Humber River

Fisheries Management Plan

A cooperative resource management plan developed by the
Ontario Ministry of Natural Resources
and the
Toronto and Region Conservation Authority

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TORONTO AND REGION Conservation
for The Living City

PREFACE

A number of federal, provincial and regional strategies exist to guide watershed management and habitat protection and rehabilitation. At a federal level, the Toronto and Region Remedial Action Plan (RAP) was established in accordance with the Canada-United States Great Lakes Water Quality Agreement and identified the Toronto and Region Area of Concern (AOCs) as one of 43 AOCs around the Great Lakes. The Stage I RAP document identifies types and sources of water pollution problems, and outlines goals, remedial actions, agencies, costs, timetables and monitoring programs. Stage II provides a framework for guiding more local initiatives, such as fisheries rehabilitation. The Humber River Fisheries Management Plan (FMP) provides direction on three RAP goals and actions:

Goal 2a)	a self sustaining fishery
Goal 2b)	rehabilitation of fish and wildlife habitat
Action 21)	protect and restore fish and wildlife habitat

Implementation of RAP recommendations, in conjunction with the recommendations of watershed based rehabilitation plans, will eventually lead to the delisting of watersheds within the Toronto and Region Area of Concern.

Provincial fisheries management plans that set the context for the Humber River Fisheries Management Plan include the Strategic Plan for Ontario Fisheries (SPOF II) and the Maple District Fisheries Management Plan. SPOF II was prepared in consultation with the public and provides a basis for actions involving the public and private sectors. The overall goal of SPOF II is to achieve:

"Healthy aquatic ecosystems that provide sustainable benefits, contributing to society's present and future requirements for a high-quality environment, wholesome food, employment and income, recreational activity and cultural heritage."

SPOF II also provides objectives, guiding principles and strategic management actions to help resolve important issues.

The Maple District Fisheries Management Plan (MDFMP) prepared by the Ontario Ministry of Natural Resources also sets a context for the Humber River Watershed Fisheries Management Plan. Through the MDFMP, general strategies and tactics to achieve specific district goals are outlined. The Humber River Fisheries Management Plan establishes fisheries management direction consistent with federal and provincial objectives but provides additional details regarding specific project locatios, priorities and species management targets at a subwatershed level.

Development of the Humber River FMP was guided by a steering committee made up of representatives from government agencies, non-government organizations (NGOs) and the public as well as comments from two rounds of public meetings. At the first round of public meetings many concerns and opportunities were expressed with regard to allowing increased access for migratory species into the watershed from Lake Ontario.

These opinions were summarized and grouped into 12 categories which were then used as criteria to evaluate management options.

These management options ranged from doing nothing to unrestricted access for all species. Following discussions with the Steering Committee a short list of options was developed. Using the decision criteria and an understanding of the fundamental characteristics and historic functions of the watershed, a preferred management option was selected. The preferred management option was presented to the public during the Round 2 public meetings and included the following:

- mitigation of the Old Mill dam north of Bloor Street in Toronto to allow jumping species access upstream;
- the removal/mitigation of dams upstream from the Old Mill dam to north of Regional Road 7 (formerly Highway 7) in Woodbridge; and
- the mitigation of the Board of Trade Golf Course barrier in Woodbridge to selectively allow native and naturalized species access to the headwaters of the upper Humber River.

Between 1998 and 2002, four dams have been completely modified 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 desireable species to upstream habitats. Undesireable species, such as sea lamprey and round goby, will be restricted from movement past the Old Mill dam. The mitigation of additional upstream barriers, on-line ponds, and the implementation of other projects such as the revegetation of stream corridors and improvement of aquatic habitat forms the basis of this plan.

EXECUTIVE SUMMARY

The need for a watershed based fisheries management plan was recognized early in the development of Legacy: A Strategy for a Healthy Humber, 1997 (MTRCA). This fisheries management plan is a resource document to be used to develop and implement rehabilitation projects and as a tool to guide and influence where development occurs.

The initial task for the Fisheries Management Plan was to establish baseline information on the condition of the fish community based upon historical conditions. Fish sampling records from as far back as 1948 as well as anecdotal information from historical references were compiled. In all, over 360 stations and more than 900 individual surveys were entered into a database. Seventy four species have been found in the watershed historically including species such as Atlantic salmon (extirpated), redside dace (provincially threatened and federally a species of special concern), largemouth bass and rainbow darter. Ten of the 74 historic species are introduced and exotic. In 2001, 43 fish species were captured including brook trout, rainbow trout, northern pike, common carp, pumpkinseed and mottled sculpin. Forty of the species captured are native.

Analyses of the recent data indicates that the aquatic habitats in the rural areas of the Upper Main, East and West Humber River subwatersheds are generally in good condition while the more urbanized Black Creek and Lower Main Humber River subwatersheds are more degraded. The best and worst habitats are found in the smaller tributaries, suggesting these watercourses are more easily impacted than the larger tributaries.

Further analysis indicates that the fish communities in many areas of the watershed lack fish-eating fish and sensitive species, suggesting degraded conditions. The distributions of the sensitive coldwater species found in the watershed, which include brook trout and mottled sculpin, are restricted to the Upper Main Humber River subwatershed and portions of the East and West Humber River subwatersheds.

The physical conditions in the watershed vary from the headwaters on the Niagara Escarpment and Oak Ridges Moraine to the mouth on the Iroquois shoreline. Streams with no tributaries, or first order streams, make up almost half of the 1300 km of watercourses in the watershed. At the mouth, the Humber River is a sixth order stream with a drainage area of 908 km^2. Stream slopes range from the almost flat river mouth area to some slopes greater than 5% in the headwaters. The coarse sands and gravels in the Niagara Escarpment area and the Oak Ridges Moraine allow little surface run-off and substantial groundwater discharge to many headwater streams, keeping water temperatures cold and flows stable. The clay soils found in the middle sections of the watershed have a much higher run-off potential and as a result stream temperatures and flows fluctuate more significantly throughout the year. The result of the variation in physical characteristics is a diversity of aquatic communities across the watershed.

Over 20 large lakes and ponds and more than 600 smaller waterbodies are found throughout the watershed. The larger waterbodies, especially the deep kettle lakes, are oxygen deprived in the lower depths for part of the year. Many waterbodies are also high in nutrients and suspended particulates. Countless artificial ponds created as dugouts or by damming of a watercourse exist in the watershed. On-line ponds negatively impact the watercourse on which they are situated by allowing the water to warm excessively, halt the transport of sediment downstream by trapping it in the pond and obstructing fish movement.

Over 110 instream barriers such as dams or weirs have been identified in the watershed, though many more exist. They have implications for water temperatures, river hydrology, flood control, bank erosion and fish passage. In the case of the Old Mill dam north of Bloor Street in Toronto, it also blocks the upstream migration of sea lamprey, an undesireable parasite that feeds on fish. Some of the dams built in the 1800's also have a cultural significance due to their historical role associated with early European settlement. To date, fish barriers between Bloor and Dundas Streets and Raymore Park north of Eglinton Avenue in Toronto, and Doctors McLean Park and the Board of Trade Golf Course, both in Woodbridge, have been mitigated with the result that rainbow trout are now able to migrate from Lake Ontario into the East Humber River and its tributaries. Prior to these barrier mitigation projects, migratory salmon had been excluded from the East Humber River for more than 100 years. Furthermore, the McFall dam in Bolton and the Palgrave dam have been mitigated to allow fish passage for resident species. Barrier mitigation is a priority action for the rehabilitation of this watershed.

Stream corridor vegetation, in the form of trees and shrubs, serves to shade watercourses which keeps them from warming, helps to contribute organic matter and woody material for cover, and stabilizes river banks. Overall, slightly more than 40% of the watercourses in the watershed have woody vegetation within the riparian zone. The Upper Main Humber River subwatershed has the most riparian vegetation while the West Humber River subwatershed has the least. As a result, watercourses in the West Humber River subwatershed warm more quickly, are often turbid and lack instream woody cover.

Wetlands are critical habitats that provide resting, feeding, spawning and nursery areas for numerous fish and wildlife species. They are also important for controlling and storing run-off, aiding in groundwater recharge/discharge, and improving water quality. The loss of wetlands can cause increased surface run-off, reduced groundwater recharge and reduce summer baseflow. Analyses of historic data indicate that over 4.5% of the watershed area was comprised of wetlands. Presently, thirty six wetlands have been evaluated in the watershed and they represent 1% of the watershed area. Additional wetlands have been identified in the TRCA's Terrestrial Natural Heritage Strategy.

The less developed areas of the Upper Main and East Humber River subwatersheds generally exhibit the best water quality in the watershed. Suspended solids, bacteria and nutrients are the causes of water quality impairment in these areas. Water quality problems stemming primarily from urban sources are more severe in the urbanized sections of the watershed and include loadings of contaminants from stormsewers, combined sewage overflow and chemical spills. Water quality problems are most severe shortly after a rainfall when pollutants that have collected in fields or paved areas get carried into nearby watercourses. In the watershed, water quality problems are most severe in Black and Emery Creeks.

Using the biological, physical and chemical data for the watershed, each watercourse and waterbody was classified into one of seven habitat categories:

- small riverine coldwater
- small riverine warmwater
- intermediate riverine coldwater
- intermediate riverine warmwater
- large riverine
- lacustrine

- estuarine

Because the habitat categories are based upon general physical and chemical characteristics, each habitat category has the ability to support a certain fish community as described below.

Small Riverine Coldwater Habitat
Watercourses in this habitat category have drainage areas less than 13.5 km^2. This category primarily includes first and second order tributaries, although a few third order watercourses do fall into this group. Most of these watercourses begin on the Niagara Escarpment and Oak Ridges Moraine where coarse soils predominate and allow for greater infiltration of precipitation and groundwater discharge to streams. Some of these watercourses will be intermittent in their main reaches but the majority will have permanent flow. Groundwater inputs also help to maintain continually cold water temperatures. They also have relatively stable flows as indicated by the high ratio of baseflow (summer low flow) to average annual flow. Predatory and specialized fish species were less numerous than expected in this habitat category. This habitat category is found in the Upper Main, East and West Humber River subwatersheds. Some of the most sensitive species in the watershed, including American brook lamprey, Atlantic salmon, brook trout, redside dace and mottled sculpin, were historically found in this habitat category. Of these species, only Atlantic salmon is no longer found in this habitat category due to overfishing, pollution, habitat destruction and the construction of dams and weirs preventing migration. Today, barriers still limit salmon and trout from accessing these watercourses in the Upper Main Humber River, although recent barrier mitigation projects have improved access to the East Humber River.

Small Riverine Warmwater Habitat
This habitat type is comprised of watercourses having drainage areas less than 10 km^2. For the most part, this means first and second order tributaries draining from the Peel Plain, although there are some third order streams in this category. Due to the dominance of clay soils in the Peel Plain, infiltration rates are low, as are the rates of groundwater discharge to streams. As a result, many of these tributaries are either reduced to standing pools or completely dry up during the summer months. As well, the low ratio of baseflow to average annual flow suggests that these tributaries have unstable flow regimes with stream levels fluctuating wildly after a rainfall. Water temperatures are unstable and may reach more than 25°C during the summer. Finally, these watercourses have a lack of specialized feeders and fish-eating fish. This habitat category is found in all subwatersheds. Sensitive species found in this habitat category include redside dace and Iowa darter.

Intermediate Riverine Coldwater Habitat
Included in this category are those watercourses whose headwaters drain the Oak Ridges Moraine and Niagara Escarpment. These permanently flowing tributaries receive a proportionately high percentage of groundwater and as a result of relatively high baseflow ratios, have relatively stable flows and cool water temperatures. Drainage areas for these watercourses range from approximately 13.5 km^2 up to 300 km^2. This habitat category is only found in the Upper Main and East Humber River subwatersheds. The majority of watercourses in this habitat category are third and fourth order streams, although some second and fifth order streams are also found. Streams in this category have a lack of specialized feeders and fish-eating fish. The historic species list contains sensitive species such as American brook lamprey, Atlantic salmon, brook trout, redside dace and mottled sculpin. Atlantic salmon, now extirpated from the watershed, were known to inhabit this habitat category prior to European settlement.

Intermediate Riverine Warmwater Habitat
This habitat category contains watercourses draining from the Peel Plain. Stream order classes in this category are mainly third and fourth order, although some are second and fifth order streams. The majority of these watercourses drain an area between 10 km^2 and 300 km^2. Because infiltration and baseflow is low, some of these streams dry up or become standing pools in the summer, particularly those in the West Humber River subwatershed. As well, the flow regime and water temperatures fluctuate due to low amounts of baseflow and high storm flows. The Upper Main, East and West Humber River subwatersheds all contain intermediate riverine warmwater habitat. Very few fish-eating fish or specialized feeders were found in this habitat category. Sensitive species presently found here include redside dace and rainbow darter.

Large Riverine Habitat
Any watercourse with a drainage area greater than 300 km^2 was included in this category. This includes the main branch of the Humber River from the confluence with the East Humber River downstream to the Old Mill dam. Since it receives water from numerous large sub-basins in the Upper Main Humber River and from two subwatersheds south of the confluence with the West Humber River subwatershed, the flow regime fluctuates greatly. Because of the width of the river, riparian vegetation is unable to effectively shade the stream. Water temperatures may also fluctuate due to inputs from upstream watercourses, surface run-off and localized groundwater sources. Specialized feeders and fish-eating fish are generally lacking from this habitat category. American brook lamprey, Atlantic salmon, redside dace and smallmouth bass are some of the most sensitive species historically found in this habitat category. This habitat category played a vital role in allowing the now extirpated Atlantic salmon access into headwater tributaries to spawn and continues to serve as the spine of the watershed linking the headwaters to Lake Ontario.

Estuarine Habitat
Estuarine or coastal wetland habitat in the Humber River watershed extends from the mouth to slightly downstream of the first weir, located at the Old Mill in Toronto, a distance of 5.5 km. This habitat is characterized by very low slope (0.03%), slow moving, turbid water, and is directly influenced by the water level in Lake Ontario. The presence of the Humber Marshes, a large provincially significant wetland area, provides spawning, nursery and feeding areas for many normally lake resident species such as northern pike, bowfin, longnose gar, yellow perch and many minnow species. As well, some of the species found in estuarine habitat only migrate through and do not live there. Trout, salmon and white sucker, for example, move through this habitat on their annual spawning runs.

Lacustrine Habitat
The Humber River watershed has over 600 ponds and waterbodies, but for the purposes of this plan, only the major waterbodies where information exists will be discussed. In this case, this includes over 10 kettle and artificial lakes and Claireville Reservoir. These habitats are found throughout the watershed and are characterized by low slope, low gradient areas that may have poor water quality, and in some of the kettle lakes, oxygen deprived near the bottom. Many species of fish are found in this habitat including northern pike, largemouth bass, yellow perch and Iowa darter. Brook trout historically existed in Elliot and Innis Lakes and recent captures have been reported.

Management Direction

Once the types of aquatic habitats found in the watershed were established, it was important to define how they were to be managed. The Fisheries Management Plan addresses, at a watershed scale, accessibility (public lands), the protection of species of conservation concern, management of consumptive uses such as harvesting of baitfish, fish stocking, angling regulations and the provision of non-consumptive uses like fish viewing and education. The Plan also explains how fisheries issues are dealt with from a development review perspective.

Seven rehabilitation activities commonly used to address aquatic habitat degradation and resource use are also described. These activities include planting streamside vegetation, improving water quality, stabilizing flows, mitigating instream barriers, instream habitat improvements, natural channel design, and fish stocking.

Management direction for individual tributaries is provided at a subwatershed level. For each of the five major subwatersheds, the plan identifies habitat categories, impacts to the quality of habitats, recommended management strategies and target species. It also details locations for public access, angling regulations and fish stocking and transfer strategies.

Implementation Plan

There are many projects that need to be implemented to achieve the goals of this Plan, some of which are expensive and long term like barrier mitigation, riparian planting, stormwater management retrofits and natural channel design. Others, like signage, angling regulation changes, stocking and fish transfers can be done more readily and inexpensively. There may also be new projects that arise as issues change or opportunities come up. The general workplan, however, outlined in the following table, has been developed for 2006 – 2010 to help set priorities and provide a general cost estimate for future budgeting. Additional details can be found in Section 6 of this document.

Implementation Plan for Humber River Fisheries Management Projects – 2006

PROJECT TYPE	DESCRIPTION AND ESTIMATED COST
Riparian Zone Planting	• West Humber, Lower Main Humber River and Black Creek subwatersheds as outlined in Toronto's WWFMMP ($330,000) • Plant 2 km in the East Humber River and 2 km in the Upper Main Humber River subwatersheds with a focus on public lands and first to third order watercourses ($34,000/km @ 10m wide) • Implement TRCA's Terrestrial Natural Heritage System Strategy
Wetland Creation & Rehabilitation	• Continue implementation of Claireville Habitat Restoration Project ($30,000) • Assess and develop rehabilitation plan for the Lower Humber Marshes as identified in Toronto's WWFMMP ($50,000)
Habitat Rehabilitation	• Upper Humber Rehabilitation Rehabilitation Initiative ($30,000) • Inwater habitat creation and shoreline naturalization at Eglinton Flats Pond, Humber Mede Pond and Eaton Hall Lake ($40,000) • Implement TRCA's Habitat Implementation Plan ($50,000)
Water Quantity & SWMP Retrofits	• Lower Main Humber River subwatershed as outlined in Toronto's WWFMMP ($990,000)
Stream Baseflow	• Establish and monitor 9 – 10 indicator stations ($7,500) • Collect water use assessment information ($8,000)
Water Quality	• Rural Clean Water Program and associated stewardship initiatives in the Upper Main, East and West Humber River subwatersheds ($50,000)
Natural Channel Design	• Lower Main Humber River subwatershed as outlined in Toronto's WWFMMP ($925,000)
Instream Barrier Mitigation	• Mitigate one barrier for non-jumping species between Bloor and Dundas Streets ($150,000) • Mitigate three barriers in the Upper Humber or East Humber ($30,000) • Groundtruth remaining potential barriers throughout the watershed ($25,000) • Albion Hills Conservation Area – Taylor Pond restoration ($50,000) and Main Pond issues scoping, options and design ($30,000)
Public Lands	• Land acquisition in Town of Caledon and Oak Ridges Moraine • Create or improve 3 angler access points in Caledon
Species of Conservation Concern	• Start implementation of the Redside Dace Recovery Plan
Angling Regulations and Enforcement	• Continue enforcement of regulations with priority areas being the Lower Humber south of Eglinton and the Upper Humber above Bolton.
Fish Stocking and/or Transfer	• Transfer smallmouth bass into the West and Lower Main Humber Rivers ($3,000) • Continue rehabilitative stocking of brown trout in the lower end of Purpleville Creek and into the Upper Main Humber River above Bolton; Continue rehabilitative stocking of rainbow trout into the East Humber River. Develop a chinook salmon and coho salmon fishery for the lower Humber. • Investigate enhancement opportunities for the native brook trout in the Upper Humber
Baitfish Harvest	• Work with baitfish harvester to implement no baitfish harvest in Purpleville Creek
Non-Consumptive Uses	• Erect signs for each fishway along the Humber • Maintain viewing window at Palgrave Fishway • Continue stewardship activities & outreach education programs associated with Watershed On Wheels ($175,000); continue work at Caldedon East, Palgrave and Bolton Community Action Sites and establish new sites
Monitoring and Surveys	• Assess fish passage in Lower Main Humber River, Raymore Park and Board of Trade Golf Club; rainbow trout reproduction in East Humber River; fish communities in Humber River Marshes ($10,000) • Identify locations for Management Zone 1B ($10,000) • Continue brook and brown trout fall spawning surveys in the Upper Humber

Implementation Plan for Humber River Fisheries Management Projects – 2007

PROJECT TYPE	DESCRIPTION AND ESTIMATED COST
Riparian Zone Planting	• West Humber, Lower Main Humber River and Black Creek subwatersheds as outlined in Toronto's WWFMMP ($330,000) • Plant 2 km in the East Humber River and 2 km in the Upper Main Humber River subwatersheds with a focus on public lands and first to third order watercourses ($34,000/km @ 10m wide) • Implement TRCA's Terrestrial Natural Heritage System Strategy
Wetland Creation & Rehabilitation	• Continue implementation of Claireville Habitat Restoration Project ($30,000) • Implement rehabilitation plan for Lower Humber Marshes ($75,000) • Wetland Creation in Black Creek ($135,000)
Habitat Rehabilitation	• Upper Humber Rehabilitation Rehabilitation Initiative ($30,000) • Inwater habitat creation and shoreline naturalization at Eglinton Flats Pond, Humber Mede Pond, Eaton Hall Lake ($10,000) • Implement TRCA's Habitat Implementation Plan ($50,000)
Water Quantity & SWMP Retrofits	• Lower Main Humber River subwatershed as outlined in Toronto's WWFMMP ($990,000)
Stream Baseflow	• Monitor 9 – 10 indicator stations ($7,500) • Collect water use assessment information ($8,000)
Water Quality	• Rural Clean Water Program and associated stewardship initiatives in the Upper Main, East and West Humber River subwatersheds ($50,000)
Natural Channel Design	• Lower Main Humber River subwatershed as outlined in Toronto's WWFMMP ($925,000)
Instream Barrier Mitigation	• Mitigate two barriers for non-jumping species between Bloor and Dundas Streets ($250,000) • Mitigate three barriers in the Upper Humber or East Humber ($30,000) • Albion Hills Conservation Area Main Pond – implementation ($250,000)
Public Land	• Land acquisition in Town of Caledon and Oak Ridges Moraine • Improve angler access at three points in the Upper Main Humber River
Species of Conservation Concern	• Continue implementation of the Redside Dace Recovery Plan • Assess the need for detailed surveys of candidate species at risk
Angling Regulations and Enforcement	• Continue OMNR enforcement activities in Lower Main Humber River subwatershed and Upper Humber above Bolton
Fish Stocking and/or Transfer	• Transfer smallmouth bass into the West and Lower Main Humber Rivers ($6,000) • Continue rehabilitative stocking of brown trout in the lower end of Purpleville Creek and into the Upper Main Humber River above Bolton; Continue rehabilitative stocking of rainbow trout into the East Humber River. Promote a chinook salmon and coho salmon fishery for the lower Humber. Introduce Atlantic Salmon to the Upper Humber if a source is available.
Baitfish Harvest	• Implement baitfish harvest changes following discussions with licenced harvester
Non-Consumptive Uses	• Develop information kiosks at access points in Upper Main Humber River ($5,000) • Erect signs for each fishway along the Humber • Continue stewardship activities & outreach education programs associated with Watershed On Wheels ($175,000); continue work at Caldedon East, Palgrave and Bolton Community Action Sites and establish new sites
Monitoring and Surveys	• Assess fish passage in Lower Main Humber River and at Raymore Park and Board of Trade Golf Club; rainbow trout reproduction in East Humber River; • Assess effectiveness of Palgrave Mill Pond dredging and fishway in relation to project goal and objectives. • Continue brook and brown trout fall spawning surveys in the Upper Humber

Implementation Plan for Humber River Fisheries Management Projects – 2008

PROJECT TYPE	DESCRIPTION AND ESTIMATED COST
Riparian Zone Planting	• West Humber, Lower Main Humber River and Black Creek subwatersheds as outlined in Toronto's WWFMMP ($330,000) • Plant 2 km in the East Humber River and 2 km in the Upper Main Humber River subwatersheds with a focus on public lands and first to third order watercourses ($34,000/km @ 10m wide) • Implement TRCA's Terrestrial Natural Heritage System Strategy
Wetland Creation & Rehabilitation	• Continue implementation of Claireville Habitat Restoration Project ($30,000) • Implement rehabilitation plan for Lower Humber Marshes ($75,000)
Habitat Rehabilitation	• Upper Humber Rehabilitation Rehabilitation Initiative ($30,000) • Shoreline naturalization at Eglinton Flats Pond and Eaton Hall Lake ($10,000) • Implement TRCA's Habitat Implementation Plan ($50,000)
Water Quantity & SWMP Retrofits	• Lower Main Humber River subwatershed as outlined in Toronto's WWFMMP ($990,000)
Stream Baseflow	• Monitor 9 – 10 indicator stations ($7,500) • Collect water use assessment information ($2,000)
Water Quality	• Rural Clean Water Program and associated stewardship initiatives in the Upper Main, East and West Humber River subwatersheds ($50,000)
Natural Channel Design	• Lower Main Humber River as outlined in Toronto's WWFMMP ($925,000)
Instream Barrier Mitigation	• Mitigate one barrier for non-jumping species between Bloor and Dundas Streets ($100,000) • Mitigate three barriers in the Upper Humber or East Humber ($30,000)
Public Lands	• Land acquisition in Town of Caledon and Oak Ridges Moraine • Improve angler access at three points in the Upper Main Humber River or East Humber
Species of Conservation Concern	• Continue implementation of the Redside Dace Recovery Plan • Continue to assess candidate species at risk
Angling Regulations and Enforcement	• Continue OMNR enforcement activities in Lower Main Humber River subwatershed and Upper Humber above Bolton
Fish Stocking and/or Transfer	• Continue rehabilitative stocking of brown trout in the lower end of Purpleville Creek and into the Upper Main Humber River above Bolton; Continue rehabilitative stocking of rainbow trout into the East Humber River. Promote a chinook salmon and coho salmon fishery for the lower Humber. Introduce Atlantic Salmon to the Upper Humber if a source is available.
Baitfish Harvest	• Continue to work with baitfish harvester to aid in assessments and issue identification
Non-Consumptive Uses	• Develop signs for Boyd CA, Kortright, and Doctors McLean Park fishway ($5,000) • Continue stewardship activities & outreach education programs associated with Watershed On Wheels ($175,000); continue work at Caldedon East, Palgrave and Bolton Community Action Sites and establish new sites
Monitoring and Surveys	• Assess fish passage in Main Lower Humber River and at Raymore Park and Board of Trade Golf Club; rainbow trout reproduction in East Humber River; • Sample an additional 20 stations (stream and lakes sites) to complement Regional Watershed Monitoring Program ($25,000) • Continue brook and brown trout fall spawning surveys in the Upper Humber

Implementation Plan for Humber River Fisheries Management Projects – 2009

PROJECT TYPE	DESCRIPTION AND ESTIMATED COST
Riparian Zone Planting	• West Humber, Lower Main Humber River and Black Creek subwatersheds as outlined in Toronto's WWFMMP ($330,000) • Plant 2 km in the East Humber River and 2 km in the Upper Main Humber River subwatersheds with a focus on public lands and first to third order watercourses ($34,000/km @ 10m wide) • Implement TRCA's Terrestrial Natural Heritage System Strategy
Wetland Creation & Rehabilitation	• Continue implementation of Claireville Habitat Restoration Project ($30,000) • Implement rehabilitation plan for Lower Humber Marshes ($75,000)
Habitat Rehabilitation	• Upper Humber Rehabilitation Rehabilitation Initiative ($30,000) • Implement TRCA's Habitat Implementation Plan ($50,000)
Water Quantity & SWMP Retrofits	• Lower Main Humber River subwatershed as outlined in Toronto's WWFMMP ($990,000)
Stream Baseflow	• Monitor 9 – 10 indicator stations ($7,500) • Collect water use assessment information ($2,000)
Water Quality	• Rural Clean Water Program and associated stewardship initiatives in the Upper Main, East and West Humber River subwatersheds ($50,000)
Natural Channel Design	• Lower Main Humber River subwatershed as outlined in Toronto's WWFMMP ($925,000)
Instream Barrier Mitigation	• Mitigate two barriers for non-jumping species between Bloor and Dundas Streets ($150,000) • Mitigate three barriers in the Upper Humber or East Humber ($30,000) • Removal of three barriers in Black Creek as outlined in Toronto's WWFMMP ($202,000)
Public Lands	• Land acquisition in Town of Caledon and Oak Ridges Moraine • Improve angler access at three points in the Upper Main Humber River or East Humber
Species of Conservation Concern	• Continue implementation of the Redside Dace Recovery Plan • Continue to assess candidate species at risk
Angling Regulations and Enforcement	• Continue OMNR enforcement activities in Lower Main Humber River subwatershed and Upper Humber above Bolton
Fish Stocking and/or Transfer	• Transfer smallmouth bass into the West and Lower Main Humber Rivers ($3,000) • Continue rehabilitative stocking of brown trout in the lower end of Purpleville Creek and into the Upper Main Humber River above Bolton; Continue rehabilitative stocking of rainbow trout into the East Humber River. Promote a chinook salmon and coho salmon fishery for the lower Humber. Introduce Atlantic Salmon to the Upper Humber if a source is available.
Baitfish Harvest	• Continue to work with baitfish harvester to aid in assessments and issue identification
Non-Consumptive Uses	• Develop interpretive signs between Lawrence and Steeles Avenues ($5,000) • Continue stewardship activities & outreach education programs associated with Watershed On Wheels ($175,000); continue work at Caldedon East, Palgrave and Bolton Community Action Sites and establish new sites
Monitoring and Surveys	• Assess fish passage in Lower Main Humber River and at Raymore Park and Board of Trade Golf Club; rainbow trout reproduction in East Humber River; • Continue brook and brown trout fall spawning surveys in the Upper Humber

Implementation Plan for Humber River Fisheries Management Projects – 2010

PROJECT TYPE	DESCRIPTION AND ESTIMATED COST
Riparian Zone Planting	• West Humber, Lower Main Humber River and Black Creek subwatersheds as outlined in Toronto's WWFMMP ($330,000) • Plant 2 km in the East Humber River and 2 km in the Upper Main Humber River subwatersheds with a focus on public lands and first to third order watercourses ($34,000/km @ 10m wide) • Implement TRCA's Terrestrial Natural Heritage System Strategy
Wetland Creation & Rehabilitation	• Continue implementation of Claireville Habitat Restoration Project ($30,000) • Implement rehabilitation plan for Lower Humber Marshes ($75,000)
Habitat Rehabilitation	• Upper Humber Rehabilitation Rehabilitation Initiative ($30,000) • Implement TRCA's Habitat Implementation Plan ($50,000)
Water Quantity & SWMP Retrofits	• Lower Main Humber River subwatershed as outlined in Toronto's WWFMMP ($990,000)
Stream Baseflow	• Monitor 9 – 10 indicator stations ($7,500) • Collect water use assessment information ($2,000)
Water Quality	• Rural Clean Water Program and associated stewardship initiatives in the Upper Main, East and West Humber River subwatersheds ($50,000)
Natural Channel Design	• Lower Main Humber River subwatershed as outlined in Toronto's WWFMMP ($925,000)
Instream Barrier Mitigation	• Mitigate one barrier for non-jumping species between Bloor and Dundas Streets ($100,000) • Mitigate three barriers in the Upper Humber or East Humber ($30,000) • Mitigate one major barrier in either the Upper Main or East Humber River ($75,000) • Barrier removal in West Humber River subwatershed ($135,000)
Public Lands	• Land acquisition in Town of Caledon and Oak Ridges Moraine
Species of Conservation Concern	• Continue implementation of the Redside Dace Recovery Plan • Continue to assess candidate species at risk
Angling Regulations and Enforcement	• Continue OMNR enforcement activities in Lower Main Humber River subwatershed and Upper Humber above Bolton
Fish Stocking and/or Transfer	• Transfer smallmouth bass into the West Humber River and Lower Main Humber River ($3,000) • Continue rehabilitative stocking of brown trout in the lower end of Purpleville Creek and into the Upper Main Humber River above Bolton; Continue rehabilitative stocking of rainbow trout into the East Humber River. Promote a chinook salmon and coho salmon fishery for the lower Humber. Introduce Atlantic Salmon to the Upper Humber if a source is available. • Assess watershed stocking program through a creel survey and fish population surveys.
Baitfish Harvest	• Continue to work with baitfish harvester to aid in assessments and issue identification
Non-Consumptive Uses	• Develop interpretive signs in the Lower Main Humber River subwatershed ($4,000) • Continue stewardship activities & outreach education programs associated with Watershed On Wheels ($175,000); continue work at Caldedon East, Palgrave and Bolton Community Action Sites and establish new sites
Monitoring and Surveys	• Assess fish passage in Lower Main Humber River and at Raymore Park and Board of Trade Golf Club; rainbow trout reproduction in East Humber River; • Continue brook and brown trout fall spawning surveys in the Upper Humber

The Future

Ongoing fisheries research, changing attitudes and new regulations will affect the management of the watershed. For this reason, the Fisheries Management Plan is designed as a 'living' document that will be updated as new fisheries data becomes available such as angling regulation changes, species recovery plans, invasive species and the implementation of habitat restoration projects. The Plan will be updated every five years with a major review of the entire document scheduled for 2015.

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Numerous other people also provided input and/or technical support:

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Ian Buchanan	York Region
Heather Broadbent	Humber Heritage Committee
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Gary Wilkins	Toronto and Region Conservation

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1.0 INTRODUCTION

The Humber River watershed is the second largest watershed in the Greater Toronto Area with a drainage area of 908 km^2 (Figure 1) and is the largest watershed managed by Toronto and Region Conservation (TRCA). In 1999, the Humber was designated a Canadian Heritage River based on its outstanding heritage and recreation values and its contribution to the development of the country.

Five main subwatersheds are found within the boundaries of the watershed; the Upper Main Humber River subwatershed is the largest at 356 km^2, the West and East Humber River subwatersheds are slightly more than 203 km^2 each, the Lower Main Humber River subwatershed is 80 km^2 in size and Black Creek is 68 km^2 in area. The watershed is home to nearly 600,000 people and covers portions of two Counties and two Townships, two Regional Municipalities and ten Local Municipalities (Table 1).

Table 1: Local and Regional Municipalities in the Humber River Watershed.

DUFFERIN/SIMCOE COUNTIES	CITY OF TORONTO	REGIONAL MUNICIPALITY OF PEEL	REGIONAL MUNICIPALITY OF YORK
Township of Adjala-Tosorontio	City of Toronto	City of Brampton	Town of Aurora
Mono Township		Town of Caledon	Township of King
		City of Mississauga	Town of Richmond Hill
			City of Vaughan

Historical development in the watershed has been concentrated in the areas south of Highway 7. As of the 1990's, 24% of the watershed was urban, almost 50% of the watershed was in agriculture and 26% was in some other form of rural land use, with approximately eight percent of the watershed identified as committed for new urban development (Marshall Macklin Monaghan, 1995).

Many rural and urban land uses impact the quality and quantity of water in the watershed as well as the physical form of the watercourses and as a result have a direct impact on the watershed's aquatic ecosystem. As such, an aquatic ecosystem tends to be an indicator of the condition of the supporting watershed. Fish and invertebrate communities and specific species are known to act as indicators of habitat quality and thus the presence or absence of particular species provides information on the condition of the whole aquatic ecosystem.

Fish communities and specific fish species are also valued by society as a renewable natural resource. Surveys in 2000 estimate that recreational anglers in Ontario spent $1.7 billion annually on items such as equipment, boats, transportation and lodging (DFO, 2002). Mosquin et al. (1995) further stated that a survey of anglers indicated that they enjoy the natural environment experience as much as, if not more, than catching fish. The fish community is also valued for other more intrinsic reasons. The movement of fish as they make their way upstream attracts many people to the Old Mill dam, the Credit and Rouge Rivers and other watercourses in the area. It is clear that protecting and maintaining aquatic habitat, and therefore, the communities it supports, is important, not only from a social but also from an ecological standpoint.

According to the literature, the fish community in the Humber River Watershed, although impacted by various present and historic practices, is still in "good" condition. In fact, in some locations the condition of the aquatic system has improved in the last 30 years when water pollution control plants were taken off-line or their ability to treat waste was improved (Wichert, 1994). However, this does not mean that the Humber River Watershed is living up to its potential or that there is no need to improve the existing resource. In the Humber River Watershed, it is important to understand where the system is in good condition and requires protection and where it is in poor condition and would benefit from rehabilitation or enhancement.

To best protect and enhance the aquatic resources it is important to understand the existing system, and the factors limiting the system from achieving its potential. The purpose of the Fisheries Management Plan is to provide the biological, chemical, and physical data necessary to manage the watershed in such a way as to protect and enhance the health of the aquatic resources, which will in turn provide tangible benefits to society.

This management plan is divided into two components, an evaluation of aquatic conditions, and management direction. The evaluation of aquatic conditions uses information collected on the physical form of the watershed including instream barriers, riparian vegetation, wetlands, flow regime, water quality, and the historic and present fish community to define a set of aquatic habitat categories and the critical factors that influence those categories. The habitat categories provide a way of looking at the watershed and defining its management potential. A comparison of existing with expected conditions then allows the identification of limiting factors for the fish community in each habitat.

The second component of the plan outlines the framework for future fisheries management based upon the habitat categories. It details locations of public land, management of species of conservation concern, consumptive and non-consumptive uses, how the document is to be used to influence and guide where development occurs, outlines general rehabilitation activities, provides management direction on a subwatershed and habitat category basis and outlines a monitoring program for the watershed.

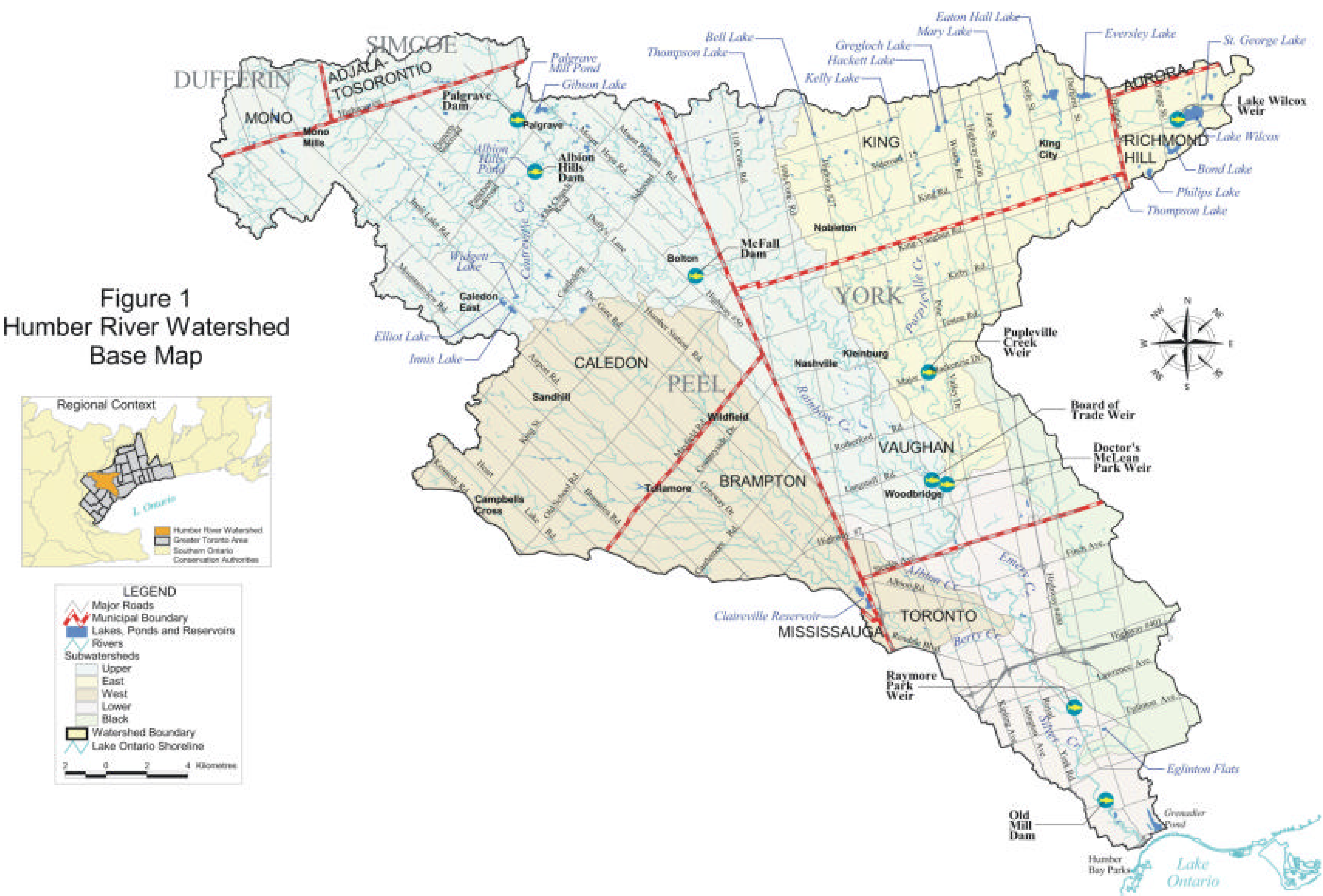


Figure 1. Humber River Watershed Base Map.

2.0 PHYSICAL CONDITIONS

The collection of data on the physical conditions helps to provide insight on the habitat at specific sites. The OMNR Stream Habitat Assessment Procedures allow for the collection of data needed to assess the chemical, physical and biological conditions of a lake or stream (OMNR, 2001). For example, fisheries experts often document whether a section of stream is lacking in riparian vegetation or contains unstable banks, which then points to rehabilitation requirements.

This method works well on a site specific basis but provides little information at a watershed or subwatershed level. Collecting physical data such as soil type, stream order and slope at a watershed or subwatershed level establishes general characteristics that can be used to categorize similar watercourses and waterbodies. For example, lakes and ponds were separated into different habitat categories from streams and rivers since they have different physical attributes and support different species. Streams were also classified as either small, intermediate or large dependant upon drainage area since species richness is related to drainage area (Steedman, 1987). Stream slope and underlying soil type were used to gauge substrate types and whether or not a watercourse may be receiving groundwater discharge.

The first separation into different habitat categories was to divide the watershed into either riverine or lacustrine (lake) habitat.

2.1 Riverine

The Humber River watershed contains approximately 1400 km of watercourses and has a drainage area of 908 km^2. Since it is impossible to deal with each watercourse individually, the grouping of watercourses based on similar characteristics was necessary. These characteristics include the following: stream size, stream slope, stream substrate, flow, and groundwater interaction.

2.1.1 Stream Order

The use of stream order was first proposed by Strahler (1964) and is a common method of dividing a watershed into similar components according to stream size and inferred function. A first order watercourse is a single, unbranched tributary. Where two first order watercourses meet, they form a second order stream. When two second order streams join, they form a third order watercourse and so on. There is no limit to the level of stream order, but where they discharge into a lake, most streams in southern Ontario would likely be 5th or 6th order streams.

Determining stream order is entirely dependant upon the scale of the data being used. A small scale map (eg. 1:100,000) will not depict many of the smaller watercourses, resulting in a different stream order classification than if a more detailed, larger scale map is used (i.e. 1:2,000). The establishment of stream order for this report was done using the Strahler method of ordering and data from the 1:10,000 Ontario Base Map series produced by the OMNR (Figure 2).

Vannote et al. (1980) showed that species diversity (and habitat diversity) increase with increasing drainage area. In other words, a watercourse with a drainage area of 5 km^2 would likely support fewer species than one with a drainage area of 500 km^2. With stream order, a lower order stream such as a first or second would, therefore, support less species than a fifth or sixth order stream. Order is thus used as an indirect measure of the size of the watercourse, and thus ecological diversity.

2.1.1.1 First Order Watercourses

Once rain falls on the ground, it flows downhill along swales, ditches or rills. At the point where water flows through a defined channel, this channel is defined as a first order tributary (Figure 2). First order streams make up the majority of stream length, at more than 660 km or almost 50% of the watercourses in the Humber River watershed (Table 2). The Upper Main Humber River subwatershed has over twice the length of first order watercourses than any other subwatershed.

The majority of these first order streams have moderate to high slopes (Figure 3). These streams would typically have high proportions of larger substrates such as gravels and cobbles overlying the stream bed. Smaller materials such as sands and silts are mostly transported downstream due to high water velocities. Pool to riffle ratios and the number of meanders would likely be low.

First order streams are often the most shaded streams in a watershed due in part to their narrow width. Because they are the least developed subwatersheds, the Upper Main and East Humber River subwatersheds have the highest percentage of woody riparian vegetation on first order streams. The West Humber River subwatershed has a very low amount of woody riparian vegetation on first order streams due largely to the clearing of land for agriculture. For the entire watershed, only 34% of first order tributaries have woody riparian vegetation present (Table 2).

Table 2: First Order Streams in the Humber River Watershed.

SUBWATERSHED	LENGTH (km)	% OF STREAM LENGTH*	STREAM LENGTH WITH WOODY RIPARIAN VEGETATION (km)	% OF FIRST ORDER STREAMS WITH WOODY RIPARIAN VEGETATION
Upper Main Humber River	331	49	137	41
East Humber River	146	49	51	35
West Humber River	138	44	24	17
Black Creek	20	44	5	26
Lower Main Humber River	28	41	9	31
WATERSHED TOTAL	663	47	226	34

* - stream lengths are based on each subwatershed except for the watershed total, which is based on stream length in the entire watershed (approximately 1400 km).

