

In-Situ Chemical Treatment for Reduction of Dissolved Arsenic Concentrations near an Active Spur Line in Burnaby, BC

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Keystone Environmental completed an in-situ chemical injection program near an active spur line to address increasing dissolved arsenic concentrations in groundwater. This presentation discusses the site history, arsenic concentration trends, pilot chemical injection program, different injection methodologies, chemical composition, analytical results and its role in the site closure strategy.

Located on the shore of the Fraser River in Canada, the site was historically owned by Canadian National Railway Company (CN) and operated by third parties to produce railway ties and utility poles, which were pressure treated with wood preservatives. Remediation of the property to address contamination from wood preservation chemicals began when the plant closed in the early 1980s. The site was then sold, and a warehouse building was constructed on the uplands; the current building tenant uses the property for storage and distribution operations.

Dissolved arsenic was identified at concentrations exceeding the regulatory standard and the site-specific toxicity reference value in monitoring wells at the Site. Prior to 2015, concentrations of dissolved arsenic in groundwater had been increasing at wells in the "discharge zone". Concentrations of dissolved arsenic exceeding the Site-specific threshold triggered implementation of a mitigation method to address the increasing concentrations.

Keystone Environmental evaluated several options to address the increasing arsenic concentrations. The selected strategy had to be feasible for implementation at an active storage and distribution facility and in the proximity of an active spur line. Keystone Environmental designed a chemical injection pilot study to investigate the ability of an injected slurry to remove arsenic from groundwater.

The study included investigating the rate of arsenic immobilization, the injection radius of influence, and the effects, benefits and limitations of different injection methods, and the optimum injected chemical composition on the site geochemistry.

A proprietary reducing agent for in-situ metal fixation was identified as a suitable chemical amendment to precipitate arsenic in-situ. Between 2015 and 2018 the chemical injection program consisted of four rounds of chemical injection downgradient of the source location, with follow up amendment applications of sulphate and/or lactate solution to address limiting reagents in the reaction zone. The first round was injected via direct push injection, and the second

round was injected via jet grouting. While jet grouting is typically used for soil stabilization or excavation support, its application here allowed for increased delivery of remediation product to the subsurface and created treated soil columns that will continue to react with the dissolved arsenic. Each round of injection also includes varying compositions of chemical being injected to promote precipitation of arsenic in sulphide mineral form.

Preliminary results of the pilot chemical injection program indicate that concentrations of arsenic are decreasing in the target injection area four years since the first round of injection.

Jason Christensen

Jason Christensen has over 21 years of experience in the environmental field and provides engineering expertise in contaminated sites remediation, site investigation, environmental engineering and wastewater treatment. His role includes being the senior technical reviewer and manager for projects that entail remediation option evaluation, remediation plan preparation, remediation system design, wastewater treatment design and operation, and permitting. He has managed the design of numerous remediation programs and the construction and installation of treatment and remediation systems.

He is a registered professional engineer in BC and Alberta, is an Approved Professional with CSAP in BC, and is a member of the Performance Assessment Committee for CSAP BC.

Antonia Gunardi

Antonia Gunardi is a registered Professional Engineer in BC with 15 years of experience and expertise in both civil and environmental consulting. She has managed and prepared various remediation plan and option evaluation for broad range of industries including residential/commercial development, industrial manufacturing, transportation, and municipal. Her experience in engineering design, construction oversight, allows her to visualize design issues quickly and more completely, to identify pertinent issues that may be overlooked and offer practical solutions to stakeholders.