Environmental Remediation of the former Moisie Royal Canadian Air Force Radar Station in Sept-Iles, Qc

RPIC 2018

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Presentation outline

1. Historical background
2. Soil and groundwater contamination
3. Performance based approach
4. Selection of remedial option
5. Initial assumptions vs Actual results
6. Conclusion
7. Acknowledgements
1. Historical background

- CFS Moisie was a former radar station of the Royal Canadian Air Forces (PineTree Line);
- Located near Sept-Îles on the North Shore of the St-Lawrence Seaway, in the Quebec Province;
- In operation between 1953 and 1988;
- Privately owned since 1989 with partial dismantling and remediation works.
2. Soil and groundwater contamination

The soil contamination originated from the leakage of two former above-ground storage tanks which used to supply diesel fuel to the station’s heating plant.

Estimation of 10 600 m³ of contaminated soils above the applicable criteria found between 6 and 10 m below ground surface.

Groundwater was contaminated by the presence of contaminated soils but no contaminated groundwater reached the Moisie River and the St-Lawrence River.
3. Performance based approach

Goals of the approach

• Opens the contract to a wider industry;
• Industry takes the risk of their technology;
• Industry is responsible for all phases of the project: design, construction and operation;
• Prevents arguments on responsibility between the different phases of the project;
• Contract management is less time consuming.
3. Performance based approach

**Information needed in request for proposal**

- Good knowledge of the site:
  - Contamination, hydrogeology
  - Environmental site assessments, treatability studies
- Many technologies applicable
  - Previous request for remediation plans: Industry proposed 3 different technologies at comparable costs
- Clear objectives
  - Reach of the applicable criteria, within a specific time frame
3. Performance based approach

Challenges

• Added complexity to contractual documents
  – Different confirmation sampling program to fit different possible technologies
  – Different terms of payments to fit different possible technologies

• Needed buy-in by the different owners and the environmental authorities
  – More planning upfront of the contract

• Contract security and Bonds
  – May reduce the number of proposals
  – May influence the proposed technology depending of the risk tolerance of the industry

• Environmental permits and authorization
  – Risk transferred to the industry
  – Depends on the selected technology
3. Performance based approach

Outcome

- Good response from the industry: 9 proposals
- Different proposed remediation options: *in situ*, *ex situ*, mix of both
- Contract awarded to: SNC-Lavalin
4. Selection of remedial option
4. Selection of remedial option

Some factors were more favorable to an in situ approach:
- Soil contamination was deep (between 6 and 10 m below ground level);
- Soil contamination spread underneath existing buildings;
- High soil permeability (mainly sand);
- A portion of contaminated soils were below groundwater level;
- Only organic contamination (petroleum hydrocarbons).

Other factors rendered the in situ option less favorable:
- The size and irregular form of the contaminated area (more than 7000 m²);
- The average level on contamination (approximately 7000 mg/kg);
- Hard to guarantee results (confirmation characterization necessary).
4. Selection of remedial option

**Expected challenges associated with *ex situ* bioremediation:**

› Presence of a large building in the excavation zone;
› Maintaining slope stability during excavation works;
› Excavation and temporary storage of non contaminated soils (near 100 000 m$^3$);
› Drawdown of the water table near a river;
› Pumping and treatment of large quantities of water in a small timeframe;
› Unknown existing biodegradation conditions in contaminated soils;
› Neighborhood disturbances (excavation activities and on-site transport).
5. Initial assumptions vs Actual results

Moving the large building proved to be easier than expected.
5. Initial assumptions vs Actual results

Slopes were more stable than anticipated, even during periods of heavy rain.
5. Initial assumptions vs Actual results

Temporary storage of non-contaminated soils was challenging due to lack of space.
5. Initial assumptions vs Actual results

Limited recovery of Liquid Petroleum Hydrocarbons (LPH).
5. Initial assumptions vs Actual results

Drawing down the water table using Well Points was more challenging than anticipated.
5. Initial assumptions vs Actual results

Groundwater pumped in Northern excavation (August 2016):
› 160 Well points
› Expected quantities: Flow of 90 m$^3$/h for 36 h, total of 3240 m$^3$
› Actual quantities: Flow of 88 m$^3$/h for 58 h, total of 5104 m$^3$

Groundwater pumped in Southern excavation (September 2016):
› 230 Well points
› Expected quantities: Flow of 85 m$^3$/h for 36 h, total of 3060 m$^3$
› Actual quantities: Flow of 235 m$^3$/h for 16 h, total of 3760 m$^3$

In total, 8864 m$^3$ of groundwater had to be pumped and treated, compared to the estimated 6300 m$^3$. 
Water was pumped into holding ponds and transferred from pond to pond.
5. Initial assumptions vs Actual results

Water treatment was quicker than expected (2 days instead of 6)
5. Initial assumptions vs Actual results

Treated water was discharged into an infiltration trench.
5. Initial assumptions vs Actual results

**Estimated quantities of soils:**
- Non contaminated soils: 108 000 m$^3$
- Contaminated soils: 10 600 m$^3$

**Actual quantities of soils:**
- Non contaminated soils: 87 440 m$^3$
- Contaminated soils: 14 280 m$^3$
5. Initial assumptions vs Actual results

The initial shape of the biopile had to be modified in order to be able to receive an additional 1300 m³ of contaminated soils out of the 3700 m³ in surplus.
5. Initial assumptions vs Actual results

One of the holding ponds had to be converted into a temporary soil storage area for the remaining 2400 m$^3$ surplus of contaminated soils.
5. Initial assumptions vs Actual results

Existing biodegradation conditions were generally good throughout the project, but removal efficiency started to decrease within the last excavated soils.
5. Initial assumptions vs Actual results

Petroleum Hydrocarbon reduction in initial 11,900 m³
(does not include the 2400 m³ temporarily stored in the holding pond)
5. Initial assumptions vs Actual results

Managing neighborhood requests was more demanding than expected.
6. Conclusion

<table>
<thead>
<tr>
<th>Expected challenges</th>
<th>Actual challenge</th>
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</thead>
<tbody>
<tr>
<td>Building in excavation zone</td>
<td>No</td>
</tr>
<tr>
<td>Stability of slopes</td>
<td>No</td>
</tr>
<tr>
<td>Excavation and storage of non contaminated soils</td>
<td>Yes / No</td>
</tr>
<tr>
<td>Water table drawdown</td>
<td>Yes</td>
</tr>
<tr>
<td>Water treatment</td>
<td>No</td>
</tr>
<tr>
<td>Biodegradation activity in soils</td>
<td>Yes / No</td>
</tr>
<tr>
<td>Neighborhood disturbances / requests</td>
<td>Yes</td>
</tr>
</tbody>
</table>
6. Conclusion

**Non anticipated challenges:**

› Discovery of underground concrete infrastructures;
› Archeological investigations requested by the Innu community;
› Very low snow accumulation and high wind erosion;
› Exceptionally violent winter storms with record high winds;
› Managing negotiations and agreements with neighbors.
6. Conclusion

Project summary:

› No imposed methodology by the client allows the contractor to choose his own approach, which results in more flexibility of execution, especially when dealing with unexpected events;

› The on-site *ex situ* biotreatment of contaminated soils was a very cost-efficient approach for this specific project. To this day, almost 90% of all contaminated soils were treated and backfilled;

› Initial assumptions turned out to be generally appropriate but contingencies were necessary.
7. Acknowledgements

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- The City of Sept-Îles and the Moisie community.
Questions ?