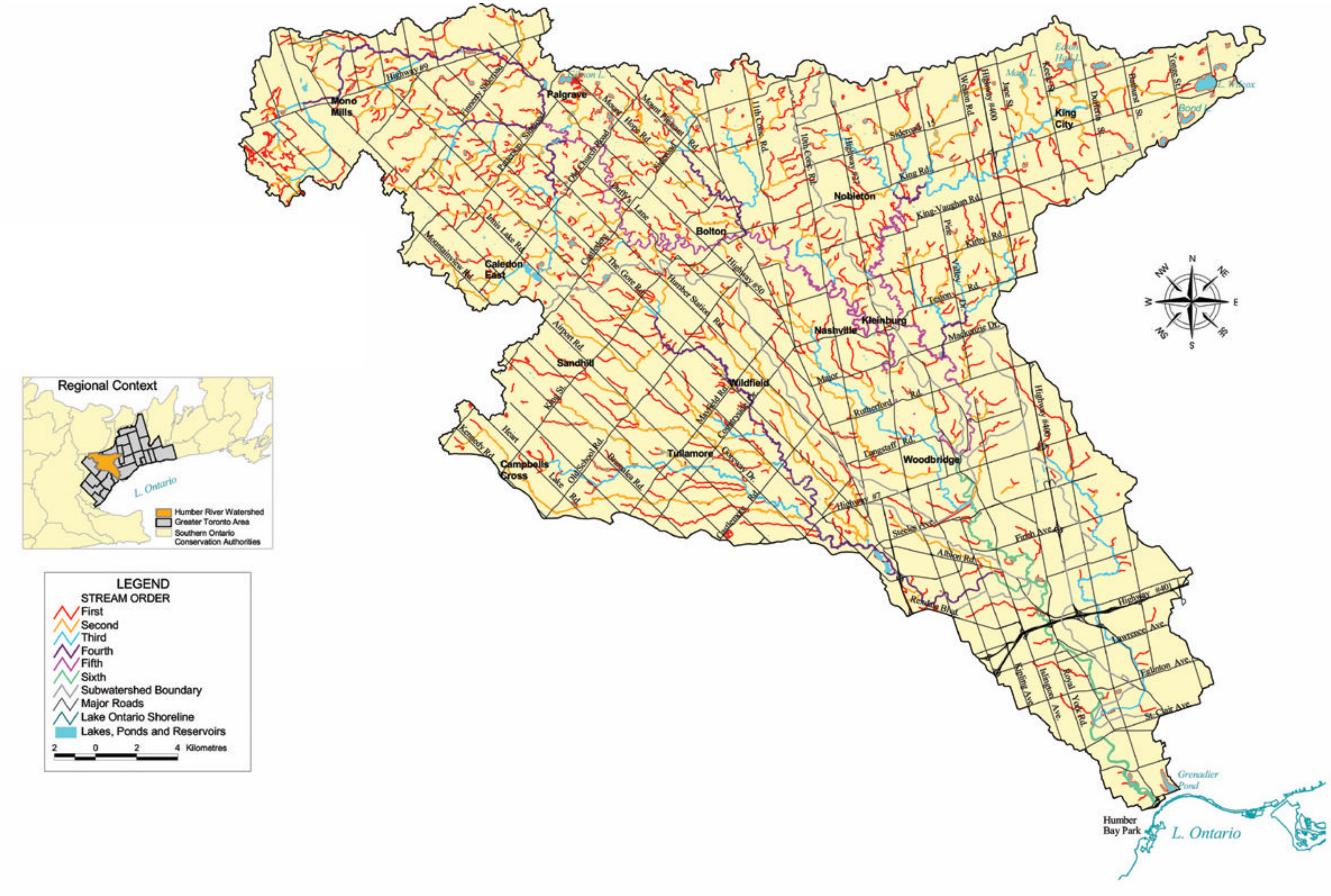


Figure 2. Stream Order for the Humber River Watershed

2.1.1.2 Second Order Watercourses

Two first order streams come together to form a second order tributary, which typically have moderate to high stream slopes (Figure 3). Sinuosity and the ratio of pools to riffles are likely low. Stream substrates are likely to be dominated by cobbles and gravels, with sands and silts likely carried downstream.

Second order streams account for 165 km or 25% of all watercourses in the watershed (Figure 2). The West Humber River subwatershed has the highest percentage of second order streams while they account for only four percent of the length of watercourses in the Black Creek subwatershed, the lowest in the entire watershed (Table 3). This is likely due to a reduction in length from urbanization.

Woody riparian vegetation is found along 45% of second order streams and is very effective at shading and stabilizing their banks. The West Humber River and Black Creek subwatersheds contain the lowest amount of woody riparian vegetation (Table 3). The altered state of these subwatersheds due to development is the reason for the lack of vegetation.

Table 3: Second Order Streams in the Humber River Watershed.

SUBWATERSHED	LENGTH (km)	% OF STREAM LENGTH*	STREAM LENGTH WITH WOODY RIPARIAN VEGETATION (km)	% OF SECOND ORDER STREAMS WITH WOODY RIPARIAN VEGETATION
Upper Main Humber River	165	24	92	56
East Humber River	67	23	32	48
West Humber River	115	36	33	29
Black Creek	1.9	4	0.37	20
Lower Main Humber River	3.9	5	2.3	60
WATERSHED TOTAL	353	25	161	45

* - stream lengths are based on each subwatershed except for the watershed total, which is based on stream length in the entire watershed (approximately 1400 km.

2.1.1.3 Third Order Watercourses

Third order streams are formed downstream of the confluence of two second order streams (Figure 2). Approximately 30 stream sections in the watershed have been designated as third order watercourses and they account for 162 km or 12% of the watershed total (Table 4).

In most Humber River subwatersheds, third order streams account for a low percentage of stream length. This is not the case in the Black Creek subwatershed where over half of the streams have been designated as third order. The reason for this is the loss of length of many historic first and second order tributaries.

Stream slopes for third order watercourses are in the moderate range (Figure 3). Stream sinuosity and the ratio of the number of pools to riffles increase as compared to first and second order streams. A higher percentage of the stream substrate is composed of sands and silts as compared to the gravelly and cobbly bottoms of lower order streams. The deposition of fine material is related to slower stream flows resulting from lower stream slopes.

The percent of woody riparian vegetation along third order streams ranges from a low of 42% in the Black Creek subwatershed to a high of 72% in the East Humber River subwatershed (Table 4). Overall, third order watercourses are 57% vegetated.

Table 4: Third Order Streams in the Humber River Watershed.

SUBWATERSHED	LENGTH (km)	% OF STREAM LENGTH*	STREAM LENGTH WITH WOODY RIPARIAN VEGETATION (km)	% OF SECOND ORDER STREAMS WITH WOODY RIPARIAN VEGETATION
Upper Main Humber River	70	10	39	56
East Humber River	42	14	30	72
West Humber River	27	9	14	51
Black Creek	24	53	10	42
Lower Main Humber River	0	0	0	0
WATERSHED TOTAL	162	12	93	57

* - stream lengths are based on each subwatershed except for the watershed total, which is based on stream length in the entire watershed (approximately 1400 km).

2.1.1.4 Fourth Order Watercourses

Two third order streams come together to create a fourth order stream. A total of eight stream sections in the Humber River have been designated as fourth order streams and they make up a total stream length of 87 km or 6% of the watershed total (Figure 2). Together, the Upper Main and West Humber River subwatersheds contain 91% of the fourth order watercourses (Table 5).

Stream slopes on fourth order watercourses generally range from low to moderate (Figure 3). Pools rather than riffles typically dominate and stream sinuosity is generally high. Smaller, fine sediments such as sands and silts make up a large portion of the substrate.

Woody riparian cover along fourth order streams for all subwatersheds is good, being found along 65% of these watercourses (Table 5). However, with the increasing width of fourth order streams, the presence of woody riparian vegetation may not significantly contribute to the amount of stream being shaded.

Table 5: Fourth order streams in the Humber River Watershed.

SUBWATERSHED	LENGTH (km)	% OF STREAM LENGTH*	STREAM LENGTH WITH WOODY RIPARIAN VEGETATION (km)	% OF SECOND ORDER STREAMS WITH WOODY RIPARIAN VEGETATION
Upper Main Humber River	43	6	35	81
East Humber River	8	2	6	71
West Humber River	36	11	16	44
Black Creek	0	0	0	0
Lower Main Humber River	0	0	0	0
WATERSHED TOTAL	87	6	57	65

* - stream lengths are based on each subwatershed except for the watershed total, which is based on stream length in the entire watershed (approximately 1400 km).

2.1.1.5 Fifth Order Watercourses

The confluence of two or more fourth order watercourses creates a fifth order stream. There are two of these stream sections in the Humber River watershed, one in each of the Upper Main and East Humber River subwatersheds (Figure 2). These two stream sections alone total 99 km of stream length, or 7% of watercourses in the watershed.

Stream slopes on these watercourses are gradual, ranging from 0-0.3% (Figure 3). Pool to riffle ratios and sinuosity are generally high and sands and silts dominate the stream bed. The percent of woody riparian vegetation along fifth order watercourses is high, at 62% (Table 6). The presence of woody riparian vegetation along these watercourses likely does little to shade them due to their width but is important in helping to stabilize the streambank.

Table 6: Fifth Order Streams in the Humber River Watershed.

SUBWATERSHED	LENGTH (km)	% OF STREAM LENGTH*	STREAM LENGTH WITH WOODY RIPARIAN VEGETATION (km)	% OF SECOND ORDER STREAMS WITH WOODY RIPARIAN VEGETATION
Upper Main Humber River	66	9	39	59
East Humber River	33	11	23	68
West Humber River	0	0	0	0
Black Creek	0	0	0	0
Lower Main Humber River	0	0	0	0
WATERSHED TOTAL	99	7	62	62

* - stream lengths are based on each subwatershed except for the watershed total, which is based on stream length in the entire watershed (approximately 1400 km).

2.1.1.6 Sixth Order Watercourses

Only one sixth order stream section is found in the Humber River watershed (Figure 2). It begins at the confluence of the Upper Main and the East Humber Rivers. This sixth order watercourse is 35 km long and accounts for 2% of the watercourse length in the watershed.

This watercourse has a stream slope of less than 0.3% (Figure 3). Sinuosity and the ratio of pools or flats to riffles or runs are high. Smaller substrates like sands and silts generally dominate stream substrates.

Almost 15 km of this watercourse has riparian vegetation that accounts for 42% of its entire length (Table 7). This vegetation has less of a role in shading the stream than it does in stabilizing the streambank.

Table 7: Sixth Order Streams in the Humber River Watershed.

SUBWATERSHED	LENGTH (km)	% OF STREAM LENGTH*	STREAM LENGTH WITH WOODY RIPARIAN VEGETATION (km)	% OF SECOND ORDER STREAMS WITH WOODY RIPARIAN VEGETATION
Upper Main Humber River	0	0	0	0
East Humber River	0	0	0	0
West Humber River	0	0	0	0
Black Creek	0	0	0	0
Lower Main Humber River	35	2.5	15	42
WATERSHED TOTAL	35	2.5	15	42

* - stream lengths are based on each subwatershed except for the watershed total, which is based on stream length in the entire watershed (approximately 1400 km).

2.1.2 Slope/Substrate/Morphology

As noted in the previous section, a second critical factor characterizing aquatic habitat is stream slope. Stream slope influences the deposition of substrate and stream morphology (MTRCA and OMNRb, 1992). High (steep) slopes tend to have high water velocities, a higher ratio of riffles to pools and substrates primarily composed of larger materials such as cobbles and boulders. Low (gradual) slope areas have lower water velocities and thus contain fine materials like sand and silt. Water velocities and the movement of stream bed material are low. In general, stream slopes are highest in first order, headwater streams and decrease with increasing stream order.

The slope map for the Humber River watershed was completed using data from the 1:10,000 Ontario Base Map series produced by the OMNR (Figure 3).

Four slope classes have been determined, with each having a different set of stream characteristics. Watercourses with slopes less than 0.3% (low) generally have a greater pool to riffle ratio than higher slope streams. Stream substrates associated with low gradient sections are made up primarily of sands and silts. On-line ponds were also included in this category.

Streams in the second slope category, 0.31 - 1.0% (moderate), are less sinuous and contain fewer pools than the streams in the first category. Substrates tend to be made up of larger materials like gravels and cobbles.

The third slope category contains streams with slopes of 1.01 - 5% (high). Riffles tend to outnumber pools as a result of higher velocities and reduced sinuosity. Stream bed material is composed of substrates like large gravels, cobbles and boulders.

The final slope category includes all those watercourses with slopes greater than 5% (very high). In these streams, riffles predominate and water velocities and erosional forces are high. Stream channels in these high velocity watercourses tend to be relatively straight. Substrates are large and are made up of boulders, cobbles and sometimes hard clay.

Stream slope is influenced by many things including the material over which the stream flows. For example, the presence of a layer of hard material such as clay, bedrock or large material such as boulders can act to hold the stream bed in position. These "layers" result in a transition in gradient, with low slope upstream and high slope downstream, thus influencing the slope and the type of material found in the stream. In some cases, these hard, less erodable layers may also be aquitards or layers of material that effectively block the upward or downward movement of groundwater and force it to move horizontally, where it may ultimately discharge to a watercourse.

Identifying distinct changes in stream slope is one method of identifying where an aquitard is at the surface and, therefore, a potential area of groundwater discharge. Development and the introduction of hard surfaces like dams, roads or concrete channels may also create a distinct change in slope, and, must be considered when analyzing the gradient profiles in Figures 4 - 6.

Based on these figures, eleven areas were located where the change in stream slope suggests that potential groundwater discharge to a watercourse occurs. In the Upper Main Humber River subwatershed, these are: (1) south of the Township of Mono and Town of Caledon Townline, (2) in close proximity to the Town of Caledon and Township of Adjala Townline, and (3) south of the City of Vaughan and Town of Caledon Townline. In the East Humber River subwatershed these locations include: (1) near and east of Highway 400, (2) north and south of Kleinburg and (3) near the confluence with the main branch of the Humber River. Four locations in the West Humber River subwatershed are found: (1) in the vicinity of King Road and Goreway Drive, (2) north of the City of Brampton and Town of Caledon Townline, (3) in the area north of Hwy 7 and (4) upstream from the confluence with the main branch of the Humber River. In the Black Creek subwatershed, one location between Finch and Sheppard Avenues may also be an area of groundwater discharge.

These areas have not been groundtruthed, but future low flow and temperature monitoring and analysis of the York/Durham/Peel/Toronto groundwater model will help in confirming these and other locations.

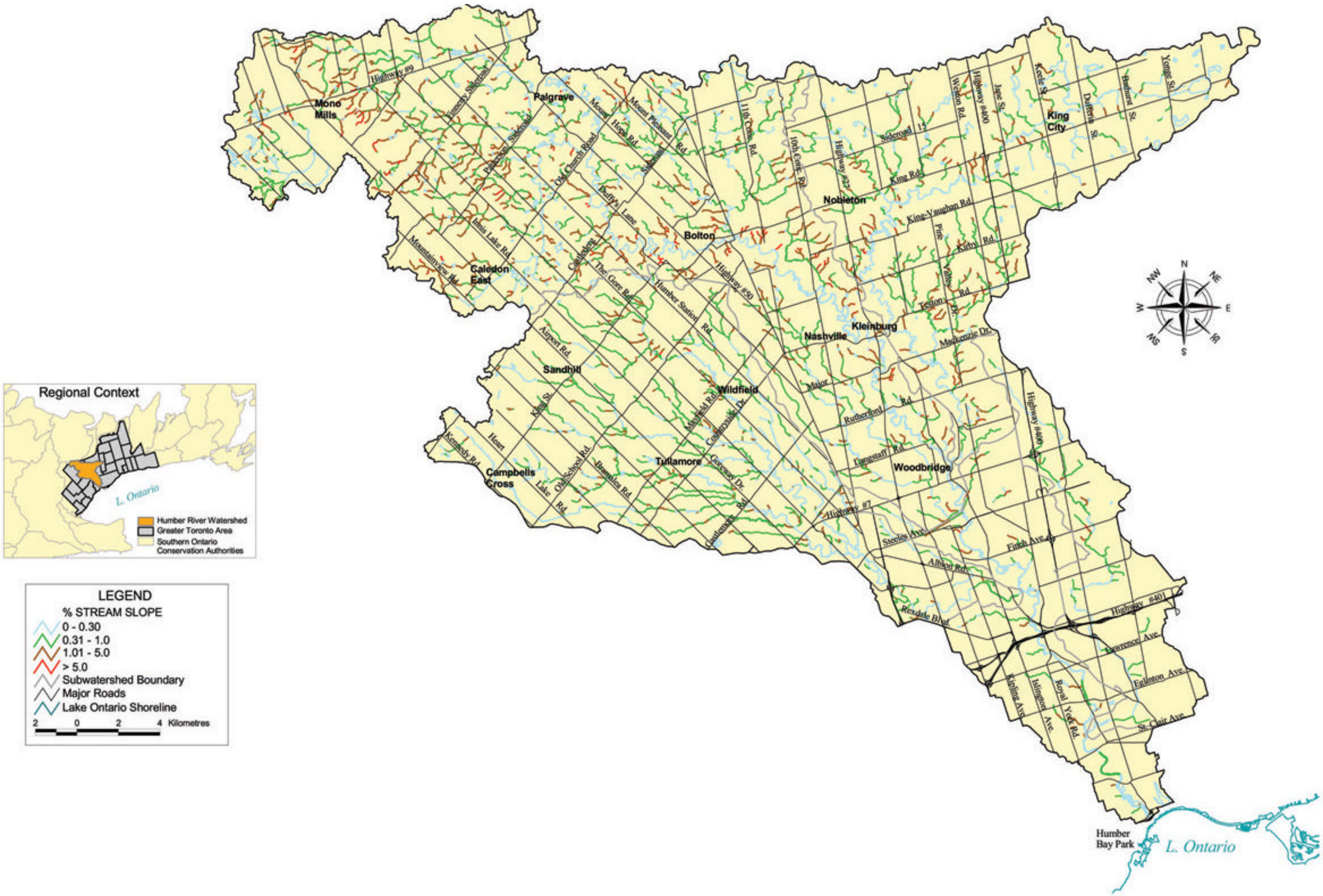
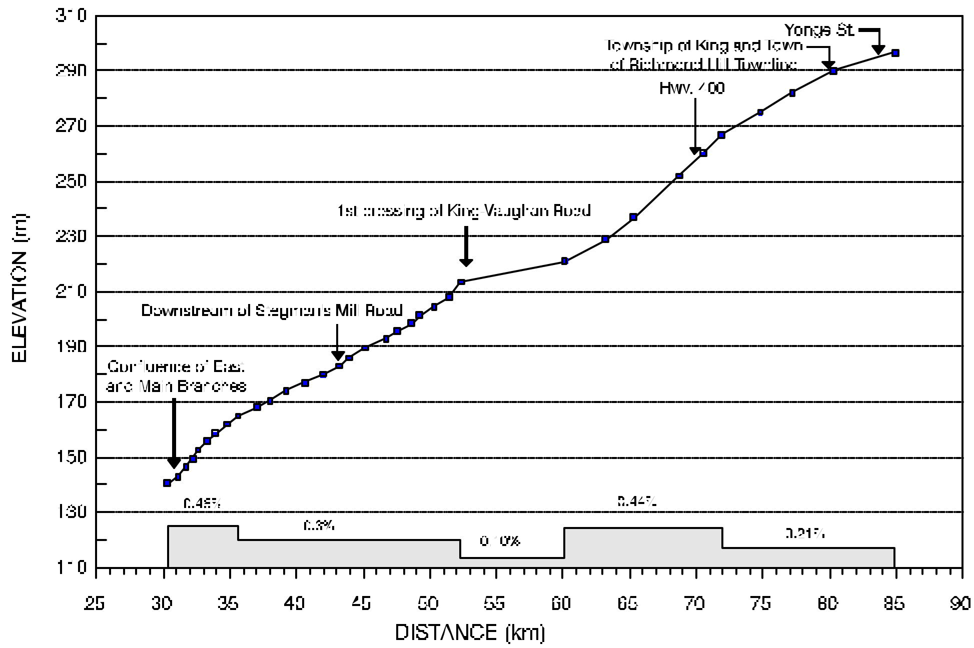
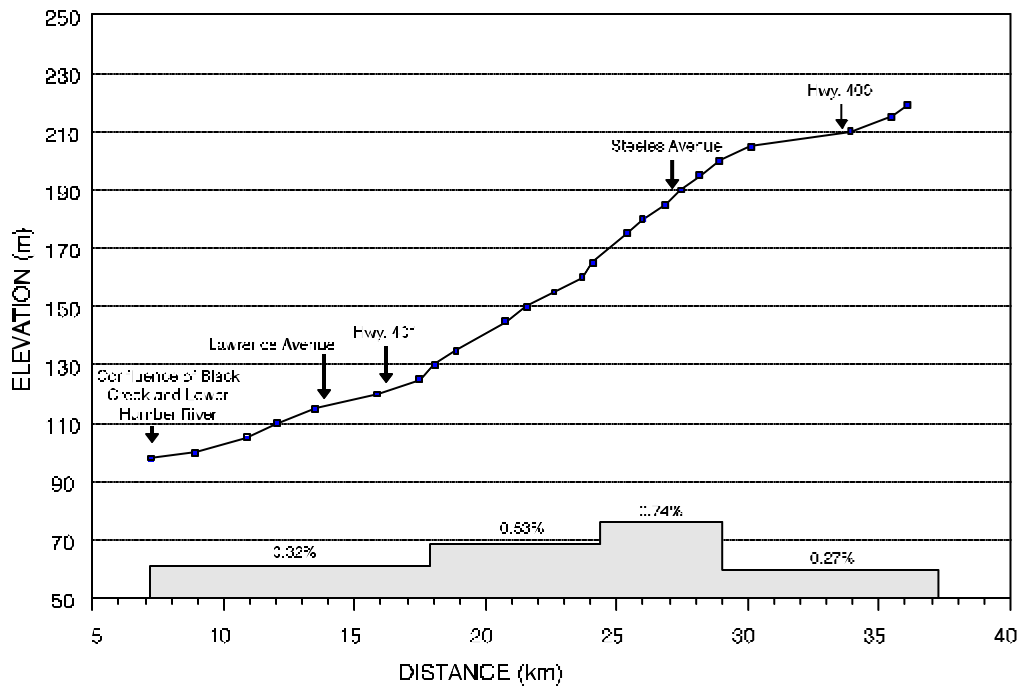


Figure 3. Stream Slope for the Humber River Watershed



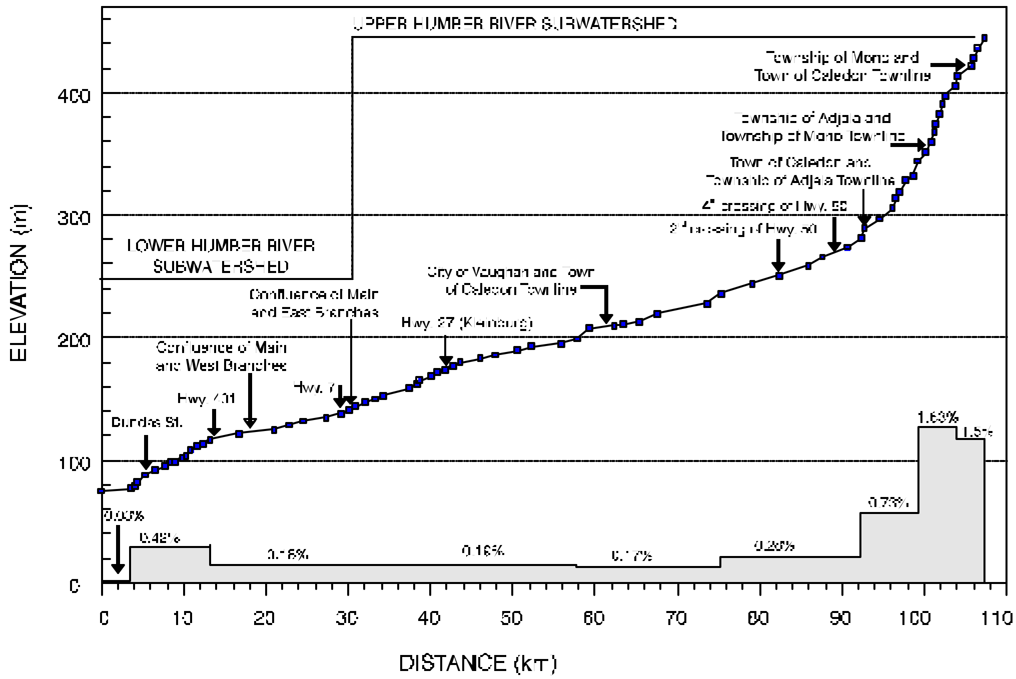
Source: MTRCA. 1988. Master Drainage Plan.

Figure 4. Slope Graph for the East Humber River Subwatershed



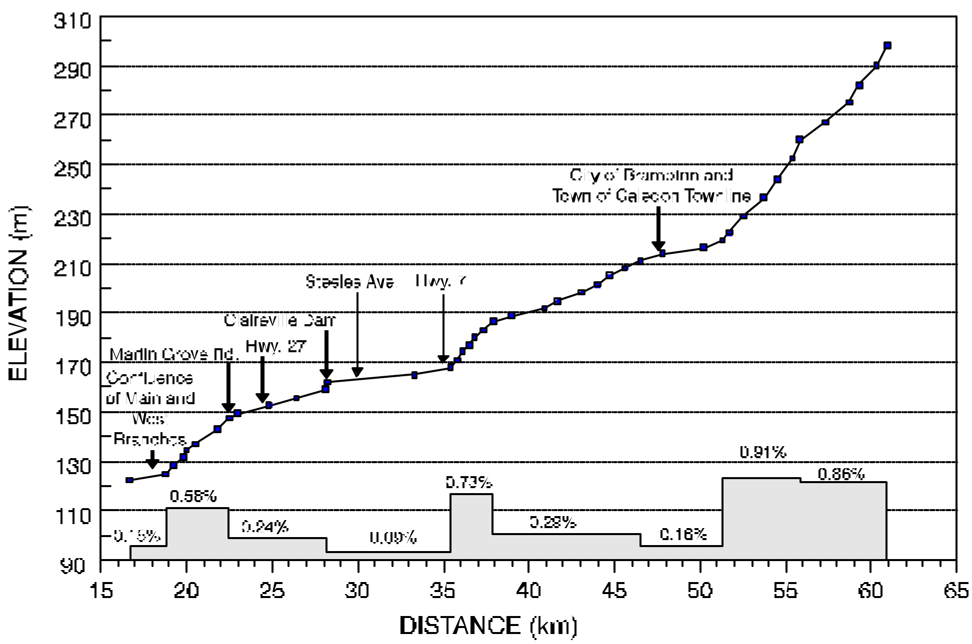
Source: MTRCA. 1983. Master Drainage Plan.

Figure 5. Slope graph for the Black Creek Subwatershed



Source: MTRCA. 1985. Master Drainage Plan.

Figure 6. Slope graph for the main branch of the Humber River



Source: MTRCA. 1983. Master Drainage Plan.

Figure 7. Slope graph for the West Humber River

2.1.3 Flow Regime

Water precipitated to the ground will take one of three pathways. It will either evaporate, run-off or infiltrate into the ground. The rate and amount of water taking each pathway depends upon factors like soil type, topography, land use, soil moisture and precipitation intensity and duration. Typically, as a natural area becomes developed, the rate and amount of surface run-off to watercourses increases and infiltration decreases. Storm events raise the water level in watercourses more rapidly, more often and to higher levels than under pre-development conditions. Watercourses may also experience lower flows during dry periods (summer) or even dry up completely due to reduced groundwater inputs.

Aquatic communities may be adversely affected by these changes in the flow regime. Sudden, flashy flows may increase erosion causing increased sedimentation, loss of cover (Pearsons and Li, 1992) or simply wash aquatic invertebrates or fish downstream. Flow attenuation through either an increase in infiltration or a change in timing of flows (or a combination of both) will help to create more stable flows, which will subsequently benefit aquatic communities.

Decreases in the amount of groundwater entering a watercourse may result in increased water temperatures or even cause a stream to dry up completely, which is particularly harmful in coldwater streams. Understanding the influence of flow regime on aquatic habitat is, therefore, of critical importance in protecting and rehabilitating aquatic communities.

2.1.3.1 Groundwater/Baseflow

Groundwater is defined as subsurface flow that occurs in fully saturated soils and geologic formations (Freeze and Cherry, 1979). Where these saturated soils or geologic formations intersect the surface, groundwater discharge occurs. Groundwater discharged to a stream forms baseflow and is critical for maintaining water flows, especially during the drier, summer months. In the Greater Toronto Area, groundwater temperatures are in the range of 8 - 10^{o} C. The more groundwater discharged to a stream the lower and more stable are water temperatures, which is important to temperature sensitive species like brook trout. Furthermore, groundwater is also relatively clear (sediment free) as it discharges into a stream. This is very important for brook trout spawning since they often spawn upon locations of groundwater discharge (upwelling). Bowlby and Roff (1986) state that groundwater discharge is one of the major characteristics that determines the presence of a cold or warmwater fish community.

One of the roles surficial geology plays in stream morphology is determining infiltration of precipitation. The type and surface area of soils within a subwatershed will control the amount and rate of run-off to the streams versus infiltration to the ground. Since the groundwater discharge is critical to maintaining baseflows, determining the type and extent of surficial materials is critical to understanding areas of potential groundwater recharge and discharge.

As a surrogate for surficial geology, soil data was felt to be an equivalent method of determining areas of high and low infiltration. Because soil is formed from physical, chemical and biological actions on surficial materials, soil type can provide an indication of the surficial materials. Digital agricultural soil data were available for the entire watershed except for the City of Toronto and Dufferin and Simcoe Counties from the Ontario Ministry of Agriculture and Food, Rural Affairs (1996). Original soil maps (Ontario Soil Survey, 1959 &1964) were available for these two areas but have not yet been digitized. Using a system developed by the U.S. Soil Conservation Service, hydrologic soil groups can be extrapolated from agricultural soil type (Reitblat, 1996). This system ranks soils from A to D, with A having the greatest infiltration potential and D the least. For example, sands and sandy loams allow water to pass through them quite easily and would be classified as hydrologic soil groups A and AB, respectively. On the other hand, since clays do not allow water to pass through easily, they have a low infiltration potential and would be rated as hydrologic soil group D (Reitblat, 1996). Hydrologic soil groups for the Humber River watershed are shown in Figure 8. Together, C and D soils make up the largest percentage of hydrologic soil groups in the watershed (Table 8).

Table 8: The Percentage of Hydrologic Soil Groups by Subwatershed.

SUBWATERSHED	HYDROLOGIC SOIL GROUP							
	A	AB	B	BC	C	CD	D	UNCLASSIFIED[b]
Upper Main Humber River [a]	3.1	33.7	3.3	0.7	33.7	3.4	13	0.5
East Humber River	1.9	23.1	1.5	1.4	45.7	22.1	3.5	0.9
West Humber River	0.4	7.2	0.4	4	47.3	7.4	32.1	1.1
Black Creek	1.7	3.9	0	0	37.4	16.7	2.9	37.4
Lower Main Humber River	16.7	5.4	0.5	0	32.8	12.1	21	11.5
WATERSHED TOTAL	2	21.6	1.8	1.6	41.3	10.6	16	4.5

[a] - digital data was not available for Dufferin and Simcoe Counties, therefore the drainage area was not used in this analysis.

[b] - urban areas or large bodies of water .

Habitat Suitability Indices developed in the United States use baseflow as a percent of mean annual daily flow to determine habitat suitability for certain trout species (Raleigh, 1982; Raleigh et al., 1984; Raleigh et al., 1986). This ratio is useful to help determine how much a watercourse fluctuates and thus provides an indication of flow stability. They suggest that ratios above 50% are excellent for trout production, between 25 and 50% are good and less than 25% are poor. The higher the ratio, the more stable the flow and the more likely the habitat is suitable for sensitive, coldwater species. Conversely, the lower the ratio, the less stable the flow and the less suitable the habitat for sensitive, coldwater species.

By comparing historical stream and baseflow data for numerous rivers around Toronto, it appears that in streams where brook trout or resident brown trout are known to exist (eg. Cold Creek, Shelter Valley Brook, Wilmot Creek, the Credit River near Cataract), baseflow to average annual flow ratios are in the order of 34.8-37.1% (Appendix I). The main branch of the West Duffins Creek has a baseflow to average annual flow ratio of only 23.5% but is still able to support migratory rainbow trout. These stations also have a high baseflow yield, another indication of the ability to support coldwater species.

When comparing flow data from nine stations in the Humber River watershed, three locations have baseflow to average annual flow ratios in the range of 32.9 to 37.7 %, indicating their ability to support coldwater species. These three locations are Cold Creek near Bolton and the Upper Main Humber River at Cedar Mills and Elder Mills (Table 9).

Although baseflow data for Purpleville Creek are not available, historic fish collection records indicate the presence of resident brook and brown trout. By inference, it is likely that this sub-basin has a high ratio of baseflow to average annual flow and is clearly able to support coldwater species.

The ratio of baseflow to average annual flow is in the order of 1% for the West Humber River subwatershed at Regional Road 107 (formerly Highway 7). This suggests that the majority of the tributaries in this subwatershed are only able to support a warm water fish community. An anomaly occurs on the tributary flowing through the hamlet of Campbell's Cross in the Town of Caledon where fish collection records as recent as 2003 indicate the presence of brook trout. Other anomalies may occur on some of the other watercourses flowing from the south Slope. Since the baseflow information at Regional Road 107 (formerly Highway 7) includes flow from all tributaries, some watercourses further upstream may have a higher baseflow to average annual ratio. As well, if the majority of flow in the West Humber River subwatershed originates from only a few tributaries (such as the one flowing through Campbells Cross), these headwater areas may be able to support coldwater communities.

Baseflow ratios in the East Humber River are available at King Creek and Pine Grove where they are approximately 12.8% and 13.9%, respectively. These are much lower than ratios for watercourses in the Upper Main Humber River subwatershed. Between these two points on the East Humber River, mean 7-day baseflow has actually increased to 0.167 $m^3/s/km^2$, suggesting that the low baseflow ratio is due to high average annual flow rather than insufficient baseflow (Table 9). There is also additional evidence that coldwater species are able to survive here. Historic fish collection records indicate the presence of brown trout up to Kleinburg and mottled sculpin throughout the main branch of the East Humber River up to Bathurst Street. These same trends are reflected in the sampling data gathered by TRCA in 2001. Some of the smaller tributaries and the main branch of the East Humber River from approximately Highway 400 to below the confluence with Purpleville Creek, through a combination of soil type and slope, may have groundwater discharge and enough baseflow to support cold water species. This is further evidenced through the sampling data gathered by TRCA in 2001, when coldwater species such as rainbow and brown trout, mottled sculpin, and American brook lamprey were found.

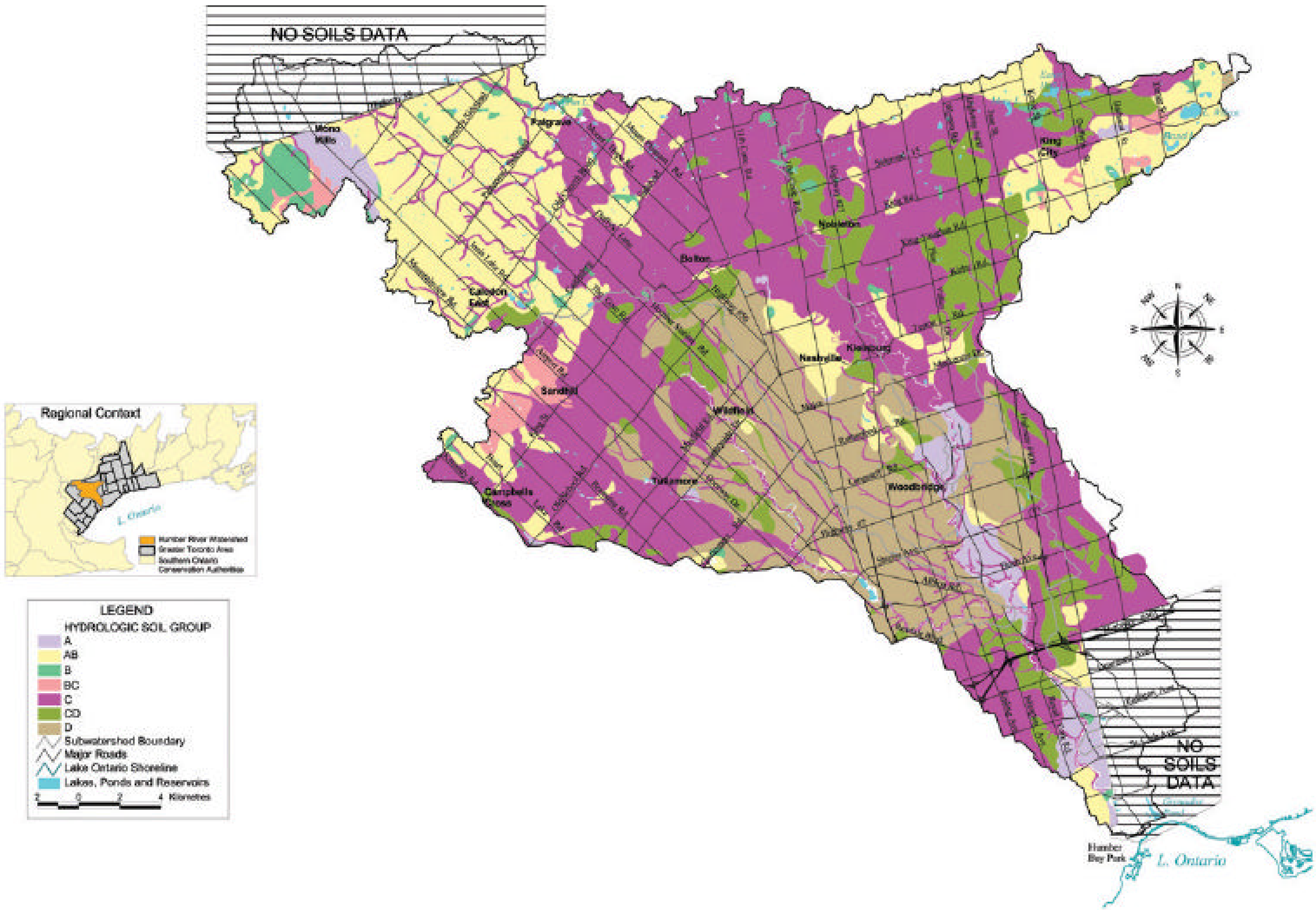


Figure 8. Hydrologic Soil Groups in the Humber River Watershed

Table 9: Analyses of Flow Data From Gauging Stations in the Humber River Watershed.

RIVER	LOCATION	STREAM GAUGE	DRAINAGE AREA (km^2)	MEAN 7-DAY BASEFLOW ($M^3/S/KM^2$)	AVERAGE ANNUAL MEAN DAILY FLOW ($M^3/S/KM^2$)	RATIO OF MEAN BASEFLOW TO AVERAGE ANNUAL FLOW (%)
Black Creek	near Weston	02HC027	58	NA	0.802	0.0
Cold Creek	near Bolton	02HC023	62.2	0.18	0.478	37.7
Humber River	at Elder Mills	02HC025	303	0.816	2.48	32.9
Humber River	near Cedar Mills	02HC012	169	0.485	1.45	33.4
Humber River	at Weston	02HC003	800	1.039	5.89	17.6
Humber River (east)	at King Creek	02HC032	94.8	0.075	0.586	12.8
Humber River (east)	near Pine Grove	02HC009	197	0.167	1.2	13.9
Humber River (west)	at Hwy. 7	02HC031	148	0.013	1.06	1.2
Humber River (west)	below Claireville Dam	02HC034	194	0.008	1.24	0.6

For watercourses with no actual baseflow ratios, the amount of baseflow must be inferred from surficial geology (soils) data and the assumption that streamflow is proportional to basin size and the percentage of coarse soils present (MTRCA, 1996). Under this assumption, an approximate estimate of baseflow ratio can be determined using the baseflow ratio at existing gauging stations and the percentage of coarse soils present in the subwatershed (Figure 9).

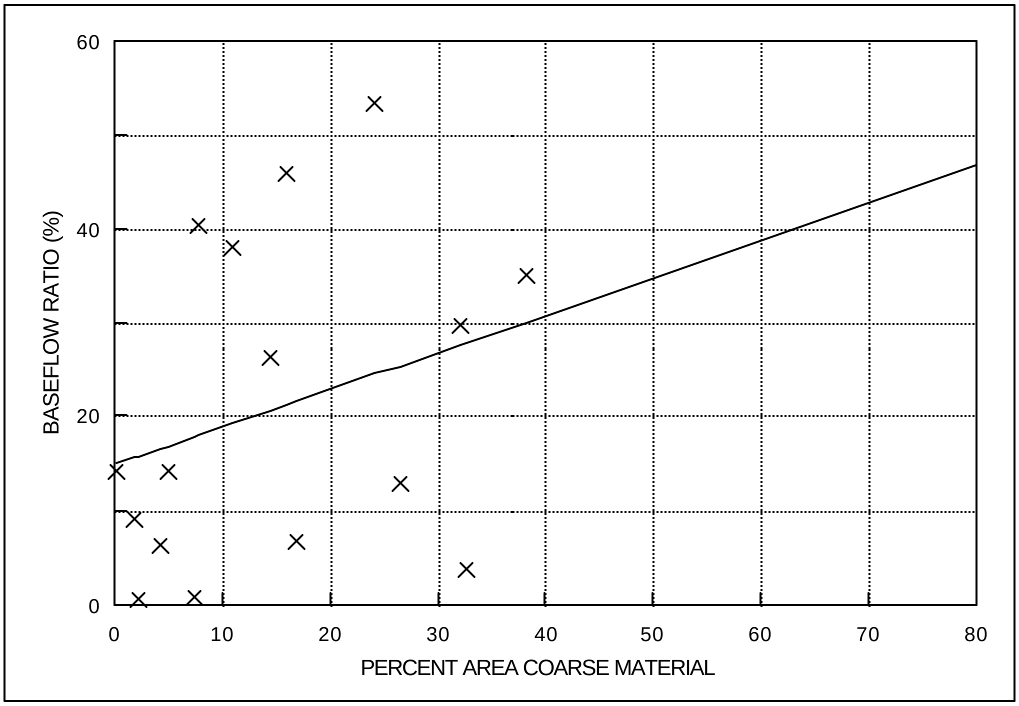


Figure 9. Relationship between percentage of coarse surficial material in a drainage area and baseflow ratio for stream gauging stations around Toronto. Flow data were obtained from gauging stations and the surficial geology is adapted from Sharpe and Finley, 1995 (Geological Survey of Canada).

Based on Figure 9, the estimated baseflow ratio for Black Creek is approximately 15%. Due to the high intensity of development and lack of baseflow, Black Creek is unable to support a self-sustaining cold water fish community but has the capacity to support a warm water fish community and due to some localized groundwater inputs, may be able to support an introduced coldwater species such as brown trout.

Overall, the Upper Main Humber River subwatershed contains the highest percentage of coarse soils in the watershed and is therefore more likely to have a high amount of infiltration and baseflow. The West Humber River subwatershed has a low proportion of coarse soils and is expected to have more surface run-off, and therefore, less baseflow, than the other subwatersheds. The East Humber River subwatershed has a moderate amount of coarse soils and as such will have areas of high and low infiltration. Black Creek has a low amount of coarse soils and as a result has insufficient baseflow to support a self-sustaining coldwater fishery. Further analysis at a sub-basin level would provide more detail on specific watercourses as to their ability to support cold or warmwater aquatic communities.

Water taking is the removal of water from either the surface or sub-surface of the earth and is used for irrigation, watering of livestock, golf courses and municipal and domestic drinking water. This issue is of concern in the watershed because of its potential impacts on the aquatic community. The removal of too much groundwater can impact watercourses by causing very low or even no flow conditions and increased summer temperatures due to lower groundwater inputs. The Ministry of Environment (MOE) oversees the permits to take water and has set limits on the amount allowed for the Humber River watershed. A permit is required when the amount to be withdrawn is greater than 50,000 L/day (50 m^3/day). This means that there are likely numerous locations where water is being taken without a permit being issued, thus making the estimation of all the water being withdrawn from the watershed challenging.

In 2000, the TRCA initiated a work plan to develop a Low Flow Management Program. This program is aimed at gaining an improved understanding of the connections between surface and groundwater systems, through the measurement and mapping of the quantity and distribution of base flows within each the watersheds found in TRCA's jurisdiction. The program itself is being developed to allow the TRCA to manage more effectively and protect baseflow systems through an integrated approach with other TRCA programs and through the MOE's Permit To Take Water approval process. The data collected in support of this program are being used to assist in the development of groundwater and water budget models which encompass information related to land use, surficial soils and the underlying geology to delineate the extent of aquifer systems and associated key recharge/discharge areas. This information is then used to adopt more comprehensive strategies for watershed management, based upon a better understanding of the distribution of baseflows and their associated influence on the aquatic ecosystem.

As a result of this Low Flow Management Program, the protection measure for baseflow has been more accurately established. The 60% durational flow (also called the 60% exceedance flow) has been established as the minimum baseflow volume to be protected during the months of June, July, August and September.

2.1.4 Instream Barriers

Natural obstacles to the movement of humans and aquatic organisms such as beaver dams and log jams have always been found in the Humber River Watershed. Log jams are often only located on the water surface and usually allow fish passage underneath. Beaver dams cause flooding and hydrologic alterations but since they are not as permanent as human-built structures, their effects are not as severe. Beaver dams and their associated ponds have also been a natural part of the Humber River's ecology for thousands of years. In fact, the presence of woody material was found to be an important habitat component in streams with anadromous fish runs (Sedell and Luchessa, 1981), and beaver activity can be a major source of woody material. Furthermore, rainbow trout are often able to pass by beaver dams and continue upstream.

Dams and weirs were constructed on the Humber River for a variety of reasons; power for saw mills, energy dissipation, flood control, irrigation, recreation and aesthetics. A number of impacts result from the construction of these barriers. The upstream ponding of the water due to its lower velocity causes suspended particles to settle out. Over time, the pond will fill in with sediment, creating the need to dredge the pond. The accumulation of sediment means that less sediment is being transported downstream, potentially starving downstream reaches of natural bed load. Should the barrier break, years of deposited sediment may be released at once, inundating downstream aquatic communities with sediment. The upstream pond is likely to receive little stream shade and as a result, will warm up considerably during the summer. The warmer water may reach temperatures beyond those tolerated by downstream aquatic communities, compromising their ability to survive. These structures also restrict upstream movement of fish and other aquatic organisms, restricting access to spawning, nursery or feeding habitats or temperature refuges.

In some cases, restriction to movement is beneficial. Undesirable species like sea lamprey are unable to move past the Old Mill dam to reach spawning grounds, thereby limiting reproductive success. Barriers may also reduce competition between species by restricting movement of undesirable fish into areas containing stable native fish communities. Colonization by invasive species, such as the round goby, can be controlled through the use of barriers. Another benefit of instream barriers is energy dissipation. A relatively large drop in elevation over a short distance can remove much of a river's erosive force thus reducing downstream erosion concerns.

A TRCA (1996b) survey of instream barriers identified more than 110 barriers in the watershed (Figure 10), however, this survey did not cover the West Humber River subwatershed and due to the presence of riparian vegetation on the smaller streams, may have missed additional barriers in the headwaters. A breakdown of instream barriers by subwatershed is shown in Table 10. Additional barriers have since been noted and there may still be unrecorded barriers, particularly in wooded areas, smaller tributaries and on private land. Beaver dams were not recorded since they are more temporary than human-made structures and they have been a natural component of the watershed for thousands of years.

Table 10: Instream Barriers in the Humber River Watershed (1996).

