Incorporating Risk-based Closure into Overall Site Management

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1

Outline

- Overview of Contaminated Sites Risk Assessment
- Risk Assessment as a Path to Closure
- Incorporating Risk Assessment into the Project Life Cycle
- Case Studies

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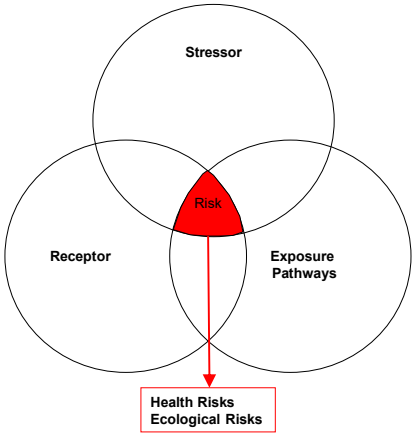
What is Risk

- The chance of harmful effects to human health or to ecological systems resulting from exposure to an environmental stressor.

- Dependent on three factors:
  - **Source:**
    - How much of a chemical is present in an environmental medium (e.g., soil, water, air).
    - Inherent toxicity of chemical.
    - Other stressors – physical (radioactivity), biological (mold).
  - **Receptor:**
    - Who / what can be exposed to a chemical.
  - **Pathway:**
    - How a person / ecological receptor can contact contaminated environmental medium.



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3

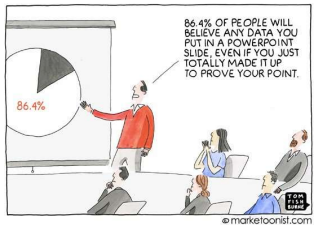
3

What is Risk Assessment

- Risk assessment is:
  - a scientific and iterative process;
  - a decision-making tool; and
  - the systematic process used to characterize the nature and magnitude of health risks to receptors from stressors in the environment.

- Varying degrees of complexity.
  - Screening level → Preliminary Quantitative → Detailed Quantitative

Increasing Cost



- You will only have a useful outcome if:
  - You have the right data.
  - Your data are representative of site conditions.
  - You understand your conceptual site model.

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4

What Risk Assessment is not…

- It is not:
  - Magic
  - A black box
  - A solution to all your problems
  - A "one size fits all" exercise

- It will not necessarily:
  - Eliminate a need for all active remediation at every site.
  - Reduce remedial costs (although it typically does)
  - Provide a path to closure (although it definitely helps on the journey).
  - Subsequent work may be required (risk management plan, remediation, ongoing management, etc.)

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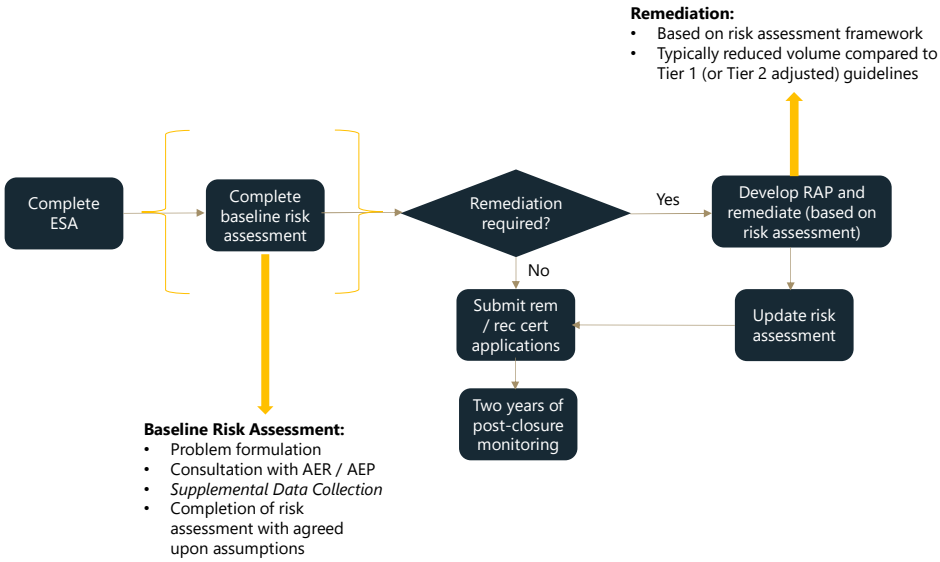
5

5

Risk Assessment as a Path to Closure



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6

6

Incorporating Risk Assessment into the Project Lifecycle

- **Phase 1 ESA:** Support / input into development of preliminary CSM
  - PCOC selection
  - Fate and Transport
  - Receptors / receiving environments
  - Exposure pathways
- **Phase 2 ESA:** Scoping / data collection
  - Soil physical properties
  - Fractionation data
  - Modifying factors
  - Parameters to support natural attenuation / ISZD
  - Characterization of receiving environments /
  - Lines of evidence in support of SSRA

