National Defence coordination, recontamination potential, operational impacts, sheetpile wall barrier design and propwash inputs, and disposal considerations. The presentation will also discuss how the uncertainty of timing to conduct the second phase of cleanup affected planning, design, regulatory, operational, and project management aspects. A brief overview of key regulatory drivers and anticipated construction elements will be provided.

3:30 pm – 4:00 pm
Phase I Environmental Site Assessment at Canadian Forces Base Esquimalt, Victoria, British Columbia
Corey G. Miller1, David Kettlewell1, Jeff Nyman2, Duane Freeman3, Rae-Ann Sharp4
1SNC-Lavalin Inc.
2SLR Consulting (Canada) Ltd.
3Department of National Defence
4Public Works and Government Services Canada

Canadian Forces Base (CFB) Esquimalt is located just west of Victoria, British Columbia and is home to the Canadian Pacific Naval Fleet. First established as a military installation by the Royal Navy in 1855 with the erection of a small naval hospital, CFB Esquimalt now encompasses 5,000 hectares of British Columbia at over 23 sites ranging from Masset to Matsqui and contains approximately 1,500 buildings. The Dockyard, Yarrows and Naden properties of CFB Esquimalt have a history of industrial use that dates back almost to the establishment of the Royal Navy facilities in 1855. Historical activities associated with the construction, maintenance and repair of naval vessels include blacksmithing, coal storage, waste incineration, machining, petroleum hydrocarbon fuel storage, sandblasting, painting, electroplating, explosives storage, solid waste disposal and bulk handling of solid and liquid hazardous wastes.

Dozens of environmental investigations have been undertaken at the Dockyard, Yarrows and Naden properties since the beginning of the “environmental age” in the early 1980s. While a few investigations have looked at the Dockyard, Yarrows and Naden properties as a whole, most investigations, even at the Phase I ESA level, have been focused on small specific areas of the three main CFB Esquimalt properties. While an extensive library of environmental investigations has been amassed, the current environmental managers at CFB Esquimalt were lacking a comprehensive and up-to-date picture of environmental conditions at the base.

In 2011, SNC-Lavalin Inc., Environment Division, and SLR Consulting (Canada) Ltd. collaborated on a Phase I ESA at the Dockyard, Yarrows and Naden properties. The Phase I ESA is to be used by the site managers as an administrative tool to collect information on the level of investigation across these large and complex properties. While previous environmental investigations may have been conducted under very different regulatory regimes, with varying standards and guidelines, the current Phase I ESA served to assess conditions with current environmental practices and legislation in mind. Every site was re-assessed to determine if the available information identified it as an area of potential concern, an area of concern or a risk managed area. A comprehensive GIS system is also being established to allow for real-time review of existing data and reports for the site. This approach will allow environmental managers at the Department of National Defence to prioritize future investigation and remediation works at CFB Esquimalt’s Dockyard, Yarrows and Naden properties.

4:00 pm – 4:30 pm
Managing Program and Project Requirements During Sediment Stabilization at the Sydney Tar Ponds
Jerome MacNeil1, Diane Ingraham1, Shouvik Gangopadhyay2, Vincent Van Zutphen2
1Sydney Tar Ponds Agency
2Nordlys LLP

Solidification and stabilization of contaminated sediments are underway at the Sydney Tar Ponds site, which is located within a tidal estuary. The remediation, conducted in three phases, allows for drainage of sections of the ponds to create an environment conducive for treatment. The construction of a new channel, within portions of the ponds that have undergone treatment, is also conducted in phases to allow for effective water management and flow. Over and above the regular concerns of a remediation site (such as meeting treatment goals), management of this project requires thorough integration between program and project managers to ensure synchronization between water management, treatment,
channel construction and infrastructure development, as conducted by multiple contractors. The various projects are performed in close quarters with limited access, sometimes within overlapping boundaries. Special attention is required to properly time the commissioning of phases of the newly constructed channel and decommissioning of infrastructure created to facilitate treatment. Other programmatic considerations include surface water runoff management, design criteria for future development at the site, frost protection and environmental concerns that overlap between multiple contractors. At the project level, careful planning of tasks is required to fulfill programmatic requirements while simultaneously managing milestones for specific activities such as treatment completion and channel construction within each phase.

For decision making at the programmatic level, systems are constantly being developed and improved to rapidly provide the necessary information. The site has been divided into small sub-areas for obtaining clearances for hand-off between contractors. Workflow patterns are modified dynamically for flexibility in decision-making across multiple projects, and tasks outside of the critical path are prioritized to ensure programmatic integration. Access patterns on site are constantly re-developed to handle changes in site characteristics as progressive treatment shrinks the zone of contamination. Access is an important consideration ensuring implementation of activities to manage all of the programmatic requirements. Thus, demarcations between clean zones and contaminated zones (including access roads) are re-established, sometimes daily, based on on-going tasks, allowing for simultaneous activity across multiple projects on site.

Careful planning of these details resulted in successful completion of the first two phases of the project. The refinement of processes and the solutions developed from each phase are carried forward to the next phase, for further streamlining of processes and early mitigation of potential hurdles. As new challenges are experienced, on-going coordination between the program and project levels ensures that decisions made to tackle new issues or variations of old issues take into consideration the “big picture”. This process will ensure a successful completion of the project and restoration of this contaminated site for beneficial use in the near future.

4:30 pm – 5:00 pm

Development of Risk-Based Sediment Remedial Objectives for Petroleum Hydrocarbon Contaminated Sediments at Coastal Marine Sites in Canada

Doug Bright1, Norm Healey2, Scott Moseley3, Dedar Boparai3

1Hemmera
2Azimuth Consulting Group Inc.
3Fisheries and Oceans Canada

Chronic and small scale to periodic accidental large-scale petroleum hydrocarbon spills occur worldwide in virtually all harbours, ports, and various other coastal ecosystems. Storm water discharges may be an important source to adjacent sediments, for example. The development of Canada-Wide Standards (CWS) for Petroleum Hydrocarbons (PHCs) has provided a basis for managing the ecological and human risks from PHC releases to Canadian soil ecosystems. There are currently no credible risk-based environmental quality guidelines for marine or freshwater sediments in any jurisdiction worldwide, however, other than site-specific risk management objectives that have been developed for sediments at some sites of larger scale petroleum product releases. The available scientific knowledge suggests an appreciable potential for toxicological risks to sediment-associated biota from PHC sediment contamination from baseline (nonpolar narcosis) and other types of toxicity, and that managing risks based on concentrations of individual mono-aromatics (BTEX) or unsubstituted polycyclic aromatics may not adequately address all compounds or modes of action that are of concern. There is significant current interest in the development PHC sediment risk management objectives worldwide, including in Australia, various United States jurisdictions, Atlantic Canada and British Columbia. We describe initial attempts on behalf of Fisheries and Oceans Canada, Pacific Region, Small Craft Harbours to develop risk-base PHC sediment objectives to assist with multiple site assessments and the overall Risk-Based Strategy for site management. We show how theoretical approaches based on equilibrium partitioning and/or non-polar narcosis will invariably lead to risk-based sediment thresholds that are far lower than achievable method detection limits for PHC CWS fractions, and lower than background sediment concentrations. Expectations are discussed regarding background and geochemically enhanced concentrations of biogenic versus petrogenic compounds that would be quantified using the PHC CWS or BC Ministry of Environment method. We provide a status update on various efforts to define acceptable thresholds for various PHC fractions, surrogates, or individual compounds based on current research. Finally, we provide recommendations for dealing with PHC sediment contamination in the interim.
10:30 am – 11:00 am

**Development and Field Trials of a New 100% Soluble Carbon-Iron Product for In-situ Remediation of Groundwater**

Kerry Bolanos-Shaw, Dr. Alan Seech, Andrzej Przepiora, and Dr. Steve Koenigsberg

The Adventus Group

Adventus’ EHC® product has been effectively used on hundreds of sites worldwide for reductive treatment of chloroethenes, chloroethanes, carbon tetrachloride and daughter compounds, and pesticides in groundwater. It consists of a combination of solid, plant-based carbon powder and fine zero valent iron (ZVI). The product is slurried and injected into the impacted groundwater plume to create ideal conditions for reductive dechlorination. As the carbon ferments, soluble volatile fatty acids (VFAs) are released to the groundwater to provide the preferred carbon source (i.e., VFAs) for indigenous dehalogenating microorganisms. The ZVI provides a reactive surface for abiotic dechlorination and releases soluble iron (Fe²⁺) which later precipitates to form additional reactive mineral surfaces downgradient from the injection zone. In combination, the VFAs and ZVI create very strong, stable reducing conditions which make dechlorination reactions more energetically feasible.

EHC is highly effective, but as a solid there can be limitations to its applicability at some sites with very tight formations or existing permanent well systems. EHC-L® was developed to address these limitations. Like EHC, EHC-L is based on a combination of slow-release fermentable carbon and iron. The difference is that EHC-L is 100% cold-water soluble. Following extensive research and development work in our laboratory, we identified an optimum combination of lecithin, which is very slowly metabolized, and a specialized ferrous salt that is protected from rapid oxidation. Lecithin vesicles that form upon emulsification provide further protection to the ferrous iron to ensure oxidation does not occur until after the product is injected, and then at a controlled rate.

Studies conducted in our laboratory indicate EHC-L supports TCE treatment efficiencies similar to those attained with EHC. Beginning in the spring of 2011, field pilot tests were initiated to obtain field data on removal efficiencies supported by EHC-L. Results from these projects and a discussion of difficulties encountered will be discussed.

11:00 am – 11:30 am

**Case Study: Innovative Use of the Membrane Interface Probe and Laser Induced Fluorescence to Direct In-situ Remediation**

Bruce Tunnicliffe, Vertex Environmental Inc.

The Membrane Interface Probe (MIP) and Laser-induced fluorescence (Laser) are powerful assessment tools that are used to provide semi-quantitative data of subsurface contamination. The MIP is used to provide information on aqueous phase contamination, the Laser to characterize petroleum hydrocarbon (PHC) source zones.

Both MIP and Laser were used prior to and during in-situ remediation of petroleum hydrocarbon (PHC) impacts at a site in central Ontario. This talk will present the pre-injection MIP and Laser results and showcase how the initial chemical oxidation design was altered based upon the MIP and Laser results. The MIP and Laser was remobilized to the site during the in-situ program, these results will also be presented to show how the altered in-situ design resulted in efficient distribution of the oxidant and good destruction of the PHCs.

11:30 am – 12:00 pm

**Ex-situ Soil Washing – Achieving Effective Mass Reduction for Organic and Recalcitrant Contaminant in Soil Via the Use of a Mobile Co-solvent/Surfactant Process**

Jean Paré, Chemco Inc.

A number of organic contaminants (petroleum hydrocarbon, PCB, dioxin, furans, etc.) are entrapped as pure product (free phase) or at high concentration in the soil matrix. These highly contaminated soils are bringing challenges for an effective low cost remediation. Ex-situ soil washing offers the benefit to effectively and economically treat these high concentrations that allow for soil to be re-used or dispose at a lower cost.
The use of a co-solvent/surfactant mix to enhance the soil washing process allows for faster desorption rate and better contact between the washing fluid and the contaminant of concern thus enhancing the result obtained with this technology. The presentation will present the process development and scale-up steps for field application then it will address the limitation for applicable contaminants and geology. Results from both lab scale bench study and full-scale application of the technology will also be presented plus a description of the positive environmental and economic impacts. This allows the attendees to better understand where and how these remediation technologies can be applied with success.

1:30 pm – 2:00 pm

**Remedial Alternatives for RDX and Other Explosives in Soil and Groundwater**

Dr. Ronnie Britto, Joel Nolin, Rick Arnseth
Tetra Tech Inc.

Organic explosives are commonly found in soil and groundwater at ammunition manufacturing, testing and storage plants in North America. The most common types of explosives are TNT, RDX, and DNTs. TNTs and DNTs are aromatic compounds, while RDX is a cyclic nitramine compound. All of these compounds exist in an oxidized state. They are amenable to reduction via either biological or chemical mechanisms. They can also be destroyed via hydrolytic techniques. Strong oxidants such as sodium persulfate can also destroy some of these explosives.

Chemical reduction of organic explosives is performed via the injection, mixing, or other means of contact with the media of concern and the chemical reductant of choice. Chemical reductants such as iron forms, manganese, and other sulfur-based reductants can be used for this purpose. Chemical oxidants such as persulfate, permanganate, hydrogen peroxide, and ozone have also been examined for the destruction of organic explosives. Biological treatment via oxidative and reductive means or in sequence have been commonly used for treatment of organic explosives. Biologically-mediated oxidation is performed with the application of air or oxygen-release compounds. Biologically-mediated reduction is performed via the addition of carbon substrates such as slow-release compost type media, synthetic compounds such as vegetable oil, or soluble carbon substrates.

Alkaline hydrolysis is a very effective destruction technology for the decontamination of organic-explosives contaminated soil. Explosives amenable to alkaline hydrolysis include RDX, TNs, and DNTs. Among these three explosives, the DNTs are the most recalcitrant. Distribution of the alkaline reagent and soil mixing to attain homogeneity are important field criteria along with the application of the appropriate field equipment to optimize the process.

The selection of the right process for organic explosives destruction depends on various factors. These include starting concentration, the media that is targeted, the physical characteristics of the location that is contaminated, the extent of contamination, the type of soil, the regulatory and risk-based cleanup goals, the geology and the hydrogeology, site geochemistry, and other site-specific factors.

Tetra Tech Inc. has performed the treatment of most of the above-described technologies on various scales at three large army ammunition plants in North America since 2004. Tetra Tech Inc. has been involved with several innovative approaches for the destruction of organic explosives. The application of these techniques to soil and groundwater from these army ammunition plants will be presented and discussed. Progression from bench-scale to pilot-scale to full-scale efforts will be presented. The field conditions and response to each of these contaminant-destruction techniques that were examined in bench-scale tests will be discussed. The description of the engineering processes that were designed and installed in the field for treatment of TNT, DNTs, and RDX will be presented. Kinetics of destruction, production and destruction of intermediate and daughter compounds will be described. Lessons learned from these applications will be discussed and applications to other sites will be examined.

2:00 pm – 2:30 pm

**Combination of Electrokinetic and Enhanced Bioremediation in a Low Permeability Soil Matrix**

Marianne Brien1, Karine Drouin2, Serge Delisle2, Sylvain Hains1, Tim Robertson1
1Golder Associates Ltd.
2National Research Council Canada, Biotechnology Research Institute

The Biotechnology Research Institute of the National Research Council of Canada, in partnership with Golder Associates Ltd., is currently developing new technology combining electrokinetics and bioremediation. Electrokinetic mechanisms are used to drive the injection of nutrients, used to support biodegradation processes, in a low permeability soil. The design and lab test phases for the system have been completed and results from these phases have identified conditions important to the proper functioning of the system. Using microcosm assays, nutrient amendments which support the aerobic biodegradation of a mixture of chlorinated and non-chlorinated contaminants have been identified. The design phase determined the number, depth, spacing and type of electrodes to be use to facilitate amendment injection in a low soil permeability zone. Other operational parameters, such as voltage and amperage of the electrokinetic module, monitoring parameters and health and safety procedures have also been determined. Pilot scale testing and validation of the system will be implemented in the fall of 2011 at a National Defence site.
Pilot Scale Study – Removal of Uranium, Radium-226 and Arsenic from Impacted Leachate by Reverse Osmosis
Allan McMurray, Ken Rilling, Chris Everest, Gary Vandergaast
Conestoga-Rovers and Associates

Introduction
Conestoga-Rovers and Associates (CRA) was retained by Atomic Energy of Canada Limited to provide a design for a full-scale treatment plant for the removal of the contaminants of concern (COCs) from impacted leachate/stormwater runoff at the Welcome Waste Management Facility (WMF); an existing low-level radioactive waste site located in Port Hope, Ontario. The COCs being: uranium (U), radium-226 (Ra-226), and arsenic (As). The effluent quality objectives include: high level of human health assurance, reduce radiological discharge to levels as low as reasonably achievable, and minimize total loading to Lake Ontario. Prior to commencing the design, CRA bench testing indicated pre-treatment of the leachate followed by reverse osmosis (RO) with the Rochem ST module is feasible. CRA performed on-site pilot testing with impacted water to: confirm design approach for the removal and concentration of radioactive waste is feasible at larger scale, demonstrate long term viability of Rochem ST modules, and determine operating envelope of the Rochem ST module. Additional objectives included cleaning frequency impact on ST module: selectivity, flux, and return to baseline performance.

Materials and Methods
On-site pilot testing was performed for three months. Pilot system comprised of independent wastewater intake and outfall systems, chemical dosing systems (mixing/storage tank, chemical metering equipment), an inclined plate clarifier, a clarifier supernatant storage tank and the Rochem RO pilot unit with sand and cartridge filtration pre-treatment. Unit contained Rochem’s ST RO modules, a spiral wound module suited for leachate processing. All treatment systems were contained in a 40 ft by 8 ft container located adjacent to the contaminated collection ponds. The RO concentrate was collected in 5,000 L storage tanks and utilized to spike the influent in order to increase influent total dissolved solids (TDS) to levels representative of predicted “worst-case” scenario of COCs concentrations. Wastewater from lagoons was pumped to the pilot system with a dedicated submersible pump. Collected samples were analyzed for COCs, chloride, sulphate, mercury, calcium, magnesium, copper, iron, silica, boron and sodium. All analysis performed by a laboratory accredited by the Canadian Association for Environmental Analytical Laboratories and approved by the Canadian Nuclear Safety Commission.

Results and Discussion
The results of pilot scale testing revealed the following:
• Removal of arsenic from 70% to 85% was achieved during preliminary chemical treatment.
• Removal of uranium and radium 226 by preliminary chemical treatment determined ineffective.
• Removal of uranium, radium 226, and arsenic observed to be 99.7%, 90%, and 99.8%, respectively, by Rochem ST module.
• Extended RO operating period by 50% with preliminary precipitation/clarification.
• Reduced organics and non ferric related suspended solids with clarifier.

Results of on-site pilot testing demonstrated the efficacy of reverse osmosis technology in removing COCs from contaminated groundwater/surface water collected from the Welcome WMF. Also, the pilot study provided operating data required in design of full-scale water treatment facility for Welcome site.

Practical Methods for the Discrimination of PAH Sources to Sediments at Fisheries and Oceans Small Craft Harbours – Creosote Inputs Versus Petroleum or Combustion Based Releases
Doug Bright1, Norm Healey2, Scott Mosely3, Dedar Boparai2
1Hemmera
2Azimuth Consulting Group Inc.
3Fisheries and Oceans Canada

Polycyclic hydrocarbons (PAHs) are among the most commonly encountered organic contaminants in freshwater and marine sediments. PAH sediment contamination, therefore, is an important driver of site assessment work and risk management decisions at many federally administered waterlot properties. Creosote-treated structures, including piling, booms, and wharves, have been installed at many foreshore and nearshore waterlot sites, and these “beneficial structures” are also a source of PAHs to the adjacent sediments within tens of centimetres to five meters or more from the structure. Several provinces and federal custodial departments recognize the limited environmental risk potential from creosote-treated beneficial use structures and make corresponding provisions in their guidance on site assessment and remediation. PAH contamination in sediment can also result from other source inputs such as new and used petroleum product releases and storm water or airborne inputs of combustion-derived PAHs. At sites where there is an ongoing source of PAHs, it is particularly important to distinguish this from creosote-derived PAHs. The ecological and human health risks from PAH sediment contamination are strongly influenced by not just the absolute concentration of individual PAHs but also by the spatial scale, composition of the mixture, and bioavailability. A minimum understanding of the PAH source input is needed, therefore. Using sediment chemistry data from federally-owned small harbours on the Pacific coast, we highlight key diagnostic...
characteristics for defining the source of PAHs to sediments, and especially for distinguishing creosote-derived PAHs from other sources. The Fisheries and Oceans Canada Small Craft Harbours Program wanted to develop guidance for site assessors on how to carry out preliminary PAH source discriminations as an aid to improving site assessment decisions and interpretations. While there are a wide variety of complex PAH source discrimination techniques that have been developed by the scientific community based on detailed chemical characterization, use of specific marker compounds (i.e., specific alkyl-PAH), and multivariate pattern analysis techniques, we needed to develop guidance for practitioners that would be less reliant on specialized analytical tests and interpretative expertise. A suggested set of simplified rules for PAH source discrimination is presented, along with an iterative approach that can be used to place PAH sediment contamination in the appropriate context.

4:00 pm – 4:30 pm
Microbial Community Sequencing as an Approach to Addressing Bioremediation Challenges in the Canadian Arctic
Charles W. Greer¹, Etienne Yergeau¹, David Juck¹, Terry Bell¹, Don Kovanen², Andrew Tam², Drew Craig²
¹National Research Council Canada, Biotechnology Research Institute
²Department of National Defence

Climate change is having some of its most profound effects in the polar regions and with increasing temperatures and the opening of the Northwest Passage, human activities in the Canadian Arctic will increase, thereby increasing the risks of accidental pollution of soil and water. Polar soils are typically characterized as nutrient poor and limited in available water. In the Canadian Arctic, the bioremediation of hydrocarbon-contaminated soils is also complicated by low temperatures, which have an impact on the availability of hydrocarbon substrates to bacteria and on the activity of the degrading bacteria. Previous studies have demonstrated that providing nutrients and increasing the soil water content has a positive influence on the hydrocarbon degradation activity of indigenous soil bacteria. A better understanding of the conditions that best affect this increased activity and of the microorganisms responding to specific treatments within this proverbial “microbial black box” will ensure that more cost-effective and timely biotreatment systems are developed to deal with inevitable environmental pollution events.

The recent explosion in the production of gene sequence information (genomics) on individual organisms as well as whole environments has a great deal of promise in dissecting the structure of bacterial communities involved in hydrocarbon degradation and will provide valuable information on which organisms are the most effective to use in this task and under which conditions they best operate. Initial sequencing results of a bioremediation project at the Canadian Forces Station Alert (CFS-Alert) demonstrated a response to hydrocarbon contamination and a response to nutrient addition, whereby Gammaproteobacteria, primarily Pseudomonas spp., showed a dramatic increase following contamination, accompanied with a decrease in overall bacterial diversity. Actinobacteria increased over time following nutrient addition, consistent with the idea that some of their members (i.e., Rhodococcus) are more efficient degraders of recalcitrant hydrocarbons, especially in harsher environments, under more nutrient limiting conditions. A variety of new genes related to known hydrocarbon degradation were also identified. These data are being used to improve the cost-effectiveness of bioremediation in cold climates and also to provide new enzymes that could be of considerable value in catalyzing reactions at low temperatures.

4:30 pm – 5:00 pm
Investigating Background Groundwater Quality at Contaminated Sites – A Hydrogeochemical Approach
Tyler Wilen, Hemmera

Often when performing groundwater investigations at contaminated sites, substances that are not considered related to the original contaminant source are detected at levels that exceed the applicable regulatory criteria. It is typically not clear if these constituents were caused by the known contaminant sources or whether they are attributable to naturally occurring or “background” conditions. Commonly, great expense is incurred to property owners to investigate naturally occurring constituents which are misinterpreted as being “contaminant” plumes. As a result, provincial governments including British Columbia have developed prescribed methods and requirements for assessing and defining background groundwater quality. However, it is still up to the property owner or environmental consultant to recognize whether or not the constituent in question is potentially naturally occurring and initiate the process. Typical regulatory approaches include installing a set number of up-gradient and/or cross-gradient groundwater wells and statistically analyzing the analytical data to define a “background” concentration for the substance. However, these methods generally do not provide a means for assessing the source and occurrence of the substance in groundwater, and whether it should be considered as part of background or naturally occurring conditions. A case study is presented where an alternative approach to establishing background concentrations in groundwater was developed for a site located in British Columbia. The evaluation started with the development of a site conceptual model, where the source of the substance was identified, followed by an analysis of the release mechanism and transport in groundwater. The approach incorporated the site geology, mineralogy, hydrogeology, and geochemistry; and was built into the existing regulatory framework that is required to demonstrate background conditions. Effectively, the approach provided a defensible scientific explanation for the natural occurrence of the substance in groundwater, and acted as an additional line of evidence to supplement the regulatory prescribed background groundwater assessment requirements. This approach can be used on any site for the purpose of determining and demonstrating whether or not a particular substance is naturally occurring or has been released due to anthropogenic activities.
10:30 am – 11:00 am


Jason Wilkins¹, Tim Sackmann² and Erin Shankie²

¹Hemmera
²Public Works and Government Services Canada

Contaminated site remediation normally ensures that hazardous chemicals released into the environment are removed and/or treated via proven remedial technologies and management practices. For federal contaminated sites, the preferred method of remediation is generally selected using a weighting system in an evaluation matrix to determine the most suitable or appropriate remedial strategy for a unique site under specific conditions. The current evaluation matrix, as documented in the Contaminated Sites Risk Management Best Practice (PWGSC, 2003) includes several evaluation criteria, including, but not limited to, technical feasibility, cost, schedule, and regulatory compliance. However, the matrix has no specific environmental or social evaluation criteria for greenhouse gas (GHG) emissions, waste generation or water consumption, which are generally referred to as green remediation indicators (GRI). To address these GRIs during the remedial options selection and evaluation process, Hemmera, in conjunction with Public Works and Government Services Canada, developed and tested a Green Remediation Evaluation Framework (the Framework).

The Framework included a detailed methodology of developing and systematically assessing site remedial activities through selecting, implementing, and evaluating GRIs. The Framework, which is implemented during the remedial options evaluation step, and can subsequently be used as a guide to track GRIs during site remediation. A pilot study was commissioned to test the Framework at a contaminated site scheduled for remediation and undergoing the remedial option evaluation phase. The results showed that applying the Framework and evaluating these GRIs had an impact on the selection of a preferred remedial technology. It was recommended that tracking of GRIs during actual site remediation be completed to verify the robustness the Framework. It was also recommended that additional pilot studies be completed under varying conditions and scenarios to further enhance the robustness and versatility of the Framework.

11:00 am – 11:30 am

Implications of Risk Assessment Methodology Changes on Contaminated Site Remediation Management Strategy

Dr. Janice Paslawski, Dr. Alexis Harvey, Deanna Cotrell, Garrett Taylor
SNC-Lavalin Inc.

Often in the absence of specific regulatory guidance, an interim management strategy will be developed on a site-specific basis for management of subsurface vapours at former petroleum facilities. An appropriate strategy is often critical to the future management of the residual contaminant at a site and must appropriately facilitate the redevelopment strategy or land management goals.

This study presents the results of a quantitative evaluation of the impacts of a regulatory environment change and the resultant potential implications to contaminated sites owners. The study considered the variation in methodology used in the generally accepted practise of evaluating risks to human health at contaminated petroleum sites within Canada.

The evaluation included the development of a risk management strategy for a contaminated site in a complicated setting where background and anomalous data exist. Development of a risk management strategy for a site in Alberta, initiated the comparison of risk assessment methodology practises in adjacent provinces. The quantitative results identify how regulatory change may have a significant implication to the risk management strategy and have a vast impact on numerous sites for the petroleum industry.

Coordination of risk assessment methodology and consistency throughout Canada is critical to the success of cost-effective and practical risk management practises in meeting with the end goal of on-going protection of human health and the environment in Canada.
11:30 am – 12:00 pm

**Odour Management for a Large Scale Sediment Remediation Project in an Urban Setting – Sydney Tar Ponds, Sydney, Nova Scotia**

Stephen Pinto, AECOM

The Sydney Tar Ponds Remediation Project is the result of nearly 100 years of steel production in Sydney, Nova Scotia. At one time, Nova Scotia produced almost 50% of Canada’s steel. When production ceased in 2001, a legacy of contaminated soils, sediments and groundwater remained, bearing such contaminants as PAHs, VOCs, PHCs, PCBs, and heavy metals. What remains today is one million tonnes of contaminated soil and sediment spread over two major sites – the North and South Tar Ponds, and the former Coke Ovens site; an area spanning 168 acres.

The primary mechanism for the clean-up is the use of solidification/stabilization (S/S) of the sediments in the Tar Ponds and the coal tar at the Coke Oven site. Approximately 700,000 tonnes of sediment and 25,000 tonnes of soil require treatment. The final design for the Tar Ponds will result in a S/S monolith, with a lined channel conveying the incoming surface and cap runoff water through the site and into Sydney Harbour.

Contaminants associated with the bi-products of steel production and in particular coking coal are potential sources of nuisance odour during construction. For example, naphthalene is a PAH compound that is highly odiferous and detectable by olfactory senses at concentrations as low as 0.08 ppm by mass. In addition, municipal sewer discharges into the Tar Ponds site occurred historically and up until approximately 2004 when wastewater infrastructure diverted the discharges to the local wastewater treatment plant. These sources of odour are present in the sediments undergoing treatment by S/S as part of the six-year remediation project.

Given the proximity of residents and off-site commercial operations to the project site, an odour management plan (OMP) was prepared and implemented. The OMP contains detailed protocols for ways and means of conducting the remediation that would reduce the odours being generated as well as mitigation methods to suppress these odours. The objective of the OMP was to reduce nuisance odours from site operations therefore reducing the impact of the project on the community.

A variety of construction methods and products are used in the mitigation of odours on site, including odour suppressing foams, Concover™, Biosolve™, project sequencing, covering stockpiles and exposed areas, and reducing the area of daily intrusive activities. This presentation will present a detailed overview of the OMP, its effectiveness to-date, and lessons learned through its implementation.

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1:30 pm – 2:00 pm

**Determination of LNAPL Mobility for Establishing Remediation Goals**

Thomas Franz¹, Farzana Islam¹, Brent Sleep², Jordan Mooers³, Craig Wells⁴

¹Franz Environmental Inc.
²University of Toronto
³Defence Construction Canada
⁴Department of National Defence

Under past federal protocols, the presence of light non-aqueous phase liquid (LNAPL) automatically resulted in high-risk scores regardless of product thickness or mobility and thus sites with LNAPL were often prioritized for action. However, recently it has been recognized that the presence of LNAPL may not automatically represent a risk to human health or the environment, especially when the LNAPL is immobile.

The mobility of LNAPL was evaluated at 5 Wing Goose Bay in order to establish remediation goals for the recovery of free product at in area where a LNAPL plume is present with an apparent thickness greater than one metre and a LNAPL volume of approximately 370,000 to 615,000 litres. The LNAPL is believed to have originated from an historic release of fuel dating back 30 years.

