TORONTO AND REGION Conservation for The Living City

Humber River State of the Watershed Report – Aquatic System

2008

EXECUTIVE SUMMARY

- The headwaters and middle reaches of the Humber River support healthy aquatic ecosystems, while the quality of aquatic habitats in the lower, more urbanized reaches is more degraded.
- The Humber River supports a relatively diverse fish community ranging from cold water to warm water species, including some very sensitive ones that otherwise experience decline when a system is heavily altered by land use change.
- Three target species have been defined for the watershed in the Humber River Fisheries Management Plan: redside dace, brook trout and rainbow darter. Reside dace is endangered under the provincial Endangered Species Act (2007) with high sensitivity to increasing flows and turbidity; its current distribution is more restricted than its historic. Brook trout and rainbow darter are found in largely the same distribution as in the past.
- Some habitat specialist fish species have not been collected for several decades, specifically those that prefer wetland or pond habitats.
- A comparison of 2001 and 2004 fish monitoring data suggests that the quality of 'good' habitat declined from 42% of the monitoring sites to only 33%. Locations of lower quality habitat occur across the watershed.
- Based on benthic invertebrate sampling in 2004, the quality of aquatic habitat at only 36% of the monitoring stations is rated as "unimpaired". Although nearly two thirds of the sites are rated as "potentially impaired", an examination of the species present showed that many of these sites still support benthic invertebrates that are indicative of good water and habitat quality.
- After limited sampling in 2005 and 2006, there is evidence that the Humber River may support a diverse community of freshwater mussels, two of which may not be found in other TRCA watersheds. Their presence is indicative of healthy aquatic habitats.
- A new non-native and invasive aquatic species, the rusty crayfish, was found in the Humber River watershed in 2003. Since 2003, the rusty crayfish appears to have expanded its range in the watershed and is a threat to native crayfish species.
- Stream temperatures in the upper Main Humber and East Humber are stable and range from cold to cool. Water temperatures are generally warm in the West Humber as well as through the lower reaches as would be expected. However, temperature fluctuations beyond what is considered the natural range are measured in the highly urbanized areas.
- The total amount of riparian natural cover in the watershed is estimated to be 7403 hectares or 61% of the total riparian area which falls short of the target of 75%.
- There are approximately 769 hectares of riparian wetlands in the watershed that represent 6% of the total potential riparian area. This amount is less than the target of 10% but is much closer than most other urban watersheds within the TRCA jurisdiction.
- Preliminary investigations have identified 1201 potential in-stream barriers and stream crossings that could be limiting the movement of fish.

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1.0 INTRODUCTION

In 1997, the Humber Watershed Task Force released the Humber River Watershed Strategy, *Legacy: A Strategy For A Healthy Humber* (MTRCA, 1997), which provided thirty objectives for a healthy, sustainable watershed, and a set of actions necessary to achieve them. It also provided an overview of the state of the Humber River watershed at that time. Since the release of the watershed strategy, a significant amount of new information has become available through monitoring, special studies and the experiences of watershed partners.

In 2004, the Toronto and Region Conservation Authority (TRCA), in partnership with watershed municipalities and the Humber Watershed Alliance initiated a study to develop an integrated watershed management plan for the Humber River. This study was initiated to fulfill the watershed planning requirements of the *Oak Ridges Moraine Conservation Plan*, 2002, and to update the strategies and recommendations of *Legacy,* in light of new information, a stronger scientific foundation and better understanding of the effects of human actions on natural ecosystems. The watershed plan is intended to inform and guide municipalities, provincial and federal governments, TRCA, non-governmental organizations and private landowners regarding management actions needed to maintain and improve watershed health.

This State of the Watershed Report provides updated information on current conditions, emerging trends and identifies key watershed management issues and opportunities in the Humber pertaining to the aquatic system. Indicators of watershed health and associated targets are used to rate current conditions. Ratings for a full suite of indicators of watershed health are summarized in, *Listen to Your River: A Report Card on the Health of the Humber River Watershed* (TRCA, 2007a).

This State of the Watershed Report also provides an overview of current management strategies and introduces some innovative approaches to address key issues, which will be considered for inclusion in the *Humber River Watershed Plan*. It begins with an overview of factors that influence watershed conditions and the indicators being used to track current conditions and evaluate watershed health.

While rivers serve the vital function of conveying water in a watershed, they are also intrinsically important as ecosystems. Rivers contribute greatly to biodiversity and form a critical component of a natural heritage system. Through their long inhabitancy in this region, aquatic species have adapted to historic patterns of stream flow, channel structure, water quality and temperature. Some of those habitat patterns are shifting or have shifted long ago in response to land use changes across the landscape.

Aquatic communities are altered to various degrees by land use change. Such alterations can include: changes in stream flow, sediment transport and deposition, contaminants, the construction of dams, the removal of riparian buffers, wetlands and small streams, and the introduction of invasive species. Aquatic studies must consider all these issues and how they influence the aquatic community to determine management strategies that protect the larger context of diverse and sensitive ecosystems. At risk is the ecological integrity and health of the aquatic ecosystem which has inextricable links to the terrestrial ecosystem, human health within the Great Lakes basin, and the social benefits of recreation and nature appreciation.

The health of the watershed is an important part of promoting a healthy lake environment. Positive interactions between Lake Ontario and the Humber River watershed coupled with informed management decisions are vital to maintaining healthy aquatic communities and habitats in both systems. This has implications in relation to the Toronto and Area Remedial Action Plan (RAP). The RAP process was initiated between Canada and the United States in the late 1980s to help address impacts on the Great Lakes ecosystem. RAP goals regarding aquatic habitat and communities include restoring a self-sustaining fishery, rehabilitation of fish and wildlife habitat, protection and rehabilitation of wetlands, absence of restrictions on fish consumption and control of stormwater quality and quantity.

The City of Toronto was identified as an Area of Concern (AOC), with the lower portion of the Humber River watershed located within the western half of the AOC. As part of the RAP process, restoration targets or delisting criteria to help meet RAP goals are required. It is recognized that meeting RAP targets will be a difficult task and a decades long undertaking considering the complex pressures associated with a densely developed landscape. To date, there have been no watersheds or subwatersheds de-listed in this AOC. Work has been ongoing to help meet the delisting criteria, but much remains to be done.

2.0 UNDERSTANDING THE AQUATIC SYSTEM

As with most living things, fish have some basic chemical, physical and biological needs. These needs are summarized in Table 1. Although the basic needs of fish are common across the group classification of ‘fishes’ (phylogeny), it is important to note that different families and species of fish differ with regards to their specialized needs, sensitivities and tolerances to environmental conditions. For example, salmonids (*e.g.*, trout and salmon) are highly sensitive in terms of water temperature, dissolved oxygen, substrate type, groundwater discharge and pollution levels, meaning that they can live within a given narrow range of these parameters. Centrachids (*e.g.*, sunfish and bass) and percids (*e.g.*, darters) are more tolerant than salmonids and can withstand a broader range of habitat conditions. Some forage minnows such as longnose dace (*Rhinichthys cataractae)* and blacknose dace (*Rhinichthys atratulus)* are very tolerant and can persist within an even broader range.

If there is a shift in habitat conditions and structure, the aquatic community will shift in response. As certain conditions to which specific species have adapted are changed, those more sensitive species often decline while more tolerant ones persist and move up or down into the altered habitats.

Table 1: The Basic Needs of Fish

Parameter	General Description	Example
Physio-chemical	Water quality and quantity	A healthy medium in which to live (*e.g.*, water quality, water temperature, water depth, natural flow regime, baseflow)
Physical	Habitat quality and quantity	Appropriate physical habitat to complete life cycles (*e.g.*, channel morphology, substrate, cover, riparian vegetation, connectivity)
Biological	Ecological integrity of aquatic community	Balanced community of other native fish and organisms (*e.g.*, benthic invertebrates, plants, algae, detritus) to sustain a healthy food web and genetic pool

It is important to note that not all habitat shifts along a system are the result of human activity. There is a natural shift in habitat conditions along a river's continuum. It is widely accepted that habitat changes from headwaters to river mouth (Vannote *et al*., 1980). Beginning at a river's source, small order streams are highly influenced and dependant upon their catchment area for allochontonous (material formed outside of the stream but is washed in from adjacent lands) sources of carbon. This carbon, in the form of leaf litter, twigs and other debris, provides food for bacteria and other small organisms such as invertebrates, which kick-start the food chain. These are low productivity streams, often groundwater fed, cold and support a defined set of more specialized, sensitive fishes (*e.g.*, brook trout). As the water flows continuously down through the watershed, it confluences and creates ever larger streams, the energy of the system transports sediments and nutrients from above, carving new niches and supporting the transition to yet another suite of species. Diversity of habitat and fish communities are usually highest through these middle reaches. Moving lower down in the system, habitat conditions tend to become more homogenous as stream size increases, energy (stream gradient) is lower, water temperatures generally rise and the influences of land on water lessen. The lowest portions of a watershed are characterized more by habitat generalist and guilds of cool or warm water fish with a wider range of tolerances. This dynamic process of a natural river system culminates as the widest, deepest branch of the river meets the lake and new sets of forces (lake influenced) and complex biotic relationships are established.

One of the main drivers of an aquatic system is stream flow. The natural flow regime is very dynamic and fluctuates with the change in seasons. Highest flow volumes are generally experienced during the spring as snow melt and rains make sizeable contributions to the streams. During summer months, water levels drop and are maintained at baseflow levels largely through groundwater inputs with additions from rain events. Typically, wetter weather returns in the fall, recharging the aquifers that in turn feed the streams. Flows through the winter months are again tied to groundwater discharge until the water locked up in snow and ice begin to melt. Fish have adapted to these changes, for example, taking advantage of the times when creeks and small streams are likely to contain sufficient water for spawning (spring and fall migration) and habitat for emerging fry.

Wetlands are also an important feature to fish and the aquatic system as a whole. Wetlands can form along rivers or lakes (riparian), or be isolated in the landscape. Depending on their type and location, wetlands filter out contaminants, nutrients and sediment as well as storing water, thereby reducing the impact of high flows and acting as a potential refuge for organisms during times of drought. Wetlands typically contain many microhabitats and frequently harbor a range of specialist fish species. They also provide high quality and necessary habitat for larval and juvenile stages of fish.

The riparian zone is the vegetation corridor established along the banks of a watercourse and, like wetlands, is an important link between terrestrial and aquatic systems. This vegetation provides organic material which, in headwater or lower order streams, supports the aquatic food chain. Riparian vegetation also contributes to in-stream habitat and moderates water temperatures by providing shade, particularly in lower order streams. Riparian zones also perform a number of critical water quality and quantity functions including filtering pollutants, nutrients and sediments from the water and reducing runoff by detaining flow enough for it to infiltrate and evaporate. Furthermore, deeply rooted vegetation such as trees and shrubs can slow or prevent excessive stream bank erosion.

2.1 A Rural and Urban Aquatic Ecosystem

Land use varies considerably within the Humber River watershed with an agricultural landscape dominating the middle and upper reaches and intense urbanization in the lower reaches (City of Toronto, City of Brampton and southern portions of the City of Vaughan). These are very distinct land uses that have evolved over different time scales and influence the aquatic ecosystem in different ways.

Agricultural activity preceded urbanization and is more associated with a loss of tree cover on tableland and the riparian zone (vegetated area adjacent to the stream). Grasses and meadow vegetation often become established as the land is cleared for crops or pasture. Although this type of riparian habitat benefits a variety of fish species, the loss of tree canopy can subject the stream to more intense solar warming and generally increase water temperatures above the optimal thermal regime for the cold and cool water fish species associated with smaller streams in the upper reaches.

Agricultural practices of applying fertilizer can also introduce higher loadings of nutrients (phosphorus and nitrogen) to small streams that would naturally be low in these compounds. Livestock waste could potentially add to nutrient loading if on land containment is lacking. Less consequential to permanently flowing water, excess nutrients can bring about low dissolved oxygen conditions in slow moving streams or online ponds.

Similar to nutrients, pesticides can also be transported to the stream during storms that produce significant runoff from farm fields. Physical disturbance to stream structure and bank stability can occur if large cattle are allowed access to streams for watering purposes or movement between grazing pastures.

Alteration to the flow regime is less associated with agricultural lands as good infiltration of rain water into the ground is still expected. However, in the past, wetlands or tributaries running through fields were generally filled in or buried necessitating the use of tile drains to prevent flooding of crop land. This resulted in habitat loss and diversion of overland flow, impacts that have created the present day aquatic system.

Unlike agriculture, urban landscapes do cause a notable change in the flow regime. Surface water contributions increase with increases in impervious cover. Rather than infiltrating through porous soils to underlying aquifers, sewers quickly convey stormwater from roads and other hard surfaces, sometimes directly to the stream, exacerbating the already high energy of storm flows. In newer developments, overland flow is directed to stormwater management ponds that capture and detain both runoff from storms and spring melt. The resulting impacts can include a loss in seasonal fluctuation (due to long detention times) and higher flow volumes throughout the year in all streams within a given catchment. Small streams in particular show the first signs of impact, as they do not have the capacity to handle larger volumes of baseflow and surging storm flows. In general, small streams have higher erosion potential than larger watercourses. This attribute has been recognized in recent years and current stormwater management practices account for the erosion sensitivity by designing larger ponds to increase detention times. Stormwater management technology is ever evolving with growing emphasis on the need for source controls in addition to the standard flow rate-based detention ponds.

Over the years, water quality in the urban portions of the Humber River has also been altered by discharges from industry, sewage treatment plants and untreated urban runoff. Under past development practices, physical alterations to streams have included removal of riparian vegetation, increased sedimentation, direct infilling, piping of creeks and extreme erosional forces. Specific areas of the lower Humber, such as Black Creek in the City of Toronto, have been subject to more aggressive forms of stream alteration including encasement in concrete or armouring with gabion or rubble.

3.0 DATA SOURCES AND METHODS

Four sources of field-derived data were used in this report to characterize the current conditions in the Humber River. Additionally, reviews of existing data, collected over many years, provided a comparison of the fish species in the past to those present now. From this, trends of improvement, further decline or indications of a stable state in species diversity can be detected, and inferences made regarding the current health of the river.

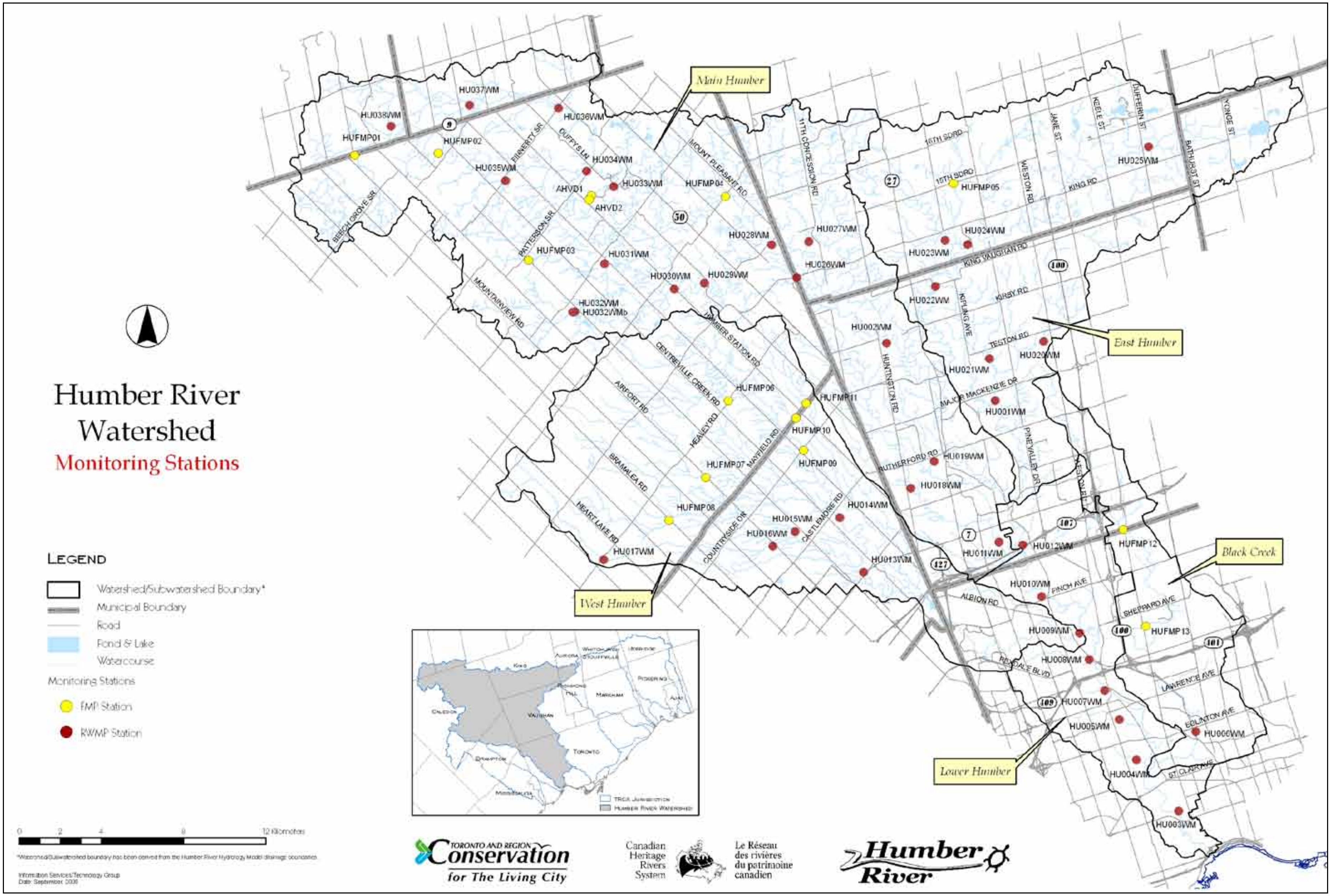
3.1 Existing Conditions Fish Data

3.1.1 Regional Watershed Monitoring Program

The first data source is the TRCA Regional Watershed Monitoring Program (RWMP).
The RWMP was established in 2001 to provide a comprehensive, integrated, and coordinated approach to environmental monitoring in the Greater Toronto Area. The program was designed to answer two basic questions: What is the condition (*i.e.*, health) of our watersheds and, is it changing over time? There are four broad monitoring themes in the program, including Aquatic Habitat and Species, Terrestrial Natural Heritage, Water Quality, and Water Quantity.

RWMP site locations were selected to provide sufficient area coverage for the watershed and associated subwatersheds and were generally limited to wadeable stream water depths (*i.e.*, less than 1 metre) as per the Ontario Stream Assessment Protocol version 5.1 (OMNR, 2003). As part of the RWMP, 38 fixed monitoring stations were selected in the Humber River with fish surveys conducted every 3 years (Figure 1). The RWMP uses a single pass electrofishing method involving intensity settings at 7 to 15 sec/m^2 with an effort ranging from 45 minutes to 2 hours depending on complexity of habitat. To maintain appropriate temperature and oxygen regimes, captured fish were placed into flow-through containers downstream of the site. Specimens were identified to species, enumerated, batch weighed, measured and released. Fish information is recorded on standard Ontario Ministry of Natural Resources (OMNR) collection forms. Two sets of RWMP data, collected in 2001 and 2004, have been analyzed for use in this report.

Figure 1: Regional Watershed Monitoring Program and Fisheries Management Plan Aquatic System Monitoring Stations



3.1.2 Fish Management Plan Data Collection

The second source of field data is Humber River Fisheries Management Plan (FMP) stations. The RWMP does not monitor all habitat types across a given watershed, as this is not required to reach the goal of identifying long-term trends. A total of 15 FMP stations were selected to capture the data gaps and provide a more comprehensive understanding of current conditions (Figure 1). Each site was sampled only once in 2004. Sampling of the FMP stations also followed the OSAP method for conducting fish surveys.

3.1.3 Lakefront Environmental Monitoring Program

The third source of field data is the TRCA Lakefront Environmental Monitoring Program (LEMP) which uses boat electrofishing as one method to assess the fish community. Seasonal fish surveys are conducted at four stations within the Humber Marshes using the TRCA electrofishing vessel. These surveys determine composition and abundance and of the fisheries and are used to track potential changes in the fisheries community.

One thousand second transects are used to mimic historical data collection to allow for consistent comparison. In all cases transects are parallel to the shoreline, although slight deviations do occur when obstacles must be avoided. Electrofishing surveys are conducted seasonally, in the spring and fall during daylight hours, and in the summer during the night.

