

# **Humber River Watershed**

## **Scenario Modelling and Analysis Report**

### **Chapter 2.0 Setting and Issues**

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Chapter

2.0

## SETTING AND KEY ISSUES

### 2.0 SETTING AND KEY ISSUES

Climate, physiography and geology form the foundation that influences the Humber watershed's hydrological and biological characteristics, while land use and management practices affect their condition. The following sections provide an understanding of the watershed's physical setting and anticipated land use changes, issues and opportunities as necessary background for the study design and interpretation of study findings. This information was particularly important in defining future scenarios and setting up hydrological models to predict the response of watershed systems to these scenarios.

#### 2.1 Climate

Climate characteristics are important input variables for hydrological studies because virtually all water in the watershed ultimately derives from precipitation and temperature affects potential evapotranspiration – two key drivers of the watershed's overall water budget.

Within the Humber River watershed area, there are three main zones of relatively contiguous and uniform climate known as the Lake Ontario Shore, the South Slope/Peel Plain, and Oak Ridges Moraine/Niagara Escarpment zones (named after the physiographic regions). The Lake Ontario Shore zone closely follows the north shore of Lake Ontario in a relatively narrow band approximately 10 kilometres inland and is under the moderating influence of the lake. The South Slope/Peel Plain zone is topographically higher and farther from the Lake, and hence the influence of the Lake is diminished. The Oak Ridges Moraine/Niagara Escarpment zone is the highest elevation area in the watershed and furthest from Lake Ontario. The three zones are largely distinguished by differing precipitation and temperature patterns.

#### Precipitation and Temperature

Based on Environment Canada climate stations in or near the watershed with at least 30 years of records, the average annual precipitation for this watershed during the period 1971 to 2000 ranged between 798 millimetres per year (mm/yr) in Woodbridge (Station 6159575) in the South Slope/Peel Plain zone, 834 mm/yr in Toronto (Station 6158350) in the Lake Ontario Shore zone, and up to 933 mm/yr near Mono Mills (Station 6152833) in the Oak Ridges Moraine/Niagara Escarpment zone (Environment Canada, 2007). The term "precipitation" includes rainfall, dew, snowfall and condensation.

Mean annual temperatures are useful for broad, regional comparisons. The mean annual temperature for the portion of the Lake Ontario Shore zone within the TRCA jurisdiction is approximately 8 degrees Celsius (°C). Given its distance from Lake Ontario and higher elevation, the South Slope/Peel Plain zone has a cooler mean annual temperature of about

7°C. The Oak Ridges Moraine/Niagara Escarpment zone has a slightly cooler mean annual temperature of about 6.5°C (Sanderson, 2004; Environment Canada, 2007)

### Evapotranspiration

The mean annual actual evapotranspiration for the region including the Humber River watershed has previously been estimated to be about 530 to 560 mm/yr, reflecting seasonal periods of soil moisture limitations (Brown *et al.*, 1980, Phillips and McCulloch, 1972, Morton, 1983). Through the application of water budget modelling, average annual total evapotranspiration was estimated to range from 469 mm/yr in the Toronto area (Lake Ontario Shore zone) to about 517 mm/yr along the Oak Ridges Moraine/Niagara Escarpment zone and an average value of 589 mm/yr for the South Slope/Peel Plain zone (Earthfx, 2008). A value of about 525 mm/yr is the average value for the entire watershed. Details regarding the modelling approach are presented in Section 4.3 (Groundwater).

### Water Surplus

The modelled average annual water surplus (i.e., precipitation minus total ET losses) under current conditions ranges from 383 mm/yr in the Toronto area to about 331 mm/yr along the Oak Ridges Moraine (Earthfx 2008). The water surplus estimate for the area in between the above mentioned two boundaries was estimated as 277 mm/yr. Average water surplus for the entire watershed was estimated at 330 mm/yr. Part of the water surplus will be converted to surface runoff into area watercourses and the balance will infiltrate through the soil profile and eventually recharge the upper portion of the groundwater system. Infiltration (recharge) is discussed further in Section 4.3 (Groundwater) and runoff is discussed in Section 4.1 (Surface Water Quantity).

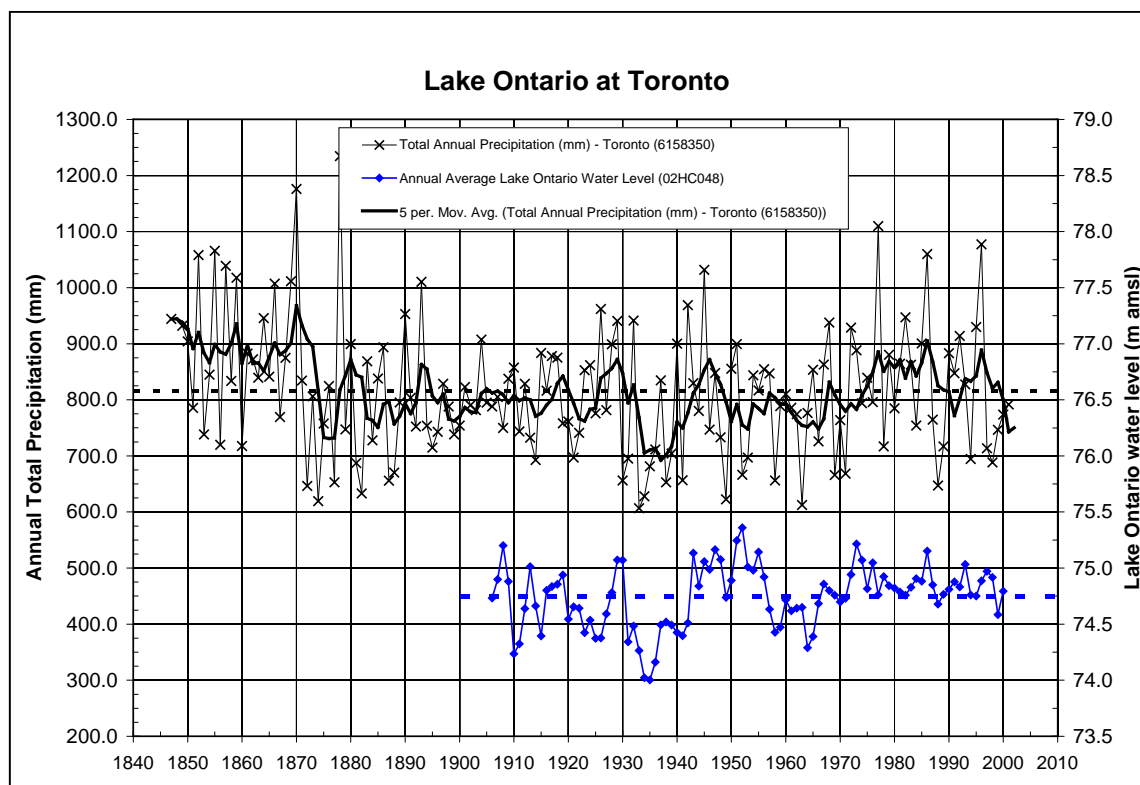
### Climate Trends

Climate varies on both a short-term (seasonally) and long-term basis, which makes the selected time period for data analysis very important for calculating the water budget. Based on long term assessments of climate data from a station in the City of Toronto (Kassenaar and Wexler, 2006) the annual precipitation in this area has varied from approximately 600 mm/yr to 1200 mm/yr, with an average value of 800 mm/yr (Figure 2-1). A decade of below average precipitation, by some 100 mm, occurred in the 1930s and above average values, in the order of 80 mm, took place during the 1970s and 1980s.

Some global climate change models predict a future climate with average temperatures and precipitation amounts that are significantly different (typically warmer and wetter) from present conditions in the Toronto Region. Two model scenarios that provide some of the most drastic climate change forecasts for Southern Ontario, generated by the second version of the Coupled Global Climate Model (Canadian Centre For Climate Modelling and Analysis, 2005) and the British Hadley Global Climate Model (Hadley Centre for Climate Change, 2005), predict average annual temperature increases of 5.3°C and 7.1°C and annual precipitation increases of 5.9% and 18.9% respectively. Some researchers also predict a global increase in the frequency of extreme, intense precipitation events (Kharin and Zwiers, 2005) although these types of change are much more difficult to predict and no conclusive determinations have yet been made regarding future extreme precipitation patterns in Southern Ontario or the Toronto area.



