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Comparing the Long Term Hydrological Performance of Reconstructed and

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The mining process results in a large disturbance of the ecological functions of nature such as the hosting of aquatic ecosystems and vegetation biomes. In order to gain access to the oil-bearing formations, the overburden material is removed and stockpiled and then, salvaged topsoil is placed over it. The oil sands industry has committed to returning the mine sites to a productive condition. An essential criterion in the design of reconstructed covers is to have sufficient available water holding capacity (AWHC) to supply enough moisture for vegetation over the growing season. In order to assess the hydrological performance of various soil cover alternatives, the generic system dynamics watershed model (GSDW) was used along with the available historical meteorological records to estimate the maximum soil moisture deficit and annual evapotranspiration fluxes. Frequency curves of the maximum annual moisture deficit ($D_{m)}$ values are constructed and used to probabilistically assess the ability of various reconstructed watersheds to provide the associated moisture demands in comparison with the natural watersheds. In the current study, watersheds of various soil types, layering, thicknesses, and topography were studied. The results showed that reconstructed watersheds tend to provide less moisture for evapotranspiration than natural systems. A hypothetical reclamation cover was suggested based on knowledge gained from the existing sites. The hypothetical cover showed similar performance to the thickest existing soil cover, confirming a high probability that the hypothetical cover can survive under the same climatic conditions. The probabilistic framework was used to integrate gained information from mature natural systems (e.g. mature canopies) and extrapolate the results to the reconstructed system, resulting in an improvement to the moisture deficit regimes of reconstructed covers. This finding show a higher possibility that reconstructed covers will adapt to the vegetation type. In brief, the adopted approach enables better understanding of the response of reconstructed systems via comparison with mature natural systems.