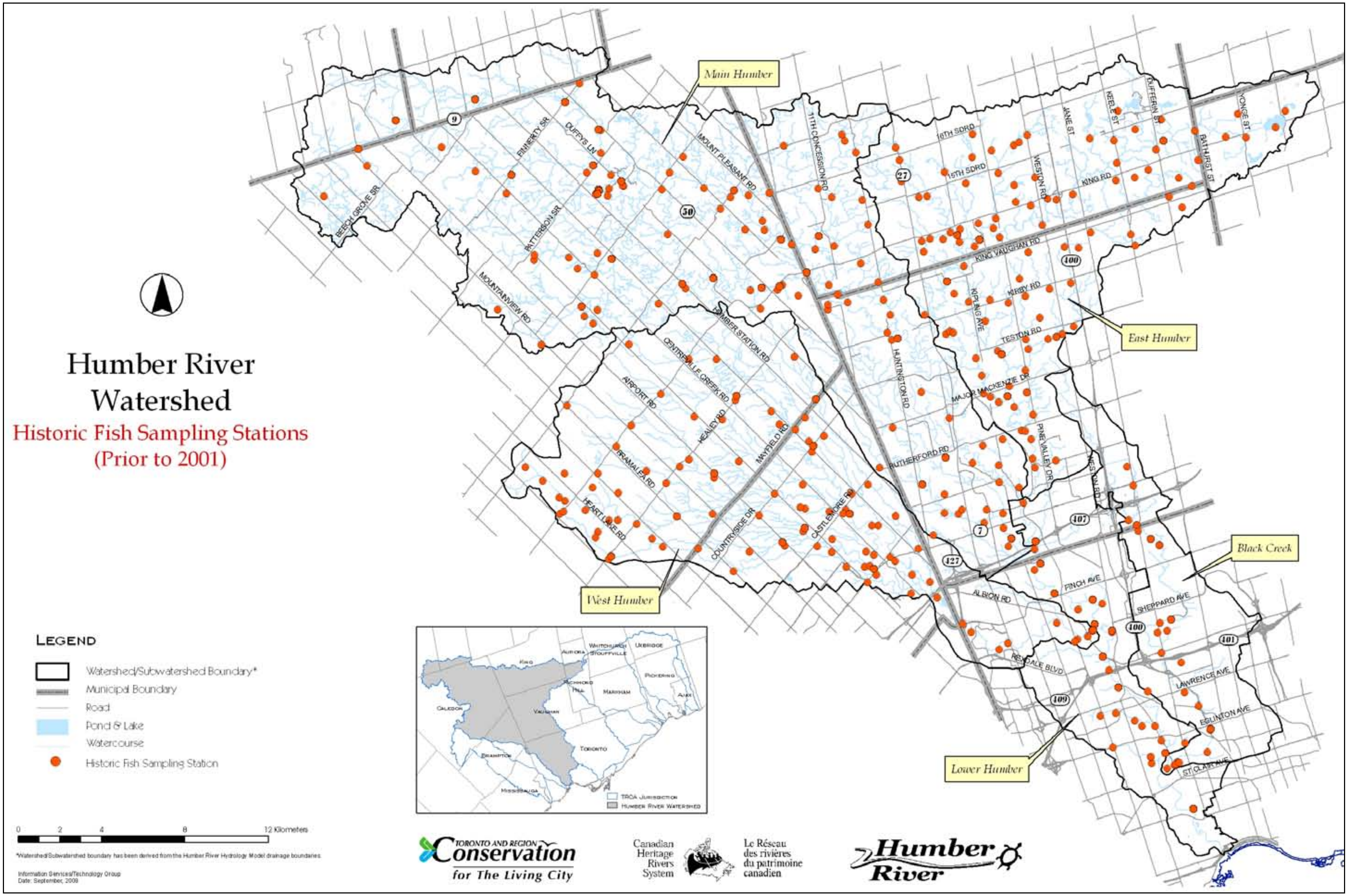
The boat is equipped with a 7.5 kw pulsed DC electrofishing unit allowing for optimum operational settings by the operator to collect fish effectively. Dip-nets used during the surveys have openings approximately 50 cm wide, 40 cm long, and 40 cm deep, with a 7 mm mesh size, and are attached to 3.0 metre long fibreglass poles. Immobilized fish were placed in the onboard live well where they were held and allowed to revive until being processed in the same manner as the stream sampling protocol. Waterfront data were collected and recorded on both OMNR field forms and modified Canadian Centre for Inland Waters (CCIW) forms.

3.2 Historic Conditions Fish Data

There have been numerous surveys of the fish community in the Humber River watershed. The earliest recorded collections date back to the early 1900's but some observations date from the mid to late 1800's. Historical observations were identified in Richardson (1948), while data collected from the early 1900's to 1972 were described in detail by Wainio and Hester (1973). Other surveys include the Royal Ontario Museum that have collected and preserved fish from 1917 to the present, and Nash (1913) who compiled a list of species from Lambton Mills to Elder Mills, but did not perform detailed surveys.

Fish data were also taken from past fish collection records (including efforts by TRCA prior to the RWMP) housed by the OMNR. Of all the fish surveys, the studies done in 1948, 1972, 1984/85, 1999, and 2001 were the most intense and broadest in spatial coverage. Depending on the source of the data, fish sampling was generally conducted using seine nets or backpack electrofishing. Prior to 2000, TRCA electrofishing protocol followed the OMNR Electrofishing Guidelines and Procedures. This information has been digitized, forming a database of more than 360 historic fish sampling stations as shown on Figure 2. Many of these stations were sampled more than once, resulting in more than 900 historic fish collection records.

Figure 2: Historic Fish Sampling Stations in the Humber River



3.3 Benthic Invertebrate Sampling

Benthic invertebrates (BI) are organisms without a backbone and generally reside within the substrate of an aquatic system (*e.g.*, insect larvae, snails, clams, and crayfish). Benthic invertebrate monitoring is part of the RWMP and the same 38 sites used for fish surveys are used for BI collection (Figure 1). Each station is sampled annually during the summer using a traveling kick and sweep-transect method as detailed in OSAP Version 5.1 (OMNR, 2003). This method maximizes reproducibility between years and provides a more complete community assessment as sampling is conducted in all stream microhabitats (*e.g.,* riffles, pools, glides).

TRCA has adopted the analytical method referred to as Benthic Aggregate Assessment (BAA) which employs a decision rule system using 10 common benthic invertebrate indices, each with their own criteria that are deemed characteristic of a healthy stream condition (**Error! Reference source not found.**).

Table 2: Benthic Invertebrate Indices and Criteria used by TRCA BAA (2004)

Index	Potentially Impaired	Unimpaired	Source(s)
% Worm	10 to 30	< 10	Griffiths (1998), David *et al.* (1998)
% Midge	10 to 40	< 10	Griffiths (1998)
% Sowbug	1 to 5	< 1	In part from Griffiths (1998)
Number of Groups		>13	David *et al.* (1998)
Diversity	1 to 3	>3	Wilm and Dorris (1968)
% Dominant Group	40 to 45	<40	David *et al.* (1998), Barbour *et al.*(1999)
% EPT	5 to 10	> 10	David *et al.* (1998), Kilgour (2000)
% Diptera	15 to 20, or 45 to 50	20 to 45	David *et al.* (1998)
% Insects	40 to 50, or 80 to 90	50 to 80	David *et al.* (1998)
Hilsenhoff Biotic Index	6 to 7	<6	Kilgour (1998)

3.4 Stream Temperature

Stream temperatures in the Humber are collected as part of the RWMP (Figure 1). Temperature data loggers were installed to record summer conditions in 2001, 2002 and 2004 at all of the 38 RWMP stations (Figure 1) . Additional temperature loggers were deployed in the upper Main Humber subwatershed in 2003 to classify streams not included in the RWMP. This data was collected using the OSAP method (see below) and analyzed for temperature stability.

3.4.1 OSAP Method

Using a method outlined in the OSAP Version 7 (Stanfield, 2005), the thermal stability of each RWMP station was determined. The temperature of the stream is logged for the warmest months of the summer for the period between July 1st and September 10th. The temperatures selected for thermal analysis were based on the following points:

- taken after 12:00 pm and as close as possible to 4:00 - 5:00 pm;
- taken between July 1st and September 10th;
- taken on days when maximum daily air temperature exceeds 24.5°C; and
- during a heat wave (> two days) and no rainfall to affect baseflow.

The stream temperatures are then compared to the maximum air temperature recorded on a data logger that has been setup within the watershed. The calculation for thermal stability is determined through a formula in the HABPROGS database (Stanfield, 2005) that relates the air temperature to the water temperature that occurs at the site under the above noted conditions.

3.5 Baseflow Index

Baseflow is a measure of groundwater contribution. When the annual quantity of baseflow is divided by the total annual flow of the stream, the ratio calculated is the baseflow index (BFI). The method used for calculating BFI and locations of stream flow monitoring stations in the Humber River are described in *Humber River State of the Watershed Report - Surface Water Quantity* (TRCA, 2008c).

3.6 Surface Water Quality

The following groups of water quality parameters are collected and analyzed in the Humber River as part of the RWMP: nutrients, metals, conventional pollutants and organic compounds. The locations of monitoring stations in the Humber are described in *Humber River State of the Watershed Report - Surface Water Quality* (TRCA, 2008b).

3.7 Riparian Natural Cover

An assessment of riparian natural cover in the Humber River watershed has been completed using geographic information system (GIS) mapping techniques. For this analysis, riparian natural cover was defined as either forest, meadow, successional (*i.e.*, shrubland or immature forest), wetland or beach/bluff vegetation types within a standard buffer distance from a watercourse or shoreline. Potential riparian areas in the watershed were delineated using the TRCA watercourse GIS theme that was digitized from 1999 ortho aerial photography, with each reach classified according to Strahler stream order. The delineation method involved applying standard buffer widths to either side of the watercourse centreline according to the stream order of the reach. The standard buffer widths applied are described in Table 3. A standard buffer width of 30 metres was also applied inland from the shoreline of all mapped lakes and ponds in the watershed. These two polygon themes were then combined into a single theme of potential riparian areas, which represents approximately 12167 hectares of the watershed.

Table 3: Standard Buffer Widths Applied to TRCA Watercourse Theme to Delineate Potential Riparian Areas

Stream order[1]	1	2	3	4	5	6	7
Average bankfull channel width (metres)	0.5[3]	1.0[3]	2.4	3.3	6.5	6.7	25.7
Standard buffer width (metres)[4]	30.25	30.5	31.2	31.7	33.2	33.4	42.8

Notes:
1. Derived from TRCA watercourse GIS theme, interpreted from 1999 ortho aerial photography.
2. Based on the combined averages of a minimum of 10 bankfull channel width measurements at three different reaches per stream order value, including at least one urban stream for each stream order value.
3. Estimated based on interpretation of 2002 ortho aerial photography.
4. Standard buffer width = 30 metres + [½ * average bankfull channel width].

The potential riparian areas theme was then correlated with GIS mapping information regarding land use and land cover types for the entire watershed derived from 2002 ortho aerial photography. A GIS was used to estimate the amount of each land use and land cover type within potential riparian areas. Areas lacking riparian natural cover were considered to be any other land use or land cover type other than forest, meadow, successional, wetland, beach/bluff or open water located within potential riparian areas. Information regarding the total potential riparian area, total area of each riparian natural land cover type, total area of riparian natural cover, and total area lacking riparian natural cover was calculated and tabulated for the entire Humber watershed, and each primary and secondary subwatershed (see Section 5.3 for summary of the results of this assessment).

3.8 In-stream Barriers

Prior to field investigations, ortho aerial photos are used to identify structures that cross streams or are in the stream, including dams, weirs, roads, bridges and railways. This method estimates the magnitude of fragmentation of aquatic habitat.

Field surveys are then required to confirm which structures are not actually passable by fish as well as locate structures that are hidden by trees or otherwise not observed using the aerial photos. During field surveys, the following measurements are made for each structure:

- date of survey
- photographic record of structure;
- type of structure (*e.g.,* span bridge, open foot culvert);
- stream width;
- bank condition;
- channel condition;
- presence or absence of groundwater discharge evidence (*e.g.,* iron staining, watercress);
- upstream and downstream photos of the structure;
- UTM coordinates using a handheld GPS unit.

For those structures determined as a barrier to fish passage, the following additional information is recorded:

- the depth of pool (the deepest portion of water downstream of the barrier but within 1 meter (perpendicular) to the barrier;
- height from the lip of the barrier to the stream bed below;
- height from the lip of the barrier to the surface of the water.

3.9 Aquatic Invasive Species

Fish surveys conducted through the RWMP and LEMP provide data on the type and number of species present in the Humber, from which aquatic invasive species are identified. Past fish survey records were also reviewed for this information. One limitation to the RWMP data relates to the timing of sampling, which is in the summer months, and does not coincide with the spring spawning migration of sea lamprey (*Petromyzon marinus*). In the case of the Humber, there are sea lamprey traps attached to the sides of the Old Mill dam, the first structure upstream from Lake Ontario. Sea lamprey are attracted to these traps and can be removed through a collection process. There is an arrangement between TRCA and Fisheries and Oceans Canada (DFO) that has TRCA managing the traps and holding the lamprey in tanks until DFO can retrieve them as part of their sea lamprey control program.

3.10 Human Use

Activities such as angling, baitfish harvesting and stocking are examples of human uses that have direct effects on the fish community. A passive connection between people and the river is simply viewing various aspects of interest (*e.g.,* fish migration or salmonid spawning in the headwaters). For angling, specific surveys (*i.e.*, creel surveys) that determine extent or quality of this activity have not been recently conducted. Ad hoc information from angling groups, the Humber Alliance and the general public provide a measure of interest in angling, popular locations as well as fish viewing opportunities. The collection of baitfish is permitted through licenses issued by OMNR. There is only one licensed bait fish harvester per watershed. Stocking programs are undertaken by OMNR and have prescribed species, numbers and locations for a given watershed.

4.0 EXISTING CONDITIONS – AQUATIC ECOSYSTEM

The Humber River watershed still maintains forested headwaters and tracts of relatively undeveloped lands in the middle to upper portions. This land cover helps maintain a healthy aquatic system and buffer the cumulative impacts of landscape change and human activities that affect the lower urbanized reaches. Underlying what we see on the surface is an array of physical differences in soils and topography which, in turn, lead to differences in groundwater recharge and discharge. Together, these elements provide a diverse assemblage of habitats for various aquatic species.

The limestone bedrock characterizing the Niagara Escarpment and coarse sands of the Oak Ridges Moraine provide substantial groundwater inputs to many headwater streams, keeping water temperatures cold and flows stable. The clay soils within the middle reaches of the watershed (particularly the West Humber) absorb less water and thus have higher runoff characteristics resulting in larger fluctuations in stream temperature and flows throughout the year.

Further downstream, before emptying into the Lake, the Humber shifts to warm water, as is generally expected. However, past urbanization has resulted in the loss of small tributaries (first and second order streams) that may have flowed cool or cold. The overland flow in urban systems is often warm as the water moves over heated pavement or through online ponds subject to solar heating. Water conveyed from upstream catchments and surface runoff generates the majority of stream flow to the lower reaches of the Humber River.

4.1 Fish Community at the Watershed Scale

Based on recent TRCA watershed based surveys (RWMP, FMP), lake front monitoring (LEMP) and past collection records, a cumulative list of fish species was complied for the Humber River (Table 3). From this list, a total of 75 fish species were documented in the watershed over the past 150 years, 64 of which are native. Although only 39 native fish species were collected during the 2004 aquatic surveys, they span 10 phylogenic families, contain many species representative of healthy stream conditions and maintain good distribution according to habitat preference. This is in contrast to more altered systems like the Don River where only 6 different fish families are still present with the more sensitive ones confined to only a few reaches (lake-based species were not included in the Humber or Don comparison).

The cold water upper reaches of the Main Humber are characterized by self-sustaining populations of brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*); the latter two are augmented by stocking. Brook trout have been present in the Humber through the collection records and are assumed to have been resident in pre-settlement times. They remain in the stream from 'egg to adult', thus they do not migrate in and out of the river like other salmonids. Brook trout spawning habitat is characterized by the presence of groundwater upwellings, clear water and clean gravelly substrates. This supply of cold, clean water provides oxygen to eggs and prevents freezing of eggs incubating through the winter months. Other cold water species that have been present through the sampling record, and persist today, include mottled sculpin (*Cottus bairdi*) and American brook lamprey (*Lampetra appendix).*

Also in pre-settlement times, the Humber River supported large runs of Atlantic salmon (*Salmo salar*) that migrated upstream from Lake Ontario to reproduce in the upper tributaries on an annual basis. Landscape alteration associated with the establishment of new settlements, clearing of land for farming, dam building to support mills and over-fishing contributed to the eventual disappearance of this species from the watershed by the mid-nineteenth century.

Once common in the smaller tributaries of the middle and lower reaches of the Humber, redside dace (*Clinstomus elgongatus*, an endangered species under the provincial *Endangered Species Act* (ESA; 2007), is now only present, in relatively high abundance, through the middle reaches of the Main and East Humber and Purpleville Creek. The West Humber now only supports a small, confined population of redside dace whereas this species has not been present in the Lower Humber since 1972 and in Black Creek since 1991. The decline of redside dace is largely attributed to higher volume flows, increased flashiness and turbidity, all impacts associated with urbanization. Reside dace are also under review for uplisting from species of concern to endangered on Schedule 1 under the federal *Species At Risk Act* (SARA; 2002).

Past records show that five darter species (perch family) have been present and distributed throughout the Humber: rainbow darter (*Etheostoma caeruleum*), fantail darter (*Etheostoma flabellare*), blackside darter (*Percina maculata*), Iowa darter (*Etheostoma exile*) and Johnny darter (*Etheostoma nigrum*). The first three darters are considered species of local concern due to their relatively high sensitivity to aquatic degradation and/or increasing rarity (discussed in next section). Today, these darters are still consistently collected through the upper half of the watershed where flows and water quality have not shifted enough to bring about declines. Moving down to the Lower Humber only rainbow, fantail and Johnny darter were collected in 2004, whereas Iowa and blackside darter have not been collected since 1999. No darter species have been collected in the highly urbanized Black Creek subwatershed since 1946.

At virtually all RWMP monitoring stations and present through the past collection records are a host of minnow species described as habitat generalists, relatively tolerant of poor water quality and are often found moving, to various extents, between the full array of thermal habitats. These species include: creek chub (*Semotilus atromaculatus*), common shiner (*Luxilus cornutus*) , blacknose dace, fathead minnow (Pimephales promelas) and longnose dace. White sucker (*Catostomus commersoni*) and brook stickleback (*Culaea inconstans*) are two other tolerant, generalist fish species that have persisted through time and are found commonly throughout the watershed. The exception is Black Creek where brook stickleback has not been collected since 1994.

A potential threat to all fish species is the new viral infection Viral Hemorrhagic Septicemia (VHS) that has entered the Lake Ontario system. The OMNR has produced guidelines designed to avoid the spreading of VHS including, direction for hatchery management, stocking practices, fishway operations and 'clean' zones where the virus has not been detected. The Humber River is situated within an 'infected' zone due to stocking and some species (*e.g.,* salmonids) being able to pass between the Lake and the watershed. To date, there have been no recorded cases of VHS in the Humber River.

Those species in Table 3 denoted with the superscript '4' are lake-based species and are typically captured at the mouth of the Humber and within the Humber Marshes (through the LEMP). Here, these species freely interact with the lake and lake-like conditions in the lower river, foraging for food, using in-stream cover and, in some cases, completing their spawning cycle (*e.g.,* northern pike, *Esox lucius,* in marsh habitats). However, these species do not depend directly on watershed habitats for their ultimate survival.

Table 4: Fish Species in the Humber River Watershed – Past and Present

Common Name	Scientific Name	Past Records up to 2000	TRCA 2001	TRCA 2004
LAMPREY FAMILY				
American brook lamprey[9]	*Lampetra appendix*	X	X	X
northern brook lamprey[2]	*Ichthyonyzon fossor*	X		
sea lamprey [1,4]	*Petromyzon marinus*	X		
GAR FAMILY				
longnose gar[4]	*Lepisosteus osseus*	X		
BOWFIN FAMILY				
bowfin[4]	*Amia calva*	X		
HERRING FAMILY				
alewife [2,4]	*Alosa pseudoharengus*	X		
gizzard shad[4]	*Dorosoma cepedianum*	X		
SALMON FAMILY				
chinook salmon [1,4]	*Oncorhynchus tshawytscha*	X		
coho salmon [1,4]	*Oncorhynchus kisutch*	X		
rainbow trout[1]	*Oncorhynchus mykiss*	X	X	X
Atlantic salmon[3]	*Salmo salar*	X		
brown trout[6]	*Salmo trutta*	X	X	X
brook trout	*Salvelinus fontinalis*	X	X	X
SMELT FAMILY				
rainbow smelt[2,4]	*Osmerus mordax*	X		
PIKE FAMILY				
northern pike[4]	*Esox lucius*	X		
MUDMINNOW FAMILY				

Common Name	Scientific Name	Past Records up to 2000	TRCA 2001	TRCA 2004
central mudminnow	*Umbra limi*	X	X	X
SUCKER FAMILY				
white sucker	*Catostomus commersoni*	X	X	X
northern hog sucker	*Hypentelium nigricans*	X	X	X
MINNOW FAMILY				
goldfish[1]	*Carassius auratus*	X		
northern redbelly dace[8]	*Phoxinus eos*	X	X	X
finescale dace	*Phoxinus neogaeus*	X		
redside dace[5]	*Clinostomus elongatus*	X	X	X
lake chub[4]	*Couesius plumbeus*	X		
common carp[1]	*Oncorhynchus kisutch*	X	X	
brassy minnow[6,8]	*Hybognathus hankinsoni*	X	X	
hornyhead chub	*Nocomis biguttatus*	X	X	
river chub	*Nocomis micropogon*	X	X	X
golden shiner	*Notemigonus crysoleucas*	X	X	
emerald shiner[4]	*Notropis atherinoides*	X	X	
common shiner	*Luxilus cornutus*	X	X	X
blackchin shiner	*Notropis heterodon*	X		
blacknose shiner	*Notropis heterolepis*	X		
spottail shiner [4]	*Notropis hudsonius*	X	X	
rosyface shiner	*Notropis rubellus*	X	X	
spotfin shiner	*Cyprinella spiloptera*	X	X	
sand shiner	*Notropis stramineus*	X		
mimic shiner	*Notropis volucellus*	X		
bluntnose minnow	*Pimephales notatus*	X	X	X
fathead minnow	*Pimephales promelas*	X	X	X
blacknose dace	*Rhinichthys atratulus*	X	X	X
longnose dace	*Rhinichthys cataractae*	X	X	X
creek chub	*Semotilus atromaculatus*	X	X	X
fallfish	*Semotilus corporalis*	X		
pearl dace	*Margariseus margarita*	X		
central stoneroller[4]	*Campostoma anomalum*	X	X	X
CATFISH FAMILY				
yellow bullhead[8]	*Ameiurus natalis*	X		
brown bullhead	*Ameiurus nebulosus*	X	X	X
channel catfish	*Ictalurus punctatus*	X		
stonecat[8]	*Noturus flavus*	X	X	X
EEL FAMILY				
American eel [4,7]	*Anguilla rostrata*	X		
KILLIFISH FAMILY				
banded killifish	*Fundulus diaphanus*	X		
STICKLEBACK FAMILY				
brook stickleback	*Culaea inconstans*	X	X	X
three-spine stickleback[4]	*Gasterosteus aculeatus*	X		
TROUT-PERCH FAMILY				
trout-perch[4]	*Percopsis omiscomaycus*	X		

Common Name	Scientific Name	Past Records up to 2000	TRCA 2001	TRCA 2004
TEMPERATE BASS FAMILY				
white bass[4]	*Morone chrysops*	X		
SUNFISH FAMILY				
rock bass	*Ambloplites rupestris*	X	X	X
green sunfish[4]	*Lepomis cyanellus*	X		X
pumpkinseed	*Lepomis gibbosus*	X	X	X
bluegill	*Lepomis macrochirus*	X	X	
smallmouth bass	*Micropterus dolomieu*	X		
largemouth bass	*Micropterus salmoides*	X	X	X
black crappie	*Pomoxis nigromaculatus*	X	X	
PERCH FAMILY				
yellow perch	*Perca flavescens*	X	X	X
White perch[4]	*Morone americana*	X		
walleye[4]	*Percopsis omiscomaycus*	X	X	
rainbow darter	*Etheostoma caeruleum*	X	X	X
Iowa darter	*Etheostoma exile*	X	X	X
fantail darter	*Etheostoma flabellare*	X	X	X
johnny darter	*Etheostoma nigrum*	X	X	X
logperch	*Percina caprodes*	X		X
blackside darter	*Percina maculata*	X	X	X
river darter	*Percina shumardi*	X		
tesselated darter[4]	*Noturus gyrinus*	X		
DRUM FAMILY				
freshwater drum[4]	*Aplodinotus grunniens*	X	X	X
SCULPIN FAMILY				
mottled sculpin	*Cottus bairdi*	X	X	X

Notes:
1 - introduced species
2 - naturalized species
3 - extirpated species
4 - found only below the Old Mill dam, Toronto and/or lake based species
5 – SARA Species of Special Concern, schedule 3 (COSEWIC) and endangered under ESA
6 - resident brown trout are naturalized while migratory brown trout are introduced
7 - Group 1: Intermediate Priority Candidate Species - COSEWIC
8 - Group 2: Intermediate Priority Candidate Species - COSEWIC
9 - Group 3: Lower Priority Candidate Species – COSEWIC

4.1.1 Species of Local Concern

Although there is no ranking system developed for aquatic species (as completed for the terrestrial species in the region), an analysis of ecological requirements has been undertaken, and some species can be identified as rare and/or sensitive within the watershed. Table 4 presents the species of local concern in the Humber River and lists their habitat requirements and sensitivities.