**Figure 2-1: Long Term Precipitation (Toronto, Queen's Park)**

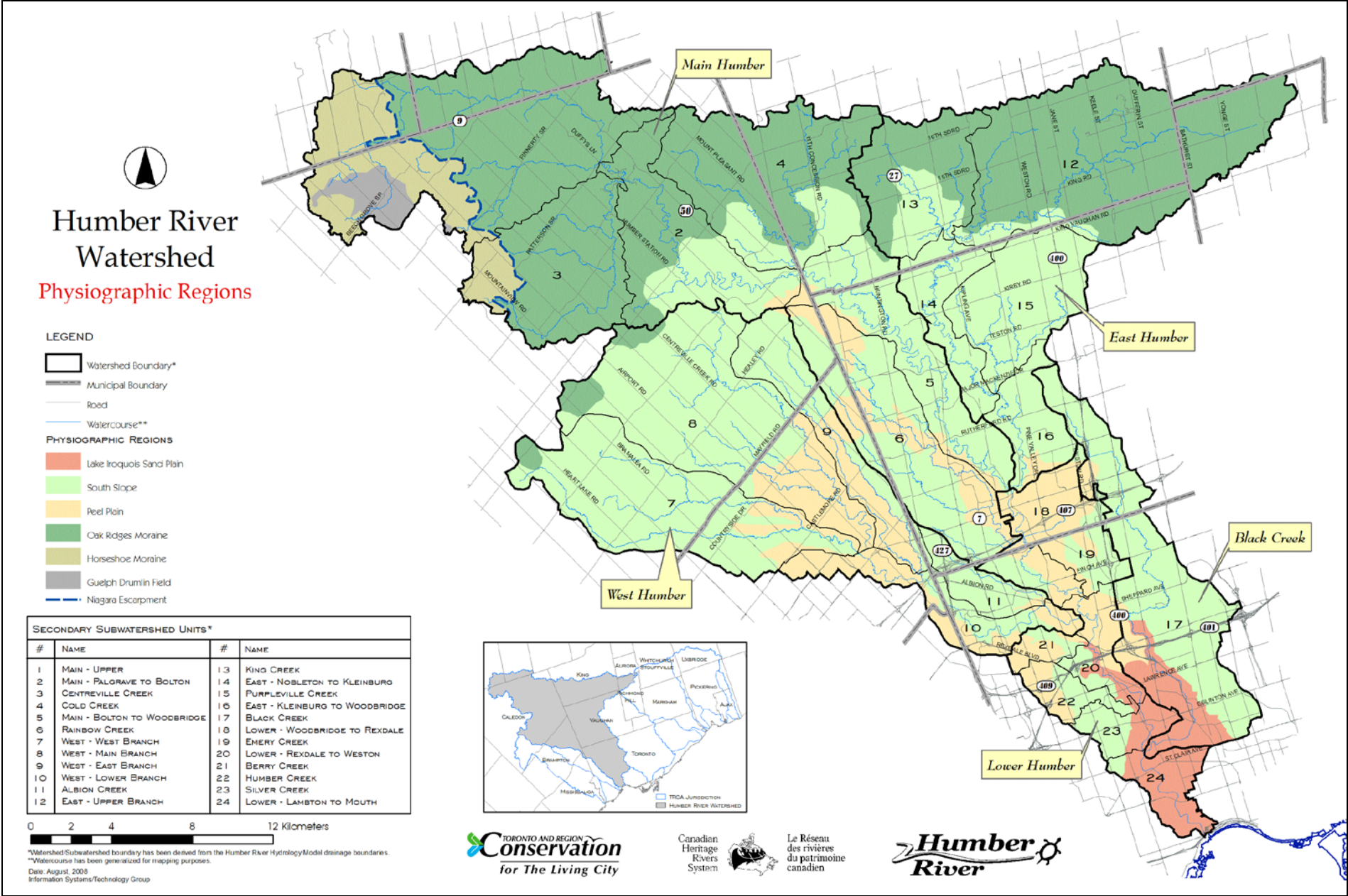


Source: Kassenaar and Wexler, 2006

## 2.2 Physiography, Topography and Soils

The landforms in the Humber River watershed are primarily the result of the movement and deposition of material by glaciers and melt-water in the most recent period of glaciations. Five major, distinct physiographic regions are found in the watershed (Figure 2-2) includes Guelph Drumlin Field, Niagara Escarpment, Oak Ridges, South Slope, Peel Plain and the Iroquois Sand Plain (Chapman and Putnam, 1984). Each region's characteristic topography and soils, affect hydrology and drainage patterns.

Figure 2-2: Physiographic Regions



### Horseshoe Moraine

The Horseshoe Moraine forms a horseshoe-shaped region above and west of the highest portions of the Niagara Escarpment. The two major landforms associated with this area are irregular stone knobs and ridges as well as pitted sand and gravel terraces and valley floors filled with swamps (Chapman and Putnam, 1984). In the Humber River watershed, the Horseshoe Moraine region is limited to the extreme northwestern portion.

### Guelph Drumlin Field

The Guelph Drumlin Field physiographic region lies above and immediately to the west of the Niagara Escarpment. The area is characterized by hummocky terrain from the high concentration of drumlins, which are rounded hills formed under glacial ice. The soils are a mix of stony glacial tills and gravel terraces from former spillways.

### Niagara Escarpment

The Niagara Escarpment extends from Niagara Falls to the northern tip of the Bruce Peninsula and appears in the landscape as a near vertical cliff or steep slope. It is due to the presence of an erosion resistant layer of Lockport dolomite rock of Silurian age, which outcrops all the way around the Michigan Basin. The dolomite rock is underlain by shales that have been eroded away, creating a magnificent escarpment (Putnam and Kerr, 1956). The portion of the Niagara Escarpment in the Humber River watershed is partially covered by the glacial tills of the Oak Ridges Moraine and appears as a steep slope rather than a vertical cliff.

### Oak Ridges

The Oak Ridges physiographic region, also partly the site of the Oak Ridges Moraine (ORM) land form; "stands out as one of the most distinctive physiographic regions of Southern Ontario" (Chapman and Putnam, 1984). It rises to a maximum elevation of about 450 m above sea level (masl) along the northern watershed divide and is the source area for many rivers and streams. Although the underlying geologic feature is a sand-rich glacial moraine, within the Rouge River watershed the soils in this physiographic region are mainly loam, with areas of clay loam and clay. This apparent contradiction is the result of a thin layer of glacial till (a mixture of a range of different clast sizes ranging from clay to boulders that were deposited directly by glacial ice) that covers most of the land surface. Localized sandy loam soils are present in the western headwater areas where the till is absent.

This region is characterized by "hummocky topography", with many closed depressions (i.e. kettle depressions) that are internally drained. These characteristics mean that the surface water collects on the land surface instead of running off into streams. This extensive ponding results in much higher recharge than would be otherwise expected for the fine grained soil types.

### South Slope

The South Slope is a sloping plain that extends across the lower headwater areas in a band from an elevation of about 245 masl at the boundary with the Oak Ridges to about 220 m at the southern boundary with the Peel Plain. This region is present in a second band that extends from an elevation about 180 to 190 masl along the southern boundary of the Peel Plain to the Lake Iroquois shoreline at an elevation of 135 masl.

This region represents the southern flank of the Oak Ridges Moraine and is underlain by glacial till. The resulting soil types are predominantly clay with some clay loam, and loam. Since the topography is not hummocky like the Oak Ridges, runoff is relatively high, and infiltration is correspondingly low.

### Peel Plain

Overlying the central portion of the South Slope is a region of flatter topography called the Peel Plain where a thin veneer of silt and clay lacustrine material up to 5 m thick was deposited over the till. The soils are predominantly clay with localized clay loam and loam. Although the topography is relatively flat, which leads to some local ponding, infiltration is still quite low because of the presence of the lacustrine clay over the till.

