Mine Tailings Mineralogy, Hydrologic and Redox Conditions Contributing to Metals Leachability, and In Situ Treatment Using Stabilization/Solidification, Barclay Sound, British Columbia, Canada

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Background/Objectives. During the 1960s, magnetite ore from the Brynnor iron mine was milled and tailings were directed along the nearby shoreline creating a sandy beach which was used as a campground for four decades. Between 2013 and 2015 environmental investigations were conducted for Constituents of Potential Concern (COPC). Concentrations of Arsenic (up to 19,200 µg/g) and Cobalt (up to 2,170 µg/g) were found in the tailings in the upland soil and intertidal sediment. Concentrations observed in the intertidal area exceed the BC Contaminated Sites Regulation standards. Due to the elevated concentrations, the campground was closed pending remediation to address arsenic leachability. Additional investigations were subsequently undertaken to develop the site conceptual model in media across the site. Intertidal sediment/pore water geochemistry and treatability testing to mitigate arsenic leachability after remediation were the objectives of these investigations

Approach/Activities. Both field and laboratory investigations were conducted to meet these objectives. First, a mineralogy evaluation was conducted to identify the minerals associated with arsenic and arsenic leachability. Second, a hydrologic consideration of groundwater and seawater flow through the tailings was evaluated and a series of bench scale leach tests were conducted to model these conditions. Third, data obtained from the bench leach tests were used to look at solubility of arsenic under a range of redox conditions for each of the tailings settings. Last, representative samples of the intertidal tailings were obtained to conduct stabilization/solidification (s/s) treatability testing using a range of reagents.

Results/Lessons Learned. Trace sulfide minerals were identified in the tailings (arsenopyrite (FeAsS) and cobaltite (CoAsS). The site conceptual model considered that the upper tailings are exposed to dissolved oxygen in infiltrating precipitation causing sulfide mineral oxidation and release of dissolved metals within the water table fluctuation zone. In deeper, oxygen-depleted areas below the water table, metals (arsenic) release is not occurring at a significant rate. Daily tidal wetting and draining combined with active groundwater discharge provided a dynamic environment in the marine intertidal zone which appears to increase metals leaching (dissolved As up to 3,960 µg/L and dissolved Co up to 942 µg/L) in spite of pH values of 7.6 to 8.1. This area was targeted for remediation using s/s to address conditions affecting leachability including attenuating metals in a more reactive matrix and/or reducing permeability of the matrix thereby reducing oxidation. Reagents employed the use of Portland Cement, blast furnace slag blended cement and bentonite. Results confirmed treatability objectives to reduce permeability and leachability could be achieved.