It is impossible to determine the mobility of LNAPL directly, and therefore, a line-of-evidence argument is required. Methodologies documented in regulatory guidance documents (American Petroleum Institute, the BC Ministry of Environment, Environment Canada) were generally followed in order to evaluate LNAPL mobility for the site-specific conditions in Goose Bay. Lines of evidence indicative of a stable LNAPL plume include: decreasing in-well LNAPL thicknesses; a decreasing LNAPL recovery rate over time; a stable or shrinking dissolved-phase plume; LNAPL soil saturation levels below residual saturation; and a LNAPL migration velocity below 10-6 cm/s. The most direct line of evidence of a stable plume would be the observation of decreasing in-well LNAPL thickness. In many cases, however, LNAPL thickness measurements are too infrequent and are influenced by groundwater table fluctuations, such that they may not be available in sufficient quantity (length of time) and/or quality. Monitoring well networks often do not have wells spaced sufficiently close to allow definite conclusions on LNAPL migration. Also, mathematical models for estimating LNAPL velocities require several model input parameters that are not easily measured. The goal of this study was to use several lines of evidence, to provide an understanding of complexities, and to develop solutions.
Boreholes were drilled through the LNAPL body to obtain samples for the determination of the soil and LNAPL parameters. Obtaining undisturbed soil cores from the LNAPL zone, soil core preservation by freezing, shipping samples into the US, and conducting pressure-saturation experiments represented significant challenges. At the Civil Engineering laboratories at University of Toronto, a test apparatus was built to perform rapid capillary pressure-saturation tests, and curve-fitting methods were employed to estimate van Genuchten and Brooks-Corey soil parameters. Modelling using the “API Interactive LNAPL Guide” was used to estimate the LNAPL migration velocity. This model uses complex relationships between permeability, LNAPL saturation, and LNAPL pressure. The model results were used to estimate the thickness at which the LNAPL plume becomes unconditionally stable; the remediation goal of reducing the LNAPL thickness to 15 to 20 cm was established.

This presentation will explain the data requirements for conducting such studies, provide experiences gained with respect to field and laboratory methods, and discuss uncertainties with the modelling methodology.

2:00 pm – 2:30 pm

**Habitat Equivalency Analysis as a Method of Determining Fish Habitat Compensation Requirements for Temporary Disruption Related to a Large Remediation Project**

Lee Nikl¹, Barbara Wernick¹, and Rae-Ann Sharp²

¹Golder Associates Ltd.
²Public Works and Government Services Canada

Public Works and Government Services Canada (PWGSC) is proposing to remediate contaminated sediment in the Esquimalt Graving Dock (EGD) Waterlot in Esquimalt, BC. The project will be conducted in phases, firstly with the installation of a temporary sheet pile wall around the perimeter of the South Jetty for erosion protection during open-water dredging of the waterlot. Following the open-water dredging the South Jetty will be dismantled, the under-jetty area remediated and the jetty reconstructed. The net result of this project sequence is the temporary alienation (loss) of fish habitat in the under-jetty area. Current approaches of addressing habitat compensation are poorly suited to this type of project because they do not appropriately reflect the temporary nature of loss and do not adequately address lost ecosystem services that occur between the time that a habitat loss occurs and services from compensatory habitat are realized.

The common approach applied to fish habitat compensation is to provide an equivalent or greater amount of habitat elsewhere, usually based on a ratio (i.e., 2:1) applied to lost surface area. This “direct” type of compensation has a long history of acceptance by Fisheries and Oceans Canada, and is almost invariably used to compensate for losses of marine intertidal, freshwater, and riparian habitats in British Columbia. It is a workable approach for most challenges of habitat management because the common scenario is one where habitat loss is permanent such as occurs from dyking or filling. An extension of this paradigm to temporary alienation of habitat would have the effect of over-compensating for the impact. For example, where a remediation project involves temporary disruptions/losses, rather than permanent losses, re-establishment of habitat form and function could occur relatively quickly following the disruption (months to a few years, depending on the habitat type involved). Impacts of this nature are commonly encountered with projects that have a remediation focus.

Habitat equivalency analysis (HEA) provides a useful framework for scaling the area required for compensatory restoration for temporary habitat disturbances. The approach provides a means to a priori determine the size of habitat that is required before the damage occurs. Depending on the site and the options available to the remediation manager, this could allow for compensatory habitat to be constructed before the damages occur. Under the typical habitat management approaches currently practiced, it is not uncommon for compensatory habitat to be constructed some time (even years) after the impact has occurred.

HEA offers value to the decision-making process in a remediation program; however, it needs to receive agency acceptance for that value to be realized. HEA utilizes methodology that has been developed in jurisdictions outside of Canada and adaptation to a Canadian policy and legal realm is therefore necessary. Similarly, some of the input parameters that HEA requires lack agreed to bio-standards but this shortcoming is no different than existing approaches. An overview of the value of HEA, along with recommendations for adapting HEA to a Canadian context and addressing scientific gaps, will be provided.
2:30 pm – 3:00 pm

Decontamination of Remote Properties by Risk Management – Use of Biological Data and Risk Analysis to Determine the Scope of Work for the Former Lighthouse at Grande-Île Project

Jean Pineault, Fisheries and Oceans Canada

Fisheries and Oceans Canada (DFO) owns several remote properties and in natural environments. Decontamination work has already been carried out according to the generic criteria approach, but this method, as well as being costly, caused significant environmental impacts. This approach is thus no longer considered.

Decontamination work at various lightstations has been carried out since fall 2005. The environmental assessment, by virtue of the Canadian Environmental Assessment Act, was used as a tool during this work to demonstrate that decontamination according to criteria results in significant environmental impacts, and that a more targeted decontamination is required (this approach was presented at the 2008 RPIC Federal Contaminated Sites National Workshop in Vancouver, BC). However the challenge of establishing the adequate scope of the remediation work, which can be problematic, remains.

The analysis of ecotoxicological risks provides essential information about the environment, however it is a highly conservative tool, poorly adapted to making decisions regarding the extent of the work. More extensive readings to reduce uncertainty in the risk analysis were considered, but did not yield the results expected, and did not allow for an acceptable scope of work to be established. Finally, the use of botanical findings would have been a better source of information in determining a level of remediation.

This presentation will describe the process carried out in the framework of the remediation of the former Grande-Île Lighthouse in Quebec. The various preparatory studies, as well as their limitations, will be presented. In conclusion, the process used to determine the scope of the work deemed satisfactory will be described.

3:30 pm – 4:00 pm

Thin Layer Capping and Long-Term Environmental Monitoring – A Design Plan, Marathon Environmental Remediation, Marathon, Ontario

Kristine Carbonneau, David G. Wilson, Carsten H. Floess

AECOM

Peninsula Harbour is a 12 km² (approximately 3,000 acres) embayment off the northern shore of Lake Superior, Canada, that was identified as an area of concern (AOC) in 1985 by the Water Quality Board of the International Joint Commission. Elevated concentrations of mercury and polychlorinated biphenyls (PCBs) in sediment and fish were identified within Jellicoe Cove in the southeastern portion of the Harbour and require active sediment management. Various sediment management options were assessed; installation of a thin layer cap (TLC) was selected as the primary active remedy by Environment Canada (EC) and the Ontario Ministry of the Environment (MOE), in consultation with the local stakeholders. The TLC, covering approximately 252,000 m² (62 acres), will include placement of approximately 15 cm of clean sand on top of previously identified mercury and PCB contaminated sediments. The construction documents and environmental assessment will be finalized in 2011; subsequently, EC and the MOE will develop an implementation schedule. The long-term monitoring program to be presented is designed to assess improvements in Jellicoe Cove sediment and biological communities following TLC construction and continued natural deposition over a 20-year period. The long-term goals are to reduce the risks associated with the contaminated sediment and restore environmental conditions in the area of concern. The sediment management project is the last remedial action required to delist Peninsula Harbour from the list of Great Lakes areas of concern. Future monitoring data collected under this program will be compared with baseline conditions from surveys performed in 2009 (benthic community, young-of-the-year [YOY] fish tissue), 2010 (fish habitat) and 2011 (benthic invertebrate tissue) as well as with data from the initial remedial investigations. The long-term monitoring program has been designed to assess: 1) the physical stability of the placed TLC; 2) fish tissue concentrations of mercury and PCBs in YOY from the Jellicoe Cove for use in the broader Peninsula Harbour fish collection program; 3) surface sediment concentrations of mercury and PCBs in the TLC and natural recovery areas within the AOC; 4) benthic community structure in the TLC and natural recovery areas within the AOC with respect to the broader Harbour; 5) benthic macroinvertebrate tissue concentrations of mercury and PCBs from the AOC with those of suitable reference areas; and, 6) temporal trends in sediment concentrations and fish and benthic macroinvertebrate tissue concentrations of mercury and PCBs in the TLC and natural recovery areas of the AOC.

This presentation will provide an overview of historical data collection on the Cove, how TLC was selected, a summary of the planned construction, and a detailed discussion of long-term monitoring data collection for both baseline and future data collection events and the long-term goals of the project.
Sustainable and Innovative Remediation of the Remote and Historic Hay Camp Abattoir and Warden Station Within Wood Buffalo National Park

Brent O’Rae, Parks Canada

Hay Camp site is located within Wood Buffalo National Park (WBNP), in the province of Alberta. The site was established in 1922 and was historically used as the centre for Park operations before the headquarters were moved to the town of Ft. Smith, NT. Site facilities during its operation included an administration cabin, a warden’s cabin, housing for park employees, an abattoir for bison, several warehouses, kitchen building, and several other support buildings. With the exception of the concrete foundations from the former abattoir, garage and lime shed, there are no buildings or structures currently located at the Hay Camp site.

The site is underlain by silt soils ranging in thickness between 2 to 4 metres (m) which is in turn underlain by varved, silty clay and clay soils to the maximum depth of investigation, 10 mbgs. The average hydraulic conductivity reported for these soils was very low.

The interpreted groundwater flow direction extends radially away in all directions from the central area of the site, with a general west to east flow direction towards the Slave River located within 200 m to the east. The groundwater gradients range between 0.01 and 0.02 m/m. The depth to groundwater generally ranges from 7 to 10 m bgs in the underlying clay unit, although seasonal groundwater levels can vary up to 3 m vertically.

Soil quality has been adversely impacted by suspected releases of heating oil and fuel hydrocarbon resulting from past operations conducted at the site. Soil impacts are manifested as elevated concentrations of petroleum hydrocarbon constituents (PHC) and polycyclic aromatic hydrocarbon (PAH) concentrations. Their concentrations in soil exceed the 2010 Alberta Tier 2 remediation criteria for the site which are based on the protection of a potable groundwater source under the natural land use category.

The aerial extent of PHC and PAH impacted soils comprise an area of approximately 11,000 m² and 24,000 m² respectively. The vertical extent of these impacts within subsoils is generally confined to a depth of between 2 to 6 m bgs across the site. The total estimated volume of impacted subsoils exceeding the Alberta Tier 2 remediation criteria is estimated at 48,000 m³.

Groundwater impacts at the site consist of elevated concentrations of various PAH constituents exceeding applicable 2009 Alberta Environment Tier 1 Groundwater Remediation Guidelines for Residential/Parkland land use and CCME Canadian Environmental Quality Guidelines for drinking water. The estimated extent of PAH groundwater impacts encompasses an area of 34,500 m², which overlaps most of the delineated soil contaminant plume.

The estimated total volume of soil that would require treatment to meet CCME criteria for both soil and groundwater impacts is approximately 55,000 m³.

In this presentation the current remedial plans will be explored, outlining the proposed activities to deal with:

- Remote settings in National Park;
- Short operating and funding timeframes;
- Limited operating budgets;
- Future land use remediation criteria;
- Anthrax contaminated soil; and,
- Magnitude and characteristics of PHCs and PAHs impacts in soil and groundwater.

Logistical challenges of dealing with the remote and complex characteristics of this historic site, as well as processes for working in a cooperative partnership with cross-jurisdictional political and third-party aboriginal stakeholder s will be highlighted, alongside with the related successes and learning experiences. Results of assessment and risk management studies at this remote site, where recent field programs overcome the challenges associated with FCSAP funding constraints and late season implementation requirements, will also be highlighted for this ecologically sensitive area.
Assessment and Remediation of a Former Unofficial Dumpsite in a National Wildlife Area

Darryl Roberts¹ and Holly Kelly²

¹Environment Canada
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The Wilmer Marsh Unit is the southernmost of the four units that make up the Columbia National Wildlife Area (NWA) in south eastern British Columbia. The area was acquired by Canadian Wildlife Service in 1973 and was designated an NWA in 1978. The Columbia NWA is a federally protected area designed to conserve wildlife and their habitat; these areas are not intended for recreational use. This area is an important segment of a bird migratory corridor in the Pacific Flyway.

Unfortunately, areas within the Wilmer Marsh Unit had been used for several decades for unauthorized dumping of refuse including automobile bodies and parts, cans, glass, building debris, scrap metal, heating oil tanks, used oil containers and filters, automotive batteries and drums. Historical management strategies included pushing debris over the edge of the river bench into the marsh 60 metres below and subsequent burial in and along the shoreline. Site assessments indicated the refuse had impacted soil on the upland remnant river bench as well as soil, sediment and surface water in the marsh below and along the shoreline. This presentation will provide a brief summary of the remedial plan developed for the site, what has been accomplished to date and work left to complete. The presentation will focus on the challenges associated with developing and implementing a remediation project in an NWA including stakeholder involvement, permitting, remediation logistics in challenging terrain, work planning around sensitive species windows and lessons learned from both the proponent and consultant’s points of view.
Health Canada Interim Position on Human Health Risk Assessment for Short-Term Exposure to Carcinogens at Contaminated Sites

Angela Li-Muller
Norm Healey
Margaret Yole and Sanya Petrovic

1Health Canada
2Azimuth Consulting Group Inc.

The Contaminated Sites Division of Health Canada is currently reviewing the policy on risk assessments for carcinogenic agents, including short-term exposure and dose averaging. This is an important concept in human health risk assessments conducted at federal contaminated sites.

The current approach to cancer risk assessment varies based on the mode of action of the chemicals under investigation. Currently, risk assessment for chemicals known to cause cancer through a mutagenic mode of action assumes a linear dose-response relationship at low doses (i.e., non-threshold). A threshold approach is applied when there are sufficient data to ascertain the mode of action at the tumour site in question and conclude that the dose-response relationship is not linear at low doses, as in the case of dioxins which cause cancer at high levels of exposure but not at low levels of exposure that would be seen at most contaminated sites. When the mode of action is unknown or when the burden of proof for a threshold mode of action has not been met, a non-threshold approach to cancer risk estimation is supported by current science.

This review evaluates whether averaging short-term exposure over a lifetime is adequate to estimate cancer risk using cancer slope factors derived from chronic animal studies in which the animals are first exposed as young adults. Both theoretical studies using mathematical models of carcinogenesis and empirical studies with exposure during discrete age windows suggest that exposures in early life stages are usually associated with higher risk for cancer effects mediated through a mutagenic mode of action. Conclusions drawn from this review indicate that applying age-dependent adjustment factors to the cancer slope factor with exposure averaged over a lifetime can provide a generally conservative estimate of lifetime cancer risks for these carcinogenic effects. When chemical-specific data are available for a susceptible lifestage, these data can be used directly to evaluate risks for the chemical and the lifestage on a case-by-case basis. As an interim measure in the absence of chemical-specific data, the US EPA approach, of defining age-dependent adjustment, was adopted as a default to address carcinogenic effects mediated through a mutagenic mode of action for contaminated site risk assessments. The total lifetime cancer risk can be estimated by summing the cancer risks for all the lifestages.

For carcinogenic effects that have not been shown to be mediated through a mutagenic mode of action, default age-dependent potency adjustment factors are not recommended at this time. However, if chemical-specific data are available on quantitative differences between early lifestages and adults, an analysis of the differences can be used to adjust risk estimates for early life exposures.

The exposure to carcinogens for only a short time, such as at remote contaminated sites, may also elicit other chronic and/or short-term non-cancer health effects such as impaired nerve function. These non-cancer effects need to be evaluated in addition to carcinogenic risks. Short-term non-cancer effects can be evaluated using short-term toxicological reference values, where available and applicable.

Proposed Toxicological Reference Values and Risk Management Concentrations for Protection of Human Health from Lead (Pb) at Federal Contaminated Sites

Ross Wilson and Mark Richardson

SNC-Lavalin Inc.

Human health risk assessments for lead (Pb) at contaminated sites require a regulatory reference exposure level (REL) or toxicological reference value (TRV) in order to characterize and quantify risks. In 2011, Health Canada (HC) released its State of Science report on Pb, indicating no thresholds for effects, particularly for impacts on children’s IQ associated with blood Pb levels as low as 1 to 2 µg/dL; however, no specific REL or TRV was prescribed by HC for use in risk assessment. Lacking advice from HC, we present a review of available toxicological and other information, and provide TRVs developed by staff of SNC-Lavalin Inc. Environment Division (SLE) for protection of children, women of childbearing age and adults. These TRVs are proposed for use in risk assessments of federal contaminated sites in Canada.
Continuing on from proposed TRVs for Pb, the presentation proposes a risk-specific dose approach (owing to the non-threshold effects of Pb in the range of exposure under evaluation; analogous to the approach for non-threshold carcinogens) for development of risk management soil concentrations for protection of human health from Pb at contaminated sites. The presentation includes consideration of soil ingestion rates, relative oral bioavailability and the risk level that could be considered to be acceptable from Pb occurring in soil. Land uses considered include residential, commercial and industrial. The presentation discusses the uncertainties associated with the various approaches and options for development of updated site-specific target concentrations for Pb in soil.

11:30 am – 12:00 pm
**Interim Guidance for Evaluating Human Health Risks Associated with Direct Exposure to Contaminated Sediments at Federal Contaminated Sites in Canada**
Adam Safruk, Chris Bacigalupo and Elliot Sigal
Intrinsik Environmental Sciences Inc.

Within Canada, Federal guidance is available for assessing risks to human health as a result of exposure to contaminants in a variety of environmental media. In addition, environmental quality guidelines have been developed by Health Canada and Environment Canada under the auspices of the Canadian Council of Ministers of the Environment (CCME) for many of these media. Currently, neither Health Canada nor the CCME have endorsed a universal approach for assessing human health risks associated with exposure to contaminants in sediment. Available sediment quality guidelines developed by the CCME are protective of ecological endpoints only.

Under contract to Health Canada, interim guidance for the completion of human health risk assessment of direct exposure pathways for sediment-contaminated sites was developed. The main objective of this document was to provide guidance for evaluating human health risks related to direct exposure to contaminated sediments at federal contaminated sites in Canada. Specific tasks included: the derivation of interim direct contact human health-based sediment quality guidelines (HHSedQGs); an evaluation of the potential use of CCME Human Health Soil Quality Guidelines (HHSQGs) or Ecological Sediment Quality Guidelines (Eco-SedQGs) as screening criteria for direct contact sediment exposure; the provision of guidance on the identification of chemicals of potential concern (COPCs) through the use of specified screening criteria and/or background data; the identification of potential receptors and exposure scenarios/pathways; and, the provision of guidance for the assessment of exposure and risk to COPCs in sediment via incidental ingestion and dermal contact.

It was recommended that the selection of COPCs in sediments at contaminated sites in Canada be based on exceedances of guidelines that specifically consider the unique characteristics of direct human contact with sediments. The elevated loading factors associated with sediments relative to soil make the dermal exposure pathway a significant contributor to total exposure for many chemicals. The HHSedQGs should contain both an incidental ingestion and dermal contact component to ensure that these guidelines are protective of combined exposure.

Consumption of fish/shellfish that have been contaminated through the food chain transfer of COPCs from impacted sediments is a potentially significant source of exposure for certain chemicals that is not represented within the interim HHSedQGs or guidance. This may be a concern for chemicals that have a tendency to bioaccumulate/biomagnify and for sites where the area of contamination represents a sufficient portion of the feeding area of fish/shellfish to influence tissue concentrations. A guidance document for indirect exposure via human consumption of fish/shellfish was developed separately.

1:30 pm – 2:00 pm
**Risk Communication in Children's Environmental Health: Partnering with Frontline Service Providers**
Ronald W. Brecher and Trevor Smith Diggins
1MTE Consultants Inc.
2Smithdiggins.com

Children's environmental health concerns often arise in communities with contaminated sites. As credible sources of information for parents and caregivers, frontline childcare workers may be valuable partners in communicating about exposure to chemicals in the child’s environment and providing sources of accurate information. This presentation identifies obstacles that must be overcome in order for childcare workers to effectively respond to concerns about children’s environmental health. The presentation is based on the results of eight awareness sessions on children's environmental health, conducted during 2011, under contract with Health Canada.

MTE Consultants Inc. was retained to develop, deliver and evaluate eight awareness sessions on children’s environmental health (Vancouver, Yellowknife, Calgary, Saskatoon, Winnipeg, Ottawa and Halifax). Audiences included public health nurses, midwives, doulas, early childhood educators and daycare workers. All sessions were delivered by R. Brecher and T. Smith Diggins.
The authors describe some of the communication challenges faced by participants in their work, and identify some of the tools and credible resources available to access information and present it to their clients. This knowledge can help project managers to leverage and support these childcare professionals as resources in the dissemination of credible, accurate and accessible information relating to children’s environmental health issues.

2:00 pm – 2:30 pm

The Use of Bioaccessibility in Risk Assessment
Iris Koch, Ken Reimer, Viviane Paquin, Cameron Olsson, Justin Dee
Environmental Sciences Group, Royal Military College of Canada

Risk assessment is the process that determines the potential for adverse effects from contaminant exposure to either humans or ecological receptors, and it is commonly used to refine estimates of necessary remediation efforts at contaminated sites. The risk assessment process depends on calculations of daily doses via different exposure pathways, and for contaminated soil the main exposure pathway for humans is inadvertent ingestion. Exposure dose calculations are now recognized to be overestimated for many contaminants (most commonly metals) in soils, where the erroneous assumption is made that 100% of the contaminant is absorbed by the organism (is bioavailable). Bioaccessibility measurements can be made to determine the fraction of a contaminant that is available in the gastro-intestinal tract for uptake by the organism and can then be used as a surrogate for bioavailability estimates to improve exposure dose calculations. Arsenic and lead are two contaminants for which a great deal of research has been done to elucidate bioaccessibility and bioavailability in soil, resulting in the development of several reliable methods for predicting bioavailability from bioaccessibility measurements, based on validation with animal models. A summary of these methods as well as a decision-making framework for their application will be provided. The current state of research for other elements in soil will be reviewed with a focus on identifying elements for which bioaccessibility or bioavailability measurements would yield the greatest effect when considering remediation of contaminated sites. The considerations that should be taken into account when carrying out bioaccessibility and bioavailability measurements will be described, based on progress made by the research consortium Bioaccessibility Research Canada in developing practical guidelines for practitioners, researchers, and regulators. Another major source of risk at contaminated source in some circumstances is through ingestion of country foods that are important to aboriginal people. For arsenic, this exposure pathway is complicated by the tendency of arsenic to reside in more than one chemical form, some of which are more toxic than others. Approaches to incorporating these complexities into risk assessment will be presented along with recent results of arsenic speciation characterized in bioaccessibility extracts of country foods.

2:30 pm – 3:00 pm

5 Wing Goose Bay: Risk Based Criteria as a Site Management Tool
David Rae, AMEC Environment & Infrastructure

5 Wing Goose Bay is a military base, located in central Labrador. The Base was founded in 1941 and has been used by the United States and Canadian military for more than 60 years. The Goose Bay Remediation Project (GBRP) is a 10 year, $300 million project to remediate or risk manage legacy contamination to the extent that it does not pose an immediate or ongoing risk to human health or the environment. The spatial, temporal, and economic scale of the GBRP demands that resources are employed in the most efficient manner to achieve the overall project goals. 5 Wing Goose Bay has a large number of individual contaminated sites with a diversity of environmental issues that require risk management including: multiple contaminant types; multiple environmental media; multiple pathways; human and ecological receptors; and, multiple stakeholders including Federal, Provincial, and Municipal governments, Aboriginal and other interest groups, and the surrounding community.

An innovative and integrated approach to risk assessment was adopted to develop a series of risk-based criteria (RBC) for the GBRP as a whole, avoiding a repetitive process of individual site-specific risk assessments at each contaminated site. Exposure zones were delineated separately for human health and ecological protection based on broadly similar exposure potential or habitat characteristics. Conceptual site models (CSMs) were developed for each exposure zone to plan and focus the approach of the risk assessment. Key items within the CSM include: site characterization; determination of the chemicals of potential concern (COPC); human receptor selection; valued environmental component (VEC) selection and characterization; selection of exposure pathways and scenarios based on these factors; and, any other specific areas or issues of concern to be addressed.

RBCs were developed for each zone through the derivation of a number of human health and ecological component values. A component value is developed to provide a receptor or group of receptors protection from a contaminant via a specific pathway. Human health component values were developed for approximately 60 COPC, four environmental media (soil, sediment, surface water, and groundwater), 10 exposure pathways and five receptor age groups. Ecological component values were developed for three environmental media (soil, sediment, and surface water) and 14 aquatic and terrestrial VECs. The final RBC for any exposure zone is the lower of the driving component value generated for human health or ecological protection, so that both are protected when the RBC is applied.
An integrated, multi-media, multi-pathway Excel toolkit was developed using an interactive graphical user interface (GUI). The toolkit is a comprehensive modeling and risk characterization package that combines contaminant transport models and risk assessment models to calculate RBC. Features include: easy-to-use, streamlined GUI; fate and transport models for vapour intrusion, groundwater transport, and food chain uptake; default input parameters specific to 5 Wing Goose Bay; and, an extensive chemical database covering a wide range of chemicals, including petroleum hydrocarbons, metals, polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), pesticides, and polychlorinated biphenyls (PCBs).

3:30 pm – 4:00 pm
Assessment of Contaminated Sediments to Support the Derivation of Site Management Decisions: What Could Possibly go Wrong?
Ulysses Klee¹, Mitra Saidi², Gary Macro³, Alison Fraser¹, Tony Windsor¹ and Guillaume Couillard¹
¹Dillon Consulting Limited
²Public Works and Government Services Canada
³Transport Canada

The Canada-Ontario Decision-making Framework (the Framework) provides an excellent weight-of-evidence approach for the assessment of contaminated sediment. Potential risks to both the ecosystem and human health are integrated and can be used to support site management decisions. However, as a result of difficulties often encountered with sediment sampling, availability of suitable reference locations, and inherent biological and anthropogenic variability, the application of the approach can be challenging, making it important to remain mindful of the four guidance “rules”. Two harbours in Ontario, Cornwall and Sarnia, which had been identified as areas of concern within the Great Lakes Water Quality Agreement, were assessed using the Framework. Although both had been subject to remediation and effluent management, residual contamination remained that posed a potential risk to human health and the environment. In both cases, the study objectives included establishing concentration-response relationships based on chemistry, toxicity testing and benthic community analysis, that could be applied to the development of remediation objectives and sediment management strategies. In both cases, reaching these objectives was met with limited success given the challenges mentioned earlier. The patterns of sediment chemistry were found to explain very little of the observed ecological impacts and variability in the data added to the uncertainty. The strongest correlations for the observed impacts were found to be with the physical nature of the sediments. In the absence of any clear correlations between sediment chemistry and the ecological effects endpoints, the recommendation for no further sediment remediation or management was ultimately based on the “biology”, and the lack of any compelling evidence to suggest that the residual sediment contamination was having significant impacts on the aquatic ecosystem.

4:00 pm – 4:30 pm
The Development of Site-specific Sediment Quality Objectives as Part of a Risk-based Approach for Managing Human Health and Ecological Risks in the Kingston Inner Harbour
Viviane Paquin and Ken Reimer
Environmental Sciences Group, Royal Military College of Canada

The Environmental Sciences Group (ESG) of the Royal Military College of Canada has implemented the Canada Ontario decision-making framework (COA) in the Kingston Inner Harbour (KIH) to assess the contaminated sediments in and adjacent to property owned by Parks Canada and Transport Canada. ESG has also undertaken a human health and ecological risk assessment (HHERA) to improve understanding of the extent of impacts posed by the sediment and biological contamination to higher trophic level species including fish, birds, small mammals and humans. The results have been written in a five volume report that has been extensively peer reviewed by KIH stakeholders, Federal Contaminated Sites Action Plan (FCSAP) expert support and third party technical experts. The aquatic sites classification system, a tool used to prioritize aquatic sites for remediation/management action has been used to classify the site. The classification by FCSAP expert support has resulted in a class 1 (high priority for action) designation. A sediment remediation/risk management strategy is now being developed for the KIH. The primary objectives of the KIH sediment management strategy are to reduce human and ecological risks posed by the contaminated sediments to acceptable levels and to enhance the sustainability of the remediation process. Accordingly, a risk-based approach has been used to develop site-specific sediment quality objectives (SeQOs) for those contaminants of concern (Cr, PCBs, As, Hg, Pb) identified as posing risk to human and/or ecological receptors in the HHERA for the KIH. This presentation will explore the development of site specific SeQOs that are protective of human and ecological health as well as the key issues that must be considered as part of the overall risk management strategy for the KIH. These include determining causation of biological effects through a strength of evidence approach, identifying and controlling ongoing sources of sediment contamination, an analysis of remediation options, assessing the potential short-term and long-term benefits and negative impacts of remedial actions including residual risks, and providing opportunities for public consultation and involvement throughout the remediation process.
Transport Canada is responsible for the administration and control of approximately 210 hectares of Victoria Harbour floor. Human health and ecological risk assessment (HHEA) of the sediment within the Harbour has been undertaken since 2005. The objectives of this work has been to i) meet federal and provincial government requirements for managing risk where land transfer and redevelopment is being considered, ii) estimate and quantify the financial liabilities associated the sediment contamination, and, iii) develop a risk management strategy for the Harbour.

An extensive tissue chemistry data set established from over 20 years of testing has been compiled for the Harbour. The tissue data has demonstrated a significant decrease in PCBs and dioxins in tissue over time, suggesting natural recovery processes are occurring. Previous coring data has also shown evidence of natural sedimentation and recovery of contaminant concentrations in sediment.

Current studies have involved the collection and analysis of geochronological sediment cores from throughout Victoria Harbour to assess rates of sedimentation and recovery of various contaminants. Radionuclide tracer profiling using Cesium-137 has also been used to assess sediment mobilization and delivery into the Harbour. Results have demonstrated consistent net sedimentation rates through the areas of the Harbour tested (averaging approximately 0.8 cm/yr). These sedimentation rates are within the lower range observed within the Puget Sound area (Bellingham Bay, Elliot Bay, Commencement Bay, Budd Inlet). The differences in sedimentation rates are likely attributable to lower rates of sediment originating from natural drainage systems and watercourses. Consistent reductions have been observed for mercury concentrations in sediment (a common anthropogenic contaminant) throughout the Harbour. Similar reductions have also been observed for PCBs and dioxins. Some variability for these compounds has been observed in portions of the Harbour, potentially suggesting the influence of ongoing sources (i.e., localized sediment disturbances). Findings of this study are being evaluated within the context of the ongoing HHERA process.
Canadian and U.S. environmental regulations and guidance have traditionally viewed the presence of free phase petroleum product (also referred to as light non-aqueous phase liquid or LNAPL) in a monitoring well as an "unacceptable risk" to human health and the environment. As a result, the mere presence of free product/LNAPL in a well has led to numerous costly, and unfortunately, often times ineffective remediation programs, all in an effort to mitigate the "perceived" risk.