### Iroquois Sand Plain

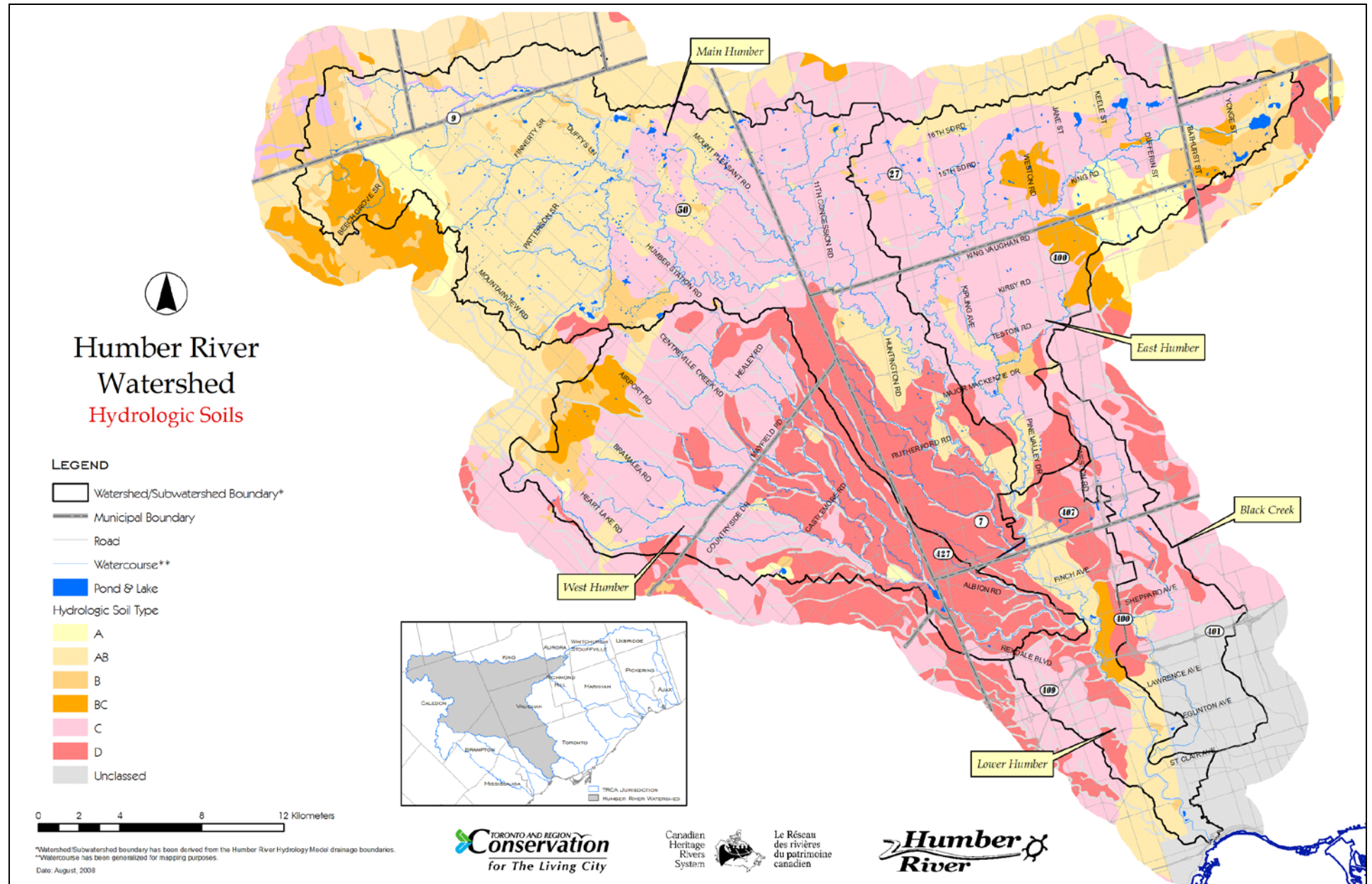
The northern edge of this physiographic region is delimited by the Lake Iroquois shoreline at an elevation of about 135 masl. This prominent ridge represents the former edge of a lake that existed approximately 10,000 years ago when water levels were about 60 m higher than the present. This high water level was caused by damming of the outlet from Lake Ontario to the St. Lawrence River by glacial ice.

South of the shoreline, the topography slopes gently towards Lake Ontario. The soils in this region are mostly sandy loam, with some loam close to Lake Ontario, where the underlying soils are finer grained.

Figure 2-3 illustrates the types of soils that occur in the Humber River watershed, according to hydrologic soil group classifications that are based on the run off potential of the soil. The four hydrologic soil groups are A, AB, B, BC, C and D, where A group soils have the smallest run off potential and highest infiltration rates and D group soils have the highest run off potential and lowest infiltration rates. Group C and D soils contain significant clay components and have moderately fine to fine structure which combined, impedes the downward movement of water.



Figure 2-3: Hydrologic Soil Groups

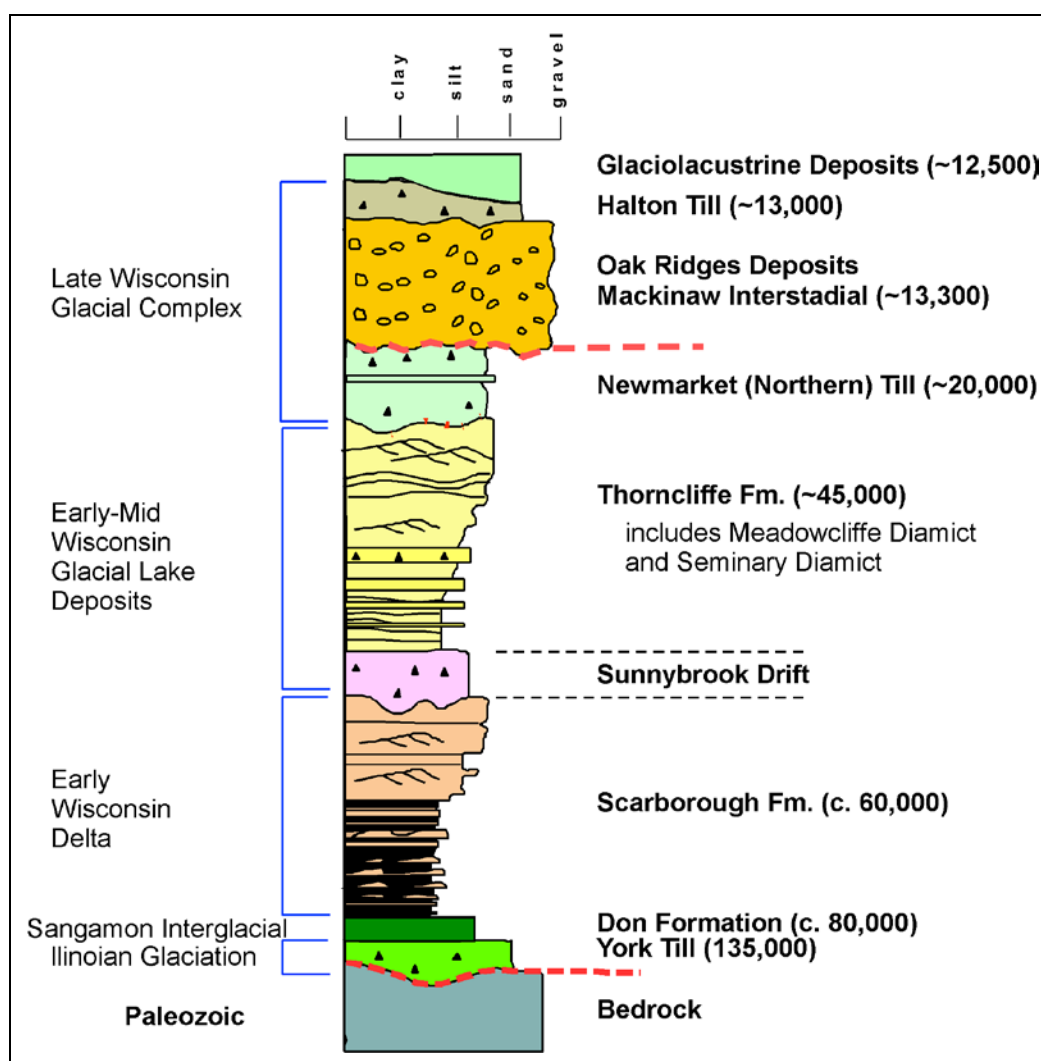


## 2.3 Geology

Successive layers of unconsolidated sediments, up to 200 m thick were deposited on top of the bedrock over the past 135,000 years. A schematic of the various geologic units is presented in Figure 2-4. The thicknesses of the stratigraphic units were estimated by the York-Peel-Durham-Toronto/Conservation Authorities Moraine Coalition (YPDT-CAMC) study team using the Geologic Survey of Canada (GSC) *golden spikes*, geophysical data (downhole and seismic), combined with water well records (Kassenaar and Wexler, 2006). A description of the origin and characteristics of each of the successive geologic units is provided in the Humber River State of the Watershed Report – Geology and Groundwater Resources (TRCA, 2008).