SUBWATERSHED	NUMBER OF BARRIERS
Upper Main Humber River	50
East Humber River	15
West Humber River[a]	19
Black Creek	16
Lower Main Humber River	10
WATERSHED TOTAL	110

[a] – no air photo interpretation completed

Human-made barriers were part of the reason that Atlantic salmon were unable to reach historic spawning grounds and have since become extirpated in the Humber River watershed. The following barrier mitigation projects have significantly improved access for migratory species and the movement of resident species:

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

Pictures of these projects are shown in Appendix II. 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. Chinook salmon can now be observed spawning in the main river upstream of Highway 7 in Vaughan. Additional projects are planned to further improve fish access within the lower watershed. These efforts should be focussed on improving access for non-jumping species rather than just "jumping" species (e.g. salmonids) to ensure improved spawning opportunities for the maximum number of species possible, while recognising the need to avoid access by species such as sea lamprey and round goby. Improving fish passage in the lower river is a high priority rehabilitation target for the watershed.

The removal or mitigation of any barrier, whether it is to allow for the passage of salmonids, the increased movement of resident fish, or thermal mitigation, should undergo careful consideration and planning before attempting. Generally, the higher the vertical drop, the greater the degree of assessment and planning required. Proponents should consult with OMNR and TRCA prior to undertaking a barrier mitigation project.

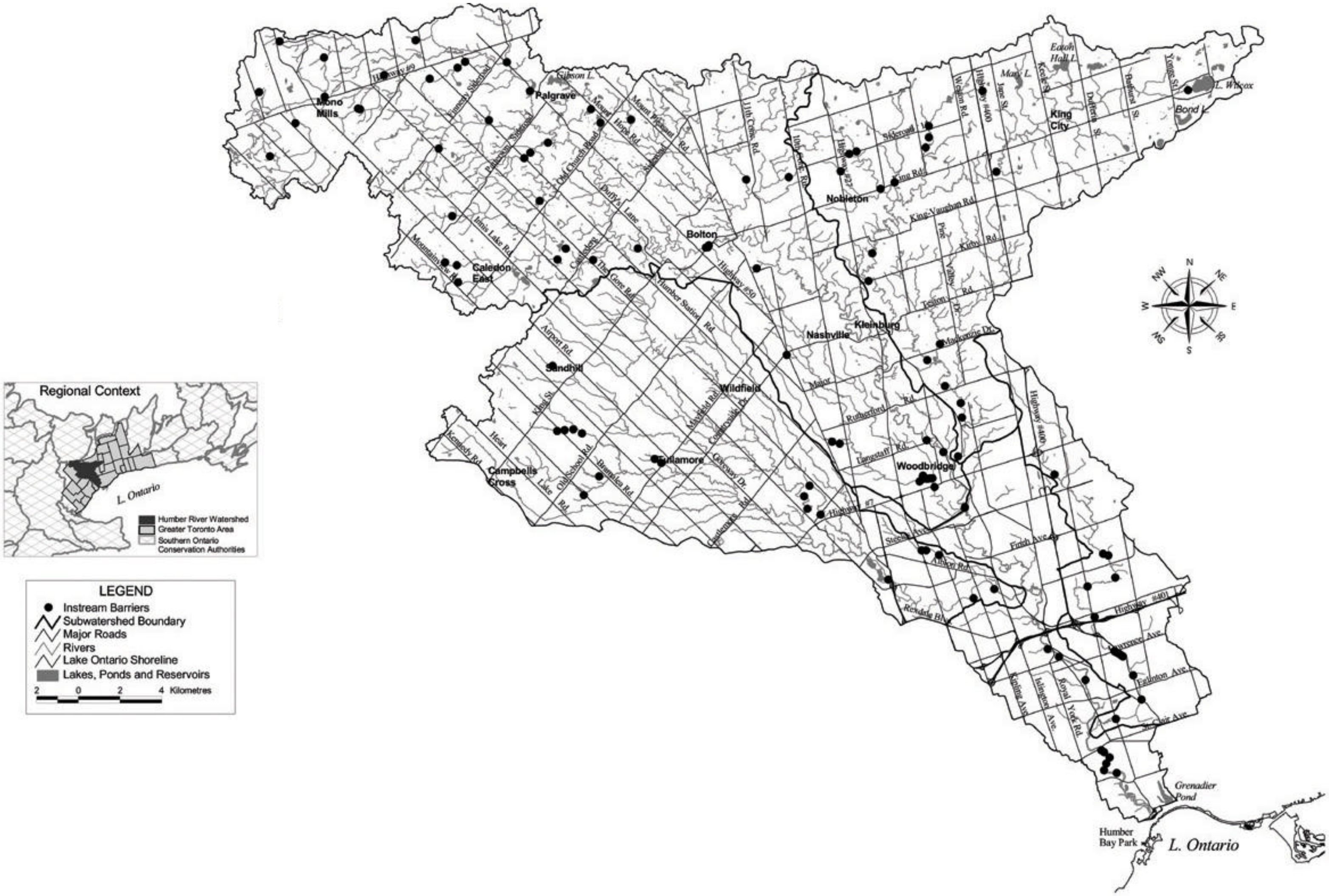


Figure 10. Instream barriers in the Humber River Watershed

2.1.5 Riparian Zone

In this document, 'riparian zone' is defined as: the zone from either edge of the channel of the stream up the slope to a point roughly equivalent to the 1:20 year flood return elevation or 30 metres, whichever is greater. It is within this area that underlying soils are saturated by groundwater or intermittently inundated by surface water at a frequency and duration sufficient to support the prevalence of vegetation typically adapted for life in a saturated soil (MNR, 1994). The vegetation communities within this zone are further divided into the following four categories: forest; meadow; wetland; and, successional. Successional habitats are generally defined as those areas that are sparsely vegetated with woody vegetation (i.e. trees and shrubs), while meadow habitats are defined as those areas dominated by herbaceous vegetation and do not include either manicured areas or woody vegetation. Those categories that abutted a given watercourse were mapped based on interpretation of 1999 orthophotography for the Humber River watershed (Figure 11). The reaches with riparian vegetation were further quantified as the length of stream with forest, meadow, wetland, or successional riparian vegetation or percentage of total stream length. Overall, just over 40% of the watershed has woody vegetation within the riparian zone (Table 11).

Riparian vegetation serves to maintain bank stability, reduce erosion, and provide cover for fish and aid in shading the stream. Because woody vegetation does not die in the fall and is generally deeper rooted, it plays a more important role in stabilizing stream banks and stream shading than does the non-woody vegetation. Nonetheless, herbaceous vegetation can provide a nearly equivalent thermal benefit to woody vegetation in the smaller headwater reaches. In both cases, though, riparian vegetation will not lower water temperatures but will serve to keep them from rising, which is especially important in coldwater systems. Riparian vegetation plays a more important role in stream shade in the smaller first, second and third order streams which are generally narrow and can be shaded almost completely. Larger, higher order streams are usually wider and riparian vegetation is less efficient at shading but still helps to stabilize banks, provide cover and contribute organic materials to the stream. Finally, insects living in vegetation overhanging a river often fall into the water and provide food for fish.

Historically, most streams had a high percentage of riparian vegetation along their banks. The dynamic nature of healthy ecosystems ensured that disturbances such as beaver dam construction and fires acted as catalysts of change. This evolutionary process resulted in an ongoing shift from one habitat type (i.e. forest, meadow, wetland, or successional) to another and back again. In turn, this progression ensured the existence of a variety of habitats necessary to support an array of species with unique and preferred life-cycle requirements. For example, the loss of riparian forest habitats through direct tree removal by beavers reduces their desired food source. This results in an associated decline in swamp succession and, ultimately, in their transition to meadow and successional habitat once the beaver have left and the dams have washed out. However, as the impacts of development exert an ever increasing influence, there is a shift that hinders this natural process of change and results in an associated decline in species diversity. Other forms of natural disturbance such as fire are suppressed in a developed setting and, in so doing, eliminate another trigger in the shift from one habitat type to another.

In addition to influencing the natural succession tendency of riparian habitat, the removal of vegetation in favour of urban or agricultural development has increased bankside erosion, increased water temperatures and removed much of the organic inputs and cover necessary for healthy aquatic communities. The planting of riparian vegetation along stream reaches is an important part of rehabilitation projects.

Given that, prior to settlement, forest cover approached 100 %, it is recommended that the entire watershed have riparian vegetation. Seventy five per cent of the riparian vegetation should be native woody species (Environment Canada, 1998), with the remaining 25 % made up of other forms of native riparian vegetation (i.e. meadow, successional and/or wetland species). It is also recommended that under developed scenarios, given that natural forms of disturbance will be altered and/or eliminated, these areas may need to be actively managed. This approach will ensure that consideration is given at a site specific level as to whether the area should be restored with woody or herbaceous material, a combination of the two, or left to succeed naturally. This strategy should allow for the maintenance of a range of habitats and, by extension, a greater diversity of faunal and floral species.

Table 11: Woody Riparian Vegetation Amounts in the Humber River Watershed*.

SUBWATERSHED	TOTAL STREAM LENGTH (km)	STREAM LENGTH WITH WOODY RIPARIAN VEGETATION (km)	% OF SUBWATERSHED	ADDITIONAL AMOUNT OF WOODY RIPARIAN VEGETATION NECESSARY TO MEET 75 % TARGET (km)
Upper Main Humber River	675.1	342.3	50.7	164
East Humber River	296	141.5	47.8	80.5
West Humber River	316	87.4	27.7	149.6
Black Creek	45.4	15.4	34	18.65
Lower Main Humber River	66.7	25.5	38.2	24.53
WATERSHED TOTAL	1399.2	612.1	43.4	437.3

* - riparian widths were determined based on a 30m wide area on either side of a watercourse.

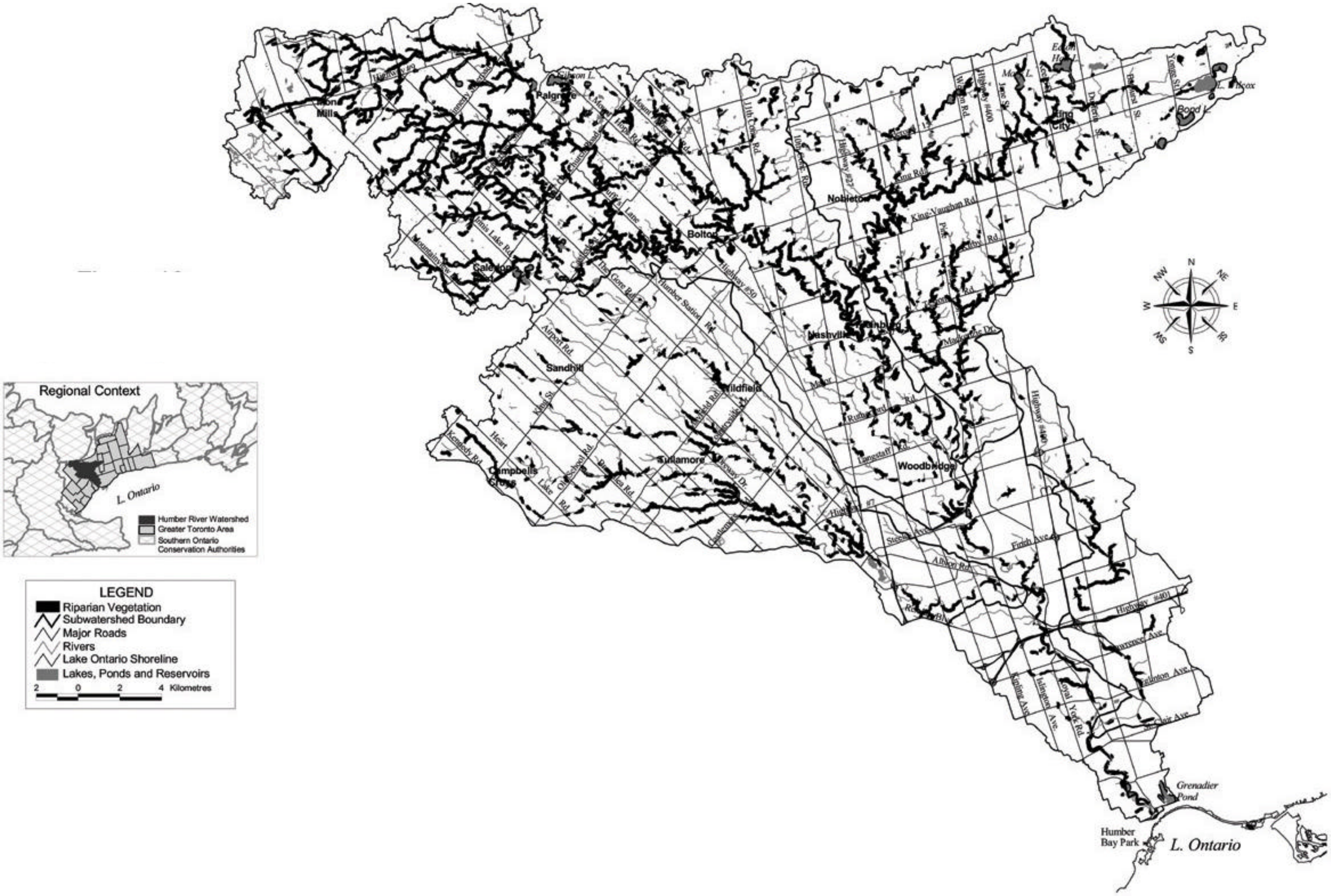


Figure 11. **Riparian vegetation in the Humber River Watershed**

2.2 Lacustrine

There are four main types of waterbodies in the Humber River watershed: impoundments (on-line ponds), off-line ponds, lakes and reservoirs. Physical characteristics of the major waterbodies found in the watershed are listed in Table 12. In general, these waterbodies can be characterized as low slope, low velocity zones of sediment deposition. Many are eutrophic and oxygen depleted near the bottom during summer months. Some, like Claireville Reservoir, are quite turbid. Due to detention time and exposure to the sun's rays, these waterbodies experience high summer temperatures which may negatively impact downstream cold or cool water aquatic communities.

Artificial and natural ponds dot the watershed. Because of the number of ponds, it is impossible to list the characteristics of each one. In general, they are likely similar in condition to the larger lakes previously mentioned.

Table 12: Major waterbodies in the Humber River Watershed.

WATERBODY	MUNICIPALITY	TYPE	SIZE (ha)	MAXIMUM DEPTH (m)	AVERAGE DEPTH (m)	OWNERSHIP
UPPER MAIN HUMBER RIVER SUBWATERSHED						
Albion Hills CA Pond	Town of Caledon	impoundment	NA	NA	NA	public
Bell's Lake	King Township	kettle lake	2.4	NA	NA	private
Elliot Lake	Town of Caledon	kettle lake	3.9	2.4	1	private
Innis Lake	Town of Caledon	kettle lake	6	11.7	3.8	private
Widgett Lake	Town of Caledon	kettle lake	3.9	6.9	1.5	private
Gibson Lake	Town of Caledon	kettle lake	4.2	NA	NA	public/private
Palgrave Mill Pond	Town of Caledon	impoundment	5.2	1.1	0.5	public
Thompson Lake	King Township	kettle lake	3.6	8.1	3.6	private
EAST HUMBER RIVER SUBWATERSHED						
Eaton Hall Lake	King Township	kettle lake	NA	NA	NA	private
Eversley Lake	King Township	kettle lake	NA	NA	NA	private
Gregloch Lake	King Township	kettle lake	1.5	5.4	2.7	private
Hackett Lake	King Township	kettle lake	5.6	16.5	3.3	private
Kelly Lake	King Township	kettle lake	0.9	10.5	3.9	private
Mary Lake	King Township	kettle lake	18	15	NA	Private/private
St. George Lake	Town of Richmond Hill	kettle lake	11	16	8	public with restricted access
Thompson Lake	King Township	kettle lake	NA	NA	NA	private
Lake Wilcox	Town of Richmond Hill	kettle lake	54.4	17	4.5	Limited public access, private shorelands
WEST HUMBER RIVER SUBWATERSHED						
Claireville Reservoir	Cities of Brampton and Toronto	reservoir	48	4	NA	Public
LOWER MAIN HUMBER RIVER SUBWATERSHED						
Grenadier Pond	City of Toronto	impoundment	18.4	6.6	3	Public
Eglinton Flats Pond	City of Toronto	impoundment	2.0	1.0	NA	Public

2.3 Wetlands

These are areas that are seasonally or permanently covered by shallow water, as well as lands where the water table is close to or at the surface. Historically wetlands were thought of as unproductive areas whose only function was to provide an area for mosquitos to grow. As a result, approximately 70% of wetlands in southern Ontario have been lost, with 85% of those losses attributed to drainage (North American Wetlands Conservation Council, 1996).

More recent studies have found that wetlands have many vital ecological roles including controlling and storing run-off, aiding in groundwater recharge/discharge, and water quality improvement, and as wildlife habitat. While all wetlands perform pivotal roles in the watershed, it is the natural on-line wetlands or riverine wetlands that are most important as fish habitat. In the headwaters, water draining from wetlands is the source of some tributaries. From a habitat perspective, these wetlands provide spawning, rearing, and feeding habitats for many fish species. Of particular note are the provincially significant Humber River Marshes located just upstream from the mouth of the Humber River. This wetland complex not only provides year round habitat for some resident fish species, it also provides seasonal habitat for lake species as well as a corridor for migrating fish species.

Analyses of historical soil data (Snell, 1988) indicate that wetlands covered more than 3800 hectares of the Humber River Watershed (Table 13). This is approximately four times higher than the amount found in the watershed today. Presently, the OMNR has evaluated 36 wetlands in the watershed, 12 of which are provincially significant (Figure 12). In total, evaluated wetlands now occupy 980 hectares or 1 % of the watershed. Environment Canada, in conjunction with OMNR and OMOE, has recommended a watershed wetland target of 10% by area in order to protect the hydrologic regime. For the Humber River watershed, this would translate to a target of 9,080 hectares of wetlands. Rather than apply this general target as a means of de-listing this ecosystem theme, this Plan recognizes the more specific watershed soils information as the basis for determining historic wetland area. The de-listing target is then derived on a percentage of historic wetland area while considering the degree of urbanization that has occurred. It is understood that existing urbanization will be a significant constraint in developing new wetlands or increasing the size of existing wetlands.

TRCA’s Terrestrial Natural Heritage System and the recently initiated project to identify sites for wetland creation in the Regions of Peel and York, also being developed by TRCA, will help to further identify potential wetland locations.

Where new wetlands are proposed or where existing wetlands are intended to be modified, the proponent should consult Ontario's Temperate Wetlands Restoration Guidelines. Every effort should be made to maximize the amount of wetland area to be created. OMNR and TRCA should be consulted early in the planning process to ensure the wetland modification designs are appropriate to the area.

Table 13: Comparison Between Historic and Present Wetland Area in the Humber River Watershed.

SUBWATERSHED	HISTORIC AREA (ha)	PRESENT AREA (ha)*	% LOST	DELISTING TARGET (ha)	RATIO TO HISTORIC TARGET	TARGET INCREASE (ha)
Upper Main Humber River	1071.56	533.4	50.2	804	75%	271
East Humber River	747.59	343.9	54	560	75%	216
West Humber River	1040.39	87	91.6	780	75%	693
Black Creek	461.9	0	100	115.5	25%	115.5
Lower Main Humber River	534.97	26.3	96.1	134	25%	108
WATERSHED TOTAL	3856.41	990.6	74	2393.5	62%	1403.5

* - Present wetland areas include only those that have been evaluated by the OMNR.

The loss of wetlands may be partly responsible for an altered flow regime in the watershed, particularly in Black Creek and the West and Lower Main Humber River subwatersheds. With much of the subwatershed's ability to store surface water lost, precipitation quickly runs off into watercourses rather than slowly infiltrating through the ground or evaporating. Unstable flows combined with a lack of cover into which fish can avoid high flows have impacted the size and composition of the aquatic community in the watershed. Furthermore, the decrease in the number and area of wetlands has reduced the habitat available for fish to spawn, feed and find shelter.

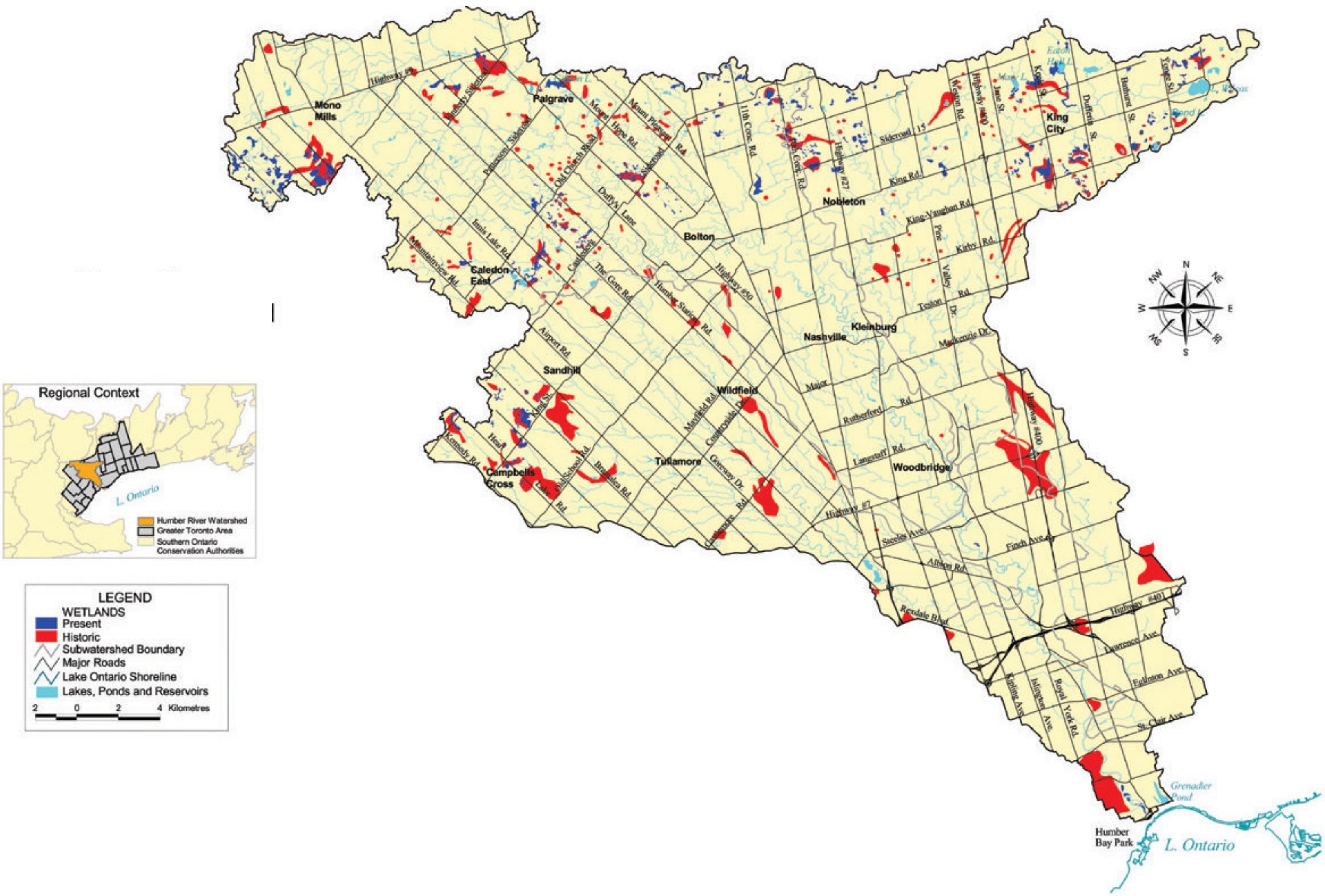


Figure 12. Locations of historic and current evaluated wetlands in the Humber River Watershed

2.4 Conclusion

The Humber River watershed covers 908 km^2 and contains five physiographic regions, all of which lend different characteristics to the watercourses that flow over them. Because of the materials found in each physiographic region, stream slope, substrate, run-off potential and groundwater recharge/discharge are extremely variable throughout the watershed. A mix of cold and warmwater riverine habitats are found in the over 1400 km of watercourses in the watershed while lacustrine habitats are present in more than 600 waterbodies. The Upper Main Humber River subwatershed has the right conditions necessary to support a coldwater fish community in many of its streams. The East Humber River subwatershed has less groundwater input than the Upper Main branch but certain sections or sub-basins, such as Purpleville Creek, clearly do support a coldwater aquatic community. In the West Humber River subwatershed, groundwater inputs are low and as such, only Kilmanaugh Creek, flowing through the hamlet of Campbell's Cross, supports coldwater species. Black Creek and the Lower Main Humber River subwatersheds are the most developed subwatersheds and would be best suited to managing toward self-sustaining warmwater aquatic communities.

Instream barriers have impacted the connection of aquatic habitats in the watershed and restricted fish movement. Mitigating the effects of these barriers is a priority action for the watershed. The mitigation or removal of instream barriers, an increase in the amount of woody riparian vegetation, particularly in the West Humber River subwatershed, and increase of overall wetland area will all serve to improve the health of the aquatic system in the watershed.

Over time, fish species have adapted to the different habitats in the Humber River watershed, creating a diversity of fish communities. Management of the Humber River watershed should therefore not be for a single fish species but must take into account the wide variety of species and aquatic habitats in the watershed.

3.0 CHEMICAL CONDITIONS

The Humber River watershed has always been an important source of agricultural products, potable water and recreation and, therefore, numerous studies have been conducted to examine water quality. The most comprehensive studies, called the Toronto Area Watershed Management Studies (TAWMS), were done in 1981-86 by the Ministry of Environment and Energy, with help from other agencies. The ten studies done in the Humber River watershed sought to better define water quality conditions, analyse cause and effect relationships for problem pollutants and areas, and develop cost-effective measures for controlling pollutant loadings to the receiving waters (MOEE, 1986). Results from these reports, as well as additional data obtained from other studies, were summarized in a water quality/quantity report prepared by the MTRCA (1995). More recent monthly water quality data from the 1996-2002 period were obtained from the City of Toronto Lake and Stream Monitoring Program, and are summarized in Tables 16 to 24. It is from these reports and additional ones prepared by TRCA (TRCA, 1998; TRCA, 2002; and, Meek et al, 1999) that a summary of the present water quality conditions in the watershed is drawn.

Due to the size and diversity of the Humber River watershed, water quality is best examined from the headwaters to the mouth. It should be noted that this is a generalization of water quality conditions in the watershed and does not specifically address local problems. More detailed information can be found in MTRCA (1995) and the TAWMS reports from the 1980's.

The less developed areas of the East and Upper Main Humber River subwatersheds generally exhibit the best water quality in the watershed. This is due mainly to the lack of urbanization, groundwater inputs and the presence of many well vegetated, natural areas which act as buffers from agricultural, industrial, commercial or residential run-off. Overland sediment delivery to streams, streambank erosion, livestock access to streams, and point sources (eg. storm sewers, Kleinburg water pollution control plant) contribute suspended solids, bacteria, and nutrients, which are the main causes of water quality impairment in this section of the watershed.

It is in the middle reaches of the watershed (ie. from approximately Highway 7 north to King Road) that the widest diversity of land uses is seen. Agriculture, natural areas, estate residential and a few small urban centres all share the landscape. Like the more rural reaches, water quality is impacted from suspended solids, nutrients, bacteria and biocides but urban sources also contribute oils, grease, road salt, metals and synthetic organic chemicals from stormwater and combined sewer outfalls, landfill leachate, snow dump sites, atmospheric fallout and spills.

The areas south of Highway 7 have the most impacted water quality conditions in the watershed. They receive all the water and the contaminants from upstream areas as well as contaminants from local sources. A high degree of urbanization has led to levels of contaminants often exceeding provincial water quality objectives.

The following is taken from Gemza and Virk (1995) who characterized lakes in the Humber River watershed as being typically eutrophic with high levels of phosphorus and seasonally depleting nitrate concentrations which often lead to surface blooms of blue-green algae. Oxygen is usually depleted below 3 m in lakes in the Greater Toronto Area by early June, with the exception of the larger Lake Wilcox that remained oxygenated to 6 m until mid-June. Most of the lakes were dimictic, mixing in the spring and in the fall, with the exception of Claireville Reservoir, which mixed in the summer. In the summer, these lakes tend to stratify, with the warmer water on top and the cooler water below and are, therefore, unable to mix. Oxygen levels in the lower portions of the lake become depleted, creating anoxic conditions. Anoxic conditions may be worsened by nutrient enrichment through the application of fertilizers or untreated sewage. Low or no oxygen in the bottom waters can result in an increase in phosphorus, manganese, hydrogen sulphide and ammonia in the deep areas, the latter two compounds being toxic to aquatic life at higher concentrations. Most kettle lakes exhibit elevated phosphorus concentrations and, often, high levels of chlorides and sodium indicative of growing stress from urbanization.

Data from the sampling stations suggest that there are also frequent exceedances of both the nitrate and phosphorus guidelines throughout the watershed (Appendix III). High phosphorus levels may be attributable to fertilizers used in residential and agricultural areas and on golf courses, to eroded soil particles from construction sites, and to sanitary sewer inputs. Phosphorus loading can lead to excessive plant growth, particularly thick mats of filamentous algae, thereby reducing available habitat for many benthic invertebrates and fish.

Recognizing the sensitivity of various taxonomic divisions of algae to different water quality conditions, the University of Toronto (U of T) initiated a study on behalf of TRCA in 2002 to monitor the distribution of periphytic algae (species live attached to substrata within the watercourses) throughout the watershed. Algae are widely considered a useful tool for assessing watershed health since they are present in most aquatic habitats, their response to change is fast because of their short lifecycles, and they play an important role in aquatic ecosystem health in that they form the basis fo the food chain. In general, there is a direct correlation between non-impacted streams (i.e. lower levels of pollution) and greater species diversity. The primary goal of this study is to characterize and monitor aquatic conditions using periphytic and soft (blue-green and green) algae as bioindicators, using similar sampling stations as for TRCA's Regional Watershed Monitoring program. The observed algal communities are then cross-referenced with the relevant water chemistry data. In May of 2002, U of T started sampling 42 sites on a semi-monthly basis, measuring: temperature, dissolved oxygen, conductivity/salinity, pH, and estimated velocity and depth. In addition, water sampling for nitrogen and phosphorus, major ions, and total metal concentrations is carried out on a monthly basis. The results of this study were not available at the time of the writing of this plan, however it is anticipated that the analysis will be available for incorporation into the next update.

Habitat loss and sedimentation, as a result of development or agriculture are also impacting some of the waterbodies in the watershed. These impacts related to human activity are likely negatively affecting fish communities. Populations of pike in Lake Wilcox, for example, appear to have dropped as a result of habitat destruction and the reduction in natural fluctuations of lake levels. St. George Lake, on the other hand, has relatively little development surrounding it and still maintains a healthy fish community. Exceedances of suspended sediment are noted to be greatest in the East Humber subwatershed at Rutherford Road (Appendix III) and may be associated with recent widespread and largescale development in this area.

Chlorides are usually present in most waters since they may be of natural mineral origin. In North America, the mean background concentration of chlorides is 8 mg/L. However, the largest contributions of chlorides can be linked to human sources such as road salt, industrial wastes, and domestic sewage. Chlorides are an important indicator of other sources of contamination. For example, an increase in chloride concentration often acts as a "signature" for runoff from salted roads and other "urban" surfaces (the spring "pulse") or leachate from landfills. While chlorides are not critical to aquatic life at levels commonly observed, concentrations of 200-500 mg/L may have an effect on aquatic life, such as inducing invertebrates to drift. Although there are limited data available, research suggests that chlorides can influence osmotic balance of fish but that these effects tend to be observed at very high levels of concentration, with the lethal concentration for fathead minnow and goldfish occurring at 7650 mg/L and 7341 mg/L, respectively. These concentrations are much higher than even the maximum level (2110 mg/L) observed at the Black Creek monitoring station.

General trends in the lethal toxicity of road salts indicate that: the tolerance to elevated concentrations of salt decreases with increasing exposure time; aquatic biota are more tolerant of salts in water with higher oxygen concentrations and lower water temperatures; and, there is significant variation in salinity tolerances from one species to another. It should also be noted that road salts may increase the mobilization of metals and their associated toxicity. Finally, road salts, by increasing the density of water, may result in meromictic conditions (permanent stratification) in lacustrine environments, where the lower layer is oxygen deprived (Evans and Frick, 2000).

In part, it was poor water quality that was responsible for the loss of Atlantic salmon from the watershed. More stringent controls, improved technology and increased public awareness has improved water quality in the watershed in some degraded areas, but overall, water quality in the Humber River watershed is good. The best water quality is found in portions of the Upper Main and East Humber River subwatersheds, where water quality is high enough to support populations of brook trout. Already developed areas in the Black Creek and the Lower Main Humber River subwatersheds have the worst water quality in the watershed. Except for the Humber River Marshes at the river's mouth, fish communities in these subwatersheds are not very diverse and are generally composed of pollution tolerant species.

4.0 BIOLOGICAL CONDITIONS

In this section of the Plan, an evaluation of the health of the fish and invertebrate community, physical habitat, flow regime, and water quality is presented. The purpose of this section is to develop an understanding of how the aquatic system functions.

The composition of a fish community or in some cases, the presence of individual fish species, is widely accepted as an indicator of the health of the aquatic ecosystem (Steedman, 1987). The Index of Biotic Integrity (IBI) system of evaluating aquatic ecosystem health includes two local indicator species. The presence of brook trout is an indicator of a healthy system while a high abundance of blacknose or longnose dace, generally indicates a degraded system (Steedman, 1987).

Living organisms are good indicators of condition since they are affected by many physical and chemical changes to their environment and thus tend to be integrators of a variety of disturbances. For rivers and streams, fish and benthic invertebrate communities are often used as indicators of aquatic health. Fish communities are used as an indicator of aquatic ecosystem condition in this Plan for several reasons: information on fish communities is readily available from the OMNR and the TRCA; there is generally comprehensive coverage for many watercourses; and, there are historic records dating back to the middle of the twentieth century. Furthermore, many fish species, especially game fish and rare, threatened or endangered species are valued by society.

Invertebrates are also important in a stream ecosystem as a source of food for many species of fish including brook trout, white sucker, redside dace, golden shiner, longnose dace, pumpkinseed and fantail darter. There are numerous advantages to using benthic invertebrates as indicators of stream health; invertebrates are good indicators of localized conditions, they integrate the effects of short-term environmental variations, sampling is relatively easy, they are a food source for many commercially and recreationally important fish species and they are abundant in most streams (Plafkin et al., 1990).

Finally, recognizing the sensitivity of various taxonomic divisions of algae to different water quality conditions, U of T initiated a study on behalf of TRCA in 2002 to monitor the distribution of periphytic algae throughout the watershed.

4.1 Historic Fish Community

There have been numerous surveys of the fish community in the Humber River watershed (Table 14). 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 collected and preserved fish 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. 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.

Table 14: Summary of Fish Surveys in the Humber River Watershed.

SURVEY DATE(S)	COLLECTORS	NUMBER OF SAMPLING STATIONS	FISH SPECIES CAUGHT
June, 1937	Mayall (Natural Resources Inventory of King Township)	16 in King Township only	17
June-July, 1946	Mayall (Ontario Department of Planning and Development)	140 throughout the watershed	29
July, 1959	Wainio (OMNR)	5 on each of the East and Upper branches, 1 on the West	21
Aug., 1972	Anderson and Taylor (OMNR)	34 throughout the watershed	32[1]
June-Aug., 1972	Wainio and Marquis (OMNR)	194 throughout the watershed	37
1974 – 1998	Metropolitan Toronto and Region Conservation Authority/OMNR	99 throughout the watershed	43
May-July, 1984	Steedman (University of Toronto)	44 throughout the watershed	32
May-Aug., 1985	Steedman (University of Toronto)	48 throughout the watershed	37
Jun-Aug., 1991	Wichert (University of Toronto)	16 throughout the watershed	24
July -Oct., 1999	Toronto and Region Conservation Authority	48 throughout the watershed	41
Aug.-Oct., 2000	Toronto and Region Conservation Authority	9 in the City of Toronto only	29
June-Sep., 2001	Toronto and Region Conservation Authority	40 throughout the watershed	42
May-Sep, 2001	Ontario Streams	11 in the Town of Caledon and City of Vaughan	23

[1] - It is likely that the record of a northern brook lamprey in this study is due to a misidentification, so that the total number of species is actually 32.

Past and present fish collections provide an important indicator of the historic distribution of fish species and communities in the watershed. This information has been digitized, forming a database of more than 360 historic fish sampling stations (Figure 13). Many of these stations were sampled more than once, resulting in more than 900 historic fish collection records.

Based on the available data, a cumulative historic list of fish species was compiled (Table 15). The cumulative historic species list indicates that there has been a total of 74 fish species documented in the watershed over the past 150 years, 64 of which are native. A list of scientific names is found in Appendix IV.

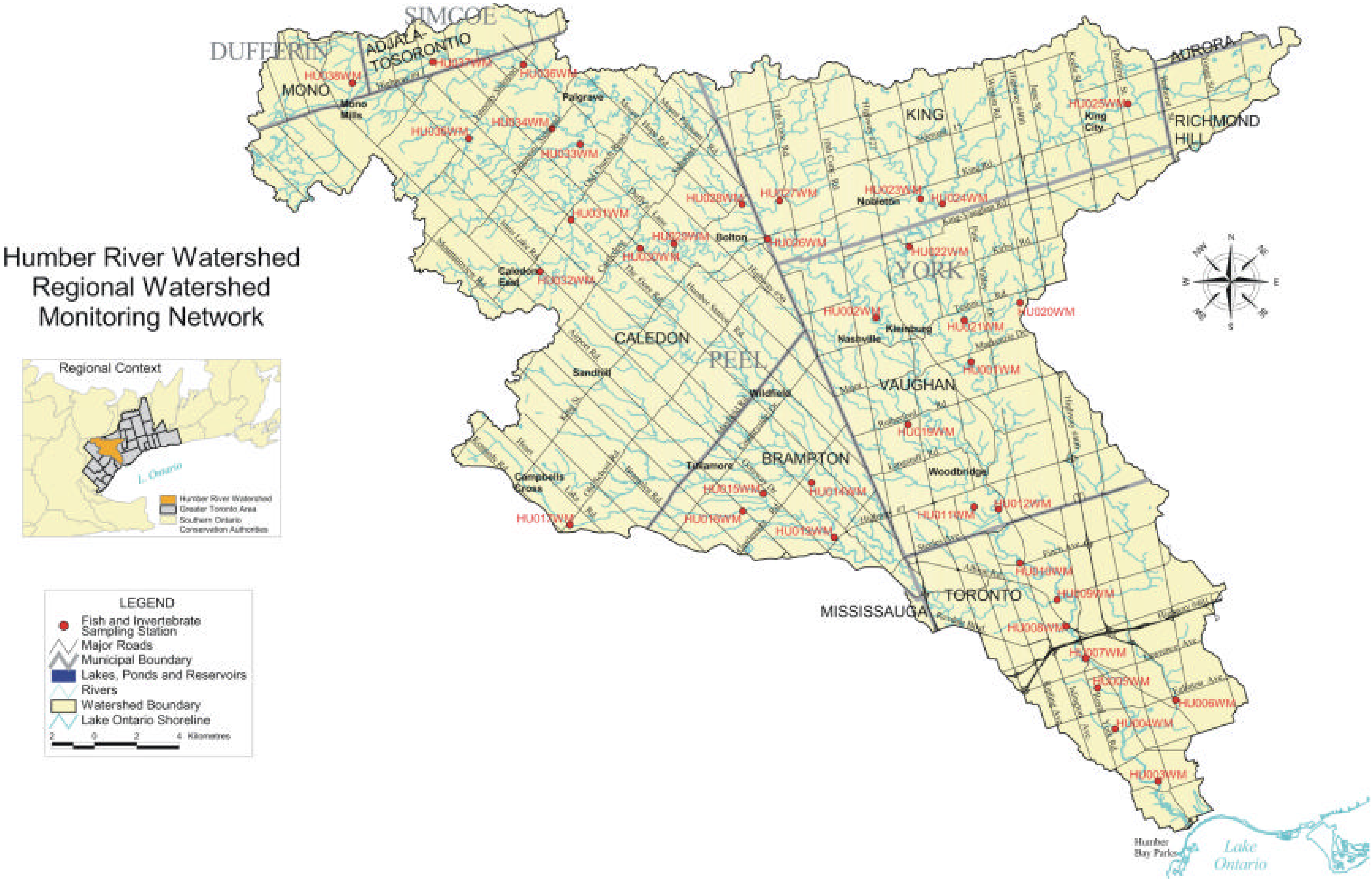


Figure 13. Aquatic Sampling Stations.

Table 15: Fish Species of the Humber River Watershed.

COMMON NAME	ODPD (1946)	Wainio (1959)	Anderson & Taylor (1972)	Wainio & Marquis (1972)	OMNR & MTRCA (1974 - 1996)	Steedman (1984/85)	Wichert (1991)	Historic Sources (1948 ODPD, 1973 Wainio)	ROM (1926 - 1996)	TRCA (1999-2000)	TRCA (2000)	TRCA (2001)	Ontario Streams (2001)
LAMPREY FAMILY													
American brook lamprey [7]		X	X	X	X	X	X		X	X	X	X	X
northern brook lamprey [52]			X										
sea lamprey[1, 4]					X				X				
GAR FAMILY													
longnose gar [4]					X			X	X				
BOWFIN FAMILY													
bowfin[4]					X			X			X		
HERRING FAMILY													
alewife [2,4]	X				X				X	X	X		
gizzard shad[4]					X			X	X	X			
SALMON FAMILY													
Chinook salmon [1, 4]					X			X					X
coho salmon [1, 4]					X			X					
rainbow trout[1]				X	X					X		X	X
Atlantic salmon [3]								X					
brown trout [6]	X	X		X	X	X	X			X		X	X
brook trout	X	X	X	X	X	X	X		X	X		X	X

COMMON NAME	ODPD (1946)	Wainio (1959)	Anderson & Taylor (1972)	Wainio & Marquis (1972)	OMNR & MTRCA (1974 - 1996)	Steedman (1984/85)	Wichert (1991)	Historic Sources (1948 ODPD, 1973 Wainio)	ROM (1926 - 1996)	TRCA (1999-2000)	TRCA (2000)	TRCA (2001)	Ontario Streams (2001)
SMELT FAMILY													
rainbow smelt[2,4]					X			X	X		X		
PIKE FAMILY													
northern pike			X	X	X				X	X	X		
MUDMINNOW FAMILY													
central mudminnow				X	X	X	X			X		X	X
SUCKER FAMILY													
white sucker	X	X	X	X	X	X	X		X	X	X	X	X
northern hog sucker	X	X	X	X	X	X	X		X	X	X	X	
MINNOW FAMILY													
goldfish [1]			X		X	X	X		X	X	X		
northern redbelly dace[9]	X	X		X	X	X	X		X			X	X
finescale dace								X	X				
redside dace [5]	X	X	X	X	X	X	X		X	X		X	
lake chub [4]									X				
common carp[1]			X		X	X			X	X	X	X	
brassy minnow [6]					X	X	X			X		X	X
hornyhead chub			X				X		X			X	
river chub	X	X	X	X	X	X	X		X	X	X	X	
golden shiner	X		X	X	X	X			X	X		X	

COMMON NAME	ODPD (1946)	Wainio (1959)	Anderson & Taylor (1972)	Wainio & Marquis (1972)	OMNR & MTRCA (1974 - 1996)	Steedman (1984/85)	Wichert (1991)	Historic Sources (1948 ODPD, 1973 Wainio)	ROM (1926 - 1996)	TRCA (1999-2000)	TRCA (2000)	TRCA (2001)	Ontario Streams (2001)
emerald shiner [9]	X		X	X	X		X		X	X	X	X	
common shiner	X	X	X	X	X	X	X		X	X	X	X	X
blackchin shiner				X									
blacknose shiner	X			X					X				
spottail shiner [4,9]					X					X		X	
rosyface shiner	X	X	X	X	X	X	X		X			X	
spotfin shiner					X				X			X	
sand shiner			X	X		X			X	X			
mimic shiner					X						X		
bluntnose minnow	X	X	X	X	X	X	X		X	X	X	X	X
fathead minnow	X		X	X	X	X	X		X	X	X	X	X
blacknose dace	X	X	X	X	X	X	X		X	X	X	X	X
longnose dace	X	X	X	X	X	X	X		X	X	X	X	X
creek chub	X	X	X	X	X	X	X		X	X	X	X	X
fallfish			X										
pearl dace					X								
central stoneroller [4]									X	X	X	X	
CATFISH FAMILY													
yellow bullhead			X	X					X				
brown bullhead	X			X	X	X			X	X	X	X	X

COMMON NAME	ODPD (1946)	Wainio (1959)	Anderson & Taylor (1972)	Wainio & Marquis (1972)	OMNR & MTRCA (1974 - 1996)	Steedman (1984/85)	Wichert (1991)	Historic Sources (1948 ODPD, 1973 Wainio)	ROM (1926 - 1996)	TRCA (1999-2000)	TRCA (2000)	TRCA (2001)	Ontario Streams (2001)
channel catfish								X	X				
stonecat[8]		X			X	X	X		X	X	X	X	
FRESHWATER EEL FAMILY													
American eel[4,6]					X			X					
KILLIFISH FAMILY													
banded killifish			X	X	X	X			X				
STICKLEBACK FAMILY													
brook stickleback	X		X	X	X	X	X		X	X		X	X
three-spine stickleback	X								X				
TROUT-PERCH FAMILY													
trout-perch[4]								X	X	X			
TEMPERATE BASS FAMILY													
white perch[2]					X				X				
white bass[4]					X			X	X				
SUNFISH FAMILY													
rock bass	X	X	X	X	X	X	X		X	X	X	X	X
green sunfish[4]									X				
pumpkinseed	X		X	X	X	X	X		X	X	X	X	X
bluegill					X			X	X	X	X	X	
smallmouth bass				X	X				X	X			

COMMON NAME	ODPD (1946)	Wainio (1959)	Anderson & Taylor (1972)	Wainio & Marquis (1972)	OMNR & MTRCA (1974 - 1996)	Steedman (1984/85)	Wichert (1991)	Historic Sources (1948 ODPD, 1973 Wainio)	ROM (1926 - 1996)	TRCA (1999-2000)	TRCA (2000)	TRCA (2001)	Ontario Streams (2001)
largemouth bass	X		X		X	X	X		X	X	X	X	
black crappie					X			X			X	X	
PERCH FAMILY													
yellow perch	X	X	X	X	X	X			X			X	
walleye					X			X				X	
rainbow darter	X	X	X	X	X	X	X		X	X	X	X	X
Iowa darter				X	X	X			X	X		X	
fantail darter	X	X	X	X	X	X	X		X	X	X	X	X
johnny darter	X	X	X	X	X	X	X		X	X	X	X	X
logperch								X					
blackside darter						X				X		X	
river darter				X									
tesselated darter [4]									X				
DRUM FAMILY													
freshwater drum[4]					X			X				X	
SCULPIN FAMILY													
mottled sculpin	X	X	X	X	X	X	X		X	X		X	X

[1] - introduced species [2] - naturalized species [3] - extirpated species
[4] - found only below the Old Milldam, Toronto [5] - nationally Species of Special Concern (COSEWIC) and provincially Threatened (COSSARO)
[6] - resident brown trout are naturalized while migratory brown trout are introduced [7] - Group 2: Intermediate Priority Candidate Species - COSEWIC
[8] - Group 3: Lower Priority Candidate Species – COSEWIC

Five native fish species, the silver lamprey *(Ichthyonyzon unicuspis*), lake sturgeon (*Acipenser fulvescens*), grass pickerel (*Esox americanus vermiculatus*), muskellunge (*Esox masquinongy*) and shorthead redhorse (*Moxostoma macrolepidotum*) are known to inhabit Lake Ontario and may occasionally enter the mouth of the Humber River, but no fisheries survey has found them in these waters. These fish were, therefore, not included as part of the historic species list.

