GROUNDWATER LEVEL OBSERVATION WELL NETWORKS IN CANADA

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INTRODUCTION

Throughout the world, for a variety of reasons and at various organizational levels, groundwater level observation well networks have been established. Reasons for establishing a network typically are: (a) obtaining information on the natural groundwater level fluctuations representative for various topographic, geologic, climatic and land-use environments, and (b) obtaining information on the behavior of various types of aquifers under man-made stress (e.g. groundwater withdrawals, injection, irrigation, surface water reservoirs and land-use changes). In recent years, increased emphasis has been placed on the impact of climate variability and climate change on groundwater resources. Observation well networks have been established at a national level, in regions (e.g. Provinces, Territories and States), locally (e.g. municipal water supplies and industries), and for research purposes.

In Canada, no national network of groundwater level observations exist and Provinces have their own networks. The first groundwater level observation wells appear to have been established in Ontario in the late 1940s. In the late 1950s and early 1960s, other Provinces started to develop networks. At present there are an estimated 1,530 provincial observation wells in Canada (see Figure 1 and Table 1). It is important to note that in contrast to meteorological and stream flow data, which may have records up to 100 years in length, groundwater level records are typically less than 25 years in length and seldom exceed 40 years.

GROUNDWATER LEVEL RECORDS

Water level measurements provide essential information on the availability of groundwater resources as they measure changes in storage in aquifers. A groundwater level, whether it is the water table of an unconfined aquifer or the potentiometric level of a semi-confined aquifer, is never at rest due to a variety of influences. The hydrographs obtained from wells are the cumulative result of the superposition of several types of fluctuations. Seasonal fluctuations are superimposed on longer-term trends. While seasonal fluctuations provide information about the recharge process and about when it occurs, longer-term trends are more important as they relate the response of that water level to changes in climate. Alternating series of wet and dry years in which the recharge originating from precipitation is above and below the mean, will produce longer-term fluctuations. In general, shallow aquifers are affected by "local" changes in recharge derived from precipitation and will respond quickly to these changes. In contrast, deep aquifers are affected by "regional" changes in recharge and show less and a delayed response. Superimposed on the seasonal fluctuations are short-term fluctuations due to changes in barometric pressure, earthquakes, earth tides, transpiration of vegetation, and in some cases the passage of trains. Man-made influences such as those due to pumping and artificial recharge (e.g. injection wells, reservoirs, canals) are superimposed on these natural fluctuations and in some cases may mask the shorter-term fluctuations.

Seasonal and longer-term groundwater level fluctuations for aquifers typical in Saskatchewan are shown in Figure 2. Figure2B shows that seasonal fluctuations in water table aquifers are characterized by a minimum in February - March, just prior to the onset of the snow melt and spring rains and that a maximum occur in May - June. Although there might be a lag, the water level in shallow semi-confined aquifers show similar seasonal fluctuations as in water table aquifers (Figure 2B). Hydrographs for unconfined aquifers at depth show no seasonal fluctuations (Figure 2C). This is due to the difference between the storage coefficient in semi-confined and unconfined (water table) aquifers. Aquifers confined by thick aquitards with a low hydraulic conductivity show small (0.1 to 0.2 m) seasonal fluctuations characterized by a minimum in the fall and a maximum in the spring (Figure 2D). These characteristics are related to loading and unloading of soil moisture at the ground surface.

Figure 1 GROUNDWATER LEVEL OBSERVATION WELLS IN CANADA IN 2003

British Columbia	164
Alberta	200
Saskatchewan	72
Manitoba	600
Ontario	355
Quebec	98
Newfoundland	10
New Brunswick	7
Nova Scotia	11
Prince Edward Island	13
TOTAL	**1,530**

Table 1 Number of groundwater level observation wells in Canada

Figure 2 HYDROGRAPHS FOR TYPICAL AQUIFERS IN SASKATCHEWAN

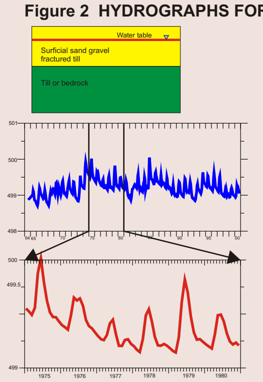

Figure 2A Hydrograph typical for water table aquifer

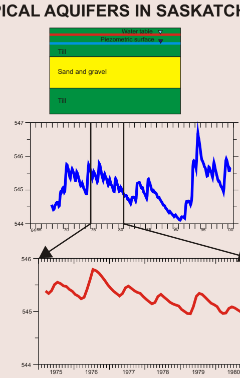

Figure 2B Hydrograph typical for shallow semi-confined aquifer

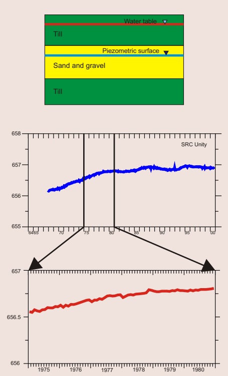

Figure 2C Hydrograph typical for an unconfined intertill aquifer

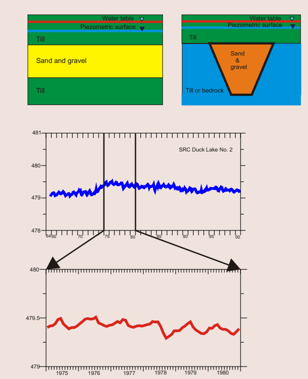

Figure 2D Hydrograph typical for deep intertill/bedrock and deep buried valley aquifer

THE FUTURE

In the past two decades, groundwater observation well networks have suffered from budget constraints. The size of provincial networks have been reduced (e.g. Alberta), and in some cases entire networks have been eliminated (e.g. Quebec, Ontario, New Brunswick).

As the demand for water likely will increase in the future there will be increasing pressures on groundwater resources. In addition, climate change may have a significant impact on the availability of groundwater resources. Consequently, to assess the availabilty and sustainability of groundwater resources the need exists for sustained funding for obtaining long-term water level records. To allow for better interpretation of groundwater level data, observation well networks should be tied into climate and streamflow networks. Equally important for the proper interpretation of water level data, but seldom done, is the systematic collection of groundwater withdrawal (pumping) data.

While groundwater resources are a provincial jurisdiction the need also exists for a Canada-wide network. This either could be a separate network or consist of selected provincial wells.

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