The surficial expression of the uppermost geologic layers is shown as surficial geology (Figure 2-5) which influences physiography, topography and soils discussed in the previous section.

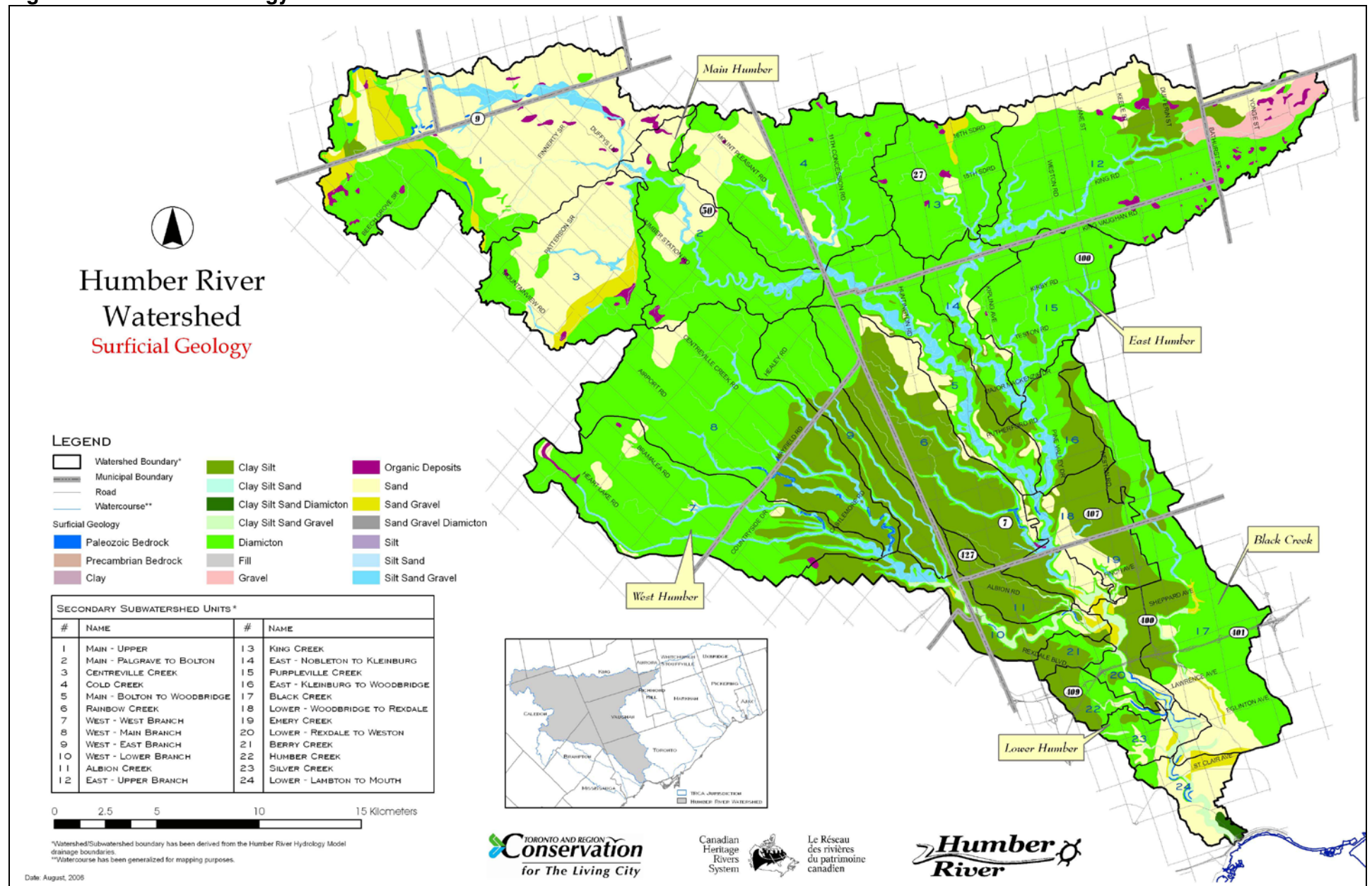
**Figure 2-4: Stratigraphic Schematic**



Source: modified from Eyles, 2002



Figure2-5: Surficial Geology



## 2.4 Hydrogeology

Groundwater flow through the TRCA area has been extensively studied by a number of groups, and the geology has been the focus of studies by the Geological Survey of Canada (GSC). These studies were used as a foundation for the construction of a groundwater flow model for the TRCA area by the YPDT-CAMC groundwater management study. In addition, the YPDT-CAMC group developed a database of borehole and water well related information, along with climate (Environment Canada) and streamflow (Water Survey of Canada and TRCA) data. The YPDT groundwater flow model has subsequently been used in this watershed planning study to assess impacts of climate change on recharge rates and other related groundwater concerns.

The headwaters area of the watershed generally functions as a groundwater divide for all three aquifer systems in the Humber Watershed. However, this divide is less pronounced along the Schomberg – Nobleton corridor, perhaps due to the inter-basin flow of groundwater from the Lake Simcoe Watershed into the Humber Watershed. The divide also becomes complex where the Oak Ridges Moraine meets the Niagara Escarpment in the Mono Mills Area.

The hydrostratigraphy used in the groundwater flow model was based on a re-interpretation of the borehole log data published by the CAMC using the GSC conceptual insights and layers as a guide to the interpretation process (Kassenaar and Wexler, 2006). The main focus of the re-interpretation and refinement was to identify aquifer/aquitard boundaries. Other goals of the reinterpretation and refinement include delineating the sub-glacial tunnel channels, mapping interconnected bedrock valley systems, and subdividing the deeper system (Lower Sediments) into the Thorncliffe, Sunnybrook and Scarborough units based on hydrogeologic function.

The reinterpretation and refinement of the GSC stratigraphic model resulted in the delineation of the following seven hydrostratigraphic units for the TRCA area:

- Halton Aquitard;
- Oak Ridges Aquifer;
- Newmarket Aquitard;
- Meltwater Channel Aquifers;
- Thorncliffe Aquifer;
- Sunnybrook Aquitard;
- Scarborough Aquifer; and
- Upper Bedrock Aquitard.

The aquifers are also sometimes referred to as the Upper Aquifer (Oak Ridges), Middle Aquifer (Thorncliffe), and Lower Aquifer (Scarborough), with a Shallow Aquifer system recognized as lying within permeable deposits of the Halton till.

Representative north-south cross sections are shown on Figure 2-6 (Main and Lower Humber River), Figure 2-7 (West Humber River) and Figure 2-8 (East Humber River) which illustrate the relationship between the hydrostratigraphy and river profile. A description of the characteristics and permeability of each of the hydrostratigraphic units is provided below. It should be noted that each of these units is not homogeneous. Each unit exhibits extensive variation both laterally and vertically. However, for the purposes of constructing a numerical hydrogeologic model, it was necessary to divide the stratigraphy into a limited number of layers. To represent



the variations in each aquifer layer, the thickness and hydraulic conductivity were varied to match the observed geologic materials in the golden spike boreholes, geotechnical boreholes, and water well records. Tunnel channel zones were also defined in terms of their location, depth, orientation, and infill material to adequately represent the cross-connection of aquifer systems.

### Halton Aquitard

This aquitard includes the Halton Till formation. The top of the Halton Aquitard usually coincides with the ground surface on the south side of the ORM. It is thickest and most continuous to the north, but is absent in some areas where it has been removed by erosion activity. Where the till cover is absent, the lower units are frequently covered with a veneer of glaciolacustrine material or more recent fluvial deposits associated with modern river valleys.

The Halton till deposits are generally less than 25 m thick and serve as an aquitard wherever present in significant thickness, limiting recharge rates to 60 to 100 mm/yr. Where the terrain is hummocky, the capture and retention time of surface water can increase the recharge to about 360 mm/yr (Kassenaar and Wexler, 2006).

Groundwater flow in this aquitard is generally vertically downward, with the exception of localized areas where the underlying aquifers are artesian (e.g. area south of Bolton along Coleraine Drive).

### Oak Ridges Aquifer

Sand bodies situated beneath the surficial tills along the flanks of the ORM deposited during the Mackinaw Interstadial are included in this aquifer complex, as well as the ORM deposits. The degree of hydraulic connection with the moraine sediments generally decreases away from the ORM. The Oak Ridges Aquifer sediments are up to 100 m thick along the core of the ORM, but in areas remote from the ORM, the sands of the Mackinaw Interstadial are locally discontinuous and generally less than 10 m thick. Headwater tributaries of the Main and East branches of the Humber River receive groundwater discharge from these deposits.