4.1.1 Native Species

Approximately 39 and 25 native species historically found in the watershed were not collected by TRCA and Ontario Streams in 2000 and 2001, respectively (Table 15). It should be noted that, because sampling by TRCA in 2000 was restricted to the City of Toronto, the data are not representative of the entire watershed and will only be used to evaluate the health of the Lower Main Humber and Black Creek. Of the species not collected, Atlantic salmon, once very common in the Humber River, are known to be extirpated from the watershed. This occurred about 100 years ago due to pollution, the construction of barriers to migration and overfishing.

Efforts to reintroduce Atlantic salmon back into some of the watersheds of Lake Ontario through experimental stocking are currently underway, however, the availability of fish for stocking in Lake Ontario tributaries is severely limited. In 2000, 30 adults were released into the river above Bolton and in the Lower Main Humber River, some with radio tags, to study interactions among various salmon and trout species during fall spawning period and assess spawning success. Redds containing viable eggs were built, however, over-winter survival of embryos decreased with increased time spent in the gravel (OMNR, 2002). Additional results of this study were generally inconclusive and the majority of the fish either succumbed to the protozoan *Ichthyoprhthirius multifiliis* ("Ick") or were caught by anglers.

The records for northern brook lamprey, fallfish and river darter are likely due to misidentification since their range does not include the Humber River (Scott and Crossman, 1973). The Royal Ontario Museum has only one record of a northern brook lamprey (ammocoete) in Lake Ontario, and this was likely a misidentification (Holm, pers. comm).

Anecdotal information regarding channel catfish in the Lower Humber River was reported in 1997 but was not confirmed. Many other species, including longnose gar, bowfin, lake chub, American eel, three-spine stickleback, white bass, green sunfish, logperch, and tesselated darter are mostly lake resident and likely use the watershed only periodically to feed or spawn. Their absence from the 2000 and 2001 surveys does not mean they have disappeared from the watershed. For example, three-spine stickleback and green sunfish were found in the spring 2002 sampling of the sea lamprey control cages at the Old Mill dam and are believed to have been attempting to migrate upstream to spawn.

Banded killifish was not found in either 2000 or 2001 but is known to exist in some of the kettle lakes in the watershed. Other species such as finescale dace, blackchin shiner, blacknose shiner, pearl dace, yellow bullhead and white perch may not have been recorded in either 2000 or 2001 because of the location and/or timing of fish surveys but may still be present.

One native fish species recorded in 2001, redside dace, is considered a Species of Special Concern (formerly Vulnerable) by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and Threatened by the Committee on the Status of Species at Risk in Ontario (COSSARO). A species is designated as one of "Special Concern" because of characteristics that make it particularly sensitive to human activities or natural events (COSEWIC, 2002) while a species is designated as 'Threatened' because it is considered at risk of becoming endangered in Ontario. Redside dace have been found in virtually every watershed inventory since 1946 and have been recorded in every subwatershed. They are currently found in the East, Upper Main and West Humber River subwatersheds.

American eel, northern redbelly dace, American brook lamprey, rainbow darter, white perch, and brassy minnow have been placed on a Group 2 Intermediate Priority, while emerald shiner, spottail shiner, and, stonecat have been placed on a Group 3 Lower Priority - Candidate List by COSEWIC. It should be noted that it is the Quebec, rather than the Ontario, population of white perch that is considered at risk. If it is, ultimately, determined that the Quebec population is not discrete or of national significance, then the species will in all likelihood be dropped from the list. All of these species, except American eel and white perch, were found in the watershed in 2000/2001. White perch has not been found in the watershed since 1995. American eel has not been found in the watershed since 1989, and was found at that time near the mouth of the river. American Eel is considered a species that is 'especially at risk' in Ontario (COSEWIC, 2002). Section 6.2 provides more information on these species and associated designations.

4.1.2 Introduced Species

Four introduced fish species were found in 2000, three in 2001 and one in 2005, and a total of eleven have been found historically (Table 16).

Table 16: Status of Introduced Fish Species in the Humber River Watershed.

COMMON NAME	INTRODUCTION TO ONTARIO	FOUND IN 2000	FOUND IN 2001	FOUND IN 2005	CURRENT STATUS
sea lamprey	Unknown	no	no	yes	below the Old Mill dam in spring
alewife	1870	yes	no	no	below the Old Mill dam in spring
round goby	1980's	no	no	yes	below the Old Mill dam
Chinook salmon	1874	no	yes	yes	migrate upstream to Woodbridge; stocked as fingerlings
coho salmon	1873	no	no	no	below the Old Mill dam in fall
rainbow trout	1904	no	yes	yes	migrate upstream to Woodbridge; stocked as yearlings
brown trout	1913	no	yes	yes	resident and migratorypresent, stocked in Upper Main Humber
rainbow smelt	1931	yes	no	no	below the Old Mill dam in spring
goldfish	early1900's	yes	no	no	scattered throughout watershed
common carp	1880	yes	yes	yes	scattered throughout watershed but mainly below Old Milldam in late spring & summer
white perch	1950s	no	no	no	below the Old Mill dam, Grenadier Pond

Recent research indicates the sea lamprey is native to Lake Ontario (Bryan et al, 2005). Regardless, the parasitic sea lamprey feeds on many lake dwelling fish species, and if left uncontrolled, may cause serious problems to the Lake Ontario fish communities. It is considered an undesireable speices in this watershed. The Old Mill dam prevents sea lampreys from moving upstream to potential spawning grounds. In 2002, Fisheries and Oceans Canada captured 2,143 sea lampreys in assessment traps at the Old Mill dam, while the total number of spawners in the Humber River was estimated to be 6,000. This represents almost 16 % of the estimated population of spawning-phase sea lampreys for Lake Ontario in 2002 (Klar and Young, 2003). Unlike Duffins Creek and the Rouge River, lampricide is not currently used in the Humber River since it doesn't harbour larval sea lampreys.

In general, lamprey cages at the Old Mill dam catch approximately 2000 lampreys/year on their way upstream (MacDonald, 1997). During the process of capturing lamprey, a number of other species caught in the traps such as white sucker, three-spine stickleback, and minnows are hand transferred upstream. Additional sampling of the sea lamprey cages in 2002 by TRCA found the following nineteen species:

Table 17: Fish Species Captured in the Sea Lamprey Traps at the Old Mill Dam in 2002.

Common Name	Common Name
Black crappie	Green sunfish
Blacknose dace	Longnose dace
Bluntnose minnow	Pumpkinseed
Brown bullhead	Rock bass
Central stoneroller	Sea lamprey
Creek chub	Stonecat
Emerald shiner	Three-spine stickleback
Fathead minnow	White sucker
Golden shiner	

Of these species, all are found in other areas of the watershed with the exception of three-spine stickleback and sea lamprey. Both are primarily lake dwelling species and would generally only enter the river for spawning purposes during the spring. In the area downstream of the Old Mill dam, there exists substrate of the size preferred by lamprey and they currently build nests and lay fertile eggs. It is during egg development that they perish. Possible reasons for this include elevated water temperatures, sedimentation or poor water quality.

Alewife were first identified in Lake Ontario in 1873 and quickly grew in numbers. Massive die-offs were commonplace about 30 years ago, but recently numbers are believed to have declined. They provide an important food source for many larger fish but may also compete with native fish species for resources. Alewife are considered naturalized in the lower watershed.

Round goby were first detected in the lower Humber at Etienne Brule Park in the fall of 2005. This species was originally introduced through ballast water into the St. Clair River in the late 1980's. They are native to Eastern Europe and capable of spawning several times per year. For this reason, they quickly proliferate and can be found reaching densities of more than 80 individuals per square metre.

Chinook salmon were initially introduced into Lake Ontario in 1874 and stocking has since continued. Their presence has helped to promote the sportfishing industry in the lake but because they are voracious feeders, they may be putting a strain on baitfish populations (OMNR, 1995). Although there are no recent records of Chinook salmon being stocked into the Humber River, they ascend the Humber River in large numbers every fall to spawn. Fingerlings of this species are now stocked into the East Humber each spring. Recent barrier mitigation projects in the Humber have allowed access into Woodbridge and the East Humber River. Chinook salmon have been reported upstream of Woodbridge in 2001 and 2003. Chinook salmon are considered an introduced "put-and-delayed take" fishery for this watershed.

Records indicate that coho salmon were only stocked in the Humber River from 1969-1971 and stocking of this fish on the Canadian side of Lake Ontario stopped in 1991. Occasional reports of coho angled from the Humber are heard every year but none have been confirmed. Stocking of coho in the Credit River resumed in 1998 and recent coho releases in the Humber River have occurred in 2004 and 2005. Coho are considered introduced to the watershed.

Rainbow trout were introduced in Ontario in 1876 where they have since become naturalized in many Lake Ontario tributaries. They are considered introduced, not naturalized, in the Humber River because they are not self-sustaining. Rainbow trout are a highly prized gamefish amongst anglers and with recent improvements in access, were found spawning in the East Humber in 2000 for the first time, and every year since. They are presently stocked in the East Humber River by the OMNR and numerous small private ponds by their owners.

Brown trout were first released into Ontario waters in 1913 and there are now naturalized resident populations in the Upper Main and East Humber River subwatersheds (where they are also stocked) and as introduced migratory populations in the Lower Main Humber River. Like rainbow trout, they are a popular fish with anglers. Recent barrier mitigation projects will improve access for migratory brown trout into the Upper Main and East Humber River subwatersheds.

Rainbow smelt were first found in Lake Ontario in 1931 and were a favourite spring catch for anglers at the river mouth. The Lake Ontario population has been declining over the past decade and large runs are no longer observed in the Humber. While they are a food source for salmon and trout, they may impact populations of other baitfish like shiners, shad and whitefish. They are considered naturalized in the Humber River watershed.

It is unknown when goldfish were first introduced into Lake Ontario but it was likely sometime in the early 1900's. They are the result of the release of domestic stock and lose their bright colours after a few generations. With their ability to survive in degraded waters, they are considered introduced in the watershed and have been found in waterbodies such as Grenadier Pond and Lake Wilcox.

Carp were first brought into Ontario from Asia in 1880 and released in a pond near Markham. They are presently found in large numbers in the Lower Main Humber River during the spring and early summer spawning periods, and in some watercourses and waterbodies in the Upper Main Humber River. Carp spawning activities can cause great damage to wetland plants and substantially increase water turbidity (Scott and Crossman, 1973; Hagen, 1996). They are considered a naturalized and nuisance species in the watershed.

White perch, found in the Lower Main Humber River and Grenadier Pond, is a recent introduction to Lake Ontario and is believed to have gained access via the Oswego River. While reported to be a good eating fish, it may also compete with other predatory fish species for food. Where they currently exist, white perch are naturalized in the Humber River. Although white perch are currently designated as a Group 2 - Intermediate Priority Candidate candidate species, it is the Quebec, and not the Ontario, population that is considered at risk.

An introduced invertebrate species recently identified in the Humber River, Rouge River and Duffins Creek, but not in the other watersheds in the TRCA's juridiction, is the rusty crayfish (*Orconectes rusticus*). Though native to parts of the Great Lakes, the rusty crayfish is believed to have been spread by anglers who use them as bait. This crayfish is of concern because it is aggressive and displaces native crayfish through direct competition. It forces native crayfish from their day-time hiding places, making them more susceptible to fish predation. The rusty crayfish is less susceptible to fish predation due to its more aggressive demeanor. Although most species of crayfish eat aquatic plants, this one eats larger amounts due to its higher metabolic rate and appetite. The reduced abundance of aquatic plants may impact the available food resource for some fish species. The rusty crayfish also directly competes with fish for food resources, with juveniles feeding particularly heavily on benthic macro invertebrates, such as mayflies, stoneflies, midges and side-swimmers.

The rusty crayfish has been detected at one sampling station in the watershed located at Castlemore Road, west of the Gore Road in Brampton.

The historic fish community provides an indication of what used to be present and helps to identify the expected or potential fish community. Comparison of the present fish community with the historic species list allows the development of an expectation for the fish community if conditions currently limiting their presence were eliminated.

4.2 Present Fish Community

The data used to evaluate the present condition of the fish community was collected by TRCA staff in 2000 and 2001 from 9 and 40 stations, respectively, and by Ontario Streams staff in 2001 from 11 stations (Figure 13 & Table 18). Each TRCA site was at least 40m in length and electroshocking was done using a backpack electroshocking unit, according to the protocol in the Ontario Ministry of Natural Resources Stream Habitat Assessment Manual (Stanfield, 2001).

As part of the analysis of species richness to identify the total number of fish species in the Humber River Watershed, 6, 37, and 11 stations were used. One station (HU018WM) was eliminated from the TRCA 2001 data set because it was dry and not sampled. Two stations located on waterbodies in 2000, one station located on a lake in 2001, and the stations located at the river mouth in both 2000 and 2001 could not be compared to Steedman's expected native species richness or the IBI because they were sampled using an eletroshocking boat. This technique is biased towards larger fish and thus many smaller species may have been missed. Further, because the 2000 sampling was limited to the City of Toronto, alone, and is not considered representative of the entire Humber River watershed, it was only used for comparison purposes against the 2001 Lower Main Humber and Black Creek data.

For calculating the IBI, only 6 (2000) and 36 (2001) stations were used from the TRCA data, while only 7 (2001) stations were used from the Ontario Streams data. One station (HU018WM) sampled in 2001 by TRCA was eliminated from the analysis because the reach was dry and could not be sampled, and another was eliminated because no fish were caught (HU005WM). The latter is located upstream of a significant drop structure (i.e. barrier), in addition to being located downstream of a commercial/industrial area and, therefore, subject to significant water quality degradation. In the late 1990's, the City of Toronto, in partnership with community groups and local schools, initiated a process to look at the feasibility of rehabilitating this reach of the Lower Humber at Alex Marchetti Park and Wincott Park through a combination of watercourse renaturalization and water quality improvements upstream (wetland creation and source controls). In 2001, the watercourse was renaturalized, with plans to undertake the upstream source controls in the future. While the project does not include short-term plans to mitigate the barrier downstream, the monitoring of the invertebrate community at HU005WM should provide an opportunity to evaluate anticipated improvements in habitat quality.

Four stations were eliminated from the Ontario Streams data set because the electroshocking effort was not available and therefore did not allow for the calculation of the catch per unit effort (CPUE). The three (2000) and two (2001) TRCA stations sampled with an electroshocking boat were removed since this technique is biased towards larger fish and thus many smaller species may have been missed.

Table 18: Comparison Between the Number of Sampling Stations and Records Used in the Data Analyses.

SUBWATERSHED	HISTORIC FISH SPECIES		2000 FISH COMMUNITY		2001 FISH COMMUNITY		
	TSS*	NUMBER OF RECORDS	TSS	SPECIES RICHNESS & IBI ANALYSIS (TSS)	TSS	SPECIES RICHNESS (TSS)	IBI ANALYSIS (TSS)
Upper Main Humber	168	421	0	0	26	26	22
East Humber River	110	221	0	0	10	9	9
West Humber River	83	162	1	0	6	6	5
Black Creek	20	44	2	2	2	2	1
Lower Main Humber	32	101	6	4	7	5	6
TOTAL	413	949	9	6	51	48	43

* - Total Sampling Stations

4.2.1 Species Richness

The number of fish species currently found in the Humber River watershed, including resident and migratory species, is 43, of which three are introduced. This number is based on the findings of both TRCA and Ontario Streams in 2001. An additional seven non- native species (sea lamprey, alewife, Chinook salmon, coho salmon, rainbow smelt, goldfish, and white perch) are known to inhabit the Humber River but were not collected during the 2001 sampling. It should be noted that sea lamprey were captured by the Sea Lamprey Control Centre in the cages located at the Old Mill dam in 2001, and both alewife and rainbow smelt were captured by TRCA near the confluence with Lake Ontario in 2000.

For comparison, the Rouge River supports a total of 51 species (MTRCA and OMNRa, 1992), 57 in the Credit River (OMNR, 2000), and the Don River, 21 species (TRCA, 1998). The total number of species in the Rouge, Humber and Credit Rivers are most comparable primarily due to the presence of coastal marshes along Lake Ontario. These marshes provide habitat on a periodic basis for many lake resident species and thus significantly boost the species richness. The Don River has the lowest species richness due in part, to the lack of a coastal marsh and the degraded state of the watershed. Sampling intensity and distribution may also be a factor in determining the differences in species richness.

Species richness is defined as the total number of species present and is used to provide a general indication of the health of the watershed fish community. Typically, the more degraded a watercourse, the lower the species richness. However, in general, smaller streams (even healthy ones) have lower species richness than larger watercourses. Therefore, species richness must be compared between similar sized streams or to an expected value for a given stream size or drainage area. Steedman (1987) developed an expected maximum species richness line for native species in southern Ontario streams (Figure 15). It is this relationship between the actual and expected number of native species that was used to assess species richness in a watercourse.

In the Humber River watershed, only in a few smaller streams with drainage areas less than 35 km^2 were more species found than would be expected by the maximum species richness line (Figure 15). More specifically, one station had more species, and three stations had an equal number of species, to that expected by Steedman. Species richness for medium and large sized drainage areas approach but are below the maximum species richness line. For large drainage areas, species richness is below the expected value for all records.

Native species richness in the Humber River watershed ranges from zero to 15 species, with a median of 8 species per station (Figure 14). While not poor, this is lower than the expected values developed by Steedman (1987). Based on his work, species richness for the stations sampled in the Humber River watershed should range from 4 to 24 species with a median of 13 (Figure 14). It appears as though the difference between actual and expected species richness is greatest in watercourses with drainage areas larger than 150 km^2 and least in watercourses with drainage areas between 10 and 35 km^2. Actual species richness in watercourses with drainage areas less than 10 km^2 and between 35 and 150 km^2 are slightly lower than that predicted by Steedman (1987). The difference between the number of expected and actual species is likely due to impacts resulting from watershed development.

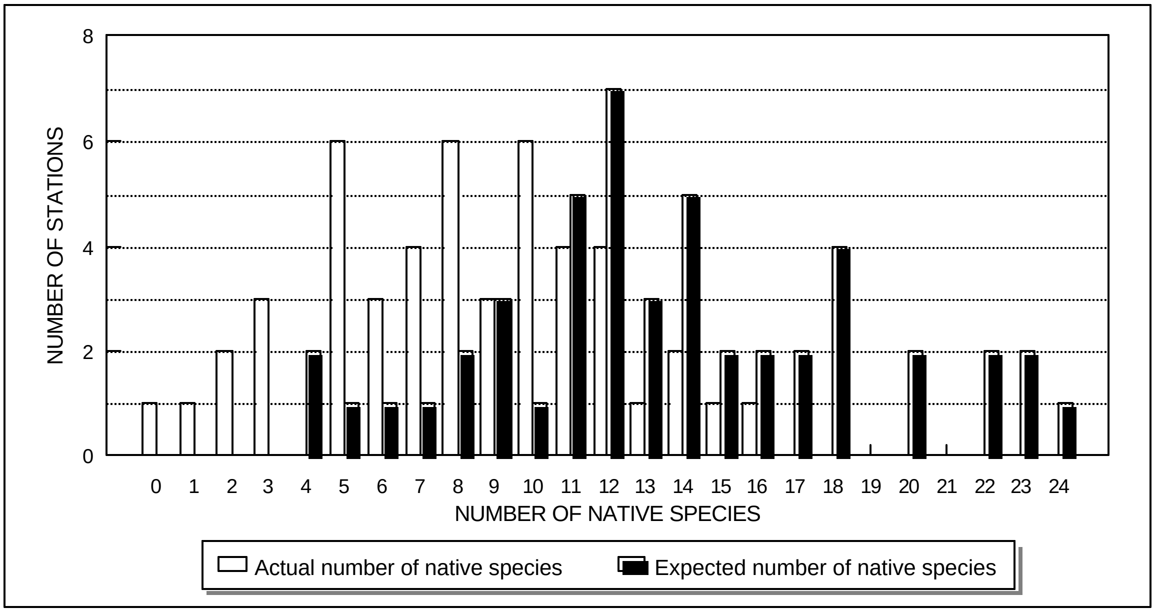


Figure 14. Frequency distributions of actual to expected native species richness for stream reaches sampled in 2001 in the Humber River watershed. Each expected number of native species value was calculated using drainage areas of the stations sampled in 2001.

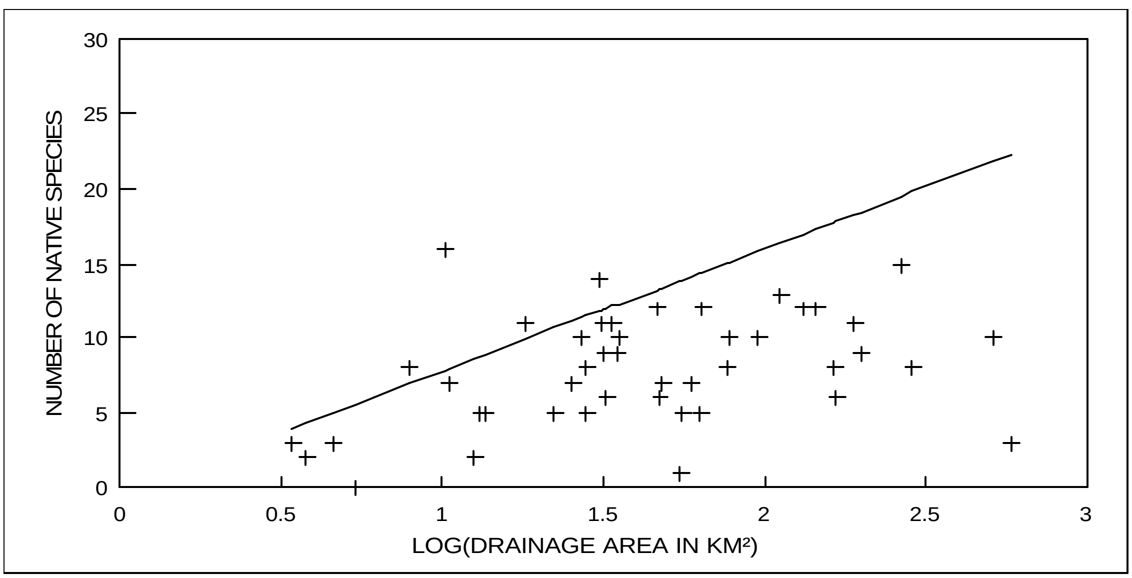


Figure 15. The relationship between species richness and stream drainage area for stations sampled in 2001 in the Humber River Watershed. The regression line is the expected native species richness for streams in the Toronto area (Steedman, 1987) and was not derived from analyses of these data.

There is no doubt that the fish community in the Humber River watershed has been impacted by habitat fragmentation from the construction of instream barriers, pollution, development and overfishing. As a result, the fish community is not as diverse as it once was. The loss of Atlantic salmon, while not restricted to the Humber River, and the reduction in numbers of other species, particularly those higher in the food chain, illustrates the need to ensure the health of the present and future fish community.

4.2.2 Index of Biotic Integrity

The Index of Biotic Integrity (IBI) is a measure of fish community associations that is used to identify the general health of the broader stream ecosystem. It was first developed to assess small to moderate sized warmwater rivers in the United States (Karr, 1981). Steedman (1987) adapted this method for streams in southern Ontario. He used ten measures of fish community composition to determine an IBI on a scale from ten (poor) to 50 (very good) grouped into four general categories: species richness, local indicator species, trophic composition and fish abundance (Table 19). A detailed explanation of these indices can be found in Steedman (1987).

Two modifications of Steedman's work were necessary for the calculation of IBI. The presence/absence of blackspot (a parasite of fish) was eliminated from the IBI because the presence of blackspot does not necessarily reflect unhealthy conditions. The second modification relates to the presence/absence of brook trout, which Steedman (1987) assumed should be present at all stations. While brook trout were more widespread historically, they were not found in all streams and their absence does not necessarily reflect unhealthy conditions. Based on this, the brook trout sub-indices was only calculated for stations that are considered to be or potentially are coldwater habitats. IBI scores for stations located on warmwater streams were calculated based on eight rather than nine sub-indices and were then transformed for direct comparison with scores from coldwater streams.

Table 19: The Nine Sub-indices that Form the Index of Biotic Integrity.

SPECIES RICHNESS
- Number of native species
- Number of darter and/or sculpin species
- Number of sunfish and/or trout species
- Number of sucker and/or catfish species

LOCAL INDICATOR SPECIES
- Presence or absence of brook trout (coldwater stations only)
- Percent of sample as *Rhinichthys* species

TROPHIC COMPOSITION
- Percent of sample as omnivorous species
- Percent of sample as piscivorous species

FISH ABUNDANCE
- Catch per minute of sampling

The modified IBI scores range from a low of nine to a high of 45, with four ranges designated to reflect stream quality: poor; fair; good; and very good.

Six stations were used in the 2000 IBI analysis, and forty three stations were used in 2001 (Figure 16). IBI scores range from 18 to 29 in 2000, and 16 to 39 in 2001, with a median score of 27 and 29, respectively, which falls into the "fair" and "good" range of biotic integrity (Table 20 and Figure 16). Because sampling was limited to the City of Toronto in 2000, and is not considered representative of the entire watershed, the analysis for 2000 is restricted to a comparison of the 2001 data with the Lower Main Humber and Black Creek subwatersheds.

In 2001, three stations had a stream quality rating of "poor" (7 percent of all stations) and were found in the Lower Main Humber and Black Creek subwatersheds (Table 20 and Figure 16). Approximately 42 % of all stations had a "fair" IBI score and this included stations from all subwatersheds except Black Creek. In 2000, 2 stations had a stream quality rating of "poor", one of which was found in Black Creek and the other in the Lower Main Humber subwatershed. The remaining four stations sampled in 2000 in Black Creek and the Lower Main Humber had stream quality ratings of "good" and accounted for 67 % of the stations.

In 2001, streams with a "good" stream quality rating accounted for 49 % of all stations. Unlike the 2000 data, Black Creek and the Lower Main Humber were the only subwatersheds without a station with a "good" stream quality rating. The only station with a stream quality rating of “very good” was found in the East Humber subwatershed.

In 2001, the grea test variation in IBI scores was found in streams with a drainage area less than 20 km^2 (Figure 18), with subwatersheds having median IBI scores ranging from 20 to 31 (Table 21). The East, West and Lower Main Humber River subwatersheds all have median IBI scores in the "good" stream quality range while the Upper Main Humber River subwatershed has a median IBI score in the "good" stream quality range. The median score for Black Creek falls into the "poor" stream quality range.

Figure 16. IBI scores for the stations sampled in 2000 and 2001

Table 20. IBI and Stream Quality Rating for Stations Sampled Between 1984 and 2001.

SUBWATERSHED	IBI SCORE*											
	9 – 20 (Poor)			21 – 27 (Fair)			28 – 37 (Good)			38 – 45 (Very good)		
	1984 - 1999	2000	2001	1984 - 1999	2000	2001	1984 - 1999	2000	2001	1984 - 1999	2000	2001
Upper Main Humber River	4 (8%)	-	0(0 %)	28 (53%)	0 (0%)	9 (41%)	20 (38%)	0 (0%)	13 (59%)	1 (2%)	0 (0%)	0 (0%)
East Humber River	1 (4%)	-	0(0 %)	10 (40%)	0 (0%)	4 (44%)	13 (52%)	0 (0%)	4 (44%)	1 (4%)	0 (0%)	1 (11%)
West Humber River	3 (10%)	-	0(0 %)	13 (42%)	0 (0%)	1 (20%)	15 (48%)	0 (0%)	4 (80%)	0 (0%)	0 (0%)	0 (0%)
Black Creek	4 (67%)	1(50%)	1 (100%)	2 (33%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Lower Main Humber River	3 (30%)	1(25%)	2 (33%)	2 (20%)	0(0%)	4 (67%)	5 (50%)	3 (75%)	0 (0 %)	0 (0%)	0 (0%)	0 (0%)
TOTAL	15 (12%)	2 (33%)	3 (7%)	55 (44%)	0 (0%)	18 (42%)	53 (42%)	4(67%)	21 (49%)	2 (2%)	0 (0%)	1(3%)

* - percentages represent the percent of stations sam pled in a subwatershed in the given time periods.

Table 21: Summary Statistics for Stations used in the IBIAnalysis for Stations Sampled in 2000 and 2001.

SUBWATERSHED	NUMBER OF SAMPLING STATIONS		LOWEST IBI SCORE		MEDIAN IBI SCORE		HIGHEST IBI SCORE	
	2000	2001	2000	2001	2000	2001	2000	2001
Upper Main Humber River	0	23	0	23	0	31	0	35
East Humber River	0	8	0	23	0	29	0	39
West Humber River	0	5	0	25	0	30	0	32
Black Creek	2	1	19	20	24	20	29	20
Lower Main Humber River	4	6	18	16	27	23	27	27

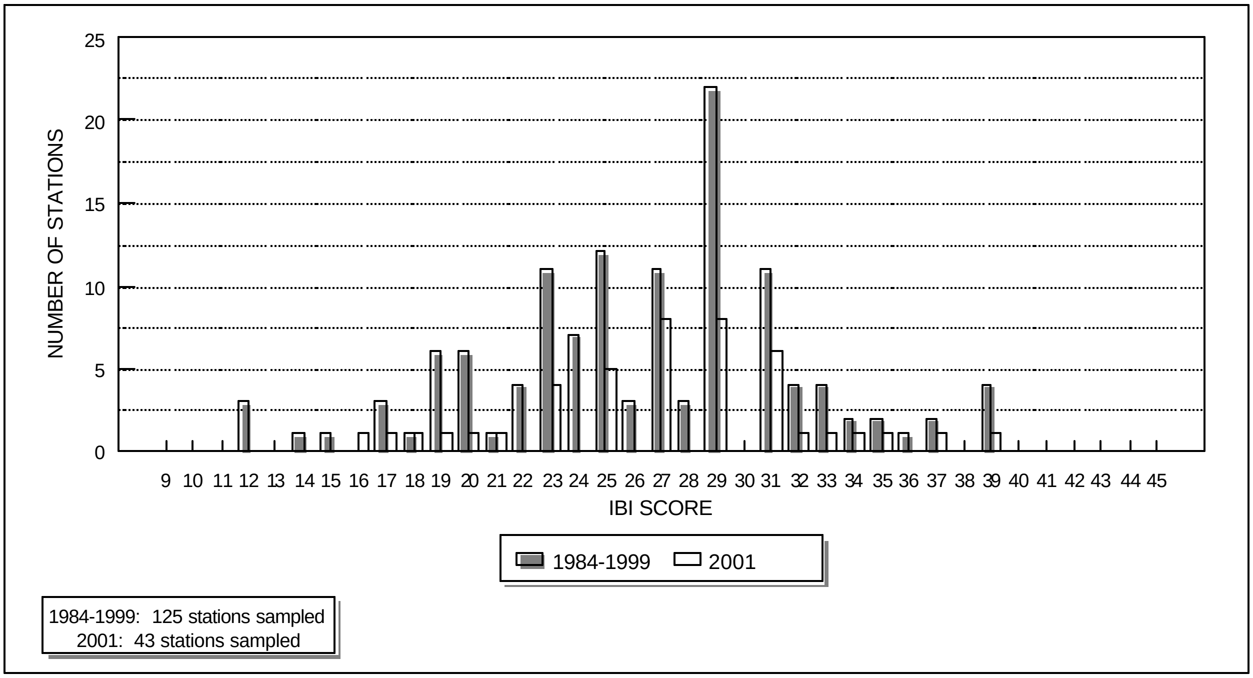


Figure 17. Frequency distribution of IBI scores calculated for stations sampled from 1984-1999 and 2001

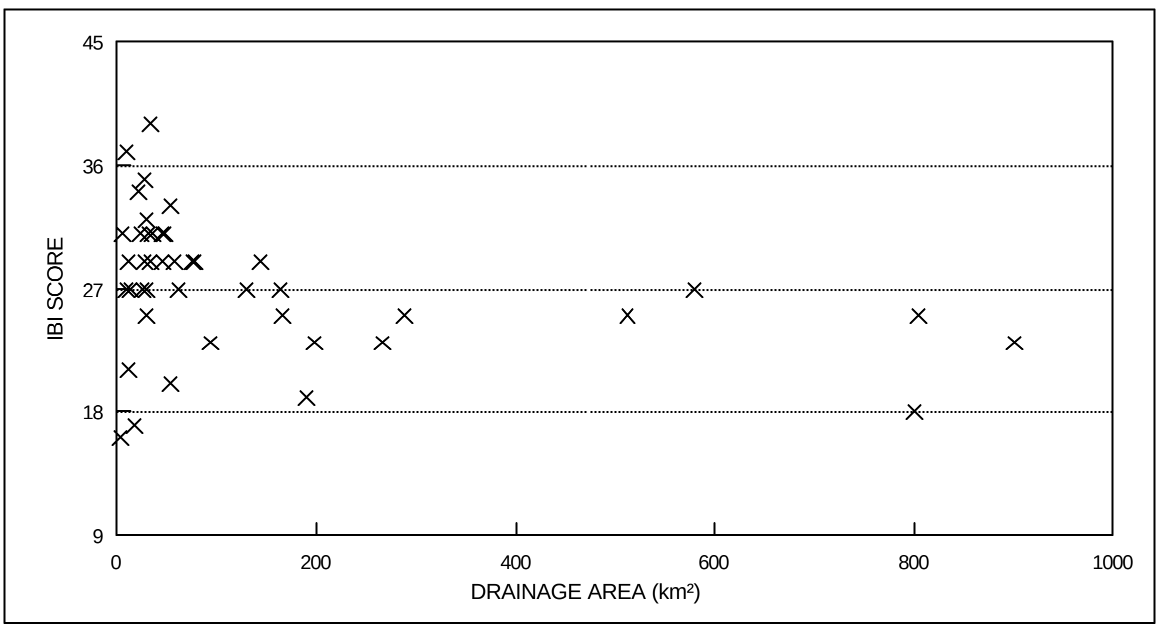


Figure 18. Frequency distribution of IBI scores at each stream drainage area for the stations sampled in 2001

Overall, IBI scores in 2001 in the three largest subwatersheds - the East, West, and Upper Main - indicate that the majority of the streams support healthy fish communities. Stream quality throughout the East, West and Upper Main Humber River subwatersheds appears to be generally "good", with one watercourse in the East Humber River having a "very good" stream quality rating. The Lower Main Humber River subwatershed was rated as "fair" in both 2000 and 2001, indicating that it has been more greatly affected. While still supporting fish communities, the Black Creek subwatershed is the most impacted. Degradation in this subwatershed has continued to the point where only tolerant species are present. In general, stream quality is better in the headwater areas than in the lower portions of the watershed, and indicates an inverse relationship between IBI scores and % urbanization (Figure 19).

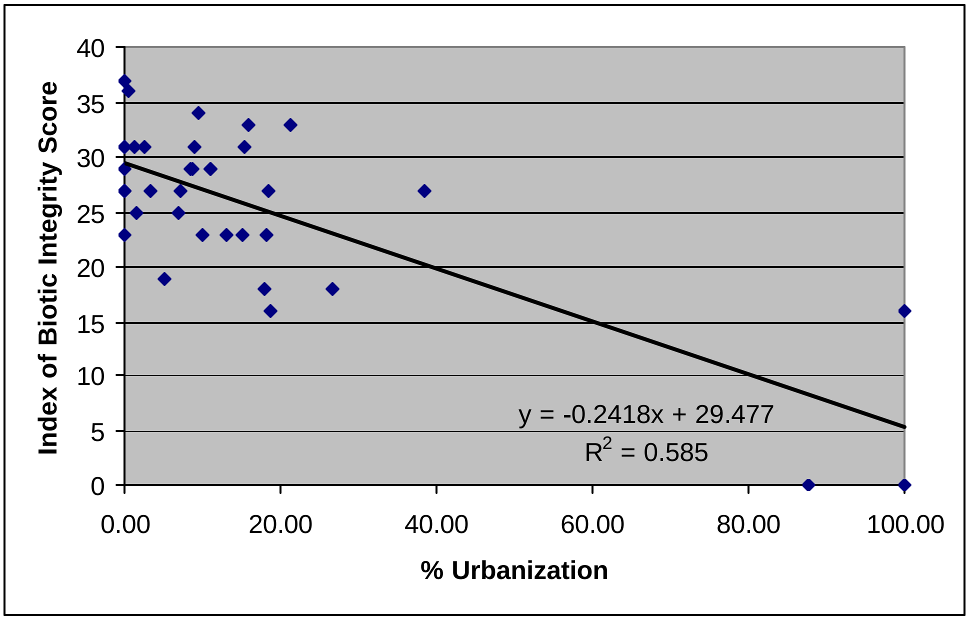


Figure 19. Index of Biotic Integrity Score versus % Urbanization

4.2.3 Fish Community Structure

IBI scores can provide further information through analysis of the sub-index scores (Table 22). For the purposes of this discussion, scores of five are called "high", three are called "medium" and one are called "low". Ninety three percent of stations scored medium or high in terms of native species, indicating that the number of species found is comparable to that expected by Steedman (1987). The indices for the number of darter/sculpin and sunfish/trout species scored high at only three and seven percent, respectively, of stations, which is a decrease for the number of darter/sculpin and an increase for the number of sunfish/trout from the 1999 data. These sub-indices scored low for fifty-three and fifty-one percent of stations, respectively. This suggests that more specialized or sensitive species are largely absent in many streams in the watershed. Twenty-three percent of stations scored low in the number of catfish or sucker species sub-index, an increase from the 1999 data. This suggests that some stream degradation has occurred.

The brook trout sub-indices scored high for 37 % of stations, an increase from the 1999 data. However, this is likely the result of factors such as: variations in timing of sampling with the 1999 sampling taking place in September and the 2001 sampling taking place in June - early August and average summer temperature and/or rainfall, rather than an actual increase in brook trout found in the watershed. A high sub-index score at 93% of the stations for the percent of sample as blacknose dace and longnose dace, both of which are considered tolerant species, indicates a low level of urbanization.

The percent of sample as omnivorous species scored high (98 % of stations), indicating that omnivores do not dominate the aquatic ecosystem in the watershed. This tends to indicate a low level of urbanization. For the percent of sample as piscivorous species sub-indices, 65 % of stations scored low. This is a decrease from the 1999 data but still indicates that a high proportion of streams have an unbalanced trophic structure, with few large piscivores present.

Steedman (1987) found that high catch and low catch per unit effort was found in warm, enriched agricultural streams and degraded urban streams, respectively. Forty four percent of stations scored high in the abundance sub-indices, a decrease from the 1999 data. This indicates that many of the watercourses sampled are still healthy, although the score was lower than previously calculated.

Table 22: Frequency Distribution of Scores for Sub-indices of the IBI.

SUB INDEX SCORE*	SPECIES RICHNESS				LOCAL INDICATOR SPECIES		TROPHIC COMPOSITION		FISH ABUNDANCE
	Number of native species (% of records)	Number of darter/ sculpin species (% of records)	Number of sunfish/trout species (% of records)	Number of sucker/ catfish species (% of records)	Presence or absence of brook trout (% of records)	% of sample as *Rhinichthys* sp.	% of sample as omnivorous sp.	% of sample as piscivorous sp.	catch per minute of sampling (% of records)
1 (low)	*7* **?**	*53* **?**	*51 ?*	*23* **?**	*63* **?**	*7* **?**	*0* **?**	*65* **?**	*56* **?**
3 (med)	*56* **?**	*44* **?**	*42* **?**	*72* **?**	*Not applicable*	*Not applicable*	*2* **?**	*Not applicable*	*0*
5 (high)	*37* **?**	*3* **?**	*7* **?**	*5* **?**	*37***?**	*93* **?**	*98* **?**	*35* **?**	*44* **?**

* - The higher the sub-index score the better the habitat rating. Values in the table indicate the percentage of sampling stations with the indicated sub-index score. Columns sum to 100% of stations. Arrows indicate an increase (?) or decrease (?) from the 1999 data. Numbers with no arrow did not change.

In 2001, 43 species were found in the Humber River watershed, the five most common of which were creek chub, white sucker, blacknose dace, golden shiner and johnny darter (Figure 20). Two species, blacknose dace and creek chub, were found at almost 80% of the stations sampled, illustrating their widespread abundance in the watershed. Two species, white sucker and johnny darter were found at 50 to 75% of stations sampled. Eight species were found at 25 to 50% of stations sampled. The remaining 31 species were found at less than 25% of stations sampled, fifteen of which were found at less than five percent of stations (Figure 19).

Sensitive species such as American brook lamprey, rainbow trout, brown trout, brook trout, redside dace, largemouth bass, and mottled sculpin were found in 25, 12, 33, 26, 10, 10, and 35 % of the stations sampled, respectively. American brook lamprey, brook, rainbow and brown trout and mottled sculpin were only found in the Upper Main and East Humber River subwatersheds. Redside dace were only found in the East, Upper Main, and West Humber River subwatersheds. Largemouth bass were found only in the Upper Main and Lower Main Humber River subwatersheds. A summary of the fish species found at each station is found in Appendix V.

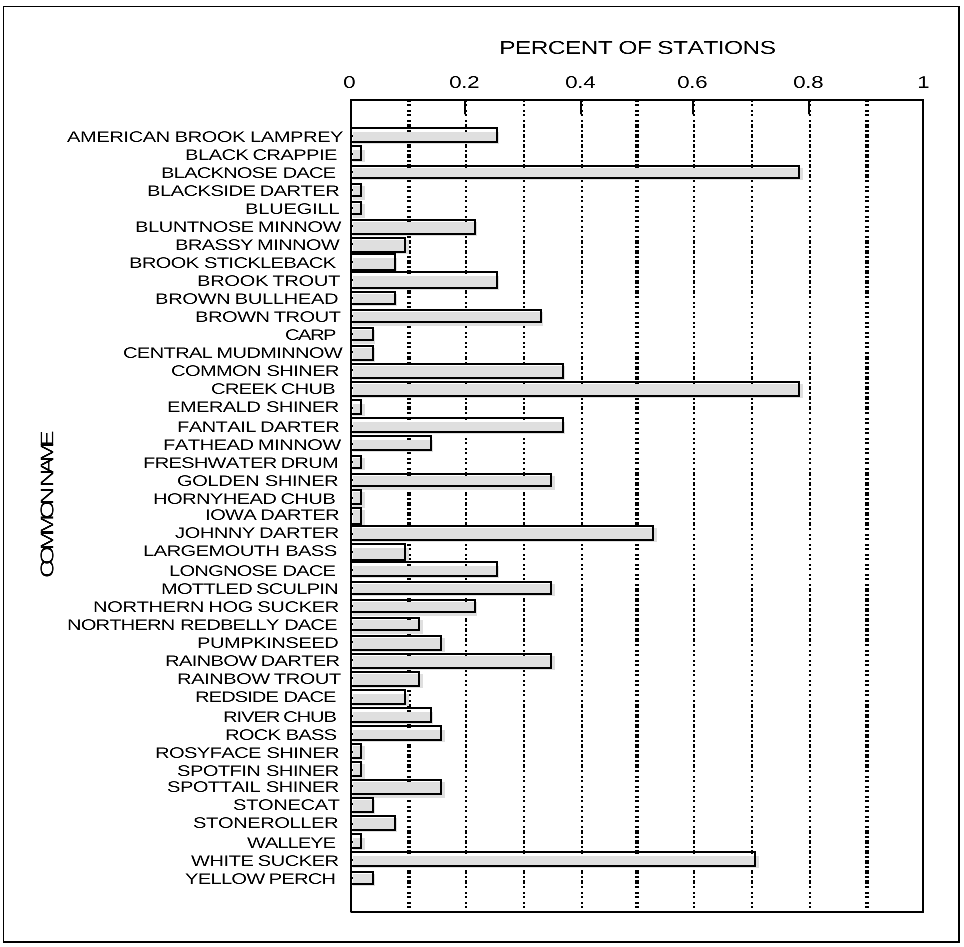


Figure 20. Frequency distribution of the individual fish species found at stations sampled in 2001.

4.3 Benthic Invertebrates

Benthic invertebrates (benthos) include all the organisms without a backbone that are found dwelling in the bottom substrate of a watercourse or waterbody, and are a crucial component of the aquatic ecosystem. According to the River Continuum Concept, the transition from small headwater areas to major rivers results in concurrent changes to structural and functional attributes of natural stream ecosystems: stream size (order), tropic state (hetero- or autotrophic), light and temperature regimes, and the trophic status of the dominant fish and invertebrates. Invertebrates can be organized into four functional feeding groups: shredders, collectors (gatherers and filter feeders), scrapers and predators. Shredders dominate in the small headwater streams and convert leaves and twigs, coarse particulate organic matter (CPOM), into an accessible form for other organisms, fine particulate organic matter (FPOM), for filter feeder collectors and shredders, which are the dominant tropic group downstream. The structural and functional attributes serve as reference points for assessment of the status of the stream ecosystem at any site and are based on forested watersheds. If the ecosystem differs from the expectations, the difference may be due to degradation resulting from human activities (Karr and Dudley, 1981).

