

Stratigraphic Controls of Quaternary Aquifer Deposits in the Primrose and Wolf Lake Oil Sands Development Areas, Northeast Alberta

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Summary

Quaternary-aged fluvial deposits in the Primrose and Wolf Lake (PAW) oils sands development areas form the fresh-water aquifers in this region. Understanding both the nature and distribution of Quaternary aquifer deposits at PAW is necessary in the monitoring and management of groundwater units above the base of groundwater protection.

The PAW area is overlain by as much as 250m of Quaternary-age sediments. The lithostratigraphy of the Quaternary deposits in this area have been extensively studied and described by Andriashek and Fenton (1989), who also discussed the subdivision of the stratigraphy in relation to glacial cycles. The complex stratigraphy of these Quaternary sediments is comprised of stacked packages of glacial diamicton (till), with interstratified fluvial and lacustrine sediments.

Detailed Quaternary geological characterization carried out in 2013 and 2014 has allowed for an increased understanding of the Quaternary stratigraphy in the PAW area. The data set, consisting of geophysical logs and core hole data, has also allowed for the refinement and expansion of the depositional model for these Quaternary-age sediments. The recent work in PAW has led to the subdivision of aquifer deposits into two main categories; 1) local aquifer deposits, and 2) regional aquifer deposits. Local Aquifer deposits are deposited during a glacial event in a sub glacial or proglacial environment, and can be found anywhere within a till unit, with low predictability and little regional continuity. Regional aquifer deposits are deposited when the ice sheets are in a receded position, appear predictably at till sheet contacts, and are mappable on a regional scale.

During the Quaternary Period in PAW, there were several episodic glacial cycles of the Laurentide Ice Sheet. A typical glacial cycle involves a major glacial advance and period of ice coverage, followed by ice sheet melting and a hiatal period that is ice free. Each ice advance is the source of one of the lodgment till units in the stratigraphic sequence. In the early phases of the following interglacial period, meltwater from ice retreat is responsible for depositing fluvial sediments over an extensive area. During subsequent ice accumulation and advance, additional fluvial sediments are deposited over the interglacial sands, resulting in the development of a compound regional aquifer deposit comprised of a retreat/advance couplet.