All of the species listed in the table are of concern due to their sensitivity to one or more of the following stressors: habitat alteration, chemical pollution, siltation and increased flow velocities.

Many are reliant on aquatic macrophytes and particular substrate types, and as such are affected by changes in hydrology which can alter these habitat conditions. Generally speaking, these impacts are associated with urbanization where catchments were fully urbanized without benefit of present day technologies, such as stormwater management and separated sewer systems (*e.g.,* Lower Humber, Black Creek and downstream reaches of the West Humber).

Table 5: List of Local Species of Concern

Common Name	Scientific Name	Preferred Environment	Sensitivity
American brook lamprey	*Lampetra appendix*	• Cold brooks and small rivers • Gravel, sand, silt, rubble • Cold water	• Turbidity • Siltation • Thermal warming • Declining nationally COSEWIC status: none
banded killifish	*Fundulus diaphanus*	• Shoals or estuaries of large lakes, clear waters in slow flowing sections of medium to large streams in the open or near sparse aquatic vegetation • Sand, gravel, detritus • Warm water	• Locally rare • High Flow Velocity COSEWIC status: Not at Risk (1989)
blacknose shiner*, blackchin shiner	*Notropis heterolepis, Notropis heterodon*	• Small streams < 3 metres wide • Sand substrate and aquatic macrophytes • Wetlands and pool habitats • Cool water	• Turbidity • High flow velocity • Locally rare • In decline in North America COESWIC status: Not at risk* (1994)
blackside darter	*Percina maculata*	• Quiet sections of cool to warmwater gravelly streams with clear to slightly turbid water and considerable aquatic vegetation • Sand, gravel, boulders, mud, silt, rubble • Warm water	• Siltation • Locally rare COSEWIC status: none
brook trout	*Salvelinus fontinalis*	• Prefers the waters of low order, high gradient headwater streams with a gravel bottom • Forested canopy • Streams with high water clarity	• Thermal warming: >20°C; >13°C during spawning • Changes in groundwater discharge • Siltation • Turbidity COSEWIC status: none

Common Name	Scientific Name	Preferred Environment	Sensitivity
central mudminnow	*Umbra limi*	• Clear to dark brown water <0.5 metres deep • Heavily vegetated with gravel, sand, silt, mud • Cool water	• High flow velocity • Likely sensitive to sound • Reliance on aquatic macrophytes COSEWIC status: none
fantail darter	*Etheostoma flabellare*	• Clear to slightly turbid streams 1-6 metres wide less than 1.5 metres deep • Gravel, rubble, sand • Warm water	• Moderate sensitivity to turbidity and siltation • Locally rare COSEWIC status: none
finescale dace	*Phoxinus neogaeus*	• Clear to stained small streams 10-50 cm deep 1-3 metres wide • Sluggish, darkly stained, swampy streams, ponds, lakes • Cool water	• Locally rare COSEWIC status: none
mimic shiner	*Notropis volucellus*	• Clear and moderately weedy lakes • Sandy pools of headwaters, creeks, and small to large rivers; quiet areas of lakes • Macrophytes • Warm water	• Apparently absent from the Metro and surrounding area, locally very rare COSEWIC status: none
Northern hog sucker	*Hypentelium nigricans*	• Clear shallow streams with high gradients and silt free bottoms • Warm water	• Moderate sensitivity to turbidity and siltation • Fast flows during spawning COSEWIC status: none
pearl dace	*Margariseus margarita*	• Clear to very stained headwater streams < 50 cm deep, 1-3 metres wide • Darkly stained or peaty wetlands • Cool lakes, bogs and creeks, pools of creeks, small rivers, ponds and lakes • Sand, gravel, silt • Cool/cold water	• Thermal warming • turbidity • Locally rare COSEWIC status: none
rainbow darter	*Etheostoma caeruleum*	• Clear water 10 to 50 cm deep • Sand, boulders, gravel • Warmwater	• Chemical pollution • Turbidity • Siltation COSEWIC status: none
redside dace	*Clinostomus elongatus*	• Prefers the waters of low order, low gradient headwater streams with a gravel bottom. • Riparian habitat consisting of pasture, meadow or thicket with abundant overhanging herbaceous vegetation and grasses • Streams with high water clarity	• Increased flows • Turbidity • Siltation • Thermal warming • Riparian alteration COSEWIC status: Endangered

Common Name	Scientific Name	Preferred Environment	Sensitivity
rosyface shiner	*Notropis rubellus*	• Lower reaches of streams near confluences • Fine gravel, sand • Warm water	• Turbidity • Siltation • High flow velocities • Locally rare COSEWIC status: Not at Risk (1994)
sand shiner	*Prosopium cylindraceum*	• Unvegetated streams 12 to 50 metres wide • Gravel, sand, mud with sparse growth of rooted aquatics • Warm water	• Moderate sensitivity to turbidity • Strong affinity for sand substrate • Locally rare COSEWIC status: none
yellow bullhead	*Ameiurus natalis*	• Shallow slow moving streams with heavy aquatic vegetation • Sand, mud, gravel, silt, boulders, rubble • Warm water	• Locally rare COSEWIC status: candidate

4.1.2 Introduced Species

The introduction of Pacific salmon species into Lake Ontario has been occurring at various intensities since the late 1800's (OMNR & TRCA, 2005). Within the Humber, rainbow trout, brown trout and, to a lesser extent, chinook salmon (*Oncorhynchus tshawytscha*) are stocked in the streams as either fry or fingerlings. The objective of this practice is to provide lake-based recreational angling opportunities.

As these salmonids mature, they migrate out to Lake Ontario and grow to the adult stage before returning to the river to spawn. Typically, stocked species are not reliant on habitat conditions for successful spawning and hatching, however, rainbow trout and brown trout populations have become self-reproducing in the middle reaches of the Main Humber and East Humber subwatersheds. These populations are referred to as 'wild type' and can be considered indicators of high quality spawning habitat.

Chinook salmon are prevented from migrating up into the East Humber, where they might compete with wild rainbow trout, by a managed Board of Trade Golf Course fishway (Clarence Street north of Highway 7 in Woodbridge). The collection records indicate that chinook have not been collected by the RWMP even below this fishway. This is attributed to the timing of their upstream migration (fall) and that chinook emigrate to the lake less than one year after being stocked in the stream, thus having no overlap with the RWMP survey schedule.

As part of the OMNR's larger Atlantic Salmon Restoration Program, the Humber River is identified as a system that will receive stocked fry and fingerlings. To date, only small numbers of Atlantic salmon eggs and fry have been stocked in the headwaters of the Main Humber subwatershed in an effort to identify suitable stocking sites. It is not known when the full stocking program will commence in the Humber but efforts in Duffins Creek, Credit River and Coburg Creek are underway.

4.1.3 Aquatic Invasive Species

Access from Lake Ontario into the watershed for sea lamprey, carp (*Cyprinus carpio)* or round goby (*Neogobius melanostomus*) is prevented, under low to moderate flow conditions because of the series of low head dams (or weirs) located within the Lower Humber subwatershed. The first of these structures is the Old Mill dam and it is fitted with lamprey cages. This species is attracted to the small openings of the cages and cannot swim out. TRCA collects the lamprey and holds them in tanks until Fisheries and Oceans retrieves them as part of the federal sea lamprey control program. Both carp and round goby are non-jumping species and appear not to be able to pass the Old Mill dam, even in high water conditions. Unless someone intentionally or accidentally introduces an invasive species, the lake is not considered a source for such species found in reaches located above these weirs.

Carp have been found periodically through sampling conducted in the watershed. The likely source being escaped individuals from stocked private ponds. Fortunately, their numbers in the watershed appear to be low and their impact on the aquatic ecosystem is expected to be minimal for most riverine areas.

Rusty crayfish (*Orconectes rusticus*) is an invasive invertebrate species that was first collected at HU010WM in the West Humber subwatershed in 2003. Subsequent sampling events in 2004 collected rusty crayfish at six RWMP stations (HU001WM, HU003WM, HU015WM, HU021WM and HU022WM) including HU010WM. Only station HU010WM had more than 2 individuals identified in the 2004 sampling. The major concern is displacement of native crayfish species and impacts to the benthic community in general should this species continue to spread, as is expected (Wilson *et. al*., 2004). The most likely source of introduction is baitfish release.

The newest aquatic invasive fish species identified in the watershed is rudd (*Scardinius erythrophthalmus)*, a minnow originating in Europe that was first identified in Canadian waters in 1990 and has the potential to compete with native minnows and hybridize with golden shiner. A single specimen was collected in Lake Wilcox, located in the headwaters of the East Humber, in October 2005. Its presence is likely the result of bait fish release and there has been no further reporting of more rudd or evidence of natural reproduction.

4.2 Fish Community at the Subwatershed Scale

4.2.1 Main Humber

The Main Humber is a primary subwatershed with six secondary subwatersheds (Figure 3). Within this primary subwatershed, a total of 47 species have been identified in past and current collection records (Table 5). The orange highlighted species have not been collected in this subwatershed for 10 years or more. Many of these species occupy pond or wetland habitat (*e.g.,* some shiners). These habitats were more commonly sampled in the past so the 'absence' of these species may reflect a change in sampling practices more so than habitat degradation given that relatively little land use change has occurred in this subwatershed.

During the 2001 and 2004 RWMP surveys 35 species were collected from riverine habitats. At the community level, they represent diverse thermal guilds as well as specialists and generalists. In terms of trophic structure, most of these species are insectivores, planktivores or detrital eaters.

The presence of piscivores (fish that eat other fish) are brown and rainbow trout (stocked), largemouth bass (*Micropterus salmoides),* rock bass (*Ambloplites rupestris*) and yellow perch (*Perca flavescens*) The presence of bass and sunfish this high up in a watershed is somewhat unusual as they are considered more warm water, pond habitat species. Their presence may represent individuals escaping from stocked private ponds and becoming established in the river.

Brook trout are in high abundance and wide distribution through the upper third of the Main Humber (Main-Upper, Palgrave to Bolton, Centreville Creek and Cold Creek secondary subwatersheds) where cold water conditions are supported by groundwater contributions on the Oak Ridges Moraine (ORM) and groundwater flowing through limestone fractures on the Niagara Escarpment (TRCA, 2008a). Rainbow trout, for the most part, have not been collected this high up in the system for 33 years and likely reflects a shift in early stocking locations and before rainbows were self-sustaining.

Figure 3: Primary and Secondary Humber River Subwatersheds

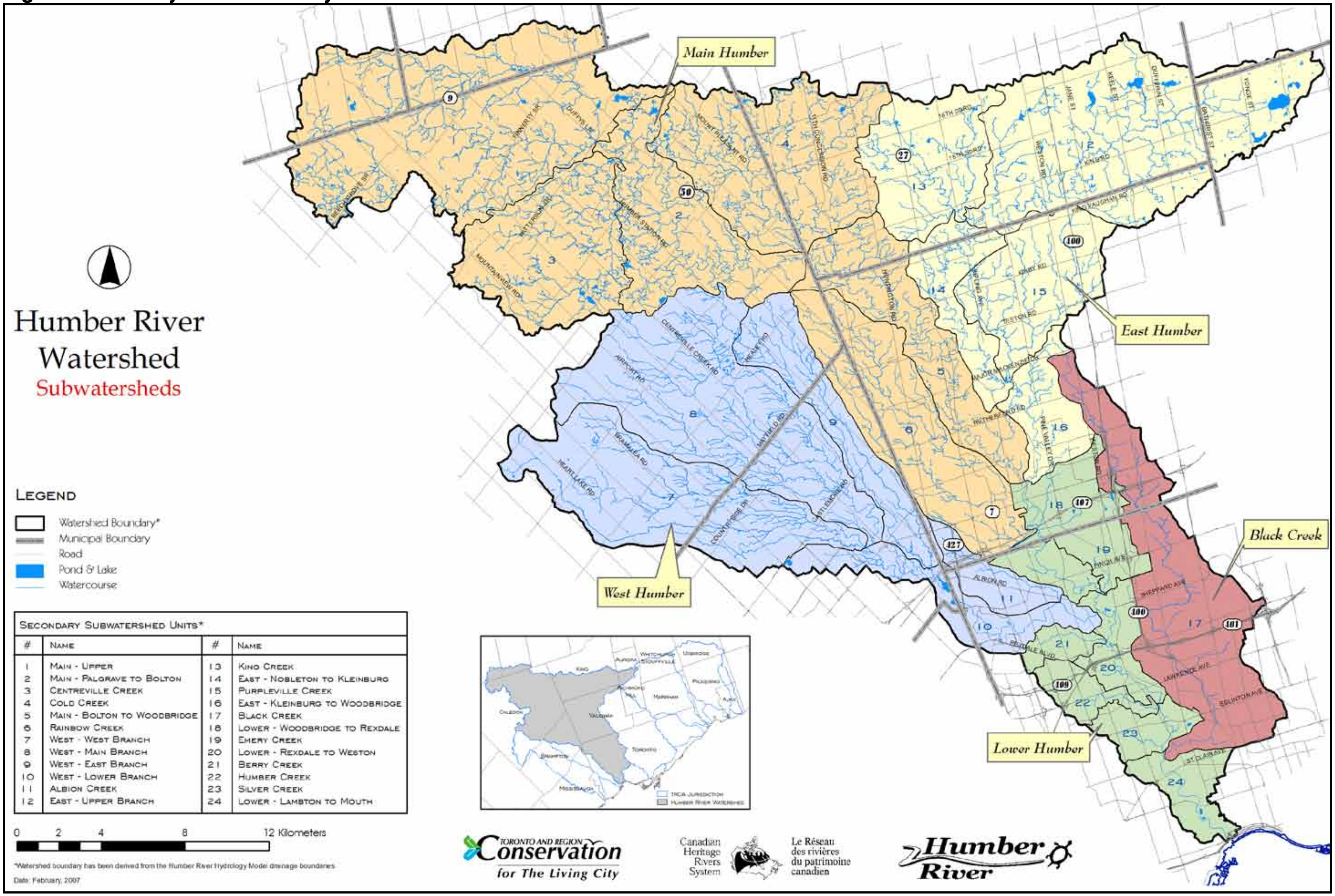


Table 6: Past and Present Species List for the Main Humber Subwatershed

Code	Common Name	Scientific Name	Last Collected	2001	2004
11	AMERICAN BROOK LAMPREY	*Lampetra appendix*	2004	X	X
12	NORTHERN BROOK LAMPREY	*Ichthyonyzon fossor*	1972		
76	RAINBOW TROUT	*Oncorhynchus mykiss*	2004	X	X
78	BROWN TROUT	*Salmo trutta*	2004	X	X
80	BROOK TROUT	*Salvelinus fontinalis*	2004	X	X
141	CENTRAL MUDMINNOW	*Umbra limi*	2001	X	
163	WHITE SUCKER	*Catostomus commersoni*	2004	X	X
165	NORTHERN HOG SUCKER	*Hypentelium nigricans*	2004	X	X
182	NORTHERN REDBELLY DACE	*Phoxinus eos*	2004	X	X
184	REDSIDE DACE	*Clinostomus elongatus*	2001	X	
186	COMMON CARP	*Oncorhynchus kisutch*	1999		
189	BRASSY MINNOW	*Hybognathus hankinsoni*	2001	X	
192	HORNYHEAD CHUB	*Nocomis biguttatus*	2001	X	
193	RIVER CHUB	*Nocomis micropogon*	2004	X	X
194	GOLDEN SHINER	*Notemigonus crysoleucas*	2001	X	
196	EMERALD SHINER	*Notropis atherinoides*	1994		
198	COMMON SHINER	*Luxilus cornutus*	2004	X	X
199	BLACKCHIN SHINER	*Notropis heterodon*	1972		
200	BLACKNOSE SHINER	*Notropis heterolepis*	1972		
201	SPOTTAIL SHINER	*Notropis hudsonius*	1994		
202	ROSYFACE SHINER	*Notropis rubellus*	2001	X	
204	SAND SHINER	*Notropis stramineus*	1999		
208	BLUNTNOSE MINNOW	*Pimephales notatus*	2004	X	X
209	FATHEAD MINNOW	*Pimephales promelas*	2004	X	X
210	BLACKNOSE DACE	*Rhinichthys atratulus*	2004	X	X
211	LONGNOSE DACE	*Rhinichthys cataractae*	2004	X	X
212	CREEK CHUB	*Semotilus atromaculatus*	2004	X	X
214	PEARL DACE	*Margariseus margarita*	1983		
216	CENTRAL STONEROLLER	*Campostoma anomalum*	2001	X	
232	YELLOW BULLHEAD	*Ameiurus natalis*	1972		
233	BROWN BULLHEAD	*Ameiurus nebulosus*	2004		X
235	STONECAT	*Noturus flavus*	2004	X	X
261	BANDED KILLIFISH	*Fundulus diaphanus*	1984		
281	BROOK STICKLEBACK	*Culaea inconstans*	2004	X	X
311	ROCK BASS	*Ambloplites rupestris*	2004	X	X
313	PUMPKINSEED	*Lepomis gibbosus*	2004	X	X
314	BLUEGILL	*Lepomis macrochirus*	1971		
316	SMALLMOUTH BASS	*Micropterus dolomieu*	1972		
317	LARGEMOUTH BASS	*Micropterus salmoides*	2004	X	X
331	YELLOW PERCH	*Perca flavescens*	2001	X	
337	RAINBOW DARTER	*Etheostoma caeruleum*	2004	X	X
338	IOWA DARTER	*Etheostoma exile*	2004		X
339	FANTAIL DARTER	*Etheostoma flabellare*	2004	X	X
341	JOHNNY DARTER	*Etheostoma nigrum*	2004	X	X
342	LOGPERCH	*Percina caprodes*	2004		X
344	BLACKSIDE DARTER	*Percina maculata*	2004	X	X
381	MOTTLED SCULPIN	*Cottus bairdi*	2004	X	X

---- orange highlighted species have not been collected in this subwatershed for 10 years or more.

As the streams confluence and flow down and away from direct influences by the ORM and Niagara Escarpment, the fish community becomes more diverse in terms of thermal guilds, habitat preference and structure. These reaches still support cold water species like American brook lamprey, mottled sculpin but transition to cool water species including redside dace, northern hog sucker (*Hypentelium nigricans*), creek chub, and blacknose dace, though the latter two species have a wider range of tolerance into warmer water. In these middle reaches, darter species (rainbow, fantail and Johnny) are observed, which tend to occupy warm water habitat in slightly larger, faster flowing streams.