The science and research describing the behaviour of LNAPL in the subsurface has developed extensively over the past two decades. The presence of LNAPL in the subsurface and the potential for LNAPL movement is now recognized as being governed by the principles of multi-phase fluid flow, which differ drastically from typical groundwater flow and dissolved phase contaminant transport. Further, different LNAPLs (i.e., gasoline, kerosene, diesel, fuel oil, hydraulic oil, lube oil, crude oil) are uniquely characterized by their chemical and physical properties which in turn, determine the migration potential and type(s) of risk or hazard associated with the material. Past experience and relatively recent LNAPL literature have shown that the following will be true for many, if not most, LNAPL sites:

1. Even where significant LNAPL thicknesses are observed in wells, the LNAPL is not migrating;
2. Only a small fraction of the LNAPL in the subsurface will be recoverable; and,
3. There will be little or no real risk associated with the LNAPL.

This keynote address discusses the alarmist attitude and stigma associated with LNAPL in a well, dispels some of the most common "myths" or misconceptions about LNAPL in the subsurface using current science, and presents a pragmatic approach for assessing true risks associated with LNAPL. The address then outlines an approach to review and screen potential LNAPL remedial technologies/alternatives for those situations where active remediation is justified based on a technically sound LCSM as well as other non-science considerations.

David Cushman, B.A.Sc., M.A.Sc., M.S., LL.B., J.D., P.Eng., P.E., CHMM, Senior Environmental Engineer and Associate, Conestoga-Rovers and Associates

David Cushman is a licensed professional engineer in the Province of Ontario and the State of Michigan, and is a Senior Environmental Engineer/Associate with Conestoga-Rovers and Associates (CRA). He holds Bachelor and Master degrees in Civil Engineering, a Master degree in Chemical Engineering, and two Law degrees (Canadian and American). He is also a Certified Hazardous Materials Manager in the United States. David has worked his entire (24-year) career in the environmental consulting engineering field specializing in the investigation, assessment and remediation of sites impacted with petroleum constituents, including sites impacted with light non-aqueous phase liquid (LNAPL).

David has conducted/managed numerous soil and groundwater investigations and remediations at more than 250 retail petroleum facilities throughout Canada and the United States and has managed numerous LNAPL monitoring and recovery programs at retail petroleum facilities, petroleum bulk plants, railroads and industrial manufacturing facilities. He has managed the design, implementation and completion of numerous in-situ remedial pilot studies and full-scale remediation programs at retail petroleum facilities, railroads and industrial manufacturing facilities.

David is the head of CRA’s LNAPL Peer-to-Peer Intranet Group and acts as a senior advisor for CRA on LNAPL projects across North America. He has given numerous LNAPL-related presentations at technical conferences and to State regulatory agencies. David was an active member of the Interstate Technology & Regulatory Council (ITRC) LNAPLs Team in the U.S. from 2008 through 2010. As a member of the ITRC LNAPLs Team, David was involved with the creation of various internet-based LNAPL training programs and technical guidance documents, as well as the preparation of LNAPL-related classroom training materials (for the 2-day ITRC LNAPL course). David Cushman/CRA was retained by Environment Canada to create technical documents relating to LNAPL mobility, and to facilitate a workshop discussing LNAPL technical issues, as well as potential policy considerations for implementation of an LNAPL framework.
Overview of FCSAP Guidance for Ecological Risk Assessments at Federal Contaminated Sites
Ute Pott, Environment Canada

Environment Canada and the Department of Fisheries and Oceans are developing guidance for ecological risk assessment (ERA). A comprehensive ERA guidance document was circulated for public peer review in Spring 2011 and is expected to be finalized early in 2012. The guidance encourages comprehensive selection of receptors and pathways and documenting how these are being followed through the risk assessment in a weight of evidence context. Appended to the comprehensive ERA manual are independent modules which address separate technical issues in more detail. Module A: Toxicity Testing and Module B: Selection or Development of Toxicity Reference Values have been recently released and two further modules on Standardization of Receptor Characteristics and Causality Assessment are currently in development. Other Federal Contaminated Sites Action Plan (FCSAP) guidance that is relevant to ecological risk assessments at contaminated sites include the federal interim groundwater guidelines, updated Canadian Council of Ministers of the Environment site characterization guidance, a repository of national and international environmental guidelines.

Finding the Lethal Needle in the Haystack: A Case Example of Using Toxicity Identification Evaluation in Aquatic Ecological Risk Assessment to Establish Causality and Focus Risk Management Actions at a Federal Contaminated Site
Howard Bailey1, Norm Healey2, Bonnie Lo1, Jane Tsang1 and James Elphick1
1Nautilus Environmental
2Azimuth Consulting Group Inc.

Risk management is not a necessary response to an adverse effect identified by a contaminated sites risk assessment. If the adverse effect is considered unacceptable, the risk assessor should consider the cause of the adverse effect. However, causality is not always included in risk assessments to the rigour that it deserves and, without information on causality, risk management actions may be ineffective. Causality will be addressed in Environment Canada’s forthcoming national guidance on ecological risk assessment. This presentation provides an introduction to toxicity identification evaluation (TIE) and presents a case study of how TIE was effectively used to identify the cause of toxicity in water samples from a contaminated site with multiple sources of contamination and associated responsible parties. Establishing the cause of toxicity allowed the federal custodian to effectively manage the unacceptable risk identified by a risk assessment of this site.

TIE is a method of systematically identifying the cause of an observed toxic response. Samples of the toxic media are chemically or physically “treated” to determine the effect of the treatment on the toxicity of the sample. For example, metals can be removed from toxic water samples by chelation; if the chelated sample is non-toxic then the investigators have evidence to consider metals as the potential cause of the toxicity in the un-chelated sample. The US EPA and other regulatory agencies have developed guidance on TIE and TIE methods for specific contaminants are available in the primary literature.

In the case example, TIE was used to identify the underlying cause of toxicity of surface water samples collected from a federal contaminated site. The site had been used as a landfill and is also transected by a major highway and a railway. There is an active landfill on the upgradient property. Surface water on the site discharges to the Fraser River, a commercially and ecologically important water body. Surface or groundwater samples from the site were contaminated with metals, PAHs, extractable petroleum hydrocarbons, and chlorinated and non-chlorinated phenols. Of these, iron was particularly elevated relative to surface water quality guidelines and iron precipitate was prevalent in surface waters throughout the site.

Reproduction of the crustacean Ceriodaphnia dubia was impaired in a seven-day assay of surface water samples from the site. Initial TIE procedures suggested that toxicity was related to organic constituents associated with the particulate fraction. The particulate phase was isolated from the sample and extracted with methanol. The methanol extract was diluted with water, applied to a solid phase extraction column, and subsequently eluted with a methanol gradient. Discrete solvent fractions were tested with and without UV. Toxicity was enhanced under UV, suggesting PAH involvement. The greatest toxicity was associated with the 95% and 100% methanol fractions. Chemical analysis of these fractions identified the high molecular weight PAHs benzo(a)pyrene and benzo(b&j)fluoranthene as responsible for the toxicity of the water samples. PAH contamination at the site was primarily limited to surface water and the source of the HMW PAHs appeared to be the upgradient landfill.
9:30 am – 10:00 am
Improving Wildlife Risk Assessment by Using Dose-response Data: an Example with PCBs
Ryan Hill, Azimuth Consulting Group Inc.

Most ecological risk assessments (ERAs) for wildlife divide exposure estimates by point estimate toxicity reference values (TRVs) using a hazard quotient. While quotient methods may be appropriate for screening-level risk assessments, they usually provide little if any information about the potential magnitude of effects, and are inadequate for more detailed assessments where characterization of actual risks is needed. For detailed assessments, practitioners should compile and plot dose-response data so that risks and uncertainties can be clearly understood. In addition, models should be fit to the data whenever possible to facilitate quantitative estimates of the expected magnitude of effects. Using an example with PCB data, this paper reviews the process of compiling, plotting and modeling dose-response data.

10:30 am – 11:00 am
Screening Level Ecological Risk Assessment Implications of Elevated Background Metal Concentrations in Newfoundland Soil
Adele Houston1, Dennis Kelly2, Rennie Hynes1, Janice Paslawski1, Alexis Harvey1
1SNC-Lavalin Inc.
2Public Works and Government Services Canada

One of the fundamental assumptions for chemical screening in an ecological risk assessment is that organisms living on a site are acclimatized to background conditions and that background conditions should not pose unacceptable risks to resident ecological populations. Understanding background conditions and their application to site investigation and risk assessment is required to manage residual impacts.

Naturally enriched metals can be found in Newfoundland soil. To characterize background metal concentrations in Newfoundland soil and assist site investigators and risk assessors in identifying which chemicals are in fact of concern at sites in Newfoundland, Environment Canada and Public Works and Government Services Canada (PWGSC) have used regional background concentrations of metals.

When food chain modelling is completed for ecological risk assessments in Newfoundland using CCME protocols and toxicological reference values, unacceptable risk can be predicted from background concentrations of metals in the food chain model to both second and third order receptors (e.g., copper, lead, and zinc). The exclusion of those metals which do not exceed background levels in the first step of the chemical screening focuses the risk assessment on those chemicals responsible for driving risks at a site. However, completion of an ecological food chain model using background concentrations has implications for the discussion of potential risks at a site and ultimately for owners of sites in Newfoundland and future site management.

11:00 am – 11:30 am
Development of Soil-to-Terrestrial Invertebrate Uptake Factors to Improve Estimation of Ecological Risk on DFO Lightstation Sites in Atlantic Canada
Malcolm Stephenson and Annick St-Amand
Stantec Consulting Ltd.

Metal contamination of soil at lightstation sites is ubiquitous. Metals are usually the primary contaminant of concern (COC) on these sites. Soil impacts arise from many years of painting with lead-based paints and from battery use and disposal. To address these concerns, Fisheries and Oceans Canada (DFO) through Public Works and Government Services Canada (PWGSC) has conducted comprehensive Phase I, II and III environmental site assessments (ERA) to fully delineate COCs at all their sites in Atlantic Canada. Now that the extent of the impacts has been determined, human health and ecological risk assessments are being used to determine if unacceptable risks are present for human or ecological receptors.

In assessing lightstation sites for many potential ecological receptors, two exposure pathways that typically contribute the most risk are: direct ingestion of surface soil and uptake of contaminants from surface soil through consumption of soil invertebrates. The latter pathway has historically been assessed by applying soil-to-terrestrial invertebrate uptake factors obtained from Sample et al., 1998. While this has enabled estimation of risk from this exposure pathway, the data used by Sample et al., 1998 are from a multitude of geographic locations and a multitude of potential sources of metal contamination.

This presentation describes the approach recently used to develop site-specific uptake factors for lightstation sites in Atlantic Canada. Results from several sites in Atlantic Canada have been pooled together to generate uptake factors applicable to this area.
Twenty-three earthworm samples were collected from lightstation sites in Atlantic Canada in areas with high, medium and low metal concentrations. Earthworm tissue metal concentrations were plotted as a function of soil metal concentration to determine if there was a relationship between the terrestrial invertebrate metal concentration and soil metal concentration.

Regression equations were derived for antimony, arsenic, barium, cobalt, copper, lead, molybdenum and zinc. Beryllium, nickel, silver and thallium were not detected in earthworm tissue. There was no apparent relationship between earthworm tissue metal concentration and soil metal concentration for tin, uranium, vanadium, cadmium, chromium, and selenium. Results for lead and zinc show that the predicted metal concentrations from Sample et al., 1998 significantly under-predict metal concentrations found in earthworms at Atlantic Canada lightstation properties.

11:30 am – 12:00 pm

Ecological Risk Assessment From a Property Management Perspective
Heather McCleave, Public Works and Government Services Canada

The Department of Fisheries and Oceans (DFO) have 1,400 properties in the Atlantic Region, many of which have impacts exceeding generic guidelines. Risk assessment tools are essential to the environmental management of these properties. The initial focus was on prioritizing and then assessing human health risk at all the major properties. In recent years our focus has expanded to include ecological risk assessment (ERA).

The ecological risk assessment process has presented us with the following challenges:
1. Inconsistencies between Assessors: Initially assessment inputs and targets varied between assessors so it was difficult to determine if the properties were being assessed with same level of conservatism. Therefore it was difficult to be confident that remediation dollars were being spent wisely.
2. Slow iterative process: The repetitive ERA process was slow. The initial ERAs were overly conservative and the iterations sometimes made only tiny steps forward. Repeated helicopter flights to collect a couple more samples was not efficient.
3. Lack of peer acceptance: New consultants were not always accepting of a prior consultant’s work. This resulted in an inefficient and confused assessment process. The ERAs need to be accepted by others today and over time.

In an attempt to address these challenges, a team of four senior ecological risk assessment specialists was engaged to develop and agree on a common ERA approach. Significant compromises were required by the team to produce a guidance document and it is not clear if anyone would choose to follow the agreed approach outside the DFO program. However, the team went on to complete approximately 25 ERAs in 2010/11. Peer reviews were completed on all of these reports and no significant disagreements in outcomes were identified.

Overall we now have a more effective and efficient ERA process. We are now completing ecological risk assessments knowing that we are achieving a consistent level of conservatism using an approach accepted by at least four major consulting firms.

Key lessons learned in conducting ERAs for a portfolio of properties include:
1. It is essential to make the often contentious but key decisions up front in the ERA process in order to achieve a consistent level of conservatism across the portfolio.
2. A team of experts/peer reviewers is also essential to the process. The process of defending positions to the group meant important issues were explored and thoughtful decisions were made. It also significantly adds to the credibility of the final product and our confidence to move forward with not a perfect process, but one that is generally accepted.
SuRF the Globe: Green and Sustainable Remediation and Its Evolution Around the World
Justin Kelley¹, Francois Beaudoin², Dave Woodward¹, Sebastien Yelle³, Stella Karnis⁴, Robert Noel-de-Tilly²
¹AECOM
²Golder Associates Ltd.
³Public Works and Government Services Canada
⁴CN

The remediation industry was born in the late 1970's in response to the discovery of contamination and a need for a better understanding of its impacts on human health and environment. Recently, with the increased awareness of global climate change, as well as sustainability being recognized as an important underpinning consideration, the remediation industry has recognized both obligations and opportunities to reduce their own ancillary environmental impacts.

The United States Environmental Protection Agency (US EPA) has recognized the importance of environmental impacts resulting from remediation as evidenced in their launch of the green remediation website and program. The Sustainable Remediation Forum (SuRF) was formed in the USA in late 2006 to increase the role of sustainability in remedial actions and in 2009 it published its groundbreaking white paper. Following the lead of SuRF US, other SuRFs have emerged across the globe in the UK, Australia, Canada and Brazil amongst others. The overarching aim of these organizations is to maximize the overall environmental, societal, and economic benefits from the site cleanup process, although the methods for reaching this goal may vary. Some of the initiatives put forth by SuRF organizations include: the development of frameworks for sustainable remediation practice; the sharing of knowledge between practitioners, academics and government agencies; research on methods and metrics; and, the general promotion of the integration of sustainability principles in the field of contaminated land remediation.

Various technical and regulatory agencies across the world are also actively exploring the role of sustainability in remediation. The interests and activities of these initiatives and evolution of green and sustainable remediation have resulted in a wide range of views on the role of sustainability in remedial action decision-making and implementation. This range is manifested most evidently as a preference for either green remediation or sustainable remediation. The US EPA defines green remediation as the practice of considering all environmental effects of a cleanup during each phase of the process, and incorporating strategies to maximize the net environmental benefit of the cleanup. Sustainable remediation is broadly defined by SuRF US as a remedy or combination of remedies whose net benefit on human health and the environment is maximized through the judicious use of limited resources and provides the best combined solution when considering environmental, social, and economic considerations.

This presentation addresses how SuRF organizations have evolved around the globe, as progressive and socially responsible entities, and how they can take advantage of the opportunities that both green and sustainable remediation represent. It also explores the critical distinction between green and sustainable remediation and attempts to define the benefits and potential problems associated with both views.

Remediation of Remote Site Under Consideration of Carbon Intensity, Social and Economic Benefits
Ingo Lambrecht¹, John Dewis¹ and Scott Moseley²
¹Franz Environmental Inc.
²Fisheries and Oceans Canada

Franz Environmental Inc. (Franz) was retained to complete remediation planning and conduct the remediation of a fuel leak at a remote Fisheries and Oceans Canada (DFO) field station. The leak originated from an underground heating oil tank and had migrated into the building perimeter drain and within the utility trench towards a drinking water well and a salmon-bearing river.

During the remedial planning stage, Franz developed a tool to evaluate the various potential remediation approaches based on a triple bottom line approach, consisting of economic, environmental and social benefits. The tool consisted of a weighted scoring system that evaluated the possible remedial approaches in regards to their environmental impact, especially carbon footprint a well as the social and economic benefits to the local community. The project was conducted using an approach that reduced carbon intensity and involved the local First Nations as the prime remediation contractor, resulting in a combination of a low environmental impact with a high social benefit and a high economic stimulus to the local community.
Life Cycle Assessment of Remediation Approaches for a Remote Diesel-contaminated Site in Hopedale, Labrador
David Sanscartier1, Manuele Margni2, Ken Reimer3, Barbara Zeeb3
1Department of Chemical and Biological Engineering, University of Saskatchewan
2Département de génie chimique, École Polytechnique de Montréal
3Department of Chemistry and Chemical Engineering, Royal Military College of Canada

Remediation of contaminated sites has obvious environmental benefits such as the minimization of the human and ecological risks associated with contaminants, and the redevelopment of under-utilized land. However, remediation activities cause negative environmental impacts such as the emission of greenhouse gases and air pollutants, and the use of non-renewable resources. Site remediation practitioners are increasingly aware of these impacts; as a result, sustainable and green remediation principles are progressively being applied worldwide.

Life cycle assessment (LCA) is a well-established analysis tool that can be used to quantify the environmental footprint of systems over their entire life cycle. Published LCA case studies of site remediation have demonstrated that impacts differ among technologies, and that the latter are strongly influenced by the use of fossil-based energy. The application of LCA to site remediation can guide the selection of the most environmentally-sound approach and thereby support sustainable remediation initiatives. The remediation of remote sites has not been extensively examined through LCA, which is the topic of this presentation.

The goal of this retrospective case study is to compare the environmental performance of three treatment options for a remote site contaminated with diesel located on a Royal Canadian Mounted Police property in Hopedale, Labrador. The study focuses on the secondary impacts of remediation (those associated with the remedial activities). The primary impacts (those associated with the contaminants) were previously addressed through risk assessment. This approach combines the benefits of site-specific and broad analyses, thus allowing a more holistic assessment. The clean-up approach used at the site (on-site ex-situ bioremediation in a temporary facility followed by disposal of the treated soil in an unlined landfill) is compared to two hypothetical options deemed capable of achieving the site-specific target level (off-site bioremediation and in-situ bioventing).

The modeling results demonstrate that remediation of remote sites may have high environmental footprints. For example all three remediation options are calculated to consume four to eight times more fuel than the estimated amount of fuel in the contaminated soil. The on-site bioremediation approach is found to have impacts on human health, ecosystem quality, climate change and resource use similar to those of the in-situ bioventing treatment, but far less than those of the off-site bioremediation treatment. Transportation of material, soil and personnel are the main contributors to life cycle impacts. In previous LCAs examining densely populated areas, in-situ treatments have been shown to have lower secondary impacts than ex-situ treatments, but the results from the current study suggest otherwise for remote locations due to the environmental burden of transporting personnel over long distances combined with generally slower in-situ treatments compared to ex-situ ones. This case study provides insights applicable to similar projects. It demonstrates the advantages of conducting an LCA early in the design process.

The presentation will introduce the application of LCA to site remediation, present the case-study results and lessons learned, and discuss the benefits and limitations of LCA as a tool to improve the environmental sustainability of site remediation.

Bear Island: Northern and Sustainable Remediation, Keys to Success
Matthew McElwaine1, Mark Yetman2, Roland Merkoski3 and Jean-Pierre Pelletier4
1Public Works and Government Services Canada
2Aboriginal Affairs and Northern Development Canada
3AECOM
4Biogénie

Bear Island is located within James Bay, approximately 160 kilometres northwest of Chisasibi, Quebec and 300 kilometres southwest of Sanikiluaq, Nunavut (54°20’N, 81°05’W). The two Doppler Radar Stations were operated on Bear Island from the 1950’s to 1965 as part of the former Mid-Canada Early Warning Line. They were abandoned in 1965 with minimal clean-up operations and the majority of the buildings were removed to their foundations. The environmental issues at Bear Island included former landfills and site buildings, as well as abandoned hazardous materials (lead acid batteries, petroleum products, asbestos), barrels, contaminated soil and scrap metal.

This presentation will present and discuss the unique challenges provided by the site location and inhabitants of Bear Island and the risk management and solutions provided by the federal government, AECOM and Biogénie during the remediation of the site.
Areas where sustainable considerations were incorporated into the remediation design and effected in an arctic environment will be highlighted and detailed. These considerations include design changes to eliminate requirements for monitoring, salvage and recycling of waste material on site, aboriginal opportunities considerations and aboriginal/stakeholder engagement.

Keys to the success of this project will be outlined and summarized in a format that can be used to implement similar solutions at other sites in the north.

4:00 pm – 4:30 pm
Incorporating Sustainability into Site Closure – A Field Example
Leanne Murdie Austrins1 and Joanne West2
1CH2M HILL Canada Limited
2Dow Chemical Canada ULC

Long term management of former chemical production facilities can be a costly and time consuming element of site closure, however, implementation of creative measures to introduce sustainability and reduce the need for onsite presence can be successfully incorporated into the site closure process. A case study facility located in Sarnia, Ontario, was an active multi-chemical production facility from the 1940’s, until it was decommissioned and sold between 2005 and 2010. The facility consisted of 322 acres of production area. Several elements which allowed for reduced onsite presence and reduction in management costs were incorporated into the site decommissioning plan, including: phased remediation planning; selection of sustainable remediation elements; sustainable surface water management; and, sustainable groundwater management. The sustainability and management modifications were successfully negotiated and approved by the local regulatory agency.

Due to the size and complexity of the site, a holistic approach for the facility was needed and a decision matrix was developed. The decision matrix categorized the site into: type of contamination (primarily perchloroethene (PCE), trichloroethene (TCE), benzene and proprietary chemicals); type of affected medium; volume of affected medium; required timeframe for remedial completion; and, pathway to potential receptors. The results of the decision matrix determined the preferred remediation alternative, options which were incorporated with sustainable practices. Ex-situ remediation consisted of excavation of contaminated subsurface medium and consolidation at a 4.7-acre onsite soil treatment area designed specifically for the site closure process. This remedial option allowed for significant reduction in disposal costs and demonstrated economic and environmental sustainability by treating on site in place of transportation offsite. In-situ remediation consisted of injection of amendment into the native soils using hydraulic fracture and injection. The in-situ treatment option was utilized for large treatment volume areas and areas which had a longer timeframe available to meet the remedial objectives and promoted sustainability in reduction of energy resources which would have been utilized in an offsite disposal treatment option. When the plant was an active operating facility, groundwater management (10,000,000 gallons per year) was conducted through manual pumping and groundwater treatment through a series of carbon treatment units, which were removed as part of the decommissioning activities. The active pumping has been replaced by passive hydraulic control through the use of tree plantations (1,200 trees of various native species) incorporated with infiltration reduction efforts. The projected end result when the tree plantations have reached maturity would be minimal manual water management, projected at 0-200,000 gallons annually, resulting in significantly reduced energy usage.

Lessons learned from the project were developed in each area of remediation and long term management, including: tree maturation projections; sampling enhancement through better understanding the timing for sampling and interrelation of soil data to groundwater data; and, optimization of fracture spacing both horizontally and vertically. Soil mixing lessons learned included amendment modifications, and refinements of the decision matrix. Overall, the project has been successful in incorporating economic and environmentally sustainable elements into the site closure process and achieving an overall reduction in long-term management needs onsite.

4:30 pm – 5:00 pm
Development of a New Methodology Framework for the Integration of Sustainable Principles in the Selection of a Remedial Option Process: A Case Study in the Gas Sector
Guillaume Carle, Sylvain Hains, Benoit Bourque, Marianne Brilin
Golder Associates Ltd.

Golder Associates Ltd (Golder) was retained by a natural gas company in order to create a research project which would develop a new framework for the integration of sustainable principles in the selection of a remediation option process. Due to the risks associated with infrastructures on site (gas pipelines) within the impacted zone, the use of excavation is limited. Within this context, the research project also aims to provide the client with an overview of the implications related to the integration of sustainable development principles when selecting a remediation option.
In order to support the development of such a methodological framework, a site was identified by the client and the relevant documentation was made available for consultation. Analysis of previous reports helped the problem formulation and lead to the creation of a conceptual model presented to the client. It was determined that Golder’s sustainability evaluation tool, GoldSET, would be used to compare different options.

The study site is located in Saskatchewan and consists in an industrial facility. Pipelines are located within the impacted zone. A literature review helped identify available treatment technologies and to retain treatment technology trains that ensure the achievement of rehabilitation objectives:
- Phytoremediation (0–1.5 m) with soil heating and in-situ chemical oxidation (ISCO) (1.5-6m) and bioremediation (1.5-6m);
- Dig and in-site treatment and bioventing (0-2m) with soil heating and ISCO (2-6m) and bioremediation (2-6m); and,
- Bioventing (0-2m) with soil heating and ISCO (2-6m) and bioremediation (2-6m).

The technology trains were subsequently integrated into GoldSET for qualitative evaluation (first iteration). Given the lack of economic, temporal and access constraints at the site, all options were prequalified. A preliminary design was developed for each of them in order to proceed with quantification. Again, the evaluation did not clearly identify an option that was superior to the other.

A detailed analysis of each option revealed that different options could present similar overall results. However, an analysis of the individual scores of both qualitative and quantitative indicators compared to weights identified one option maximizing the priority considerations and two options with a higher general score.

The development of the methodological framework revealed that the detailed analysis of performance scores by priority considerations or by indicator allows both a better understanding of the real issues regarding the selection of the rehabilitation option, but also allows the opportunity to identify actions to further maximize the gain in terms of sustainable development. The integration of this methodological framework as part of a multicriteria analysis shows great potential for improving the overall sustainable benefit on an economic, social and environmental basis.

This presentation will be delivered in French.
The Ontario Ministry of the Environment (MOE) owns and manages a PCB waste storage site in London, Ontario. The MOE contracted Quantum Murray LP (QMLP) to safely excavate and transport for offsite destruction approximately 36,000 cubic metres of PCB contaminated soils, sediment and debris from four landfill cells that make-up the storage site. QMLP subcontracted CH2M HILL Canada Limited (CH2M HILL) to oversee the monitoring and provide other consulting services for the project. This project is to comply with Environment Canada PCB Regulation (SOR/2008-273), which requires that stored PCB waste be removed and sent to an authorized destruction facility by December 31, 2009.

This project had numerous designs and monitoring components that were unique as a result of the site’s urban location. Two temporary structures were erected so that the secure PCB waste materials could be excavated under cover to prevent contaminants from making contact with rainwater and to control dust generation; one of the structures is equivalent to the length of three football fields. Over a kilometre of on-site roadways were paved for dust control and suppression.

The project monitoring included on-site monitoring of soil, air, dust, surface water, and groundwater and offsite monitoring of air and dust. A network of off-site air monitoring equipment was used as an early detection system so that the team could take appropriate remedial actions to protect the public and the environment. A dust control and suppression plan was implemented to monitor and minimize the generation of dust and airborne particulates on-site. A storm water and erosion control plan was in place to control surface water quality and groundwater sentry monitoring was completed to verify that the activities have no influence over local environmental conditions. Within the first several months of the project, over 500 dust particulate data points were measured and interpreted; approximately 250 soil samples, 36 dust swab samples from neighbouring properties; 50 PCB samples from off-site air stations; 10 on-site dust swab samples from trucks and other surfaces; have been collected, analyzed and interpreted. Results indicate that control measures worked to satisfaction.

The construction progress and monitoring program results were shared with the community. Sensitive receptors are present adjacent and near the property and include an active day care nursery within 500 m. An extensive community outreach program was integral to the execution of the project and involves:

- Public information centres;
- Community liaison group meetings;
- Meetings with local health and safety committees, municipal and local agencies;
- Quarterly project newsletters;
- A complaints response procedure;
- A website with project and contact information; and,
- A voicemail hotline for upcoming events and to leave comments, questions or suggestions.

The focus of the presentation will be on components and activities to protect the public and environment and will include: the secure design features and unique remediation challenges overcome by the team; the monitoring network to provide an early warning system for public and environment protection; monitoring results; and, the community outreach and engagement program.
9:00 am – 9:30 am

It Takes a Community to Clean-up a Remote Site – Training Initiatives and Economic Development During the Remediation of the Former Mid-Canada Line Site 500
Wayne Ingham¹, Chief Edmund Hunter² and Mike Cartan³
¹WESA Group Inc.
²Weenusk First Nation
³Ontario Ministry of Natural Resources

In the mid-1950’s, the Department of National Defence (DND) established seventeen radar sites in Ontario as part of the Mid-Canada Line (MCL) Project. The sites were located along or near the coasts of Hudson Bay and James Bay and were retired in the 1960’s. Three of the sites were remediated between 2001 and 2009. The Ontario Ministry of Natural Resources (MNR) is managing the full environmental remediation and clean-up of the remaining fourteen sites. The remediation of the former Mid-Canada Line Site 500 began in 2010 and is scheduled to be completed in 2012. The site is located approximately 30 km east of the community of Peawanuck, Ontario. With a population of just over 200 people, Peawanuck is home to the Weenusk First Nation. The remediation of Site 500 is managed by the MNR with partial funding provided by DND. Weenusk First Nation is a major stakeholder in this clean-up and expressed interest in actively participating in the remediation of the site.

Upon award of the multi-year contract to be the Quality Assurance and Quality Control Contractor for the MNR, WESA Group Inc. (WESA) employed a number of local First Nations workers to assist in the collection of ambient air, soil, groundwater and building material samples and monitoring of explosive vapours during the remediation work at the site during year one of the project. These employees underwent on-the-job training as well as some formal training but the need for a more formal training program was identified. WESA applied for funding through ECO Canada’s Contaminates Remediation Training Organization of Canada (CRTOC) program to bring these trainings direct to the community. This application was successful and, with the support of both the MNR and Weenusk First Nation, WESA presented training to individuals from the community of Peawanuck in the spring of 2011. Training included a contaminated site hazards course, an environmental sampling assistant course, as well as an asbestos abatement course. In addition, all trainees were offered the opportunity to undergo two weeks of on-the-job training at Site 500 during the remediation program of 2011.

The objective of the training program was to train locally and increase employment of First Nations in the contaminated site remediation industry; to develop a skilled pool of labour available for work not only on the Mid-Canada Line sites but also within related sectors such as mining or land management and to increase the number of local First Nations residents qualified to work in contaminated site remediation and related environmental industries.