Groundwater flow in this unit is primarily horizontal towards Lake Ontario, with localized flow towards watercourses that cut into the aquifer.

### Newmarket Aquitard

This aquitard includes the Newmarket Till formation and is generally between 20 to 30 m thick with the thickest locations reaching depths of up to 100 m below ground surface. The till has been eroded in some parts in the northern portion of the watershed, corresponding to the locations of interpreted tunnel channels where meltwater flow eroded down through the Newmarket Till into underlying sediments.

Hydrogeologic investigations conducted by the Interim Waste Authority (IWA, 1994a) and continued by Gerber and Howard (1996; 2000; Gerber *et al.*, 2001) suggest that the bulk permeability of the Newmarket Till is controlled by large scale features such as fractures and layers of sand and gravel.

Figure 2-6: Geologic Cross Section - Main and Lower Humber River

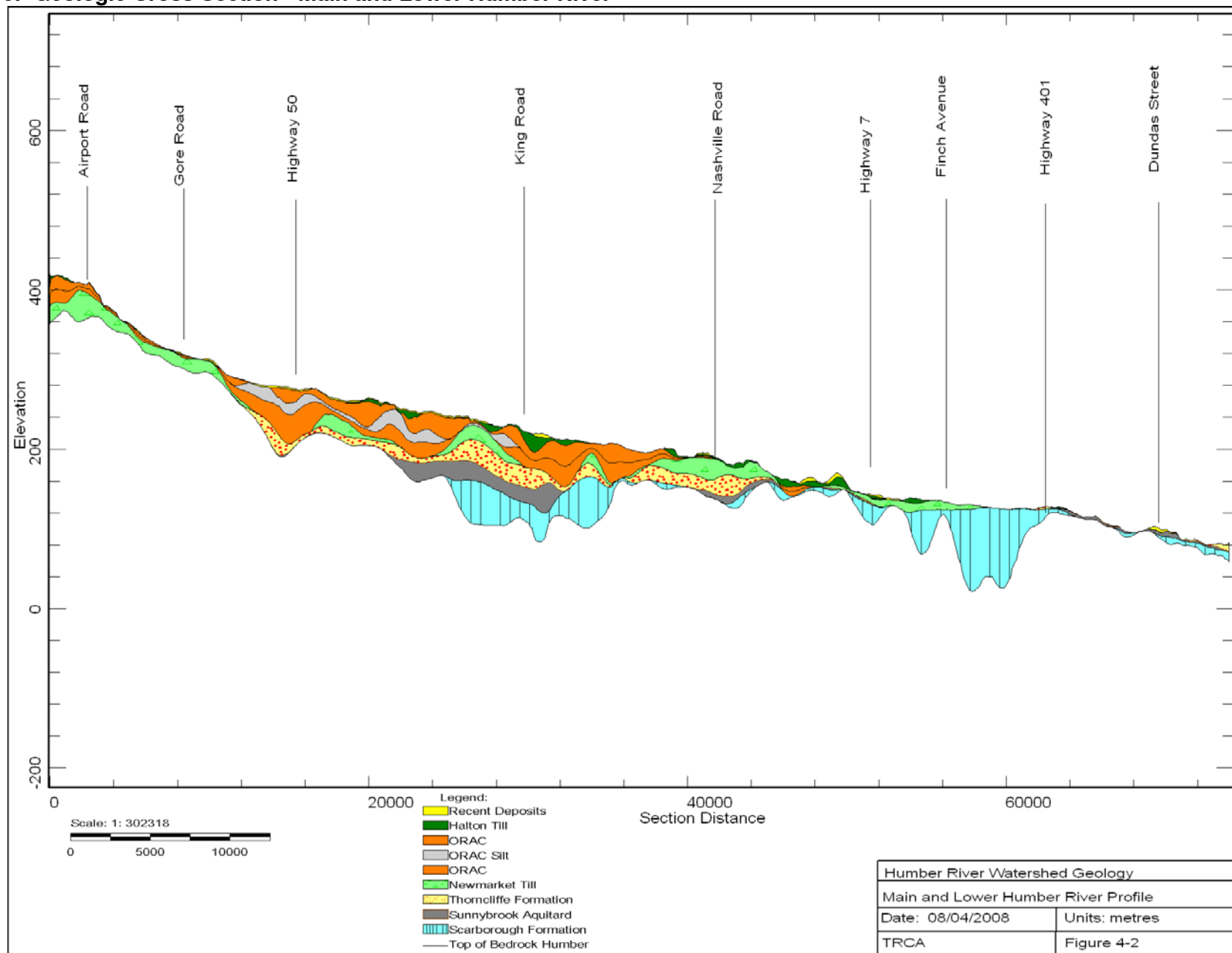


Figure 2-7: Geologic Cross Section – West Humber River

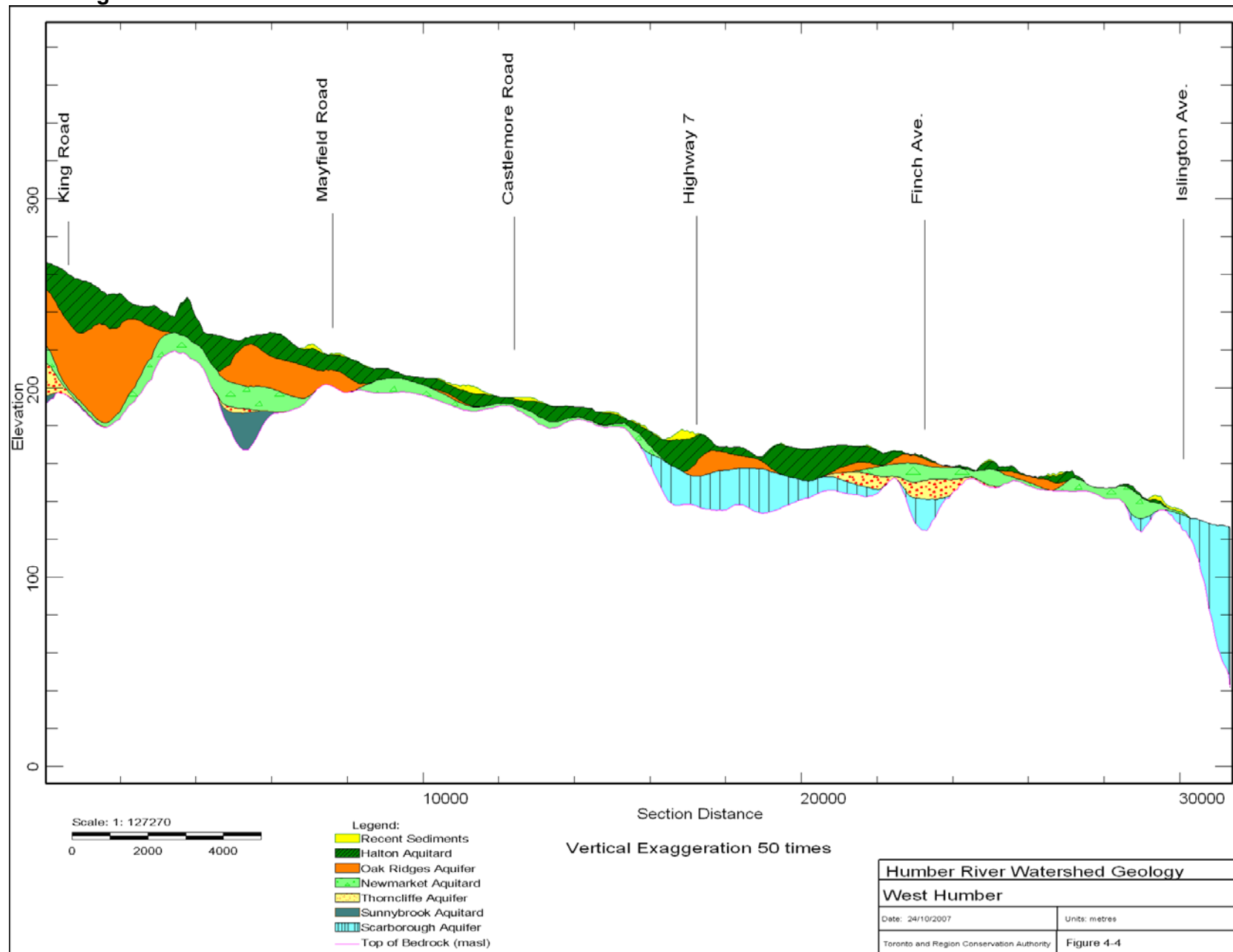
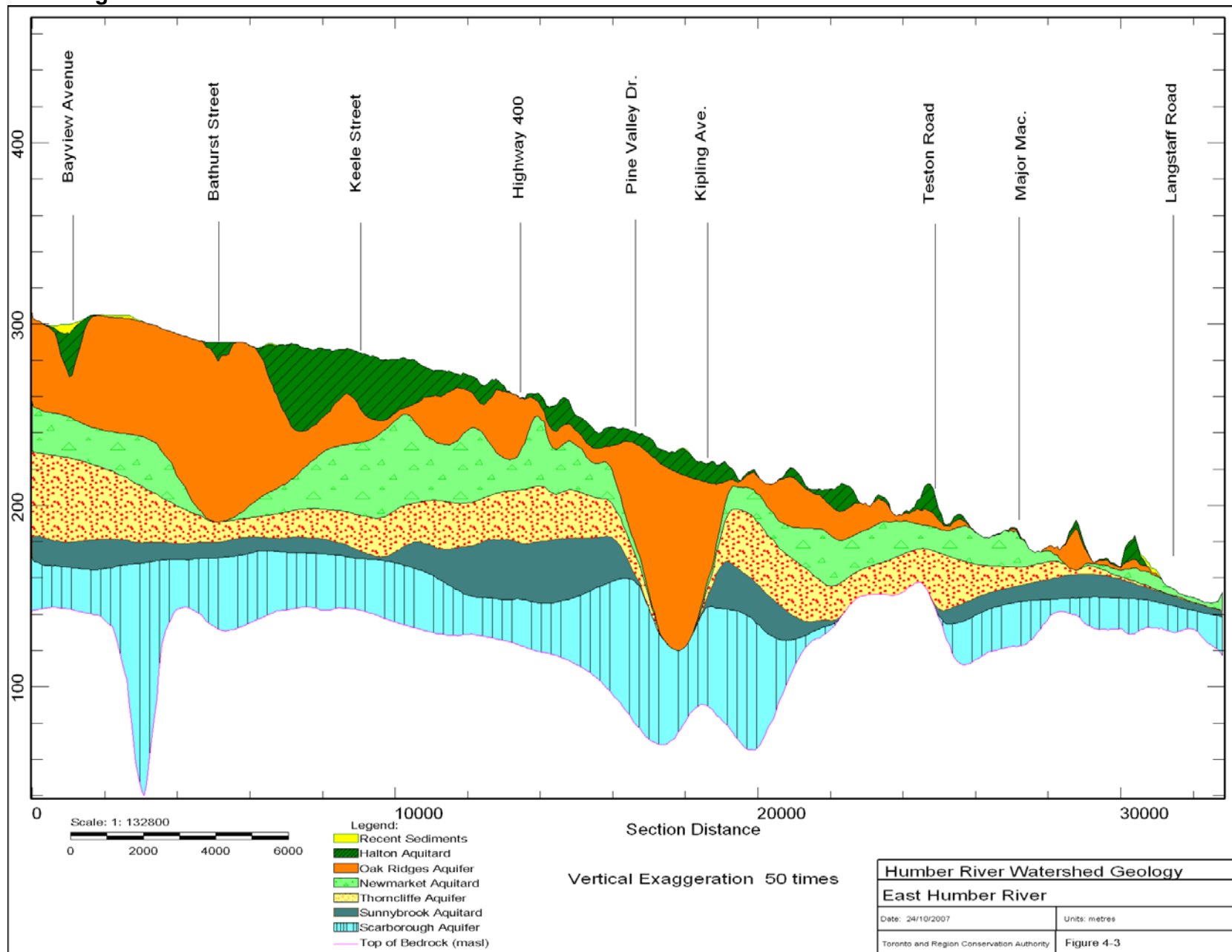


Figure 2-8: Geologic Cross Section – East Humber River



## Humber River Watershed Scenario Modelling and Analysis Report

Groundwater flow in this unit is predominantly downward, with the leakage to the underlying Thorncliffe Formation estimated to be in the range of 30 - 40 mm/year. The amount of vertical leakage will obviously differ where the till has been removed by meltwater erosion (tunnel channels) and depends on the local characteristics of channel infill sediments.

### Meltwater Channel Aquifers

As discussed in section 2.3, meltwater channel systems trend generally north-south to northwest-southeast extending from north of the ORM into the area north of Lake Ontario. These features represent areas where the Newmarket Aquitard has been partially or completely eroded. Digital elevation models and cross sections of the area illustrate these channels in both plan view and section, and the interpretation is consistent with available borehole data, and previous hydrogeological studies.

A complex series of channels extend from north of Palgrave south into Caledon East and west towards Caledon. Two small parallel channels extend south along Regional Road 50 toward Bolton. The “Nobleton” channel trends from Holland Landing east of Bradford southward to east of Nobleton and Kleinberg. The “Oak Ridges” Channel passes southwest through Newmarket and Aurora, east of King City and intersects the Nobleton Channel near Woodbridge.

