

Executive Summary

The Ontario government has introduced legislation to protect drinking water at the source, as part of an overall commitment to human health and the environment. A key focus of the legislation is the production of locally developed, science-based source water assessment report and protection plans. The Lakehead Region Conservation Authority (LRCA) is participating in this initiative.

The Water Budget is one in a series of Technical Guidance Modules that was mandated to help watershed communities develop the Assessment Report. A water budget is a process that identifies how much water is available in the watershed, and illustrates how water moves through the watershed (lakes, streams and under the ground). The water budget takes into account all the activities that require water, including both the needs of people and the environment. It also accounts for anticipated future water needs.

The Lakehead Region Conservation Authority has prepared this water budget 'conceptual understanding' on a watershed basis. The conceptual understanding provides an overview of how the groundwater and surface water interact and move through the watershed. This understanding has enabled the LRCA to determine if there is a need for, and level of, water budget assessment through numeric modeling.

The Kaministiquia River and its tributaries form the most significant drainage system in the Lakehead Source Protection Area (Lakehead SPA). Other major rivers in the Lakehead SPA are the Neebing, Current, McIntyre and Wolf Rivers. The major urban centre in the Lakehead SPA is the City of Thunder Bay, which has a total population of approximately 110,000, comprising about 90% of the total population of the Lakehead SPA. The Municipalities of Oliver Paipoonge, Neebing, and the Township of Shuniah have a combined total population of approximately 10,000. The Townships of Conmee, O'Connor, Gillies and Dorion have a combined total population of about 3,000.

Within the Lakehead SPA, there are 21 quaternary watersheds with a total drainage area of approximately 11,526 km². The Kaministiquia River and its tributaries form the major watershed in the Lakehead SPA and drain an area of approximately 7,812 km² (approximately 68% of the total watershed area). The remaining smaller watersheds comprise 3,714 km² (approximately 32%) of which the most important are: Current River watershed (663 km²), Neebing River watershed (232 km²), McIntyre River watershed (210 km²), and the Wolf River watershed (730 km²). All of the 21 quaternary watersheds eventually drain to Lake Superior via the Kaministiquia River, Neebing River, McIntyre River, Current River, Wolf River, McVicar Creek, Whiskeyjack Creek and Lomond River, as well as some other minor creeks and streams northwest and south of the City of Thunder Bay.

The Lakehead SPA is characterized largely by shallow soils over bedrock with sporadic occurrences of deeper overburden in the area of Kaministiquia River Valley, Whitefish and Slate River Valleys and the area south of the Dog Lake moraine. Another isolated area of thick overburden occurs in the area of Dorion, in the northeast part of the Lakehead SPA. The overburden is mostly sand and gravel (Kaministiquia and Slate River valleys consist predominantly of clay) through which infiltration of precipitation readily occurs. There are areas with thicker more fine-grained deposits such as clay and silt and while these accept less water, there is still

significant ground water recharge. The underlying Precambrian bedrock is comparatively impermeable and therefore deflects groundwater flow laterally to the streams, wetlands and lakes. Most of the shallow private wells are located within the area of thicker overburden.

In the past the City of Thunder Bay has obtained its drinking water from Lake Superior and Loch Lomond. However, Loch Lomond will likely be decommissioned by the end of 2007 and then all surface water supplies for the City of Thunder Bay will come from Lake Superior. In addition to the City of Thunder Bay, the hamlet of Rosslyn Village is also supplied with municipal water supply from a well field (the Rosslyn well field) utilizing one ground water well for potable water. Within the City of Thunder Bay, 8% of the population obtain drinking water from private wells. Approximately 13,000 people within the rural population get their water supply from domestic wells.

The water balance was calculated based on the six meteorological stations within and in the vicinity of the Lakehead SPA. An assessment of soils, topography, and landcover was compared to the average annual streamflow of twelve gauging stations within the SPA. This was conducted for the period of 1970 to 1994, when the meteorological records were most coincident with existing streamflow records. Measured meteorological data and related calculations (like actual evapotranspiration) were interpolated for the Lakehead SPA from values measured (or calculated) at six meteorological stations. Individual month and annual interpolations were made using an Inverse Distance Weighting formulation. This interpolation is dependent on the variation between observed data points.

The interpolated average annual precipitation for the Lakehead SPA during this period was approximately 843 mm/yr. The interpolated actual evapotranspiration and surplus were estimated to be 508 mm/yr and 335 mm/yr, respectively. This surplus is then available for surface runoff and groundwater recharge. The average recharge for the area was approximately 168 mm/yr and average surface runoff was 167 mm/yr. Since the recharge ultimately reaches the watercourses in this shallow flow system, it generates baseflow. The combination of surface runoff and baseflow is generally within 10% of the observed streamflow for smaller watersheds. For larger watersheds like the Kaministiquia River (02AB006) and Shebandowan River (02AB009) the deviation becomes larger and is in the range of 20 to 28%.

When considering the entire Lakehead SPA, consumptive surface and groundwater takings equal 61.17 and 3.75 Mm³/yr (Million cubic metres per year), respectively, for a total of approximately 65 Mm³/yr. Compared with the available surplus, there are ample drinking water supplies within the Lakehead SPA. On a regional basis, there is low water use, low growth and minimal land use changes. There are no known water quality issues. Therefore, the team has selected a simple analytical modelling approach to conduct a Tier 1 water budget assessment.

The Tier 1 water quantity stress assessment relied on the Water Budget Conceptual Understanding. A Tier 1 Water Budget and Water Quantity Stress Assessment were performed for Loch Lomond (surface water based former municipal drinking water supply) and the Rosslyn Wells (groundwater-based drinking water supply). Although Loch Lomond will likely be decommissioned as a source of drinking water supply, it may be used in the future for other purposes. Analysis was performed for both of the watersheds and identified a Low Level of stress for both existing and future conditions.