Trainees from this program were employed throughout the four-month clean-up project at Site 500 in 2011, which brought many economic benefits to the Weenusk First Nation and the members of the community of Peawanuck. During this presentation the economic benefits to the community will be presented. As well, some trainees who are pursuing careers in the environmental remediation industry through both job opportunities and further education in this field will be profiled.

9:30 am – 10:00 am

Remediation of Contaminated Sites on Reserve Lands – A Partnership from Clean Up to Prevention
Eugenia Escamilla-Duarte and Shelly Johnson
Aboriginal Affairs and Northern Development Canada

In addition to the elimination of unacceptable human and ecological risks, remediation of contaminated sites on reserve lands is about forming relationships, building capacity and partnering with communities - the process is unlike any other in the federal department as it often impacts the very place where people live and work.

This presentation will review the opportunities and challenges of contaminated sites projects on reserve lands, by highlighting what it takes to implement a remediation program, challenges with the continuous changes to guidelines, potential violations as the program moves to risk manage in the face of budget constraints and the complexities of cost sharing. Physical obstacles imposed by weather, isolation, site location and capacity within the community to complete the project, will also be examined. We share this story so that there is a better understanding of the contaminated site management program, as it is delivered by Aboriginal Affairs and Northern Development Canada South of 60°, beyond numbers, reporting and briefing notes.

To truly understand the impact on the community, multiple perspectives from community members is our most valuable resource. Chiefs from several communities will share their experiences of the opportunities and impacts contaminated sites have had in their communities. The economic benefits seen through a demand in local labour with the remediation projects, and rebuilding of community infrastructure will also be discussed.
Developing a Good Conceptual Site Model for Federal Contaminated Sites – Common Shortfalls and Data Needs
François Lauzon, Pierre Maheux, David Wilson, Sonny Sundaram and Marc Bouchard
Stantec Consulting Ltd.

The conceptual site model (CSM) is one of the primary planning tools that can be used to support the decision-making process managing contaminated land and groundwater on a large scale. The CSM organizes available information about a site in a clear and transparent structure and facilitate the identification of data and information gaps. Once the CSM is established, additionally needed data can be gathered and integrated in the CSM, followed by a revision of the CSM and a refinement of decision goals, if required. Thus, the CSM matures and enables an improved understanding of the site characteristics, such as contamination status, receptor profiles, etc., and the re-adjustment of decision criteria.

In the federal context, it is becoming routine for custodians to request a CSM in the course of a PH 3 environmental site assessment (Step 5 of the 10-Step process). Unfortunately, most request for proposals do not provide details as to the level of maturity required of the CSM. With some guidance provided by Health Canada in the context of the CSM to support a risk assessment, most custodians see the CSM as a relatively generic tool identify sources of contamination at the site, potential chemicals of concern, and the media (soil, groundwater, surface water, structures) affected in a simplistic 3-D diagram. Unfortunately, without the right level of data analysis, these low maturity models provide very little support in helping to evaluate potential or preferred cleanup options. As such, CSMs should be seen a dynamic models with varying levels of maturity that will ultimately assist in the selection of the best remedial action plan (RAP). During the life cycle of a CSM, the following maturity levels should be considered:

- Maturity Level I (typical models developed based on existing federal guidance) – Key Decisions
  1. Is there a potential threat to human health and the environment?
  2. Which chemicals from what media pose a potential risk under the land use scenario?

- Maturity Level II, III – Key Decisions
  1. Does a risk exist above tolerable levels based on default criteria?
  2. What action level would be acceptable based on default risk criteria?
  3. Based on realistic exposure and response scenarios, what site cleanup goals or action levels are required?

In order to build-up a complete, full-matured CSM (Level II/III), data and information are required from different areas or disciplines:
- Archeological/historical use,
- Physiography: region with similar geologic structures and climate,
- Climatic data: hydrologic budget, fauna, flora, and land use, precipitation rates, air temperature and prevailing wind speed and direction,
- Geology: types of geologic materials, structural geologic features, depositional environments and geomorphology,
- Hydrogeology:
  - Aquifer characteristics:
    - Type (examples: unconfined, confined, or semi-confined),
    - Characteristics (examples: hydraulic conductivity, transmissivity, storativity),
    - Geology (materials and structure),
  - Hydrologic budget:
    - Recharge rates (examples: precipitation, artificial recharge),
    - Discharge rates (examples: evaporation, transpiration, groundwater pumping),
  - Groundwater flow:
    - Hydraulic gradient (examples: groundwater elevations, flow direction),
    - Flow velocity (travel time),
    - Boundary conditions (examples: Dirichlet, Neumann).

This presentation will present the importance of a dynamic CSM process to choose an appropriate RAP based on an actual arsenic contaminated site from a former mine site in Ontario.
11:00 am – 11:30 am

**Proposed Scientific Approach for Achieving Site Closure of Aquatic Contaminated Sites**

Dr. Tamsin Laing¹, Melanie Fortune¹, Keith Lennon², Eric Chiang² and Dr. Daniela Loock¹

¹Royal Military College of Canada  
²Fisheries and Oceans Canada

Federal aquatic contaminated sites are managed using the 10-step Framework for Addressing and Managing Aquatic Contaminated Sites Under the Federal Contaminated Sites Action Plan (FCSAP) (Chapman, 2010). Site closure is not listed as a discrete step in this framework but corresponds to the final decision point on the achievement of remedial goals, i.e., the contaminated site no longer poses unacceptable human health and ecological risks, and these conditions are expected to continue into the foreseeable future. A site closure process and reporting framework is currently under development by Public Works and Government Services Canada. However, the scientific basis for determining when site closure is achieved for aquatic contaminated sites is needed.

Under the direction of the Fisheries and Oceans Canada (DFO) FCSAP expert support group, the Environmental Sciences Group (ESG) conducted a review of the relevant scientific literature, guidance frameworks, and international policy documents on monitoring plan development and site closure for aquatic contaminated sites. The intent of the review was to summarize the state of science and international policy on long-term monitoring and closure of aquatic contaminated sites and to initiate development of a guidance framework for evaluating the attainment of site closure for FCSAP aquatic sites. Site closure demonstrates program and site-level achievements, as well as documents the achievement of the remedial and/or risk management objectives.

Site closure is closely tied to the design of the monitoring program: the monitoring objectives, monitoring tools, and exit criteria decided at the start of the program are used to determine when the remedial goals have been achieved. To facilitate a consistent approach for FCSAP aquatic contaminated sites, we identified general objectives for monitoring remedy performance and ecosystem recovery. For each general monitoring objective, we then determined an appropriate subset of monitoring tools. Finally, we provided examples of quantitative action levels (i.e., exit criteria) that signal the attainment of the desired condition for a particular monitoring objective.

Under the proposed FCSAP aquatic site closure guidance framework, site closure is achieved when all of the exit criteria for the monitoring objectives have been met. Final site closure may not be attainable for those sites where contaminants remain in place (e.g., capped sites, engineered containment facilities) and ongoing maintenance and performance monitoring are required. However, once the exit criteria for monitoring objectives related to ecosystem recovery are achieved, the scale and frequency of the monitoring can be greatly reduced.

This presentation will discuss the proposed approach for developing long-term monitoring programs that are capable of achieving site closure for FCSAP aquatic contaminated sites. An initial draft guidance framework for evaluating the attainment of site closure will also be presented.

11:30 am – 12:00 pm

**Natural Attenuation and Risk Based Groundwater Monitoring Strategy**

Stephen Livingstone, Franz Environmental Inc.

It is anticipated that within the next three-to-five years, many of the contaminated sites under the Federal Contaminated Sites Action Plan (FCSAP) program will be at Step 10 – Long-term monitoring of the Contaminated Sites Management Working Group Federal Approach to Contaminated Sites. Federal projects typically required some form of long-term monitoring (>3 years) where groundwater impacts are present above the applicable provincial guidelines/standards after the source has been removed or the site is under risk management. The costs for data collection are compounded by the costs of processing, management, review and preparation of the monitoring reports. A cost benefit analysis by the U.S. Army Corps of Engineers (US ACoE) reported that over 50% of the site investigation costs are associated with site monitoring over the long-term.

Groundwater monitoring datasets are known to have considerable scatter in the data, i.e., high variability, which decreases the ability to identify temporal trends as well as the confidence in plume stability. The variability in groundwater monitoring data that is unrelated to the long-term temporal trend decreases the ability to understand the effectiveness of natural attenuation (and other site remedies). There is a clear recognition that because there are multiple steps involved in obtaining a temporal concentration data set (purging, sample collection, shipping, sample transfer and analysis), there are many opportunities for introducing variability into the data set. Variability in groundwater monitoring results creates a challenge to manage groundwater plumes by making it more difficult to evaluate the monitoring data. Generally, the only recommended action is to conduct more monitoring, because the larger amounts of data are necessary to compensate for the high variability and identify true spatial and temporal trends. This is a concern given the high cost of long-term monitoring (LTM) programs. LTM is defined as monitoring conducted after some active, containment or risk management program has been implemented and is used to evaluate the project objectives or to ensure site compliance.
The Natural Attenuation and Risk Based Groundwater Monitoring Strategy (NARB-GWS) presented describes the approach that can be employed for sites currently considered under or entering a long-term monitoring program. The strategy could be useful in the design of a program during the initial phase or a re-evaluation of the site monitoring plan following several years of monitoring with predictable and stable results in a low-risk of impact environment.

For this strategy, three key methods are used to analyse and evaluate the source area and groundwater impacts and behaviour namely:

A. Statistical Analysis – evaluates the temporal and spatial trends to understand plume migration, understand outliers and interpolate contaminant behaviour;

B. Natural Attenuation Assessment – evaluates the behaviour of the contaminants to understand the primary and secondary processes that determine the plume migration and attenuation processes; and,

C. Operable Contaminant Pathway Assessment – evaluates the possible ingestion routes, transport of contaminants to local receptors or potential off-site migration.

The end goal is to terminate/reduce long-term monitoring programs while documenting, controlling and/or preventing impacts.

Techniques for Obtaining Accelerated Environmental Approvals and Acceptance

Steve Scandlen¹, James Sprenger¹, Meggen Janes¹, Don Forbes², Krista Barfoot¹

¹CH2M HILL Canada Limited
²Infrastructure Ontario

CH2M HILL Canada Limited was retained by Infrastructure Ontario to obtain the environmental approvals required to initiate construction of the 2015 Pan Am Games Athletes Village at the West Don Lands (WDL). The required approvals included records of site condition (RSC) for all properties, in order to redevelop the land for residential use, and the environmental risk assessments (ERA) that identify the necessary risk management measures required to allow for the change in land use. The Ontario Ministry of the Environment (MOE) is the governing body that provides its acceptance of the risk assessment and other regulated approvals.

The process was initiated in late April 2010, and the final approvals were required by November 2011, in order to meet the aggressive development schedule. This translated to ERA acceptance, for eight properties, by April 2011, to allow certificate of property use development and RSC acknowledgement by November. The typical risk assessment involves intensive intrusive soil and groundwater investigation, exposure and risk modelling, and documentation and correspondence with the MOE to refine and resolve scientific issues. The MOE’s review process is regulated to take up to 22 weeks, with a typical timeline from ERA development to ERA acceptance times for ERA reports in the order of 2.5 years.

The WDL site had several stakeholders, most involved as future owners. Part of the project scope was to provide each stakeholder a chance to review the applicable documents (i.e., Phase Ones, Phase Twos, ERAs, and RSCs) prior to final submission to the MOE, which added time to the already compressed schedule. Each stakeholder was allowed input on the various rounds of comments received from the MOE, as noted above.

Three accelerating initiatives were undertaken:

1. Dedicated teams. All stakeholders, including the MOE, assembled a dedicated team of experts in three primary areas: site assessment, exposure calculations, and risk management measures. These teams were assigned directly to the WDL project for consistent and continuous interaction.

2. Early and continual communication with the stakeholders. This was achieved by engaging all stakeholders at initial meetings to understand their concerns, and to gain endorsement on communication timelines and the schedule required to deliver this project. Regular meetings were set up to communicate schedule updates and to discuss upcoming reviews, and to address issues immediately.

3. Real-time meetings. Meetings were held during the review periods where comments on reports were discussed, and changes made to the document real time. These meetings often required a day, but with all of the players in the room, at the end of the day, comments were resolved and the document was ready for submission. An issue that came to light early on was that of tracking comment resolution. This was done by assigning a dedicated staff member to track the comments during the real-time meetings, and publish the resolutions for endorsement.

Taking these steps, the program met the schedule requirements, and set a new bar for risk assessment production in Ontario. Construction of the Pan Am Games Athletes’ village commenced in September 2011.
2:00 pm – 2:30 pm

**A New Tool for Managing Large Portfolios of Phase I Environmental Site Assessments**

Paul Hurst\(^1\), Don Plenderleith\(^1\), Brad Trask\(^2\) and Lori Bishop\(^3\)

\(^1\)Golder Associates Ltd.
\(^2\)CBCL Limited
\(^3\)Public Works and Government Services Canada

A requirement for completing 60 Phase I environmental site assessments (ESAs) within a three month timeframe for Public Works and Government Services Canada (PWGSC), Atlantic Region required an innovative approach to acquiring, managing and reporting the site information. The sites were located in Cape Breton, Nova Scotia and generally consisted of small sections of right-of-way or isolated properties related to former coal mining activities. Golder Associates Ltd. (Golder) proposed to PWGSC a “horizontal” approach to information acquisition and interpretation in which each specific aspect of Phase I information would be managed across the portfolio of sites and stored in a database, instead the traditional “vertical” approach of performing each Phase I ESA as a distinct project from start to finish. PWGSC agreed to the approach. Golder partnered with CBCL Limited on this project.

Data management played a key part in the approach. A database was configured to store and manage each report section across the portfolio. Task-specific teams were responsible for acquiring and interpreting each specific data component in the Canadian Standards Association (CSA) Standard Phase I protocol. CBCL’s Nova Scotia field staff performed all of the site inspections and recorded their information on site inspection forms with fields that matched the database to allow easy information transfer.

Photo-documentation was done using a GPS equipped camera. This allowed photo locations and camera orientations to be directly plotted on the site plans. Field staff captioned each photo using a proprietary electronic tool for automatic uploading and tracking into the central database. All aerial photographs were digitized, with the site boundaries added, framed as figures, and uploaded to the database. An archaeologist with environmental photo interpretation experience completed the air photo interpretation for the portfolio. Background information from EcoLog and Nova Scotia Environment was obtained in digital form, uploaded to the database and stored under the appropriate site Property Identification (PID) number. Once all information was input into the database by the task-specific teams, the project manager was responsible for final interpretation and reporting to ensure consistency among the 60 sites. The reports were generated by outputting all of the data fields for a given site. The appearance of the reports closely emulated that of conventional Phase I ESAs which are produced as text documents. The final QA/QC senior review of each report was done vertically, one by one, in the traditional approach.

Some of the advantages of this horizontal approach to information management on portfolios of Phase I ESAs are:

- Several task specific teams can work on the project concurrently, with each team specializing in only one or two types of information;
- Information can be entered into the database from several locations concurrently (i.e., on-site, and in the office);
- Output, in the form of a complete report, or a partial report is easily available for any combination of sites in the portfolio if requested by the client;
- Site-specific information can be updated or added in the database, and an updated report can be easily generated when needed; and,
- The digital nature of the project allowed for all data to be easily provided in a format suitable for integration with PWGSC’s existing GIS systems.

This tool is designed so that it could easily be adapted to larger or smaller portfolios.

2:30 pm – 3:00 pm

**Overview of ITRC’s New Guidance on S/S Performance Standards**

Charles Wilk and Matt Geary

CETCO

The Solidification/Stabilization (S/S) Technical Team of the Interstate Technology and Regulatory Council (ITRC) recently completed technical guidance titled Development of Performance Specifications for Solidification/Stabilization. This presentation will provide an overview of the ITRC-published guidance.

ITRC was established in 1995 as a state-led, national coalition of personnel from the environmental regulatory agencies of all 50 U.S. States and the District of Columbia, U.S. Environmental Protection Agency (EPA), Department of Defense, Department of Energy and industry partners. The ITRC S/S Team was formed in 2009 with the aim of developing the technical and regulatory guidance needed to support the on site use of S/S in the remediation of contaminated property.
S/S is a contaminated site treatment technology with a long history of use in EPA’s Superfund program to address the nation’s worst sites. The treatment involves mixing binding agents into contaminated soil or sediment. S/S protects human health and the environment by immobilizing hazardous constituents within treated material. Contaminated soil is often treated in place (in-situ) resulting in improved constructability of contaminated property. Treatment of excavated material can result in beneficially re-useable construction fill.

Over the years and for many projects, individual federal and state regulators have set a variety of performance specifications for projects where S/S-treated material has been left on site. The ITRC’s S/S Team developed the guidance document; along with both classroom and internet-based training courses, to meet the information needs of regulators. The guidance is intended to assist regulators in setting consistent performance standards that are appropriate for the conditions of a specific site. Site owners, consultants and contractors can also benefit from an understanding of the guidance.

The guidance covers: (a) S/S treatment overview; (b) a process for selecting appropriate performance specifications; (c) measurements during full-scale implementation to ensure successful treatment; (d) long-term stewardship considerations; and, (e) potential stakeholder concerns.

3:30 pm – 4:00 pm
Application of Treasury Board’s New Policies on the Management of Projects to Federal Contaminated Site Projects
Monique Punt¹, Stephen Fleming¹, Craig Hawkes¹ and Nick Monteiro²
¹Bronson Consulting Group
²Aboriginal Affairs and Northern Development Canada

The Treasury Board of Canada has introduced new policies on Investment Planning and on the Management of Projects to enhance management accountability and project management performance within federal departments and agencies. These policies are significantly changing how departments manage projects and obtain approval to perform them. Due to the unique nature of contaminated site projects, applying the new policies to these projects presents some challenges, particularly because the policies were developed with large information technology projects in mind.

As part of the policy implementation plan, an initiative was undertaken in 2010 and 2011 to perform an Organizational Project Management Capacity Assessment (OPMCA) for the Northern Contaminated Sites Program (NCSP) at Aboriginal Affairs and Northern Development Canada (AANDC). While the OPMCA is intended to determine the overall capacity of a department to manage projects, the results of this preliminary assessment enabled the NCSP to understand its capacity to manage projects as per the new policies and to assess the potential impact of these policies on the NCSP’s authority for project approval. As well, because NCSP’s projects make up a significant portion of AANDC’s project portfolio, the NCSP assessment was one of the main sources used to develop the department’s overall OPMCA score.

As part of this work, a review was also performed of the new requirements to accurately assess individual NCSP projects in accordance with the IP/PM Standard for Project Complexity and Risk and 18 contaminated site projects were assessed using the Treasury Board Project Complexity and Risk Assessment Tool.

This presentation will summarize the methodologies used, the results obtained and the challenges faced in applying these policies. Recommendations will also be made for other departments who need to apply these policies to their contaminated site projects.

4:00 pm – 4:30 pm
Use of Earned Value Management in Monitoring and Controlling the $85M Mid-Canada Line Clean-up Project
Chris Ludwig¹, Grant Ritchie², Mike Cartan² and Christine Leblanc²
¹Franz Environmental Inc.
²Ontario Ministry of Natural Resources

In the mid-1950’s, the Department of National Defence (DND) established seventeen radar sites in Ontario, as part of the Mid-Canada Line (MCL), situated mostly along or near the coasts of Hudson Bay and James Bay. The MCL sites were retired in the 1960’s. As of February 2008, one of the sites had been decommissioned and remediated (Fort Albany, 2001 by Ontario).

The MCL remediation project entails environmental remediation and clean up of sixteen MCL sites over six years (2009-2015). The clean-up involves removing hazardous waste, land filling non-hazardous waste/debris at two of the sites, demolition of all buildings and structures, on-site treatment of hydrocarbon contaminated soils and off-site treatment or disposal of other contaminated soils and debris. The 2009/10 Provincial Budget identified $85 million as the total budget for the project. This figure includes the $30 million funded through a contribution agreement with the federal government.
In 2011, Franz Environmental Inc. (Franz) was commissioned by the Ministry of Natural Resources (MNR) to undertake a review of the project in terms of identifying which components of the project are at risk of having significantly greater costs; the likelihood of the Ministry incurring risk; and which components of the project may need to be deleted or reduced in scope to keep the project within budget, with the attendant risks to the Ministry/project.

The project is in year three of a six-year planned schedule. Based on the experience of the first two and half years of the project, Franz used earned value management (EVM) techniques to predict what the schedule and costs variances will be at the end of the project, and where changes need to be implemented. EVM is a widely accepted project management technique for measuring cost and schedule performance. EVM uses a set of metrics that are combined to produce indicators of project performance. In particular, EVM can be used to measure how efficiently a project is using its budget (cost variance) and following its schedule (schedule variance). These performance measurement indicators are built on three independent metrics: earned value, planned value and actual costs. EVM was applied to the MCL project to: a) assess project performance to date; b) predict the future performance of the project; and, c) identify tasks and issues which need to be addressed in order to keep the project on track in terms of budget and schedule.

4:30 pm – 5:00 pm

**Adopting Performance Specifications for Site Remediation: A Tool for Project Managers**

Brian Whiffin¹, Valerie Moran², Sebastien Yelle²

¹CH2M HILL Canada Limited
²Public Works Government Services Canada

Performance specifications offer an opportunity to increase innovation and transfer risks during the remediation of contaminated sites. However, this approach has not been routinely adopted for federal projects. The presentation will evaluate the benefits that can be achieved by using performance specifications for site remediation. Performance specifications will be defined relative to the status quo of detailed specifications. This will include an evaluation of the conditions that are best suited to this approach. The use of performance specifications for different types of contracts will be examined. Linkages will be established to facilitate the implementation of performance specifications under the 10-step FCSAP program and to integrate this approach with the requirements under CEAA. The application of performance specifications will be illustrated using case histories from selected federal projects to demonstrate how the approach was applied the results achieved. The presentation material is based on a more extensive workshop presentation developed under direction and support from Public Works and Government Services Canada.
8:30 am – 9:00 am

**Introducing the Draft CCME Protocols for the Derivation of Groundwater and Soil Vapour Quality Guidelines**

Ian Mitchell\(^1\) and Miles Tindal\(^2\)

\(^1\)Meridian Environmental Inc.
\(^2\)Axiom Environmental Inc.

In 1996 the Canadian Council of Ministers of the Environment (CCME) published A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines, later updated in 2006. This document was used to develop the Canadian Soil Quality Guidelines, which are risk-based guidelines used for the assessment, management and remediation of federal contaminated sites as well as contaminated sites in several other Canadian jurisdictions.

Many federal contaminated sites investigations also include the collection of groundwater data and, in recent years, soil vapour data. Therefore a need was identified for risk-based guidelines for evaluating groundwater and soil vapour quality. In response to this need, CCME has developed separate draft protocols for the derivation of groundwater quality guidelines and soil vapour quality guidelines. These draft protocols are designed to parallel and complement the soil quality guidelines protocol and enable the derivation of defensible risk-based groundwater and soil vapour quality guidelines using a consistent approach.

The presentation will provide background on why these draft protocols were developed, how they relate to the soil quality guidelines protocol and where they differ or introduce new concepts, the exposure pathways considered in the guideline derivation, and the current status of the protocols.

9:00 am – 9:30 am

**Background Soils Database in Atlantic Canada**

Rita Mroz, Brian Drover and Brad MacLean

Environment Canada

In 2004, Environment Canada (EC) recognized the need to establish background soil data, specific to Atlantic Canada, which could be used during the assessment of federal contaminated sites in the Atlantic region. This data could be used to estimate region-specific background soil concentrations, particularly for metals, in areas where naturally occurring concentrations exceed the soil quality guidelines established by the Canadian Council of Ministers of the Environment (CCME). Other jurisdictions, such as British Columbia, Ontario and Quebec have existing soils databases and EC determined that a similar database for the Atlantic region would be useful.

The primary purpose of the background soils database is to provide site professionals with background soil concentrations, to be used in risk assessment projects at federal sites in the Atlantic region. The establishment of the background soils database allows for the screening of site data to determine if it is within the typical background range. The creation of an Atlantic region background soils database will allow for the comparison of data from a specific site to the background concentrations for that region. Chemical concentrations that exceed the relevant CCME guidelines would not be considered contaminants of concern if these concentrations fall within the background concentration range for that parameter in that region.

In 2004, the Atlantic region was subdivided into soil zones in recognition that the overall region has inherent differences in soil quality and geology and the each zone would be expected to share similar geochemical and geophysical properties. The second step was to establish a soil sampling protocol that would ensure each sample was collected in a consistent manner. Initial samples were analyzed for a suite of parameters including: metals, PAHs, PCBs, grain size, pH, and total organic carbon. A decision was later made to reduce the analytes to metals, pH, TOC and grain size in order to reduce analytical costs. The majority of the samples were collected in 2007, in cooperation with the North American GeoLandscapes Project, with partners including Natural Resources Canada and provincial natural resource departments. In 2010, a gap analysis was completed to validate the soil zone approach and sampling protocol, analyze the raw soil data to generate summary statistics and background range values for each soil zone, and recommend any changes to the overall approach. The results of this gap analysis will be presented.
9:30 am – 10:00 am

**Use of Remote Sensing Hyperspectral Analysis in Remediation Design at the Former North Rankin Nickel Mine**

Paul Bandler¹, Stephen Hooey² and Yannick Lanthier¹

¹WESA Group Inc.
²Aboriginal Affairs and Northern Development Canada

The North Rankin Nickel Mine, Nunavut, operated between 1957 and 1962. Approximately 300,000 tonnes of tailings were deposited along the shoreline within the current hamlet boundary. In 1994, site closure and reclamation plans were completed. Tailings were consolidated in two deep granite basins near the shore and encapsulated with approximately one metre of granular cover material. However a 10,000m² section of tailings remained uncovered. Thermistor readings indicate freezing is occurring as projected.

Aboriginal Affairs and Northern Development Canada (AANDC) retained WESA Group Inc. (WESA) to provide consulting services to assess risks of exposed tailings to humans and the environment. One aspect of the tailings assessment was to conduct a remote sensing spectral analysis. This analysis was undertaken to help AANDC in locating the abundance of tailings and their spatial distribution across the town’s shore.

WESA tasked the Worldview-2 satellite to collect a high-resolution (2m) multispectral image (8 bands) over the town of Rankin Inlet while a field team conducted a ground-level spectral survey. A first endmember extraction process allowed us to map the varying concentrations of tailings across the site. The same endmember extraction process was applied to an archived Quickbird image from 2003.

Spectral analysis of tailings abundance and dispersion has correlated well with in-situ observations and chemical testing of exposed tailings and areas of erosion. In 2011, WESA used high precision GPS to create a topographic model of the exposed tailings area and surrounding erosion zones identified by the spectral analysis. This model was used to design an isolation cover of appropriate thickness and with suitable drainage refinements for the exposed area. The remedial design was completed in August 2011.

10:30 am – 11:00 am

**Comparison of Observed Vapour Attenuation Versus Model Predicted for Sites Contaminated with Chlorinated Solvents**

Lindsay Smith-Munoz¹, Ian Hers², Jo-Ann Aldridge¹, Meghan Roushorne¹ and Asish Mohapatra¹

¹Health Canada
²Golder Associates Ltd.

Health Canada uses the Johnson and Ettinger model to predict risks associated with soil vapour transport to indoor air from subsurface contamination. This model may not predict vapour intrusion with the same level of conservatism for chlorinated solvents as it does for petroleum hydrocarbons.

To evaluate the suitability of Health Canada’s vapour intrusion model for chlorinated solvent chemicals, a data set was compiled from sites in Canada, United States (including Alaska and the Lower 48 States), and Europe for sites with both indoor air and soil vapour or groundwater analyses. Data was collected and added to the publicly available US Environmental Protection Agency empirical vapour intrusion database. The data set was assessed and filtered, to remove sites and contaminants with apparent background influences, and sites with low source, soil vapour and/or indoor air concentration. Attenuation factor consistency between multiple chemicals at the same site, and sample detection limit were also used to filter the data.

For all results below, the observed 75th percentile empirical attenuation factor was compared to model predictions.

**Results**

For residential land use and coarse-grained soil, the observed attenuation factor for filtered data was 3.3 x 10⁻⁴, whereas model predicted factors were 4.5 x 10⁻⁴ to 1.1 x 10⁻³. It is likely that the model is adequate for predictive purposes for this scenario.

For residential land use and fine-grained soil, the observed attenuation factor was 1.4 x 10⁻⁴, whereas the model predicted factors range from 7.6 x 10⁻⁵ to 1.1 x 10⁻⁴, so it cannot be said the model makes adequately conservative predictions for this scenario.

For commercial land use (coarse and fine soil combined), the observed attenuation factor is 3.4 x 10⁻⁴, whereas the model predicted factors range from 2.0 x 10⁻⁵ to 2.0 x 10⁻⁴, and the model may not be adequately conservative.

For residential buildings and coarse-grained soils the observed value is slightly greater than the modelled range. For fine grained soil the observed attenuation was again higher than modelled.
For commercial land use, the observed attenuation factor was $1.6 \times 10^{-2}$, whereas the model predicted factors were much lower at $3.7 \times 10^{-4}$ to $1.7 \times 10^{-4}$ for both coarse- and fine-grained soil. The model over-predicted attenuation and under-predicted risk.

Subslab soil vapour data suggested an empirical attenuation factor of 0.02 is conservative for a majority of sites.

**Discussion**

Model predictions were closer to being adequately conservative for groundwater versus soil vapour and for residential versus commercial buildings. Soil vapour samples are subject to more data quality issues, particularly as a combination of newer and older data was used in this assessment. The observed attenuation factors were closer to model predictions when deeper, near contamination source soil vapour data were used. Model assumptions may need to be adjusted to ensure the model is adequately conservative for all scenarios. The importance of data quality cannot be overstated.

11:00 am – 11:30 am

**On-site Environmental Analysis at Remote Sites in Northern Ontario and Nunavut**

Allison Rutter and Graham R. Cairns
Queen’s University

An on-site laboratory (OSL) offers many advantages, however, working in remote sites requires excellent logistical support and highly skilled personnel. Each site offers unique challenges and clean-up operations are often hampered by the presence of snow, permafrost and the muddy conditions encountered when the spring thaw arrives. To prevent project cost overruns, reliable analytical results are required as quickly as possible.

Shipping samples to laboratories in the south is the limiting factor for many cleanup operations. Chartered aircraft are used to transport samples. Due to the prohibitive costs, these flights are often flown on a weekly basis and bad weather can further hamper turnaround times.

The OSL can produce equivalent results at levels that meet and exceed regulatory requirements in a highly efficient manner. For very remote locations, even the most expedited service cannot compete with the turnaround time from an OSL.

To reduce the start-up costs associated with complex dangerous goods shipments, standard lab methods were modified to decrease solvent and reagent usage. These modified procedures were fully validated in the south and also in the OSL prior to receiving samples. Site-specific method development was thus required and performed. The work had the added benefit of minimizing solvent discharge to the environment.