The sediments that infill these channels are quite variable, ranging from sand and gravel to silt and clay. The nature of the infill sediment is important, particularly where the Newmarket Aquitard has been completely eroded, because the hydraulic conductivity of this sediment will control the vertical flow of water between the aquifer units.

In areas where the infill is coarser, these channel aquifers result in horizontal flow of groundwater, including flow across the northern watershed boundary at Palgrave,

### Thorncliffe Aquifer

This aquifer comprises the Thorncliffe Formation and reaches its maximum thickness (up to 60 m) on the ORM. The top of this aquifer is up to 150 m below ground surface on the ORM. Groundwater flow is generally south towards Lake Ontario, with local deviation towards the adjacent Don and Rouge River watersheds.

### Sunnybrook Aquitard

This aquitard comprises the Sunnybrook Drift unit and separates the Thorncliffe aquifer from the underlying Scarborough Aquifer. This unit thins in the western part of the watershed where the bedrock elevation rises, while it thickens in areas where it fills valleys. In the Humber River watershed, this aquitard is generally less than 20 m thick, but may be upwards of 50 m thick in areas around Bolton and King City.

### Scarborough Aquifer

This aquifer unit includes the Scarborough Formation along with minor till layers. To the northeast, the unit thins out where the bedrock elevation is higher, and for digital layer

continuity reasons, it was extended into this area to represent lower aquifer materials that may or may not actually be Scarborough Formation, but share similar hydraulic characteristics.

The Scarborough aquifer thickness reflects the bedrock valley system, and its distribution of thick material, even if not highly permeable, is very significant as the overall transmissivity (product of aquifer thickness times the hydraulic conductivity of the formation) of the Scarborough aquifer is high within the valley systems. Groundwater flow in this aquifer is generally south towards Lake Ontario, with local deviation towards the Don and Rouge River watersheds.

### Upper Bedrock Aquitard

The shale and limestone bedrock is not considered to be a good aquifer from either a quantity or quality perspective, although higher hydraulic conductivity may be encountered where there are bedding planes, joints or fractures. However, there is a small area in the Mono Mills area (Upper Main Humber subwatershed) where pervious limestone deposits form a significant local aquifer. A former municipal well was located in this area, but was decommissioned due to elevated levels of nitrate in the groundwater.

