Characterization of Hydraulic Conductivity Profiles for Reclamation Sites at an Oil-sand Mine

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Oil-sand mine operators in NE Alberta must reclaim disturbed landforms to "equivalent landscape capability". An important part of these landscapes are wetlands and their watersheds; two have recently been constructed in the Athabasca Oil Sands Area and are the first reclamation projects of their kind. The hydrologic and ecologic evolution of the watersheds is being closely monitored, but hydrogeological properties are poorly constrained. Here, hydraulic conductivities (K) of as-built reclamation materials were evaluated for Syncrude Canada's Sandhill Fen Watershed (SHW). For the purpose of groundwater flow modeling, saturated K was measured in the field using a Guelph Permeameter and in the laboratory using a constant head permeameter. Field measurements were in Pleistocene fluvial sand (PfS), soft tailing sand (TS), and peat-mineral mix (PMM). Measurements on extracted clay-rich till (CRT) core samples were performed in the laboratory to accommodate a lengthy running time due to the comparatively low K. The geometric mean K values for the SHW reclamation materials are found to be $5.1x10^{-5}$ m/s for Pfs, $2.6x10^{-5}$ m/s for TS, $1.5x10^{-5}$ m/s for PMM, and $1.1x10^{-9}$ m/s for CRT. With the largest range in values, the K of the PMM is markedly influenced by heterogeneous distributions of variable mineral content which likely influences surface water manifestations. Comparison to previous slug tests completed in the deeper saturated TS reveals the shallow unsaturated zone has a higher average K as a response to lesser compaction. These constraints on the hydraulic conductivity and variability of the reclamation materials are essential for numerical models used to stimulate groundwater flow in constructed reclamation wetlands to predict future performance.