As part of the Ministry of Natural Resources clean-up of Site 500 (Winisk), of the Mid-Canada Line, a mobile laboratory was set up with two gas chromatograms to analyze total petroleum hydrocarbons and polychlorinated biphenyls. Turnaround times of 32 hours for up to 30 samples per day were required to support the remediation. The laboratory successfully provided high quality results and met all turnaround time requirements for over 100 days of operation during the summer of 2011. Logistical challenges and the development of site-specific protocols will be discussed.

At the DYE-M, Distant Early Warning Site, Cape Dyer, Nunavut, atomic absorption instruments were operated in flame and hydride generation modes and an x-ray fluorescence spectrometer (XRF) was used to analyze the contaminated soil samples. Toxicity characterization leachate procedure (TCLP) for lead in soil was also performed on site. The laboratory was in full operation for two seasons of eleven weeks each. A throughput of 2,500 to 4,000 samples per season and a required turnaround time of 24 to 48 hours were required and successfully met to support the extensive clean-up required of metal contaminated soils. Some of the issues which had to be overcome will be discussed.

11:30 am – 12:00 pm

**Integrated Approach to the Remediation of Chlorinated Organic Compounds in Low Permeability Soils – A Field Study**

Leanne Murdie Austrins and Christopher Peace
CH2M HILL Canada Limited

The biological and chemical degradation pathways of chlorinated organic compounds (COCs) in soil and groundwater are well documented. Using varying combinations of chemical reduction and enhanced bioremediation, the rate of in-situ degradation can be enhanced. However this process can be severely limited by stratigraphy and the geochemical environment. Many chemical substrates used to break down COCs are short lived and must quickly come into contact with their intended target. In the case of biological degradation, microorganisms are unable to proliferate effectively in the presence of many free-phase chlorinated solvents and bioremediation is only able to occur on edge of free phase zones. In low permeability fractured soils, in-situ remediation is limited not only by the reaction, but the transport of the contaminants from the soil to the groundwater. This transport is a rate-limiting step and can result in on-going high concentrations of the contaminants for many years.
To effectively overcome these challenges, an integrated approach to in-situ remediation of chlorinated solvents at low permeability sites was necessary. Introducing substrate to promote chemical degradation to address free-phase compounds followed by substrate to enhance bioremediation to address residual and diffusion contaminant concentrations allowed effective treatment of the bulk of the contaminants and enhanced bioremediation of contaminant concentrations remaining. Methods to increase the bulk permeability of the soil, or increase the rate at which COCs will release from soil particles, was necessary to allow for the effective delivery of chemical substrates to reaction sites and increase the rate at which treatment will occur. Evidence for the efficacy of this integrated approach has been demonstrated in a low permeability fractured silty clay fill where concentrations of contaminants exceed their solubility limits. Based on the site investigations, it was determined that two mechanisms of in-situ destruction of chlorinated solvents could be employed to effectively reduce the concentrations these chemicals in soil and groundwater. Direct dechlorination of the compounds through chemical reaction with zero valent iron (both granular ZVI and emulsified ZVI), and enhancing bioremediation through the addition of emulsified vegetable oil (EVO) and glycol. The efficacy of the remediation in the silty clay was improved by hydraulic soil fracturing.

At this time, results of sampling events have provided evidence for proof of concept using the integrated remedial approach. In addition, field evidence indicates the methods employed have started to affect contamination thought to be sorbed onto clay particles in the matrix, creating a remedial diffusion halo effect.

1:30 pm – 2:00 pm

**McNabs Petroleum Handling and Storage Area Remediation Project as a Driver of Provincial-Federal Partnerships**

Mabuye Dia, Parks Canada

Located on McNabs Island in Nova Scotia this former petroleum handling and storage area was transferred from the Department of National Defence to Parks Canada in 1964 for creation of the Halifax Defence Complex National Historic Sites. After completing the boundary delineation for Fort McNabs National Historic Site, Parks Canada transferred the surplus land to the Nova Scotia Department of Natural Resources in 2000 to be part of a provincial park. In 2003, the Hurricane Juan storm surge exposed a portion of pipeline located on the western shore of McNabs Island on lands transferred from Parks Canada and heavy oil was released onto the shoreline. Parks Canada, as a former custodian of the site, and in collaboration with the Province of Nova Scotia and all stakeholders, including the Friends of McNabs Island and the Aboriginal partners, completed additional environmental site assessment and risk assessment studies, fully remediated contaminated soil and water, and implemented and successfully completed a confirmatory sampling program of this very complex project involving many players and considerable technical ability.

2:00 pm – 2:30 pm

**Case History and Site Remediation at the Top of the World – Rogers Pass West**

Darlene Atkinson¹, Dan Walker¹ and Danielle Backman²

¹Golder Associates Ltd.

²Mount Revelstoke and Glacier National Parks, Parks Canada

Rogers Pass is a famous high mountain pass located in Glacier National Park, in the Selkirk Mountains of southern BC. From the late 1880's to 1916, Canadian Pacific Railway (CPR) operated a passenger station and rail yard at the top of the pass. During this time, avalanches claimed the lives of over 200 railway workers, which led to the construction of the 8 km long Connaught Tunnel through Mount MacDonald and the abandonment of the Rogers Pass station and rail yard in 1916. The top of the pass sat relatively dormant until the late 1950's, when the Trans-Canada Highway was constructed through Rogers Pass. Subsequent to highway construction, a number of facilities were developed at the top of the Pass. On the west side of the highway (“Rogers Pass West”), these facilities included a service station, a hotel, and a Parks Canada interpretive centre.

Subsurface investigations identified several sources of soil and groundwater contamination at Rogers Pass West. Shallow petroleum hydrocarbon contamination of soil and groundwater was identified at the service station pump island and tank nest, attributed to gasoline and diesel stored and handled at the site. Shallow polyaromatic hydrocarbon soil contamination was identified at various locations, and is inferred to be due to deposition of residues from inefficient combustion of coal in locomotives, during the era of the CPR rail yard. Deeper contamination by high-viscosity, high-density petroleum product was also identified (up to 11 m below grade), and is attributed to releases of heavy oils during the era of the CPR rail yard. A human health and ecological risk assessment was conducted to evaluate the risks associated with the identified contamination.

The preferred remediation strategy at the service station included removal of the existing underground storage tanks, excavation of contaminated soil, and emplacement of an oxygen-release compound (calcium peroxide) to enhance bioremediation. At other areas of the site with shallow soil contamination posing unacceptable risks, targeted excavation of contaminated soil was completed. Approximately 1,570 m³ of petroleum hydrocarbon-impacted soil was excavated and disposed at an off-site licensed facility. At the service station, complete removal of contaminated soil was not feasible due to the presence of existing buildings, infrastructure, and shallow groundwater. An oxygen-release compound was placed
2:30 pm – 3:00 pm
**Assisted Revegetation Following Contaminated Site Remediation in the Arctic: Case Study at Cape Dyer (DYE-M)**

**Baffin Island, Nunavut**

Dr. Barbara Zeeb, Sarah Ficko and Brandon Smith
Royal Military College of Canada

Construction, operation, and maintenance of a large Distant Early Warning (DEW) Line Station at Cape Dyer (DYE-M) Baffin Island, Nunavut from 1956-1989 resulted in the contamination of soils and ground water at numerous locations of the site. In 2008, extensive remediation work was conducted at the beach area of the site to remove material from several buried landfills. Subsequent reshaping of the terrain resulted in approximately 19,700 m$^2$ of land devoid of vegetation. Areas lacking vegetation are less stable and more vulnerable to wind and water erosion, unable to provide food or habitat for animals, and visually unappealing. In addition, as plant growth in arctic locations is constrained by short growing seasons, harsh environmental conditions, low species diversity, and minimal soil fertility, re-establishment of plant cover through natural succession events is a significantly longer and slower process than in more temperate climates.

In 2009, a pilot-scale project was initiated at the site to investigate the feasibility of using assisted revegetation to accelerate plant growth on the disturbed regions of the beach area. Approximately 500 Salix arctica (Arctic willow) cuttings were collected from a nearby donor population following a frost, and transplanted in plots of ~20 cuttings, to create small “islands” within each unvegetated area to accelerate growth of these slow-growing woody perennial species. Fifty pounds of Lolium multiflorum (annual ryegrass) was spread by hand across all unvegetated areas as a “nurse grass” to establish an immediate plant community, improve nutrient content in the soil, create microenvironments to improve germination, and provide windbreaks to help trap native seeds blowing across the unvegetated areas. Ripe seeds and berries from native species were collected by hand from the areas surrounding the disturbed sites and spread by hand across all unvegetated areas. In July 2010, it was determined that 95% of the S. arctica cuttings planted in September 2009 had survived the winter and produced new shoot growth. Furthermore, significant root development was found on excavated specimens. The highest density of new seedling growth was also observed around rocky areas and within S. arctica patches indicating that these areas provide microclimates that enhance seed germination and seedling growth. Following a second winter, the survival rate of S. arctica in July 2011 had decreased to 73%, partially due to a landslide which had covered one segment of the revegetation areas. In September 2011, another 150 S. arctica cuttings were planted on the remaining areas to increase the number of islands, as it appeared that S. arctica islands did indeed help to accelerate revegetation on the reshaped areas at Cape Dyer. Based on the survival rate success of S. arctica cuttings and native plant seedlings in 2010 and 2011, this work will be continued at DYE-M in 2012 and potentially expanded to other northern sites as well.

3:30 pm – 4:00 pm
**Use of Bioengineering Techniques for Re-vegetation of Riparian Areas at the Colomac Mine Remediation Project, Northwest Territories**

Morag McPherson$^1$, Rebecca Vanderspiegel$^2$, Melissa Munger$^2$ and Mary Hewitt$^3$

$^1$Fisheries and Oceans Canada
$^2$Aboriginal Affairs and Northern Development Canada
$^3$Flat River Consulting Ltd.

Aboriginal Affairs and Northern Development Canada (AANDC) assumed responsibility for the Colomac Mine, a former gold mine located approximately 220 km north of Yellowknife, NT, in 1999. A remediation plan for the site was developed and approved in 2004, with remediation activities occurring at the site between 2005 to present.

During mine operation, a total of 23 fuel spills were reported at the mine, including two major fuel spills at the tank farm in 1990 and 1997. Released hydrocarbon product continued to flow through fractures and faults along the shoreline of Steeves Lake, adjacent to the mine, resulting in the contamination of shoreline sediments and development of a chronic hydrocarbon sheen until remedial actions were completed in 2010.

Contaminated sediments along 750 m of impacted shoreline were contained and capped in the summer of 2010 during remediation activities at the site to prevent mobilization of hydrocarbons from contaminated sediments and prevent ongoing hydrocarbon inputs to Steeves Lake.
The shoreline remediation work required a ss.35(2) Fisheries Act authorization from Fisheries and Oceans Canada for the harmful alteration, disruption or destruction of fish habitat. A component of the fish habitat compensation requirements involved the restoration of shoreline vegetation and riparian areas on the mine site.

An expert in bioengineering techniques for land and riparian restoration was engaged to assist in exploring options for re-vegetation techniques in the north and to provide local training. Re-vegetation treatments for the riparian areas focused on the establishment of pioneering species, using willow, alder and wetland sedges harvested from the mine site. Site preparation involved using the "rough and loose" technique where possible to improve natural recovery. Willow cuttings were used in live gravel bar staking and simple live staking. Seeding with arctic grass seed mix and alder seeds was completed in prepared areas. Sedge plugs were used to create new wetland and flood zone riparian areas.

A monitoring framework was developed to evaluate the success of the re-vegetation effort over time. The first of five years of monitoring was completed during the summer of 2011. Initial results show that plant survival and growth on the majority the revegetation areas where bioengineering techniques were used met expected success rates. Some poor results were documented in areas where techniques were either used incorrectly or too late in the season.

This presentation will provide a summary of the revegetation requirements associated with the Steeves Lake shoreline remediation, the use of bioengineering training and techniques for re-vegetation in a northern environment, and the framework used to monitor and assess re-vegetation success.

Lessons learned will be discussed including the need for early identification of re-vegetation and restoration requirements in the planning process to incorporate into project management, and the need to include expertise and training within the revegetation plan. The bioengineering techniques provided a successful, cost-effective and local approach to restoration in a northern environment.

4:00 pm – 4:30 pm
Development of a Soil Washing and Value Added Aggregate Production Process for the 2010 Soil Treatment Program at the Liard Maintenance Yard KM 762.5, Alaska Highway
Ivy YuXia Liu1, Richard Wells1, Marta Rosa1 and Raman Birk2
1Franz Environmental Inc.
2Public Works and Government Services Canada
Franz Environmental Inc. (Franz) was retained by Public Works and Government Services Canada (PWGSC) to conduct a soil treatment program at the Liard Maintenance Yard. The site is located south of the Liard River resort area, at kilometre 762.5 on the south side of the Alaska Highway and is currently used as a vehicle maintenance garage and fuelling facility. Franz developed an innovative soil treatment method in 2009 and implemented the program to treat hydrocarbon-impacted soil in both 2009 and 2010. The approach included using an excavator equipped with a bucket screener to aerate and screen impacted soil to separate the granular soil into winter sand and drain rock aggregate while spraying the material with water at a high pressure. The work was conducted by Winnipeg Environmental Remediation Inc. using an excavator and a screening bucket. The soil treatment program was conducted from September 17, 2010 to October 7, 2010. During this period, 2,600 m³ of contaminated soil was treated using this approach. Franz personnel were on-site to monitor the treatment progress and to evaluate the treatment progression through the implementation of a unique sampling program consisting of pre-treatment and post-treatment soil analysis. The sampling method was designed to allow for statistical evaluation of sampling data used to quantify petroleum hydrocarbons (PHCs) reduction. Parametric two-sample t-test and/or non-parametric two-sample Wilcoxon-Mann-Whitney (WMW) Test was applied to assess whether the reduction results are statistically significant. Reductions of PHCs (EPH C10-C19 and C19-C32) in treated soil ranged from 13% to 63% compared to concentrations before the treatment. The treatment process resulted in an average contaminant reduction of 32%, p-value of both parametric and non-parametric statistical analysis approach 0. The results of the statistical analysis on sample data indicated that the PHCs reduction was statistically significant. Franz recommends completing another round of soil treatment in order to further treat soil in the STF to concentrations compliant with respect to the BC Contaminated Site Regulations, Residential level (BC CSR RL) standards.
The Port Hope Project is part of the larger Port Hope Area Initiative (PHAI), a community-based program for the development and implementation of a safe, local, long-term management solution for historic low-level radioactive waste (LLRW) in the Municipalities of Port Hope and Clarington, Ontario, Canada. Atomic Energy of Canada Limited (AECL) is the project proponent, Public Works and Government Services (PWGSC) is managing the procurement of services and the MMM Group Limited-Conestoga-Rovers and Associates joint venture is providing detailed design and construction oversight and administration services for the project. The Port Hope Project includes the construction of a long-term waste management facility (LTWMF) in the Municipality of Port Hope and the remediation of 20 LLRW and industrial sites within the Municipality. The total volume to be remediated is over one million cubic metres and will come from sites that include formal temporary storage sites, ravines, beaches, parks and vacant industrial sites all within the urban area of Port Hope.

In addition to special considerations for the handling of LLRW, the Port Hope Project has numerous challenges due to the urban nature of the sites and onerous site constraints. Challenges have included:

- The transport of large quantities of waste on urban roads;
- The incorporation of site restoration design elements that will benefit the community;
- Two sites with steep ravines and streams bounded by private residences;
- Beachfront site with deep excavation requirements, shallow groundwater and sandy soils;
- Former coal gasification plant site with deep excavation requirements and groundwater seepage adjacent to private residences;
- Mixed LLRW and industrial contaminants on a large former industrial pier adjacent to the Harbour and the Ganaraska River;
- Former municipal landfill containing a combination of municipal solid waste and LLRW surrounded by private residences, an arena and a high school; and,
- LLRW below a roadway through a residential neighbourhood on a steep slope.

The presentation will discuss the special remediation design options that have been considered to address the unique conditions present at many of the Port Hope sites. The use of risk assessment at select industrial sites will be reviewed. Environmental protection measures to control dust, surface water, odour, etc. will also be discussed with emphasis on considerations for the type of contaminants present and the close proximity of offsite receptors.
8:30 am – 9:00 am

**HOListic Management of Brownfield REgeneration (HOMBRE)**
Hans van Duijne, Deltares

At the heart of HOMBRE is the ambition to create a paradigm shift to ‘Zero Brownfields’ where brownfields become areas of opportunity that deliver useful services for society, instead of derelict areas that are considered useless. This ambition will be met by looking at how synergies between different types of services might leverage change where none was possible before.

Each brownfield has its own potential for delivering useful combinations of services and hence new opportunities, such as synergies between services such as development, water improvement and renewable energy. An intelligent and holistic suite of technologies management measures and land use is the key that can unlock this potential. HOMBRE is centred on the identification of synergies and the design of the approaches needed to achieve them.

An overarching assessment of opportunities and services lets stakeholder(s) choose how these are taken into account for the possible re-uses. The HOMBRE shift in thinking relates not only to the redevelopment itself, but also to gaining better understanding in early recognition and prevention of land that might become brownfield in the future, and how to monitor this as part of the land use cycle.

A visual decision support tool – the Brownfield Navigator – is being developed by HOMBRE to guide stakeholders showing synergies between services and the opportunities these create at the different stages in the land use cycle. The goal is to enable better communication between stakeholders about opportunities and inspire them to find better solutions with higher added value. HOMBRE will illustrate what might be possible with a number of case studies where implementing suites of ‘hard’ and ‘soft’ technologies, has facilitated cost-effective, timely, and sustainable brownfield regeneration along with broader services to the environment, economy and society.

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9:00 am – 9:30 am

**Evaluation of Groundwater Transport of Perfluorinated Chemicals at a Former Fire-Fighting Training Area**
Lindsay Paterson¹, Ian Mitchell¹, Ian Chatwell² and Raman Birk³
¹SLR Consulting (Canada) Ltd.
²Transport Canada
³Public Works and Government Services Canada

SLR Consulting (Canada) Ltd., on behalf of Public Works and Government Services Canada and Transport Canada, has evaluated perfluorinated chemicals (PFCs) in groundwater at a former fire-fighting training area since 2006. The PFCs are related to the historical use of aqueous film forming foams during fire-fighting training exercises.

Groundwater PFC concentrations were identified at the site above site-specific risk-based targets. Analytical modelling of groundwater transport of PFCs was utilized to assist in estimating the current extent of the PFC groundwater plume, locating delineation wells and predicting the potential arrival time of the PFC plume at down-gradient receptors of concern.

Challenges in the evaluation of PFC groundwater transport included the paucity of literature on sorption coefficients (Kd values) for many PFCs and the substantial temporal variation in groundwater concentrations of perfluorohexane sulfonate (PFHxS) and perfluorooctane sulfonate (PFOS). The variation in PFOS and PFHxS concentrations over time has been attributed, in part, by the project laboratory to analytical subsampling methodologies, and in particular, to the stratification of perfluorosulfonates in high level aqueous samples.

The extensive groundwater dataset collected at the site has also identified differences in PFC composition with distance from the source. The predominant PFCs in groundwater at or immediately near the source are PFHxS and PFOS (approximately 80% of measured PFCs) while shorter chain perfluorocarboxylates (i.e., PFBA, PFPeA and PFHxA) comprise the majority of the measured PFCs approximately 160-200 m from the source. Consequently, analytical modelling of groundwater at the site has evaluated the transport of a variety of PFCs, not just PFOS and PFHxS.
9:30 am – 10:00 am
Toxicity Review of Perfluorocarboxylates
Tara Siemens Kennedy1, Ross Wilson1, Bertrand Langlet2 and Darcy Longpré2
1SNC-Lavalin Inc.
2Health Canada
In recent years, the presence of perfluoroalkylated substance (PFAS) contaminated sites in Canada has been recognized. Previous work conducted on behalf of Health Canada indicates that several classes of PFASs, including perfluorosulfonates (PFSA), perfluorocarboxylates (PFCA), fluorotelomer alcohols (FTOH), fluorotelomer sulfonates (FTSA) and polyfluorinated sulfonamides (FSA), are likely to be present at some contaminated sites in Canada. Although several international health agencies have developed human health guidelines for perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), few guidelines exist for other PFASs. SNC-Lavalin Environment Inc., on behalf of Health Canada, has conducted a toxicity literature review for PFCAs. The review was conducted to compile available data on the toxicokinetics and toxicological effects of PFCAs. Guidelines and toxicity reference values (TRVs) developed by international health agencies were reviewed. For PFCAs with TRVs from more than one agency, a comparative analysis of the data, rationale and uncertainties used to develop the TRVs was conducted to determine the most appropriate TRV for use by Health Canada. In addition, the review identified PFCAs with no available TRVs, but sufficient data to derive de novo TRVs, as well as recommended approaches for assessing PFCAs with no TRVs/insufficient data to derive de novo TRVs. The results of the review will be considered in the future development of environmental quality guidelines for PFCAs.

10:30 am – 11:00 am
Assessing Carbon 14 as a Potential Contaminant of Concern at a Research Laboratory
Phyllis Gregoire1, Tim Whalen1, Andrew Sorensen2 and Cher LaCoste2
1Golder Associates Ltd.
2Fisheries and Oceans Canada
Carbon 14 is not a typical contaminant of concern assessed during routine environmental site investigations. Carbon 14 was reportedly used in a laboratory on a federal research facility and discharged to an infiltration pit. This particular scientific research facility has been active since the 1960’s. Prior to this date the area was undeveloped and forested. The total area of the property is approximately 1.2 hectares and consists of a main research building, wet lab, two lake water storage tanks, pump house (off site), spawning pool, four outdoor fish tanks, garage workshop, flammable materials storage shed, powerhouse, boat storage building and two residential buildings.

The research laboratory historically and currently disposes of used chemicals in a sink, which discharges to an infiltration pit located in the northeast corner of the site, approximately 30 metres west of a creek. The infiltration pit was installed in the 1960’s. The size, depth and extent of the pit is not fully known because it is currently overgrown with brush at the surface, but it is understood to be lined with gravel. The discharge to the pit from the laboratory sink is located approximately 40 metres from the building and is connected with a relatively shallow PVC pipe. We understand that the chemicals, including carbon 14, were discharged with no treatment but were heavily diluted with water.

The assessment included soil and groundwater sampling near the infiltration pit by means of borehole drilling and monitoring well installation. One inferred upgradient groundwater sample was collected from an existing monitoring well and two surface water samples were also collected near the inferred downgradient creek.

Carbon 14 is radioactive and does not have typical federal or provincial regulatory criteria, or techniques for field screening. Therefore additional health and safety precautions (i.e., beta-counter) and sampling procedures for unique parameters needed to be developed and undertaken. Other issues unique to carbon 14 focused on sampling considerations and data assessment criteria (i.e., Canadian Nuclear Safety Commission regulations).

The results from this site indicated that the samples collected were “free of significant” carbon 14 concentrations. The questions for regulators are: Was this research facility an isolated case where carbon 14 was considered a potential contaminant of concern worthy of its own assessment or is this typical of other research facilities? Should future preliminary assessments include an inventory of current and historical chemicals used at the laboratory and methods of disposal? Are the risks related to carbon 14 significant enough to spend the time and money on intrusive investigations?
11:00 am – 11:30 am

**Development of a Remedial Action Objective for Tributyltin**
Rachael Jones¹, Andrew Mylly², Gary Lawrence¹
¹Golder Associates Ltd.
²Public Works and Government Services Canada

Golder Associates Ltd. is working as part of a multi-consultant team to develop a strategy for remediation of a contaminated waterlot owned by Public Works and Government Services Canada (PWGSC). Sediments within the waterlot and surrounding marine environment are contaminated by metals, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) and tributyltin (TBT). The remedial action objectives (RAOs) are based on the findings of ecological and human health risk assessment, combined with remediation of sediment to meet numerical objectives and thereby reduce financial liability to PWGSC. However, these RAOs require customization for TBT (an antifouling agent used historically on paints applied to boat hulls) because federal and provincial agencies in Canada have not established threshold values for organotins in marine sediments. Furthermore, the environmental behaviour of TBT warrants a different approach relative to other substances of concern. For example, TBT is a bioaccumulative substance that partitions to organism tissues and has a strong relationship between body burden and adverse effects. Also, TBT is a regional contaminant found throughout the Georgia Basin, particularly in high shipping/boating areas.

Other jurisdictions, such as the Puget Sound Dredge Disposal Analysis (PSDDA) program in Washington State, have developed sediment-screening levels. However, these screening levels have high uncertainty in the technical derivation procedures, and are not closely linked to the protection goals for the waterlot. Therefore, it was considered necessary to develop remedial targets for TBT that protect valued ecosystem components and can form the basis for a practical and technically defensible remediation design.

A tiered risk assessment framework was applied with the objectives of identifying sediment management units that may require intervention and that lie beyond the remedial footprint identified for other substances. Tissue-based thresholds were developed for TBT based on integration of numerous relevant toxicity studies from literature. Tissue thresholds were converted to the corresponding sediment-based value (in organic carbon units) by considering bioaccumulation factors observed at other industrial shipping sites in the Georgia Basin. Finally, the sediment TBT threshold was converted to the dry weight threshold by considering the site-specific organic carbon data.

The identification of sediment units of potential concern was based on the following lines of evidence:
- Absolute risks – Exceedance of site-specific TBT sediment thresholds reflecting two different levels of conservatism;
- Relative risks – Difference between near-field elevations of TBT and the regional reference conditions; and,
- Uncertainty in contaminant distributions – Variations in sediment TBT concentrations, and the strength of their linkage to the waterlot uses, were evaluated using spatial analysis (GIS) and review of site use patterns.

Cumulative probability plots showed there would be limited benefit to the environment in terms of considering additional sediment TBT contamination for removal (i.e., beyond the currently proposed remediation footprint). Although limited areas of sediment bed were predicted to have low to moderate effects to sensitive species, diminishing returns are evident beyond the proposed remedial footprint. In these outlying areas, active remediation would not significantly reduce ecological risk, but would incur significant cost and short-term disruption to resident communities.

11:30 am – 12:00 pm

**Comparison of Sand Separation and Mechanical Dewatering Technology on Three Major Dredging Projects, Including Beneficial Use**
Bastiaan Lammers, Harry van Dam, Neil Geevers
Stuyvesant Environmental Contracting LLC / Boskalis Environmental

The presentation will, from an engineering point of view, give insight in the decision making during the design and engineering phase of sediment management projects involving sand separation and mechanical dewatering. Three major dredging projects will be showcased: Miami River, Miami, Florida; Fox River, Greenbay, Wisconsin; and, Lower Passaic River, Newark, New Jersey. These projects commonly involve the environmental cleanup of sediments but can also include the sustainable management of sediments arising from a maintenance dredging project. All projects have in common the application of sand separation and mechanical dewatering equipment, however the implementation of the technology is different on each of the projects.

This presentation explains the factors that influence the technological decision making related to the management of these sediments and also the importance of the integrated approach.
1:30 pm – 2:00 pm  
**The Link Between Tailings Pond Gas Generation and Unstable Ice Conditions: Colomac Mine Remediation Project, Northwest Territories**

Rebecca Vanderspiegel¹, Ron Breadmore¹, Rachel James², Robin Bourke², Kristin Salzsauler²  
¹Aboriginal Affairs and Northern Development Canada  
²Golder Associates Ltd.

Aboriginal Affairs and Northern Development Canada (AANDC), formerly Indian and Northern Affairs Canada (INAC), assumed responsibility for the Colomac Mine, a former gold mine, located approximately 220 km north of Yellowknife, NT, in April 1999.

During mine operations (1990-1997), cyanide bearing tailings were deposited in Tailings Lake, located 5 km north of the main mine facilities. In 2002-2003 high cyanide concentrations in Tailings Lake were treated using an enhanced natural remediation (ENR) process, which involved the addition of mono-ammonium phosphate (MAP) to Tailings Lake (and Zone 2 Pit) to facilitate bioremediation of cyanide by naturally occurring algae and bacteria. Exposed tailings beaches were capped with waste rock in 2006 to prevent wildlife exposure to the tailings via direct contact and dust inhalation.

As early as 2002, areas of gas generation have been observed in Tailings Lake resulting in the development of areas of poor ice quality, some of which remain as open vents throughout the winter period.

In response to health and safety concerns associated with poor ice quality, an investigation was initiated in October 2009 to identify gas generating mechanisms in Tailings Lake. A two-phase investigation, completed in October 2010, included the collection of gas, water quality, sediment samples and bathymetry data, and the isotopic analysis of gas samples (Golder, 2011).

The investigation indicated that gas generation was primarily associated with and/or immediately down gradient of capped tailings beaches located at the south end of Tailings Lake and to a lesser extent in the capped mid-lake tailings beach located on the east shore. Multiple physical, chemical and biological mechanisms were hypothesized to be contributing to gas generation.

This presentation investigates the link between gas generation in Tailings Lake and the development of poor ice conditions, which constitutes a potential health and safety concern at mine remediation sites. Several health and safety measures to restrict access to Tailings Lake have been put into place including the placement of waste rock barriers to warn approaching snowmobilers, warning signs posted at the high water level mark and dissemination of public safety announcements.

As similar processes may be active in other tailings ponds, mine and exploration project operators, environmental assessors, and mine remediation personnel need to be aware of the potential for weak ice formation in tailings ponds as a potential health risk when conducting work and post closure monitoring, at these locations. Further research is required in order to better understand the processes that may contribute to the generation of gas in tailings ponds to determine if these processes are similar to or different than mechanisms that account for the generation of methane and hydrogen sulfide in anoxic water bodies and wetlands.

2:00 pm – 2:30 pm  
**Enhanced In-situ Bioremediation of Chlorinated Ethenes – A Canadian Perspective**

Phil Dennis, Peter Dollar, Jeff Roberts and Sandra Dworatzek  
SIREM

Bioremediation of chlorinated ethenes including perchloroethene (PCE) and trichloroethene (TCE) in groundwater is a proven remedial approach, particularly in the United States. In Canada, enhanced in-situ bioremediation (EISB), including biostimulation and bioaugmentation, is less common despite internationally recognized Canadian expertise in these fields. Barriers to implementation have included the regulatory approval process and perceptions that the geological and climatic conditions in Canada may be unsuitable for successful bioremediation.

The Canadian federal regulatory framework includes the New Substances Notification (NSN) Regulation which requires that new products, including bioremediation amendments be approved prior to use or manufacture in Canada. KB-1®, a bioaugmentation culture that promotes the complete dechlorination of chlorinated ethenes, was the first such culture to pass through the NSN process and was added to the Domestic Substances List in 2008. Since then KB-1® has been applied successfully at several sites in Canada.

