(An) In Situ Treatment Train for Mitigation of Vapour Intrusion from LNAPL in a Residential Area, Calgary, Alberta

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Approximately ten years ago, a homeowner reported petroleum odours in their basement prompting an investigation into a gasoline release at a nearby service station located in a mixed residential/commercial area. Following the initial investigation of the extent of the groundwater and light non-aqueous phase liquid (LNAPL) contaminant plume, a remedial strategy was developed. The remedial strategy combined two primary technologies:

- monitored natural attenuation (MNA) for the dissolved plume outside the LNAPL footprint
- in situ treatment for LNAPL source reduction

Remedial endpoints were set at site-specific Tier 2 groundwater guidelines. The established guidelines were governed by risks to aquatic life in the adjacent river and associated flood fringe, which abutted the dissolved contaminant plume.

Pilot testing of in situ chemical oxidation (ISCO, catalyzed hydrogen peroxide [H_2O_2]) injections, paired with soil vapour extraction (SVE) was undertaken in an area straddling two of the affected, occupied residential properties. The aggressive off-gassing and liberation of LNAPL from soil into a monitoring well as part of the ISCO reaction in this small LNAPL source area demonstrated the multi-faceted mass reduction processes (i.e., desorption, volatilization, and oxidation) that occur with H_2O_2. These new observations helped inform the basis of design for an expedited remediation using a treatment train.

Multi-purpose injection wells were installed to be utilized for H_2O_2 injections after an air sparging (AS) pre-treatment step to reduce the LNAPL mass and mitigate potential vapour intrusions during ISCO. Both technologies were accompanied by robust SVE, as well as fully integrated sub-slab depressurization systems to mitigate vapour intrusion into the overlying residential buildings. The AS/SVE treatment rotated among 94 nested vertical injection well pairs and 30 vertical SVE wells over a 7-month period, removing approximately 1,000 kilograms of subsurface hydrocarbon mass from the targeted treatment zone prior to H_2O_2 injection. The remedial effort eliminated risks to aquatic life in the adjacent river, with groundwater in only three monitoring wells exhibiting benzene concentrations above drinking water guidelines following ISCO. No vapour intrusion occurred within the residences, which remained occupied during the implementation.

This presentation will touch on:

- The use of geospatial tools and visualization to define an in situ targeted treatment zone
- The added precautions, including community relations, involved when remediating beneath and immediately adjacent to occupied residential buildings
- The benefits of sequential implementation of multiple in situ technologies (i.e., a treatment train) for effective contaminant reduction and mitigation of risk during remediation
- Continual optimization of remedial system operation, even in short term applications

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Andrea Hachkowski is a Professional Engineer with over 20 years of experience in the development and implementation of risk management and remedial strategies for large-scale complex contaminated sites. Her focus is incorporation of qualitative and quantitative human health and ecological risk assessment to optimize remedial designs. She has used this approach to achieve regulatory closure for sites throughout Canada, including manufactured gas plants, mines, chemical manufacturing facilities, and oil and gas facilities.