The River Continuum Concept may adequately explain the general organization of benthic invertebrates within the stream, but the micro-distribution of aquatic invertebrates is extremely important and may be a function of a substratum-detritus interaction, with current, and light silt deposition as secondary roles (Rabeni and Minshall, 1977). Many aquatic insects show a definite preference for certain particle sizes of substrate that may be efficient at collecting food (detritus). Further, interactions with other organisms whether they are predators or competitors also play a major role in the distribution of organisms (Power et al., 1988). Foraging fish can significantly alter the behaviour, population structure, and community structure of stream benthic invertebrates (Gilliam et al.,1989).

The use of benthic invertebrates in assessing water quality is well recognized as invertebrates are important agents of contamination transfer between sediments and higher trophic levels in aquatic systems (Corkum et al., 1995). Biomonitoring using benthic macroinvertebrates has many advantages: (1) they are good indicators of localized conditions because of their restricted mobility and habitat preference; (2) they integrate the effects of short-term environmental variations; (3) they are relatively easy to collect; (4) they are abundant in most streams; and (5) they serve as a food item for many fish important commercially and for recreation (Plafkin et al., 1990; Griffiths, 1993).

Several components can be used to assess the stream community, but no component should be used exclusively. The number of taxa or taxa richness is the basic component of most faunal evaluation systems and generally increases with improved water quality, habitat diversity, and habitat suitability. The absence of generally pollution-sensitive benthic groups such as mayflies, caddisflies, and stoneflies, and the dominance of worms and midges may indicate impairment. Also, overall low abundance may suggest degradation. However, taxa richness and abundance are variable, and some high quality headwater streams may be naturally unproductive, supporting only a very limited number of taxa. The relative abundance or percent contribution of each taxa provides a rapid indication of the balance or evenness of the community, with greatly skewed abundances indicating faunal imbalance (abundances >20% may indicate imbalance) (Plafkin et al., 1990).

Several biotic indices have been developed to determine stream health. One index is Hilsenhoff's Biotic Index (B.I.). Each species is pre-assigned a value on a 0-10 scale based on its known tolerance to organic pollution; the higher the value, the more tolerant the organism (Hilsenhoff, 1987). The pollution tolerance value is multiplied by the relative abundance of each taxon and summed to provide a score for each station. The Hilsenhoff values are grouped into six water quality categories and given a rating (Table 23). Although the Hilsenhoff Biotic Index has only been evaluated for organic pollutants, it may be applicable for toxic pollutants (Plafkin et al., 1989). Regardless of the index used, communities that are diverse with abundant individuals generally reflect a healthy environment. Given a stress to the ecosystem, there is a predictable change in species composition and number (Corkum et al., 1995).

Table 23: Comparison of the Scores between Hilsenhoff's Biotic Index and Hilsenhoff's Family Biotic Index.

Hilsenhoff's B.I. Scores (1987)	Hilsenhoff's F.B.I. Scores (1988)	B.I. assigned values	Degree of Organic Pollution	Water Quality
0.00 - 3.50	0.00 - 3.75	0	Organic pollution unlikely	Excellent
3.51 - 4.50	3.76 - 4.25	1	Possible slight organic pollution	Very good
4.41 - 5.50	4.26 - 5.00	2	Some organic pollution probable	Good
5.51 - 6.50	5.01 - 5.75	3	Fairly substantial pollution likely	Fair
6.51 - 7.50	5.76 - 6.50	4	Substantial pollution likely	Fairly poor
7.51 - 8.50	6.51 - 7.25	5	Very substantial pollution likely	Poor
8.51 - 10.00	7.26 - 10.00	6	Severe organic pollution likely	Very Poor

As with most indices, the B.I. has its limitations. Similar to the Index of Biotic Integrity, Hilsenhoff's Biotic Index was originally developed for streams further south (Wisconsin) and requires modification for application to southern Ontario. Bode (1988) has adapted tolerance values for New York State and expanded the list of taxa, but only on the less sensitive 0-5 scale. Also, Hilsenhoff's B.I. does not include many non-insect taxa such as crayfish, snails, clams, leeches, and worms, which potentially could constitute a large portion of a sample, rendering the station without a B.I. score. When Hilsenhoff (1988) developed the Hilsenhoff Family Biotic Index (F.B.I.) for rapid bioassessment in the field, he encompassed more groups of invertebrates. Now, most of the non-insect taxa in the sample could be evaluated, but at a loss of resolution at the higher taxonomic level. Subsequently, the F.B.I. would tend to overestimate the scores for less polluted streams, and underestimate the scores for polluted streams (Hilsenhoff, 1988).

A second indices is the Shannon-Weaver diversity index (Shannon, 1948), which takes into account species richness and proportion of each species within the local aquatic community. Typically, a Shannon-Weaver diversity index greater than 3 indicates an unimpaired benthic community, while an index below 1 generally reflects a degraded habitat. It is noted that the Shannon-Weaver index is generally applied to quantitative data and that its application to the semi-quantitative data derived from the TRCA sampling is to provide a general indication of diversity only (Golder Associates, 2002).

Like the fish sampling data, benthic invertebrate records for the watershed date back approximately 50 years. Data collected between 1946 and 1972 is detailed in Wainio and Hester (1973) and is summarized here. In 1946, Mayall et al. collected invertebrate data at 140 stations throughout the watershed. Many stations were dry and so data only exist for 69 stations. They found that the five most commonly found invertebrates were mayflies, caddisflies, true flies and beetles. Dragonflies, damselflies, snails and stoneflies were also frequently collected. Invertebrate communities were much poorer in variety in the lower sections of the watershed than in the Upper sections. For example, no mayflies or caddisflies were found downstream of the confluence with Black Creek and very few in Black Creek itself; this was possibly attributed to organic pollution in the area.

Anderson and Taylor (1972) also collected invertebrate data from 34 stations during their survey, particularly as they apply to trout species. Midge larvae, caddis fly larvae and mayfly nymphs were amongst the most common species found, and were abundant in the brook trout areas of the upper watershed down to the confluence with the East Humber River. Snails, while not abundant in the upper watershed, were another of the common species found. In the East Humber River, the most common invertebrates included caddisfly larvae, mayfly nymphs and midge larvae. Invertebrate populations in the West Humber River are considerably different from the remainder of the watershed. Caddisflies, mayflies and midges are less abundant here than elsewhere in the watershed, while snails were very common.

In 1993, as part of the West Humber River Subwatershed Study, 11 stations were sampled (Aquafor Beech, 1997). Their analysis suggested that the more western tributaries, which also tended to be permanently flowing, are slightly to moderately impaired, while the main branch and Salt Creek are considered moderately impaired and the eastern tributaries moderately to severely impaired. Of the intermittent streams, Salt Creek is the least impaired.

4.3.1 Watershed Survey of Benthos in 2001 and 2002

In 2001, 38 stations were sampled using a similar methodology to that outlined in the Stream Assessment Protocol for Southern Ontario (Stanfield, 2001) (Figure 12). Station HU0018WM, however, was dry so it was not sampled. Using a modified kick and sweep technique, benthic invertebrates were collected over a minimum distance of 40m. The composite sample obtained reflects the species using all of the habitats present at the site. In 2002, the approach was further modified to reflect the following:

1. Stream width less than 10 m - sampled bank to bank; and,
2. Stream width greater than 10 m - sampled at appropriate points for reach length.

Based on the 2001 analysis from 37 stations, the benthic invertebrate community at most locations was in "good" condition with some localized "hotspots". A variety of indices of composition were calculated including taxa richness, number of *Ephemeroptera*, *Plecoptera* and *Trichoptera* (EPT) taxa, percentage of each major taxonomic group, Shannon-Weaver diversity index, and Hilsenhoff's Biotic Index. The same 38 stations were sampled in 2002, however the data and associated analyses were not available at the time of printing of the plan.

The density and diversity of benthic invertebrates throughout the Humber River watershed are generally indicative of good water quality and habitat quality. The Shannon-Weaver diversity index ranged from a low of 1.00 at HU006WM to a high of 4.64 at HU011WM. However, while there was a change in species composition from the headwater to the mouth, this could be attributed to the changes in habitat type.

In the upper regions of the Humber River, the chironomid community is more diverse than in the lower regions. A number of chironomid species occurring at sites in the section from HU027WM-HU038WM are considered riverine species (i.e. *Psectrocladius sp*., *Rheotanytarsus sp*., *Saetheria sp*., *Stempellinella sp*., *Trissopelopia sp.*) and are typically associated with good water and habitat quality. Most of these species were absent from the lower regions.

In the middle regions of the Humber River system (HU007WM-HU014WM), a few sites yielded a number of chironomid species that are generally absent under eutrophic conditions and are typically associated with rapidly flowing, cool water. These include *Parametriocnemus sp*. and *Nilotanypus sp*. that were present at HU010WM and HU011WM.

The EPT taxa were also numerous in the middle regions, with a maximum of 13 taxa recorded at station HU012WM. The ephemeropteran *Isonychia sp*. was found in the headwater regions at sites HU029WM and HU038WM and is a good indicator of a healthier watercourse. *Hetageniidae* appear in several of the mid region and headwater sites (i.e. HU010WM, HU011WM, HU012WM, HU029WM, HU036WM) and are also indicators of well oxygenated flowing water and cooler temperatures. Also noteworthy was the occurrence at stations HU027WM and HU030WM of the Plecopteran *Paraleuctra sp*. that can be considered indicative of good habitat and water quality.

The downstream stations in the Humber River (HU001WM - HU003WM) had higher densities of organisms than either Etobicoke or Mimico Creeks. Density ranged from 919 individuals in 41 taxa at HU001WM to 3076 organisms in 36 taxa at HU003WM. While these sites are located in sections of the Humber River that flow through heavily populated urban areas, they do not appear to be noticeably impacted. The Shannon-Weaver diversity index at these stations is above 3, and a number of EPT taxa (7 at HU001WM and HU003WM, 11 at HU002WM) were present. The diversity of chironomid species ranges from lake species such as *Microtendipes sp*. and *Odontomesa sp*. at the mouth, to species known to inhabit cool, flowing water such as *Diamesa sp*. and *Parametriocnemus sp*.

Station HU006WM stands out among the 38 sites sampled on the Humber River as being potentially impaired. This site is located on a section of Black Creek which flows through a park with sports fields, and differed from the other sites in the high percentage of oligochaetes (87%) and a low diversity of benthic organisms (H'=1.00, taxa richness is 15). The abundance of oligochaetes is indicative of nutrient inputs at this site since these organisms tend to occur in high numbers in organically enriched, soft sediment. The low diversity may also be an indication of nutrient input as well as high sediment loading from runoff and the possible presence of pesticides and/or herbicides.

A recent find in the Humber River is rusty crayfish (*Orconectes rusticus*), a benthic invertebrate native to the Ohio River basin. It is believed to have spread through it's use as bait and is of concern due to highly aggressive nature, large appetite and ability to reach higher population densities than native crayfish.

4.4 Conclusion

The present number of fish species found in the watershed is 43, 31 less than the historic total of 74 and 18 less than the number found between 1984 and 1999. A total of 25 native species found historically were not found in 2001, while four introduced species were captured. The reduced number of species is partly due to the location, timing and reduced number of stations sampled recently compared to that sampled between 1984 and 1999. While most introduced species presently have a small impact on the aquatic resources of the watershed, some species like carp, round goby, sea lamprey and rusty crayfish have the potential to seriously impact native aquatic communities. Increases in the distribution and number of introduced species of not only fish, but also aquatic vegetation and micro-organisms, may alter the delicate balance of native ecosystems.

Throughout the watershed, species richness, while generally good, appears to be lower than that expected for similar sized streams in southern Ontario. This is most evident in the medium to large watercourses. The single highest IBI score indicating "very good" stream quality, was located in the East Humber River subwatershed. Every subwatershed but Black Creek and the Lower Main Humber contained stations that had scores of "good" stream quality. The greatest range in IBIs was also found in small streams, suggesting that they are more responsive to impact from surrounding land use than larger watercourses. One of the most urbanized subwatersheds, Black Creek, had the lowest median IBI score at 20. This subwatershed supports aquatic ecosystems of poor or marginal health. The Upper Main Humber River subwatershed, on the other hand, had the highest median IBI score of 31 and supports relatively healthy aquatic systems.

Examination of the individual sub-indices suggests some of the symptoms of development. Approximately 50% of the stations sampled had very low numbers of sensitive species like sculpin and trout. Many stations also had a low proportion of top predators like trout, northern pike or bass, suggestive of degraded conditions in some areas.

Other sub-indices paint a better picture of the aquatic community in the watershed. In most streams, species composition appears to be diverse and relatively well balanced. Evidence that general aquatic conditions are still good despite localized areas of impact is reinforced by high numbers of native species, and low numbers of blacknose and longnose dace and omnivorous species. The three most numerous species are white sucker, blacknose dace, and johnny darter. Even though they are considered to be tolerant warmwater species, their widespread distribution in the watershed does not necessarily indicate degraded conditions watershed-wide. These species have historically been found throughout the watershed due to their ability to survive in many habitats, both healthy and degraded. Furthermore, sensitive species like brook trout, redside dace and mottled sculpin were found at 10-35 % of the stations sampled, and at least one sensitive species was found in all subwatersheds except for Black Creek.

Overall, the benthic communities in the Humber River system are indicative of good water and habitat quality for an urbanizing stream, in particular in comparison with some of the other urban streams sampled, such as the Don River, Etobicoke Creek and Mimico Creek. The diversity at most sites was good and changes in species composition among the sites can be attributed to changes in the habitat types rather than other influences. There is only one area (i.e. Station HU006WM) where some impairment was noted, possibly due to surrounding land use, and this area should be focussed on in subsequent monitoring efforts.

5.0 HABITAT POTENTIAL

Based on the information presented in the previous sections, the watercourses in the Humber River Watershed can be divided into one of seven habitat categories, originally developed in the Don River Fisheries Management Plan (MTRCA, 1996). These seven habitat categories are as follows: small riverine coldwater, small riverine warmwater, intermediate riverine coldwater, intermediate riverine warmwater, large riverine, estuarine and lacustrine.

Separating watercourses into small, intermediate or large was based upon stream size, or drainage area. The river continuum concept (Vannote et al., 1980) suggests that as a watercourse becomes larger, the complexity of habitat increases and the watercourse is able to support a greater number of species. Steedman (1987) showed that species richness initially rises dramatically in streams with drainage areas up to 10 km^2, increases more slowly in streams with drainage areas between 10 and 200 km^2 and then levels off as drainage area increases beyond 200 km^2 (Figure 21). It was on this basis that small, intermediate and large riverine habitats were defined (Table 34).

To define a watercourse as either cold or warmwater, physical and biological attributes were used. Flow regime, and more specifically, the ratio of baseflow to average annual flow, hydrologic soils and stream slope were used to estimate whether a watercourse would have the cold, stable flows necessary to support coldwater habitat (Table 34). The historic presence or absence of trout was also used to identify cold or warmwater tributaries.

Estuarine habitat is formed where the large riverine habitat enters Lake Ontario. The watercourse in this area has a very low slope and water level is influenced directly by Lake Ontario. Estuarine habitat was defined as that area from the river mouth upstream to the highest water level recorded in Lake Ontario (data from 1918-1994), an elevation of 75.7 m. This level was located just downstream of Old Mill dam. Lacustrine habitat is defined as both on-line and off-line ponds, reservoirs and kettle lakes.

Habitat categories for the Humber River watershed are illustrated in Figure 22.

Locations where cold and warm water habitats adjoin or where large riverine and estuarine habitats meet are likely transitional areas where species may move between habitats depending upon the season, flows or other environmental influences.

Table 24: Rationale Behind Defining the Aquatic Habitat Categories.

HABITAT CATEGORY	FLOW REGIME			BIOLOGICAL CHARACTERISTICS
	MEAN BASEFLOW ($m^3/s/km^2$)	PRIMARY HYDROLOGIC SOIL GROUP	DRAINAGE AREA (km^2)	FISH COLLECTION RECORDS
Small Riverine Coldwater	high	A, AB or B	less than 10	trout historically or currently present
Small Riverine Warmwater	low	BC, C, CD or D	less than 10	trout not present historically or currently
Intermediate Riverine Coldwater	moderate-high	A, AB or B	10 - 300	trout historically or currently present
Intermediate Riverine Warmwater	low	BC, C, CD or D	10 - 300	trout not present histor ically or currently
Large Riverine	low - moderate	NA	> 300	trout not present historically or currently
Estuarine	NA	NA	NA	NA
Lacustrine	NA	NA	NA	NA

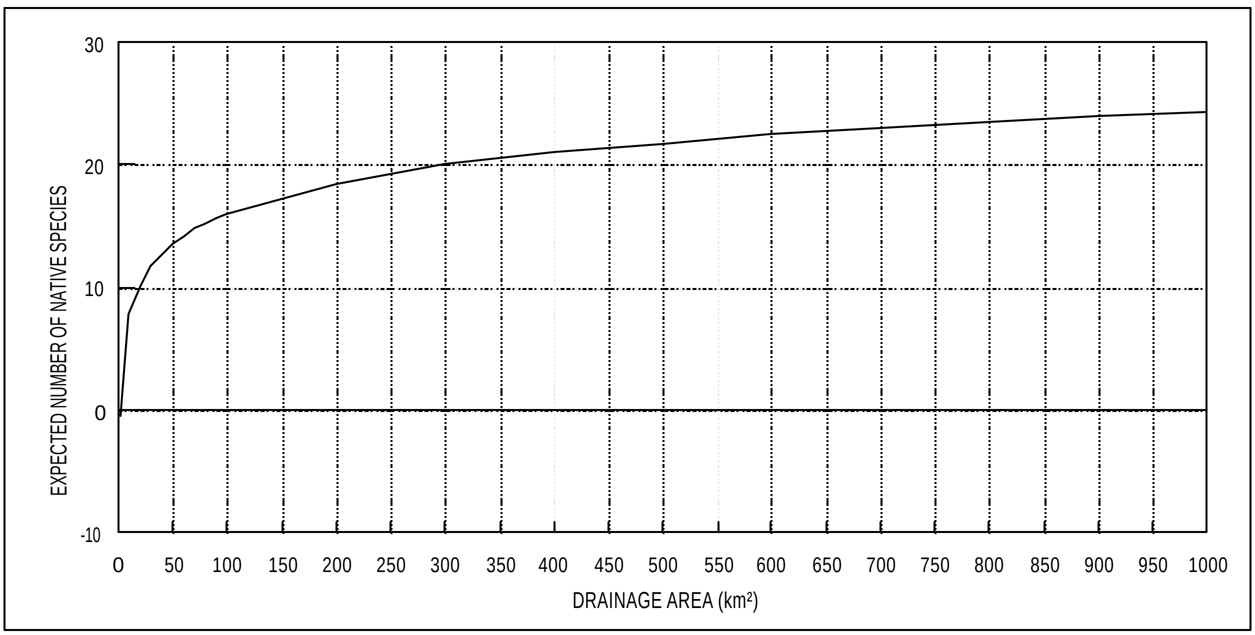


Figure 21. The relationship between the expected number of native species and drainage area.

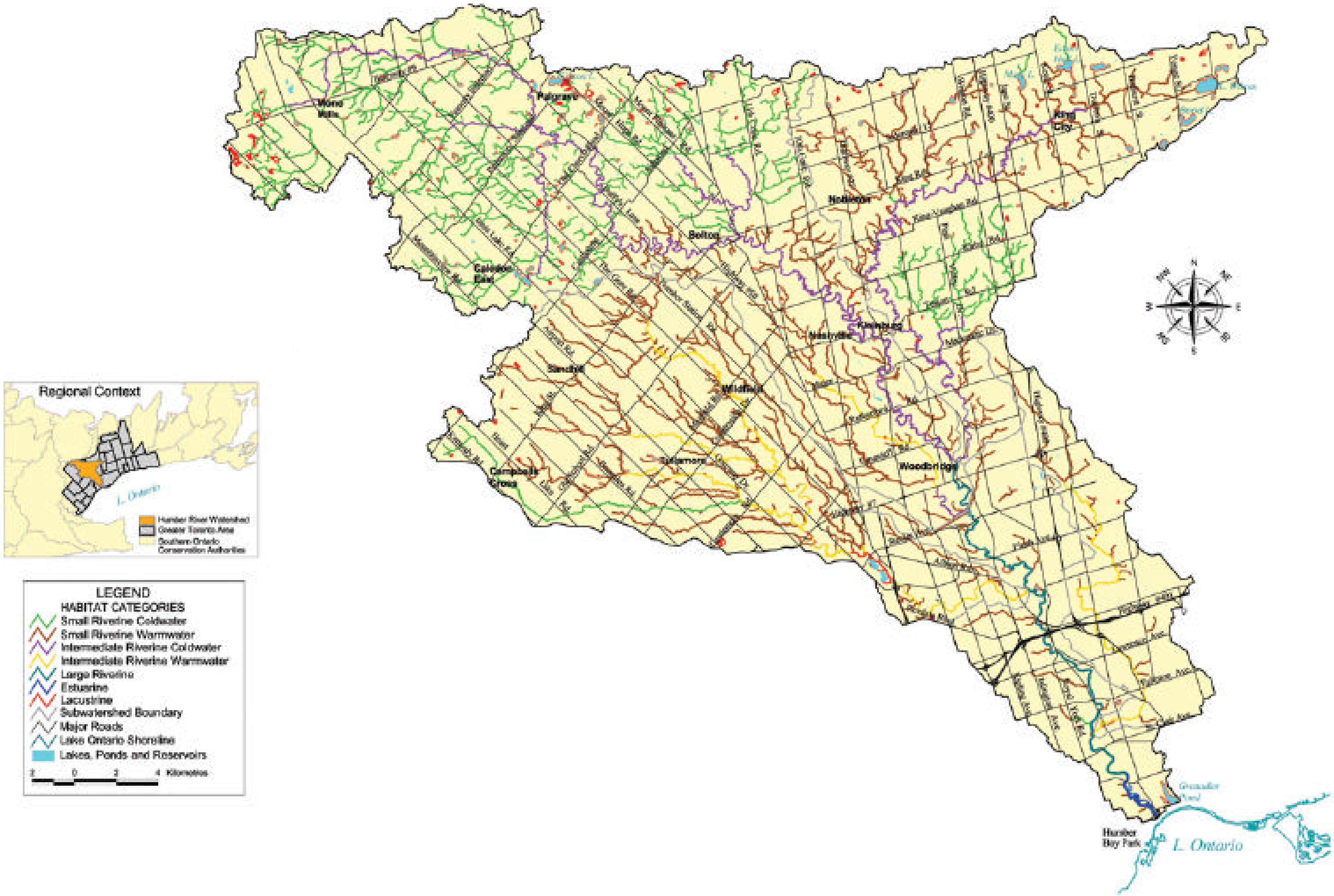


Figure 22. The locations of the aquatic habitat categories in the Humber River Watershed.

5.1 Small Riverine Coldwater Habitat

Watercourses in this habitat category have drainage areas less than 13.5 km^2. This primarily includes first and second order tributaries, although a few third order watercourses do fall into this group. Most of these watercourses begin on the Niagara Escarpment and Oak Ridges Moraine where coarse soils predominate and allow for greater infiltration and groundwater discharge to the stream. Some of these watercourses will be intermittent but the majority will have permanent flow. They also have relatively stable flows because of large groundwater inputs, often greater than 20% of average annual flow. Groundwater inputs also help to maintain continually low water temperatures.

Even though Cold Creek, which joins the Main Humber River downstream from Bolton, and Purpleville Creek, which drains into the East Humber River, are underlain by mainly 'C' soils with low infiltration rates, they both contain small riverine coldwater habitats. They are classified as small riverine coldwater habitat because they currently support trout and they have high baseflows, likely due to inputs from a regional aquifer.

This habitat category is also found in the Centreville Creek sub-basin and the tributary of the West Humber River flowing through Campbells Cross.

Historically, 31 fish species have been found in this habitat category, four of which are introduced (Table 35). Atlantic salmon likely used these watercourses to spawn, or for feeding as juveniles during their first two years. Overfishing, pollution, habitat destruction and the construction of dams and weirs are all reasons for the extirpation of this species from Lake Ontario in the late 1800's. Today, barriers still prevent salmon and trout introduced into Lake Ontario from accessing these watercourses. In 2001, 20 species were found, one of which is introduced. Based on a maximum drainage area of 13.5 km^2, the number of native species expected at a single location in this habitat category ranges from six to nine, with more species expected in the larger drainage areas. At one station, thirteen species were found, which is more than expected.

Five sensitive species are found in this habitat category. American brook lamprey, brown and brook trout, redside dace and mottled sculpin. Redside dace is considered a Species of Special Concern by COSEWIC (Mosquin et al., 1995) and provincially Threatened by COSSARO. American brook lamprey, northern redbelly dace, rainbow darter, and brassy minnow are listed as a Group 2 Intermediate – Priority Candidate species and emerald shiner is listed as a Group 3 Lower - Priority Candidate species by COSEWIC.

Table 25: Historic and Present Fish Species Found in Small Riverine Coldwater Habitat.

HISTORICALLY FOUND	FEEDING STRATEGY*	PRESENTLY FOUND**	HISTORICALLY FOUND	FEEDING STRATEGY	PRESENTLY FOUND
American brook lamprey [3]	C, H	X	Blacknose dace	I	X
Rainbow trout[1]	P, I		Longnose dace	I	
Atlantic salmon	P, I		Creek chub	I, O, P	X
Brown trout[1]	P, I	X	Pearl dace	I	
Brook trout	P, I	X	Brown bullhead	O	
Central mudminnow	I		Brook stickleback	I	X
White sucker	I	X	Rock bass	I, P	
Northern hog sucker	I	X	Pumpkinseed	I	X
Northern redbelly dace[3]	O, I	X	Smallmouth bass	C, P, I	
Redside dace[2]	I	X	Largemouth bass	I, P	
Brassy minnow [3]	H	X	Rainbow darter [3]	I, C	X
Common shiner	I, O	X	Iowa darter	I, C	
Blackchin shiner	I		Fantail darter	I	
Blacknose shiner	I		Johnny darter	I	X
Emerald Shiner [4]	I, H	X	Golden Shiner	O	X
Fathead Minnow	O	X	Mottled sculpin	I	X
Bluntnose minnow	O	X			

* - C - Crustaceans, H - herbivore, I - insectivore, O - omnivore, P - piscivore

** - present data were collected from six stations

[1] - introduced

[2] - nationally Species of Special Concern (COSEWIC) and provincially Threatened (COSSARO)

[3] - Group 2 - Intermediate Priority Candidate (COSEWIC)

[4] - Group 2 - Lower Priority Candidate (COSEWIC)

IBI analysis was performed on six stations in this habitat category, with scores ranging from 25 to 37 and a median score of 30, or "good" stream quality. All of the stations were found in either the Upper Main, West or East Humber River subwatersheds. The station with the lowest IBI score in this habitat category was found in the East Humber River subwatershed.

Examining IBI sub-indices individually indicates that the number of native species caught at each station closely matches the expected number of native species for 50 % of stations (Table 25). A low percentage of stations scored high for the next two species richness sub-indices, indicating a lack of specialists. Fifty per cent of the stations scored high for the number of sucker/catfish species. Only 50 % of stations scored high with respect to the presence or absence of brook trout while 100% scored high in percent of sample as *Rhinichthys sp*. This suggests that these streams are not highly urbanized and contain a relatively intact riparian buffer. Analysis of the trophic composition sub-indices suggest that omnivores do not dominate the fish communities and that there is a lack of piscivorous species. Finally, 50 % of stations scored high in the abundance sub-indices.

In general, watercourses classified as small riverine coldwater appear to be healthy and able to support healthy aquatic communities. Since many of these watercourses are located in headwater areas, their protection and enhancement will not only sustain existing aquatic communities, but will also benefit those downstream.

Table 26: Frequency Distribution of Scores in Small Riverine Coldwater Habitat for Sub-indices of the IBI.

SUB INDEX SCORE*	SPECIES RICHNESS				LOCAL INDICATOR SPECIES		TROPHIC COMPOSITION		FISH ABUNDANCE
	Number of native species (% of records)	Number of darter/sculpin species (% of records)	Number of sunfish/trout species (% of records)	Number of sucker/catfish species (% of records)	Presence or absence of brook trout (% of records)	% of sample as *Rhinichthys* sp.	% of sample as omnivorous sp.	% of sample as piscivorous sp.	catch per minute of sampling (% of records)
1 (low)	17 ?	50 ?	17 ?	33 ?	50 ?	0 ?	0	67 ?	50 ?
3 (med)	33 ?	33 ?	66 ?	17 ?	not applicable	not applicable	0	not applicable	0
5 (high)	50 ?	17 **?**	17 ?	50 **?**	50 **?**	100 **?**	100	33 **?**	50 ?

* - the higher the sub-index score the better the habitat rating. Values in the table indicate the percentage of sampling stations with the indicated sub-index score. Columns sum to 100% of stations. IBI analysis was done on six stations in small riverine coldwater habitat. Arrows indicate an increase (?) or decrease (?) from the 1999 data. Numbers with no arrow did not change.

5.2 Small Riverine Warmwater Habitat

This habitat type is comprised of watercourses having drainage areas less than 10 km^2. For the most part, this means first and second order tributaries draining from the Peel Plain, although there are some third order streams in this category. Due to the dominance of clay soils in the Peel Plain, infiltration rates are low, as are the rates of groundwater discharge to streams. As a result, many of these tributaries are either reduced to standing pools or completely dry up during the warmer summer months. A low baseflow and high average flow is also reflected in the low ratio of baseflow to average annual flow. Finally, water temperatures are likely to fluctuate and become quite warm during the summer.

This habitat category is found in all subwatersheds and includes such tributaries as Salt Creek in the West Humber River and Black Creek.

The number of species found in this habitat category in 2001 was 2, much less than the 36 species found historically (Table 26). However, it should be noted that only two stations were sampled in this habitat category and that one of them is located just upstream of a barrier that precludes fish passage. Redside Dace were detected in one tributary in 1999. All of the species found historically and presently, except for goldfish, are native. Drainage areas for this habitat category range up to 10 km^2 and the expected number of native species at any one site varies from five to seven, with more species expected in watercourses with larger drainage areas.

Table 27: Historic and Present Fish Species Found in Small Riverine Warmwater Habitat.

HISTORICALLY FOUND	FEEDING STRATEGY *	PRESENTLY FOUND**	HISTORICALLY FOUND	FEEDING STRATEGY	PRESENTLY FOUND
American brook lamprey [3]	C, H		Blacknose dace	I	X
Northern pike	P		Longnose dace	I	
Central mudminnow	I		Creek chub	I, O, P	X
White sucker	I		Yellow bullhead	O	
Northern hog sucker	I		Brown bullhead	O	
Goldfish [1]	O		Banded killifish	I, C	
Northern redbelly dace [3]	O, I		Brook stickleback	I	
Redside dace [2]	I	X	Rock bass	I, P	
River chub	I		Pumpkinseed	I	
Golden shiner	I		Smallmouth bass	C, P, I	
Emerald shiner [4]	I		Largemouth bass	I, P	
Common shiner	I, O		Yellow perch	I, P	
Blackchin shiner	I		Rainbow darter [3]	I, C	
Blacknose shiner	I		Iowa darter	I, C	
Rosyface shiner	I		Fantail darter	I	
Sand shiner	I		Johnny darter	I	
Bluntnose minnow	O		Mottled sculpin	I	
Fathead minnow	O				

* - C - crustaceans, H - herbivore, I - insectivore, O - omnivore, P - piscivore
** - present data were collected from one station
[1] - introduced
[2] - nationally Species of Special Concern (COSEWIC) and provincially Threatened (COSSARO)
[3] - Group 2 - Intermediate Priority Candidate Species (COSEWIC)
[4] - Group 3 - Lower Priority Candidate Species (COSEWIC)

An IBI score of 16, or "poor" stream quality, was calculated for the station in this habitat category where fish were caught. The station was located in the Lower Main Humber River subwatershed.

Analysis of the IBI sub-indices indicated that 100 % of stations scored medium with respect to the number of native species (Table 27). One hundred percent scored low in the number of darter/sculpin in the remaining three species richness sub-indices. This suggests that there is a lack of specialists in these watercourses. The station scored low in the percent of sample as *Rhinichthys sp.* sub-indices, indicating a relatively high degree of urbanization. The station scored high in the percent of sample as omnivorous species, indicating that omnivores do not dominate fish communities at these locations. The station scored low in the piscivorous species sub-indices, indicating an absence of piscivorous species, and likely slightly unbalanced trophic structures. The station scored low in the abundance sub-indices, suggesting a significant level of degradation in this watercourse.

The lack of piscivorous species and other specialists, a case often found in impaired streams, suggests degradation in these watercourses. The intermittent nature of these watercourses, though, may limit the presence of piscivorous species and as such, will also dictate the fish community present. Some sensitive species such as American brook lamprey, redside dace, largemouth bass, and rainbow darter, are able to survive in these watercourses and management for these species should ensure the survival of other, more tolerant species.

Table 28: Frequency Distribution of Scores for Small Riverine Warmwater Habitat for Sub-indices of the IBI.

SUB INDEX SCORE*	SPECIES RICHNESS				LOCAL INDICATOR SPECIES		TROPHIC COMPOSITION		FISH ABUNDANCE
	Number of native species (% of records)	**Number of darter/sculpin species (% of records)**	**Number of sunfish/ trout species (% of records)**	**Number of sucker/ catfish species (% of records)**	**Presence or absence of brook trout (% of records)**	**% of sample as *Rhinichthys* sp.**	**% of sample as omnivorous sp.**	**% of sample as piscivorous sp.**	**catch per minute of sampling (% of records)**
1 (low)	*0*	*100* **?**	*100* **?**	*100* **?**	*not applicable*	*100* **?**	*0* **?**	*100*	*100* **?**
3 (med)	*100* **?**	*0*	*0* **?**	*0* **?**	*not applicable*	*not applicable*	*0*	*not applicable*	*0*
5 (high)	*0* **?**	*0* **?**	*0*	*0* **?**	*not applicable*	*0* **?**	*100* **?**	*0*	*0* **?**

* - The higher the sub-index score the better the habitat rating. Values in the table indicate the percentage of sampling stations with the indicated sub-index score. Columns sum to 100% of stations. IBI analysis was done on one station in small riverine warmwater habitat. Arrows indicate an increase (?) or decrease (?) from the 1999 data. Numbers with no arrow did not change.

5.3 Intermediate Riverine Coldwater Habitat

Included in this category are those watercourses whose headwaters drain the Oak Ridges Moraine and Niagara Escarpment. These permanently flowing tributaries receive a proportionately high percentage of groundwater and as a result have relatively high baseflow ratios, have relatively stable flows and water temperatures. Drainage areas for these watercourses range from approximately 10 km^2 up to 300 km^2. The majority of watercourses in this habitat category are third and fourth order streams, although some second and fifth order streams are found.

This habitat category is only found in the Upper Main, East and West Humber River subwatersheds.

Historically, forty-six fish species have been found in this habitat category, of which three are introduced (Table 28). The most noteworthy species no longer occurring here is Atlantic salmon, an important piscivore and sport fish. Thirty-two species of fish, of which two are non-native, were found here in 2001. The expected number of native species at a site ranges from four to twenty-four, with more species expected at larger drainage areas. At none of the twenty-six stations were more species found than expected. At only one station did the number of expected species equal the number of actual species.

The redside dace, a nationally species of special concern and provincially threatened as defined by COSEWIC (Mosquin et al., 1996) and COSSARO, respectively, and brook trout, an indicator of high quality coldwater habitat, are two significant species presently found in this habitat category. Brown trout and American brook lamprey, other sensitive species requiring cold water, were also found here. American brook lamprey, northern redbelly dace, brassy minnow, and rainbow darter are listed as Group 2 Intermediate, and spottail shiner and stonecat are listed as Group 3 Lower - Priority Candidate species by COSEWIC.

Table 29: Historic and Present Fish Species found in Intermediate Riverine Coldwater Habitat.

HISTORICALLY FOUND	FEEDING STRATEGY*	PRESENTLY FOUND**	HISTORICALLY FOUND	FEEDING STRATEGY	PRESENTLY FOUND
American brook lamprey [4]	C, H	X	Mimic shiner	O, I	
Rainbow trout[1]	P, I	X	Bluntnose minnow	O	X
Atlantic salmon [2]	P, I		Fathead minnow	O	X
Brown trout1	P, I	X	Blacknose dace	I	X
Brook trout	P, I	X	Longnose dace	I	X
Central mudminnow	I	X	Creek chub	I, O, P	X
White sucker	I	X	Pearl dace	I	
Northern hog sucker	I	X	Yellow bullhead	O	
Northern redbelly dace[4]	O, I	X	Brown bullhead	O	X
Redside dace[3]	I	X	Stonecat[5]	I	X
Common carp[1]	O		Banded killifish	I, C	
Brassy minnow [4]	H	X	Brook stickleback	I	X
Hornyhead chub	C, I, H	X	Rock bass	I, P	X
River chub	I	X	Pumpkinseed	I	X
Sand shiner	I		Bluegill	I	
Golden shiner	I	X	Smallmouth bass	C, P, I	
Emerald shiner [5]	I		Largemouth bass	I, P	X
Common shiner	I, O	X	Yellow perch	I, P	
Blackchin shiner	I		Rainbow darter [4]	I, C	X
Blacknose shiner	I		Iowa darter	I, C	
Spottail shiner [5]	C, I	X	Fantail darter	I	X
Rosyface shiner	I	X	Johnny darter	I	X
Central Stoneroller	H	X	Mottled sculpin	I	X

* - C - crustaceans, H - herbivore, I - insectivore, O - omnivore, P - piscivore, Pa - parasite

** - present data were collected from 26 stations

[1] - introduced

[2] - extirpated

[3] - national Species of Special Concern (COSEWIC) and provincially Threatened (COSSARO)

[4] - Group 2 - Intermediate Priority Candidate Species (COSEWIC)

[5] - Group 3 - Lower Priority Candidate Species (COSEWIC)

IBI scores were calculated for 24 stations in this habitat category and range from 23 to 39 with a median value of 31, or "good" stream quality rating. The station with the highest IBI score in the watershed, a "very good" stream quality rating, is found in this habitat category and is located on Purpleville Creek. Two stations scoring 23 or "fair" stream quality were located in the Upper Main and East Humber River subwatersheds.

Analysing the IBI sub-indices shows that only 37 % of stations scored high with respect to the number of native species found (Table 29). The percent of stations scoring high is even lower for the last three species richness sub-indices, indicating a lack of specialized feeders. Brook trout were found at 50 % of stations sampled. One hundred percent of stations scored high with respect to the percent of sample as *Rhinichthys sp.*, suggesting little urbanization in these watercourses. Piscivorous species were lacking from 58 % of stations while all stations scored high in the percent of sample as omnivores. Scores from the fish abundance sub-indices suggests a moderate amount of degradation has occurred in the watercourses sampled.

Historically and today, this habitat category has supported many sensitive species including salmonids, redside dace, darter species and mottled sculpin. Piscivorous species and other specialized feeders are lacking from many of the watercourses but, otherwise these watercourses remain relatively healthy. Management of this habitat category must be directed towards protecting and improving conditions for sensitive species. In so doing, the less sensitive species will also survive.

Table 30: Frequency Distribution of Scores for Intermediate Riverine Coldwater Habitat for Sub-indices of the IBI.

SUB INDEX SCORE*	SPECIES RICHNESS				LOCAL INDICATOR SPECIES		TROPHIC COMPOSITION		FISH ABUNDANCE
	Number of native species (% of records)	**Number of darter/ sculpin species (% of records)**	**Number of sunfish/ trout species (% of records)**	**Number of sucker/ catfish species (% of records)**	**Presence or absence of brook trout (% of records)**	**% of sample as *Rhinichthys* sp.**	**% of sample as omnivorous sp.**	**% of sample as piscivorous sp.**	**catch per minute of sampling (% of records)**
1 (low)	*0*	*46 ?*	*54* **?**	*13***?**	*50?*	*0* **?**	*0*	*58 ?*	*42 ?*
3 (med)	*63 ?*	*50* **?**	*38* **?**	*83* **?**	*not applicable*	*not applicable*	*0*	*not applicable*	*0*
5 (high)	*37* **?**	*4 ?*	*8* **?**	*4 ?*	*50?*	*100* **?**	*100*	*42* **?**	*58* **?**

* -The higher the sub-index score the better the habitat rating. Values in the table indicate the percentage of sampling stations with the indicated sub-index score. Columns sum to 100% of stations. IBI analysis was done on twenty four stations in intermediate riverine coldwater habitat. Arrows indicate an increase (?) or decrease (?) from the 1999 data. Numbers with no arrow did not change.

5.4 Intermediate Riverine Warmwater Habitat

This habitat category contains watercourses draining from the Peel Plain. Stream orders in this category are mainly third and fourth order, although some are second and fifth order streams. The majority of these watercourses drain an area between 10 km^2 and 300 km^2. Because infiltration and baseflow is low, some of these streams dry up or become standing pools in the summer, particularly those in the West Humber River subwatershed. As well, the flow regime and water temperatures fluctuate due to low amounts of baseflow.

This habitat category occurs in the Upper Main, East and West Humber River subwatersheds.

Thirty-seven species of fish have historically been found, of which two are introduced (Table 30). In 2001, twenty species were found in this habitat category, including redside dace and rainbow darter. The expected number of native species ranges from 11 to 18 per site, with more species expected at larger drainage areas. At individual stations, the actual number of species found was generally less than, with the exception of one station that was equal to that expected by Steedman.

Table 31: Historic and Present Fish Species Found in Intermediate Riverine Warmwater Habitat.

HISTORICALLY FOUND	FEEDING STRATEGY	PRESENTLY FOUND	HISTORICALLY FOUND	FEEDING STRATEGY	PRESENTLY FOUND
American brook lamprey[3]	C, H		Blacknose dace	I	X
White sucker	I	X	Longnose dace	I	X
Northern hog sucker	I	X	Creek chub	I, O, P	X
Goldfish[1]	O		Central stoneroller	I	X
Northern redbelly dace[3]			Yellow bullhead	O	
Redside dace[2]	I	X	Brown bullhead	O	X
Common carp[1]	O		Stonecat[4]	I	
Brassy minnow[3]	H		Brook stickleback	I	
River chub	I		Rock bass	I, P	X
Golden shiner		X	Pumpkinseed	I	X
Common shiner	I, O	X	Bluegill	I	
Blackchin shiner	I		Smallmouth bass	C, P, I	
Blacknose shiner	I		Largemouth bass	I, P	X
Spottail shiner[4]	C, I	X	Yellow perch	I, P	X
Rosyface shiner	I		Rainbow darter[3]	I, C	X
Sand shiner	I		Iowa darter	I, C	
Mimic shiner	O, I		Fantail darter	I	X
Bluntnose minnow	O	X	Johnny darter	I	X
Fathead minnow	O	X	Mottled sculpin	I	

* - C - crustaceans, H - herbivore, I - insectivore, O - omnivore, P - piscivore
** - present data were collected from nine stations
[1] – introduced
[2] - nationally Species of Special Concern (COSEWIC) and provincially Threatened (COSSARO)
[3] - Group 2 - Intermediate Priority Candidate Species (COSEWIC)
[4] - Group 3 - Lower Priority Candidate Species (COSEWIC)

IBI scores for the 9 stations used in the analysis range from 20 to 34, with a median value of 29, or "good" quality. The station with the lowest IBI is located in the Black Creek subwatershed while the station scoring 34 is in the Upper Main Humber River subwatershed.

The IBI sub-indices for this habitat category indicate that fewer native species were found than expected (Table 31). The sub-indices for the number of darter/sculpin, sunfish/trout and sucker/catfish species did not score high for any of the stations sampled. This is a decrease from the data calculated for 1999. The percent of sample as *Rhinichthys sp*. and omnivorous species both scored high for 100 and 86 % of stations, respectively, suggesting these species do not dominate the aquatic system. Piscivorous species were only found at 14 % of stations, an indication of degraded habitat. The abundance sub-indices suggest that the watercourses found in this habitat category are not considerably degraded.

Overall, this habitat category continues to sustain a relatively diverse aquatic community with fewer species than what was found historically. While this habitat is still able to support sensitive species such as darters, the lack of specialized feeders and piscivores indicates some degradation. As such, management for sensitive species and piscivores will also ensure the survival of the more tolerant fish species.

Table 32: Frequency Distribution of Scores for Intermediate Riverine Warmwater Habitat for Sub-indices of the IBI.

SUB INDEX SCORE*	SPECIES RICHNESS				LOCAL INDICATOR SPECIES		TROPHIC COMPOSITION		FISH ABUNDANCE
	Number of native species (% of records)	Number of darter/sculpin species (% of records)	Number of sunfish/trout species (% of records)	Number of sucker/catfish species (% of records)	Presence or absence of brook trout (% of records)	% of sample as *Rhinichthys* sp.	% of sample as omnivorous sp.	% of sample as piscivorous sp.	catch per minute of sampling (% of records)
1 (low)	*14 ?*	*29 ?*	*43 ?*	*14 ?*	*not applicable*	*0*	*0 ?*	*86 ?*	*71 ?*
3 (med)	*29 ?*	*71 ?*	*57 ?*	*86 ?*	*not applicable*	*not applicable*	*14 ?*	*not applicable*	*0*
5 (high)	*57 ?*	*0 ?*	*0 ?*	*0 ?*	*not applicable*	*100*	*86 ?*	*14 ?*	*29 ?*

.* - The higher the sub-index score the better the habitat rating. Values in the table indicate the percentage of sampling stations with the indicated sub-index score. Columns sum to 100% of stations. IBI analysis was done on seven stations in intermediate riverine warmwater habitat. Arrows indicate an increase (?) or decrease (?) from the 1999 data. Numbers with no arrow did not change.

5.5 Large Riverine Habitat

Any watercourse with a drainage area greater than 300 km2 was included in this category. This includes the sixth order stream in the Lower Main Humber River subwatershed and a portion of the fifth order reach of the Upper Main Humber River up to the confluence with the East Humber River. Since it receives water from numerous large sub-basins in the Upper Main Humber River and from two subwatersheds south of the confluence with the West Humber River subwatershed, the flow regime can fluctuate greatly. Because of the width of the river that does not allow for much shading by riparian vegetation, water temperatures are also unstable.