Geological and geochemical conditions which stand out as challenges in Canada include low groundwater temperatures and low permeability matrices. Successful bioremediation is possible using technologies that can mitigate these factors and a growing body of knowledge is providing insights into what is possible and how to best apply various technologies.
Groundwater temperatures defined as cold (i.e., below 10°C) are commonly found north of 45 degrees latitude, which includes much of Canada. Understanding the feasibility of bioremediation of chlorinated ethenes and the practical limits of bioremediation of chlorinated ethenes under cold conditions is important in remedy selection and expectation management for Canadian bioremediation projects. Examples of successful bioremediation at cold sites in Alaska, Denmark and Canada will be presented with a focus on degradation half-lives, concentrations of dechlorinating bacteria (Dehalococcoides) and remediation outcomes.

Low permeability strata are common in some of the most highly industrialized areas of Canada, notably in Southern Ontario and Quebec. Originally conceived as an oil and gas extraction technology, hydraulic fracturing can also be used to improve distribution of bioremediation amendments thereby improving bioremediation outcomes. Examples of successful implementation of hydraulic fracturing for bioremediation in clay strata will be discussed.

An evolving regulatory environment and the prudent use of advanced bioremediation approaches, including a number of Canadian technologies, provides the necessary resources for the successful implementation of bioremediation projects in Canada.

2:30 pm – 3:00 pm

**Remedial Measures at the Former Drumheller Institution Landfill, Drumheller, Alberta**

Mike Grinnell1, Julie Dittburner1, Joan La Rue Van Es2

1Franz Environmental Inc.
2Public Works and Government Services Canada

Franz Environmental Inc. was retained by Public Works and Government Services Canada on behalf of Correctional Services Canada (CSC) to develop a remedial action plan (RAP) to address potential surface water discharge and slope failure at the former landfill located within the grounds of the Drumheller Institution in Drumheller, Alberta. The former landfill is situated approximately 500 metres southeast of the Drumheller Institution on tablelands above an existing coulee. It occupies and area of approximately 150 by 200 metres and was used to dispose domestic and light industrial debris generated by the Institution from the mid 1960’s to the late 1980’s. Surface water generated from the landfill discharges into a creek, which subsequently drains into the Red Deer River, located at the base of the coulee; approximately 50 to 60 m below the landfill bed. The landfill is not engineered and it is reported that wastes were historically pushed over the edge of the coulee. The surface of the landfill has historically been used as a burn area and is occasionally used to store spoil piles from the excavations around the site.

The primary goals of the project were to stabilize the slope (to remove physical hazards) and contain/control surface water (by means of in-situ passive treatment) emanating from the former landfill. The work required to achieve these goals was implemented over a three-year period between 2010 and 2012.

Project components included:
1. Reviewing historical reports and undertaking a data gap analysis;
2. Conducting ongoing sampling to ascertain metal concentrations in surface and groundwater discharging from the landfill;
3. Conducting qualitative slope stability analysis at the former landfill site using existing data on the soil/waste properties and newly acquired topographic data obtained during site visits;
4. Developing a RAP and technical specifications to complete work on site;
5. Completion of a “cut and fill” excavation program to remove soil from the top of the slope and place at the bottom to create a slope of 2.5 horizontal to 1.0 vertical thus removing physical hazards and reducing the risk of future slope failure;
6. Construction of an engineered wetland/natural attenuation zone at the base of the landfill to mitigate metals concentrations in surface and groundwater discharged from the base of the landfill into the creek; and,
7. Submission of an environmental assessment for the project in accordance with the Canadian Environmental Assessment Act.

Key challenges included:
1. Working on a steep sloped site situated at a remote location. The excavation and construction work programs needed to be carefully planned and implemented to avoid creating any undue physical hazards.
2. Co-ordination of a multi-disciplined team composed of environmental engineers, geoscientists, geotechnical engineers and land surveyors. The project required that environmental, geotechnical and topographic factors be taken into consideration in both the design and construction phases of the work.
3. A monitoring plan was required during construction to report achievements, work task completion or amendments to the planned work by the contractor to the client in a timely manner.
Assessing the Risk of Organic Contaminants to Groundwater and Vapour Intrusion at the Community Scale

Nizar Mustafa¹, Kevin Mumford², Denis O’Carroll¹ and Jason Gerhard¹
¹Department of Civil and Environmental Engineering, University of Western Ontario
²Department of Civil Engineering, Queen's University

The redevelopment of brownfields often requires the remediation of soil and groundwater to acceptable standards. In Ontario, these standards are based on risk-based criteria applied within the boundaries of the contaminated site. However, often the critical contaminant pathways and risk receptors are beyond the site boundaries and in the community. The goal of this research is to evaluate the transport, and transformation of organic industrial compounds at the scale of a single contaminated site versus that of a community, and assess the implications for risk-based decision-making. A three-dimensional numerical model was developed that integrates a state-of-the-art vapour intrusion model (Abreu and Johnson, 2005; 2006) with MODFLOW/MT3D to simulate the flow and transport of organic contaminants in groundwater, soil vapour, and indoor air. Monte Carlo suites of simulations were employed to investigate the influence of heterogeneity in subsurface physical, chemical and biological properties on contaminant transport in a community-scale aquifer. Simulation results included ensemble mean and variance of the contaminant concentrations at control planes located downgradient of the source, and the probability of exceeding a regulatory-based concentration level at key groundwater, surface water, and indoor air receptors in the community. Two high priority contaminants (benzene and naphthalene) were considered in this work. Comparisons between ensemble Monte Carlo results and scenarios with uniform physical, chemical, and biological properties were used to elucidate the sensitivity of risk-based outcomes to the various types of heterogeneity. Results of this study will be used to identify the most sensitive parameters in determining risk at the community level, conditions where risk to the community differs significantly from risk at a single contaminated site, and how that risk evolves after site remediation.

Intricacies Associated with Risk Assessments for Four Marine Navigation Light Sites in Southern Ontario

Erik J. Martin, Katherine Appleby and Jim Kroetsch
CH2M HILL Canada Limited

CH2M HILL Canada Limited (CH2M HILL) was retained by Public Works and Government Services Canada (PWGSC) on behalf of Fisheries and Oceans Canada (DFO) Central and Arctic Region to complete a supplemental investigation, site-specific human health risk assessment (SSRA-HH), and site-specific ecological risk assessment (SSERA) for four marine navigation light (MNL) sites located in southern Ontario. Based on previous environmental investigations, the sites in general were impacted by metals (such as cadmium and lead) and petroleum hydrocarbons (PHC) (such as PHC fractions F1 to F3). The sources of contamination were attributed to the historical use of lead-based paint, acid batteries, and/or PHC-based fuels at the sites.

The supplemental investigations at the four sites served to support the SSRAs-HH and SSERAs through better characterization of soil quality and further delineation of metals and PHC impacted soils. Because it was understood that lead-based paint had historically been used at the sites, soil samples were also analyzed for polychlorinated biphenyls (PCBs) (used in lead-based paint to improve the covering ability and elasticity characteristics). Furthermore, the sampling plan included the collection of paint samples from site structures for analysis of lead and PCBs. Finally, for two of the sites, vegetation and invertebrate samples were collected for analysis of metals to support the exposure assessments of the SSERAs and to further assess potential effects on plants and soil organisms, respectively, from soil chemicals of concern (COCs).

From a broad perspective, the four MNL sites appeared to have similar characteristics and therefore it was anticipated that the results of the SSRAs-HH and SSERAs for the sites would be similar. Indeed, for all four sites, the SSERAs concluded (using a weight-of-evidence approach) that it was unlikely that there would be population-level effects on terrestrial receptors as a result of exposures to COCs in soil. As such, ecological site-specific target levels (SSTLs; or cleanup levels) were not derived nor were recommendations for risk management/remediation provided.

In contrast to the SSERAs, the SSRAs-HH conducted for the four sites produced varying results. The recommendations ranged from “no further work required” to “source removal and remediation (excavation and disposal)”. Upon review of the four SSRAs-HH, it was apparent that the varying results and recommendations were due to a relatively small number of parameters including: i) the soil guidelines used (Provincial versus Federal); ii) the concentrations of COCs in soil; and, iii) the most sensitive receptors (residential versus recreational) used for modelling.

This set of SSRAs-HH and SSERAs demonstrated that the outcome of a risk assessment for a MNL site is likely to be governed by a small number of specific parameters, which can be fully identified following successful contaminant delineation. As a management tool, DFO could make use of this knowledge and group MNL sites (requiring further evaluation) according to these parameters. This would allow DFO to manage groups of sites with similar risk profiles collectively thus achieving schedule and cost efficiencies. It is also anticipated that this would result in significant efficiencies for outside consultants (for example, risk assessors) and consequently further cost-savings for DFO.
Over the course of 13 years (1998 to 2011), the Environment Division of SNC-Lavalin Inc. (SLE) was retained by Correctional Service Canada (CSC) through Public Works and Government Services Canada (PWGSC) to conduct extensive environmental investigations to characterize a site located within the Joyceville Institution property. The site consisted of undeveloped marshlands. Environmental investigations of the site began in 1998/1999 with an investigation of soil, sediment, surface water and groundwater surrounding a former landfill. The results of this sampling program led to a series of investigations, between 2000 and 2010, of soil, sediment, surface water and groundwater quality within a nine hectare marsh located immediately adjacent to the former landfill. Based on collection of additional historical information, the investigation area was expanded in 2002/2003 to include a secondary marsh area. The site was complex owing to the fact that surface soils were formerly submerged, being exposed due to water level declines of the adjacent river. A risk assessment approach was recommended to determine if elevated metals concentrations measured in the area investigated were due to the natural sequestering of metals by the former marsh and not to anthropogenic pollution. Human health and ecological site specific risk assessments (SSRAs) were conducted in accordance with the federal risk assessment framework and considered potential risk to human receptors, defined as security personnel undertaking routine patrols and recreational receptors inadvertently trespassing upon the property, and ecological valued ecosystem components (VECs), including mammalian wildlife, avian wildlife, terrestrial plants and soil invertebrates. Freshwater aquatic life, such as the benthic community and piscivorous birds, and mammals associated with aquatic environments within the contaminated site and the adjacent river were also evaluated for potential impacts following the Environment Canada Decision-Making Framework for Assessment of Great Lakes Contaminated Sediment. The extensive investigation of the scientific literature on the natural tendency of marshes to sequester metals, combined with other lines of evidence, ultimately lead to the conclusion that metals contamination was due to natural causes and was not due to anthropogenic pollution. This determination ultimately prevented the unnecessary expenditure of tens to hundreds of thousands of dollars by CSC to remediate a site where it had not caused the elevated metal contamination and where disruption of the existing functioning ecosystem may not have been appropriate.
Gala Keynote

Making the Science Make Sense

Communicating with the public about health and environmental concerns can be a risky business…unless the science makes sense! Canada’s prominent risk communication specialists discuss public perceptions, language traps, stakeholder capacity, active listening, dealing with outrage, and other barriers to communicating risks. The speakers will also present some simple planning tools for developing clear, consistent messages in response to challenging questions from concerned audiences.

Ronald W. Brecher, Ph.D., DABT, C.Chem., Vice President, MTE Consultants Inc.

Dr. Ronald Brecher is recognized in Canada and internationally for his expertise in toxicology, risk assessment and risk communication. He obtained a B.Sc. (Hon.) in biochemistry from Carleton University in 1980, and a Ph.D. in Medicinal Biochemistry from Sussex University in 1987. As well as being a Diplomate of the American Board of Toxicology (DABT), and a Chartered Chemist (C.Chem.), Ronald is a member of the Society of Toxicology of Canada, the U.S. Society of Toxicology, the Society for Risk Analysis and the International Hormesis Society. He has 20 years of experience as a consultant in toxicology, working with governments, industry and individuals, with an emphasis on assessing and communicating the health impact of chemicals. Ronald is often called upon to provide his expertise in the public forum, and has presented at numerous public meetings across Canada.

Trevor Smith Diggins, Risk Communication Specialist, Smithdiggins.com

A communication specialist for 30 years, Trevor Smith Diggins’ expertise in risk and crisis communication training has taken him from Ottawa and Washington to Pearl Harbor and Okinawa, Japan. Trevor has delivered risk communication, crisis and media training for Health Canada; Indian and Northern Affairs Canada; the Ontario Ministry of Environment; Canadian Department of National Defence; the U.S. Army; the U.S. Navy Bureau of Medicine; NASA; the Nova Scotia Department of Health; BC Health; Dofasco; and numerous others. In 2004, he provided Homeland Security crisis response training to Emergency Responders at four US Navy Medical Hospitals around the world. Trevor was invited to the Pentagon by the Under Secretary of Defense to recognize the success of an installation restoration project in Memphis, where he provided risk communication support.
Thursday, May 3, 2012

**PLENARY STREAM: UPDATE ON THE FCSAP PROGRAM**

9:15 am – 10:00 am  
**The FCSAP Program: An Update on Progress and What’s Ahead**  
Susan O’Connor\(^1\) and Clayton Truax\(^2\)  
\(^1\)Contaminated Sites Division, Environment Canada  
\(^2\)Public Works and Government Services Canada

This presentation will provide an update on progress to date, key accomplishments and next steps of the Federal Contaminated Sites Action Plan (FCSAP) since the 3rd RPIC Federal Contaminated Sites National Workshop held in Montreal in 2010.

Details will be provided on: 1) status of sites in the Federal Contaminated Sites Inventory; 2) progress on assessment and remediation activities; 3) changes in Phase II including eligibility, performance measurement and communications; 4) key accomplishments; 5) new guidance, training and tools; and 6) a look forward.

10:30 am – 11:00 am  
**Innovative, Sustainable and Green Remediation Technologies, Approaches and Best Practices**  
Clayton Truax and Anne Thompson  
Public Works and Government Services Canada

The development and promotion of innovative technologies has been identified as a secondary benefit that could result from the expenditure of $3.5B over 15 years to address federal contaminated sites through the Federal Contaminated Sites Action Plan (FCSAP). In order to realize this benefit, Public Works and Government Services Canada (PWGSC), as part of their FCSAP Expert Support role, is working on initiatives to promote the use of innovative technologies and approaches, including sustainable and green approaches and best practices at federal contaminated sites.

In order to heighten awareness of such optional approaches to addressing contamination at federal sites, PWGSC has undertaken a number of initiatives:

- Held a series of Innovative Remediation Solutions Workshops in five regions across Canada: Atlantic (Halifax) in 2007; Quebec (Montreal) in 2007; Western and Northern (Banff) in 2008; Ontario (Toronto) in 2009; and, Pacific and Yukon (Vancouver) in 2009;
- Developed a range of communication tools such as case studies and technology profiles;
- Developed information sources such as the Guidance and Orientation for the Selection of Treatment Technologies (GOST) Database;
- Reviewed and evaluated procurement methods to encourage innovative technology use; and,
- Piloted an Innovative Remediation Technology Vendors Workshop for PWGSC Senior Managers.

This presentation will showcase recent work undertaken by PWGSC to build awareness and acceptance of such approaches. Most specifically, the presentation will profile examples of innovative, sustainable and green remediation technologies, approaches and best practices undertaken and underway at various federal custodian sites. These will include case studies profiling projects developed through collaboration with private sector contractors and federal custodians.

11:00 am – 11:45 am  
**Auditing Environmental Liabilities**  
Louise Bertrand, Office of the Auditor General of Canada

The session will provide an overview of the Government of Canada’s environmental liabilities, which are reported in its financial statements. The session will cover the role of the Office of the Auditor General of Canada, which is to audit those liabilities in order to provide an opinion on the Government’s financial statements and on whether they conform to Canadian public sector accounting standards.
2:00 pm – 5:00 pm

**Toronto Waterfront Walking Tour**

Waterfront Toronto is the public advocate and steward of waterfront revitalization. Created by the Governments of Canada and Ontario and the City of Toronto, Waterfront Toronto is mandated to deliver a revitalized waterfront and has a 25-year mandate to transform 800 hectares of brownfield lands on the waterfront into beautiful, sustainable mixed-use communities and dynamic public spaces. The project is one of the largest infrastructure projects in North America and one of the largest waterfront redevelopment initiatives ever undertaken in the world. A guided bus/walking tour will show workshop participants what's being undertaken and planned for in the Central Waterfront, East Bayfront and West Don Lands (including the future site of Pan Am Athlete's Village) with a focus on sustainability and brownfield remediation.
Canada is known as a laggard amongst industrialized nations when it comes to innovation and commercialization. Canada’s environmental industry often suffers from the same stigma. Jeff Westeinde’s fun and informative presentation will discuss the barriers, and more importantly the opportunities, for the Canadian environmental industry to provide world-class leadership in this area. Jeff will use real life examples to assist the audience to develop tools to take leadership and drive innovation in their part of the industry.

Jeff Westeinde, P.Eng., Founding Partner, Windmill Development Group

Jeff Westeinde, P.Eng., is an active investor and entrepreneur in both the cleantech and real estate sectors with investments in solar energy and technologies that promote the beneficial re-use of waste as well as significant real estate holdings.

Jeff Westeinde is a founding partner of the Windmill Development Group, Canada’s leading sustainable real estate developer. Jeff provides his expertise with the selection, remediation and development of brownfield sites in urban areas, a major part of Windmill’s development model.

Jeff is the founder and served as the Chief Executive Officer of Quantum Murray LP, Canada’s largest environmental decommissioning contractor until late 2011. Jeff co-founded the Quantum Environmental Group, a national full service environmental remediation and hazardous waste materials management company, in 1992 and championed a merger in 2007 with Murray Demolition, Canada’s largest demolition contractor, to form Quantum Murray LP. Quantum Murray achieved revenues of $250 million and employed over 800 professionals from offices throughout British Columbia, Alberta, Saskatchewan and Ontario under Jeff’s leadership. Quantum Murray has been recognized as one of Canada’s fastest growing companies and one of the Top 50 Employers in Canada.

Jeff is an active participant in the Canadian environmental and cleantech sectors. As the lead investor and director in Envirogreen Technologies Ltd., Jeff is responsible for pioneering a high technology solution to divert hazardous wastes from landfills for beneficial re-use in mine site reclamation for the benefit of clients throughout North America. As the lead investor and director in Clearly Solar Energy, Jeff has constructed and operates over a dozen solar generation sites throughout Ontario.

Jeff has been distinguished as Entrepreneur of the Year by Ernst and Young, named one of Canada’s Top 40 under 40 by the Globe and Mail, and won the Young Alumni Award from the University of Western Ontario.

Jeff is active on numerous charitable, civic and industry initiatives including serving as the founding chairman of the Invest Ottawa (formerly OCRRI), is on the Community Services Cabinet for the United Way of Ottawa and is on the Algonquin College Foundation Board.

Jeff is an avid outdoorsman whose passion for mountain climbing, skiing, golfing, fishing are but a distant second behind his love for his family.
Phytoextraction of Persistent Organic Pollutants (POPs) using Native Colonizers at Contaminated Sites in Canada
Sarah Ficko1, Barbara A. Zeeb1, Brian Campbell1, Surmita Paul1 and Allison Rutter2
1Royal Military College of Canada
2Queen’s University

Most published studies investigating phytoextraction of persistent organic pollutants (POPs) have focused on crop species (i.e., Cucurbita pepo L. ssp pepo). Recently, Ficko et al. (2010) documented for the first time multiple weed species that can also accumulate polychlorinated biphenyls (PCBs) in plant shoot tissues. They further demonstrated that with the inclusion of an optimal density factor, 18 of the 27 species studied could theoretically extract a similar or greater quantity of PCBs than C. pepo. This work has been followed up by looking at three promising phytoextracting perennial weed species planted in monoculture plots at two PCB-contaminated sites over a period of two years. Amongst other things, the study demonstrated that Solidago canadensis plants may accumulate PCBs along the stem length in a similar manner as C. pepo plants. Advantages of using weeds for phytoextraction include that they are easy to cultivate and propagate, generally self-sustaining, relatively inexpensive, and are often harder than many cultivated species. At Point Pelee National Park (PPNP) in southern Ontario, a legacy of past agricultural activities (i.e., apple orchards and vegetable fields) and pest control strategies are responsible for large quantities of DDT being deposited into the environment. Human health concerns and wildlife species losses linked to DDT exposures have led to the initiation of important restoration projects with the ultimate aim of returning DDT-contaminated sites within PPNP into natural successional regimes. The restoration project at PPNP includes a Phytoremediation Strategy Plan (PSP) to investigate the potential of using this technology to assist with DDT remediation within the Park. One aspect of the PEP involves an investigation of the free growing native plant species, already growing within contaminated areas, to phytoextract DDT. We are in the process of comparing these data to that of the PCB accumulators identified above. This project has wider applications as many sites in Canada are contaminated with POPs, and when traditional remediation techniques are not logistically possible, advanced phytotechnologies may be an asset.

Evaluating Risks to Remediation and Construction Workers in Trenches and Excavations
Ian Mitchell, Geneva Robins, Dan Stein, Lindsey Mooney and David Williams
Meridian Environmental Inc.

While federal contaminated sites risk assessments have traditionally focused on long-term occupants of a site, other human receptors such as remediation, utility and construction workers must also be considered. These receptors are also considered in the development of Management Limits for soil quality guidelines; however there are currently no formal guidelines for the assessment of risks to workers in trenches and excavations. These workers are often only present at the site for short periods of time, but may have relatively high exposures, particularly if they are working in trenches or excavations where they may have closer contact with contamination than long-term site occupants.

Volatile contaminants may enter trench air and, particularly for narrow trenches, the concentrations of these contaminants may be significantly higher than in indoor air due to the absence of a concrete foundation slab and the potential for contamination to be in direct contact with the base and walls of the trench. The Canadian Council of Ministers of the Environment (CCME) and other agencies have recently been developing approaches for modelling vapour intrusion into trenches and excavations to address these scenarios. Workers may also be exposed to contaminants by direct contact with contaminated soil and groundwater.

One of the key remaining challenges for evaluating risks to remediation and construction workers is the lack of appropriate toxicity benchmarks. Since these scenarios involve short-term exposures to relatively high concentrations or doses, the chronic toxicity limits used for other receptors may not be appropriate. Using chronic limits in a trench worker risk assessment often results in the prediction of unacceptable risks from concentrations that are well below published soil quality guidelines. However, federal agencies and other jurisdictions are often reluctant to allow occupational exposure limits to be used in these situations, since the worker may not be aware of the contamination. Additionally, there are relatively few toxicity limits based on subchronic or repeated acute exposures currently available, and the exposure duration in these studies may not be appropriate for a trench worker exposure scenario.

The poster will detail methods currently used to evaluate risks to workers in trenches and excavations, current data gaps and challenges, and provide case study examples.
A Case Study for Successful Risk Management and Stakeholder Involvement: PCB Contamination in Saglek, Labrador

Ken Reimer, Royal Military College of Canada

For twenty years, the southern headland shore of Saglek Bay, Labrador was the home of a large United States Air Force (USAF) communication station. Although the USAF vacated the site in 1971, an assessment in 1995 found polychlorinated biphenyls (PCBs) in three regions of the site, including a beach adjacent to the ocean. This soil was stockpiled over three seasons from 1997 to 1999 and eventually removed for incineration in Quebec.

As a consequence of chronic erosion of PCB contaminated soils into the ocean, elevated PCB levels were measured in sediments, shorthorn sculpin (Myoxocephalus scorpius; benthic feeding fish) and black guillemots (Cepphus grylle; diving seabird) in 1998-2000. The concentrations measured in marine sediments and biota were found to be orders of magnitude above background, creating sub-lethal effects, and ultimately risk to these receptors. However, a sediment transport model suggested that the most heavily contaminated sediments would be redistributed and would be mixed/covered with clean sediments over a five to ten year period.

On-going work with these receptors beginning in 2006-07 confirmed that PCB concentrations in both sediment and biota had decreased substantially. These trends demonstrate that ecosystem recovery is occurring and effects based studies corroborate these results, where the declines in PCB concentration have been associated with a decline in biological effects. More recently, the sediment PCB concentrations appear to have dropped below the site-specific guideline for the protection of ecosystem health for resident receptors. The pelagic and wider ranging arctic char (Salvelinus alpinus) captured from Saglek has always had PCB concentrations equivalent to Arctic background areas. Surprisingly, approximately 25% of the ringed seals (Pusa hispida) captured from Saglek Fiord contain levels of PCBs that are higher than other eastern Arctic sites. Work on both the feeding behaviour and movement patterns of ringed seal in northern Labrador has been carried out to better understand these results. Nevertheless, the rapid decreases in the biotic PCB concentrations at Saglek Bay are unprecedented and demonstrate the resilience and efficiency with which natural ecosystem recovery can take place in a dynamic and highly energetic coastal marine environment once a chronic input source is removed.

In 2002, a human health risk assessment (HHRA) led to the posting of signs advising that harvesting not take place within five km of the site. A new HHRA is being completed using the most up-to-date data for marine and terrestrial species from the Saglek Bay area as well as food basket and exposure scenarios which are relevant to the current and intended uses of the site. These results will inform a decision as to whether the advisory signs can be modified or removed.

This project engaged stakeholders at the outset (1997) and has involved them in decision-making process throughout the program. Indeed, the risk management approach to the marine sediments would not have been possible without their support. The overall outcomes indicate that the environment can recover after contaminant source removal and suggest that similar positive results will be found at other northern cleanup projects.

Trowbridge Island Light Station Risk Assessment

Karin Guiguer¹, Adam Dawe¹, Lauren McDonald¹, Randi Hay²

¹Franz Environmental Inc.
²Fisheries and Oceans Canada

Franz Environmental Inc. (Franz) completed a site-specific human health and ecological risk assessment (RA) on behalf of Public Works and Government Services of Canada (PWGSC) and Department of Fisheries and Oceans (DFO) on the Trowbridge Island Light Station, in Lake Superior near Thunder Bay, Ontario. The site was developed as a light station in the 1920s and includes a cottage, (home to a seasonal resident), several maintenance buildings, and a lighthouse. The topography of the island is quite variable and uneven with the highest point on the island approximately 30m above lake level.

During preparation of the workplan, Franz identified that there would be significant challenges in conducting remediation or risk management on the site, due to the uneven terrain on the island and its remote location. In some areas contamination is located near vertical cliff faces. As such, Franz was able to plan the RA approach to minimize the need for risk management and/or remediation. Franz’s approach was based on multiple lines of evidence and included vegetation sampling to reduce uncertainty in estimating exposure to ecological receptors (herbivores) as well as completing an assessment of the health of the local ecosystem.

Historic application of paint to exterior building surfaces on the island has resulted in elevated concentrations of lead (Pb) and zinc (Zn) in surface soils exceeding the Canadian Council of Ministers of the Environment (CCME) residential/parkland guidelines by as much as 100 and 40 times respectively. High concentrations were limited to a few isolated hot spots. The human health RA involved assessing risks to human receptors (visitors, cottage resident(s), maintenance workers) while the ecological RA assessed risks to plants, invertebrates, mammals and birds. Statistical analysis of the site data was conducted in a manner to best represent human and ecological use of the site and in accordance
with Health Canada protocols. Background vegetation and soil samples were taken from an area of the site with no visual evidence of contamination for statistical comparison. Despite the high Pb and Zn concentrations, no risks to human receptors were identified as only limited exposure (i.e., short duration) is anticipated on a remote island.

Statistical outputs revealed marginal risks to ecological receptors (i.e., effects were possible but not likely). Based on visual observations of the health of the plants on the site, no obvious signs of stresses due to contamination were noted. The conclusions to the RA relied on multiple lines of evidence: toxicological data, risk calculations, vegetation and background samples, analytical data and observations on the health of the ecosystem. Given the low level of risk to ecological receptors and the lack of visual evidence of stresses, Franz concluded that remediation would be more harmful to the ecosystem than leaving contaminated soil in place. This was considered an effective management strategy for the site as it would not result in significant adverse effects to human receptors nor the environment.

This project demonstrates effective use of site-specific risk assessment and risk management in managing challenging sites.

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**Specialized Project Management Controls for a 747 Crash Site Clean-Up**

Rob McCullough, Don Carey and Michael Charles
Stantec Consulting Ltd.

On October 14, 2004, MK Airlines Flight No. 1602 crashed just after takeoff from the Stanfield International Airport in Halifax, Nova Scotia. Stantec was immediately retained by MK Airlines through their agent Clyde & Co. of London, UK, to assist with the clean-up of the crash site. The site included the fully fueled plane wreck, contents of its cargo, including lobster, fish, hazardous waste and about 100,000L of fuel. This poster addresses the complex project management controls associated with initial site lockdown, stakeholder management (ranging from Transportation Safety Board, RCMP, Boeing, Halifax Airport, MK airline, and insurers), material and hazardous waste recovery, surface water, groundwater and soil controls/remediation, and final closure. This was a particularly unusual remediation project owing to the many different interest groups, the need to rapidly re-open in order to maintain airport operations, as well as mechanisms to control and recover very unusual wastes (ranging from depleted uranium, compressed/explosive airframe parts, biohazardous wastes, and impacted soil/bedrock and groundwater).

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**A Review of Background Concentrations of Elevated Metals at Environmental Assessment Sites along the Alaska Highway**

Doug McMillan¹, David Kettlewell¹ and Megan Shannon-Martin²

¹SNC-Lavalin Inc.
²Public Works and Government Services Canada

Public Works and Government Services Canada (PWGSC) is currently the federal custodian for the 90 m wide right-of-way (ROW) of the current Alaska Highway alignment between Km 133 and Km 968, in Northern BC. The highway was constructed in 1942 as a wartime effort and upgraded for public traffic between the 1940s and 1950s. Settlements had not existed prior to the highway construction period along much of the route, and consequently historic camps, storage areas, refuelling stops, equipment maintenance areas, military bases, air strips, and dump sites were established as the construction proceeded. These historic sites represent a potential environmental liability and PWGSC retained SNC-Lavalin Inc., Environment Division (SLE) to complete a series of environmental site assessment (ESAs) in Management Area 3 between KM 548 and 719 of the Alaska Highway. Management Area 3 is located almost entirely within the BC Northern Rocky Mountains and the geology of the area consists of unconsolidated glacial deposits including fill and outwash gravel deposits.

As part of SLE’s assessment of sites along Management Area 3, up to 133 soil samples were collected and submitted for analysis of potential contaminants of concern (PCOC) including total metals with the objective of investigating the presence or absence of contamination associated with the historic sites. Analytical data was compared to both federal and provincial standards. The analytical results identified elevated concentrations of arsenic, barium, cadmium, molybdenum, nickel, selenium, vanadium and zinc. Two background locations were included in the investigation at areas with little to no signs of anthropogenic disturbance. The analytical results of soil samples collected at these sites also indicated elevated concentrations of barium and selenium greater than the standards and guidelines. In many cases where elevated metals concentrations were identified, no patterns were observed suggesting source impacts due to anthropogenic contamination.