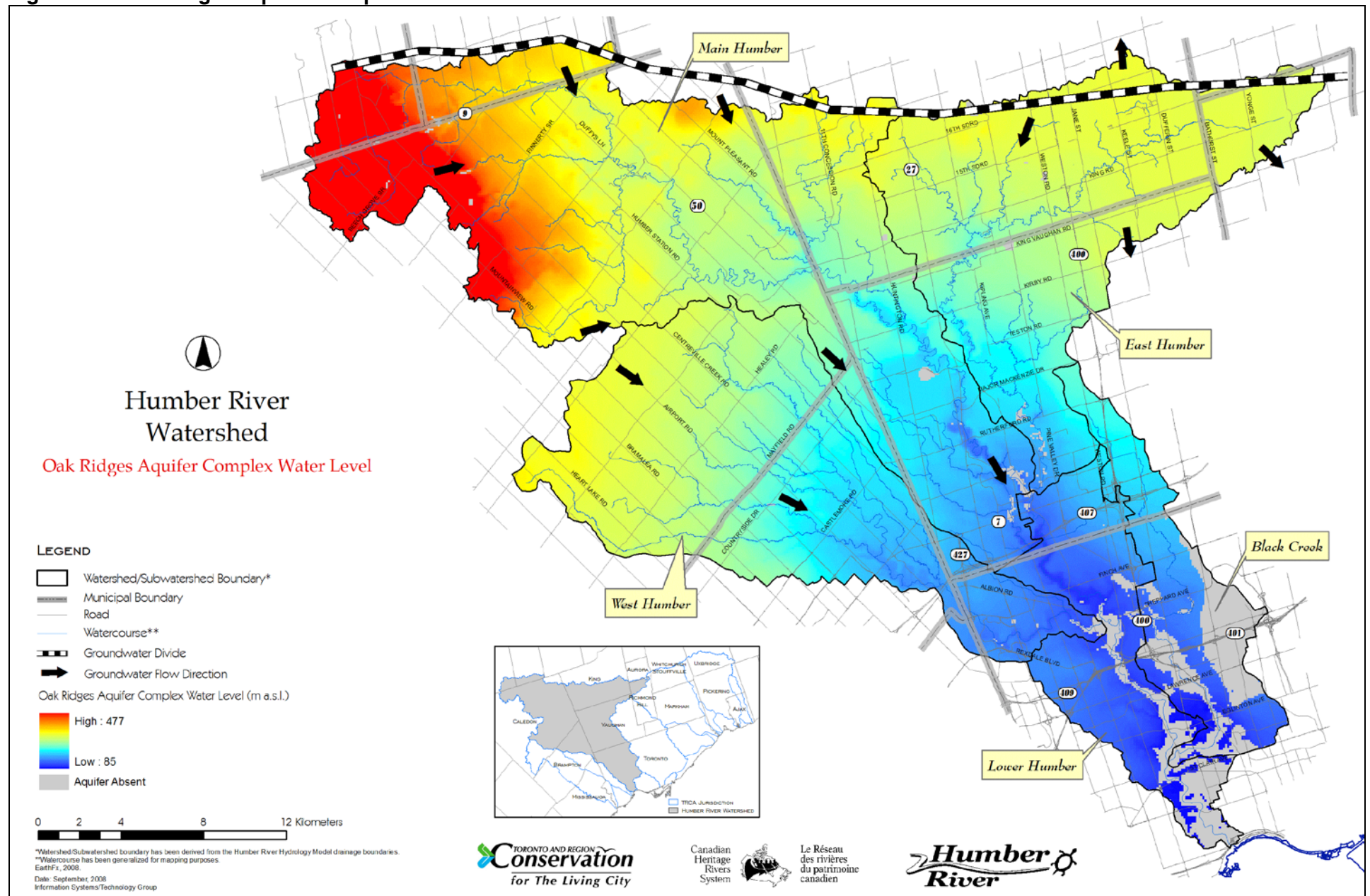
### Overall Groundwater Flow

Groundwater flow is generally from north to south, or from the Niagara Escarpment and ORM to Lake Ontario. In the Oak Ridges Aquifer the flow patterns are still directly influenced by topography and the stream network. As with the shallow groundwater, inflows from the Credit River watershed are predicted around Caledon and significant outflows to the Rouge River watershed are predicted in the Oak Ridges area. In the Thorncliffe Aquifer, the effect of topography is more subdued than the upper aquifer, but the inflows and outflows are still predicted to occur in the Caledon and Oak Ridges areas, respectively. Groundwater movement into the watershed also occurs along the north eastern boundary from tunnel channels carved into the deep Scarborough Aquifer Complex (SAC).

In the Scarborough Aquifer, inflow from the Credit River watershed is greater in the upper aquifer systems, as indicated by the closely spaced contours at the edge of the Niagara Escarpment. Some groundwater movement from the Humber watershed into the Don and Rouge River watersheds occurs south of Oak Ridges in the northeastern corner of the watershed. This deep aquifer is of interest as a potential supply of municipal water to Caledon or Caledon East (Holysh, 2003). Based on the reflection seismic surveys completed near Caledon East and Bolton, it is interpreted that this aquifer system extends along the buried bedrock valley from at least Willoughby Road (west of Caledon Village) to the Bolton area in the east. Assuming an average width of 1,200 m, an average thickness of 20 m, a relatively flat vertical gradient of 0.002, and a hydraulic conductivity of  $10^{-3}$  m/s, the volumetric flux at Bolton would be estimated to be 4,147 m<sup>3</sup>/day.

The water table elevation map derived from observed water levels in MOE water well records shows the expected strong influence of the surficial features (escarpment, ORM, watercourses) on the water table. The predicted flows into the Humber watershed from the Credit River watershed around Caledon, and predicted outflows to the Humber River around Oak Ridges are noticeable. Figure 2-9 illustrates water levels in the Oak Ridges Aquifer (i.e., the upper aquifer) and the approximate groundwater divide. The groundwater divide varies slightly, depending on which aquifer is considered, but the Oak Ridges Aquifer is used as a guide.

Figure 2-9 Oak Ridges Aquifer Complex Water Levels



## 2.5 Land use

The physical setting of the Humber River watershed has influenced settlement patterns and land use, which is currently comprised of 40% rural and agricultural uses, 27% urban, 32% natural (forest, wetland, successional and meadow) and 1% watercourses and waterbodies (Figure 2-10). Agricultural lands are predominantly found in the headwaters of the Main, West and East Humber Rivers. Urban and urbanizing lands are generally in the mid and lower reaches with the exception of the communities of Oak Ridges, King City and Nobleton located in the headwaters of the East Humber, and the villages of Caledon East and Palgrave in headwaters of the Main Humber. Large tracts of natural cover are located in the headwaters of the Main and East Humber Rivers. In other portions of the watershed, natural cover is highly fragmented and generally restricted to river valleys and lands where soils are too wet to permit agricultural uses.

The watershed covers parts of the Regional Municipalities of Peel and York, the City of Toronto, Simcoe County and Dufferin County and includes portions of 10 Greater Toronto Area municipalities (Figure 2-10). Most municipal water supplies are reliant on Lake Ontario-based systems, with the exception of the communities of Palgrave and Caledon East, which are served by Region of Peel groundwater wells, and Nobleton, King City and Kleinburg which are served by York Region groundwater wells. The remaining rural areas rely on groundwater from private wells. Wastewater in the cities of Toronto, Mississauga, Brampton, and the communities of Caledon East, Bolton, King City and Woodbridge is collected by sewers and treated at sewage treatment plants that outlet to Lake Ontario. In the community of Kleinburg in Peel Region, wastewater is collected by sanitary sewers and treated at a sewage treatment plant that outlets to the main channel of the Humber River. The community of Nobleton, in York Region, has an approved Environmental Assessment to construct a stand-alone sewage treatment plant to service its new urban development, which will outlet to the East Humber River. Within the remaining rural portions of the Regions of York and Peel, private sewage treatment systems (septic tile beds) are operated by individual landowners.

Land use in parts of the watershed is guided by a number of special policies and plans. The provincial *Greenbelt Plan (2005)*, including the *Oak Ridges Moraine Conservation Plan (2002)*, and *Niagara Escarpment Plan (1994)*, affords protection to natural and agricultural lands in the headwaters and along major Humber River tributaries under specific policy designations (see Figure 2.5-2). There are also currently five Special Policy Areas (SPAs) within the Humber watershed (Figure 2-11). SPAs are areas within a community that have historically existed in the flood plain. SPAs address the significant social and economic hardships to the community that would result from the strict adherence to provincial policies concerning development in flood vulnerable areas. The intent of the SPA designation is to provide for the continued viability of existing uses to sustain these communities provided that flood hazard management measures are taken.

While the watershed plan will provide guidance for the management of all watershed lands, these special land use policy areas represent additional opportunities and tools for implementation of progressive management strategies.