Redside dace and rainbow darter, two target species in the *Humber River Fisheries Management Plan* (OMNR & TRCA, 2005) had overlapping distributions in the past through tributaries to the lower Main Humber from Bolton to Woodbridge (subwatershed 5 on Figure 3). Redside dace have not been collected in these reaches for 33 years whereas rainbow darters are still present. Redside dace are more sensitive to increasing flows than darters, which may have happened as portions of the upstream catchments were developed. Other species that prefer slower moving water and pool or pond habitat, such as northern redbelly dace, blackchin shiner (*Notropis heterdon*), yellow bullhead (*Ameiurus natalis*), brook stickleback and Iowa darter, have also not been collected in over three decades. This is in contrast to the sensitive species that are still present which prefer riffle-run habitat associated with faster flowing water such as American brook lamprey, hornyhead chub (*Nocomis biguttatus*) and fantail darter.

A unique secondary subwatershed, that is considered to be part of the Main Humber, but is geographically distinct, is Rainbow Creek (subwatershed 6 on Figure 3). This system is one of the few, in the entire TRCA jurisdiction, that supports blackside darter (*Purcina maculate*), although they are not considered a particularly sensitive species. Redside dace and fantail darter are also present but only in the lower reaches where Rainbow Creek joins the Main Humber. All three of these species prefer relatively deep pool habitat, cool temperatures and small to medium sized streams. Mottled sculpin were the only cold water species to have been collected in Rainbow Creek, but have not been observed for 22 years.

4.2.2 East Humber

The East Humber is a primary subwatershed containing 5 secondary subwatersheds (Figure 3). A total of 47 species have been identified historically within the whole East Humber, with 25 species having been recently collected (Table 6). This places the East Humber as one of the most diverse systems in the watershed, a close second only to the Main Humber. The Oak Ridges Moraine underlies the upper third of the East Humber influencing the Upper Branch and King Creek (subwatersheds 12 and 13 respectively on Figure 3). This influence appears stronger in King Creek as it supports cold water species (American brook lamprey, mottled sculpin) whereas the Upper Branch (of the East Humber) does not and never has. Brook trout have never been observed in the Upper Branch.

There are several lakes in the Upper Branch subwatershed (*e.g.,* Lake Wilcox and Lake St. George) that likely have a warming influence on this system. These features provide habitat for pond-based species such as the banded killifish (*Fundulus diaphanous*), which is relatively rare in the TRCA jurisdiction, blackchin shiner (*Notropis heterodon*) and yellow bullhead. The killifish has not been collected in over 10 years, and the latter two, not since the early seventies. This may be a result of the habitat type not being sampled anymore although growth of urban areas in the subwatershed has also recently occurred.

Table 7: Past and Present Species List for the East Humber Subwatershed

Common Name	Scientific Name	Last Collected	2001	2004
AMERICAN BROOK LAMPREY	*Lampetra appendix*	2004	X	X
NORTHERN BROOK LAMPREY	*Ichthyonzon fossor*	1995		
RAINBOW TROUT	*Oncorhynchus mykiss*	2004	X	X
BROOK TROUT	*Salvelinus fontinalis*	2004		X
NORTHERN PIKE	*Esox lucius*	1999		
CENTRAL MUDMINNOW	*Umbra limi*	2004		X
WHITE SUCKER	*Catostomus commersoni*	2004	X	X
NORTHERN HOG SUCKER	*Hypentelium nigricans*	2004	X	X
GOLDFISH	*Carassius auratus*	1985		
NORTHERN REDBELLY DACE	*Phoxinus eos*	1985		
FINESCALE DACE	*Phoxinus neogaeus*	1971		
REDSIDE DACE	*Clinostomus elongatus*	2004	X	X
COMMON CARP	*Oncorhynchus kisutch*	1995		
BRASSY MINNOW	*Hybognathus hankinsoni*	1984		
HORNYHEAD CHUB	*Nocomis biguttatus*	1993		
RIVER CHUB	*Nocomis micropogon*	2004	X	X
GOLDEN SHINER	*Notemigonus crysoleucas*	2001	X	
EMERALD SHINER	*Notropis atherinoides*	1999		
COMMON SHINER	*Luxilus cornutus*	2004	X	X
BLACKCHIN SHINER	*Notropis heterodon*	1974		
BLACKNOSE SHINER	*Notropis heterolepis*	1974		
SPOTTAIL SHINER	*Notropis hudsonius*	2001	X	
ROSYFACE SHINER	*Notropis rubellus*	1993		
SAND SHINER	*Notropis stramineus*	1972		
MIMIC SHINER	*Notropis volucellus*	1995		
BLUNTNOSE MINNOW	*Pimephales notatus*	2004	X	X
FATHEAD MINNOW	*Pimephales promelas*	2004	X	X
BLACKNOSE DACE	*Rhinichthys atratulus*	2004	X	X
LONGNOSE DACE	*Rhinichthys cataractae*	2004	X	X
CREEK CHUB	*Semotilus atromaculatus*	2004	X	X
YELLOW BULLHEAD	*Ameiurus natalis*	1972		
BROWN BULLHEAD	*Ameiurus nebulosus*	2004		X
STONECAT	*Noturus flavus*	2004		X
BANDED KILLIFISH	*Fundulus diaphanus*	1995		
BROOK STICKLEBACK	*Culaea inconstans*	2004		X
ROCK BASS	*Ambloplites rupestris*	2004	X	X
PUMPKINSEED	*Lepomis gibbosus*	2004	X	X
BLUEGILL	*Lepomis macrochirus*	1999		
LARGEMOUTH BASS	*Micropterus salmoides*	1999		
BLACK CRAPPIE	*Pomoxis nigromaculatus*	1995		
YELLOW PERCH	*Perca flavescens*	1995		
WALLEYE	*Percopsis omiscomaycus*	1995		
RAINBOW DARTER	*Etheostoma caeruleum*	2004	X	X
IOWA DARTER	*Etheostoma exile*	1999		
FANTAIL DARTER	*Etheostoma flabellare*	2004	X	X
JOHNNY DARTER	*Etheostoma nigrum*	2004	X	X
MOTTLED SCULPIN	*Cottus bairdi*	2004	X	X

---- orange highlighted species have not been collected in this subwatershed for 10 years or more

Historically, both redside dace and rainbow darter have been collected in the Upper Branch of the East Humber and lower reaches of King Creek. They haven't been collected in the Upper Branch for about 6 years, but both are still present in King Creek and occur in tributaries to the East Humber between Nobleton and Kleinburg (subwatershed 14 on Figure 3). In addition to redside dace and rainbow darter, these lower reaches still support a number of sensitive cold to cool water species (*i.e.,* mottled sculpin, northern hog sucker and fantail darter). Again, pond and wetland habitat species have had prolonged absence from the collection record (blackchin shiner, brassy minnow and yellow bullhead).

Purpleville Creek (subwatershed 15 on Figure 3) is a unique subwatershed in the East Humber as it presently supports brook trout, rainbow trout, brown trout as well as redside dace and rainbow darter. These species occur along a gradient from the headwaters to the confluence with the main channel of the East Humber. The Oak Ridges Moraine Aquifer Complex outcrops along the stream channel in this subwatershed (TRCA, 2008c), resulting in more groundwater discharge than in any other part of the East Humber. The gradient of thermal guild diversity and sensitive species presence alludes to a high quality and functional system. Expansion of urban settlement boundaries in the City of Vaughan are anticipated in this subwatershed.

The lowest reach of the East Humber flows from Kleinburg to Woodbridge (subwatershed 16 on Figure 3). This lowest reach has not been sampled since 1999. In that year, rainbow darter were collected among other relatively common and tolerant cool to warm water species that are also present throughout the East Humber, including white sucker, blacknose dace, longnose dace, fathead minnow and brook stickleback. Historic collection records indicate that greater species diversity characterized this portion of the East Humber in the past; pond and wetland habitat specialists were present as well as mottled sculpin. Pond and wetland species have not been collected in 30 years and sculpin have not been collected in 17 years. A combination of a shift in sampling protocols (i.e., riverine) and some habitat loss are likely contributors to this shift in species (*i.e.,* more emphasis on river sampling and wetlands not a dominant feature on the landscape). Redside dace has not been collected in this reach since 1985 but flow conditions have likely increased as a result of upstream development.

4.2.3 West Humber

The West Humber primary subwatershed contains 5 secondary subwatersheds (Figure 3). Historically 39 species have been collected but more recent sampling has collected only 16 (Table 7). The majority of current sampling occurs in the lower reaches where flows are permanent as opposed to only seasonal streams in the upper half of the subwatershed. The physiography is very different in the West Humber compared to elsewhere in the watershed. Soils are predominantly fine-textured with high clay content and low permeability and topography is gently sloping, which produces a more linear stream network (low stream sinuosity). The stream flow regime is driven mostly by surface runoff, creating cool to warm water aquatic habitat types. The fine-textured soils that characterize the subwatershed naturally cause turbid in-stream conditions during storm events, a condition that fish communities would either be tolerant of, or take refuge from.

The present fish community reflects this thermal and sediment regime with tolerant species such as white sucker, common shiner, blacknose dace, longnose dace, fathead minnow, creek chub, brook stickleback, pumpkinseed and rock bass widely distributed through the subwatershed.

Table 8: Past and Present Species List for the West Humber Subwatershed

Common Name	Scientific Name	Last Collected	2001	2004
AMERICAN BROOK LAMPREY	*Lampetra appendix*	1972		
BROOK TROUT	*Salvelinus fontinalis*	1946		X*
WHITE SUCKER	*Catostomus commersoni*	2004	X	X
NORTHERN HOG SUCKER	*Hypentelium nigricans*	2004	X	X
GOLDFISH	*Carassius auratus*	1999		
NORTHERN REDBELLY DACE	*Phoxinus eos*	1994		
REDSIDE DACE	*Clinostomus elongatus*	2004	X	X
COMMON CARP	*Oncorhynchus kisutch*	1999		
BRASSY MINNOW	*Hybognathus hankinsoni*	1980		
RIVER CHUB	*Nocomis micropogon*	1984		
COMMON SHINER	*Luxilus cornutus*	2004	X	X
BLACKCHIN SHINER	*Notropis heterodon*	1985		
BLACKNOSE SHINER	*Notropis heterolepis*	1972		
SPOTTAIL SHINER	*Notropis hudsonius*	1994		
ROSYFACE SHINER	*Notropis rubellus*	1986		
SAND SHINER	*Notropis stramineus*	1972		
MIMIC SHINER	*Notropis volucellus*	1995		
BLUNTNOSE MINNOW	*Pimephales notatus*	2004	X	X
FATHEAD MINNOW	*Pimephales promelas*	2004	X	X
BLACKNOSE DACE	*Rhinichthys atratulus*	2004	X	X
LONGNOSE DACE	*Rhinichthys cataractae*	2004		X
CREEK CHUB	*Semotilus atromaculatus*	2004	X	X
CENTRAL STONEROLLER	*Campostoma anomalum*	1999		
YELLOW BULLHEAD	*Ameiurus natalis*	1972		
BROWN BULLHEAD	*Ameiurus nebulosus*	1984		
STONECAT	*Noturus flavus*	1999		
BROOK STICKLEBACK	*Culaea inconstans*	2004	X	X
ROCK BASS	*Ambloplites rupestris*	2004	X	X
PUMPKINSEED	*Lepomis gibbosus*	2004		X
BLUEGILL	*Lepomis macrochirus*	1999		
SMALLMOUTH BASS	*Micropterus dolomieu*	1994		
LARGEMOUTH BASS	*Micropterus salmoides*	2004	X	X
YELLOW PERCH	*Perca flavescens*	1980		
RAINBOW DARTER	*Etheostoma caeruleum*	2004	X	X
IOWA DARTER	*Etheostoma exile*	1999		
FANTAIL DARTER	*Etheostoma flabellare*	2004		X
JOHNNY DARTER	*Etheostoma nigrum*	2004	X	X
RIVER DARTER	*Percina shumardi*	1972		
MOTTLED SCULPIN	*Cottus bairdi*	1999		

---- orange highlighted species have not been collected in this subwatershed for 10 years or more

*2004 brook trout record provided by OMNR Biologist

In terms of more sensitive species, rainbow darters are widely distributed over the sampling area and have been present through the collection record however redside dace, which used to have a similar distribution, are today confined to a few tributaries that receive drainage from the West Branch and Main Branch (subwatersheds 7 and 8 respectively on Figure 3). Urban developments across the lower third of the West Humber have likely increased stream flows and exacerbated the natural condition of silty, turbid water quality during storm events. Rainbow darter is known to occupy main channel habitat (as well as tributary) and thus have higher tolerance to faster flows with less riffle-pool habitat than redside dace. Loss of riparian habitat, associated with significant agricultural lands in this catchment, is another impact that redside dace would respond too, but to which darters are not considered specifically sensitive. The loss of wetland habitat can also be associated with the agricultural practices (i.e., land drainage) and may help explain the prolonged absence (three decades) of wetland-pond species from the West Humber.

Exceptions to this surface runoff dominated stream flow regime are the West Branch and Lower Branch (subwatersheds 7 and 10 on Figure 3). The West Branch appears to support brook trout in the upper reaches and redside dace in the lower reaches. Stream flow in this subwatershed is influenced by groundwater discharge from the Oak Ridges Moraine Aquifer Complex to the westernmost reach, north of Healey Road (TRCA, 2008c). Flows in the lowermost reach of Lower Branch (subwatershed 10 on Figure 3) are also being influenced by groundwater discharge. Significant increases in baseflow observed along this reach may be due to groundwater inputs from the Oak Ridges Aquifer Complex (or equivalent geologic unit) and the Scarborough Aquifer Complex (TRCA, 2008c). These inputs of relatively clean and cold groundwater provide a localized buffering effect on warmer flows from upstream areas, as redside dace are still found in the Lower Branch subwatershed.

4.2.4 Black Creek

Black Creek historically supported only 18 species of which 4 have been recently collected (Table 8). This system has been highly altered due to past development that occurred long before the advent of stormwater controls and the generally better planning considerations of today. A common practice done throughout Black Creek was to channelize reaches of the watercourse to prevent flooding (exacerbated by urbanization). This alteration removes nearly all in-stream habitat and flow attenuation. Fish sampling only began after habitat and water quality conditions were in decline. Thus, a more diverse community, as found in the other subwatersheds, would likely have characterized Black Creek a century ago. Losses of more sensitive minnow species, including redside dace, were evident 15 years ago or more.

Today, only the most pollution tolerant fish species remain in Black Creek (*i.e.*, white sucker, blacknose dace, fathead minnow and creek chub). The persistence of these species suggests that this system has at least stabilized, albeit in a poor state of health. The issues in Black Creek are numerous (*e.g.,* flashy storm flows, poor water quality, channelization and poor in-stream habitat structure) and will take time to improve but it is unlikely to get any worse.

Table 9: Past and Present Species List for Black Creek Subwatershed

Common Name	Scientific Name	Last Collected	2001	2004
WHITE SUCKER	*Catostomus commersoni*	2004	X	
GOLDFISH	*Carassius auratus*	1991		
REDSIDE DACE	*Clinostomus elongatus*	1991		
COMMON CARP	*Oncorhynchus kisutch*	1994		
HORNYHEAD CHUB	*Nocomis biguttatus*	1991		
COMMON SHINER	*Luxilus cornutus*	1991		
MIMIC SHINER	*Notropis volucellus*	1991		
BLUNTNOSE MINNOW	*Pimephales notatus*	1994		
FATHEAD MINNOW	*Pimephales promelas*	2004	X	
BLACKNOSE DACE	*Rhinichthys atratulus*	2004	X	
LONGNOSE DACE	*Rhinichthys cataractae*	1991		
CREEK CHUB	*Semotilus atromaculatus*	2004	X	
BROWN BULLHEAD	*Ameiurus nebulosus*	1989		
BROOK STICKLEBACK	*Culaea inconstans*	1994		
PUMPKINSEED	*Lepomis gibbosus*	1999		
RAINBOW DARTER	*Etheostoma caeruleum*	1946		
FANTAIL DARTER	*Etheostoma flabellare*	1946		
JOHNNY DARTER	*Etheostoma nigrum*	1946		

---- orange highlighted species have not been collected in this subwatershed for 10 years or more

4.2.5 Lower Humber

The Lower Humber subwatershed contains 7 secondary subwatersheds (Figure 3). Historically, 54 species were collected in the Lower Humber with recent sampling finding only 22 species (Table 9). Similar to Black Creek, the Lower Humber flows through a fully urbanized catchment that has altered and influenced the river system for many decades. Long reaches move through areas that have been cleared of trees and hydrologically changed by weirs and dams since the mid 1800s. More intense settlement and unmitigated urbanization likely began affecting the lower reaches by the 1920s with associated stressors on the river being steady ever since. Not surprisingly, the small tributaries feeding the main branch (*i.e.*, Emery Creek, Berry Creek, Humber Creek, Silver Creek and an unnamed tributary flowing from Woodbridge to Rexdale) no longer support the diversity of the past (up to 31 species were once found in the unnamed tributary). Instead, where sampling data exists, mostly tolerant cool-warmwater species remain, including white sucker, common shiner, blacknose dace and creek chub, fathead minnow and brook stickleback.

However rainbow darters have also maintained their historic distribution through the Lower Humber and, as discussed in earlier sections, up into the rest of the watershed. This is good news as rainbow darters have been extirpated in neighbouring watersheds where urban flows and general degradation of habitat and water quality likely caused the decline. In this respect, conditions in the Lower Humber are being well buffered by the relative natural and healthy state of the upper half of the watershed.

Redside dace, mottled sculpin, and a variety of shiners, as well as the habitat specialists described earlier, have not been collected for many years. This is likely a combination of physical habitat loss and urban impacts that have occurred (*i.e.*, fast, flashy flows, increased stream temperatures and turbidity) which are not tolerated by these very sensitive species.

Eventually, the Lower Humber drains into Lake Ontario where both riverine and lake-based species interact producing a highly diverse fish community that is reflected in historic collection records and still present. Many of the lake-based and/or estuarine fishes species not collected in the past 5 years can be explained by the location and timing of the RWMP sampling events. For example, sea lampreys are known to be below the Old Mill dam (the first barrier up from the lake) during the spring, and chinook salmon are present in the fall. RWMP sampling does not occur during these seasons. Since the notching of the Old Mill dam, chinook salmon make it up into the watershed during high flow but many of the lake-based, non-jumping species cannot pass this structure. It is expected that these species are present below the dam but this lowest reach is too deep for sampling methods used by the RWMP. In general, the distribution of non-jumping fish in the Lower Humber is challenged by the many weirs and dams that are impassable during summer low flow and sometimes even high spring flow conditions. However, future plans by MNR to construct a fishway at the Old Mill to pass all species may change the distribution of non-jumping fish.

Table 10: Past and Present Species List for the Lower Humber Subwatershed

Common Name	Scientific Name	Last Collected	2001	2004
AMERICAN BROOK LAMPREY	*Lampetra appendix*	1999		
SEA LAMPREY	*Petromyzon marinus*	1985		
ALEWIFE	*Alosa pseudoharengus*	1999		
GIZZARD SHAD	*Dorosoma cepedianum*	1999		
CHINOOK SALMON	*Oncorhynchus tshawytscha*	1993		
RAINBOW TROUT	*Oncorhynchus mykiss*	2004	X	X
BROWN TROUT	*Salmo trutta*	2004		X
RAINBOW SMELT	*Osmerus mordax*	1989		
NORTHERN PIKE	*Esox lucius*	1999		
WHITE SUCKER	*Catostomus commersoni*	2001	X	
NORTHERN HOG SUCKER	*Hypentelium nigricans*	2004	X	X
GOLDFISH	*Carassius auratus*	1992		
REDSIDE DACE	*Clinostomus elongatus*	1972		
CARP	*Cyprinus carpio*	2001	X	
BRASSY MINNOW	*Hybognathus hankinsoni*	1999		
HORNYHEAD CHUB	*Nocomis biguttatus*	1972		
RIVER CHUB	*Nocomis micropogon*	2004	X	X
GOLDEN SHINER	*Notemigonus crysoleucas*	2001	X	
EMERALD SHINER	*Notropis atherinoides*	1999		
COMMON SHINER	*Luxilus cornutus*	2004	X	X
BLACKCHIN SHINER	*Notropis heterodon*	1972		
BLACKNOSE SHINER	*Notropis heterolepis*	1972		
SPOTTAIL SHINER	*Notropis hudsonius*	1999		
ROSYFACE SHINER	*Notropis rubellus*	1991		
SAND SHINER	*Notropis stramineus*	1999		
BLUNTNOSE MINNOW	*Pimephales notatus*	2004	X	X
FATHEAD MINNOW	*Pimephales promelas*	2004	X	X
BLACKNOSE DACE	*Rhinichthys atratulus*	2004	X	X

Common Name	Scientific Name	Last Collected	2001	2004
LONGNOSE DACE	*Rhinichthys cataractae*	2004	X	X
CREEK CHUB	*Semotilus atromaculatus*	2004	X	X
CENTRAL STONEROLLER	*Campostoma anomalum*	2004	X	X
YELLOW BULLHEAD	*Ameiurus natalis*	1972		
BROWN BULLHEAD	*Ameiurus nebulosus*	2001	X	
STONECAT	*Noturus flavus*	2004	X	X
AMERICAN EEL	*Anguilla rostrata*	1989		
BROOK STICKLEBACK	*Culaea inconstans*	2004	X	X
THREESPINE STICKLEBACK	*Gasterosteus aculeatus*	1946		
TROUT PERCH	*Gasterosteus aculeatus*	1999		
WHITE PERCH	*Morone americana*	1994		
WHITE BASS	*Morone chrysops*	1992		
ROCK BASS	*Ambloplites rupestris*	2004	X	X
PUMPKINSEED	*Lepomis gibbosus*	2004		X
BLUEGILL	*Lepomis macrochirus*	1999		
SMALLMOUTH BASS	*Micropterus dolomieu*	1999		
LARGEMOUTH BASS	*Micropterus salmoides*	1999		
BLACK CRAPPIE	*Pomoxis nigromaculatus*	1995		
YELLOW PERCH	*Perca flavescens*	1995		
RAINBOW DARTER	*Etheostoma caeruleum*	2004	X	X
IOWA DARTER	*Etheostoma exile*	1999		
FANTAIL DARTER	*Etheostoma flabellare*	2004		X
JOHNNY DARTER	*Etheostoma nigrum*	2004	X	X
BLACKSIDE DARTER	*Percina maculata*	1999		
FRESHWATER DRUM	*Aplodinotus grunniens*	1997		
MOTTLED SCULPIN	*Cottus bairdi*	1992		

---- orange highlighted species have not been collected in this subwatershed for 10 years or more

--- yellow highlighted species are known to be present below the first dam though the Lake Environmental Monitoring Program and other programs/reportings, but are not captured through the RWMP.