Analytical results from investigations were compared to the regional background concentrations. A statistical summary of concentrations indicated that the maximum, average, and 90th percentile concentrations of several metals were greater than the BC regional background concentrations. Based on the analytical results and statistical analysis, the elevated metals parameters identified cannot be attributed to regional background concentrations using the available information.
Application of a Data Fusion Framework for Combined Exposure Analysis of a Chemical Mixture and Contaminated Sites Human Health Risk Assessment and Management
A.K. Mohapatra1, R Dyck2, A Zargar3, S Islam4, Rehan Sadiq5
1Health Canada
2University of British Columbia
A modified Joint Director Laboratories (JDL) data fusion (DF) framework was developed to integrate data from disparate sources to estimate risks associated with potential exposure to a petroleum hydrocarbon mixture. The framework was used to detect patterns and integrate various toxicological datasets from the F1 group of hydrocarbons. F1 toxicological data were fused where available. The main objective of our case study was to demonstrate the applicability of the DF based approach in risk assessment and management projects. For chemical mixture risk assessment, the problem formulation was defined using an illustrative example of a contaminated site. Traditionally, health risk assessments of mixtures are evaluated using a surrogate of chemical mixture data (e.g., current practice of F1 hydrocarbons assessment) or through component data. For neurotoxicity response analysis, neurotoxic metabolites toxicological data were fused with predictive toxicological data and then probability-boxes (p boxes) were developed to represent the toxicity of each compound. The neurotoxic response was given a rating of “low”, “medium” or “high”. These responses were then weighted by the percent composition in the illustrative F1 hydrocarbon mixture. The resulting p-boxes were fused according to Dempster-Shafer Mixture rule of combination. The fused p boxes were fused again with toxicity data for n-hexane. These types of dataset integration exercises from various disparate sources may help contaminated sites risk assessment and risk management projects where a key risk management decision may be required based on site specific exposure analysis, operable exposure pathways and toxicity assessment. Various hydrocarbon contaminant mixtures remain in various forms in contaminated sites. Further, presence of mixture of hydrocarbons, metals, and other contaminants pose a significant challenge to effectively determine toxicity potential of the combined chemical exposure and how to risk manage them. Our initial assessment of the data fusion framework using illustrative examples show that it may provide an effective way to assess, evaluate and risk manage contaminated sites. Currently, Health Canada is exploring data fusion applications in the development of a multi-criteria decision analytic tool and evaluating applicability of various predictive toxicology tools in contaminated sites risk management projects.

Optimization of a Mine Closure Program – Remediation of the Gowrie Wash Plant
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1AECOM
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The Sydney Coalfield on Cape Breton Island in Nova Scotia, Canada, has been the centre of commercial coal production for nearly three centuries. This prosperous industry left a legacy of former sites associated with mining operations, some of which require remedial measures. The Cape Breton Development Corporation (CBDC) on formation in 1967 inherited the land ownership and hence the responsibility of the former mines. Upon cessation of active mines in 2001, CBDC as landowner began a comprehensive mine site closure and reclamation program engaging Public Works and Government Services Canada (PWGSC) as overall program managers. The program includes over 600 individual properties ranging from relatively small and simple to large and complex. CBDC’s mandate was transitioned to Enterprise Cape Breton Corporation (ECBC) on December 31, 2009.
One of the large and complex sites within the mine closure program is the former Gowrie Wash Plant. The Gowrie site was constructed by the Dominion Coal Company in 1893 and was used for washing coal from the Gowrie Colliery, located nearby. During its operation, coal was transported to the site by rail, where it was washed and bagged for sale on the domestic residential market. The resulting wash water and coal fines were carried via flume and ditch to the southeast into Morien Bay. Operations were abandoned in 1897 leaving behind over 170,000 cubic metres of waste rock in a pile that has slowly eroded and weathered over the years, silting drainage courses and producing numerous seeps of Acid Rock Drainage.

AECOM, retained by PWGSC under standing offer agreement, was engaged to conduct assessment and characterization investigations at the site. A remedial action plan was then prepared whereby capping was identified as the preferred remedial solution. Prior to undertaking the engineering design of the multilayer cap, a feasibility study was undertaken to determine the viability of the site as a central repository for the overall program. Proximal sites, where waste rock was present, were identified and waste material quantified. Consolidated waste rock configurations were prepared to obtain a basis for cap design over the on-site and imported material. The feasibility study identified viability for up to eight other contaminated mine sites which were located in close proximity to Gowrie.

The engineering design then proceeded in a phased approach. First enabling infrastructure was designed and constructed including access roads, surface water diversion ditches, settling ponds, and a downstream berm that would eventually form the downslope toe of the final cap. Waste material volume fluctuations from the ‘exporting sites’ was anticipated and, as such, the design was initiated with flexibility to expand the volume within the cap by adjusting the profile up or down while maintaining the same footprint. As the transfer of material to Gowrie proceeded deviations from pre-construction estimates were recorded and accommodated by adjusting the cap profile.

This poster will provide additional detail of the remedial approach (from Phase I to VI) at the Gowrie Wash Plant and how this approach was managed in order to synchronize with overall program objectives.

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**Construction Management of a Strategically Sequenced and Performance Based Contract – Sydney Tar Ponds Stabilization and Solidification**

Bruce Noble and David Wilson  
AECOM

The Sydney Tar Ponds Remediation Project is the result of nearly 100 years of steel production in Sydney, Nova Scotia, leaving a legacy of soils, sediments and groundwater contaminated with PAHs, VOCs, PHCs, PCBs and heavy metals. The primary mechanism for the clean-up is solidification/stabilization (S/S) of approximately 700,000 tonnes of coal tar contaminated sediment in the marine influenced and urban setting of the Tar Ponds. AECOM is providing engineering design and construction management and oversight services in support of the Sydney Tar Ponds Agency, a special operating division of the Province of Nova Scotia in charge of the clean-up.

The remedial design for sediment remediation by S/S was incorporated into a performance based contract. The identified benefits of adopting a performance based contract vehicle included performance, cost, and closure assurance while enabling contractor flexibility and innovation on technology, means and methods, and ability for improved scheduling.

The remediation of contaminated sediments by S/S includes a step-wise sequence of work whereby enabling works are constructed, followed by sediment treatment by S/S, followed by construction of an engineered multi-layer cap over the treated sediments. The site is delineated into three distinct phases, based on the natural spatial configuration of the site. Therefore, the sequence of enabling works, sediment treatment, and capping is repeated for each of the phases.

The S/S contractor is responsible for S/S mixing methods, delivery of reagents, and sequencing within an established milestone schedule for each phase. In addition, the contractor is responsible for quality control, in particular for meeting sitespecific criteria for post-mixing strength, permeability, and leachability. An independent quality assurance consultant conducts testing and reporting of results, also measured against the site-specific criteria noted above.

With the large volume of sediment, a significant amount of data is generated during the in-situ treatment process for approximately 3,000 treatment cells. Each cell comprises its own unique set of data which is reviewed and verified to substantiate performance measures have been achieved. The systems and procedures allow for near real-time communication of “status” on various parameters throughout the execution of the work; something that the project demands.

Ensuring the sequenced work is undertaken without impacts of “domino effect” delays from one contractor to the next and, at the same time, taking advantage of schedule gain where an opportunity exists has been a strong focus of the construction management team. In addition, the program is executed over several years and seasonal shut downs and planned demobilization must be considered. As of Spring 2012, the project will have achieved over 70% physical progress and remains on schedule and on budget.
This poster will describe the development and optimization of the remedial approach, data management, and reporting protocols since construction began in 2009. In addition, this poster will present pros and cons related to key success factors for implementation of performance based contracts including; site characterization; owner, contractor, regulator buy-in; timing and end-use definition; risk management of unknowns; contractor security; and, performance criteria definition.

Remedial Feasibility Assessment of Soil Washing and Physical Separation, LeBreton Flats, Ottawa, Ontario
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1Golder Associates Ltd.
2National Capital Commission
The LeBreton Flats is one of the last consolidated waterfront properties in the downtown core. Its unique location along the Ottawa River, in the heart of Canada's Capital, is of prime importance to the urban structure of Ottawa. The study site includes approximately 6 hectares of land within the central part of LeBreton Flats (the site). LeBreton Flats was first used in the 1800s for industrial activities including lumber mills and coal storage and eventually foundry operations, metal processing, railway operations, coal storage facilities, service stations, garages, junkyards and landfills. Furthermore, LeBreton Flats was razed by fire at the turn of the 20th century. The federal government (National Capital Commission or NCC) acquired LeBreton Flats in 1962 at which time all the existing structures were demolished.

The above historical use of the site has resulted in a layer of overburden across the site which ranges between one and six metres in thickness over bedrock and which has been found to contain pervasive metals, polycyclic aromatic hydrocarbons (PAHs) and petroleum hydrocarbons (PHC) impacts above the applicable assessment criteria per the Canadian Council of Ministers of the Environment (CCME) Guidelines. The overburden is also typified by the presence of demolition debris including concrete, metal, slag and brick. Current estimates place the volume of impacted overburden at the site on the order of 100,000 m³. The previous approach to manage the impacted overburden in place through risk assessment was not acceptable for the site given its future development potential, which requires basements and foundations to bedrock and overall future and current surrounding residential land use.

Following a screening of remedial technologies, it was determined that a combination of physical separation, supplemented by a process of soil washing held significant potential and required further evaluation. This further evaluation included a detailed assessment of the overburden in terms of grain size distribution and contaminant distribution by grain size. The objective of the evaluation was to quantify materials by grain size and quality such that a screening and washing process could be scoped to maximize the diversion of material from the regional waste disposal sites. For this evaluation, separation of coarse material (>13 mm), gravel material (2 mm-13 mm), coarse soil (75 µm-2 mm) and fine soil (<75 µm) was evaluated.

Problems to overcome during this evaluation included: the difficulty of separating clay clumps from coarse materials during pre-screening; the absence of test protocol and standards for the evaluation of non-soil material (i.e., rock) and the need to develop a method; and, issues associated with the adherence of fine particles to the coarse material.

The results of the evaluation concluded that the action of separation through dry screening to a size of 75 µm did result in a reduction of contaminant concentrations while concentrating the contaminants into the fine fraction. However, this dry process was found not to result in a sufficient reduction of contamination concentrations to render the coarser material suitable for beneficial reuse. As a result, it was concluded that a wet process is needed to remove the impacted fines which are thought to be adhering to the coarse fraction. The estimated potential diversion from landfill could be upwards of 75% (70,000 m³) following a wet soil washing process.

Phase I and II Environmental Site Assessments at a Correctional Institution
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A Phase I environmental site assessment (ESA) was conducted on behalf of Correctional Service Canada at the CORCAN Agribusiness operations associated with the Pittsburgh Correctional Institution in Kingston, Ontario (the site). The site consists of a 720-hectare farm with a variety of operations including an abattoir, composting facility, greenhouses, military vehicle servicing, and storage areas. Former operations at the site include a machine repair shop, feedlot, a root cellar and a mattress-making shop. The physical setting of the site includes frontage on the Styx River, marshlands, lowlands and a rocky ridge.
Numerous areas of potential environmental concern (APECs) were identified through the collection and review of historical data, aerial photographs, previous reports, water well records, regulatory database searches, interviews and site visits. Many of these APECs resulted from the long-term historical use of the site for farming purposes including the servicing and storage of farm equipment. To facilitate classifying the thirty-five identified APECs, they were grouped into seven categories:

- Fill and dumping in exterior areas (included a landfill and former silica mine);
- Other exterior areas (included fuel pipelines, marshes, pesticides use, firing range, former feed lot and storage of waste and military vehicles);
- Water and wastewater discharges;
- Above-ground and underground storage tanks;
- Chemical handling and storage (included reported spills and observed leaking and staining);
- Building relating issues (included asbestos, PCBs, lead, mercury and mould); and,
- Off-site sources (included a service station, an impound lot/automotive recycler, storage tanks and reported spills).

Subsequent to the Phase I ESA, Phase II ESAs were conducted on the site in order to determine the presence and significance of any environmental impacts related to fourteen of the identified APECs. As part of these investigations, numerous boreholes were drilled into soil and bedrock and equipped with monitoring wells. Soil, groundwater, surface water and sediment samples were collected and submitted for analysis of parameters of potential concern including metals, microbiology parameters, VOCs, PHCs and PAHs.

Due to the size and nature of the site, several area-specific land uses were identified for generic Canadian Council of Ministers of the Environment guideline selection. The majority of the site was classified as being under a potable groundwater condition due to identified nearby water wells except for the on-site landfill area which, based on a site-wide elevation survey was interpreted as being within a separate aquifer system. Since there are no down-gradient water wells, the landfill was classified as being under a non-potable groundwater condition.

Based on the analytical results and site features, six contaminated sites were identified and classified using the National Classification System for Contaminated Sites. These included elevated levels of metals, E. Coli and total coliforms in surface water and groundwater in a former feedlot area, free phase hydrocarbons in fractured bedrock in the vicinity of storage tanks and servicing garage, elevated metals and hydrocarbons in debris storage areas and elevated PAHs and E. Coli levels in a stream that discharges to the River Styx. Recommendations for additional investigative work were provided and are now in progress.

Integrated Environmental Management of a Parliamentary Heritage Building
James Crichton, Golder Associates Ltd.

The Wellington Building is a designated heritage building located within the Parliamentary Precinct in the heart of Ottawa, Ontario. Public Works and Government Services Canada (PWGSC) has been responsible for procuring and managing services related to the complete renovation, historical restoration and seismic upgrade of the building. Since 2006, Golder Associates Ltd. (Golder) has been involved in the integrated environmental management associated with building restoration both in terms of designated substances in the building as well as the management of contaminated groundwater in the complete zone of central demolition during renovations.

Golder’s involvement at this site started with the completion of a designated substances survey prior to renovation/demolition activities. Initial sample results identified limited quantities of these materials present in the building following selective designate substances abatement completed through the years. However, in some cases after peeling away the layers, it was evident that these materials were still present at this site. The evidence of additional designated substances not expected to be present required an innovative approach to assess, specify and manage these materials during building renovation/demolition activities. Several operations required quick decision making with multi-stakeholder involvement to ensure regulatory compliance while keeping on schedule and creating procedures for the removal of unique materials.

This site required several challenging abatement considerations, including asbestos-containing mastic on lead coated structural beams slated for demolition, and asbestos-containing spray applied fire proofing encapsulated behind lead based paint on concrete structural slab slated for demolition. The management of these materials required constant assessment of how removal techniques might impact worker exposure to designated substances considering the unique management/removal techniques required. The site investigation team was composed of one scientist from CLAW Environmental Services and one scientist from Golder Associates Ltd. CLAW Environmental Services is Golder’s Aboriginal partnership firm located in Ottawa, Ontario.

In addition to providing services associated with designated substances and other hazardous substances, Golder was involved with the management of contaminated groundwater at the site during excavations. As part of the renovations, excavations were required inside the building beneath the depth of sub slab weeping tile system. Analytical results of the excavation water identified elevated concentrations of total suspended solids, polycyclic aromatic hydrocarbons (PAHs), acetone and petroleum hydrocarbons fractions 1 to 4 (PHC F1-F4) in the excavation water. Concentrations exceeded the City of Ottawa Sewer Use limits and as such, excavation water could not be discharged directly to the sewer. Based on existing information at the site, the source of the contaminants was interpreted to be potentially from groundwater in-flow contaminated from a coal tar membrane beneath the building.
Golder conducted an options analysis to evaluate the most appropriate solution to manage excess excavation water. Treatment and disposal to sewers was selected as the preferred option. The recommended treatment system was designed with a bag filter to reduce TSS, followed by an organo clay vessel to reduce PHC F2 and F3, followed by two GAC vessels for final polishing.

Assessing Diesel Contaminated Groundwater in the Vicinity of a Fluctuating Reservoir

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³Aboriginal Affairs and Northern Development Canada

The work described herein outlines the methods undertaken and results obtained during a supplemental assessment of soil and groundwater at a site in northern-central British Columbia. The site was the location of the power generation facility for the community of Tsay Keh Dene, at the northern shore of Williston Reservoir, the largest dammed reservoir in the province of British Columbia.

The hydrogeology of the site is complicated by the proximity to Williston Reservoir, the largest dammed reservoir in the province of BC. Throughout the year the water level in the reservoir fluctuates by an average of 11.3 metres (m) and by up to 17.1 m. While the reservoir water fluctuations are known to affect groundwater elevations in site wells closest to the reservoir (approximately 85 m away), the existing wells at the site were installed to assess high water conditions, and were not sufficiently deep to capture the groundwater once it fell below the silt layer at the site.

Further complicating the assessment was the geology present at the site. The site is underlain by sands and gravels to depths of between approximately 8.5 m and 15.5 m. An apparent continuous silt layer was observed beneath the sands and gravels; this silt ranged in thickness between approximately 0.15 m and approximately 2.1 m. Below the silt, another sand and gravel unit was observed to the maximum depth the boreholes were drilled to – around 20 m.

Monitoring wells previously installed at the site by Golder Associates Ltd. and others generally penetrated the upper sand and gravel unit, but generally were not installed in the deeper sand and gravel (except at two locations). Field programs historically targeted “worst-case” conditions; therefore water sampling was undertaken in the fall, shortly after the reservoir reached its annual maximum. This timing targeted the falling groundwater table. In years with a below-average reservoir level, many site wells did not contain water. Sufficient information was collected, however, to suggest the groundwater flow direction varied between maximum and falling groundwater conditions. The variation in water flow direction contributed to uncertainty in conclusions of previous assessments: that the groundwater contamination was delineated.

In March 2011, funding was made available to undertake a supplemental assessment of the site. Existing borehole and groundwater data were examined to plan delineation locations, taking into consideration the inferred groundwater elevation at the annual reservoir low, and the inferred depth to the silt layer.

Based on our understanding of the general groundwater flow directions at the site, and data gaps from previous assessments, monitoring wells were installed to delineate the dissolved phase plume across its extent near the source, midway along the plume, and downgradient beyond the plume. Monitoring wells outside the known dissolved plume were installed in adjacent pairs to target both high- and low-water conditions, to permit assessment of the site at any time in the year. Monitoring wells within the plume were only installed to the silt unit (i.e., did not penetrate the silt).

The result of the assessment was a refinement of the conceptual model for the site, and further data to support our conclusion that the plume was stable. Refinements to the conceptual model included a better understanding of the correlation between reservoir level and groundwater levels at the site, a topographical “map” of the silt unit underlying the site (which is inferred to influence the movement of groundwater and liquid diesel beneath the site), and a better understanding of the extents of the remaining liquid diesel and dissolved phase contaminant plumes at the site. Data collected in March 2011 represented groundwater conditions during near historic reservoir lows, and represented groundwater conditions in only the lower sand and gravel. Further assessment during seasonal high water levels would provide valuable information about the extent of groundwater contamination in the upper sand and gravel unit.
Adaptive Management of Phase I-II ESAs at High Arctic Marine Navigational Sites
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A requirement for completing four Phase I-II environmental site assessments (ESA) of marine navigational sites in Arctic waters near to the close of the 2009 field season for Public Works and Government Services Canada (PWGSC), on behalf of Fisheries and Oceans Canada (DFO), required adaptive management of schedule and scope. The scope of work involved a preliminary review of background information, organizing travel to the sites to perform Phase I and II ESAs, and reporting on the results. Approval to proceed was received in the first week of September 2009. The site investigation team was composed of one scientist from IMG-Golder Corporation (IMG-Golder) and one scientist from Golder Associates Ltd. (Golder). IMG-Golder is Golder’s Inuvialuit partnership firm located in Inuvik, Northwest Territories.

The locations were:
1. Deer Island (near Chesterfield Inlet);
2. Simpson Strait (near Gjoa Haven);
3. Bassett Point (on Pike Island in Frobisher Bay); and,

Because of the lateness in the season, site visit logistics were organized concurrently with the background information review, and the site investigation team was mobilized within a week of receiving authorization to proceed. The site visit plan was to visit the sites from west to east via a combination of scheduled flights and chartered fixed-wing aircraft, for Deer Island, Simpson Strait and Mansel Island, and by charter boat from Iqaluit for Bassett Point. The first site, Deer Island, was visited without problems. Two attempts were made to reach the second site, Simpson Strait, but each time the plane had to turn back because of rapidly deteriorating weather conditions at the site. Rather than wait for possible better weather and risk losing precious remaining time in the field season, the decision was made to move on to the remaining two sites, and do a desktop Phase I ESA of Simpson Straight.

Reaching Bassett Point required chartering a boat in Iqaluit and motoring 70 km southeast in Frobisher Bay. The GPS coordinates of the given site were out in the water, and from that point three beacons were visible on shore. One beacon could not be reached due to its location on a rocky headland, so Golder visited and sampled the other two beacons as reasonable surrogates for the inaccessible beacon, which was the intended site. These sites are usually maintained via helicopter, but the DFO helicopter had returned to the south for winter. Finally, the Mansel Island site was visited by the site assessors, via tundra fire equipped twin otter, and sampled as per the original scope of work.

Issues of environmental concern at the sites were metals in shallow soil from galvanized steel, and some burned areas where electrical components appeared to have been incinerated.

With frequent communication between Golder and PWGSC, and adaptive management of scope and schedule, the body of environmental information on these four high Arctic DFO sites was significantly advanced.

Essential Stakeholder Engagement in Developing a Geographic Information System Implementation Strategy for Chippewas of Kettle and Stony Point First Nation
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CLAW Environmental Services Inc. (CLAW), in joint venture with Golder Associates Ltd. (Golder), was retained by the Chippewas of Kettle and Stony Point First Nations (CKSPFN) and Aboriginal Affairs and Northern Development Canada (AANDC) to develop a Geographic Information System (GIS) implementation strategy in support of the on-going Camp Ipperwash investigation and land transfer negotiations.

The Government of Canada and the CKSPFN entered into formal negotiations for the clean-up, clearance and return of former Camp Ipperwash through a final settlement agreement. In order to facilitate the data management and data dissemination of information related to unexploded explosive ordnance (UXO), environmental contaminants, species at risk, cultural and land planning information, all parties seek to identify the strategic business and technical requirements required for the short, medium and long-term period, and opportunities for collaboration.

A GIS Working Group was established to review requirements and recommend proposals related to the implementation of a GIS. The GIS Working Group identified the need to develop a GIS strategic plan and vision for the use of GIS technology in CKSPFN. The plan would address the short, medium and long-term data management and data dissemination requirements, including information management/technology (IM/IT) and human resources considerations.
A comprehensive stakeholder engagement approach is essential for developing a GIS strategy and vision especially within the highly sensitive land transfer negotiations. It was extremely important from the First Nation stakeholders perspective to be provided with the best information and tools to gain the best understanding of the results of the contaminated site investigation and mitigation, and come to the negotiation table with equality in terms of knowledge. GIS was used to facilitate this knowledge.

CLAW developed the GIS strategy based on a phased approach beginning with a review of vision and strategic planning documents and through a facilitation of visioning sessions to develop an overall GIS integrated approach. The visioning began with consultation sessions with the senior community elders and the community leads. This provided an understanding of the importance to the community, the vision for the future of the community, and how an implementation of GIS would help with the community's future.

Using the understanding of what is important to the community and the vision for the future from the visioning sessions, specific data and GIS requirements were solicited from various stakeholder interviews that will have or benefit from related source GIS data. These stakeholders were the community and local regulating agencies that may use, contribute to or benefit from a community GIS.

CLAW proposed an implementation plan based on this intensive stakeholder engagement to ensure that the end result had immediate buy-in from the community. The final approved GIS strategy included the following geospatial perspectives: base mapping (for context), roads and road-related assets, parcel boundaries, parcel and leases, utility locates, building/facilities locations, heritage, land use planning, emergency response, housing management, Camp Ipperwash field program monitoring (negotiations), and environmental management.

The GIS strategy project contributed to positive land transfer negotiations and CKSPFN business operations and capacity building.

**Terrestrial Wildlife Exposure to Perfluorinated Chemicals at a Former Fire-Fighting Training Area**

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SLR Consulting (Canada) Ltd. has been retained by Public Works and Government Services Canada (PWGSC), on behalf of Transport Canada, to evaluate perfluorinated chemicals (PFCs) in a variety of environment media at a former fire-fighting training area. The PFC contamination is associated with the historical use of aqueous film forming foams during fire-fighting training exercises. Environmental investigations have included the collection of co-located soil, plant, earthworm and small mammal liver (i.e., deer mouse and vole) tissue samples. Preliminary risk calculations indicated the potential for adverse effects to small mammals exposed to PFCs at the site based on measured earthworm and/or plant concentrations (i.e., dietary exposures) and incidental soil exposures. Deer mouse and vole livers were collected from the site and analyzed to determine whether concentrations exceeded liver values in literature corresponding to adverse effects levels.

Plant, earthworm and small mammal tissue data were also used to estimate the dietary risk to herbivores, omnivores and carnivores consuming prey items containing perfluorooctane sulfonate (PFOS), perfluorohexane sulfonate (PFHxS) and total PFCs. Specifically, exposure to deer mice, American robin and white-tailed deer was estimated based on dietary requirements and plant and/or earthworm concentrations. Exposure and risk to the American kestrel, black bear, coyote, red fox, American badger and western toad were estimated based on all available tissue data and dietary requirements. No deer tissue data was available to estimate exposure in top carnivores such as the cougar. The United States Environmental Protection Agency method for estimating biomagnification with food chain multipliers (FCMs) is reliant on the octanol-water partition coefficient (KOW) of the contaminant; due to their chemical properties, KOW values are not available for many PFCs. As a result, modelling the exposure of top predators (i.e., cougar) through consumption of secondary and tertiary consumers (i.e., deer and badgers) was not possible. In this case study however, the size of the contaminated area is small in comparison to the home range of top carnivores and risk is unlikely. Ecological risk assessment using mathematical estimations of bioaccumulation is possible for many compounds; however, evaluation of PFC risk to wildlife at present largely relies on tissue sampling. Estimation of risks to terrestrial wildlife is further complicated by a lack of toxicological reference values (TRVs) for many receptors.
Scientific Advancements in Human Health Risk Assessment and the Derivation Process of Soil Quality Guidelines for the Protection of Human Health
C. McEwan, B. McEwen, D. Longpre
Health Canada

Health Canada’s Contaminated Sites Division develops Canadian Soil Quality Guidelines for the Protection of Human Health (SQGHH) in collaboration with the Canadian Council of Ministers of the Environment (CCME). SQGHH are developed for use at contaminated sites to provide levels in soil for which no human health risks are expected. It is our objective to incorporate scientific advancements in human health risk assessment (HHRA) into the SQGHH derivation process to improve management of contaminated sites in Canada through the development of soil quality guidelines based on exposure, toxicological and environmental data.

The CCME has published A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines (CCME 2006) which outlines the SQGHH derivation process. In support of HHRA and deriving SQGHH, research has been completed to refine the following areas: environmental fate/behaviour of chemicals, chemical toxicology, background exposure, human physiology (soil and dust ingestion and bioavailability) and anthropometric parameters (body weight).

Outcomes of this research include:
1. Toxicological profiles were recently developed (new SQGHH) and updated (existing SQGHH) for polycyclic aromatic hydrocarbons, n-hexane, and several metals (i.e., Pb, Ni, Zn and Ba) and are in progress for vinyl chloride, perfluoroalkylated substances and a number of other metals (e.g., Cr);
2. New exposure media (dust, indoor air, breast milk) were included in the assessment of environmental sources of chemicals;
3. Estimated daily intake (EDI) methodology was updated to include a probabilistic approach;
4. Exposure factors were updated to reflect current data collected from the Canadian population (i.e., body weight harmonization project) (ongoing);
5. Updated soil and dust ingestion rates (ongoing); and,
6. Collaboration with the Geological Survey of Canada to obtain background soil concentrations relevant to human health (ongoing).

SQGHH are used by site managers across Canada to screen potentially contaminated sites for further management activities. Additionally, SQGHH scientific supporting documents, which describe the methods and data used to derive SQGHH, present information site managers can use to interpret HHRA and develop site-specific objectives. Implementation of new research allows site managers to have increased confidence in SQGHH values and promotes consistency with regulatory organisations in other provinces and countries.

An Analysis of the Sustainable Decision Support Tool at Contaminated Sites in the North
Jody Klassen, Environment Canada

The Canadian Federal Contaminated Site Action Plan (FCSAP) has developed a sustainable decision support tool (SDST) to provide federal contaminated site custodians with a clear strategy for sustainable decision making. The tool incorporates sustainability indicators to weigh the costs and benefits of remedial options to each of the three pillars of sustainability (environmental, social and economic) to help custodians determine the best remedial option for their site. What is “right” for any site however is dependant on many variables such as logistical considerations and social drivers for clean-up objectives; this is particularly true for remote, Arctic sites. The SDST has been evaluated for federal contaminated sites in the Arctic to determine how effective it is at representing the environmental, economic and social conditions of the North, and findings of the study are used to improve use of the sustainable decision support tool at remote/Northern federal contaminated sites.
Driving the Development and Large Scale Implementation of New Technologies Through University, Industry and Government Partnerships

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5Royal Military College of Canada

Many new remedial substrates are being developed in the laboratory environment that have great promise for field application. Often these innovations are abandoned or modified to the point where they are no longer effective remedial technologies due to issues that arise in scaling from a bench scale to field scale level. Substrates developed to breakdown target contaminants that are successful under laboratory conditions may be rendered inactive by matrix interferences experienced in the field or may be rendered innocuous during transport from manufacturing sites to the treatment area. University researchers, who are able to develop new remedial substrates, often do not have the resources available to allow the optimization and scale up of these technologies to the point where they have a viable commercial application. Creation and fostering of partnerships between universities, industry, and government agencies can significantly contribute towards moving bench scale remedial technologies into viable commercial applications through successful field demonstrations. CH2M HILL Canada Limited (CH2M HILL) is actively working with the University of Western Ontario (UWO), the University of Toronto (U of T), and the Royal Military College of Canada (RMC), using our experience with various government agencies and leveraging our industrial client, Dow Chemical Canada ULC (DOW) to provide a mutually beneficial situation allowing field trials for application of innovative technologies. A specific example of this successful partnership was demonstrated by a recent field trial carried out by CH2M HILL and UWO in conjunction with researchers from Uof T and RMC. UWO and their affiliates developed and optimized a process for synthesizing a more mobile nano scale zero valent iron (nZVI) in the laboratory, and in partnership with CH2M HILL, scaled this process from production of 10 mL of nZVI per batch to 200L of nZVI per batch. CH2M HILL, through DOW, provided a field trial location, technical expertise and the logistical and safety support necessary to scale up to a successful pilot field application where 760L of iron were synthesized in the field and added to the subsurface for the treatment of ten cubic yards of subsurface soils and associated groundwater.

CH2M HILL, through our industry client DOW, has provided the universities with practical application experience, regulatory guidance, and safety experience allowing a successful and safe field trial to be conducted. The universities have provided the innovative technologies, primarily new processes or amendments for both in-situ and ex-situ remediation, and government support has been provided through access to additional funding to the universities available specifically for projects with industry support. Continuation of successful partnerships represents the future of furthering the progress and introduction of innovative technologies into the remediation industry.

Dual Phase Extraction for LNAPl Recovery at the 5-Wing Goosebay Canadian Air Force Base

Christian Gosselin1, Mathieu Barbeau2, Fabien Comby1, Kevin Barrest1

1Golder Associates Ltd.
2Golder Construction Inc.