**Humber River Watershed Study Area**

**LEGEND**

- Primary Subwatershed Boundary\*
- Municipal Boundary
- Road
- Pond & Lake
- Watercourse\*\*
- Oak Ridges Moraine Conservation Plan Area
- Greenbelt Protected Countryside
- Niagara Escarpment Plan Area
- General Land Use (2002)
- Rural
- Natural
- Urban

0 2 4 8 12 Kilometers

\*Watershed/Subwatershed boundary has been derived from the Humber River Hydrology Model drainage boundaries.  
 \*\*Watercourse has been generalized for mapping purposes.  
 Road, Greenbelt, N.E.C. and O.R.M. boundary © Queen's Printer for Ontario, 2007

**Toronto and Region Conservation for The Living City**

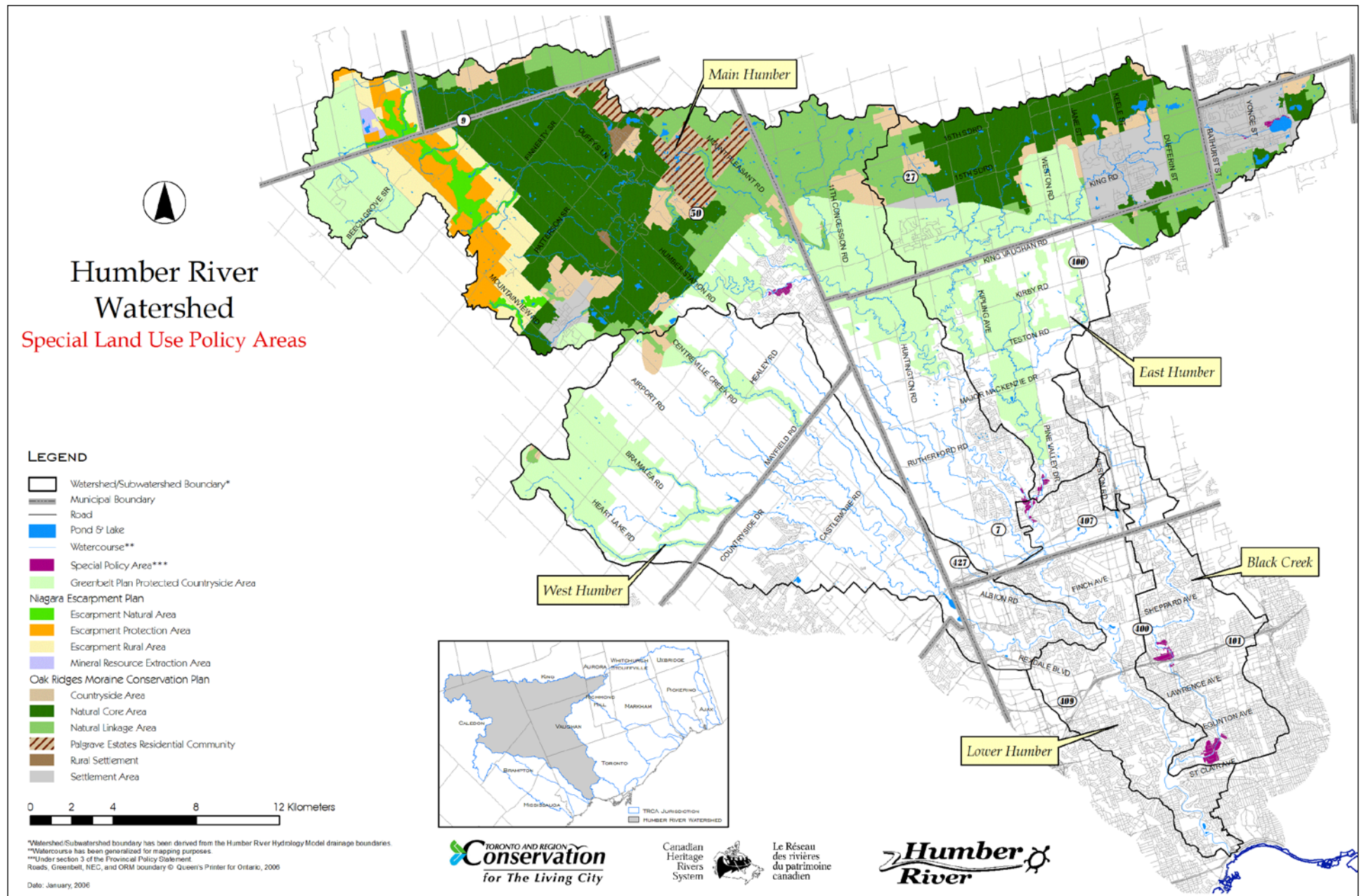
Canadian Heritage Rivers System

Le Réseau des rivières du patrimoine canadien

**Humber River**



Figure 2-11 Special Land Use Policy Areas



## **2.6 Key Issues**

The Characterization phase of this study identified current and potential future stresses affecting watershed conditions and put forward possible management approaches for further analysis. The five primary issues and opportunities facing this watershed are summarized below.

### **1. Urban growth pressure**

The Greater Toronto Area has experienced a rapid pace of urban growth in the past ten years. York Region is noted as having one of the highest population growth rates in all of Canada and similar population growth rates have occurred in Peel Region. A substantial portion of urban settlement areas in the watershed designated by municipal official plans has already been developed or in advanced stages of the urban development planning process. Recent provincial studies project population growth of 4.5 million in the Greater Toronto Area over the next 20 years (Hemson Consulting Ltd., 2005) and identify lands in the Humber River watershed as potential areas where some of this growth may be accommodated (OMPIR, 2006). The watershed plan must provide guidance to municipalities contemplating where projected population growth should be accommodated to reduce the negative impacts of this growth on watershed systems and where possible achieve net gain.

### **2. Lack of natural cover**

The fragmented state of the natural heritage system is typical of conditions throughout the Toronto Region and is not considered sufficient to sustain regional biodiversity. TRCA's *Toronto and Region Terrestrial Natural Heritage System Strategy* (2007b) aims to protect and restore a target of 30% good quality habitat in the Toronto Region. In the Humber River watershed, this target translates to an increase from the current amount of natural cover of 32% of the watershed area, to 39% or greater. Progressive and protective policies of provincial and municipal governments and TRCA will significantly contribute to the achievement of this goal. However further evidence of the other watershed benefits of this targeted system, beyond biodiversity, will assist in demonstrating the effectiveness of this management strategy.

### **3. The need for improved stormwater management**

Watershed monitoring indicates that despite implementation of stormwater management in new urban developments, the environmental quality of the Humber River watershed has continued to deteriorate with urbanization. Although much of the urban development in the watershed has been serviced by ever-evolving state-of-the-art stormwater management practices, stream channels have continued to experience accelerated erosion. The resulting channel alterations have impaired aquatic habitat, contributed sediment loading to Lake Ontario and put infrastructure at risk in some reaches.

Emerging studies from the Toronto Region and other jurisdictions outside Ontario suggest that a new approach is needed to urban community design – one that attempts to preserve pre-development water balance on site to the extent possible through “low impact design” and other better site planning considerations.

In addition to taking new approaches to planning greenfield developments there is also a need to look at ways to improve stormwater management in older urban developments. Most Humber River watershed municipalities have undertaken studies to identify strategies for incorporating new end-of-pipe stormwater management facilities in older urban areas that were developed prior to stormwater controls or retrofitting (i.e. improving the performance) of existing stormwater management facilities. The City of Toronto's Wet Weather Flow Management Master Plan makes further recommendations for applying a treatment train approach to stormwater retrofits in its existing urban areas, whereby lot level source controls, conveyance and end-of-pipe measures form a comprehensive solution (TSH, 2003; City of Toronto, 2006). The watershed planning studies offer an opportunity to look at the cumulative effects of extending these approaches throughout the watershed.

#### **4. The need to adopt more sustainable urban design forms and lifestyles**

Past experience in the Humber River watershed and other watersheds has shown that current approaches will be limited in their ability to protect the watershed against impacts from future stresses. In fact, jurisdictions around the world are calling for new, more sustainable, approaches to watershed management and have already begun to implement innovative practices. The David Suzuki Foundation defines sustainability as simply "living within the Earth's limits" and states that "our quality of life is fundamentally dependent upon the environment". Leading jurisdictions are attempting to define the requisites for sustainability as part of their plans and management strategies. Observed trends in management and design approaches include: the protection of natural systems as a basis for economic and social health; restoration and net gain; management at source; biomimicry; and integrated management at multiple scales. The watershed plan must provide guidance in practical terms for improved "sustainability" in the watershed.

#### **5. Climate change**

Global climate change models predict a future climate for the Toronto Region that will be warmer and wetter than average present conditions. There is also expected to be an increased frequency of extreme, intense precipitation events. Changes in average annual and seasonal temperature and precipitation are likely to affect the watershed's hydrology and biological systems. An improved understanding of the potential effects and mitigative strategies is necessary to assist in raising local public awareness and action on this global concern.

The challenge for this watershed study was to evaluate the watershed's response to the anticipated future stresses and the relative effectiveness of management strategies. The findings are intended to provide scientifically-based guidance for future decision-making that will ensure the overall protection and enhancement of the watershed.

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