The number of fish species presently found in large riverine habitat in the Humber River watershed is 24, two of which are introduced (Table 32). Historically, 38 species were found here, of which only one was introduced. The expected number of species for this habitat category ranges from 22 to 24. At no stations were more species caught than were expected.

Table 33: Historic and Present Fish Species Found in Large Riverine Habitat.

HISTORICALLY FOUND	FEEDING STRATEGY	PRESENTLY FOUND	HISTORICALLY FOUND	FEEDING STRATEGY	PRESENTLY FOUND
American brook lamprey [4]	C, H	X	Longnose dace	I	X
Atlantic salmon [1]	P		Creek chub	I, O, P	X
White sucker	I	X	Fallfish	I, C, F	
Northern hog sucker	I	X	Central stoneroller	I	X
Redside dace [2]	I		Yellow bullhead	O	
Common carp [3]	O	X	Brown bullhead	O	X
Brassy minnow [4]	H		Stonecat [5]	I	X
Hornyhead chub	C, I, H		Brook stickleback	I	
River chub	I	X	Rock bass	I, P	
Golden shiner	I	X	Pumpkinseed	I	X
Emerald shiner [5]	I		Bluegill	I	
Common shin er	I, O	X	Smallmouth bass	C, P, I	
Blackchin shiner	I		Largemouth bass	I, P	
Blacknose shiner	I		Yellow perch	I, P	
Rosyface shiner	I		Rainbow darter [4]	I, C	X
Sand shiner	I		Iowa darter	I, C	
Bluntnose minnow	O	X	Fantail darter	I	X
Fathead minnow	O		Johnny darter	I	X
Rainbow Trout	I	X	Blackside darter	I	
Spotfin Shiner	I	X	Blacknose dace	I	X

* -C - crustaceans, H - herbivore, I - insectivore, O - omnivore, P - piscivore.

** - Present data were collected from five stations.

[1] – extirpated

[2] - nationally Species of Special Concern (COSEWIC) and provinciallyThreatened (COSSARO)

[3] – introduced

[4] - Group 2 Intermediate Priority Species (COSEWIC)

[5] - Group 3 Lower Priority Species (COSEWIC)

IBI scores for the five stations sampled in large riverine habitat ranged from 18 to 27, with a median of 25, or "fair" stream quality. One station sampled near the mouth of the river was not included in the IBI analysis because the sampling was carried out using an electroshocking boat that is biased towards larger species of fish.

Analysing the IBIs in terms of their nine sub-indices shows that none of the stations scored high in the native species sub-indices, a decrease over the data from 1999 (Table 33). Eighty percent of the stations scored low in the number of darter/sculpin and sunfish/trout sub-indices and there was no change in the number of stations that scored high. No stations scored high in the number of sucker/catfish sub-indices, suggesting a lack of these species. Brook trout are not expected in this category and this is reflected in the no stations scoring high in this sub-indices. One hundred percent of stations scored high in the % of sample as Rhinichthys species sub-indices, indicating they do not dominate the fish community. Though all stations scored high in the % of sample as omnivorous species, only 50 % stations scored high in the piscivorous species sub-indices, indicating few piscivorous species although more than in 1999. One hundred percent of stations scored high in the abundance sub-indices, suggesting little degradation has occurred in these watercourses. In order to improve the integrity of these areas, regeneration should focus on increasing the number of specialized feeders and piscivorous species.

An important role that this habitat category has played historically is to allow the passage of migratory species like Atlantic salmon to their spawning grounds in headwater streams. The presence of instream barriers in this stretch of river stopped this from occurring. More recently, these barriers have been partial or complete barriers to the introduced pacific salmon and rainbow and brown trout. As well, these barriers prevent other lake species such as walleye and northern pike from accessing the lower river as they would have historically done. At the same time, though, these barriers have prevented the parasitic sea lamprey from reaching upstream spawning grounds. Recent barrier mitigation projects at the Old Mill dam and Raymore Park have improved upstream movement of rainbow trout into headwater areas and the same should be true for Chinook salmon and brown trout. Additional changes to the Old Mill dam should be considered to further improve upstream access by migratory salmonids, recognizing the need to balance this with preventing access by sea lamprey. Should barrier mitigation be undertaken, care must be taken to ensure that sea lamprey or carp are not allowed access to upstream areas.

Not only has this habitat category historically provided a corridor for migrating fish, it has also supported a variety of sensitive resident species. Redside dace, smallmouth bass and five darter species have all been found here. American brook lamprey and rainbow darter, both of which are listed as Group 2 Intermediate, and stonecat that is listed as Group 3 Lower - Priority Candidate Species by COSEWIC were all found in this habitat category in 2001. Management of this habitat category must ensure the survival of these species and in doing so, will ensure the continuation of less sensitive species.

Table 34: Frequency Distribution of Scores for Large Riverine Habitat for Sub-indices of the IBI.

SUB INDEX SCORE*	SPECIES RICHNESS				LOCAL INDICATOR SPECIES		TROPHIC COMPOSITION		FISH ABUNDANCE
	Number of native species (% of records)	Number of darter/sculpin species (% of records)	Number of sunfish/trout species (% of records)	Number of sucker/catfish species (% of records)	Presence or absence of brook trout (% of records)	% of sample as *Rhinichthys* sp.	% of sample as omnivorous sp.	% of sample as piscivorous sp.	catch per minute of sampling (% of records)
1 (low)	*20*	*80 ?*	*80*	*60 ?*	*not applicable*	*0 ?*	*0*	*50 ?*	*100 ?*
3 (med)	*80 ?*	*20 ?*	*20*	*40 ?*	*not applicable*	*not applicable*	*0*	*not applicable*	*0*
5 (high)	*0 ?*	*0*	*0*	*0*	*not applicable*	*100 ?*	*100*	*50 ?*	*0 ?*

* -The higher the sub-index score the better the habitat rating. Values in the table indicate the percentage of sampling stations with the indicated sub-index score. Columns sum to 100% of stations. IBI analysis was done on five stations in large riverine habitat. Arrows indicate an increase (?) or decrease (?) from the 1999 data. Numbers with no arrow did not change.

5.6 Estuarine Habitat

Estuarine habitat in the Humber River watershed extends from the mouth to just above Bloor Street, a distance of almost 6 km. This habitat is characterized by very low slope (0.03%), slow moving, turbid water, and is directly influenced by the water level in Lake Ontario.

Steedman's (1987) model predicts that a drainage area of 907 km^2 should contain 24 species. In 2001, 10 species were found in this habitat category in the Humber River watershed while the historical list contains 57 species (Table 34), however it should be noted that the sampling was limited to that done by boat. Electroshocking by boat is generally biased towards larger species. The current species makeup likely contains more species such as bowfin, rainbow trout, Chinook salmon, and black crappie, which are found periodically in this habitat but due to the timing of the survey were not collected. The large number of species is due to the presence of the Humber Marshes, a large wetland area that provides spawning, nursery and feeding areas for many species that are normally lake resident.

Spottail shiner, a Group 3 Lower Priority Candidate species as defined by COSEWIC, was found in this habitat category in 2001.

Due to limitations of the model, an IBI value was not calculated for the station that was located close to the river/lake interface. In the Humber River Marshes themselves, aquatic habitat problems include high turbidity, lack of aquatic macrophytes and poor nursery habitat. Management of this habitat category must focus on improving water quality and rehabilitating existing wetland habitats.

Table 35: Historic and Present Fish Species Found in Estuarine Habitat.

HISTORICALLY FOUND	FEEDING STRATEGY	PRESENTLY FOUND	HISTORICALLY FOUND	FEEDING STRATEGY	PRESENTLY FOUND
Sea lamprey [1]	Pa		Creek chub	I, O, P	
Longnose gar	P		Central stoneroller	I	
Bowfin	I, P		Brown bullhead	O	X
Alewife [1]	O, I, P		Channel catfish	I, H	
Gizzard shad	H		Stonecat [4]	I	
Coho salmon [1]	P		American eel [3]	I, P	
Chinook salmon [1]	P		Three-spine stickleback	I	
Rainbow trout [1]	P		Trout-perch	I	
Atlantic salmon [2]	P		White perch [1,3]	I, P	
Brown trout [1]	P		White bass	P, I	
Rainbow smelt [1]	C, P		Rock bass	I, P	
Northern pike	P		Green sunfish	I	
White sucker	I	X	Pumpkinseed	I	X
Northern hog sucker	I		Bluegill	I	
Goldfish [1]	O		Smallmouth bass	I, P	
Lake chub	I		Largemouth bass	I, P	X
Common carp [1]	O	X	Black crappie	C ,F	
River chub	I		Yellow perch	I, P	X
Golden shiner	I		Walleye	P	X
Emerald shiner [4]	I		Rainbow darter [3]	I	
Common shiner	I, O	X	Iowa darter	I, C	
Spottail shiner [4]	C, I	X	Fantail darter	I	
Rosyface shiner	I		Johnny darter	I	
Spotfin shiner	I		Logperch	C, I	
Sand shiner	I		Blackside darter	I	
Bluntnose minnow	O	X	Tesselated darter	I	
Fathead minnow	O		Freshwater drum	O, I	X
Blacknose dace	I		Mottled sculpin	I	
Longnose dace	I				

* -C -crustaceans, H - herbivore, I - insectivore, O - omnivore, P - piscivore, Pa – parasite; ** - Present data were collected from two stations; [1] – introduced; [2] – extirpated; [3] - Group 2 Inter Priority Candidate Species (COSEWIC); [4] -Group 3 Lower Priority Candidate Species (COSEWIC)

5.7 Lacustrine Habitat

The Humber River watershed has over 600 ponds and waterbodies, but for the purposes of this plan, only the major waterbodies where information exists will be discussed. In this case, this includes over 10 kettle and human-made ponds and Claireville Reservoir. These habitats are characterized by low slope, low gradient areas that may be eutrophic, and in some of the kettle lakes, are anoxic near the bottom.

Twenty-seven fish species have been identified in the historic fish surveys of the lakes and ponds in the Humber River watershed (Table 35). Of these, three (goldfish, common carp and white perch) are non-native. Walleye, historically found in the Lower Main Humber River subwatershed, have been introduced into St. George Lake and appear to have developed a self-sustaining population. The presence of brook trout in Elliot and Innis Lakes is likely since surveys in 1995 found brook trout both up and downstream of these waterbodies. Some present fisheries data were gathered in 2000 and 2001 for Claireville Reservoir, Eglinton Flats and Eaton Hall but for many of the other waterbodies designated as lacustrine habitats such as Mary and Hackett Lakes, recent data could not be found. It is recommended that additional work be done to assess the fish communities in these locations.

While waterbodies do often provide habitat for many aquatic species, they may also negatively affect downstream aquatic communities. The creation of an on-line pond may hinder or even block fish passage. Cold water habitats may also be negatively influenced by on-line ponds as they tend to decrease thermal stability necessary for such species as brook trout.

Management of this habitat category should strive to maintain and improve habitat and water quality for sensitive species. This will also ensure the survival of more tolerant species.

Table 36: Historic Fish Species Found in Lacustrine Habitat.

FISH SPECIES*	WATERBODY NAME														
	Bell's Lake	Eaton Hall	Elliot Lake	Innis Lake	Widgett Lake	Palgrave Pond	Gregloch Lake	Hackett Lake	Kelly Lake	St. George Lake	Thompson Lake (King Township)	Wilcox Lake	Claireville Reservoir	Eglinton Flats Pond	Grenadier Pond
Brook trout			X	X											
Northern pike							X	X		X		X			X
Bowfin														X	
Central mudminnow						X				X		X			
White sucker		X	X	X	X	X						X	X	X	X
Northern hog sucker													X		
Goldfish [1]													X	X	
Common carp [1]		X										X	X	X	X
Northern redbelly dace[2]						X			X		X				
Finescale dace									X						
Golden shiner	X	X	X			X				X		X			X
Emerald shiner [3]															X
Common shiner						X							X	X	
Bluntnose minnow												X	X		
Fathead minnow						X							X		
Blacknose dace						X									
Creek chub						X									
Yellow bullhead				X											
Brown bullhead	X		X			X	X			X	X	X		X	X

FISH SPECIES*	WATERBODY NAME														
	Bell's Lake	Eaton Hall	Elliot Lake	Innis Lake	Widgett Lake	Palgrave Pond	Gregloch Lake	Hackett Lake	Kelly Lake	St. George Lake	Thompson Lake (King Township)	Wilcox Lake	Claireville Reservoir	Eglinton Flats Pond	Grenadier Pond
Banded killifish										X		X			
White perch[1,2]															X
Rock bass			X							X		X	X		
Pumpkinseed	X	X	X		X	X	X	X		X		X	X	X	X
Bluegill		X	X		X			X		X		X			X
Smallmouth bass				X											
Largemouth bass	X	X	X				X	X		X		X	X	X	X
Black crappie		X										X	X		X
Yellow perch		X	X	X	X		X	X		X		X			X
Walleye		X								X					
Fantail darter						X									
Iowa darter		X	X	X	X		X	X		X		X			
Johnny darter						X									

* - data from Claireville Reservoir, Lakes Wilcox and St. George, and Grenadier pond includes data from 1980 to the present. All other data came from Wainio and Hester (1973);

[1] – introduced;

[2] - Group 2 - Intermediate Priority Candidate Species (COSEWIC);

[3] - Group 3 - Lower Priority Candidate Species (COSEWIC)

Due to the characteristics in each subwatershed, not all habitat categories are found in every subwatershed. A summary of the habitat categories by subwatershed is presented in Table 37.

Table 37: Habitat Categories by Subwatershed.

SUBWATERSHED	HABITAT CATEGORY
Upper Main Humber River	Small Riverine Coldwater
	Small Riverine Warmwater
	Intermediate Riverine Coldwater
	Intermediate Riverine Warmwater
	Large Riverine
	Lacu strine
East Humber River	Small Riverine Coldwater
	Small Riverine Warmwater
	Intermediate Riverine Coldwater
	Lacustrine
West Humber River	Small Riverine Coldwater
	Small Riverine Warmwater
	Intermediate Riverine Warmwater
	Lacustrine
Black Creek	Small Riverine Warmwater
	Intermediate Riverine Warmwater
	Lacustrine
Lower Main Humber River	Small Riverine Warmwater
	Large Riverine
	Lacustrine
	Estuarine

6.0 FRAMEWORK FOR FISHERIES MANAGEMENT

The previous section of this plan forms the physical and biological background of the watershed. Each watercourse and waterbody has been placed into one of seven aquatic habitat categories. Section 6.0 provides information to the reader on the recommendations that have been made in the form of a framework for fisheries management. Direction is provided in seven areas of interest for watershed residents and resource managers. Of importance is the section on subwatershed management where specific direction is given on how habitats within each of the five major subwatersheds are to be managed in the future.

6.1 Public Lands

At 908 km^2, the Humber River watershed is one of the larger watersheds in southern Ontario and is the largest in the TRCA's jurisdiction. Public landowners in the watershed include the Province of Ontario, the TRCA, local and regional municipalities, and educational institutions. The locations of these lands in the watershed are shown in Figure 23. Since inception, the TRCA has acquired 6,427 ha (16,067.5 acres) of land in the watershed and includes the Albion Hills and Boyd Conservation Areas, the Palgrave and Glen Haffy Forest and Wildlife Areas, the Nashville and Bolton Resource Management Tracts, as well as numerous valleylands in the City of Toronto. Public lands provide access to various sections of the river for angling, walking, wildlife viewing, education and habitat rehabilitation opportunities.

While the majority of public land is open to the public for hiking angling, nature viewing and a variety of other uses, some lands require additional permission to enter. Properties such as Lake St. George Field Centre, Cold Creek and Claireville Conservation Areas have restricted public access and only under certain conditions are the public allowed to enter. Check with the landowner, whether they are public or private, before entering property for any reason. In addition, all signs such as No Trespassing, No Angling, or Private Property, should be respected.

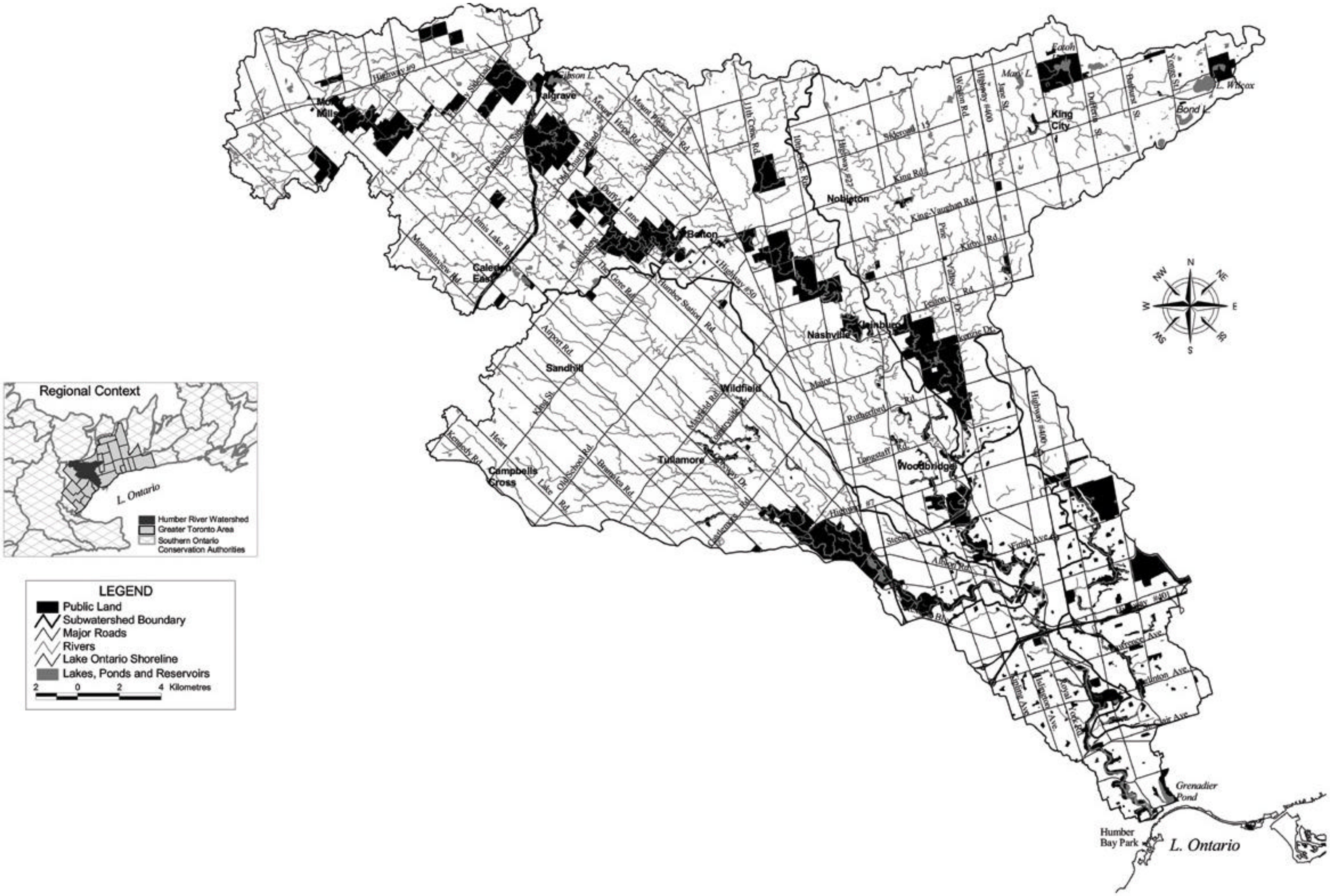


Figure 23. The Locations of Public Land in the Humber River Watershed

6.2 Species of Conservation Concern

The designation of species of national significance is given by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). COSEWIC was established in 1977 and includes representatives of federal, provincial and territorial governments, and national environmental organizations. With respect to fish, of the 1,091 species known to occur in Canada, only 53 have had their designation reviewed by COSEWIC (Mosquin et al., 1995). Habitats of rare, threatened, special concern and endangered fish are protected under the Federal Fisheries Act.

The designation of species of provincial significance is made by the Ontario Ministry of Natural Resources and, as of 1995, is based on recommendations made by the Committee on the Status of Species at Risk in Ontario (COSSARO). The Committee's purpose is to ensure a uniform, science-based, defensible approach to provincial status evaluations and recovery work for species at risk in Ontario. The work of the provincial committee, COSSARO, is integrated with the work of COSEWIC. The Ontario Ministry of Natural Resources has made a commitment to continue to participate in a national approach, as embodied by the work of COSEWIC, through its ratification of the National Accord for the Protection of Species at Risk (1996). The most recent listing of species-at-risk is available on the MNR website at **http://www.mnr.gov.on.ca/mnr/fwmenu.html**.

Fisheries records indicate that one national Species of Special Concern, the redside dace, is currently found in the Humber River watershed. This small fish has been found throughout the watershed with densities highest in areas with low urban hydrologic impacts.

The candidate list of species for designation includes three priority groupings to reflect the relative urgency to be afforded to each for assessment by COSEWIC and potential listing. Groups 2 and 3 contain species that are of intermediate or lower priority for COSEWIC assessment. American brook lamprey, northern redbelly dace, brassy minnow, and rainbow darter, all listed as Group 2 Intermediate, and emerald shiner, spottail shiner, and stonecat, listed as Group 3 Lower - Priority Candidate species by COSEWIC were all found in the watershed in 2001. The Ontario population of American brook lamprey is considered 'especially at risk' in this category.

It should be noted that there is a significant range in the amount of scientific information available about individual fish species, about the interactions between species, and about the sensitivities of species to cumulative environmental stressors. With respect to Species of Conservation Concern, it is generally accepted that identified species are under varying levels of threat as a result of human activities. However, the range and combinations of factors potentially limiting the viability of populations and species is often poorly understood. In the absence of sufficient information upon which to base management decisions for Species of Conservation Concern, the *precautionary principle* is applied as a management direction within this FMP. This approach necessitates that an appropriate level of understanding of cumulative effects and what constitutes significant portions of habitat of Species of Conservation Concern be acquired as part of the evaluation process for all developments or activities that may impact aquatic ecosystems within a given watershed.

In cases where a Species of Conservation Concern has already been extirpated from a watershed, but where the Fisheries Management Plan identifies the same species as a potential candidate for recovery within the watershed, rehabilitation requirements need to be integrated into the implementation of development proposals.

Redside Dace

The redside dace is generally uncommon, however, it was once locally abundant throughout the Ontario range. Recent collections, though, reveal a significant decline in the distribution within Ontario (Holm and Crossman, 1986). Only fifty percent of the historical capture sites, surveyed by the Royal Ontario Museum between 1982 and 1985, produced recaptures. Habitat degradation has caused extirpation (local extinction) within several watersheds (McKee and Parker, 1981). Healthy populations still exist in the Rouge and Humber Rivers as well as Fourteen Mile, Sixteen Mile and Bronte Creeks. The redside dace was historically found in the Upper Main, East and West Humber River subwatersheds and were reported as common within the East Humber River during surveys in 1972 (Wainio and Hester, 1973). Since 1984, there have been 31 reported capture sites within the Humber River watershed.

In Ontario, the redside dace inhabits slow moving sections of small headwater streams which have mixtures of stream side shade and pool and riffle habitat (Holm and Crossman, 1986). Pools are used as residence habitat and the upstream end of riffles are used for spawning. Redside dace will spawn over excavations made by creek chub and common shiner. Spawning takes place in late spring when water temperatures reach approximately 18°C. Stream sections with overhanging vegetation, undercut banks and submerged branches and logs are most suitable. Bottom substrates include boulders, rocks, gravel or sand, often with shallow surface covering of detritus or silt (McKee and Parker, 1981). Streams are clear or colourless in conjunction with hard substrates and clear to brown tinged in streams with organic substrates. Redside dace prefer clear water and is sensitive to turbidity, however, redside dace have been found in some streams of moderate turbidity (Holm and Crossman, 1986). Temperatures are usually less than 20 °C and dissolved oxygen concentrations are at least 7 mg/L (McKee and Parker, 1981). Redside dace are also considered moderately sensitive to direct disturbance by human beings and/or domesticated animals, particularly during the spring spawning period (Holm, pers. comm).

Destruction and degradation of habitat have been the major factors in the reduction of redside dace distribution. Changes in stream hydrology, siltation, removal of natural edge cover, channelization and agricultural pollution of streams, and direct disturbance by people and domestic animals in urban and urbanising areas reduces suitable habitat and food sources. The species is now restricted to the headwaters of many streams where it was once widespread.

Protection from harvest, stream hydrology and water quality protection, riparian zone rehabilitation, riparian zone protection, restricting livestock access and mitigation of instream barriers and ponds are seven principle actions for sustaining redside dace within a healthy, diverse fish community. The most stringent instream construction window of July 1st to September 15th is used to protect this species from further decline.

Representatives from the OMNR, TRCA, CVC, Ontario Streams, Department of Fisheries and Oceans, and the ROM have developed a recovery strategy for the redside dace in Ontario. Ontario Streams, on behalf of the Recovery Strategy Team, receives federal and provincial funding to implement the recovery strategy and work on habitat rehabilitation projects to help restore a viable population of redside dace in a significant portion of their historic range in Canada. Further work is underway to monitor distribution, implement habitat rehabilitation projects and build information resources for the public. For further details on the development of the recovery plan, refer to the redside dace website at http://www.redsidedace.ca.

Atlantic Salmon

Atlantic salmon were once very abundant in the Humber River. Historical information suggests that the Humber was second in prominence to the Credit River with noted spawning grounds (Dymond, 1965). The first government sawmill was built in 1793 near the location of the present "Old Mill" and probably initiated the demise of this species by blocking the migration of adults on their way to spawning grounds in the upper watershed. By 1824 there were 13 mills on the river and by 1860 there were more than 90 in operation. Stocking managed to sustain a presence of this species up to about 1876 but by 1898, the species had been extirpated from Lake Ontario.

The cumulative effects of early settlement and growth in southern Ontario drastically changed the landscape and the functions of its watersheds. The multitude of dams on the river and its tributaries, loss of forest cover, baseflow reduction, urban and rural pollution, combined with unregulated harvest lead to the demise of the naturally reproducing wild salmon.

Now that the agricultural and timber harvest booms of the early twentieth century are over in the watershe, there has gradually been changing social values in the landscape. The late Dr. E.J. Crossman, Curator of Ichthyology, Royal Ontario Museum, once said "the rivers of Southern Ontario can thank two historical milestones - the invention of electricity and Hurricane Hazel for their recovery". If these events had not occurred, the dams would still be running the mills and people would still be developing the floodplains." Fewer dams, more forest and the protection of valuable headwater areas will eventually restore coldwater habitats in the Humber River. With this change will come the opportunity one day to restore the Atlantic salmon to the watershed, and with it a part of our natural heritage.

Ontario is in the process of developing a recovery strategy for this species. For further information, refer to www.atlanticsalmonontario.ca

American Eel, Northern Redbelly Dace, American Brook Lamprey, Brassy Minnow, Rainbow Darter, White Perch, Emerald Shiner, Spottail Shiner, and Stonecat

American eel, American brook lamprey, northern redbelly dace, rainbow darter, white perch and brassy minnow have been classified as Group 2 Intermediate Priority, while emerald shiner, spottail shiner, and stonecat have all been classified as Group 3 - Lower Priority Candidates by COSEWIC. It should be noted that white perch is introduced to Ontario and that it is the Quebec, not the Ontario, population that is considered at risk. If it is determined that the Quebec population is not discrete or of national significance the species will, in all likelihood, be dropped from the list (Campbell, 2002). American eel and American brook lamprey are considered species that are 'especially at risk' in Ontario. Candidate species are drawn from numerous scientific sources for consideration of inclusion on the COSEWIC list of species of conservation concern.

The American brook lamprey, northern redbelly dace, rainbow darter, brassy minnow, emerald shiner, spottail shiner, and stonecat were all found in the watershed in 2001. The American eel was last found in the watershed in 1989 and was found near the mouth, while the white perch was last found in 1995.

Barriers, overfishing, pollution and ecological change at an international scale are all considered factors in the apparent decline of the American eel population, to the point where the Great Lakes Fisheries Commission - Lake Ontario has stated that "without management intervention, extirpation of the American eel in the Great Lakes Basin is likely" (GLFC, 2002). Similar stressors are also likely responsible for the reported national decline in the other species. The American brook lamprey was found at 11 stations, brassy minnow was found at 5 stations, rainbow darter was found at 18 stations, northern redbelly dace was found at 6 stations, and the spottail shiner was found at 7 stations in 2001. The relative abundance of these species in recent and historical sampling suggests that they are likely less at risk at a local level than the other listed species.

6.3 Consumptive Uses

Consumptive uses include any method of harvesting fish such as angling or baitfish removal and results in the loss of fish from the system. Consumptive uses are one expression of the economic value of the resource and it is important that these opportunities be provided while at the same time protecting the long-term sustainability of the resource.

This section will deal with consumptive uses through regulations, stocking and baitfish harvest recommendations. It recommends angling and harvest regulations and suggested changes to reflect current concerns and fisheries management goals. This section also provides direction regarding fish stocking as a fisheries management tool for re-establishing native species, providing put-and-delayed-take fishing opportunities or population rehabilitation.

6.3.1 Fishing

The Humber River watershed has been the focus of native, commercial and sport fishing harvest for centuries. The local Mississauga Indians were known users of the Humber River salmon as late as 1796 (Dymond, 1965).

Historically, Atlantic salmon, brook trout, bass and pike were harvested from its waters for food. Spear fishing for salmon was common during the fall as a source of food and income. Today, consumptive uses are primarily limited to recreational angling, where pesticide and heavy metal contaminates constrain the harvest value for food. Further north into the headwaters of the Humber River, coldwater streams and lakes provide ample opportunities for brown and brook trout, bass and pike. These areas provide better quality angling where fish can be eaten with fewer concerns about contamination.

6.3.1.1 Regulations

Fishing seasons, sanctuaries, methods and limits are regulated by the Ontario Ministry of Natural Resources under the Ontario Fisheries Regulations of the federal *Fisheries Act*. The *Fish and Wildlife Conservation Act* (FWCA) contains provisions for regulating access to fishing on private land through the *Trespass to Property Act*. The FWCA and associated regulations also regulate other aspects of fishing including winter fishing huts, commercial fishing and private aquaculture and stocking. The Fisheries Act is used to regulate fishing seasons, catch and possession limits, size limits, gear types and sanctuaries.

Ontario conservation officers and deputy conservation officers are Fishery Officers with the delegated authority to enforce the Fisheries Act.

Fish habitat is protected through the habitat provisions of the Federal Fisheries Act as administered by Fisheries and Oceans Canada or a designated agent. The Act can also be used to require a fishway in the construction of new dams or the rehabilitation of old dams.

Fishing seasons in the Humber River vary depending on the species being angled and the location in the watershed. This section presents a brief overview of the angling regulations for the more commonly sought species as they currently apply to the Humber River watershed and do not cover the entire list of regulations, nor all waterbodies and watercourses in the province (Figure 24).

THESE ARE THE 2005-2006 REGULATIONS. CHANGES ARE EXPECTED FOR 2007 BASED ON THE IMPLEMENTATION OF THE ECOLOGICAL FRAMEWORK FOR FISHERIES MANAGEMENT.
CURRENT ANGLING REGULATIONS ARE FOUND IN THE RECREATIONAL FISHING REGULATIONS SUMMARY PUBLISHED ANNUALLY BY THE ONTARIO MINISTRY OF NATURAL RESOURCES

http://www.mnr.gov.on.ca/mnr/fwmenu.html

The Humber River watershed is found in Division 4 and any angler between the ages of 18 and 64, inclusive, must have a valid licence to fish. The open season for bass (either smallmouth or largemouth) extends from the last Saturday in June until November 30. Northern pike can be caught from January 1 to March 31 and then from the second Saturday in May until December 31.

Open seasons for salmon and trout were amended in 2000 in response to the recommendations of this Plan. A year round open season for rainbow and brown trout currently exists between Lake Ontario and Eglinton Avenue. The normal open season for rainbow and brown trout (last Saturday in April - September 30) is extended to December 31 for the river section from Eglinton Avenue to Steeles Avenue. Upstream of Steeles Avenue, angling is NOT allowed in the Humber River and its tributaries from October 1 to the Friday before the last Saturday in April, inclusive. This zone is a fish sanctuary during the closure of trout season. This does not apply to ice fishing on the headwater lakes. The open season for lake trout is from January 1 until September 30. Atlantic salmon is closed all year.

There are also some additional regulations regarding catch and possession limits of trout upstream from Eglinton Avenue. The catch and possession limit for brook and brown trout is two in one day with a regular licence and one with a conservation licence. The aggregate catch limit with a regular licence for brook trout, brown trout, lake trout, Pacific salmon, rainbow trout and splake is five, with not more than two brook or brown trout in the aggregate. The aggregate conservation licence limit is two, with not more than one lake trout and not more than one brook or brown trout in the aggregate.

Some illegal fishing activities include spearing, snagging, netting or using more than one fishing line. Destroying or allowing lawfully caught fish, which are suitable for eating, to spoil is also an offence. It is also illegal to angle within 22.9 metres (75 feet) downstream from the lower entrance to a fishway, canal, dam, obstacle or leap. There are also additional regulations on catch and possession limits and many other aspects of sportfishing.

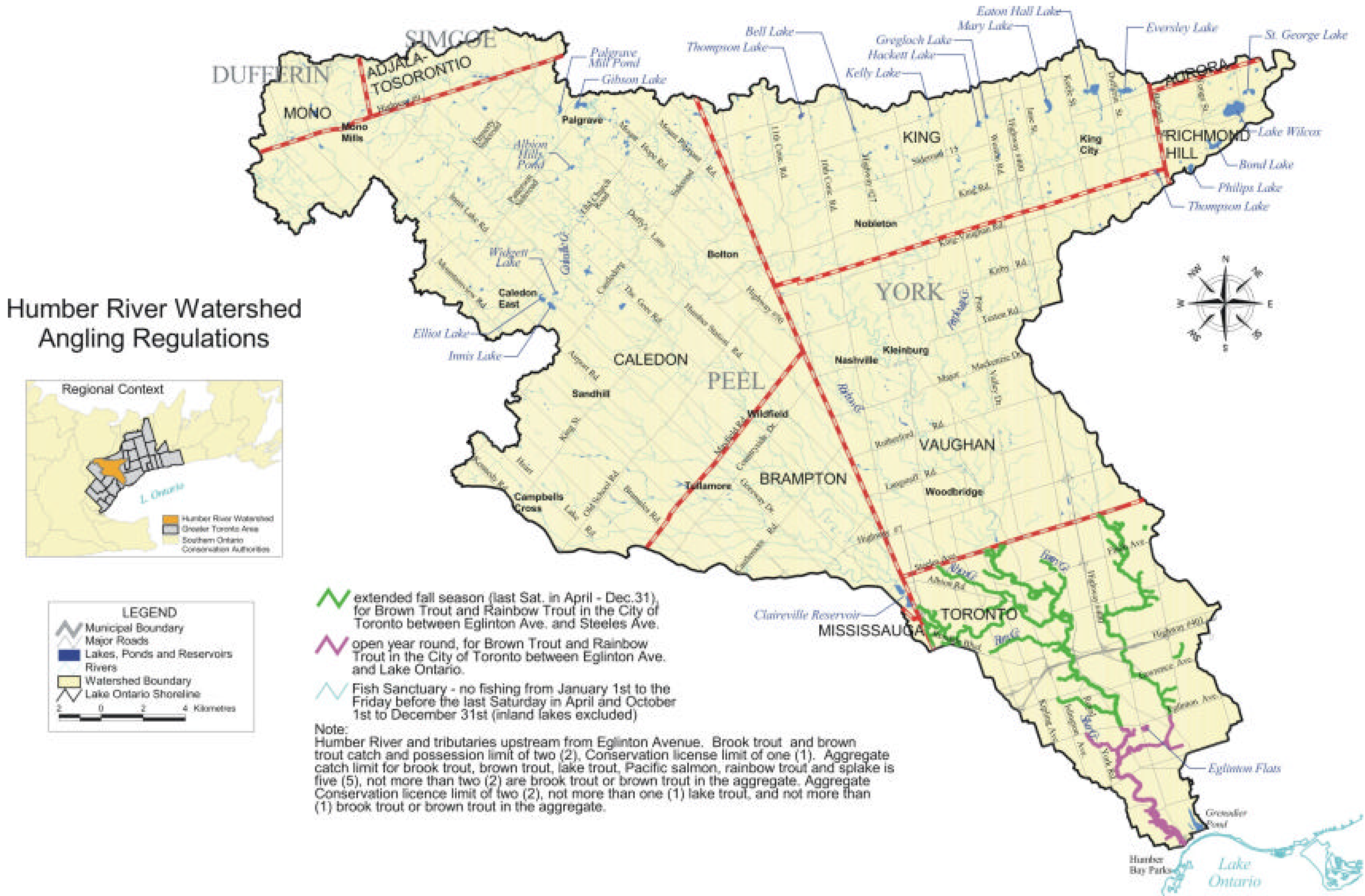


Figure 24. **Angling Regulations in the Humber River Watershed**

To reduce illegal activities, the idea of a River Watch or River Keeper program was suggested at the first round of public meetings in 1999. A program whereby trained members of the public would be allowed monitoring and education duties is a good idea, particularly during the spring and fall migrations of salmon and trout. This type of program would require a committed and coordinated volunteer effort, as well as OMNR and local police involvement and training. Presently, there are models of this program operating in the Grand, Credit, Rouge and Duffins River Watersheds.

A similar program introduced by the OMNR is the Fish and Wildlife Guardian Program. Fish and Wildlife Guardians are volunteers who assist OMNR's compliance efforts. The primary roles of a Guardian are:

- Providing the public with local knowledge and awareness about fishing and hunting rules and regulations; and,
- Acting as the "eyes and ears" for OMNR, noting any non-compliance activities they may observe and sharing this with district enforcement staff.

Each volunteer accepted into the Guardian program is trained in the following:

- introduction to the various statutes;
- conflict avoidance and conflict resolution;
- cross-cultural awareness; and,
- note taking and observational skills.

Anyone who is over eighteen, and who has not been convicted of a Fish and Wildlife-related or Criminal offence within the last five years, is eligible to apply to the Guardian Program. The OMNR office in Aurora has more information.

Enforcement of the fishing regulations is done by OMNR Conservation Officers with some limited assistance from local police and public. It is their responsibility to control illegal activities such as poaching, overfishing, angling without a licence, etc**. If you see any illegal activities, please contact the 24 hour, 7 days a week tips line at 1-877-TIPS-MNR (847-7667).**

6.3.1.2 Stocking

Stocking is a type of fisheries management tool that can have one of several purposes. Put-and-take stocking refers to releasing catchable sized fish for public or private benefit. Many fish farms have ponds that are stocked in this manner. Put, grow and delayed take stocking is similar but the fish are released at a small size with the intention of having them grow in the environment in which they were stocked with the expected benefit to the public occurring years later. The Chinook and coho salmon fishery of Lake Ontario is a put, grow and delayed take fishery.

Rehabilitative stocking involves species that are planned for re-introduction or rehabilitation where an existing population is extirpated or has diminished beyond the point of natural recovery. This is typically a result of over-exploitation, habitat destruction or lethal contamination. Fish are stocked at various life stages, either fry, fingerling or yearling, with the intention of having them grow to maturity and become self-sustaining over a number of years of stocking effort. Brook trout and rainbow trout are typically used for rehabilitative stocking of river tributaries whereas lake trout are used for rehabilitative stocking of Lake Ontario.

Using data from Wainio and Hester (1973) and the Lake Ontario Management Unit (1997), government stocking records for the Humber River watershed go back to 1923 and indicate that a total of 1.5 million fish have been stocked by various provincial agencies over this period. This sum was made up of seven species; brook (306,960), brown (675,587) and rainbow trout (307,237), coho salmon (181,165), largemouth (69,000) and smallmouth bass (7,000) and walleye (74, 272). All species were stocked as either fingerlings, yearlings or both, although brook and brown trout have also been stocked as fry.

Brook trout were stocked annually from 1923 to 1972 in sections of the Town of Caledon and the Townships of Mono, and Adjala-Tosorontio but have not been stocked since. This stocking was likely done to enhance resident populations. Brown trout have been stocked in most years between 1932 and 2003, with no fish being releaseed between 1961 and 1973. Most of these fish were stocked in the upper and east branches of the watershed and was also likely done to enhance resident populations. Currently, brown trout are stocked in the East and Upper Main Humber River by local fish and game clubs and the OMNR. Since 2001, OMNR stocks 47,500 brown trout annually into the Humber River upstream of Bolton and a few smaller tributaries located near Highway No. 9.

Rainbow trout, stocked in parts of the Town of Caledon, the City of Vaughan and King Township, were done between 1935-1940 and then in most years from 1959-1972 and every year from 1994-2004. Each year in the spring, over 20,000 yearling rainbow trout are stocked in the East Humber River.

In 2000, 30 Atlantic salmon adults were released into the Upper and Lower Main Humber River subwatersheds, some with radio tags, to study interactions among various salmon and trout species during the fall spawning periods and assess spawning success. However, the results of this study were generally inconclusive and the majority of fish either succumbed to the protozoan *Icthyoprhthirius multifiliis* ("Ick") or were caught by anglers.

Coho salmon were stocked in parts of the Town of Caledon from 1969-1971 and 1973-1975 and in 2004. The stocking of migratory rainbow trout and coho salmon was done to create and enhance a "put, grow and delayed take" fishery in the Lower Main Humber River.

All stocking of bass has been in lakes rather than the watercourses and include Claireville Reservoir (largemouth), Wilcox Lake (both species), Mary Lake (largemouth), Bell's Lake (both species) and Innis Lake (smallmouth). Stocking was done between 1949 and 1966 and in the 1980's to either expand the range of these species in the watershed or to enhance present populations. No information was found on more recent stocking of these species.

In 2001, almost 75,000 walleye were stocked near Woodbridge. No additional stocking of walleye has since been done. Young walleye have been detected in recent years using the Humber River Marshes (MNR, 2004).

Government stocking has put a great number of fish into the watershed over the last 70 years but this is not the total extent of stocking in the watershed. The numbers mentioned above do not include any private stocking into ponds or that done by local angling groups prior to 1992. Some of the more common species used for the stocking of private ponds include brook and rainbow trout and largemouth bass. No comprehensive information could be found on the numbers of fish stocked by private landowners.

Permits are required for the sale, transfer and stocking of fish in Ontario. Landowners should be aware that any private stocking of in-land waterways, ponds within the floodplain or connected lakes must be first approved by the Ontario Ministry of Natural Resources. Stocking of fish must be consistent with the management recommendations of the Humber River Fisheries Management Plan.

6.3.2 Baitfish Harvest

Baitfish are mainly minnow and shiner species such as white sucker, northern redbelly dace, emerald shiner, spottail shiner, common shiner and creek chub. Juvenile gamefish such as pike, trout, bass and salmon are not considered baitfish.

The commercial harvest of baitfish from the waters of the Humber River has been ongoing for many years. These fish are sold as bait to anglers for use in southern Ontario and beyond. Commercial harvesters are regulated by the OMNR and must report their catches on a regular basis. Historically, several individuals have been permitted to harvest baitfish from the Humber watershed but this system was recently changed to reduce the number of users to one per watershed.

Typically, fish are collected using seines that are large, fine mesh nets sometimes 10 metres in length. The fish are then sorted by species where gamefish are removed. Shiners, suckers and minnows are then graded by size and transported to holding tanks in local retail stores.

On a smaller scale, recreational anglers are permitted, as part of their regular sportfish licence, to catch baitfish as defined in the Ontario Sport Fishing Regulations.

The protection of species of conservation concern is of particular importance when considering the potential impacts from the baitfish harvest industry. Within the Humber River watershed, licensed baitfish harvesters should:

- be aware of areas which support significant species, such as the redside dace, and reduce the risk of accidental harvest;

- be capable of identifying these significant species;
- carefully sort their catch and release significant species within the West, East Humber and Upper Main Humber River.

Purpleville Creek, a small tributary of the East Humber River should be closed to baitfish harvest in order to protect the redside dace population.

6.4 Non-consumptive Uses

Discussions of consumptive uses of a fishery examine the various aspects of the direct user of the resource, usually recreational anglers or commercial baitfish harvesters. This is often tied in with an economic value. What is commonly overlooked are those users of the resource who are not directly "consuming" the resource. These non-consumptive uses often provide a different type of "fishy" experience. In this plan, non-consumptive uses have been classified into two groups, education and viewing, both of which are inter-related.

Education is an integral part of helping people understand the importance of healthy habitat and clean water for not only the aquatic system, but for themselves. The purpose of the experience is to increase awareness and appreciation of the resource, while not necessarily using it directly. This educational experience may occur through programs such as Healthy Yards, Yellow Fish Road, Adopt a Pond, Adopt a Stream or Aquatic Plants, through a local interest or community group, or through classroom study. An increase in or the promotion of educational programs will also serve to heighten interest in the health of the watershed.

The second type of non-consumptive use, which can also be an educational experience, is that of fish viewing. Trout, salmon and white sucker spawning runs in the spring and fall provide an excellent opportunity to see lots of fish or some very large fish, up close. Northern pike, bass and pumpkinseed all spawn in the spring to early summer and generally close to shore, potentially providing another viewing opportunity. Presently, many people are attracted to the area below the Old Mill dam to watch the migratory trout, salmon and white suckers move upstream.

Currently there exists a viewing area at Wilcox Lake close to where pike spawn. Except for the Old Mill dam, most of the public lands have very little or no information identifying reasons why fish are there, or even the types of species present. The outdoor experience could likely be improved if information were available to the people using the area.

In 2001, a viewing window was installed associated with the Palgrave Mill Pond fishway. The window allows individuals to observe the fish as they travel through the fishway.

Of concern when promoting viewing is that the time when fish are most easily seen often occurs during a very sensitive period when the fish are spawning. These fish may be easily scared and disturbed, especially if people enter the water. Care must be taken when viewing fish that disturbance is minimized.

There exist many opportunities to see fish viewing expanded in the watershed. They can be included as part of Community Action Sites or other local initiatives, at sites such as the Old Mill dam, Wilcox Lake, Eglinton Flats or other popular areas or perhaps even as fish viewing tours at peak times of the year. In many cases, signs would be enough but in some areas, the construction of boardwalks to allow the public access may be needed.

6.5 Rehabilitation Activities

A number of recent projects have been developed that are more focused on implementation of terrestrial habitat goals, but when completed, will also greatly benefit the aquatic system. These include TRCA's Terrestrial Natural Heritage Strategy and the Habitat Implementation Plan for the Humber. These documents will be useful for helping to prioritize future implementation projects.