Golder Construction Inc. (Golder) was mandated by Defence Construction Canada to design, construct, operate and optimize a multiphase extraction system to recover floating liquid phase hydrocarbons (LPH) from a site historically used for fuel delivery and storage at the 5-Wing Goosebay Canadian Air Force Base. Based on factors such as the site’s soil composition and depth of LPH (approximately 30 m), a dual phase extraction system with simultaneous liquid recovery (water and hydrocarbons) and soil vapour extraction was recommended by Golder. The resulting system makes use of independent submersible pneumatic pumps and vacuum pumps, and results in increased treatment flexibility and decreased operational costs as compared to a traditional bioslurping or total phase extraction system (TPE).

The resulting remediation system is composed of four independent treatment units connecting 18 networks of subsurface piping (with a total linear length of 9,000 m) and incorporating 64 wells spanned over the site. The system was specifically designed to remain in full operation during the winter months, enabling continuous and effective recovery efforts. Each network is made up of three distinct piping systems: a compressed air system, a vacuum extraction system and a liquid recovery system. The units include an air compressor, a vacuum pump and a recovery treatment system allowing for removal and storage of the collected product and the reinjection of treated water.

All wells are equipped with a submersible pneumatic pump and a pressure regulator, as well as an adjustment system that facilitates pump optimization and seasonal fluctuations. The pumps are fully retractable to allow for repairs and maintenance. To ensure the ongoing adaptability and efficiency of the system throughout the operational period, individual networks and wells can be cycled to optimize recovery and can be operated in dual- or single-phase (vacuum or liquid) extraction. The system was installed between July and September 2011, operations will continue into 2014. The poster will also present the results of the recovery rates using dual phase extraction and how optimization of such system is performed.
The Department of National Defence’s Framework for the Management of Large Contaminated Sites Projects

Ranjeet Gupta, Department of National Defence

A variety of factors make it difficult to scope and forecast costs on large contaminated sites projects. These include differing objectives of the project stakeholders, conflicting interpretation of policies and regulations, unknowns in the subsurface environment, and legal issues. Uncertainty is always directly correlated with risk. Large contaminated sites projects are often initially assessed as high risk because remedial objectives, metrics for success, and remediation techniques typically cannot be determined until late in the project lifecycle.

Proper project management helps to reduce and manage risk. It puts in place an organization where lines of accountability are short and responsibilities of individuals are clearly defined. Its processes are documented and repeatable, so that those involved in the project can learn from the experiences of others.

By April 1, 2012, all federal departments and agencies are to have the systems and processes in place to meet the requirements of the Treasury Board of Canada (TBS) Policy on the Management of Projects. The policy requires that projects be managed in a manner that is consistent with their assessed level of complexity and risk. This includes demonstrating that effective project management systems and processes support the project management function.

The Department of National Defence (DND) is the single largest custodian of Federal real property. Its portfolio of contaminated sites includes military installations and other sites impacted by national defence activities dating back over half a century, long before the environmental impacts of such activities were adequately understood or managed. To date, DND has received over $300 million from the Federal Contaminated Sites Action Plan in order to implement contaminated sites projects and to effectively manage its contaminated sites program. The funding has enabled remediation activities at 186 sites and assessment activities at 337 sites.

This poster will provide an overview of DND’s standard project management framework and the general process the department employs for identifying, developing, and implementing large contaminated sites projects within the policy framework issued by TBS.

Dust in the Wind? Particulate Matter and Risk Communication on the NRCan Booth Street Remediation Project

Chris Ludwig¹, Susan Winch¹, Catherine Leblanc¹, Trevor Bergh² and Miguel Lariviere³

¹Franz Environmental Inc.
²Natural Resources Canada
³Public Works and Government Services Canada

Franz Environmental Inc. was retained by Public Works and Government Services Canada (PWGSC) on behalf of Natural Resources Canada (NRCan) to provide human health risk assessment (HHRA) and risk management services to address potential fugitive dust from a large soil remediation project at NRCan’s Booth Street Complex in downtown Ottawa. Parents of an adjacent daycare and site employees raised concerns about potential human health risks and potential damage to sensitive equipment resulting from fugitive dust migration.

The primary goal of the project was to develop site-specific dust thresholds that were protective of human health, and to confirm and communicate whether fugitive dust from the Booth Street Complex soil remediation project adversely affected human receptors and sensitive equipment on and off site.

Project requirements included:
1. Reviewing historical reports and undertaking a Data Gap analysis;
2. Undertaking an HHRA based on previously identified contaminant concentrations within the remediation area and making assumptions about migration of that soil as fugitive dust;
3. Development of a risk-based Particulate Matter 10 (PM10; particles with diameter less than 10 µm) threshold protective of all human receptors;
4. Development of a comprehensive suspended and settled particulate matter sampling protocol to monitor PM10 in real-time, both indoors and outdoors;
5. Execution of the sampling program including dust monitoring, surface dust swab sampling and pre- and postremediation surface soil sampling, according to a strict time-sensitive scheduling;
6. Development of a risk management plan and mitigation measures to be implemented if the real-time monitoring data indicated PM10 concentrations exceed the risk-based criteria; and,
7. Communicating real time PM10 results to daycare parents and workers, site employees, PWGSC and NRCan. This included a presentation to concerned parents and NRCan employees at an open house at the commencement of the project.
Key challenges included:
1. The potential dust migration was a sensitive, high profile issue, with daycare parents and operators, NRCan employees and others expressing concerns. This was successfully addressed through open and transparent risk communication.
2. A strict time-sensitive scheduling for the particulate matter monitoring program was required and was followed consistently. This was done by developing a small core team of field personnel who were dedicated to the project.
3. A monitoring plan was required to be adapted to incorporate program amendments from the client or contractor in a timely manner.

Remediation of Penhold Communication (Tx) Bunker Site (or Sometimes You Just Have to Dig It Up)
Chris Ludwig¹, Jonathan Markiewicz¹, Ed Domijan², Chris Doupe²
¹Franz Environmental Inc.
²Public Works and Government Services Canada

The Penhold Tx site is owned by the Crown under the custodianship of Public Works and Government Services Canada (PWGSC). There is an easement in favour of the Crown around the site in all directions to allow access and work space. Environmental remediation activities and investigations have been carried out at the site, dating back to 1994 as a result of diesel and other fuel tanks historically present at the site. The majority of the work has focused on the presence, impact, and remediation of liquid-phase petroleum hydrocarbons (LPH) and petroleum hydrocarbons (PHCs) in deeper soils. To a lesser degree volatile hydrocarbons (benzene, toluene, ethylbenzene, total xylene – BTEX) and polycyclic aromatic hydrocarbons (PAHs) contamination in soils and groundwater are problematic. In 2004 a multiphase extraction system (MPES) was installed to remove the LPH from the groundwater with follow up hydraulic ground fracturing, installation of recovery wells and networks, and the supply and operation of a multi-phase recovery system to treat groundwater. After several years this system was deemed to have had limited effect in meeting site goals and a new approach was required. While most of contamination is in the Crown-owned portion of the site, there are impacts present within the easement as well, which is privately owned and subject to Provincial requirements. The site overlies overburden and bedrock groundwater, both falling within the definition of a “domestic use aquifer” as defined by Alberta Guidelines. This has driven the need to actively remediate the soil and ground water impacts.

In the summer and fall of 2011, Franz Environmental Inc. completed Phase III ESA delineation activities, a Tier 2 risk assessment, remedial action plan preparation, and preparation of specifications and drawings for tender. Site work is expected in the late fall and winter of 2011-2012 and site remediation results will be available for presentation at the RPIC Federal Contaminated Sites National Workshop in 2012.

This presentation will discuss:
• The limitations of in situ remediation systems in meeting site goals.
• How Alberta Tier 2 risk assessment was used to adjust clean up targets.
• Comparison of actual versus estimated contaminated soil and ground water volumes, and sources of variance.
• The challenges of excavating deeper contaminated soils and groundwater in a relatively remote rural location in the middle of winter.
• Lessons learned on this project for future PHC remediation projects.

Removal of Historic Low-Level Radioactive Sediment from the Port Hope Harbour
Andrea Ferguson Jones¹, Glenn Case², Dave Lawrence³, Mark Kolberg⁴
¹MMM Group Limited
²Port Hope Area Initiative Management Office
³Public Works and Government Service Canada
⁴W.F. Baird & Associates Coastal Engineers Ltd.

Port Hope is located on the northern shore of Lake Ontario at the confluence of the Ganaraska River and has existed as a Port of Entry since at least 1819. Once operated as a major Lake Ontario port, through periods of vibrant industrial growth, it is now a recreational anchorage for the local yacht club.

The history of the Port Hope harbour from the early 1800s to today is typical of other small-town ports along Lake Ontario that have experienced growth and decline in direct relation to Great Lake shipping volumes and the shift in industry and commerce to larger urban areas. However, in the case of the Port Hope harbour, the presence of low-level radioactive sediment, resulting from a former radium and uranium refinery that operated alongside the harbour, currently limits redevelopment and revitalization opportunities.
The presence of low-level radioactive waste is not limited to only harbour sediments. Several other on-land locations within the community are also affected by the low-level radioactive waste management practices of the past. To address these situations, the Port Hope Area Initiative project is currently underway to implement a local, safe, long-term waste management solution. The Port Hope Area Initiative is a community initiated undertaking that will result in the consolidation of an estimated 1.2 million cubic metres of the low-level radioactive waste from the various sites in Port Hope into a new engineered above ground long-term waste management facility. The remedial cleanup of the estimated 120,000 cubic metres of contaminated sediments from the Port Hope harbour is one of the more challenging components of the Initiative. This poster demonstrates how the historical development of the harbour over the past 200 years, the nature and extent of the contaminated sediments, and Municipality of Port Hope's desires for future redevelopment of the waterfront area have all played a role in the design of the remedial cleanup plan for the Port Hope harbour.

Ecological Risk Assessment of Perfluorooctane Sulfonate in Surface Water and Sediment in the Vicinity of a Former Fire Fighter Training Area in Eastern Ontario

David Tarnocai, SNC-Lavalin Inc.

Perfluorinated compounds have relatively recently been the subject of considerable interest due to the bioaccumulative properties, toxicity and persistence of a number of perfluorinated compounds. Sediment and surface water sampling of a small creek in the vicinity of a former firefighter training area indicated impacts to both media by perfluorinated compounds. A defined concentration gradient along the creek suggests a principal source for perfluorinated compounds in the aquatic environment is principally related to former operations at the fire fighter training area. An ecological risk assessment was undertaken to evaluate the risk to aquatic receptors through hypothetical perfluorooctane sulfonate (PFOS) exposure, principally through biomagnification. Although the potential for adverse effects to aquatic mammal piscivorous wildlife were identified at a minority of sampling locations, central tendency exposure, considered more applicable to mobile receptors, indicates that no significant adverse population level effects are likely.

Small Craft Harbours in the Pacific Region: Habitat Impact, Benign Alteration or Habitat Creation? An Experimental Approach with Preliminary Data

Steve MacDonald, Herb Herunter, Eric Chiang, Hannah Stewart, Steve Tang, Beth Piercey
Fisheries and Oceans Canada

In an effort to better understand the effects of coastal development on aquatic habitats, a collaborative research program was developed in conjunction with the Fisheries and Oceans Canada (DFO) Science Branch, Federal Contaminated Sites Action Plan (FCSAP) Expert Support, DFO FCSAP Custodian, and DFO Ecosystem Management Branch.

This research project examined how habitat alteration associated with the construction and operation of small craft harbours on the Pacific coast of British Columbia, Canada, potentially impacts coastal habitat communities. We investigated three categories of physical structures: floating breakwaters, rock-rubble breakwaters, and harbour floors. In addition, anthropogenic contamination from vessel storage, operation and maintenance was investigated.

We hypothesised that:
1. Linkages exist among chemical contamination/toxicity levels (resulting from current or historical site activity), substrate characteristics, and benthic communities at a site, ultimately affecting the productive capacity of the site.
2. The physical modification of coastal habitat resulting from harbour construction will potentially alter benthic communities as measured by community composition, diversity and biomass.
3. There exists a small but powerful set of biological, physical and chemical response variables that are generally applicable as indicators of the ecological health of small craft harbours on the Pacific coast of British Columbia.

Biological responses to habitat alterations were measured with estimates of community composition and biomass on different harbour structures. Changes to communities were explored using MDS ordination and Simpson’s indices. Physical responses were measured with particle size analysis, organic carbon content, water temperature, salinity, oxygen, and benthic light levels. Responses to anthropogenic contamination were based on a sediment triad approach and measured through sediment chemistry, benthic community structure, and sediment toxicity.

The preliminary results from year one data, based on three small craft harbours (Port Hardy, Lund and Cowichan) show that there exists a gradient of contamination across these sites, as indicated by sediment chemistry and benthic community composition. Species diversity and abundance decreases with higher degrees of harbour sediment contamination. While community composition differed between breakwater types, the abundance and diversity were indistinguishable between structures, and both were greater than samples from the soft sediment habitats which are frequently altered by coastal development. The floating breakwaters potentially create two types of communities; one that tolerates exposure to wave action and another found in protected environments. As well, the preliminary results provide clues on the choice of species and/or taxa groups for use as indicators of disruption of both consolidated and unconsolidated habitat.
Development of Pollutant Target Concentrations for the Protection of Habitats of Fish and Fish-consuming Wildlife at Contaminated Sites

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In this study, we present a framework for (i) the verification that current sediment criteria are protective of fish and other upper trophic level food web consumers, and (ii) the development of pollutant target concentrations that are protective of human and wildlife consumers of fish. The application of the proposed framework relies on two data requirements: A. information about the relationship between contaminant concentrations in sediments and biological receptor organisms, which is referred to as the biota-sediment-accumulation factor (BSAF); and B. toxicological or human health risk based threshold values. Polychlorinated biphenyl (PCB) data obtained through monitoring programs were used (i) to derive a BSAF that could be used to verify whether current sediment criteria are protective of human and wildlife consumers of fish, and (ii) to develop pollutant target concentrations that are protective of human and wildlife consumers of fish. A large number of datasets of pollutant concentrations in crustaceans, bivalves, fish and marine mammals were used.

The findings from this study indicate that intra- and inter-site variability in the BSAF can be substantial and that this needs to be incorporated in the derivation of target concentrations that are protective to human and wildlife consumers of fish. One of the consequences of the substantial variability in concentrations among individuals of sampled species is that a comparison of average concentrations to criteria values does not reveal the possibility that a substantial fraction of the target population can contain concentrations that are above the criteria values, sometimes to a large extent. To verify that current sediment quality criteria are protective of fish and other upper trophic level food web consumers, the observed BSAFs were used to predict PCB concentrations in biota based on a scenario where concentrations in sediments are equal to the sediment quality guidelines (SQG) for Canada and British Columbia (BC). The resulting concentrations in biota were compared to the BC Tissue
Residue Guidelines (TRG) for fish and shellfish for the safe consumption by wildlife (0.1 µg/g wet weight (ww)) and humans (2.0 µg/g ww). At concentrations of total PCBs in sediments equal to the BC SQGs, greater than 50% of the Dungeness Crab population can be expected to be above both TRG at all sites. Similar results were obtained for English Sole, Ling Cod, Starry Flounder and Rockfish, with large proportions of each population in excess of the TRG values. These results indicate that the current guidelines do not ensure that shellfish and fish will be safe for consumption by wildlife or humans. Predicted biota concentrations in Harbour Seal were compared to a Toxicity Reference Value (TRV) of 1300 µg/kg ww. For Harbour Seals in Vancouver Harbour and the Strait of Georgia, the majority of the population can be expected to contain wet weight based whole body concentrations above the TRV. These populations are therefore expected to experience immunotoxicity effects, disruption of hormone function, growth and development as a result of PCBs. Harbour Seals in the Central Coast showed a smaller proportion of the population above the TRV.

**Assessment of Benthic Fish Communities at Federal Contaminated Sites in the Huron-Erie Corridor, 2010**

J. Barnucz and N.E. Mandrak
Fisheries and Oceans Canada

The objective of this study is to determine the effects of contaminants on fishes and fish habitat at selected FCSAP sites in the Huron-Erie corridor. This study will inform long-term management of sites to reduce risk to fishes and fish habitat. The findings will indicate whether or not the contaminants at the sites are having local effects on the ecosystem as measured by the local fish community. We hypothesized that Index of Biotic Integrity (IBI) scores will be significantly lower at contaminated sites indicating a negative effect. Most of these sites have not yet been assessed in any way; therefore, the findings will also provide a baseline for the fish community and habitat prior to any further actions. As sediments are typically contaminated at FCSAP sites, fish community sampling targeted benthic fishes, which are most likely to be in contact with the contaminated sediments. In 2010, trawling surveys were performed at 11 FCSAP sites and 11 control sites using a modified Missouri trawl. This sampling yielded a total catch of 3,601 fishes with 2,371 caught at FCSAP sites and 1,230 caught at control sites. Sampling yielded a total of 30 species in FCSAP sites and 26 species in control sites. The IBI scores were greater at seven control sites and the same for one site respectively.
pair. The mean IBI score was 11.8 for FCSAP sites (range 4-22) and 13.4 for control sites (range 8-19). However, the IBI scores for FCSAP and control sites did not differ significantly (p = 0.46). Although preliminary results of this survey indicate there was no overall significant difference in the IBI scores of the FCSAP and associated reference sites, additional reference sites, further from the FCSAP sites, will be added to this study to address the possibility that the reference sites used were within the zone of influence of the FCSAP sites. Additional future work may include other measures of fish assemblage difference, such as multivariate analyses, and conducting a new survey to incorporate several sampling methods and a greater effort over several seasons.

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**Hydrocarbon Concentrations and Patterns in Free-ranging Sea Otters (Enhydra lutris) from British Columbia, Canada**

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With oil pollution recognized as a major threat to British Columbia's recovering sea otter (Enhydra lutris) population, it is important to distinguish acute from chronic exposures to oil constituent groups in this marine mammal. Concentrations and patterns of alkanes and polycyclic aromatic hydrocarbons (PAHs) were determined in blood samples from 29 live-captured sea otters in two coastal areas of British Columbia, as well as in representative samples of their invertebrate prey. Hydrocarbon concentrations in sea otters were similar between areas and among age and sex classes, suggesting that metabolism dominates the fate of these compounds in sea otters. Biomagnification factors derived from PAH ratios in otter:prey supported this notion. Although some higher alkylated three- and four-ring PAHs appeared to biomagnify, the majority of PAHs did not. The apparent retention of alkyl PAHs was reflected in the composition of estimated sea otter body burdens, which provided an alternative way of evaluating hydrocarbon exposure. Alkyl PAHs made up 86 ± 9% of estimated body burdens (4,340 ± 2,950 µg), with no differences between males and females (p = 0.18). The importance of measuring both parent and alkyl PAHs is underscored by their divergent dynamics in sea otters, with ready depuration of parent PAHs (metabolized or excreted) by sea otters on the one hand and biomagnification of alkyl PAHs on the other.

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**Towards New Estimated Daily Intakes for the Canadian Population**

Y. Bonvalot and A. Peisajovich
Health Canada

**SUMMARY**

Health Canada's Contaminated Sites Division is involved in the revision and development of new human health soil quality guidelines (HHSQGs). Part of the HHSQG development process relies on Estimated Daily Intakes (EDIs) which estimate the typical concurrent background exposure to chemicals from all known or suspected sources (air, water, soil, dust, food and consumer products) via all known or suspected routes of exposure (inhalation, ingestion, dermal contact) for the average Canadian. Instead of using a deterministic approach to derive EDIs, a probabilistic one has been developed and will be presented as well as its strengths, limitations and recommended future improvements.

**OBJECTIVES**

Assess new estimated daily intakes for the Canadian population needed to derive soil quality guidelines for human health.

**METHODS**

For each chemical under HHSQG revision or update, an extensive review of all the available Canadian databases covering air, water, soil, dust and food was performed through grey and scientific literature searches. The scientific validity of all available papers, grey reports and databases was assessed using a quality score tool developed for this purpose. Then, after final selection of key data, all the environmental concentration distribution parameters and all the physiological distribution parameters involved in the EDI equations were estimated. The Crystal Ball add-in software for Excel was used for the Monte-Carlo simulations and probabilistic EDI distributions were obtained for each of the five Health Canada human receptor age groups.

**RESULTS**

Instead of deriving deterministic EDIs, EDI multimedia probabilistic distributions are obtained through a fully transparent and systematic approach. This has already been done for eight chemicals or species (Barium, Beryllium, Cadmium, Total and Hexavalent Chromium, Lead, Nickel, Zinc).

**CONCLUSION**

This is a first step to derive Canadian EDIs integrating all the pertinent information available. However, through this systematic and transparent process a lot of limitations can be identified (data gaps, methodological limitations, no available correlations between media of exposure, etc.). This allows prioritization of future research projects to improve Health Canada EDIs.
Challenges of Iron in Groundwater Remediation Projects – A Case Study
Jason Downey, newterra

Naturally occurring iron in the dissolved form is commonly found in groundwater across North America. This seemingly harmless compound can lead to a number of challenges for environmental engineers working to remediate properties with groundwater contamination where dissolved iron is present.

Iron in the dissolved form will readily convert to a rust colored precipitate called iron oxide when exposed to air in recovery wells, pneumatic pumps, vacuum extraction process lines, air strippers, and tanks. Iron oxide particles are typically in the range of 0.5 micron to 2 micron and can bind up to form larger particles. Once in the oxidized form, iron will settle and plug piping, tanks, reinjection wells, carbon filters, air strippers and bag filters, which result in ongoing operating and maintenance challenges and operating cost overruns.

The discharge of iron-impacted water is highly regulated in most regions. This is primarily due to the oxidation potential of dissolved iron, which consumes oxygen from rivers and streams, as well as the increased turbidity, and sedimentation of precipitated iron. The increasingly stringent regulations for iron-impacted water require remediation engineers to remove the iron prior to discharge in many applications.

newterra, working with a team of environmental consultants, experienced these challenges first hand on a brownfield redevelopment site in Belleville, Ontario. On this site, groundwater levels are monitored and controlled to prevent the flow of contaminated groundwater off the property.

newterra will present a case study on this project explaining the challenges found on this site, the process followed to qualify and quantify the iron problems, and the steps taken to narrow down the best treatment solution. In addition, the case study will describe the technology chosen to manage the iron problems on the project.

By sharing the challenges, method of technology selection, and lessons learned. Delegates will be able to apply our experience to their own water treatment challenges and build upon the lessons learned by newterra.

Phytoremediation of Petroleum and Salt Impacted Soils: Successfully Meeting Generic Tier 1 Standards and Making Green Technologies Work
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We have successfully developed and implemented advanced phytoremediation systems for removal of petroleum hydrocarbons (PHCs), PAHs, and salt from soils. The plant growth promoting rhizobacteria (PGPR) enhanced phytoremediation systems (PEPS) we deploy provide large amounts of root biomass in impacted soils, which promotes growth of rhizosphere microorganisms. The root and rhizosphere biomass facilitate rapid partitioning of contaminants out of the soil, and their subsequent uptake and metabolism by microbes and plants. PEPS result in degradation of PHCs in soil and large amounts of biomass for sequestration of salt into plant foliage. We have performed several full-scale deployments of PEPS. PEPS, when implemented by properly trained personnel, lead to aggressive plant growth on poor quality, contaminated soils. The result is PHC and salt remediation to Tier 1 standards. Not only are these ‘green’ solutions for remediation of impacted sites, but the costs for PEPS are less than half the costs associated with landfill disposal. From 2007 to 2011, we utilized PEPS at 16 sites in Alberta, British Columbia, Manitoba and Quebec for PHC remediation. At all sites, we achieved ~ 35% remediation per year of PHC from soil (mostly fractions 3 and 4). At 6 sites, we have met Tier 1 standards, and at the remaining 10 sites, we are well on our way to achieving remediation goals within a 2 to 3 year treatment period. We are now refining CCME PHC analytical methods to make phytoremediation and other ‘green’ in-situ remediation techniques more efficient. Our work shows that PEPS is broadly deployable at a wide variety of PHC impacted sites (including sites that have barite as a co-contaminant), with a time frame of only two to three years to complete remediation. Beginning in 2009, we initiated full-scale deployments of PEPS at 10 salt impacted sites in Saskatchewan, Alberta and the Northwest Territories. PGPR greatly enhanced plant growth on the salt impacted soils, allowing good plant growth on soils with ECe’s up to 25 dS/cm. Furthermore, the plants (both grasses and cereals) take up sufficient amounts of salt to make phytoremediation feasible. Notably, we have already achieved salt remediation to regulatory targets at two of the sites. The advanced ‘green’ PEPS technologies described above are based on procedures that have been scientifically proven and are effective at full field-scale levels when deployed by highly trained scientists.
Developing Canada’s First Human Health-based Sediment Quality Guidelines
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Health Canada

BACKGROUND
Health Canada’s Contaminated Sites Division (CSD) supports the Canadian Council of Ministers of the Environment (CCME) in the development of human health-based Environmental Quality Guidelines for soil and drinking water, etc.

Currently, CCME sediment quality guidelines are based solely on the protection of ecological health because there are no human health-based guidelines. Typically, risk assessors adopt or modify soil human health-based quality guidelines as surrogates for sediment guidelines and exposure. Such an approach under- or overestimates risk based on physio-chemical differences between soil and sediment, exposure pathways and different exposure scenarios.

METHODS
CSD formed a sediment working group (SedWG) to develop: 1) guidance for risk assessment of contaminated sediments; and, 2) a protocol for health-based sediment guidelines.

RESULTS
1. 2010 Initial Scoping Project:
   • Searched worldwide to determine that no health-based sediment quality guidelines exist, other than for fish/shellfish consumption pathway;
   • Developed Conceptual Exposure Models of human activities in sediment environments; and,
   • Proposed an approach for risk assessment of contaminated sediments.

2. A sediment workshop followed that solicited feedback from external experts. The workshop identified the following gaps:
   • Sediment ingestion rates;
   • Relative importance of suspended sediment as an ingestion pathway;
   • Estimates of parameters for dermal contact with sediments;
   • Relevance of floc and implications for sampling sediment contaminant concentrations; and,
   • Regional variability and availability of background sediment data.

3. In 2011, contracts on contaminated sediments developed:
   • Draft interim risk assessment guidance;
   • Draft guidance on the fish/shellfish consumption pathway; and,
   • De novo sediment ingestion rates for sediment and suspended sediment.

IMPACTS OF THE PROJECT
In the future, SedWG plans to:
• Publish risk assessment guidance for contaminated sediments; and,
• Produce the first human health-based sediment quality guidelines for direct contact (ingestion and dermal) and fish/shellfish consumption pathways.

Tools and Methods to Reduce and Control Uncertainties Associated with the use of In-situ Remediation Techniques (Chemical Oxidation) for Organic Contaminants in Soil and Groundwater
Jean Paré, Chemco Inc.

In-situ chemical oxidation techniques are commonly used for the remediation of organic contaminants in soil and groundwater. These technologies are now well established and recognized by the specialized environmental firms and the different levels of government.

However, the field application in a heterogeneous aquifer brings some challenging distribution and contact issues that may impact the necessary contact between the contaminant and the oxidant in the aqueous and gaseous phase. These parameters therefore influence the outcome and results of the in-situ remediation technique.

This presentation presents various tools that are available and applicable to better characterize and understand the aquifer and the various parameters that impact on how the most commonly used oxidizers (hydrogen peroxide, sodium and potassium permanganate, sodium persulfate and sodium percarbonate) interact with the organic contaminants.

Field and laboratory data will be presented to better understand where and how these in-situ remediation technologies can be successfully applied.
Environmental Assessment of Federal Contaminated Sites in Nunavut
M. Corriveau¹, Y. Lanthier¹, P. Bandler¹, W. Ingham¹, E. Solski²
¹WESA Group Inc.
²Aboriginal Affairs and Northern Development Canada

The Contaminated Sites Directorate of Aboriginal Affairs and Northern Development Canada (AANDC), Nunavut region is responsible for managing contaminated sites on Crown Land in Nunavut. The department has now investigated approximately 343 sites, listed in the Nunavut Contaminated Sites Database. These remote sites are former mineral or petroleum exploration, mining, research, tourism and/or military operations that, in some cases, were established more than fifty years ago.

WESA Group Inc. (WESA) was retained by AANDC through a standing offer agreement to design and conduct historical records reviews, as well as Phase I and Phase II Environmental Site Assessments (ESAs) at many sites throughout Nunavut. The main goal of this research was to confirm the content of AANDC’s Northwest Territories/Nunavut contaminated site database and to acquire additional information regarding potential environmental issues on the subject sites in order to aid AANDC in prioritizing sites for remediation. In addition, WESA’s GIS department developed a customized database tool which contains historical information as well as recent assessment data for use within the department.

Based on a review of AANDC files in Iqaluit, sites were selected for a Phase I and/or Phase II ESA. WESA investigative teams traveled to the various remote sites either by Twin Otter or helicopter, generally staying one to two days at each site. Known and potential sources of contamination were identified and catalogued at each site. Soil, sediment and water samples were collected and submitted for analyses of metals, PHCs, BTEX, VOCs, PAHs and/or PCBs, where appropriate. Descriptions of the physical conditions, known and potential receptors, and potential exposure pathways were also noted at each site. All sites were then evaluated using the National Classification System for Contaminated Sites to facilitate classification and prioritization of sites for remediation by AANDC.

National Defence – Explosive Soil Concentrations for Military Training Sustainability: An Update (June 2011)
Yann Berthelot¹, Geoffrey I. Sunahara¹, Pierre Yves Robidoux¹, Dr. Sonia Thiboutot², Dr. Guy Ampleman²
¹National Research Council Canada
²Defence Research and Development Canada

Military activities, specifically live fire trainings, munitions testing, and disposals may result in the dispersion of energetic materials (EM) and heavy metals in the environment. In the absence of Canadian soil guidelines for EM, and in order to quantify the risks associated with these substances on human health and the environment, the Department of National Defence (DND) through Defence Research and Development Canada (DRDC) contracted in 2006 the Biotechnological Research Institute (BRI) of the National Research Council (NRC) to develop a set of Canadian ecological and human health military threshold values for EM. Initially called military training soil quality guidelines, in 2008 these guidelines were updated to consider the latest Canadian Council of Ministers of the Environment (CCME) methodology for ecological receptors and integrate more recent EM related toxicological and accumulation data. At that time, the guidelines were renamed soil concentrations for military training sustainability (SCMTS) as the values derived are not meant to be used as remediation guidelines but rather serve the purpose of promoting sustainable management of EM contaminated soils in active training ranges. In 2011, BRI performed conformity checks and updated the 2008 management guidelines and toxicity database to include additional new information with respects to biological effects and accumulation of energetics in ecological receptors.

This presentation will provide a better understanding of:
1. The importance of promoting sustainable military training activities;
2. The need to determine Canadian sustainable management “guidelines” for EM;
3. The methodology used to determine the EM soil thresholds;
4. The human health and ecological risks associated with energetic materials released into the environment; and,
5. The updated 2011 SCMTS.
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