4.3 Other Aquatic Communities

4.3.1 Freshwater Mussels

Freshwater mussels are not traditionally considered a fish species, but they are included under the Federal Fisheries Act (DFO, 1986). Mussels are filter feeders that feed primarily on algae and bacteria and thereby help to improve water quality. Mussels have adapted to and must rely on fish communities in order to complete their life cycle. The adult female mussel releases glochidia (larval form) into the water column which will attach firmly to the body of a host fish and live there for an average of one to six weeks before dropping off into the sediment. This process does not harm the host fish. In areas where mussels are found it is important to maintain an ecosystem condition that supports not only the mussel itself, but also host fish species. For details regarding host fish species, refer to Appendix A of this report.

Due to their slow growth, long life spans, poor dispersal, sensitivity to erosion and water pollution, and complex reproductive requirements, freshwater mussels are especially vulnerable to physical and chemical habitat alteration. Freshwater mussels are considered the most endangered organisms in North America with nearly 70% of species at risk of extinction (Metcalfe-Smith *et al*., 2004). Several freshwater mussel species are listed under the federal Species At Risk Act (SARA) and under the new provincial Endangered Species Act (ESA) with two more under review by Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the Committee on the Status of Species at Risk in Ontario (COSSARO).

The status of native mussel species and distributions are not well understood within the TRCA jurisdiction. However, the Humber River likely contains good mussel habitat based on an informal survey that readily found six mussel species across the West, Main and East Humber River subwatersheds in 2005 and 2006 (Table 10). To date, of all the other TRCA watersheds, two of those species (elktoe and fatmucket) are only known to occur within the Humber River. The status ranks have been taken from the Natural Heritage Information Centre website. With the recent enactment of the federal *Species At Risk Act*, and current listing of seven mussel species with two more expected in the spring of 2006, it is important for a management agency such as the TRCA to understand mussels in our jurisdiction.

Table 11: Mussel Species in the Humber River Watershed

Common Name	Scientific Name	Status	Drainage Basin	Number of Host Fish Species
elktoe	*Alasmidonta marginata*	S3	Lake Ontario	3 Fish Species
cylindrical floater	*Anodontoides ferussacianus*	S4	Lake Ontario	13 Fish Species
creek heelsplitter	*Lasmigona compressa*	S5	Lake Ontario	16 Fish Species
common floater	*Pyganodon grandis*	S5	Lake Ontario	32 Fish Species
creeper	*Strophitus undulatus*	S5	Lake Ontario	30 Fish Species
fat mucket	*Lampsilis siliquoidea*	S5	Lake Ontario	9 Fish Species

Sources:
Ohio State University Department of Evolution, Ecology & Organismal Biology, 2005; Clarke, 1981; and, Parmalee, P.W. and A.E. Bogan, 1998.

4.3.2 Crayfish

As with mussels, crayfish are not traditionally thought of as a fish species but are defined as such under the *Federal Fisheries Act* (DFO, 1986). The Humber contains three native aquatic crayfish species and one invasive species (see section 4.1.3). Through the TRCA Terrestrial Natural Heritage Program, the chimney crayfish (*Cambarus fodiens*) was found. Although they live primarily in terrestrial wet environments (*e.g.,* riparian wetlands), they require nearby watercourses where groundwater discharge is present. Not surprisingly, this species of crayfish are found in the Main Humber subwatershed and is another confirmation of functional groundwater-supported habitats.

4.4 Aquatic Ecosystem Health

4.4.1 Fish Index of Biotic Integrity (IBI)

As indicated previously in Section 3.1.1 there have been two RWMP aquatic system surveys (2001 and 2004) conducted at 38 fixed stations with the results for Fish IBI, Temperature Stability and Benthic Aggregate Assessment scores illustrated on Figure 4. For the purposes of comparing fish IBI, a measure of fish health, only the RWMP data sets were used; data collected for special projects (*i.e.,* FMP sites) were not included in the comparison as they occurred in different habitat types and will not likely be repeated in future years. There are 2 additional sampling events in 2004 as HU009WM and HU022WM were sampled twice, however only one set of data per station was used in the evaluation.

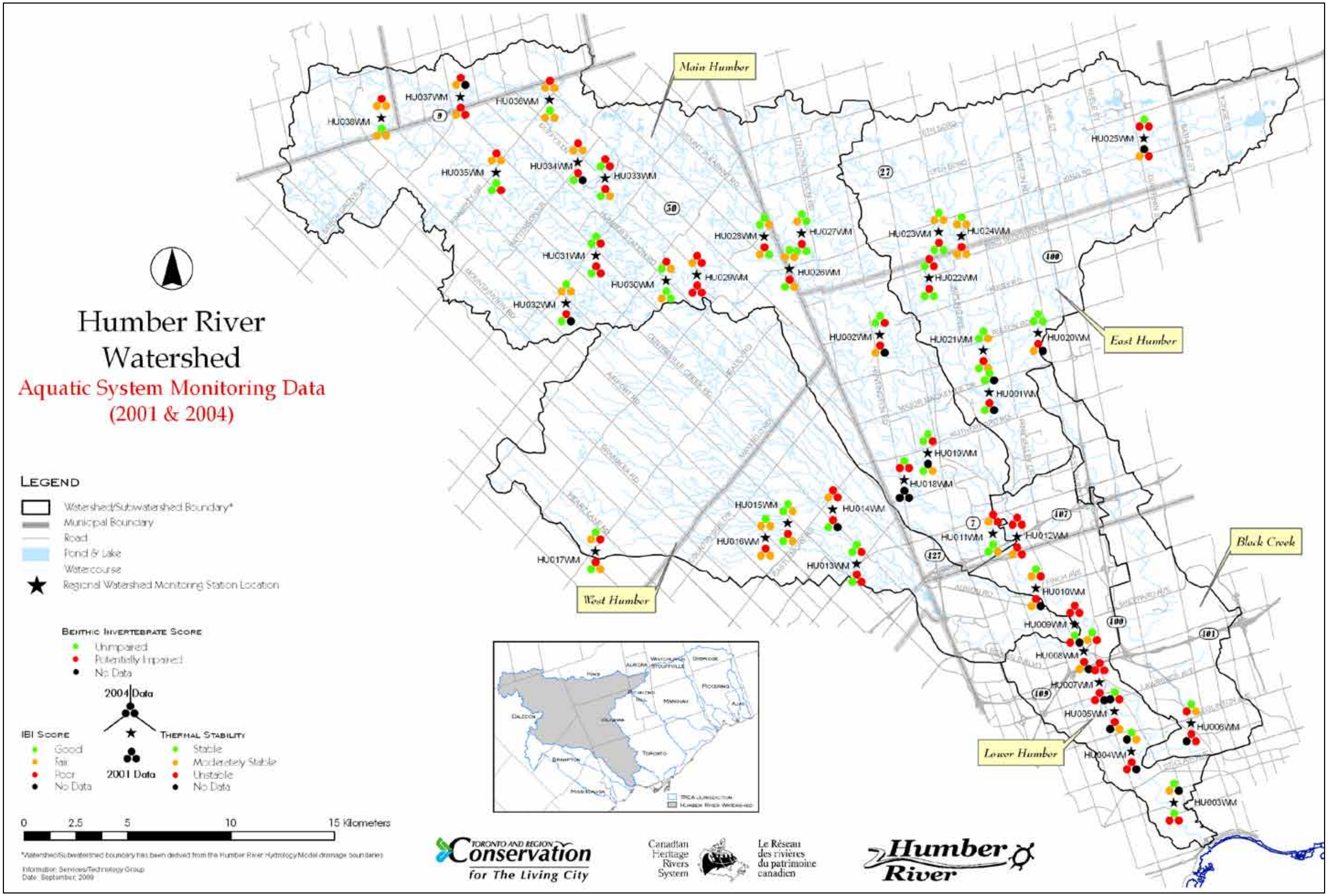
4.4.2 Fish IBI Results

Using Steedman (1987), the calculated IBI scores for the 2001 survey event indicate that almost half (42%) of the stations fall within the "good" range of overall health and are located not in the true headwaters but through a wide swath across the middle to upper reaches intersecting the Main Humber, West Humber (where streams had continuous flow) and East Humber subwatersheds (Figure 4). Most of these high quality stations are located in the Main Humber followed equally by the East and West Humber (Table 11). It should be noted that the Main Humber is geographically the largest subwatershed and by default contains the greatest number of RWMP stations and thus, there is a bias towards finding more of any IBI category in this subwatershed.

The contrasting point is that Black Creek has only one RWMP station to represent overall subwatershed health in any given year. Although not expected to score very high, a variety of factors could skew the sampling results of this one station if occurring temporally close to the survey (*e.g.,* heavy rain event or chemical spill). With these considerations in mind, a reasonable interpretation of results is that a gradient of 'good' to 'poor' health was measured across the entire Humber River watershed starting from the permanently flowing, upper and middle reaches and declining in health down through to the lowest reaches. The median IBI score for the entire watershed in 2001 was 27, falling within the "fair" stream quality rating.

By comparison, the calculated IBI scores for the 2004 survey event indicate that fewer stations (33%) achieved a "good" range of overall quality but still followed a similar gradient of health as 2001. The median IBI score for the 2004 sampling event was 25, again falling with the "fair" stream quality rating. The shifts away from a 'good' score down to 'fair' occurred in the Main Humber and the West Humber.

Figure 4: Aquatic System Monitoring Results from RWMP (2001 and 2004)



The Main Humber shifted from 44% of stations scoring ‘good’ in 2001 to only 33% in 2004. The stations that shifted from ‘good’ to ‘fair’ were not all in the same spatial area. Three headwater stations changed (HU034WM, 35 and 32) then two middle reach stations in close proximity to each other (HU026WM and 27), then one station in Rainbow Creek (HU019WM) and the most downstream station which reflects the cumulative condition of the subwatershed (HU011WM). It is difficult to apply a singular casual factor for the changes, but HU032WM is influenced by Town of Caledon and HU019WM is downstream of Bolton which may indicate local urban impacts at these sites, but can not account for other measured changes. Larger considerations are those of climate and the natural variability of fish communities in response to weather driven conditions (e.g., duration of wet seasons, air temperatures, etc.).

The West Humber subwatershed shifted from 80% of stations scoring ‘good’ in 2001 to only 40% in 2004; however that is a reflection of only 2 stations changing from ‘good’ to ‘fair’. The sites were not close together and, surprisingly, HU019WM measured only ‘fair’ even though this is in the cold water stream, not influenced by development and would be expected to have more stable conditions. The other station is within the direct influence of the City of Brampton (HU014WM) where urban impacts are possible.

The Lower Humber, Black Creek and the East Humber subwatersheds remained relatively unchanged in their overall scoring between 2001 and 2004.

Table 12: Fish IBI Stream Quality Ratings at RWMP Humber Stations, 2001 and 2004

Subwatershed	# of Stations Sampled	2001					2004				
		Poor	Fair	Good	Very Good	No Fish	Poor	Fair	Good	Very Good	No Fish
Black Creek	1	0	0	0	0	1	1	0	0	0	0
East Humber	7(8)*	0	3	4	0	0	1	2	5	0	0
West Humber	5	0	1	4	0	0	0	3	2	0	0
Main Humber	18	1	8	8	0	1	1	11	6	0	0
Lower Humber	7(8)*	4	2	0	0	1	4	2	0	0	2
TOTAL	38 (40)*	**5**	**14**	**16**	**0**	**3**	**7**	**18**	**13**	**0**	**2**
IBI Percentage		**13%**	**37%**	**42%**	**0**	**8%**	**18%**	**45%**	**33%**	**0**	**5%**

* sampling of some RWMP stations were done twice in 2004

To better understand the system’s integrity at the subwatershed scale, there is a step in the calculation of IBI that compares the expected number of native species at a station to the actual number of native species captured at the same station. The expected number is based on the premise that the number of species increases with drainage area due to increased habitat diversity, nutrients, food and other factors (Karr, 1981). Using RWMP stations with the largest drainage areas for each subwatershed, the expected level of native species diversity versus the actual number of native species collected in 2001and 2004 are presented in Table 13. These stations represent the cumulative condition of the entire catchment as well as where the greatest number of species would be expected to occur. It is important to recognize that within a subwatershed, there can be reaches that are definitively healthy. However, overall, there maybe impacts to the larger system that, when added together, exert greater influence on the health of furthest downstream reach.

Table 13: Maximum Number of Species Expected vs. Maximum Number of Species Captured in Humber River Subwatersheds

Subwatershed	Station # with Largest Catchment Area	Expected # Native Species	2001 Captured # of Native Species	2004 Captured # of Native Species
Black Creek	HU006WM	14	0	3
East Humber	HU022WM	17	14	13
West Humber	HU013WM	17	12	14
Main Humber*	HU002WM	20	15	16
Lower Humber	HU003WM	24	14	12
Rainbow Creek	HU011WM	13	12	9
Purpleville Creek	HU001WM	12	9	16

* Station HU002WM was selected for this analysis which is positioned about 1/3 of the way up the Main Humber subwatershed. This station was considered more representative of true conditions than the station at the bottom of the catchment (HU012WM) which is influenced by Hwy 407 and captures drainage from the East Humber)

The maximum expected number of native species within the Humber watershed ranged from 12 to 24, while the actual maximum number of native species found in 2001 only ranged from 0 to 15. The difference between the expected and actual number of native species was highest at stations in, Black Creek, Lower Humber, West Humber, Main Humber and East Humber respectively. The East Humber appeared to be the healthiest subwatershed in terms of species diversity, with both the upper Main Humber and the West Humber also having relatively good scores.

The actual maximum number of native species found in 2004 ranged from 3 to16, very similar to the 2001 results. The *difference* between the expected and actual number of native species was highest at stations in the Lower Humber, Black Creek, East Humber, Main Humber and West Humber respectively. Thus, the West Humber subwatershed appears to be the healthiest subwatershed in terms of the species diversity in 2004, followed closely by the East Humber and Main Humber.

The smaller subcatchments of Purpleville Creek (East Humber) and Rainbow Creek (Main Humber) were evaluated separately as they are quite distinct systems both functionally and geographically. Species diversity in 2001 was close to the expected number for both systems which are still relatively undeveloped. A similar condition was observed in 2004 for Rainbow Creek but more species diversity was observed in Purpleville Creek than was predicted for the catchment area.

Closer examination of the species list in 2004 indicates the full range of thermal and trophic guilds are present (*e.g.,* mottled sculpin, American brook lamprey, brown trout, rainbow trout, redside dace, common shiner, longnose dace and pumpkinseed) as well as both benthic and water column species. There is cold water flowing down from the upper reaches of Purpleville Creek where brook trout are found. As the influence of groundwater lessens further downstream, cool water fishes species (e.g. redside dace) are collected in the middle reaches. It is suggested that the bottom reach of Purpleville Creek is a transition zone between fish communities in the East Humber that are either warm water or migratory (*i.e.*, rainbow trout). The high productivity makes sense when one is aware of the diverse habitat and natural state of the surrounding land.

4.4.3 Benthic Aggregate Assessment

Benthic Aggregate Assessment (BAA) scores for the Humber were calculated from data collected at the 38 RWMP stations sampled in 2001 and 2004 (Figure 4). For purposes of characterizing current conditions, the data from 2004 was used. A simple correspondence analysis was used to check if there was any difference between community composition in 2001 and 2004.

The decision rule for determining the relative health of the site uses Barbour *et* al. (1999) as a basis for evaluation. If five (5) or more of the indices have values falling outside the expected limits for an unimpaired community, the site was considered 'potentially impaired' (Jacques Whitford Environment Limited, 2001). Otherwise, the site was considered 'unimpaired'.

The BAA is a relatively high level interpretation of benthic community response with organisms evaluated at the taxonomic level of family and not species. However, some insect families, such as chironomids (non-biting midges), display a wide range of tolerance for pollution that can only be appreciated if the species are known. The potential issue of not having this level of data is a stream could be less impacted than BAA scores might suggest (Golder Associates, 2002). The RWMP identified benthic invertebrates down to species during sampling in 2001 and 2004. From this dataset, a list of 'good indicator species' relatively sensitive to pollution, was generated from the TRCA benthic invertebrate bio-indicator database and compared to stations with 'potentially impacted' scores to better understand the gradient of conditions within the Humber watershed.

4.4.4 Benthic Aggregate Assessment Results

Watershed Condition

The BAA results for the Humber in 2004 demonstrated that nearly two thirds of sites were potentially impaired (Figure 4). However, only 3 stations displayed extensive impact (*i.e.,* 8 or more indices had values that fell outside the 'unimpaired' criteria) and included: King Creek (HU023WM), Black Creek (HU006WM) and the Lower Humber (HU008WM). This is where considering the species present may help discern gradients of relative health at the subwatershed scale and is discussed below. It is important to note that these more sensitive species do not make-up the dominant organisms in the broader community.

There is no obvious pattern of 'unimpaired' sites as all the subwatersheds measure these good conditions at varying locations (*e.g.*, not all are headwater streams or just within rural areas). The spatial distribution of both high quality and impacted sites amongst subwatersheds is also discussed below as a means of identifying likely or dominant factors influencing the benthic community (*e.g.,* land use or 'natural' habitat conditions).

Main Humber

In the Main Humber, BAA scores indicated unimpaired conditions at 62% (or 11/18) of its stations in 2004. These healthy conditions were found largely in the upper reaches of the subwatershed where rural land uses are dominant. Of those sites assessed as 'potentially impaired' (39% or 7/18) most were in lower reaches or near urban areas. Within this 'potentially impaired' subset, HU002WM, HU026WM and HU027WM are clustered together in the middle reaches. These are also the only stations where species indicative of good habitat and water quality samples were collected. Site conditions are summarized as follows:

- All three sites supported the midge *Parakiefferiella sp.* which requires cold temperatures and moderate to high dissolved oxygen.
- The mayfly *Baetis sp.*, having varying needs including cold, clear water, was common to both HU002WM and HU027WM in addition to the beetle *Optioservus sp.* which requires cool temperature and moderate dissolved oxygen levels.
- The beetle *Stenelmis crenata*, requiring cool temperatures and high dissolved oxygen, was found at HU002WM and HU026WM.
- A good habitat quality midge Paratendipes *sp.*, typically associated with warmer water habitats with moderate dissolved oxygen, was found at HU026WM and HU027WM.
- HU027WM was one of only 5 sites in the entire watershed, where 2 or more stonefly species were found. The stonefly *Leuctra sp.* is known to require cool water and moderate to high dissolved oxygen.

East Humber

In the East Humber, BAA scores indicated potentially impaired conditions at 86% (or 6/7)of the stations. Only HU022WM was rated as 'unimpaired', which is located downstream of King-Vaughan Road on the western, middle reach of the subwatershed. However, there are species present at some of the 'potentially impaired' stations that are indicative of good water and habitat. Of particular note were stations HU001WM which is downstream of the unimpaired station and HU021WM which is in a tributary that feeds HU001WM. Both sites supported species such as the beetle *Dubiraphia sp.* and the crayfish *Orconectes sp.* that both prefer cool temperatures and clear water as well as the adult form of *Dubiraphia sp.,* which also requires high dissolved oxygen during this life cycle phase. Stations HU023WM and HU025WM are spatially isolated from each other and from the aforementioned stations but each supported the same sensitive benthic species.

West Humber

In the West Humber, BAA scores indicated potentially impaired conditions at 60% (or 3/5) of its stations. The three potentially impaired stations, HU015WM, HU016WM and HI013WM, are clustered together with the first 2 sites occupying the same lateral position (on different tributaries) and feed the large reach where HU013WM is measured. At all three sites, numerous good water and habitat quality species were collected, including the caddisfly, *Cheumatopsyche sp.*, a lower mesotrophic species (occupies habitat with fairly low nutrient concentrations where availability of dissolved oxygen is not an issue) and the presence of the midge, *Thienemannimyia group*, which requires cool, clear water with high dissolved oxygen. Also found were the aforementioned beetle *Dubiraphia sp*. and midge *Paratanytarsus sp.*

Lower Humber

In the Lower Humber, BAA scores indicated that 71% of the stations (5/7) were potentially impaired. Of these 5 stations only 2 (HU008WM and HU010WM) supported relatively sensitive species. Only two of these species are the same as found in the East and West Humber (*Cheumatopsyche sp.* and *Thienemannimyia* genus). HU010WM, located in the upper reaches of this subwatershed and downstream of 2 unimpaired sites (Finch Avenue), had four other notable species, though not as reflective of high quality habitat as others discussed. These relatively sensitive species included the caddisfly *Hydropsyche bronta* and mayfly *Isonychia sp.*

which both require cool water with moderate to high dissolved oxygen. Also found was the cranefly *Antocha sp*, a species found in cold streams with typically high dissolved oxygen as well as the beetle *Stenelmis sp.*, which also requires high dissolved oxygen levels but only warm-cool temperatures**.**

Black Creek

Black Creek subwatershed only has one monitoring station was considered impaired state with no species considered as indictors of higher quality stream health.