There are numerous rehabilitation activities that can be implemented by those wishing to improve the health of the watershed. The purpose of this section is to describe some, but not all, of these activities in order to provide a general level of understanding of stream rehabilitation. This is only a summary of some rehabilitation methods and those wishing additional details should refer to the Community Fisheries Involvement Program (CFIP) Field Manuals, published by the OMNR (1989), Ontario's Stream Rehabilitation Manual (Heaton et al, 2002), or contact the TRCA.

Before work begins on any rehabilitation project, it is important to check with the local Conservation Authority and Ministry of Natural Resources office to determine if permits are required. This is particularly important in the case of instream works where extensive channel alterations are proposed or fill is proposed in floodplains or valley slopes. These agencies may also be able to recommend rehabilitation locations, offer advice or tie the project in with other local initiatives.

6.5.1 Riparian Vegetation

The benefits of the riparian zone and the vegetation found within it are outlined in more detail in Section 2.1.5, but include bank stabilization, stream shading, source of material for cover and inputs of organic materials. Indirect benefits include attracting insects that then provide a source of benthic invertebrates to the aquatic environment. Historically, many of the watercourses in the watershed had dense riparian vegetation, in addition to thick forests covering much of the tablelands. Urban and rural land use has removed much of this vegetation and in many areas, the planting of streamside vegetation is a simple and relatively inexpensive method of riparian zone rehabilitation. Objectives 1, 2, 12 and 13 in Legacy: A Strategy for a Healthy Humber (MTRCA, 1997) addresses the protection and regeneration of aquatic and terrestrial habitats, which includes the target for woody riparian vegetation cover along 75% of the watercourse length.

Riparian vegetation can either be of the woody or non-woody variety. Woody plants such as shrubs and trees tend to live longer, have deeper roots and are easier to obtain and plant. Some common species used include red osier dogwood (*Cornus stolonifera*), highbush cranberry (*Viburnum trilobum*), pussy willow (*Salix discolor*), slender willow (*Salix petiolaris*) and eastern white cedar (*Thuja occidenitalies*). Non-woody species include grasses or legumes and are useful in establishing a ground cover to help reduce erosion. Ensure that the species chosen is native to the area and suitable for the site selected since some species are better adapted to certain soils types or for wetter or drier conditions.

Some site preparation may be necessary before planting. This may include clearing of weeds to help reduce competition or ensuring that any dangerous hazards are well marked or removed. When planting grasses or legumes, a good seed bed must be prepared and fertilizer may be necessary. This type of planting is best done in the spring. Mulch is recommended to help reduce weed growth. For shrub plantings, plant in a zig-zig manner and use mulch around the base of the shrub to reduce weed competition and keep the soil moist. Shrub planting is best done in either the spring or fall when the plants are dormant. Live cuttings from some shrubs such as willows are also effective in establishing new plants. Trees are planted in much the same manner as shrubs. Remove an area of sod around the spot where the tree is to go, dig deep enough to ensure the roots are covered and then fill in the hole and pack down with your foot. Pour water at the base of the tree to ensure good growth and cover the bare soil with mulch. To help minimize rodent damage, use a tree guard around the base of the tree.

6.5.2 Water Quality

Since fish spend their entire lives in water, ensuring that the water is clean is one of the most important tasks to maintain and enhance the aquatic system. In Legacy: A Strategy for a Healthy Humber (MTRCA, 1997), Objectives 4-10 inclusive deal with protecting surface and ground water from impacts such as sedimentation, excess nutrients and bacteria, chemical fertilizers, oils, grease, metals, road salt and other contaminants.

There are numerous methods of improving water quality that are beyond the scope of this plan in terms of providing specific details. However, there are some general suggestions that are simple and inexpensive to implement. The first simple method of improving water quality is to be conscious of what you pour down the storm sewer. By not dumping wastes, used oil, or other contaminants down the drain, into storm sewers or directly into a watercourse, there is no impact from the contaminant and no clean up cost. Hazardous waste disposal sites are available at most municipal landfill sites where harmful chemicals can be disposed of safely. Excess applications of pesticides or fertilizers, particularly before rains events, are likely to be washed into storm sewers and then into a nearby stream. Reducing or even eliminating these applications will certainly benefit the health of the local river.

Non point and illegal sources of pollution are considered major contributing factors to degraded water quality in Black Creek. Detection of spills, defined as "releases of pollutants into the natural environment originating from a structure, vehicle, or other container, and that are abnormal in light of all circumstances" (MOE, 2002) is difficult and relies heavily on the general public to report suspected spills. Spills should be reported immediately to the Ministry of the Environment and to the municipality when they cause or are likely to cause any of the following:

- impairment to the quality of the natural environment - air, water, or land;
- injury or damage to property or animal life;
- adverse health effects;
- safety risk;
- making property, plant, or animal life unfit for use;
- loss of enjoyment of normal use of property; or
- interference with the normal conduct of business.

The Spills Action Centre, staffed on a 24-hour basis, receives and records province-wide reports of spills and co-ordinates appropriate responses. Suspected spills should be reported to the Spills Action Centre **(Toll Free: 1-800-268-6060; Tel: (416) 325-3000).**

While prevention may be the cheapest and simplest solution, there are also ways to rehabilitate areas of poor water quality. The planting of the riparian zone will intercept sediment and harmful chemicals before they get into the watercourse. Restricting cattle access from watercourses will reduce nutrient inputs, bank erosion and destruction of riparian vegetation. Safe manure storage and handling will also reduce nutrient inputs to streams. In urban and developing areas stormwater management facilities are important features to allow sediment and other contaminants to settle out before they reach the watercourse. Though it seems quite removed from impacting water quality, keeping your vehicle well tuned will reduce emissions that can reach a watercourse through precipitation or overland run-off.

6.5.3 Water Quantity

Land development has considerably altered the natural cycle of water infiltration and run-off in the watershed. Converting land to urban or agricultural uses generally has meant that water (ie. precipitation) is quickly removed and not allowed to infiltrate through the ground. Parking lots, storm sewers, concrete channels and tile drains all work to rapidly remove water from an area. As a result, streams quickly rise following storm events and peak earlier than they did historically. Furthermore, less water infiltrates through the ground, potentially affecting groundwater resources. During drier periods, especially in the summer, baseflows may be reduced due to lower groundwater levels.

Very high and very low flows have serious implications for aquatic communities. Too much water and the stream banks and bed are subject to greater erosional forces. This may result in increased sedimentation and channel scour, particularly if woody riparian vegetation is not present. As well, any instream structures where fish can escape from high flows such as a log jam, may be washed downstream. Loss of these 'velocity refugia' may mean that fish and other aquatic organisms are also carried downstream, possibly to unsuitable habitats. The high levels of suspended solids often seen during high flows may also cause damage to fish gills, reduce foraging ability for sight dependent species and result in the sedimentation of important spawning areas. High flows also present a safety hazard to both human life and property.

In terms of its importance to the biotic side of the aquatic ecosystem, not enough water means impaired productive capacity. The loss of small streams due to changes in drainage patterns can also have downstream impacts in the form of reduced flows, crucial during the summer months. Reduced groundwater inputs may alter the thermal regime of a watercourse, making it less suitable for coldwater species.

Sustainable use, the protection of groundwater and stormwater management are all very important water quantity issues addressed as Objectives 3-5 in Legacy: A Strategy for a Healthy Humber (MTRCA, 1997). The removal of water for such uses as crop or golf course irrigation or drinking water all serve to reduce the amount of water available to the river. Even small things such as turning the faucet off when brushing your teeth, watering your yard at night to reduce evaporation or disconnecting your downspout from the stormwater system will help to reduce pressure on the water cycle.

Ensuring important groundwater recharge and discharge areas are protected from development is another step in maintaining or improving water quantity. Enhancing recharge by creating wetlands or renaturalizing lands are two methods of increasing groundwater recharge and slowing overland flow. Reforesting recharge areas to allow water to soak into the ground is another step.

Finally, flow attenuation is the third major component of improving water quantity. Lakes, ponds, floodplain areas and, historically, the many wetlands that once covered the watershed would store water from the spring melt or following a summer rain and release it slowly during the year. With development, the watershed's ability to store precipitation has been dramatically reduced and as a result, precipitation quickly rushes overland and into nearby watercourses. Flow peaks therefore are larger and occur more quickly after a storm event. The construction of wetlands or stormwater management ponds, holding water on the top of buildings and infiltation of clean run-off are just a few of the methods of slowing the rush of water into the river.

6.5.4 Instream Barriers

The impacts, both positive and negative, of instream barriers have been dealt with in detail in Section 3.3 and include alteration of channel hydraulics, the deposition of sediment, and the warming of water in the head pond and restricting movement of aquatic organisms upstream and downstream of the barrier. Objective 12 in Legacy: A Strategy for a Healthy Humber (MTRCA, 1997) relates to the protection and regeneration of aquatic habitats. Instream barrier mitigation is one action used to achieve this objective.

One method of reducing the thermal impact is to convert the outlet structure of a pond to a bottom draw where cooler water from the bottom is drawn to the outlet and the surface water remains. A minimum depth of 4 metres is needed to achieve temperature stratification. Downstream aquatic communities also benefit from the higher oxygen content of the cooler water. Various types of fishways including rocky ramps, step-pool, vertical slot and Denil styles can be used if removal of the barrier is not a viable alternative. In some cases, sections of the dam may be removed to lower the height of the barrier but not remove it entirely. When mitigating barriers, care must be taken to ensure that significant cultural heritage or other social functions of the barrier are considered.

6.5.5 Natural Channel Design

Historically, engineers and biologists have not always agreed upon the best method to solve or reduce the impacts of development on a watercourse. Traditionally, solutions have involved the use of straight concrete channels, sheet piling or other 'hard' techniques. More recently, the use of natural channel design has been viewed as the most environmentally conscious way to rehabilitate an altered watercourse.

Natural channel design has been presented as a method to integrate the fields of fluvial geomorphology, hydrology and ecology to redesign single channel reaches (Gerdes, 1994). It is an attempt to mimic the natural form and function of a stream channel by applying geomorphological and physical relationships to its' design. This also means taking into account the watershed or ecological perspective, as well as the local conditions of the site. The outcome of a project planned according to natural channel design principles is a healthy and stable river configuration which results in increased stream stability, reduced erosion, habitat diversity (fish and wildlife), reduced downstream impacts, terrestrial linkages and integration of floodplain dynamics with the river (Gerdes, 1994).

Before beginning a natural channel design project, some initial measurements of the characteristics of the watercourse need to be surveyed. Components such as meander length, bankfull width, slope, and discharge are a few of the important characteristics to be examined.

Mathematical relationships have been established amongst many of these variables (see Newbury and Gaboury, 1993) to use as the basis for a natural channel design project.

There are numerous techniques used in natural channel design and only a few are mentioned here. Stabilization of aggressively eroding stream banks can be done through soil bioengineering techniques that deflect the current away from the failed bank or protect it. Materials used to protect stream banks can include various size fieldstones, log cribs and root wads, live fascines and shrub plantings. To protect the stream bed from vertical scour, the use of rocky ramps or a log sill creates a variety of stream habitats, allows upstream passage of aquatic species, are aesthetically pleasing, contribute to oxygenation and reduced construction costs (Salvatori and Jurak, 1994).

While not applicable in every situation, the use of natural channel design is an approach that provides many benefits and as such, should be looked at closely before beginning any stream rehabilitation or realignment projects. For further information on natural channel design, consult the Natural Channel Design Guidelines published by the Ministry of Natural Resources.

6.5.6 Fish Stocking

While stocking has been traditionally used to introduce new species to an area, the use of rehabilitative stocking can be done to supplement an existing population or to re-introduce a species to an area where it has been extirpated. For example, the stocking of brown trout in the East Humber River has been done to rehabilitate a resident coldwater fishery. Stocking is considered a short-term rehabilitation solution where the stream is capable of supporting each life stage of the species. This type of stocking is not a long term method of fisheries rehabilitation in this scenario. In situations where the health of the river is degraded, longer term put-and-delayed-take stocking may be used to promote urban angling opportunities. Historically stocking has been done by government agencies but recently, angling clubs and concerned citizens have been participating.

Stocking of the Humber River by government agencies has been limited to eight fish species; coho and chinook salmon, rainbow, brown, and brook trout, smallmouth and largemouth bass and walleye. It is currently unknown what other species may have been stocked in the waters of the Humber River. Some accidental and some intentional introductions have likely occurred over the years and while the transfer of baitfish from one body of water to another is illegal, this type of activity is difficult to enforce. Any fish transfer must be approved by the MNR before it happens.

The stocking of Chinook and coho salmon is geared toward establishing an urban put-and-delayed-take fishery in the lower Humber River. Urban fishing opportunites should be encouraged, where possible, with supplemental stocking of catchable sized largemouoth bass, northern pike, rainbow trout and brown trout.

The use of rehabilitative stocking should continue in the watershed. The reintroduction of Atlantic salmon will require stocking, as will attempts to expand the range of other historic species such as walleye. Stocking of migratory rainbow trout in the East Humber is geared toward establishing a self-sustaining fishery. Stocking locations and species should be consistent with the management zone into which the species is being stocked.

6.5.7 Habitat Rehabilitation

There are a wide variety of techniques used to rehabilitate and recreate aquatic habitat features and functions, all of which require varying levels of planning and effort. In all cases a clear understanding of site specific conditions and channel characteristics is needed to ensure that the proposed technique is appropriate. In general, it is considered preferable to minimize the use of techniques that inhibit natural processes, and to prioritize those that mimic natural processes. For example, streambank erosion is a natural phenomenon that occurs in all river systems, typically on significant time scales. Inwater habitat rehabilitation measures aimed at reducing unnatural rates of erosion should be applied cautiously and using a broader systematic approach, where all significant contributing factors in addition to the immediate symptom - bank erosion - are identified and remedied where possible. Wherever possible, techniques that restrict natural erosion should be avoided unless a structure is at risk (e.g. road, building, etc.). Efforts should be aimed at remedying the cause of the erosion problem, rather than arresting the process of erosion.

Because land development has resulted in significant changes to water quantity and the associated flow regime, loss of riparian vegetation, and the creation of instream barriers, all of which have negatively affected inwater habitat features, there is usually a need to implement rehabilitation strategies. Inwater habitat features are a very important component of the aquatic community, providing refugia, a source of organic matter, and potential spawning habitat. Rehabilitation techniques include measures such as soil bioengineering (e.g. live staking, fascines, brushlayers, brushmattress, live cribwall, willow posts, native material revetment, and live rock revetment) and habitat improvement (e.g. LUNKERS, boulder placement, large woody material placement: log cover, and log jams). Project planning guidance and more detailed approaches to stream rehabilitation measures can be found in Ontario's Stream Rehabilitation Manual (Heaton et al, 2002).

6.6 Plan Input and Review

The long-term health of rivers and streams, including the protection of fish habitat, is an essential consideration in any land use planning process. Discussion at the early stages of project design should occur between proponents, municipalities, Fisheries and Oceans Canada (DFO), the OMNR, MOE, and TRCA to ensure that appropriate fish habitat protection measures are considered in the planning stages. DFO, OMNR, OMOE, and TRCA use opportunities in the planning process defined under the Planning Act and the Environmental Assessment Act, to ensure that future activities resulting from development approvals will be consistent with the provisions of the Fisheries Act. Approval under the Planning Act does not absolve a proponent from meeting the requirements of any other statutes, required after the Planning Act approvals have been received, such as a work permit under the Navigable Waters Protection Act, the Public Lands Act, the Lakes and Rivers Improvement Act, the Ontario Water Resources Act, and the Conservation Authorities Act. However, in many cases, consideration of fish habitat protection for the proposed development under the Planning Act may address the concerns that are commonly raised when applications are received for legislative approvals.

This Fisheries Management Plan is a resource document to be used to incorporate fisheries interests into the planning and permitting processes. The plan provides information on aquatic habitats and associated fish communities for all watercourses in the watershed and identifies the type of information that is lacking. Protection measures are also identified.

The timing for construction activities in watercourses is based on this information (Table 37). In the permitting process for applications to alter a watercourse, staff at the TRCA and OMNR may require proponents to provide detailed site or reach specific information to evaluate resource management concerns such as, channel morphology, flooding and erosion. Development setbacks, designed to protect species-at-risk, riparian zones or other important stream corridor features, will need to be identified in project proposals. In order to evaluate projects with regard to the objectives of the fish management plan as well as the Federal Fisheries Act, staff may require pre and post project habitat descriptions as well as details of calculations for proposed natural channel designs. The scope of the study and level of detail required will be dependant on the size of the project, the location and the extent of the proposed alteration.

In some cases where a species of conservation concern exists, proponents may be required to re-design their proposals to avoid alterations to aquatic habitat.

Table 38: Guidelines for the Timing of Construction Activities in Watercourses.

HABITAT CATEGORY	CONSTRUCTION PERIOD*
Small Riverine Warmwater	July 1 to March 31
Small Riverine Coldwater	July 1 to September 15
Intermediate Riverine Warmwater	July 1 to March 31
Intermediate Riverine Coldwater	July 1 to September 15
Large Riverine	July 1 to March 31
Estuarine	July 1 to March 31
Lacustrine	July 1 to March 31

* - subject to conditions or modification where a threatened or endangered species recovery plan directs otherwise or where a migratory corridor exists. For example, areas managed for redside dace have a defined construction period of July 1 to September 15th.

6.7 Subwatershed Management

Management direction for each subwatershed and aquatic zone is based upon a number of factors. First and foremost, the characteristics of each subwatershed are controlled by such factors as bedrock and surficial geology, landform, soils, vegetation, and the atmosphere which all work to maintain clear water and regulate hydraulic flow (Tovell, in Salvatori and Jurak, 1994). Ultimately these factors also control the fish community present. For example, the combination of geology, slope and soils have created a situation where very low to no summer baseflows are found in most of the tributaries in the West Humber River subwatershed. Because of the limited baseflow in most tributaries, a warmwater fish community is typically supported. It is upon these types of characteristics and comparison with historic fish communities that the management directions were primarily based.

Management direction is also based on community values. At the first round of public meetings in 1999, many concerns and desires were expressed with regard to allowing increased access for migratory species into the watershed from Lake Ontario. These opinions were summarized and grouped into 12 categories, which were then used as criteria to evaluate management options.

These management options ranged from the "do nothing" option to unrestricted access for all species. Following discussions with the Steering Committee, a shortlist of options was developed. Using the decision criteria and an understanding of the fundamental characteristics and historic functions of the watershed, a preferred management option was selected. The preferred management option was presented to the public during the second round of public meetings and is as follows:

- mitigation of the Old Mill dam north of Bloor Street in Toronto to allow jumping species access upstream;
- the removal/mitigation of dams upstream from the Old Mill dam to north of Regional Road 7 (formerly Highway 7) in Woodbridge; and
- the mitigation of the Board of Trade Golf Course barrier in Woodbridge to selectively allow native and naturalized species past and on to the headwaters of the Upper Main Humber River.

A number of barrier mitigation projects were completed from 1999 - 2002 as a result of the public meetings, with the primary aim of allowing all migratory coldwater species access to potential spawning grounds in the East Humber River and the lower section of Purpleville Creek. This creates new urban angling opportunities in the spring and fall in the lower river. The barrier on Purpleville Creek north of Major Mackenzie Drive is maintained to protect upstream brook trout populations from migratory fish from Lake Ontario.

The following barrier mitigation projects have significantly improved access for migratory species and the movement of resident species:

1. Six dams notched between Highway 401 and Bloor Street in Toronto;
2. Denil fishway constructed at Raymore Park north of Eglinton Avenue in Toronto;
3. Rocky ramp built at Doctors McLean (Fundale) Park on Islington Avenue, north of Regional Road 7 (formerly Highway 7) in Woodbridge;
4. Denil fishway built at the Board of Trade Golf Course on Clarence Street, north of Regional Road 7 (formerly Highway 7) in Woodbridge;

5. Notching of dam and rocky ramp built at McFall Dam north of King Road, east of Highway 50 in Bolton; and,
6. Step-pool fishway with viewing window constructed at the Palgrave Mill Pond on Highway 50 south of Highway 9 in Palgrave;

As a direct result of these barrier mitigation projects, rainbow trout were observed spawning in the East Humber River for the first time in 2000. Additional projects are planned to further improve fish access within the watershed. Further work is needed for the five dams located between the Old Mill dam and Dundas Street and one north of Lawrence Avenue to improve passage for non-jumping species. A selective fishway is recommended at the Old Mill dam to prevent upstream movement of sea lamprey and round goby while still allowing movement of trout and salmon and non-jumping species such as walleye, bass, and minnow species.

Future barrier mitigation projects include:

1. Assessment of the on-line ponds in Albion Hills Conservation Area;
2. Mitigating the low level crossing in Boyd Conservation Area; and
3. Dams on private properties in the Upper Main, East and West Humber River subwatersheds.

Each management zone in each subwatershed will be managed for a certain aquatic community which is dependant upon the physical characteristics of that subwatershed (Figure 25). The following discussion divides each subwatershed into management zones for which specific management direction can be applied. For each subwatershed information is provided on general characteristics important or limiting physical characteristics, management direction, targets and rehabilitation recommendations for each zone.

General prioritized rehabilitation needs for the watershed can be found by referring to Tables 39-43. With specific reference to those areas designated as 'channelized watercourses', it should be noted that many of these reaches have been designed as flood control channels. As such, any increases in roughness associated with rehabilitation works may result in overtopping and flooding of adjacent structures/buildings. All proposals, such as riparian plantings, must be carefully evaluated by the appropriate agencies to ensure their compatibility with the design of these flood control channels.

In addition to highlighting proposed rehabilitation needs for the management zones within each subwatershed, the following priorities have been allocated to each identified rehabilitation priority:

1. **HIGH** - those rehabilitation strategies that are considered to be in greatest need within the management zone to achieve the conditions necessary to re-establish and/or maintain the target species, and are considered achievable;
2. **MEDIUM** - those rehabilitation strategies that are considered to be in need but of lesser immediate importance within the management zone to achieve the conditions necessary to re-establish and/or maintain the target species, and are considered achievable;
3. **LOW** - those rehabilitation strategies that are considered of least immediate importance within the management zone to achieve the conditions necessary to re-establish and/or maintain the target species, and/or may not be considered currently achievable due to a lack of opportunity.

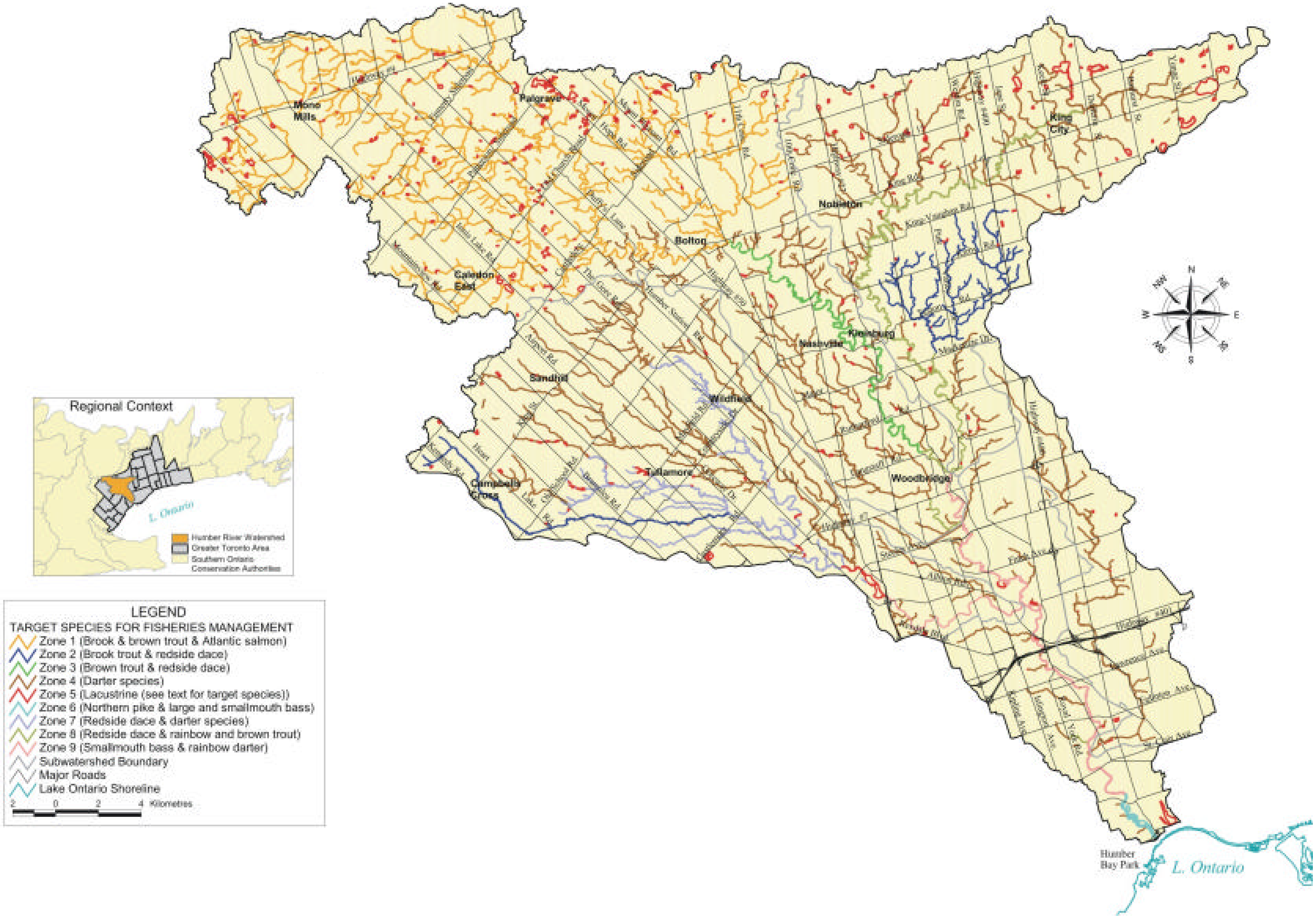


Figure 25. Management Zones and Target Species for Fisheries Management.

6.7.1 Toronto Wet Weather Flow Management Master Plan

Current and historical approaches to servicing development within the Toronto and GTA area have led to environmental and flooding problems. A need was identified to prepare a comprehensive and focused master planning process to develop a cost-effective approach to managing municipal services. Toronto's wet weather flow is to be managed on a watershed basis that recognizes rainwater as a potential resource that can be utilized to improve the health of Toronto's watercourses and the nearshore zones of Lake Ontario, and to protect and enhance the natural environment of Toronto's watersheds. The goal is to reduce and eventually eliminate the adverse impacts of wet weather flow on the built and natural environment and to achieve measurable improvements in the ecosystem health of watersheds (XCG Consultants Ltd., 2003).

The Municipal Class Environmental Assessment (Class EA) describes the process that municipalities must follow to meet Ontario's Environment Assessment requirements for Master Plans. The process involved extensive public and stakeholder involvement throughout the Master Plan's development. This process involved many public agency organizations, municipalities and their related departments, local residents and environmental organizations, including the TRCA as well as a number of other interest groups.

Through the Class EA process the preferred alternative that was selected for the Master Plan, was that of Strategy Number 5. The development of the Preferred Strategy consists of source control measures, conveyance control works, end-of-pipe facilities, basement flooding works, enhanced municipal operations, public education and outreach programs, environmental monitoring and plan review, stream restoration works, and waterfront management works (XCG Consultants Ltd., 2003).

A series of technical objectives have also been developed to guide the implementation process. The "wet weather flow quantity and quality issues are to be managed on a watershed basis to enhance and preserve ecosystem health through a hierarchy of source, conveyance and end of pipe control and/or treatment measures. The source control measures will be considered first in this hierarchy in a manner that is balanced with the other two measures in terms of environmental, social and economic impacts and benefits" (XCG Consultants Ltd., 2003).

The implementation of the Wet Weather Flow Management Master Plan (WWFMMP) will:

1. Contribute to achieving healthy aquatic communities, including warm or cold water fisheries;
2. Contribute to reducing fish consumption advisories due to local wet weather sources;
3. Manage wet weather flows to reduce erosion impacts on streams and riparian habitats and on public and private properties and open spaces;
4. Contribute to the re-establishment of a more natural hydrologic process, based on maximizing permeability and minimizing runoff at source;
5. Contribute to the protection, re-establishment and rehabilitation of natural features such as wetlands and ecological corridors;
6. Contribute to the virtual elimination of toxic contaminants in the ground and surface waters utilizing the principle of pollution prevention at source;
7. Contribute to achieving Federal, Provincial and Municipal water and sediment quality objectives and guidelines in area water courses and along the waterfront;

8. Eliminate discharges of sanitary sewage including those associated with combined sewer overflows (CSO's), sanitary sewer overflows (SSO's) treatment plant by-passes, illegal cross-connections, and spills;
9. Improve water quality for body contact recreation in rivers and recreational areas and reduce posting of beaches by the Medical Officer of Health;
10. Contribute to eliminating objectionable deposits, nuisance algae growth, unnatural colour, turbidity and odour in order to improve the aesthetics of area surface waters;
11. Manage wet weather flow to reduce basement flooding and other adverse impacts;
12. Reduce sanitary sewer infiltration and inflows to City design standards; and,
13. Eliminate or minimize threat to life and property from flooding;
(XCG Consultants Ltd., 2003)

The key control measures outlined in the WWFMMP for the next 25 years are as follows:

- 34,000 roof downspouts to be disconnected;
- 26,000 rain barrels to be installed;
- 1,186 km of filtration/exfiltration systems to be constructed under public roadways;
- 56 stormwater management facilities to be constructed;
- 204 underground stormwater management facilities to be constructed;
- 38 fish barriers to be removed;
- restoration of the Humber River Marshes;
- 13 km of stream bank to be revegetated;
- 15 km of stream to be restored;
- 35 ha of valley lands to be reforested;
- 5 ha of wetlands to be created;
- basment flooding in seven identified cluster areas to be addressed;
- 212 isolated basement flooding locations to be addressed; and,
- reconstruction or protection of municipal infrastructure located in the valley lands at 6 locations (XCG Consultants Ltd., 2003).

Overall, the 25 year implementation plan addresses source controls, conveyance controls, end of pipe facilities, basement flood relief measures, stream restoration works, enhanced municipal operations, a dry weather remediation program, enhanced public education and community outreach, environmental monitoring to evaluate the plan performance, and waterfront management. The preferred strategy has been designed to have a phased implementation schedule. The first phase focuses on the next 25 year period, but the preferred strategy will be implemented over a 100 year time frame. The 25 year implementation plan has program and project costs that have been assigned to the 1-5 year, 6-10 year,11-15 year, 16-20 year, and 21-25 year time frames. This implementation plan also addresses each of the 13 WWFMMP objectives.

Many components of the Humber River WWFMMP document will have impacts on fish ecology and aquatic ecosystem function. As plans are developed for implementation, OMNR and TRCA shall endeavour to guide the planning decisions in a manner that will be consistent with this Fisheries Management Plan. This guidance will address not only the fish community itself, but also the overall aquatic ecosystem and fluvial geomorphic requirements of the river or stream.

6.7.2 Upper Main Humber River Subwatershed

With an area of 357 km^2, this is the largest subwatershed in the Humber River watershed and contains 597 km or 47% of the watercourses. Presently, the subwatershed is mostly rural or natural with small urban centres such as Bolton and Mono Mills. Many of the watercourses are relatively undisturbed and in good health, however, countless small, private on and off-line ponds which are used primarily for irrigation, agriculture or recreation, are present.

Many important groundwater discharge areas that serve as headwater sources are found in this subwatershed. According to Hinton (1997), major discharge zones occur in Centreville and Cold Creeks, as well as along the Main Humber River upstream of the confluence with Centreville Creek. The water supplied by these discharges is crucial to the continued health of the coldwater aquatic habitats found in these areas. Protection of the existing resources such as riparian vegetation, wetlands, discharge/recharge areas, baseflow and water quality is the priority for this subwatershed. Rehabilitation of degraded habitats, particularly in the lower sections of the subwatershed, is also an important element in enhancing the aquatic ecosystem.

A total of 45 fish species have been found in this subwatershed historically including American brook lamprey, brook trout, migratory Atlantic salmon, redside dace, white sucker, creek chub, brook stickleback, fantail and rainbow darter and mottled sculpin. Two species found here, rainbow and brown trout, are introduced. In 2001, 32 fish species were found in the Upper Main Humber River subwatershed, including brook trout, rainbow and brown trout, and mottled sculpin. Native brook trout, a very sensitive species and popular game fish, exists in numerous tributaries where they may be separated from (eg. Centreville Creek) or live alongside (eg. Cold Creek) naturalized brown trout

Thirteen native species once found in the Upper Main Humber River subwatershed were not found in 2001, including Atlantic salmon and smallmouth bass. For species such as bluegill and smallmouth bass, it is possible that they have not been found due to the location and timing of surveys. Atlantic salmon, on the other hand, are known to be extirpated from the watershed.

This subwatershed contains six habitat categories; small riverine cold and warmwater, intermediate riverine cold and warmwater, large riverine and lacustrine, and the following management zones:

1. Zone 1a (brook and brown trout and Atlantic salmon);
2. Zone 1b (baseflow sensitive watercourses);
3. Zone 3 (brown trout and redside dace);
4. Zone 4 (darter species);
5. Zone 7 (redside dace, rainbow and brown trout);
6. Zone 8 (lacustrine); and,
7. Zone 9 (smallmouth bass and rainbow darter).

Figure 26 and Table 39 provide a summary of rehabilitation priorities for the Upper Main Humber River subwatershed.

Table 39: Rehabilitation Priorities for the Upper Main Humber River Subwatershed.

	MANAGEMENT ZONES						
	Zone 1A	**Zone 1B**	**Zone 3**	**Zone 4**	**Zone 5**	**Zone 8**	**Zone 9**
Approximate Location	Headwaters to Bolton.	All headwater tributaries of the watershed	Confluence of Cold Creek/Upper Main Humber to Langstaff Road.	Most of Rainbow Creek, some smaller tributaries draining main branch of the Humber River.	On-line ponds and natural and artificial lakes.	Board of Trade Golf course to confluence with East Humber Rvier.	Mouth of Rainbow Creek to confluence with East Humber River.
Stream Order	First to fifth.	First.	Fifth and sixth.	First to third.	Not applicable.	Third	Sixth.
Channel Slope	Moderate to high.	High.	Low to moderate.	High.	Low.	Low to moderate	Low to moderate.
Target Fish Species	Brook and brown trout and Atlantic salmon.	Contributing and seasonal in-situ habitat for Zone 1A.	Brown trout and redside dace.	Darter species.	Resident warm and cold water communities.	Redside dace, rainbow and brown trout.	Smallmouth bass, rainbow darter.
Aquatic Habitat Category	Small Riverine Coldwater and Intermediate Riverine Coldwater.	Small Riverine Coldwater.	Intermediate Riverine Coldwater.	Small Riverine Waterwater and Intermediate Riverine Warmwater.	Lacustrine.	Intermediate Riverine Coldwater.	Large Riverine.
Median IBI	Good.	Not available.	Fair.	Good.	Not available.	Good.	Fair.
MANAGEMENT DIRECTION							
Riparian Zone[1]: Thermal benefits, erosion stability, habitat creation, and run-off filtration. **Delisting Target:** 75% of watercourse length with woody vegetation. Additional 164 km needed. Goal is 2 km annually.	**High Priority** - focus on Albion Hills Conservation Area, Glen Haffy, Palgrave, Cold Creek and other public lands. Private landstewardship in Centreville, Cold and Coffee Creeks; implement TRCA's Habitat Implementation Plan.	**Low Priority** - Cold Creek Conservation Area; implement TRCA's Habitat Implementation Plan.	**High Priority** - focus on Nasville Tract and public lands upstream from Kleinburg and downstream from Rutherford Road; implement TRCA's Habitat Implementation Plan.	**Medium Priority** - private lands in Rainbow Creek through stewardship initiatives.	**Low Priority** - efforts to be directed to public lands.	**Low Priority** - Doctor McLean's Park in Woodbridge.	**Low Priority** - Main Humber River downstream from Woodbridge.

	MANAGEMENT ZONES						
	Zone 1A	**Zone 1B**	**Zone 3**	**Zone 4**	**Zone 5**	**Zone 8**	**Zone 9**
Wetland Creation & Rehabilitation Wetlands - Attenuate run-off and increase infiltration. Habitat creation. Planting of aquatic vegetation, enhancing spawning habitats. **Delisting Target:** 75% of historical area. Additional 271 ha of wetlands.	**High Priority** – protect existing wetlands. Rehabilitate or restore wetlands where degraded or eliminated. **Medium Priority** – create wetlands identified in TRCA's Terrestrial Natural Heritage Strategy and recently initiated project to identify sites for wetland creation in the Regions of Peel and York; implement TRCA's Habitat Implementation Plan.	**High Priority** – protect existing wetlands. **Medium Priority** - create wetlands identified in TRCA's Terrestrial Natural Heritage Strategy and recently initiated project to identify sites for wetland creation in the Regions of Peel and York; implement TRCA's Habitat Implementation Plan.	**High Priority** – protect existing wetlands. Rehabilitate or restore wetlands where degraded or eliminated. **Medium Priority** - create wetlands identified in TRCA's Terrestrial Natural Heritage Strategy and recently initiated project to identify sites for wetland creation in the Regions of Peel and York; implement TRCA's Habitat Implementation Plan.	**High Priority** – protect existing wetlands. **Medium Priority** - create wetlands identified in TRCA's Terrestrial Natural Heritage Strategy and recently initiated project to identify sites for wetland creation in the Regions of Peel and York.	**High Priority** – protect existing wetlands. **Medium Priority** - create wetlands identified in TRCA's Terrestrial Natural Heritage Strategy and recently initiated project to identify sites for wetland creation in the Regions of Peel and York.	**Medium Priority** – protect existing wetlands. **Low Priority** - create wetlands identified in TRCA's Terrestrial Natural Heritage Strategy and recently initiated project to identify sites for wetland creation in the Regions of Peel and York.	**Medium Priority** – protect existing wetlands. **Low Priority** – create wetlands identified in TRCA's Terrestrial Natural Heritage Strategy and recently initiated project to identify sites for wetland creation in the Regions of Peel and York.
Habitat Rehabilitation Rehabilitate altered streams. Addition of tree stumps, logs, brush bundles for instream cover. **Target:** 150 pieces of large woody material or equivalent per km .	**High Priority** – Continue work with Trout Unlimited in Centreville Creek and Ontario Stream's Upper Humber River Rehabilitation Project. **Medium Priority** - identify degraded reaches.	**Low Priority** - Identify degraded reaches.	**Low Priority** - Identify degraded reaches.	**Low Priority** - Identify degraded reaches.	**Low Priority** - Identify degraded reaches.	**Low Priority** - Identify degraded reaches.	**Low Priority** - Identify degraded reaches.

	MANAGEMENT ZONES						
	Zone 1A	**Zone 1B**	**Zone 3**	**Zone 4**	**Zone 5**	**Zone 8**	**Zone 9**
Water Quantity & SWMP Retrofits **Target:** Maximum 10% total impervious surface in management zone. Protect or enhance existing water budget.	**High Priority** – existing quantity ponds to be retrofitted to include quality control. **High Priority** – stormwater pond outlets to have bottom draw outlets or sub-surface drainage. **High Priority** – protect or enhance existing water budget.	**High Priority** – protect or enhance existing water budget.	**High Priority** – existing quantity ponds to be retrofitted to include quality control. **High Priority** – stormwater pond outlets to have bottom draw outlets or sub-surface drainage. **High Priority** – protect or enhance existing water budget.	**High Priority** – existing quantity ponds to be retrofitted to include quality control. **High Priority** – stormwater pond outlets to have bottom draw outlets or sub-surface drainage. **High Priority** – protect or enhance existing water budget.	**High Priority** – protect or enhance existing water budget.	**High Priority** – existing quantity ponds to be retrofitted to include quality control. **High Priority** – stormwater pond outlets to have bottom draw outlets or sub-surface drainage. **High Priority** – protect or enhance existing water budget.	**High Priority** – existing quantity ponds to be retrofitted to include quality control. **High Priority** – stormwater pond outlets to have bottom draw outlets or sub-surface drainage. **High Priority** – protect or enhance existing water budget.
Stream Baseflow **Target:** Protect 60% duration flow for June, July, August and September	**High Priority** – maintain or enhance existing baseflow.	**High Priority** – maintain or enhance existing baseflow.	**High Priority** – maintain or enhance existing baseflow.	**High Priority** – maintain or enhance existing baseflow.	Not applicable.	**High Priority** – maintain or enhance existing baseflow.	**High Priority** – maintain or enhance existing baseflow.
Water Quality Restrict livestock access and reduce agricultural runoff through the Rural Clean Water Program. Pollution prevention, lot level and conveyance controls, end of pipe controls.	**High Priority** - identify livestock access and manure storage locations. **High Priority** – reduce overland sediment run-off over all construction periods. **Medium Priority** – implement best management practices for all land uses.	Not applicable at this time.	**High Priority –** identify livestock access locations. **High Priority** – reduce overland sediment run-off over all construction periods. **Medium Priority** – implement best management practices for all land uses.	**High Priority –** identify livestock access locations. **High Priority** – reduce overland sediment run-off over all construction periods. **Medium Priority** – implement best management practices for all land uses.	**High Priority –** identify livestock access locations. **High Priority** – reduce overland sediment run-off over all construction periods. **Medium Priority** – implement best management practices for all land uses.	**High Priority –** identify livestock access locations. **High Priority** – reduce overland sediment run-off over all construction periods. **Medium Priority** – implement best management practices for all land uses.	**High Priority –** identify livestock access locations. **High Priority** – reduce overland sediment run-off over all construction periods. **Medium Priority** – implement best management practices for all land uses.
Natural Channel Design	**Low Priority** - alongside Highway 50 north of Palgrave	None identified.	None identified.	**Low Priority** – Rainbow Creek Park.	None identified.	None identified.	None identified.

	MANAGEMENT ZONES						
	Zone 1A	**Zone 1B**	**Zone 3**	**Zone 4**	**Zone 5**	**Zone 8**	**Zone 9**
Instream Barriers: Mitigate identified barriers or install bottom draw, if appropriate. **Delisting Target:** Free range for all native species from Lake Ontario to Highway 9, except where otherwise indicated.	**High Priority** – mitigate Taylor Pond and assess mitigation options for Albion Hills CA Pond. **High Priority –** mitigate private on-line ponds. **High Priority - i**dentify additional barriers and assess stream crossings for fish passage.	**Low Priority** - assess stream crossings for fish passage.	Restricted access for rainbow trout and Pacific salmon upstream of Board of Trade Golf Course. **Low Priority** - assess stream crossings for fish passage.	**Medium Priority** - identify additional barriers and assess stream crossings for fish passage.	**High Priority** - mitigate identified barriers or install bottom draw, if appropriate. **High Priority** – identify all on-line ponds.	Restricted access for rainbow trout and Pacific salmon upstream of Board of Trade Golf Course. **Low Priority -** assess stream crossings for fish passage.	**Low Priority** - assess stream crossings for fish passage.
Public Lands **Target:** All public lands accessible for angling.	Most public lands (Palgrave FWA, Albion Hills CA, Glen Haffy CA, Bolton Tract) are accessible, some restirctions apply. Access to private lands by permission only. **High Priority** – implement best managemen t practices on all public lands; land acquisition; improve trialheads and access.	Cold Creek CA. **High Priority** – implement best management practices on all public lands.	Nashville RMT. **High Priority** – implement best management practices on all public lands; land acquisition.	Rainbow Creek Park. **High Priority** – implement best management practices on all public lands.	Gibson Lake, Albion Hills CA, Glen Haffy FWA. **High Priority** – implement best management practices on all public lands.	Doctors McLean Park, Vaughan Grove Sports Park. **High Priority** – implement best management practices on all public lands.	Doctors McLean Park, Nort Johnson Park. **High Priority** – implement best management practices on all public lands.
Species of Conservation Concern	**Low Priority** – assess populations of Group 2 and 3 Priority Candidate Species.	None recommended at this time.	**High Priority** – implement recommendations of Redside Dace Recovery Strategy. **Low Priority** – assess populations of Group 2 and 3 Priority Candidate Species.	**Low Priority** – assess populations of Group 2 and 3 Priority Candidate Species.	None recommended at this time.	**High Priority** – implement recommendations of Redside Dace Recovery Strategy. **Low Priority** – assess populations of Group 2 and 3 Priority Candidate Species.	**Low Priority** – assess populations of Group 2 and 3 Priority Candidate Species.

	MANAGEMENT ZONES						
	Zone 1A	**Zone 1B**	**Zone 3**	**Zone 4**	**Zone 5**	**Zone 8**	**Zone 9**
Angling Regulations and Enforcement	**Medium Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.	None recommended	**Medium Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.	No changes recommended.	**Low Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.	**Medium Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.	**Medium Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.
Fish Stocking and/or Transfer: (1) encourage re-introduction of Atlantic salmon; (2) rehabilitative stocking of brown trout fry/fingerlings; (3) transfer migratory adult brown trout into the Upper Main Humber River.	**High Priority** – stock 40,000 brown trout between Zones 1a and 3 annually for 10 years. Introduce Atlantic salmon when sufficient donor stock exists.	None recommended	**High Priority** - stock 40,000 brown trout between Zones 1a and 3 annually for 10 years. Introduce Atlantic salmon when sufficient donor stock exists.	None recommended	None recommended	None recommended	**Medium Priority** - Transfer native lake-run warmwater species such as smallmouth bass into suitable locations.
Baitfish Harvest	No changes recommended.	No changes recommended.	No changes recommended.	No changes recommended.	No changes recommended.	No changes recommended.	No changes recommended.
Non-comsumptive Uses Education and stewardship programs, signs and information kiosks.	**High Priority** – continue outreach education programs associated with Watershed On Wheels; golf course stewardship, continue work at Caldedon East, Palgrave and Bolton Community Action Sites and establish new sites. **High Priority –** develop signs for fishway projects at Palgrave and McFall dam ; information kiosks at major access points; maintain viewing window at Palgrave fishway.	None recommended at this time.	**High Priority** – continue outreach education programs associated with Watershed On Wheels.	**High Priority** – continue outreach education programs associated with Watershed On Wheels.	**High Priority** – continue outreach education programs associated with Watershed On Wheels; golf course stewardship.	**Medium Priority – develop signs for fishway projects at Doctors McLean Park.**	**High Priority** – continue outreach education programs associated with Watershed On Wheels.

