


Canadian Nuclear Safety Commission / Commission canadienne de sûreté nucléaire

Canada

# The Role of a Physically Based Conceptual Site Model in Groundwater Monitoring and Remediation



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## Groundwater Monitoring and Remediation



- Conceptual site model
  - “written and illustrative representation of the physical, chemical, and biological processes that control the transport, migration, and actual or potential effects of contamination in: soil, air, groundwater, surface water, and sediments to human and ecological receptors” – CSA N288.7, *Groundwater protection programs at Class 1 nuclear facilities and uranium mines and mills*
- Understanding the physical processes
  - ➡ modelling groundwater flow and contaminant transport
  - ➡ monitoring and remediation options

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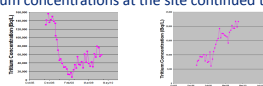
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## Case Study – Tritium in Groundwater at a Tritium Processing Facility in Canada



- Exceptionally high level of tritium in the groundwater at a tritium processing facility was observed
- Facility was shut down by the regulator
- Licensee undertook activities to address the matters
  - stopped the practice of dumping facility washing water onto the ground, thus stopping uncontrolled release
  - drilled many boreholes and conducted hydraulic tests
  - constructed a conceptual site model
  - delineated the plume in the groundwater
  - conducted a 3-D groundwater flow and tritium migration modeling
- But tritium concentrations at the site continued to increase...



Observed <sup>3</sup>H Concentrations in Groundwater Monitoring Wells up to 2009

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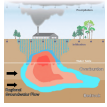
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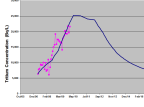
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**Canadian Nuclear Safety Commission Staff's Regulatory Approach: Independent Modelling**

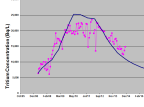
- Checked all reports available, including air release records, and borehole profiles
- Hypothesized that the increasing trend was caused by tritium in the soil above the water table from earlier releases being gradually pushed downward by precipitation
- A semi-analytical solution was developed to predict tritium concentration in the monitoring wells based on soil profile
- Monitoring data confirmed the modelling conducted in 2009



Conceptual Site Model



Observed up to, Predicted in, 2009



Observed up to 2014

<sup>3</sup>H Concentrations in Groundwater Monitoring Wells

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**Conclusions**

- Understanding the physical processes is key to the conceptual site model
- The Canadian Nuclear Safety Commission's regulatory approach of independent modelling contributed to
  - a fair and comprehensive review of licensee's applications
  - the Commission making informed regulatory decisions
  - developing stakeholders' confidence in the regulator's competence and independence

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**Questions?**

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**Thank You!**

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