Additional Spatial Patterns

A subset of stations occurs on the undeveloped portion of the Oak Ridges Moraine (ORM) within the upper Main Humber and East Humber subwatersheds. Generally, stations within this type of setting are expected to score 'unimpaired', however BAA results indicate 3 stations on the ORM are 'potentially impaired' (HU025WM, HU031WM and HU032WM).

Station HU025WM is situated in the Upper Branch of the East Humber, 5 kilometres downstream of Lake Wilcox where the stream is characterized by slow moving water and deep runs. In terms of species, this site was found to have a relatively low proportion of sensitive mayflies (*Ephemeroptera sp*.) caddisflies (*Plecoptera sp.*) and Stoneflies (*Trichoptera sp.*) that make of the %EPT index. If a sample contains 10% or greater EPT, the site is considered very healthy. Station HU025WM only had 2% EPT. This is most likely a function of the low percent riffle habitat (9%) that EPT species prefer and thus are not expected to occupy run dominated streams.

Stations HU031WM and HU032WM are located in Centreville Creek subwatershed (subwatershed 3 on Figure 3), downstream of the village of Caledon East, which was developed prior to requirements for stormwater treatment. In contrast with other comparable ORM sites (*i.e.,* size, stream substrate) including HU034WM, HU036WM, and HU037WM, station HU031WM was found to have a relatively high proportion of aquatic worms (86%). Their dominance may be a response to thermal stress, as this was the only significant habitat difference between HU031WM and the other cold water ORM stations. At HU031WM, classified as cold water habitat in the *Humber River Fisheries Management Plan* (OMNR & TRCA, 2005), there was a higher average summer maximum water temperature of 20.4° C and an unstable thermal stability rating (as per OSAP). A relatively low proportion of EPT taxa (<1%) further indicates a stressed condition. Detailed site conditions for substrate and flow conditions may reveal other reasons for such a high presence of aquatic worms at station HU031WM (e.g., soft sediment and/or slow, sluggish flow).

Further examination of the benthic community composition suggests that site HU032WM may have experienced fairly recent and possibly regular impacts. A shift in community composition from only 3% worms in 2001 increased to 37% in 2004. A high proportion of tolerant midges were also observed (42% in 2001 and 50% in 2004). Both taxa have life characteristics yielding relatively fast population growth rates and can take advantage of rapidly changing or unstable habitat conditions. This site was found to have relatively fewer and lower abundance of "permanent" benthic taxa (*i.e.,* non-insects), another line of evidence suggesting that stream conditions are dynamic (*e.g.,* altered stream flow and/or sediment transport regimes).

Another notable spatial pattern in the BAA results is the clustering of very healthy, 'unimpaired' stations HU009WM, HU011WM, and HU012WM (Figure 4). This pattern is unexpected given the sites proximity or direct positioning in more developed regions of the watershed (Sheppard Avenue and Weston Road – first site; Highway 7 and Kipling Avenue – latter 2 sites) and the predominance of nearby sites assessed as ‘potentially impaired’. The reason for the ‘unimpaired’ scores appears to be related to habitat differences. In comparison with sites of similar stream order and land use, these 3 sites have relatively higher percent in-stream cover and predominately gravel substrate. This particularly contrasts with sites situated in more upstream reaches. In addition, HU009WM and HU012WM have relatively lower percent pool habitat compared to riffles; the latter habitat type is associated with very sensitive benthic species. Station HU011WM, located on Rainbow Creek was historically classified as a cold water reach and seems to have maintained the sensitive benthic species despite a more unstable thermal regime at present.

Changes Over Time
A simple correlation analysis between 2001 and 2004 benthic invertebrate data showed no significant difference in benthic community structure between the two years at the watershed level. Such an analysis is necessarily coarse with only 2 years of data and does not evaluate within subwatersheds. However, this preliminary consideration sets the stage for our understanding of how the Humber may respond to future land use changes and how to improve protective management strategies.

5.0 EXISTING CONDITIONS – FACTORS AFFECTING AQUATIC HABITAT

Metrics that influence, to varying degrees, in-stream habitat conditions for fish and other aquatic communities include:

- Groundwater inputs;
- Baseflow and total stream flow;
- Stream temperature;
- Water quality
- Riparian vegetation;
- In-stream barriers.

The strength of these influences change across the landscape from source to mouth (*e.g.,* small tributaries are characterized by groundwater inputs that can drive stream temperature regimes and are more affected by catchment attributes). However, as identified at the start of this report, it is total flow that is generally considered the overall driver of the aquatic system, making mitigation of stormwater a key factor in protecting stream form and function. Stream temperature and water quality are important factors that can directly affect fish health but impacts to these metrics are often linked to stormwater and the associated urbanization.

Other metrics considered in the section are more linear measurements of available habitat or fragmentation across the watershed (*e.g.,* riparian zone vegetation coverage or location of in-stream barriers). Angling pressure and baitfish harvesting can impact fish communities if the frequency or intensity of these human activities are not sustainable. For these reasons, angling and harvesting will also be discussed, though they are not specifically a measure of stream health.

The aspects of groundwater, baseflow and total flow that pertain most directly to fish presence and distribution in the Humber River were woven into the discussions of fish community at the watershed and subwatershed scales (Sections 4.0, 4.1 and 4.2). The two technical background reports *Humber River State of the Watershed Reports – Geology and Groundwater Resources* (TRCA, 2008a) and *Surface Water Quantity* (TRCA, 2008c) provide details on these metrics.

5.1 Stream Temperature Regime and Stability

Water temperature plays an important role in the location of aquatic communities. On-line ponds, water-taking, decreased infiltration, increased surface runoff or the removal of streamside vegetation, roadway runoff, and climate change are ways the thermal regime of a watercourse can be altered. By understanding the variations in stream temperature, an assessment of the suitability of a stream to support a cold, cool or warm water aquatic community can be made.

The *Humber River Fisheries Management Plan* (FMP) (OMNR & TRCA, 2005) classified streams into thermal habitat types based mainly on fish presence, some field investigations and professional understanding of how aquatic systems are structured. The more recent temperature data collected by the RWMP (2001 and 2004) helps to refine the FMP direction by providing a context of thermal stability and more detailed stream temperature data.

Thermal stability refers to how often and for how long a given habitat type (*e.g.,* warm water) reaches temperatures beyond (or below) the tolerance of the appropriate fish community. For example, if a warm water stream supports a thermal fish guild with an upper temperature limit of 30°C, and the stream exceeds this temperature 3 times through the summer with an average duration of 4 days, this stream would be classified as thermally unstable relative to another stream that has sustained summer temperatures of 29°C but did not exceed the maximum value tolerated by fish. Both conditions are arguably stressful, but fish have adapted over millennia to variable thermal conditions.

The concept of measuring stability is relatively new and tends to characterize streams as unstable when anthropogenic influences are pronounced (*e.g.,* groundwater taking, increases in surface runoff, vegetation loss). An unstable condition offers greater challenge for adaptation by fish unless, over the very long term, this type of thermo-dynamic becomes the norm. The results of analyzing stream temperature data for stability in the Humber River (using OSAP method) are shown in Figure 4 (2001 and 2004) and listed below in Table 14.

Table 14: Thermal Stability Ratings in the Humber River Watershed (2001 and 2004)

SUBWATERSHED	2001				2004			
	Unstable	Moderately Stable	Stable	No Data	Unstable	Moderately Stable	Stable	No Data
MAIN HUMBER	5	6	2	5	4	8	1	5
WEST HUMBER	1	3	0	1	3	2	0	0
EAST HUMBER	1	2	2	2	1	3	0	3
LOWER HUMBER	1	1	0	5	3	1	0	3
BLACK CREEK	1	0	0	0	0	1	0	0

Given the large tracts of natural landscape in the Main Humber subwatershed, it is not surprising that temperatures at the majority of 2001 and 2004 stations in this subwatershed were moderately stable or stable (62% and 79% respectively; stations without data not included). All these stations occur in the upper half of the Main Humber where cold water reaches have been identified in the FMP. Station HU027WM is the only station to show stable results in both 2001 and 2004. This station is located within known brook trout habitat flowing through a large forest tract and rural land uses in the upstream catchment. Cold water streams are assumed to be mostly groundwater fed that effectively maintains a consistent discharge temperature.

The East Humber was the only other subwatershed to have thermally stable conditions in 2002. Stations HU022WM and HU023WM are located close together, in cool water habitat, just downstream of Nobleton within a long tract of natural landscape. In 2004, HU022WM did not have any temperature data collected and HU023WM shifted down to moderately stable, but numbers were close to the threshold between stable and moderately stable indicating a large temperature shift did not occur. Overall, the East Humber does not appear to have temperature concerns, as the only consistently unstable station occurs downstream of the community of Oak Ridges, in Richmond Hill (HU0025WM) and receives warm surface water discharge from Lake Wilcox.

Causes for no temperature data being collected are often one of the following and not unique to RWMP sampling surveys: loggers being swept away or moved by heavy storm events, vandalism or theft, unexpected low flow conditions (loggers measure air temperature). Unexpected low flow conditions can be associated with climate (*e.g.*, dry year) but water taking activity can result in unnaturally low flows or compound dry year conditions. Station HU001WM in the lower East Humber may be influenced in this capacity as no data were collected in 2001 or 2004 and there is known water taking that, at times, caused a 25% reduction or more in baseflow (TRCA, 2008c).

The middle to upper tributaries of the West Humber are generally warm and known to run seasonally dry. It is for this reason that RWMP stations are all located in the bottom reaches. The upstream variability may account for the more often thermally unstable conditions determined for this subwatershed. The only station that does not fit this characterization is HU017WM, located within a permanently flowing cold water stream that supports brook trout. This reach was rated as moderately stable in 2001 and unstable in 2004. However, it is also subject to high water taking activity (TRCA, 2008c) and is lacking natural riparian vegetation to shade the stream from solar warming (see Figure 5).

None of the stable stations across the middle to upper reaches are located downstream of on-line ponds, thus the reaches are not subject to enhanced or acute solar warming. These results reinforce the understanding that canopy cover, groundwater contributions and stream morphology are important aspects of the aquatic system and maintenance of habitat and function.

The Lower Humber and Black Creek are more difficult to characterize due to the limited data collected. Most stations in the Lower Humber have no data for both sampling years, likely due to loggers being lost during large storm events. As with the other metrics (fish and benthic invertebrates) the results from the single station in Black Creek only reflects the cumulative effects on stream temperature which are assumed to be numerous and related to heavy urbanization causing warm, unstable thermal conditions with maximum stream summer temperature of 26°C in 2004.

5.2 Water Quality

The concentrations of suspended sediment, chloride, nutrients, organics and heavy metals can all impact aquatic communities if they are present in the stream above given tolerance thresholds. Acute versus long-term exposure to contaminants must also be considered when determining effects on aquatic life. Full details of the analysis of water quality in the Humber River, including fish consumption advisories, can be found in the *Humber River State of the Watershed - Surface Water Quality* (TRCA, 2008b).

From the above cited report, the following parameters were identified as present in the Humber River at levels of concern for aquatic biota during the period of 2002 to 2004 covering a range of climatic conditions and predominately dry weather sampling: total suspended solids, chloride, total phosphorus, polychlorinated biphenols and some heavy metals (copper, iron,). These compounds are measured at 10 water quality sampling stations and indicate that contaminants do not occur evenly across the watershed. Two areas of the Humber that are not represented by the sampling are the Upper Branch of the East Humber and Purpleville Creek.

5.2.1 Total Suspended Solids

There are limitations to the utility of total suspended solids (TSS) data collected through the RWMP for interpreting aquatic system monitoring data as wet weather flow conditions are typically not captured. Thus, the results do not reflect the elevated in-stream concentrations experienced during heavy rain events when road surfaces are washed clean and overland flow picks up soil. The ensuing discussion is delivered within this context.

The water quality guideline for TSS under dry weather flow is based on detrimental affects to fish (mainly respiratory stress) and fish habitat (alteration of suitable spawning substrates) and is set at a maximum increase of 25 mg/L from background levels and a threshold value of 30 mg/L (CCME, 2006), which is useful when background levels are not known. Severity of impacts to fish health by TSS laden storm flows depend on the species, frequency and duration of exposure and ability to find habitat refugia (*e.g.,* deep pools). Settlement of TSS is of significant concern for egg survivorship of species that build nests and require clean substrate such as brook trout, chinook salmon and common shiner, all present in the Humber. The loss of eggs and larval fish by siltation (smothering) can similarly impact benthic invertebrate communities.

Concentrations of TSS observed during dry weather flow conditions in the Main Humber, East Humber, Black Creek and Lower Humber are of limited concern to fish (exception is the West Humber). Overall concentrations appear to be on a declining trend, as measured at the furthest downstream station located at Old Mill where 77% of samples met threshold values.

Only 48% of TSS samples collected in the West Humber were below threshold values during dry weather flow. However, this subwatershed is characterized by fine-textured clay soils and naturally produces turbid conditions under high flows (maximum value of 613 mg/L observed during storm events in 2003/2004). Behavioural effects on fish due to high, acute turbidity include impaired movement, migration and feeding but are considered reversible once water clarity returns to background conditions (CCME, 2006). Interestingly, the fish species occupying West Humber reaches still include those sensitive to highly turbid conditions (*i.e.*, redside dace and rainbow darter) suggesting the levels being measured are within the range to which sensitive fish have adapted or can recover from.

5.2.2 Chloride

For riverine species, the acute flush of de-icing salt laden snow melt water may not be as great a concern as more prolonged exposure given the latter condition can reduce dissolved oxygen concentrations, interrupt nutrient cycling and increase release of toxic metals from stream bed sediment (Wegner and Yaggi, 2001). More frequent melting events, associated with predicted climate change effects, may increase the health risk to riverine fish. Fish occupying on-line pond habitat may be at greater risk with denser, salty-water occupying bottom waters which are used by fish as winter or summer refugia. Salt water also causes resuspension of fine particulate matter (CCME, 2006) adding further stress to resident pond fish.

In-stream chloride concentrations are generally increasing across the Humber watershed, especially in urban areas (TRCA, 2008b). The increasing trend is most likely linked to the proliferation of roads across the watershed and use of de-icing salts during winter months.

Highest exceedances observed during dry weather flows are most common in the lowermost reaches of the West Humber. As urbanization continues, chloride concentrations are expected to rise.

5.2.3 Phosphorus

Phosphorus is a nutrient. Sources can include decomposition of plant matter, animal droppings, runoff from lands where fertilizers are applied and sewage treatment plant (STP) effluents. In itself, this chemical is not toxic to fish, however build up in slow moving streams or pond habitat can lead to a proliferation of algae and aquatic plant growth. As this vegetation dies back, bacteria and other organisms help the plant matter decay, using up oxygen in the process. This can subsequently lead to anoxic conditions (low oxygen). The stress to fish is exacerbated during winter months as refuge areas are often the bottom waters of ponds or deep pools. These areas can become completed depleted of oxygen when ice forms causing fish kills.

This parameter is in exceedance of OMOE Provincial Water Quality Objectives (PWQO) of 0.03 ug/L in streams during dry weather flows across most of the Humber watershed (TRCA, 2008b). Given the sources of phosphorus, significant ones being agricultural land runoff and septic/sanitary sewage overflow into storm sewers , it make sense that samples taken at Cold Creek and Albion Hills (natural landscape areas in the headwaters of the Main Humber) measured the lowest total phosphorous (TP) concentrations with more than half the samples being below guidelines. At the current time, TP levels below the Kleinburg sewage treatment plant are not a concern, however expansion of the plant is planned.

5.2.4 Un-ionized Ammonia and Nitrates

Un-ionzied ammonia, which can be very toxic to fish, is a compound that forms when nitrates are chemically reduced. Nitrates can also be prevalent in STP discharge. Fortunately, this parameter is not a concern in the Humber as dilution capacity of receiving waters is high and dissolved oxygen levels are also high enough to prevent the conditions that cause the production of un-ionized ammonia.

5.2.5 Polychlorinated Biphenols

Polychlorinated biphenols (PCBs) are a group of synthetic organic chemicals with no natural sources. Acute and chronic exposure of fish to PCBs in laboratory tests have resulted in various degrees of liver damage as well as impaired developmental, immunological and endocrine functions (U.S. EPA, 1999). This class of environmental contaminants is known to reduce hatching success and larval survival in most fish. A study involving rainbow trout shows a possible depression of estradiol levels, which could inhibit spawning (Matta *et al*., 1987).

PCB levels in the Humber were elevated during 2000 and 2001 although there is no specific spatial trend (TRCA, 2006j). These types of compounds are very persistent in the aquatic environment and will be detectable for many years, even if no further releases were to occur.

5.2.6 Copper

As reported by Johnson *et al.* (2007), excess copper impairs function of gills, gut and sensory pathways in freshwater fish. The report highlights interruptions to critical behavior (*e.g.*, predator avoidance and feeding) and exposure of larval fish (most vulnerable stage) to elevated copper as key causes of population declines. Copper concentrations between 50 and 100 ug/L were reported to be lethal to zebrafish embryos.

Copper concentrations were fairly high in the past but are declining in the Humber with the majority of samples meeting the PWQO guideline (TRCA, 2008b). The highest levels of copper were found in the Lower Humber and Black Creek.

5.2.7 Iron

Iron is known to precipitate on the gills of fish and on fish eggs which most likely interferes with oxygen uptake however, there are few studies that quantify iron-induced gill damage (Peuranen *et al.*, 1994). There were elevated levels of this metal at all water quality sampling stations, with the Main Humber (Cold Creek) and the West Humber (Highway 7) having the most number of samples to exceed PWQO guidelines (TRCA, 2008b). While sources of iron can be from urban uses, the soils of the Humber watershed are naturally rich in iron which can explain the presence of high concentrations in both natural and urban areas. The aquatic community would have adapted, to an extent, to these iron-rich background levels.

5.2.8 Fish Consumption

Currently, there are fish consumption advisories in the Humber River watershed in the 2005 - 2006 Guide to Eating Ontario Sport Fish (OMOE, 2005) which are based on 2004 data. There are no significant changes from previous years. Please refer to the *Humber River State of the Watershed Report – Surface Water Quality* (TRCA, 2008b) for specific details.

5.3 Riparian Natural Cover

Based on the GIS mapping method described in section 3.7, the total potential riparian area in the Humber River watershed is estimated to be 12167 hectares (Table 14). For the purposes of this assessment, riparian natural cover is defined as either forest, meadow, successional (shrubland or immature forest), wetland or beach/bluff vegetation types. In 2002, approximately 61% of riparian areas in the watershed had natural vegetation cover. This leaves 4764 hectares or 39% of the total riparian area lacking natural cover. Figure 5 illustrates Humber River areas that lack riparian natural cover. It should be noted these areas may still have riparian cover (*e.g*., crops, pasture, landscaped yards or parkland), but not natural vegetation communities. Considering that Environment Canada (2004) recommends that 75% of riparian areas should have natural vegetation cover, efforts towards restoring natural riparian vegetation and wetlands are still needed in the Humber watershed. To fully achieve the Environment Canada target, restoration of natural vegetation on an additional 1703 hectares of riparian area is required.

When riparian natural cover estimates are examined at subwatershed scales (see Appendix B for summary tables), portions of the watershed where riparian tree and shrub planting and wetland restoration efforts should be focused become clearer. At the primary subwatershed scale, the West Humber has the greatest portion of riparian areas that lack natural cover (59%), followed by Black Creek (45%). However, few large scale opportunities to restore riparian natural cover remain in the fully urbanized Black Creek subwatershed. At the secondary subwatershed scale (Appendix B), the following subwatersheds were estimated to have greater than 40% of their riparian areas lacking natural cover, with significant opportunities remaining for restoration plantings (*i.e.*, not fully urbanized):

- West Humber – Main Branch (subwatershed 8);
- Rainbow Creek (subwatershed 6);
- West Humber – West Branch (subwatershed 7);
- King Creek (subwatershed 13); and,
- Cold Creek (subwatershed 4).