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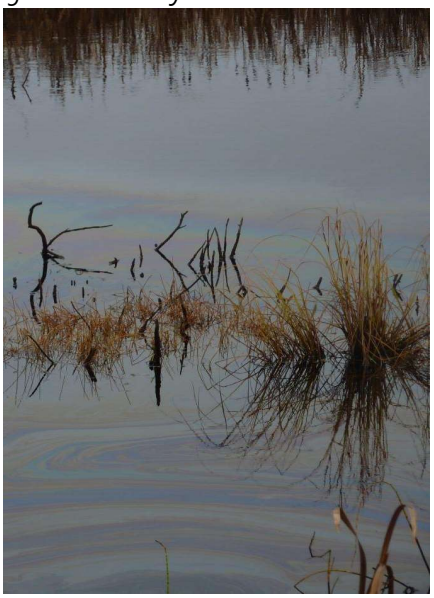
7

Incorporating Risk Assessment into the Project Lifecycle

- **Remedial Action Plan:** Baseline / post-remedial risk assessments
  - Minimize remedial volumes
  - Opportunities for soil reuse
  - SSROs
  - Evaluation of confirmatory samples
- **Risk Management Plan:** Actual versus theoretical risks
  - Exposure control
  - Monitoring
  - Triggers
  - Contingencies



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8

Case Study #1 – Risk Management of a Salt Contaminated Site in Northern Alberta

- Former salt storage yard in Northern Alberta.
- Sodium and chloride contamination.
- SAR up to 42 and EC above 30 dS/cm^2.
- Adjacent to culturally and economically important river.
- Risk assessment to demonstrate salinity could be left in place without creating a risk to receptors:
  - Guideline recalculation for chloride (species sensitivity distribution – 120 mg/L → 640 mg/L).
  - Calculation of mass flux into river.
  - Capping / containment with walking trail of worst-case impacts.
- Regulatory acceptance allowed for site redevelopment into recreation area.
- Remedial cost savings of more than $500k.

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9

Case Study #2 – Various Bromacil Impacted Sites Across Alberta

- Assorted sites with sterilant use, primarily on agricultural lands.
- Bromacil contamination in soils and/or groundwater at various concentrations.
- Coarse- and fine-grained soil.
- Driving pathways vary depending on the site.
- Risk assessment to develop risk-based bromacil criteria that are less conservative than Tier 1 values.
- Regulatory acceptance including approval to apply at multiple sites without renegotiation of approach.
- Remedial cost savings of more than $1M across various sites.

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10

Case Study #3 – Remediation of a Former Well Site

- Former gas lease on First Nations land.
- Hydrocarbon contamination in coarse-grained soils up to 14 mbgs.
- Agricultural end land use.
- Vapour intrusion pathway was driving risk based on depth of contamination and limitations of Johnson and Ettinger Model.
- Developed site-specific remedial objectives for soil vapour and implemented vapour sampling program across the site.
- Obtained regulatory buy-in for vapour sampling coupled with risk assessment to evaluate need for further remediation.
- Vapour data indicated sufficient attenuation was occurring and that residual concentrations in soil did not pose a risk to human health.
- Remedial cost reduction of hundreds of thousands of dollars.

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11

Case Study #4 – Field-Wide Risk Assessment

- Field of remote former lease sites in northeastern BC.
- Several sites with wetlands. One cut and fill site located adjacent to an economically and culturally important river.
- Characterized by produced water spills, hydrocarbons and metals in soils, groundwater, surface water and sediment.
- Weight of evidence approach coupled with consideration of sustainability metrics to minimize the need to truck impacted materials more than 400 km each way for disposal.
- Left salinity in place at concentrations exceeding 10,000 mg/kg in soils and 4,000 mg/L (at point of discharge) in water and much higher at upgradient locations from receptor
- Obtained verbal approval from regulators on application of a field wide approach which was accepted by buyer.
- Reduced liability by an estimated $30M across the sites.

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12

Summary and Conclusions

- Risk assessment
  - Decision-making tool
  - Not a black box / do not risk things away
- Start with the end in mind
  - Engage your risk assessment professional(s) early and often
- Conventional / innovative risk-based approach
  - Area / portfolio-wide approaches
- Regulatory consultation
- Benefits:
  - Reduced remedial volumes
  - Reduced remedial costs
  - Shorter timeline to closure
  - Approval of portfolio-wide approaches
  - Liability reduction
  - Increased sustainability

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13

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14