Whitehorse - Tuesday, September 11, 2018

Session #2 - Water Management at Closure

Time **1110am-1130am**

Topic

Performance of the Operating Demonstration - Scale Constructed Wetland Treatment System at Minto Mine

Abstract One component of Minto Mine's Reclamation and Closure Plan is the design and implementation of a Constructed Wetland Treatment System (CWTS) for passive water treatment at closure. A phased approach to a full-scale implementation of a CWTS at Minto Mine was initiated in 2014 and is currently at the on-site demonstration-scale and parameter optimization stage before a full scale CWTS is implemented. The demonstration-scale system has two independent series in parallel with two cells in each series and a final catchment basin, and has successfully treated constituents of potential concern in the mine site's sub-arctic continental climate. Efficiency of any CWTS is site-specific and, like any water treatment facility, requires a commissioning period for optimization to achieve peak performance. System commissioning is dependent on biological, chemical, and physical parameters being adjusted each year until the system reaches targeted operational ranges. The system was planted with robust Carex aquatilis (aquatic sedge) and aquatic mosses (bryophytes) from natural wetlands onsite that serve as the headwaters of Minto Creek, while water for the system was sourced from a constructed sump that collects mine-impacted seepage water from waste rock, tailings, and construction-grade rock fill. A maturation period is necessary for vegetation to establish and for sufficient quantities of microbes to populate the system. The CWTS was designed to target specific physicochemical parameters for treatment (confirmed through off-site pilot-scale testing), which enabled sulfate-reducing bacteria to treat metals and metalloids in the water. The constituents being evaluated for removal from treated water include cadmium, copper, molybdenum, selenium, and zinc. Removal of these metals and metalloids was achieved, and further refinement of rate coefficients is being assessed for the full-scale design. Reducing conditions are required for nitrate and selenium treatment, as well as for creating metal-sulfides that remove copper, cadmium, molybdenum, and zinc from the water. The CWTS was designed to develop and sustain stable reducing conditions. This was targeted within a soil oxidation-reduction potential (ORP) range of -100 to -250mV, and can be achieved even when overlaying dissolved oxygen concentrations are in aerobic ranges. A targeted hydraulic retention time (HRT) also contributed to generating reducing conditions in the CWTS. The operational period began in 2017 and lasted 35 days thus far, which followed system commissioning (2 years). In the operational period, the CWTS achieved an average decrease in concentration of 64.8% for cadmium, 64.8% for copper, 60.6% for molybdenum, 87.5% for selenium and 96.1% for zinc. Treatment is based on first-order removal rate coefficients (RRC), meaning that the percent decreases in target constituents are subject to change based on feed water chemistry and flows. RRCs were developed in pilot-scale testing (off-site), refined during on-site demonstration-scale testing, and will be used for sizing of the full-scale design. Further trials are planned for 2018 to refine RRCs based on testing a wider range of HRTs. Many mines globally, including sub-arctic mines in Northern Canada and the US are pursuing CWTS for water treatment. The authors hope this case study will contribute to the growing body of knowledge in this area of reclamation science and engineering.

Presenter(s) Emilie Bouchard, Minto Mine

Bio(s) Emile Bouchard has been an environmental officer with Minto Mine for just about 2 years working on various environmental projects. She has a strong academic background in environmental science; completing her Masters Degree in Environmental Engineering with a focus on alpine hydrology.