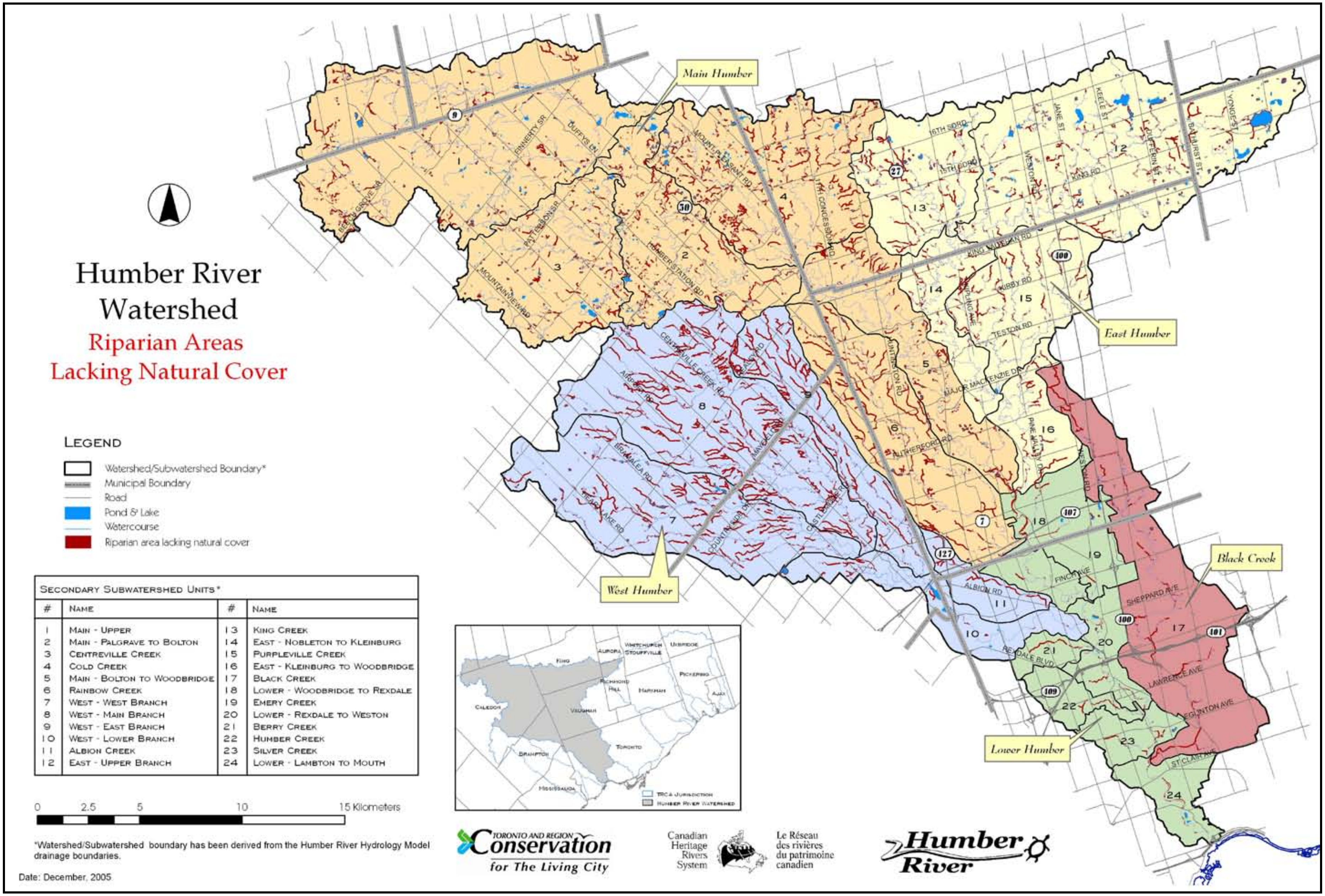
A moderately urbanized watershed was defined as having 10% to 20% impervious cover. It is estimated that percent total impervious cover (TIC) in the Humber River in 2002 was 12.6%. Within this range of watershed TIC, there is general agreement that impacts to streams are measurable. Losses of sensitive fish species are likely to have occurred when watershed TIC approaches 20% (CWP, 2003; Stanfield and Kilgour, 2005; Paul and Meyer 2001; Morely and Karr, 2002). To gain a perspective on how well the Humber watershed compares to other urban watersheds, a review of available information on natural riparian cover in other watersheds within the Great Lakes Basin was undertaken. Several of these papers provided estimates of percent treed riparian zone in the range of 40% to 50% for moderately urbanized systems. By comparison, the Humber River watershed does not quite meet this level with only 35% of riparian areas being forested.

A target for riparian wetland cover has been developed and is discussed in the following section, but no targets have been developed for the other vegetation types.

Table 15: Riparian Natural Cover in the Humber River Watershed, 2002

TOTAL HUMBER WATERSHED	**Total Riparian Area (hectares)**		**Total Riparian Area With Natural Cover (hectares)**	**Total Riparian Area Lacking Natural Cover (hectares)**
	12167		7403	4764
Percentage of Total Riparian Area	100%		61%	39%
Vegetation Type in Riparian Areas (hectares)	**Forest**	**Meadow**	**Successional**	**Wetland**
	4196	2137	278	769
Percentage of Total Riparian Natural Cover	57%	29%	4%	10%
Percentage of Total Riparian Area	35%	18%	2%	6%

Figure 5: Riparian Areas Lacking Natural Cover



5.3.1 Riparian Wetlands

The Humber River watershed has many riparian wetlands that support a relatively healthy aquatic ecosystem and fish community (769 ha or 6% of all riparian areas). The headwaters in both the Main Humber and East Humber contain most of these wetland habitats associated with small streams and kettle lakes and ponds. The cumulative benefits of small headwater streams and riparian wetlands make them critical to maintaining the health of the Humber River. Approximately 73% of the total drainage network of the Humber River is made up of these low order stream habitats, many of which have small riparian wetland pockets. Environment Canada (2004) recommends that 10% of the entire watershed should be wetland cover. Based on this, a target for riparian wetlands has been set as 10% of the total riparian area, which translates to approximately 1217 ha of riparian wetlands as a target for the Humber River. This target is not currently achieved with the present 768 ha (or 6%) of riparian wetlands. However, it is likely that the estimated quantity of wetland cover generated through aerial photo interpretation is low, as treed wetlands are typically classified as forest using this assessment method.

5.4 In-stream Barriers and Watercourse Crossings

In terms of fish habitat, in-stream barriers can cause habitat fragmentation, interrupt sediment transport and alter thermal conditions if associated with online ponding, prevent purposeful movement to avoid stressful conditions (*e.g.,* chemical spills) and preclude some species from returning to suitable habitat and spawning areas. However, barriers can also be useful to fish management by way of excluding of invasive fish species from the watershed entirely or specific ‘unaffected’ reaches. Strategic barriers can also be used as a species partition, for example, separating migratory salmonids from resident trout and/or salmon communities.

In-stream barriers common in the Humber River are old dams and low-head weirs structures originally built to run saw and grist mills and later for energy dissipation, flood control, irrigation, recreation or aesthetics (the later purposes often had impoundment ponds associated with them). Culverts that have a vertical drop at the downstream end, referred to as “perched” culverts, can also prevent or limit fish passage and are very abundant in the Humber. Watercourse crossings such as roads, railroads, driveways or trails can also restrict fish movement. There are numerous beaver dams and log jams in the Humber that can prevent fish passage but they are, for the most part, temporary and play an important role in the aquatic ecosystem.

There has not been a formal barrier survey conducted for the Humber however a total of 1201 potential in-stream barriers and watercourse crossings have been identified in the Humber Watershed using air photo interpretation (Figure 6). A relatively small number of confirmed barriers are the large dams and/or historic structures that have received investigation for other purposes (*e.g.,* structural integrity evaluation). There are also the well known series of 7 weirs, that prevent passage of some jumping and all non-jumping fish species, located through Étienne Brûlé Park in the City of Toronto, starting with the first barrier upstream of the lake, the Old Mill Dam. Table 15 lists the locations of potential and confirmed barriers by subwatershed.

Figure 6: Potential and Confirmed In-stream Barriers and Watercourse Crossings

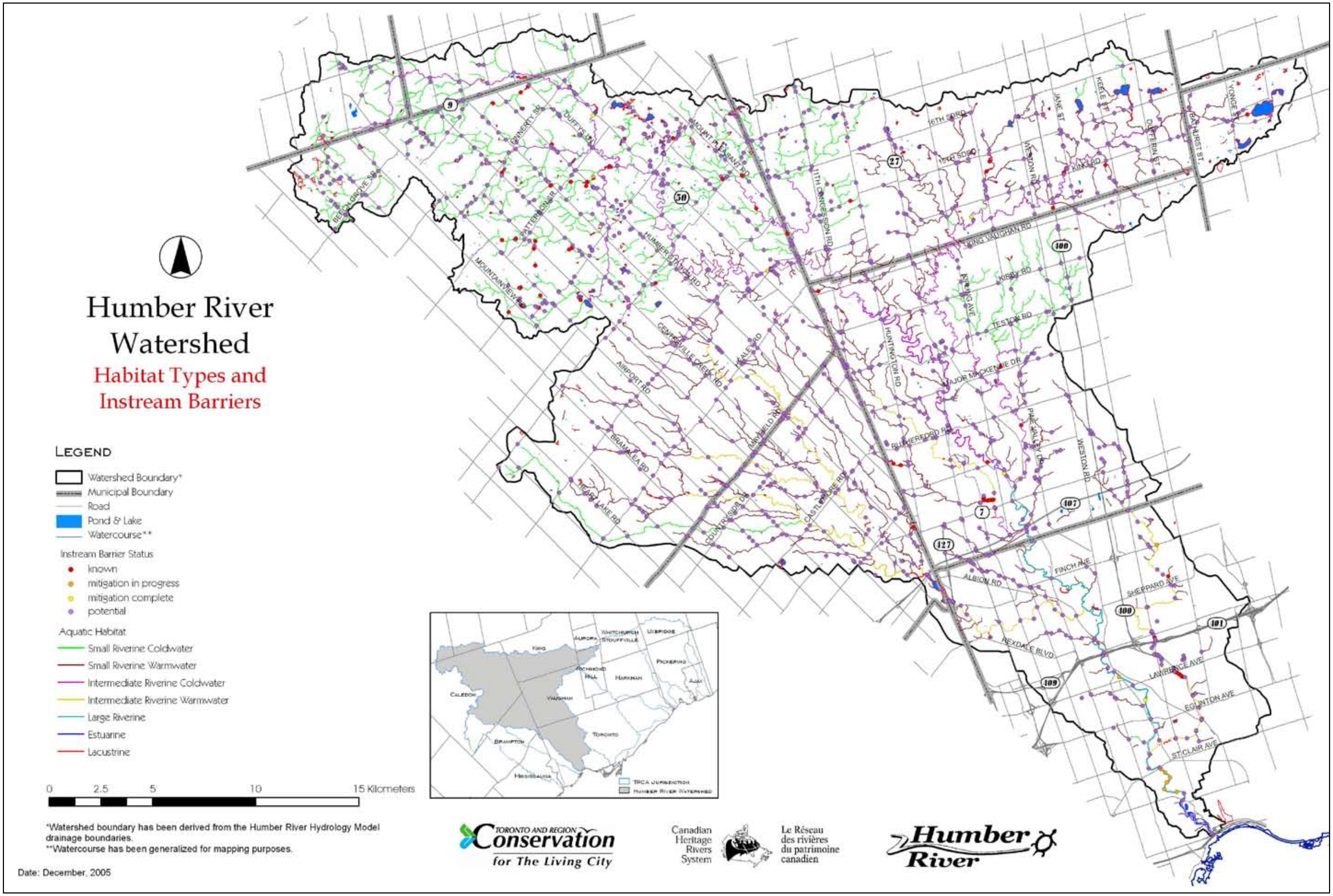


Table 16: Potential and Confirmed In-stream Barriers and Watercourse Crossings, 2004

	Main Humber	East Humber	West Humber	Black Creek	Lower Humber	Total
Potential Barriers	560	225	282	73	61	1201
Confirmed Barriers	43	8	2	13	7	73

The large majority of potential barriers are believed to be perched culverts and low-head weirs in the upper reaches of the watershed. The watercourse crossings in the lower reaches of the watershed are mostly bridges, spans or culverts that generally do not prevent fish passage. Even though the estimate of 1201 potential barriers may seem high, there are likely additional barriers or crossings in densely wooded areas or on smaller tributaries that have could not be detected through aerial photo interpretation.

Between 1998 and 2002, five dams in the Humber River have been fully mitigated and provide passage for all species of fish, while six barriers have been partially modified. These partial modifications are considered short-term solutions that improve access for species capable of jumping over obstacles, with longer term objectives being aimed at passage of all species to upstream habitats. The following barrier mitigation projects have significantly improved access for migratory species and the movement of resident species from 2000-2005:

- Denil fishway constructed at Raymore Park north of Eglinton Avenue in Toronto;
- Rocky ramp built at Doctors McLean (Fundale) Park on Islington Avenue, north of Regional Road 7 (formerly Highway 7) in Woodbridge;
- Denil fishway built at the Board of Trade Golf Course on Clarence Street, north of Regional Road 7 (formerly Highway 7) in Woodbridge;
- Notching of dam and rocky ramp built at McFall Dam north of King Road, east of Highway 50 in Bolton;
- Step-pool fishway with viewing window constructed at the Palgrave Mill Pond on Highway 50 south of Highway 9 in Palgrave and
- Six weirs notched between Highway 401 and Bloor Street in Toronto (partial and subject to further assessment for complete mitigation).

As a direct result of these barrier mitigation projects, migratory rainbow trout from Lake Ontario were found spawning in the East Humber River for the first time ever in 2000 and every year since. Additional projects are planned to further improve fish movement between Lake Ontario and the Humber River. Of particular note is the provincial Environmental Assessment underway to mitigate the lower Humber weirs (OMNR, 2007). These efforts are focused on improving access for non-jumping species in addition to “jumping" species (*e.g.,* salmonids) and improve access to spawning habitat for the maximum number of species possible. These improvements still need to be weighed against the risk of also allowing invasive species access to the Humber (*i.e.*, sea lamprey, round goby and rusty crayfish).

5.5 Human Use: Angling, Baitfish Harvesting and Recreational Viewing

Human use of the aquatic ecosystem in the Humber watershed is largely confined to two activities, consumptive and non-consumptive uses. Sport fishing and baitfish harvesting are the two largest of such uses. There are many popular angling destinations within the Humber River watershed including the Humber Marshes, the Old Mill Dam and Glen Haffy Conservation Area. The spring and fall salmonid migrations attract the most intensive angling along the lower reaches of the Humber up to Steeles Avenue Further north into the headwaters of the Humber River, cold water streams and kettle lakes provide ample angling opportunities for brown and brook trout, bass and pike. These areas provide better quality angling where fish can be eaten with few concerns about contamination (OMOE, 2005).

There is no current assessment on the level of fishing pressure sustained by the Humber River and whether there are concerns around over-fishing and its potential effects on fish community structure and abundance.

The Ontario Ministry of Natural Resources issues one annual baitfish harvest license for the Humber River watershed. The licensee is required to report total annual catch amounts. Between 2000 and 2002, the baitfish harvest averaged 575 gallons annually. It is not known where the major extraction locations are within the watershed or the specifics of the species being harvested (*i.e.,* species type, relative numbers, age classes, and biomass).

Fish viewing tends to involve trout, salmon and white sucker spawning runs in the spring and fall which provide excellent opportunity to see a lot of fish or some very large ones up close. Many people are attracted to the area below the Old Mill dam to watch these fish move upstream. Northern pike, bass and pumpkinseed all spawn in the spring to early summer and generally close to shore, providing another viewing opportunity in the Humber Marshes and Lake Wilcox.

Except for the Old Mill dam, most of the public lands have very little or no information identifying reasons why fish are there, or the types of species present. In 2001, a viewing window was installed associated with the Palgrave Mill Pond fishway (Upper Main Humber). The window allows individuals to observe the fish (*e.g.*, brook trout) as they travel through the fishway, though there is some concern that fish may be disturbed or scared by viewers.

6.0 RATINGS FOR AQUATIC ECOSYSTEM HEALTH

This section provides an evaluation of three biological indicators of stream health (fish and benthic invertebrate communities and aquatic invasive species) and four stream habitat measures (temperature, in-stream barriers, riparian wetlands and riparian natural cover). The results are presented below. Groundwater, baseflow and water quality conditions and ratings were evaluated in other State of the Watershed reports (TRCA, 2008a, TRCA 2008c and TRCA 2008b). A discussion of those ratings will not be repeated in this report. The following discussion details how the ratings were determined for each indicator.

Objective: Protect, restore and enhance the health and diversity of native aquatic habitats and communities			**C**
Indicator	**Measure**	**Target**	**Rating**
Fish community	Presence / absence of indicator species	Maintain or restore historical distribution of native target species: brook trout, redside dace and rainbow darter (as per the *Humber River FMP*).	B
	IBI scores (2004)	Achieve the highest average IBI score by subwatershed: Very Good = A- to A+ Good = B- to B+ Fair = C- to C+ Poor = D- to D+ No Fish = Fail	East Humber B- Main Humber B West Humber C Lower Humber D Black Creek D-
Benthic invertebrate community	Benthic Aggregate Assessment scores (2004)	100% of RWMP stations achieving “unimpaired’ scores using BAA and/or presence of high quality indicator species	C
Habitat	Thermal regime	Thermal regime and stability at all RWMP stations should reflect the requirements of the target species: brook trout, redside dace and rainbow darter (as per the *Humber River FMP*)	B
	In-stream barriers	Identify all barriers to native fish passage (interim target)	D
	Riparian natural cover; Riparian wetland cover;	75% of total potential riparian area has natural cover; 10% of total riparian area is wetland	C C
Invasive and exotic species	Prevention, presence and distribution of aquatic invasive species	Prevent the introduction and/or spread of aquatic invasive species	C

6.1 Presence of Indicator Species

Target: Maintain or restore historical distribution of native target species: brook trout, redside dace and rainbow darter (as per the Humber River FMP).

Watershed Rating: B

This rating is based on past distribution of target species in comparison to present RWMP data. Knowledge of in-stream barriers should also be considered, once the data becomes available.

As discussed in Sections 4.1 and 4.2 of this report, the current distribution of brook trout is essentially the same as historically recorded and thus receives a rating of “A”.

Redside dace historic distribution was far more extensive than is currently supported. Main areas of loss are the Upper Main Humber, the Upper Branch of the East Humber, the West Branch of the West Humber, the Lower Humber and Black Creek. With multiple areas in decline, a relatively low rating is reasonable, however, there are habitat restoration projects being planned for redside dace in the West Humber. A rating of “C+” is assigned to this species.

Rainbow darter still maintains the good distribution in the Humber with losses relative to historic conditions only occurring in the Upper Branch of the East Humber, Black Creek and the lowest reaches of the Lower Humber. An intermediate rating of “B” was applied to this species. Although somewhat subjective, the mid-point of these three targets produced the overall rating of “B”.

An abundance target would also be useful, however, only a limited number of past collection records are detailed enough to generate this metric.

6.2 IBI Scores

Target: Achieve the highest average IBI score by subwatershed.

Subwatershed Ratings:

- *East Humber B-*
- *Main Humber B*
- *West Humber C*
- *Lower Humber D*
- *Black Creek D-*

Overall Watershed Rating: D

This rating is based on the set of IBI scores for each RWMP station in each primary subwatershed during the 2004 sampling survey. Each score was assigned a numeric and alpha value corresponding to the standard ‘school report card’, that is:

‘Very good’ = 80 or “A”
‘Good’ = 70 or “B”
‘Fair’ = 60 or “C”
‘Poor’ = 50 or “D”
‘Fail’ = 0 or “F” (no fish)

The numeric average was tallied for each subwatershed and translated to the alpha grade (flexibility to apply either a "+ or –"qualifier was applied if average value fell between "grades"). From this calculation, the Main Humber and East Humber were determined to be the healthiest subwatersheds in 2004, which is in agreement with discussion and analysis in Section 4.4.2.

The Lower Humber subwatershed represents the cumulative condition of the entire watershed and received an average grade of "D" or "Poor". This determination is lower than the median IBI score for the watershed in 2004, which translated as "Fair". This is a "good news story" as the high number of "Fair" scores, that produced the median value, was achieved in the upper half of the watershed, reaffirming that this area is still relatively healthy.

6.3 Benthic Invertebrates

Target: 100% of RWMP stations achieving "unimpaired' scores using BAA and/or presence of high quality indicator species

Watershed Rating: C

This rating was based on the results of the benthic aggregate assessment with consideration for the presence of species indicative of good habitat and water quality. Of the 38 stations monitored in 2004, 14 (or 36%) were found to be 'unimpaired' using the BAA. Of the 24 remaining stations scoring "potentially impaired", 12 (or 32%) were found to support a relatively high number of invertebrate species indicative of good habitat and water quality conditions inferring that the sites were close to being "unimpaired". The last 12 (or 32%) stations scored "potentially impaired" and did not support the "good indicator" species. Under this species-specific approach, 68% of stations could arguably "unimpaired" giving the Humber benthic invertebrate community indicator a report grade of "C".

6.4 Thermal Regime and Stability

Target: Thermal regime and stability at all RWMP stations should reflect the requirements of the target species: brook trout, redside dace and rainbow darter (as per the Humber River FMP)

Watershed Rating: B

This rating was based on the results of the 2001 and 2004 RWMP thermal monitoring. For the most part, temperature loggers measured cold, cool and warm water conditions where they were expected in the Main, East and West Humber subwatersheds, based on underlying geology and/or natural lake influences. Areas that had less agreement with geological conditions tended to also reflect a shift away from past cold-cool water fish communities to present ones dominated by relatively warmer water species. This was particularly noted in Rainbow Creek, the bottom reach of the East Humber, the Lower Humber and Black Creek. The Lower Humber and Black creek were also measuring thermally unstable conditions assumed to be caused by urbanization. The West Branch of the West Humber also indicated thermally unstable conditions despite groundwater discharge significant enough to support brook trout. When tallying the RWMP stations in these impacted areas, 12 out of 38 do not support the target species habitat requirements or 70% do support the target species and this translates to the rating of "B"

6.5 In-stream Barriers

Target: Identify all barriers to native fish passage (interim target)

Watershed Rating: D+

The total number of in-stream barriers in the Humber Watershed has not been determined as a formal in-stream structure survey and barrier assessment has not been undertaken. Without quantification of the barrier issue, any rating applied to this measure is rather subjective and should reflect the amount of work already done relative to what the Humber River FMP outlines in its implementation project schedule. In recognition of the 6 barrier mitigations successfully completed since 2000 and that plans for a fishway at the Old Mill dam are being developed, a rating of “D+” seems reasonable.

Following a complete in-stream structure survey and barrier assessment, future ratings should be based on the actual numbers of in-stream barriers that have been mitigated in comparison to the total number of barriers that have been identified in the watershed.

6.6 Area of Riparian Natural Cover

Target: 75% of total potential riparian area contains natural cover. Watershed Rating: C

This rating is based on 2002 estimates of riparian natural cover described in Section 5.3 and the Environment Canada recommendation that 75% of riparian areas should be natural cover. The total amount of riparian natural cover in the Humber is 7403 ha, representing 61% of the total riparian area. This translates to a rating of “C” for the riparian natural cover indicator based on the following report card rating criteria:

A = Greater than 75% of potential riparian areas contain natural cover

B = 63 to 74% of potential riparian areas contain natural cover

C = 51 to 62% of potential riparian areas contain natural cover

D = 38 to 50% of potential riparian areas contain natural cover

F = Less than 38% of potential riparian areas contain natural cover

6.7 Area of Riparian Wetlands

Target: Area of riparian wetland cover is 10% of total potential riparian area.

Watershed Rating: C

This rating is based on the assessment of riparian natural cover described in Sections 5.3 and 5.3.2 and the target of 10% of riparian area as wetland. The total area of riparian wetlands in the Humber Watershed is 769 ha and the total potential riparian area in 12167 ha , meaning that only 6%of existing riparian area is wetland. This falls short of the 10% target and translates to a rating of “C”

6.8 Prevention, Presence and Distribution of Aquatic Invasive Species

Target: Prevent the introduction and/or spread of aquatic invasive species

Watershed Rating: C

This rating is more qualitative than the others as it considers the level of effort being applied to this target. The sea lamprey control structure, and associated operations, represents active management and an effective, coordinated approach. This is unique to the Humber River (with respect to other watersheds in TRCA jurisdiction). The capture of a single rudd in Lake Wilcox does not represent an establishing population. The plan to do follow-up monitoring in Lake Wilcox to determine any further concern is a positive component to preventing potential distribution. Existing RWMP efforts could detect round goby should this species move over the Old Mill dam, but there is no aquatic invasive species response program or protocol in place else the initial detection of rusty crayfish may not have led to the spreading in subsequent years. Considering the overall efforts and gaps, the watershed received a rating of “C”.

7.0 SUMMARY AND MANAGEMENT CONSIDERATIONS

The aquatic ecosystem in the Humber River is generally quite healthy, especially in the upper half of the watershed where urban land use has been limited and natural landscape conditions still support high functioning streams. The relative good health still maintained through the middle reaches of the Humber are attributed to the natural flow and sediment regimes not being heavily altered in the upper reaches. The lowest portions of the watershed have been urbanized intensely during the period before stormwater management and more protective legislation of aquatic systems were applied. Habitats in these reaches are degraded, in some areas, severely enough to limit the fish community to only tolerant fish species (*e.g.,* Black Creek and small tributaries to the Lower Humber). With the progression of urbanization in new areas (*e.g.*, Rainbow Creek and Purpleville Creek subwatersheds), it is critical that development practices be consistent with the need to maintain the ecological function of local and downstream catchment areas, in particular, managing stormwater to maintain predevelopment water balance.

The following management considerations have been identified to protect enhance or rehabilitate aquatic habitat and manage existing and future fish communities in the Humber River. Recommendations for groundwater, surface water quantity and quality appear in *Humber River State of the Watershed Report – Geology and Groundwater Resources* (TRCA, 2008a) and *Humber River State of the Watershed Report – Surface Water Quantity* (TRCA, 2008c) and *Humber River State of the Watershed – Surface Water Quality* (TRCA, 2008b), respectively. Some recommendations have been taken directly from the *Humber River Fisheries Management Plan* (OMNR & TRCA, 2005) and are denoted with an asterisk (*).

Fish: The overall fish community of the Humber reflects good biodiversity with sensitive cold and cool water species and warm water habitat specialists, particularly in the upper two thirds of the watershed. The historic distribution of 2 out of 3 target species (brook trout and rainbow darter) is still closely maintained, indicating past, healthy conditions have not altered significantly in these areas and in-stream barriers may not be a limiting factor for these species. Sea Lamprey control measures have effectively kept the Humber protected from this invasive species.

Aspects of concern are apparent in some middle and most of the lower river sections (Lower Humber, Black Creek, Rainbow Creek and bottom reaches of West Humber) and include, shifts from specialist fish species to more tolerant, generalists; reduction in the historic distribution of the target and threatened species redside dace; habitat degradation related to past urbanization (*i.e.*, altered flows, poor water quality, sedimentation and erosion) and the detection, then spread, of the invasive rusty crayfish. Management considerations are:

1. Maintain or restore natural stream flow patterns and protect aquatic habitats.
2. In new urban developments on the Oak Ridges Moraine, it is critical that predevelopment water balance be maintained through stormwater management in order to maintain the current groundwater flow regime and habitat types.
3. Focus on maintaining and enhancing brook trout and redside dace habitat in Purpleville Creek; brook trout in the upper Main Humber; rainbow trout reproduction in the East Humber; lake based fish community in the Humber Marshes*
4. Support and start implementation of the draft Redside Dace Recovery Plan (OMNR, 2005)*
5. Continue brook trout fall spawning surveys in the Upper Main Humber*
6. Continue to monitoring presence and distribution of rainbow darter.
7. Enforce and implement the OMNR guidelines designed to avoid spreading the infection Viral Hemorrhagic Septicemia (VHS).

Benthic Invertebrates: Overall, the condition of the benthic invertebrate community in the Humber is fairly good. Although almost two thirds of the monitoring sites in 2004 were assessed as 'potentially impaired', a closer examination of species lists showed many of these sites to support invertebrates of good water and habitat quality. With this consideration, only about one third of the stations are more definitively 'impaired' with the majority of those in streams adjacent to or downstream of urban areas. Management consideration is:

1. Develop a rating method with a greater spread of stream health scores beyond just 'unimpaired' and 'potentially impaired' to better identify stations that may be supporting a natural condition or just beginning to show signs of impact. This would also better showcase small incremental improvements.

Freshwater Mussels: After limited sampling during 2005 and 2006, evidence of mussels species, two rare to the TRCA jurisdiction, were found in the West, Main and East Humber River subwatersheds. Management consideration is:

1. Undertake formal mussel surveys to develop fisheries management targets and strategies for protecting and enhancing mussel populations.

Stocking: Currently both rainbow trout and brown trout are stocked in the Main and East Humber River subwatersheds. It is the intention that Atlantic salmon be stocked in high enough numbers to reestablish this extirpated species within the Lake Ontario basin. At the moment, only small numbers of this species are being stocked as part of the ongoing determination of appropriate stocking sites within the Humber. Chinook salmon are not intensely stocked but many move up into the watershed during the fall migration. A fishway was installed to selectively only pass rainbow trout into the East Humber. Management considerations are:

1. On an interval basis, evaluate the decision to stock fish for recreational use versus restoration to ensure competition for resources are not an issue (*i.e.*, rainbow trout, brown trout vs. brook trout and Atlantic salmon)

2. Continue investigating and definitively identify appropriate stocking sites and habitat rehabilitation needs for Atlantic salmon in preparation of future full implementation of restoration program.

3. Transfer smallmouth bass into the West and Lower Main Humber Rivers*

Aquatic Invasive Species: The Old Mill dam prevents access by sea lamprey, gobies and carp coming up from Lake Ontario. Carp have been found I small numbers within the watershed likely do to individuals stocking private ponds. Two relatively new species have been collected, rusty crayfish and rudd. These introductions are likely the results of live bait release. Rusty crayfish are spreading through the middle reaches of the Humber. Management considerations are:

1. Improve activity education on the impacts of live bait release.

2. Continue partnership with DFO to actively manage sea lamprey populations and prevent invasion into the Humber River.

3. Any future designs of a fishway at the Old Mill dam to improve fish passage of non-jumping native species must address the issue of invasive such as round goby, carp and other potential future species.

4. Develop a targeted monitoring program to detected new or increased distribution of invasive species; this must be coordinated with a response program to any changes.

Angling: There are multiple fishing destinations known throughout the Humber River. Species of recreational interest are rainbow trout, brown trout, brook trout and likely pond/lake-based species such as bass and pike. Angling pressure on the resource is not measured. Baitfish is collected in the Humber but locations and species being harvested are not specifically recorded. Management considerations are:

1. Improve recreational fishing opportunities through sustainable practices.
    a. Create or improve three (3) angling access points in Town of Caledon*

2. Determine baitfish harvest limits and sensitive locations (*e.g,.* redside dace streams).

3. Improve activity education on the impacts of live bait release (a necessary repeat from angling)

4. Continue enforcement of regulations with priority areas being the Lower Humber south of Eglinton and the Upper Main Humber above Bolton*

5. Work with baitfish harvester to implement no baitfish harvest in Purpleville Creek*

Thermal Regime and Stability: Stream temperatures across the upper Main Humber River are cold, relatively stable and mostly groundwater fed. East Humber River streams run cool and stable where natural tracts of land are maintained (east of Nobleton). Stream temperatures tend to fluctuate within the eastern most headwaters (King City) where inland lakes likely influence receiving waters. The West Humber tributaries flow seasonally and mostly warm but are relatively unstable. The exception is the permanently flowing, cold water tributary in the west, which may be impacted by water taking activity and lack of riparian natural cover. There is relatively little data collected for Black Creek and the Lower Humber, but based on fish communities and some logger measurements, these streams are warm water that experience unstable summer conditions, particularly Black Creek. Management considerations include:

1. Additional stream temperature data collection needs to be undertaken in the various subwatersheds to better classify the thermal conditions of the watercourses and to identifying specific thermal issues.

2. Stream temperature analysis needs to be conducted in conjunction with the baseflow monitoring, riparian habitat loss/degradation and the groundwater models to help identifying impacts to fish habitat from current and future water taking activities.

    a. Establish and monitor 9 to 10 indicator stations for baseflow*
    b. Collect water use assessment information.
    c. Map riparian habitat conditions at those sites.

In-stream Barriers: The most common barriers to fish passage in the Humber River appear to be low head weirs and dams, perched culverts and beaver dams but an on-ground, formal inventory has not been undertaken. Using air photo interpretation, a total of 1201 potential in-stream barriers have been identified. To date, a total of 11 structures have been fully or partially mitigated in the Humber River to improve fish passage. Management considerations are:

1. Optimize fish passage for native fish and stocked migratory species with due regard for the prevention of invasive species access or spread through the watershed.

    a. Conduct formal in-stream barrier survey to further prioritize mitigation work.

2. Continue to evaluate methods described in the Environmental Study Report for the Lower Humber River Barrier Mitigation Project (OMNR, 2007).

3. Mitigate one barrier between Bloor and Dundas Streets*

4. Mitigate three barriers in the Upper Main Humber or East Humber*

5. Assess existing fishway efficacy to pass jumpinh and non-jumping fish species at Raymore Park and Board of Trade Golf Club*

Riparian Natural Cover Vegetation: The target of having 75% of the total riparian area with natural cover has not yet been met with only 61% riparian natural cover in 2002, and most of this located in the Main and East Humber. Management considerations are:

1. Focus reforestation activities in the headwaters to anchor the substantial area of high quality stream habitat and help to mitigate cumulative impacts of urbanization in the middle and lower reaches of the watershed.

2. Enhance tree cover in pervious areas through the middle reaches of the watershed to help mitigate the thermal and erosion impacts.

3. Restore wetlands and/or meadows on marginal agricultural lands with a focus on opportunities in the West Humber subwatershed, to maintain and enhance habitat for redside dace and potentially brassy minnow, sand shiner, pearl dace and freshwater mussels.

4. Focus riparian natural cover restoration efforts on the West Branch and Main Branch of the West Humber, Rainbow Creek, King Creek and Cold Creek subwatersheds, where greater than 40% of potential riparian areas lack natural cover (Appendix B) and significant opportunities remain for restoration.

5. Plant 2 km in the East Humber and 2 km in the upper Main Humber subwatersheds with a focus on public lands and first to third order watercourses*

6. Continue implementation of Claireville Habitat Restoration Project*

7. Develop rehabilitation plan for the Humber Marshes as identified in the City of Toronto Wet Weather Flow Management Plan*

General Consideration:
With the many relatively pristine locations in the Humber River watershed, the amount of land in public ownership and the number of concerned watershed residents, many opportunities exist to improve the aquatic system rating in the future. This will translate into benefits for both the aquatic and terrestrial systems as well as enhance the experience society has with its natural environment.

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Appendix A Mussel Species in the Humber River and Host Fish Species

Common Name	Scientific Name	Status	Sub-catchment	Host Species
Elktoe	*Alasmidonta marginata*	S3	Main Humber	Rock bass
				White sucker
				Northern hog sucker
Cylindrical Floater	*Anodontoides ferussacianus*	S4	West Humber	Black crappie
				Blacknose shiner
				Bluegill
				Bluntnose minnow
				Brook stickleback
				Common shiner
				Fathead minnow
				Iowa darter
				Largemouth bass
				Mottled sculpin
				Sea lamprey
				Spotfin shiner
				White sucker
Creek Heelsplitter	*Lasmigona compressa*	S5	West Humber	Black crappie
				Bluegill
				Brassy minnow
				Brook stickleback
				Creek chub
				Emerald shiner
				Gizzard shad
				Green sunfish
				Longnose dace
				Mimic shiner
				Rhinichthys sp.
				Slimy sculpin
				Smallmouth bass
				Spotfin shiner
				Yellow bullhead
				Yellow perch
Common Floater	*Pyganodon grandis*	S5	West Humber	Banded killifish
				Black crappie
				Blackchin shiner
				Blacknose dace
				Blacknose shiner
				Bluegill
				Bluntnose minnow
				Brook silverside
				Brook stickleback
				Central stoneroller

				Common carp
				Common shiner
				Creek chub
				Freshwater drum [Sheephead]
				Gizzard shad
				Golden shiner
				Goldfish
				Green sunfish
				Iowa darter
				Johnny darter
				Largemouth bass
				Pearl dace
				Pumpkinseed
				Rainbow darter
				Rock bass
				Round goby
				Striped shiner
				White bass
				White crappie
				White sucker
				Yellow bullhead
				Yellow perch
Creeper	*Strophitus undulatus*	S5	Main and West Humber	Black crappie
				Blacknose dace
				Blackside darter
				Bluegill
				Bluntnose minnow
				Brook stickleback
				Central mudminnow
				Common shiner
				Creek chub
				Fantail darter
				Fathead minnow
				Green sunfish
				Iowa darter
				Johnny darter
				Largemouth bass
				Logperch
				Longnose dace
				Northern redbelly dace
				Pumpkinseed
				Rainbow darter
				River Chub
				Rock Bass
				Sand shiner

				Smallmouth bass
				Spotfin shiner
				Stoneroller
				Walleye
				White crappie
				Yellow bullhead
				Yellow perch
Fat Mucket	*Lampsilis siliquoidea*	S5	West Humber	"Sunfish"
				Rock bass
				White sucker
				Pumpkinseed
				Warmouth
				Bluegill
				Longear sunfish
				Striped shiner
				Common shiner

Appendix B – Results of Riparian Natural Cover Assessment, 2002

Table B1: Main Humber Subwatershed

MAIN HUMBER Secondary Subwatersheds	Total Riparian Area (ha)	Riparian Forest	Riparian Meadow	Riparian Successional	Riparian Wetland	Total Riparian Natural Cover (ha)	Total Area Lacking Riparian Natural Cover (ha)
1. MAIN – UPPER	1649.96	972.42	128.28	23.72	185.15	1309.57	340.39
Percentage	100	58.94	7.77	1.44	11.22	79.37	20.63
2. MAIN – PALGRAVE TO BOLTON	913.21	414.36	139.39	20.15	67.45	641.35	271.86
Percentage	100	45.37	15.26	2.21	7.39	70.23	29.77
3. CENTREVILLE CREEK	831.27	464.56	73.91	9.46	91.91	639.84	191.42
Percentage	100	55.89	8.89	1.14	11.06	76.97	23.03
4. COLD CREEK	1223.88	346.77	188.32	54.77	124.37	714.23	509.65
Percentage	100	28.33	15.39	4.47	10.16	58.36	41.64
5. MAIN – BOLTON TO WOODBRIDGE	715.56	261.16	211.77	28.42	10.72	512.07	203.49
Percentage	100	36.50	29.59	3.97	1.50	71.56	28.44
6. RAINBOW CREEK	731.77	81.57	215.11	11.15	9.95	317.79	413.98
Percentage	100	11.15	29.40	1.52	1.36	43.43	56.57
MAIN HUMBER (TOTAL)	6065.65	2540.84	956.78	123.95	489.56	4134.85	1930.80
Percentage	100	41.89	15.77	2.04	8.07	67.78	31.83

Table B2: West Humber Subwatershed

WEST HUMBER Secondary Subwatersheds	Total Riparian Area (ha)	Riparian Forest	Riparian Meadow	Riparian Successional	Riparian Wetland	Total Riparian Natural Cover (ha)	Total Area Lacking Riparian Natural Cover (ha)
7. WEST – WEST BRANCH	843.39	219.76	162.71	18.29	12.58	413.34	430.04
Percentage	100	26.06	19.29	2.17	1.49	49.01	50.99
8. WEST – MAIN BRANCH	1258.23	188.86	207.43	18.42	23.88	438.60	819.63
Percentage	100	15.01	16.49	1.46	1.90	34.86	65.14
9. WEST – EAST BRANCH	486.45	41.71	115.45	3.22	1.93	162.31	324.14
Percentage	100	8.58	23.73	0.66	0.40	33.37	66.63
10. WEST – LOWER BRANCH	215.52	59.00	75.86	29.17	2.58	166.62	48.91
Percentage	100	27.38	35.20	13.54	1.20	77.31	22.69
11. ALBION CREEK	76.54	1.29	10.61	0.45	0.40	12.75	63.79
Percentage	100	1.68	13.86	0.59	0.52	16.65	83.35
WEST HUMBER (TOTAL)	2880.13	510.63	572.07	69.55	41.37	1193.61	1686.52
Percentage	100	17.73	19.86	2.41	1.44	41.44	58.56

Table B3: East Humber Subwatershed

EAST HUMBER Secondary Subwatersheds	Total Riparian Area (ha)	Riparian Forest	Riparian Meadow	Riparian Successional	Riparian Wetland	Total Riparian Natural Cover (ha)	Total Area Lacking Riparian Natural Cover (ha)
12. EAST – UPPER BRANCH	1103.49	354.86	182.91	24.50	157.40	719.68	383.82
Percentage	100	32.16	16.58	2.22	14.26	65.22	34.78
13. KING CREEK	413.18	96.68	82.20	6.04	40.21	225.13	188.05
Percentage	100	23.40	19.89	1.46	9.73	54.49	45.51
14. EAST – NOBLETON TO KLEINBURG	311.95	164.88	63.58	19.62	6.74	254.83	57.12
Percentage	100	52.86	20.38	6.29	2.16	81.69	18.31
15. PURPLEVILLE CREEK	456.41	160.27	110.84	10.80	17.97	299.88	156.53
Percentage	100	35.11	24.29	2.37	3.94	65.70	34.30
16. EAST – KLEINBURG TO WOODBRIDGE	193.41	80.17	33.68	4.24	1.90	119.99	73.42
Percentage	100	41.45	17.41	2.19	0.98	62.04	37.96
EAST HUMBER (TOTAL)	2478.43	856.87	473.21	65.19	224.23	1619.50	858.93
Percentage	100	29.75	16.43	2.26	7.79	56.23	34.66

Table B4: Black Creek Subwatershed

BLACK CREEK	Total Riparian Area (ha)	Riparian Forest	Riparian Meadow	Riparian Successional	Riparian Wetland	Total Riparian Natural Cover (ha)	Total Area Lacking Riparian Natural Cover (ha)
17. BLACK CREEK (TOTAL)	330.46	104.18	69.04	4.26	4.53	182.02	148.45
Percentage	100	31.53	20.89	1.29	1.37	55.08	44.92

Table B5: Lower Humber Subwatershed

LOWER HUMBER Secondary Subwatersheds	Total Riparian Area (ha)	Riparian Forest	Riparian Meadow	Riparian Successional	Riparian Wetland	Total Riparian Natural Cover (ha)	Total Area Lacking Riparian Natural Cover (ha)
18. LOWER – WOODBRIDGE TO REXDALE	169.50	67.58	41.32	3.73	4.20	116.84	52.66
Percentage	100	39.87	24.38	2.20	2.48	68.93	31.07
19. EMERY CREEK	15.33	7.38	3.51	0	0	10.89	4.44
Percentage	100	48.13	22.91	0	0	71.04	28.96
20. LOWER – REXDALE TO WESTON	80.02	41.90	13.46	4.15	0	59.52	20.50
Percentage	100	52.37	16.82	5.19	0	74.38	25.62
21. BERRY CREEK	23.37	3.24	2.34	1.66	0	7.24	16.13
Percentage	100	13.87	10.02	7.11	0	30.99	69.01
22. HUMBER CREEK	27.30	12.40	0.49	1.22	0	14.11	13.19
Percentage	100	45.41	1.79	4.48	0	51.68	48.32
23. SILVER CREEK	44.14	18.85	3.75	2.83	0.23	25.66	18.48
Percentage	100	42.71	8.49	6.41	0.51	58.13	41.87
24. LOWER – LAMBTON TO MOUTH	53.13	31.92	1.40	1.11	4.77	39.20	13.93
Percentage	100	60.09	2.63	2.08	8.98	73.78	26.22
LOWER HUMBER (TOTAL)	412.79	183.27	66.27	14.71	9.21	273.45	139.34
Percentage	100	44.40	16.05	3.56	2.23	66.24	33.76

Table B6 – Total Humber River Watershed

TOTAL HUMBER RIVER WATERSHED	Total Riparian Area (ha)	Riparian Forest	Riparian Meadow	Riparian Successional	Riparian Wetland	Total Riparian Natural Cover (ha)	Total Area Lacking Riparian Natural Cover (ha)
HUMBER RIVER (TOTAL)	12167	4196	2137	278	769	7403	4764
Percentage	100	35	18	2	6	61	39