	MANAGEMENT ZONES						
	Zone 1A	**Zone 1B**	**Zone 3**	**Zone 4**	**Zone 5**	**Zone 8**	**Zone 9**
Monitoring and Surveys Fish passage at mitigated barriers, spawning surveys, distributions of Species of Concern and invasive species, additional aquatic community data; baseflow indicator sites.	**High Priority** – conduct aquatic habitat and species surveys in 2004 at Highway 9 east of St. Andrews Road, Coolihans Sideroad west of Centreville Creek Road, Innis Lake Road south of Patterson Sideroad and Castlederg Sideroad east of Mount Hope Road. **Medium Priority** – expand existing brook and brown trout spawning surveys to private lands, Cold Creek and north of Highway 9. **Medium Priority** – conduct surveys to determine mussel and rusty crayfish distributions. **Medium Priority** – complete U of T project to assess algae communities.	**High Priority** – determine location of this management zone in the subwatershed.	**Medium Priority – ** determine presence of redside dace for this reach. **Medium Priority** – complete brown trout spawning surveys for this reach. **Medium Priority** – complete U of T project to assess algae communities.	**High Priority** – conduct aquatic habitat and species surveys in 2004 at Nashville Road west of Huntington Road. **Medium Priority** – com plete U of T project to assess algae communities.	**Medium Priority** – assess aquatic communities and habitat in Bell's Lake, Elliot Lake, Innis Lake, Widgett Lake, Gibson Lake, and Thompson Lake.	**Medium Priority** – complete U of T project to assess algae communities.	**Medium Priority** – complete U of T project to assess algae communities.

[1] – those areas currently vegetated with herbaceous vegetation are considered lower priority for restoration than manicured vegetated reaches. This does not mean, however, that opportunities to establish woody riparian vegetation in currently vegetated areas will not be pursued.

6.7.3 East Humber River Subwatershed

The East Humber River subwatershed drains from St. George Lake to Pine Grove, an area of approximately 200 km^2 and contains approximately 257 km or 20% of the watercourses in the watershed. Almost 70% of the soils found here have a moderate to high run-off potential that results in relatively high overland flow. As a result, the ratio of baseflow to average annual flow on the main branch of the river is approximately 13%, slightly less than the minimum 25% ratio of baseflow to total annual flow required by trout and salmon species. Groundwater seeps and springs are vital to the existence of these species and in locations where high amounts of groundwater discharge to a watercourse, are excellent coldwater habitats may be found. Purpleville Creek (also known as Cold Creek or Teston Road Tributary) has high amounts of groundwater discharge and is able to support coldwater species such as brook trout and mottled sculpin.

Land use is mainly rural (hobby farms, rural estate) and natural with some small urban centres such as Oak Ridges, King City, Nobleton and the northern end of Woodbridge. Urban uses are increasing in the lower portions of the watershed. Woody riparian vegetation is good, being found along approximately 48% of the length of the watercourses in this subwatershed.

In all, 50 fish species have been found in the subwatershed. Of these, rainbow and brown trout, goldfish and common carp are the only non-native species. Rainbow and brown trout, found in both coldwater riverine habitats, are both considered to be naturalized. Goldfish and common carp, the other introduced species, are found in both river and lake environments and considered nuisance species. Presently 22 fish species are found here, including rainbow and brown trout, redside dace, rainbow darter and mottled sculpin. Redside dace, a nationally ranked species of special concern as defined by COSEWIC and provincially threatened species as defined by COSSARO, is found in some of the tributaries in the watershed. The presence of sensitive species such as mottled sculpin indicates high quality coldwater habitat.

Banded killifish, black crappie, blackchin shiner, blacknose shiner, bluegill, bluntnose dace, brassy minnow, brook stickleback, brook trout, brown bullhead, central mudminnow, common carp, common shiner, creek chub, finescale dace, goldfish, hornyhead chub, Iowa darter, largemouth bass, mimic shiner, northern pike, northern redbelly dace, rosyface shiner, sand shiner, smallmouth bass, stonecat, walleye, yellow bullhead, and yellow perch were not found in 2001 in this subwatershed. Atlantic salmon are known to be extirpated from the watershed but many of the other species may still exist in the various tributaries but have not been collected during sampling due to timing and location of surveys.

The East Humber River subwatershed contains four habitat categories: small riverine cold and warmwater, intermediate riverine cold and lacustrine and four management zones:

1. Zone 2 (brook trout and redside dace);
2. Zone 4 (darter species);
3. Zone 5 (lacustrine); and,
4. Zone 8 (redside dace and rainbow and brown trout).

Figure 26 and Table 40 provide a summary of rehabilitation priorities for the East Humber River subwatershed.

Table 40: Rehabilitation Priorities for the East Humber River Subwatershed.

	MANAGEMENT ZONES			
	Zone 2	**Zone 4**	**Zone 5**	**Zone 8**
Approximate Location	Purpleville Creek	Throughout subwatershed	On-line ponds, 10 kettle lakes	West of Dufferin south to confluence with Upper Main Humber River
Stream Order	First to fourth	First to second	N/A	Three to five
Slope	Moderate to high	Moderate	Low	Low
Target Species	Brook trout and redside dace	Darter species	Resident warmwater communities	Redside dace, rainbow and brown trout
Aquatic Habitat Category	Small Riverine Coldwater and Intermediate Riverine Coldwater	Small Riverine Warmwater	Lacustrine	Small Riverine Coldwater and Intermediate Riverine Coldwater
Median IBI	Good	N/A	N/A	Fair
MANAGEMENT DIRECTION				
Riparian Zone[1]: Thermal benefits, erosion stability, habitat creation, and run-off filtration. **Delisting Target:** 75% of watercourse length with woody vegetation. Additional 80.5 km needed. Goal is 2 km annually.	**High Priority** – primarily private lands in Pupleville Creek; some work at Kortright north of Major Mackenzie needed.	**High Priority** – private lands along the East Humber River and its' tributaries.	**Low Priority** -efforts to be directed to private lands.	**High Priority** – private lands and TRCA properties (Humber Trails and Boyd CA) along the East Humber River from Dufferin Street to confluence with Main Humber River Woodbridge.
Wetland Creation & Rehabilitation Wetlands - Attenuating run-off and increasing infiltration. Habitat creation. Planting of aquatic vegetation, enhancing spawning habitats. **Delisting Target:** 75% of historical area. Additional 216 ha of wetlands.	**High Priority** – protect existing wetlands. Rehabilitate or restore wetlands where degraded or eliminated. **Medium Priority** – create new wetlands identified in TRCA's Terrestrial Natural Heritage Strategy and recently initiated project to identify sites for wetland creation in the Regions of Peel and York.	**High Priority** – protect existing wetlands. **Medium Priority** – create new wetlands identified in TRCA's Terrestrial Natural Heritage Strategy and recently initiated project to identify sites for wetland creation in the Regions of Peel and York.	**High Priority** – protect existing wetlands. **Medium Priority** – create new wetlands identified in TRCA's Terrestrial Natural Heritage Strategy and recently initiated project to identify sites for wetland creation in the Regions of Peel and York.	**High Priority** – protect existing wetlands. **Medium Priority** – create new wetlands identified in TRCA's Terrestrial Natural Heritage Strategy and recently initiated project to identify sites for wetland creation in the Regions of Peel and York.

	MANAGEMENT ZONES			
	Zone 2	**Zone 4**	**Zone 5**	**Zone 8**
Habitat Rehabilitation Rehabilitate altered streams. Addition of tree stumps, logs, brush bundles for instream cover. **Target:** 150 pieces of large woody material or equivalent per km .	**Medium Priority** – Continue work with Ontario Streams on Purpleville Creek. **Low Priority** - identify degraded reaches.	**Low Priority** - identify degraded reaches.	**Low Priority** - Inwater habitat creation and restoration. Possible use of lake lung if situation requires.	**Medium Priority** – Continue work with Ontario Streams on East Humber River.
Water Quantity & SWMP Retrofits **Target:** Maximum 10% total impervious surface in management zone. Protect or enhance existing water budget.	**High Priority** – existing quantity ponds to be retrofitted to include quality control. **High Priority** – stormwater pond outlets to have bottom draw outlets or sub-surface drainage. **High Priority** – protect or enhance existing water budget.	**High Priority** – existing quantity ponds to be retrofitted to include quality control. **High Priority** – stormwater pond outlets to have bottom draw outlets or sub-surface drainage. **High Priority** – protect or enhance existing water budget.	**High Priority** – protect or enhance existing water budget. No identified retrofit opportunities.	**High Priority** – existing quantity ponds to be retrofitted to include quality control. **High Priority** – stormwater pond outlets to have bottom draw outlets or sub-surface drainage. **High Priority** – protect or enhance existing water budget.
Stream Baseflow **Target:** Protect 60% duration flow through regulatory approvals process.	**High Priority** – maintain or enhance existing baseflow. **High Priority** – determine instream flow requirements for target species.	**High Priority** – maintain or enhance existing baseflow. **High Priority** – determine instream flow requirements for target species.	Not applicable.	**High Priority** – maintain or enhance existing baseflow. **High Priority** – determine instream flow requirements for target species.
Water Quality Restrict livestock access. Reduce agricultural runoff. Pollution prevention, lot level and conveyance controls, end of pipe controls.	**High Priority – identify livestock access locations.** **High Priority** – reduce overland sedim ent run-off over all construction periods. **Medium Priority** – implement best management practices for all land uses.	**High Priority –** identify livestock access locations**.** **High Priority** – reduce overland sediment run-off over all construction periods. **Medium Priority** – implement best management practices for all land uses.	**High Priority –** identify livestock access locations**.** **High Priority** – reduce overland sediment run-off over all construction periods. **Medium Priority** – implement best management practices for all land uses.	**High Priority –** identify livestock access locations**.** **High Priority** – reduce overland sediment run-off over all construction periods. **Medium Priority** – implement best management practices for all land uses.

	MANAGEMENT ZONES			
	Zone 2	**Zone 4**	**Zone 5**	**Zone 8**
Natural Channel Design	None identified.	**Medium Priority** - outlet channel from Wilcox Lake to Yonge Street.	None identified.	None identified.
Instream Barriers: Mitigate identified barriers or install bottom draw, if appropriate. **Delisting Target:** Free range for all native and naturalized species from Lake Ontario to King Road.	Maintain designated species partition in Purpleville Creek north of Major Mackenzie to segregate migratory rainbow trout from resident brook trout. **High Priority –** mitigate private on-line ponds in Purpleville Creek. **High Priority -**identify additional barriers and assess stream crossings for fish passage.	**High Priority** - identify additional barriers and assess stream crossings for fish passage. **High Priority** – mitigate one barrier on private property annually .	**High Priority** - mitigate identified barriers or install bottom draw, if appropriate. **High Priority** – identify all on - line ponds. **Medium Priority** - Investigate appropriateness (historical context) of connecting Wilcox Lake to downstream wetlands.	Maintain designated species partition in Purpleville Creek north of Major Mackenzie to segregate migratory rainbow trout from resident brook trout. **High Priority** – mitigate low - level crossing in Boyd CA and repair rocky ramp in Doctors McLean Park. **High Priority -**identify additional barriers and assess stream crossings for fish passage.
Public Lands **Target:** Most public lands accessible for angling.	Little public access.	Some in Boyd CA.	West and northeast ends of Wilcox Lake.	Good public access in Boyd CA, Humber Trails and other TRCA properties.
Species of Conservation Concern	**High Priority** – implement recommendations of Redside Dace Recovery Strategy. **Low Priority** – assess populations of Group 2 and 3 Priority Candidate Species.	**Low Priority** – assess populations of Group 2 and 3 Priority Candidate Species.	None recommended at this time.	**High Priority** – implement recommendations of Redside Dace Recovery Strategy. **Low Priority** – assess populations of Group 2 and 3 Priority Candidate Species.
Angling Regulations and Enforcement	**Medium Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.	**Low Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.	**Medium Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.	**Medium Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.
Fish Stocking and/or Transfer Encourage put-and-delayed-take Pacific salmon fishery for the lower Humber	Stock lower Purpleville Creek with 7,500 brown trout annually.	None recommended.	None recommended.	Continue rehabilitative stocking of migratory rainbow trout and resident brown trout. Contiue stocking of fingerling coho and Chinook salmon.

	MANAGEMENT ZONES			
	Zone 2	**Zone 4**	**Zone 5**	**Zone 8**
Baitfish Harvest	Purpleville Creek - no baitfish harvest permitted.	No changes recommended.	No changes recommended.	No changes recommended.
Non-comsumptive Uses Education, signs, stewardship programs.	None recommended at this time.	**High Priority** – continue outreach education programs associated with Watershed On Wheels; golf course stewardship.	**High Priority** – continue outreach education programs associated with Watershed On Wheels; golf course stewardship. **Medium Priority** – repair and develop signs and boardwalk in the pike spawning area in Wilcox Lake.	**High Priority –** develop signs for Boyd CA, Kortright, and Doctors McLean Park fishway. **High Priority** – continue outreach education programs associated with Watershed On Wheels; golf course stewardship.
Monitoring and Surveys	**Medium Priority** – conduct brook trout spawning surveys on private lands in Purpleville Creek.	**High Priority** – conduct aquatic habitat and species surveys at 15th Sideroad east of 8th Concession Road.	**Medium Priority** – assess aquatic communities and habitat in Eversley Lake, Gregloch Lake, Hackett Lake, Kelly Lake, Mary Lake and Thompson Lake.	**Medium Priority** – conduct rainbow trout spawning surveys and follow -up assessment to determine success of spawning.

[1] – those areas currently vegetated with herbaceous vegetation are considered lower priority for restoration than manicured vegetated reaches. This does not mean, however, that opportunities to establish woody riparian vegetation in currently vegetated areas will not be pursued.

6.7.4 West Humber River Subwatershed

At an area of approximately 200 km^2, this subwatershed is the same size as the East Humber River subwatershed and contains 311 km of watercourses. It is the most highly agricultural of all the subwatersheds, with 67% in some form of farming. In most cases, it is field crops such a corn or sorghum that are grown. Other land uses include urban and urbanizing (20%), rural estate (4%) and major greenspace (9%).

This subwatershed lies over the mostly flat Peel Plain, which is made up of highly impermeable clay soils. As a result, water is unable to easily penetrate into the soil and quickly runs across the land's surface. This is particularly evident following the spring melt or a storm event. Many of these watercourses tend to rise and fall quickly following a rain and often dry up or are reduced to standing pools in the summer months. In fact, the ratio of baseflow to average annual flow at Regional Road 107 (formerly Highway 7) and below Claireville Dam is in the order of 1%. At times, the minimum recorded baseflow at these locations is 0 $m^3/s/km^2$, indicating conditions of no flow.

While low or non-existent baseflows are the norm in this subwatershed, one watercourse has enough baseflow to flow year round. Flowing through Campbell's Cross, this tributary is unique in the subwatershed in that it can support a coldwater aquatic community to its confluence with an unnamed tributary west of Goreway Drive and north of Castlemore Road.

This subwatershed has one of the lowest amounts of woody riparian vegetation in the watershed at 28%. This lack of vegetation has further intensified the low infiltration capacity of the clay soils that dominate the area, likely increasing the number and length of the streams that dry up during the summer.

Many of the 17 fish species found in 2001 are considered to be tolerant warmwater species, although some sensitive species like redside dace and rainbow darter are also present. The 17 fish species found is 23 fewer than the 40 found here historically, which included American brook lamprey, blackshin shiner, blacknose shiner, bluegill, bluntnose dace, brassy minnow, brook trout, central stoneroller, common carp, goldfish, iowa darter, longnose dace, mimic shiner, mottled sculpin, northern redbelly dace, pumpkinseed, river chub, river darter, rosyface shiner, sand shiner, smallmouth bass, stonecat, yellow bullhead, and yellow perch.

It is likely that many of these species such as northern redbelly dace, river chub, blackchin shiner and yellow perch still exist in this subwatershed but due to the timing and location of surveys, were not captured. This subwatershed has four aquatic habitat categories - small riverine warmwater, small riverine coldwater, intermediate riverine coldwater, and lacustrine, and the following five management zones:

1. Zone 2 (brook trout and redside dace);
2. Zone 4 (darter species);
3. Zone 5 (lacustrine habitat);
4. Zone 7 (redside dace and darter species);
5. Zone 9 (smallmouth bass and rainbow darter).

Figure 26 and Table 1 provide a summary of rehabilitation priorities for the West Humber River subwatershed.

Table 41: Rehabilitation Priorities for West Humber River Subwatershed.

	MANAGEMENT ZONES				
	Zone 2	**Zone 4**	**Zone 5**	**Zone 7**	**Zone 9**
Approximate Location	North of Campbell's Cross to confluence west of Goreway Drive	Throughout subwatershed	On-line ponds and Claireville Reservoir	Old School Road south to Steeles Avenue	South of Claireville Reservoir
Stream Order	First and second	First and second	N/A	Third and fourth	Fourth
Slope	Low to moderate	Low to moderate	Low	Low to moderate	Low to moderate
Target Species	Brook trout and redside dace	Darter species	Resident warmwater communities	Redside dace and darter species	Smallmouth bass and rainbow darter
Aquatic Habitat Category	Small Riverine Coldwater	Small Riverine Warmwater	Lacustrine	Small Riverine Warmwater and Intermediate Riverine Warmwater	Intermediate Riverine Warmwater
Median IBI	Good	N/A	N/A	Good	N/A
MANAGEMENT DIRECTION					
Riparian Zone[1]: Thermal benefits, erosion stability, habitat creation, and run-off filtration. **Delisting Target:** 75% of watercourse length with woody vegetation. Additional 149.6 km needed.	**High Priority** – private lands along Campbell's Cross tributary.	**High Priority** – primarily private lands; also Claireville CA between Regional Road 107and Steeles Avenue and Albion Creek (identified in Toronto's WWFMMP).	**Low Priority** - efforts to be directed to Claireville CA and private lands.	**High Priority** – primarily private lands; also Claireville Conservation Area between Castlemore Road and Steeles Avenue.	**High Priority** – between confluene of West Humber River and Main Humber River and Claireville Conservation Area ; identified in Toronto's WWFMMP.

	MANAGEMENT ZONES				
	Zone 2	**Zone 4**	**Zone 5**	**Zone 7**	**Zone 9**
Wetland Creation & Rehabilitation Wetlands - Attenuating run-off and increasing infiltration. Habitat creation. Planting of aquatic vegetation, enhancing spawning habitats. **Delisting Target:** 75% of historical area. Additional 693 ha of wetlands	**High Priority** – protect existing wetlands. Rehabilitate or restore wetlands where degraded or eliminated. **Medium Priority** – create new wetlands identified in TRCA's Terrestrial Natural Heritage Strategy and recently initiated project to identify sites for wetland creation in the Regions of Peel and York.	**High Priority** – protect existing wetlands. Rehabilitate or restore wetlands where degraded or eliminated. **Medium Priority** – create new wetlands identified in TRCA's Terrestrial Natural Heritage Strategy and recently initiated project to identify sites for wetland creation in the Regions of Peel and York; continue existing work at Claireville CA.	**Medium Priority** – create new wetlands identified in TRCA's Terrestrial Natural Heritage Strategy. **Low Priority** - Inwater habitat creation and restoration and aquatic plantings.	**High Priority** – protect existing wetlands. Rehabilitate or restore wetlands where degraded or eliminated. **Medium Priority** – create new wetlands identified in TRCA's Terrestrial Natural Heritage Strategy and recently initiated project to identify sites for wetland creation in the Regions of Peel and York; continue existing work at Claireville CA.	**High Priority** – protect existing wetlands. **Medium Priority** – create new wetlands identified in TRCA's Terrestrial Natural Heritage Strategy.
Habitat Rehabilitation Rehabilitate altered streams. Addition of tree stumps, logs, brush bundles for instream cover. **Target:** 150 pieces of large woody material or equivalent per km.	**Low Priority** - identify degraded reaches.	**Low Priority** - identify degraded reaches.	**Low Priority** - Inwater habitat creation and restoration. Aquatic plantings.	**Low Priority** - identify degraded reaches.	**Low Priority** - identify degraded reaches.
Water Quantity & SWMP Retrofits **Target:** Maximum 10% total impervious surface in management zone. Protect or enhance existing water budget.	**High Priority** – implement recommendations of Brampton Stormwater Retrofit Study. **High Priority** – stormwater pond outlets to have bottom draw outlets or sub-surface drainage. **High Priority** – protect or enhance existing water budget.	**High Priority** – implement recommendations of Brampton Stormwater Retrofit Study. **High Priority** – stormwater pond outlets to have bottom draw outlets or sub-surface drainage. **High Priority** – protect or enhance existing water budget.	**High Priority** – protect or enhance existing water budget. **Medium Priority** - review operation of Claireville Reservoir water levels in relation to fisheries management interests.	**High Priority** – implement recommendations of Brampton Stormwater Retrofit Study. **High Priority** – stormwater pond outlets to have bottom draw outlets or sub-surface drainage. **High Priority** – protect or enhance existing water budget.	**High Priority** – implement projects identified in Toronto's WWFMMP. **High Priority** – protect or enhance existing water budget.

	MANAGEMENT ZONES				
	Zone 2	**Zone 4**	**Zone 5**	**Zone 7**	**Zone 9**
Stream Baseflow **Target:** Protect 60% duration flow through regulatory approvals process.	**High Priority** – determine instream flow requirements for target species. **Medium Priority** – maintain or enhance existing baseflow.	**High Priority** – determine instream flow requirements for target species. **Medium Priority** – maintain or enhance existing baseflow.	Not applicable.	**High Priority** – determine instream flow requirements for target species. **Medium Priority** – maintain or enhance existing baseflow.	**High Priority** – determine instream flow requirements for target species. **Medium Priority** – maintain or enhance existing baseflow.
Water Quality Restrict livestock access. Reduce agricultural runoff. Pollution prevention, lot level and conveyance controls, end of pipe controls.	**High Priority –** identify livestock access locations**.** **High Priority** – reduce overland sediment run-off over all construction periods. **Medium Priority** – implement best management practices for all land uses.	**High Priority –** identify livestock access locations**.** **High Priority** – reduce overland sediment run-off over all construction periods. **Medium Priority** – implement best management practices for all land uses.	**High Priority** - Control waterfowl access to waterbodies.	**High Priority –** identify livestock access locations**.** **High Priority** – reduce overland sediment run-off over all construction periods. **Medium Priority** – implement best management practices for all land uses.	**High Priority** – reduce overland sediment run-off over all construction periods. **Medium Priority** – implement best management practices for all land uses.
Natural Channel Design	None identified.	None identified.	Not applicable.	None identified.	**High Priority** – one project identified in Toronto's WWFMMP.
Instream Barriers Mitigate identified barriers or install bottom draw, if appropriate. **Delisting Target:** free passage of all native species throughout the subwatershed, except for Claireville Reservoir.	**High Priority** - identify additional barriers and assess stream crossings for fish passage. **Medium Priority** – mitigate one barrier on private property annually.	**High Priority** - identify additional barriers and assess stream crossings for fish passage. **Medium Priority** – mitigate one barrier on private property annually.	None identified.	**High Priority** - identify additional barriers and assess stream crossings for fish passage. **Medium Priority** – mitigate one barrier on private property annually.	**High Priority** - identify additional barriers and assess stream crossings for fish passage. **High Priority** – remove one weir and one service line based on Toronto's WWWMMP recommendations.
Angling Regulations and Enforcement	**Low Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.	**Low Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.	**Low Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.	**Low Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.	**Low Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.

	MANAGEMENT ZONES				
	Zone 2	**Zone 4**	**Zone 5**	**Zone 7**	**Zone 9**
Public Lands **Target:** All public lands accessible for angling.	Castlemore/Airport Rds (Stephen Llewellyn Trail).	Parks – Lucinda, Carberry, Blue Jay, Ezard, Bellini Valley, Castlemore.	Claireville Reservoir, Indian Line Campground.	Blue Jay Park, Castlegrove Park, Cassin Park, Wildfield Park, Claireville CA.	Summerlea Park, West Humber Parkland, Kipling Heights Park, Watercliffe Park, Garland Park, Ester Lorrie Park, Humber Arboretum, Humberwoods Park.
Species of Conservation Concern	**High Priority** – implement recommendations of Redside Dace Recovery Strategy. **Low Priority** – assess populations of Group 2 and 3 Priority Candidate Species.	**Low Priority** – assess populations of Group 2 and 3 Priority Candidate Species.	None recommended at this time.	**High Priority** – implement recommendations of Redside Dace Recovery Strategy. **Low Priority** – assess populations of Group 2 and 3 Priority Candidate Species.	**Low Priority** – assess populations of Group 2 and 3 Priority Candidate Species.
Fish Stocking and/or Transfer	None recommended.	None recommended.	None recommended.	None recommended.	None recommended.
Baitfish Harvest	No changes recommended.	No changes recommended.	No changes recommended.	No changes recommended.	No changes recommended.
Non-comsumptive Uses Education, signs, stewardship programs.	**High Priority** – continue outreach education programs associated with Watershed On Wheels.	**High Priority** – continue outreach education programs associated with Watershed On Wheels; golf course stewardship.	**High Priority** – continue outreach education programs associated with Watershed On Wheels; golf course stewardship.	**High Priority** – continue outreach education programs associated with Watershed On Wheels; golf course stewardship.	**High Priority** – continue outreach education programs associated with Watershed On Wheels; implement WWFMMP outreach ideas.
Monitoring	None recommended at this time.	**High Priority** – conduct aquatic habitat and species surveys at Mayfield Road east and west of Humber Station Road, Old School Road west of Airport Road, Gore Road south of King Road and Bramalea Road north of Mayfield Road (trib downstream of Banty's Roost G.C.).	**High Priority** – identify all on-line ponds. **Medium Priority** – assess aquatic communities and habitat in Claireville Reservoir.	**High Priority** – conduct aquatic habitat and species surveys at Countryside Drive east of The Gore Road.	None recommended at this time.

[1] – those areas currently vegetated with herbaceous vegetation are considered lower priority for restoration than manicured vegetated reaches. This does not mean, however, that opportunities to establish woody riparian vegetation in currently vegetated areas will not be pursued.

6.7.5 Black Creek Subwatershed

At an area of 68 km^2, this is the smallest subwatershed to be examined in this section and contains 46 km of watercourses. It is also the second most developed, with over 70% of the subwatershed in some form of urban land use. Other land uses in the subwatershed include greenspace (21%) and rural and agriculture (5%). This intense urban use has changed the drainage network and hydrologic patterns in the subwatershed to one of few tributaries that are all quickly affected by storm events.

This subwatershed is underlain primarily by soils with low infiltration rates although there are areas in the southern parts of the subwatershed with deposits of sand. This indicates that groundwater discharge to Black Creek would be expected to be low and not likely to support coldwater aquatic communities except where groundwater contributions create refuge areas. In addition, the degree of development has likely further reduced the amount of recharge/discharge that would have exacerbated the low groundwater discharge rates historically found.

A total of 18 species were found here historically, 16 of which are native. Of note is the historic presence of redside dace and rainbow and fantail darter, suggesting that water quality and habitat in Black Creek were once much better. In 2001, sampling at one station only captured northern hog sucker. Species not found in 2001 include blacknose dace, bluntnose minnow, brook stickleback, brown bullhead, common carp, common shiner, creek chub, fantail darter, fathead minnow, goldfish, hornyhead chub, johnny darter, longnose dace, mimic shiner, pumpkinseed, rainbow darter, and redside dace.

In 2002, brown trout were stocked near Chaminade School south of the 401 at Jane Street and further sampling indicates that there was some survival.

Three aquatic habitat categories - small riverine warmwater, intermediate riverine warmwater and lacustrine - have been designated in the Black Creek subwatershed, which make up two management zones:

1. Zone 4 (darter species);
2. Zone 5 (lacustrine habitat).

Figure 26 and Table 42 provide a summary of rehabilitation priorities for the Black Creek subwatershed.

Table 42: Rehabilitation Priorities for the Black Creek Subwatershed.

	Management Zones	
	Zone 4	**Zone 5**
Approximate Location	Most of subwatershed	Small ponds at Smythe Park and others.
Stream Order	First and second	N/A
Slope	Low	Low
Target Species	Darter species	Resident warmwater fish community
Aquatic Habitat Category	Small Riverine Warmwater and Intermediate Riverine Warmwater	Lacustrine
Median IBI	Poor	Not available
MANAGEMENT DIRECTION		
Riparian Zone[1]: Thermal benefits, erosion stability, habitat creation, and run-off filtration. **Delisting Target:** 75% of watercourse length with woody vegetation. Additional18.65 km needed.	**High Priority** – implement recommendations of Toronto's WWFMMP.	**Low Priority –** direct efforts to public lands
Wetland Creation & Rehabilitation Wetlands - Attenuating run-off and increasing infiltration. Habitat creation. Planting of aquatic vegetation, enhancing spawning habitats. **Delisting Target:**75% of historical area. Additional 115.5 ha of wetlands.	**High Priority** – implement recommendations of Toronto's WWFMMP.	**Low Priority** – direct efforts to public lands
Habitat Rehabilitation Rehabilitate altered streams. Addition of tree stumps, logs, brush bundles for instream cover. **Target:**150 pieces of large woody material or equivalent per km.	**Low Priority** - identify degraded reaches.	**Low Priority** – activities include addition of inwater cover

	Management Zones	
	Zone 4	**Zone 5**
Water Quantity & SWMP Retrofits **Target:** Maximum 10% total impervious surface in management zone. Protect or enhance existing water budget.	**High Priority** –implement projects identified in Toronto's WWFMMP. **High Priority** – protect or enhance existing water budget.	**High Priority** – protect or enhance existing water budget.
Stream Baseflow **Target:** Protect 60% duration flow through regulatory approvals process.	**High Priority** – determine instream flow requirements for target species. **Medium Priority** – maintain or enhance existing baseflow.	Not applicable.
Water Quality Pollution prevention, lot level and conveyance controls, end of pipe controls.	**High Priority** –implement projects identified in Toronto's WWFMMP.	**High Priority** - control waterfowl access at Smythe Park.
Natural Channel Design	**Medium Priority** - Lambton Golf Course channel.	Not applicable.
Instream Barriers Mitigate identified barriers or install bottom draw, if appropriate. **Delisting Target:** free passage for all native species throughout the subwatershed.	**High Priority** - identify additional barriers and assess stream crossings for fish passage. **High Priority** – mitigate barriers (1 service line, 2 dams) identified in Toronto's WWFMMP.	**Low Priority** - Mitigate or convert outlets to bottom draw
Public Lands **Target:** All public lands accessible for angling.	Parks - Black Creek, Derrydowns, Downsview Dells, Westview, Coronation, Keelesdale, and Smythe.	Smythe Park.
Angling Regulations and Enforcement	**Low Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.	**Low Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.
Species of Conservation Concern	**Low Priority** – assess populations of Group 2 and 3 Priority Candidate Species.	**Low Priority** – assess populations of Group 2 and 3 Priority Candidate Species.
Fish Stocking and/or Transfer	Continue brown trout stocking with Chaminade Collegiate School.	None recommended.
Baitfish Harvest	No changes recommended.	No changes recommended.
Non-comsumptive Uses Education, signs, stewardship programs.	**High Priority** – continue outreach education programs associated with Watershed On Wheels; golf course stewardship; implement WWFMMP outreach ideas.	**High Priority** – continue outreach education programs associated with Watershed On Wheels; implement WWFMMP outreach ideas.

	Management Zones	
	Zone 4	**Zone 5**
Monitoring and Surveys	**High Priority** – conduct aquatic habitat and species surveys at Highway 7 east of Jane Street and Jane Street south of Sheppard Avenue. **Medium Priority** – conduct thermal and survival estimates of stocked brown trout.	**High Priority** – identify all on -line ponds. **Medium Priority** – assess aquatic communities and habitat in Smythe Park.

[1] – those areas currently vegetated with herbaceous vegetation are considered lower priority for restoration than manicured vegetated reaches. This does not mean, however, that opportunities to establish woody ripa rian vegetation in currently vegetated areas will not be pursued.

6.7.6 Lower Main Humber River Subwatershed

At 80 km^2, this is the second smallest of the five major subwatersheds in the Humber River watershed and contains 62 km of watercourses. It is also the most highly urbanized, at 78%. Greenspace is found mainly in the steep valley and floodplain areas and covers over 1800 hectares or 22% of the subwatershed. Some of the smaller tributaries have been piped and/or channelized during development and presently support tolerant warmwater fish communities. In the main branch of the river, some banks have been hardened, seven instream barriers block upstream movement of non-jumping species and numerous outflows from storm sewers and combined sewer outfalls all act to negatively impact the fish community. Two of the largest waterbodies in the subwatershed are Eglinton Flats and Grenadier Ponds.

A total of 57 fish species have been found in this subwatershed historically, including nine introduced species. This is more than 80% of the fish species found historically in the entire watershed and includes many species found more commonly in Lake Ontario, indicating this subwatershed's importance for lake resident species. 2001 records found 22 species in this subwatershed, including one introduced species and numerous piscivorous species such as largemouth bass. Fish species found here historically but not found in 2001 include alewife, American brook lamprey, American eel, black crappie, blackchin shiner, blacknose shiner, blackside darter, bluegill, brassy minnow, brook stickleback, brown trout, central stoneroller, Chinook salmon, emerald shiner, fallfish, fathead minnow, gizzard shad, goldfish, hornyhead chub, iowa darter, koi, mottled sculpin, northern pike, rainbow smelt, redside dace, river darter, rock bass, rosyface shiner, sand shiner, sea lamprey, smallmouth bass, spottail shiner, threespine stickleback, trout perch, white bass, white perch, and yellow bullhead. The absence of species such as sea lamprey, Chinook salmon, rainbow trout and brown trout is due to the timing of the survey since these species are found every year during their respective migrations. Furthermore, the brief sampling in the Humber River Marshes and lack of sampling in Grenadier Pond is the likely reason for species such as rainbow smelt, goldfish, American eel, three-spine stickleback, white perch, white bass, and black crappie not appearing in the 2001 species list.

This subwatershed includes four habitat categories: small riverine warmwater, large riverine, lacustrine and estuarine, and the following five management zones:

1. Zone 4: darter species;
2. Zone 5: lacustrine;
3. Zone 6: northern pike and large and smallmouth bass;
4. Zone 8: redside dace, and rainbow and brown trout; and,
5. Zone 9: smallmouth bass and rainbow darter.

Figure 26 and Table 43 provide a summary of rehabilitation priorities for the Lower Main Humber River subwatershed.

Table 43: Rehabilitation Priorities for the Lower Main Humber River Subwatershed.

	MANAGEMENT ZONES				
	Zone 4	**Zone 5**	**Zone 6**	**Zone 8**	**Zone 9**
Approximate Location	Throughout subwatershed.	Eglinton Flats, Humber Meade and Grenadier Ponds.	North of Bloor St to mouth, depending on lake level.	Lower end of Silver Creek, south of Eglinton Ave.	North of Steeles Ave to Old Mill Dam.
Stream Order	First	Not applicable	Sixth	First	Sixth
Slope	Moderate to high	Low	Low	High	Low to moderate
Target Species	Darter species	Resident warmwater communities	Northern pike, small and large mouth bass	Redside dace, rainbow and brown trout	Smallmouth bass and rainbow darter
Aquatic Habitat Category	Small Riverine Warmwater	Lacustrine	Estuarine	Small Riverine Coldwater	Large Riverine
Median IBI	Poor	Not available	Not available	Not available	Fair
MANAGEMENT DIRECTION					
Riparian Zone[1]: Thermal benefits, erosion stability, habitat creation, and run-off filtration. **Delisting Target:** 75% of watercourse length with woody vegetation. Additional 24.5 km needed.	**High Priority** – revegetation along Berry and Emery Creek identified in Toronto's WWFMMP.	**Low Priority**	**Low Priority**	**Low Priority**	**Low Priority**
Wetland Creation & Rehabilitation Wetlands - Attenuating run-off and increasing infiltration. **Delisting Target:** 75% of historical area. Additional 108 ha of wetlands; 4 hectares of new wetlands and 15.5 ha of wetland rehab for the Humber River Marshes	**High Priority** - component of stream renaturalization project in Alex Marchetti Park. **Medium Priority** – create new wetlands identified in TRCA's Terrestrial Natural Heritage Strategy.	**Low Priority** - Inwater habitat creation and restoration and aquatic plantings. **Medium Priority** – create new wetlands identified in TRCA's Terrestrial Natural Heritage Strategy.	**High Priority** – Develop and implement coastal wetland rehabilitation plan for Humber River Marshes. **Medium Priority** – create new wetlands identified in TRCA's Terrestrial Natural Heritage Strategy.	**Medium Priority** – create new wetlands identified in TRCA's Terrestrial Natural Heritage Strategy.	**Medium Priority** – create new wetlands identified in TRCA's Terrestrial Natural Heritage Strategy.

	MANAGEMENT ZONES				
	Zone 4	**Zone 5**	**Zone 6**	**Zone 8**	**Zone 9**
Habitat Rehabilitation Rehabilitate altered streams. Addition of tree stumps, logs, brush bundles for instream cover. **Target:**150 pieces of large woody material or equivalent per km .	**Low Priority** - Identify degraded reaches.	**Low Priority** - Identify degraded reaches.	**High Priority** - Inwater habitat creation, including addition of log cribs, brush bundles, aquatic vegetation or other structures to increase habitat diversity as per costal wetland rehabilitation plan.	**Low Priority** - Identify degraded reaches.	**Low Priority** - Identify degraded reach es.
Water Quantity & SWMP Retrofits **Target:** Maximum 10% total impervious surface in management zone. **High Priority** – protect or enhance existing water budget.	**High Priority** – implement projects identified in Toronto's WWFMMP. **High Priority** – protect or enhance existing water budget.	**High Priority** – protect or enhance existing water budget.	**High Priority** – implement projects identified in Toronto's WWFMMP. **High Priority** – protect or enhance existing water budget.	**High Priority** – implement projects identified in Toronto's WWFMMP. **High Priority** – protect or enhance existing water budget.	**High Priority** –implement projects identified in Toronto's WWFMMP. **High Priority** – protect or enhance existing water budget.
Stream Baseflow **Target:** Protect 60% duration flow through regulatory approvals process.	**High Priority** – determine instream flow requirements for target species. **Medium Priority** – maintain or enhance existing baseflow.	**High Priority** – determine instream flow requirements for target species. **Medium Priority** – maintain or enhance existing baseflow.	**High Priority** – determine instream flow requirements for target species. **Medium Priority** – maintain or enhance existing baseflow.	**High Priority** – determine instream flow requirements for target species. **Medium Priority** – maintain or enhance existing baseflow.	**High Priority** – determine instream flow requirements for target species. **Medium Priority** – maintain or enhance existing baseflow.
Water Quality Pollution prevention, lot level and conveyance controls, end of pipe controls.	**High Priority** – implement projects identified in Toronto's WWFMMP.	Control waterfowl access at Grenadier, Eglinton Flats and Humber Meade Ponds.	**High Priority** – implement projects identified in Toronto's WWFMMP.	**High Priority** – implement projects identified in Toronto's WWFMMP.	**High Priority** –implement projects identified in Toronto's WWFMMP.
Natural Channel Design	**Low Priority** – identify potential locations.	Not applicable.	**Low Priority** – identify potential locations.	**Low Priority** – identify poten tial locations.	**High Priority** –implement projects identified in Toronto's WWFMMP.

	MANAGEMENT ZONES				
	Zone 4	**Zone 5**	**Zone 6**	**Zone 8**	**Zone 9**
Instream Barriers Mitigate identified barriers or install bottom draw, if appropriate. **Delisting Target:** Free range for all native and naturalized species from Lake Ontario upstream.	**High Priority** - identify additional barriers and assess stream crossings for fish passage.	Not applicable.	None identified.	**Moderate Priority** - identify additional barriers and assess stream crossings for fish passage.	**High Priority –**maintain sea lamprey barrier at Old Mill dam. **High Priority -** mitigate barriers between Bloor Street and Highway 401. **Medium Priority** – improve flow through Raymore Park fishway during low flow periods. **Low Priority** - identify additional barriers.
Public Lands **Target:** All public lands accessible for angling.	Alex Marchetti Park, The Elms Park, Pine Point Park.	Grenadier, Humber Meade and Eglinton Flats Ponds.	Good public access; boat launch.	Edenbrook Park.	Lower Main Humber Park system.
Angling Regulations and Enforcement	**Low Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.	**Low Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.	**High Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.	**Low Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.	**High Priority** – increase enforcement and implement a Fish and Wildlife Guardian Program.
Species of Conservation Concern	**Low Priority** – assess popula tions of Group 2 and 3 Priority Candidate Species.	None recommended at this time.	**Low Priority** – assess populations of Group 2 and 3 Priority Candidate Species.	**High Priority** – implement recommendations of Redside Dace Recovery Strategy. **Low Priority** – assess populations of Group 2 and 3 Priority Candidate Species.	**Low Priority** – assess populations of Group 2 and 3 Priority Candidate Species.

	MANAGEMENT ZONES				
	Zone 4	**Zone 5**	**Zone 6**	**Zone 8**	**Zone 9**
Fish Stocking and/or Transfer	None recommended	**Low Priority** – Continue to move northern pike into Grenadier and Eglinton Flats Ponds.	**High Priority** – Encourage put-and-delayed-take Pacific salmon fishery for the lower Humber through fish stocking	None recommended	**High Priority** – Transfer native lake-run warmwater species into suitable habitats in the Main Humber River **High Priority** – Encourage put-and-delayed-take Pacific salmon fishery for the lower Humber through fish stocking
Baitfish Harvest	No changes recommended.	No changes recommended.	No changes recommended.	No changes recommended.	No changes recommended.
Non-comsumptive Uses Education, signs, stewardship programs.	**High Priority** – continue outreach education programs associated with Watershed On Wheels; implement WWFMMP outreach ideas.	**High Priority** – continue outreach education programs associated with Watershed On Wheels; implement WWFMMP outreach ideas.	**High Priority** – continue outreach education programs associated with Watershed On Wheels; implement WWFMMP outreach ideas.	**High Priority** – continue outreach education programs associated with Watershed On Wheels; implement WWFMMP outreach ideas.	**High Priority** – continue outreach education programs associated with Watershed On Wheels; golf course stewardship; implement WWFMMP outreach ideas.
Monitoring and Surveys	No changes recommended at this time.	No changes recommended at this time.	**Medium Priority** - spring and fall littoral index netting.	No changes recommended at this time.	**High Priority** – survey incidental fish species captured during sea lamprey assessment at the Old Mill dam.

[1] – those areas currently vegetated with herbaceous vegetation are considered lower priority for restoration than manicured vegetated reaches. This does not mean, however, that opportunities to establish woody riparian vegetation in currently vegetated areas will not be pursued.

6.8 Monitoring

Watershed monitoring allows comparison of historical and current data collections to compare trends in communities over time or identify the success or failure of rehabilitation projects. Monitoring is essential for any future report carding on watershed health. Many different parameters can be monitored including the fish and benthic communities, physical habitat, water temperatures, baseflow and water quality. To date, the most comprehensive studies have involved fish and benthic surveys. The studies done in 1946, 1972 and 1984/85 had watershed-wide coverage and repeat many of the same stations. More recent fish and benthic surveys have been project specific and have not covered the entire watershed. In 1995/96, temperature and baseflow monitoring was done at many locations throughout the watershed (Hinton, 1997). A total of 48 stations were sampled in 1999 and in 2001, 51 sampling stations were sampled by TRCA and Ontario Streams (Figure 13). At 38 stations, benthic, fish, stream habitat and algal data were collected by TRCA, although one station was dry so that no actual measurements could be made. Fish and stream habitat data were collected using the new OMNR protocol. At two other stations, located in lacustrine and estuarine habitats, only fish species were collected. The remaining 11 stations were only sampled for fish and the work was carried out by Ontario Streams.

The cost of orchestrating watershed-wide surveys on an annual basis to monitor different ecosystem elements is prohibitive but regular observations are essential, particularly if a watershed report card program is intended. In 2001, TRCA initiated the Regional Watershed Monitoring Program (RWMP), with an objective of monitoring 150 stations across it's jurisdiction for benthic invertebrates annually and approximately 50 stations for aquatic habitat and species each year (therefore, each station would have the complete suite of indicators sampled every three years). The selection of stations for fish and benthic monitoring program is based upon stations where historic records are found and is weighted toward third order streams or larger. While some of these stations will remain as fixed stations, it is possible that the location of some stations will change when the need for information arises.

TRCA, in association with York University, has developed the Regional Watershed Monitoring and Reporting Service Pilot Project. This project provides access to aquatic monitoring data for the Humber River watershed. You can access this project through the website:
http://plasma.ycas.yorku.ca/trca/humber/main/

Stations in lacustrine or estuarine habitats require more specialized equipment such as an electroshocking boat, hoop nets, gill nets or seine nets. The use of an electroshocking boat is least preferred means for long-term monitoring. It is recommended that spring or fall Littoral Index Netting be used to monitor fish populations in these habitats. These habitats could be sampled on a less frequent basis.

More recently, data on baseflow and stream temperatures have been collected with a watershed wide initiative undertaken by TRCA in 2002 to measure low flow and stream temperatures. Baseflow information is collected at a time when stream flows are at their lowest and a 72 hour period following a precipitation event. Baseflow data may be collected during fish and benthic sampling but may also require additional field time. These data provide important information on the locations and conditions of coldwater streams, as well as stream flows (intermittent vs. permanent, high groundwater inputs vs. low groundwater inputs) and should be collected periodically to develop a baseline for every watercourse in the watershed.

There are important timing limitations to the collection of the temperature data (Department of Fisheries and Oceans, 1996). In conjunction with measurements taken during the 4:00-4:30 pm window, the use of temperature recorders is also necessary to ensure that all the data are collected.

6.9 The Future

Ongoing fisheries research, changing attitudes and new regulations will affect management of the watershed. For this reason, the Fisheries Management Plan is designed as a 'living' document that will update information such as angling regulation changes, species recovery plans, implementation of habitat projects or as new fisheries data becomes available. This information will be updated every five years with a major review of the entire document scheduled for 2015.

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8.0 GLOSSARY

Anoxic
A deficiency of oxygen.

Aquifer
A subsurface body of sediment (or rock) that contains sufficient saturated permeable material to conduct groundwater and yield economically significant quantities of potable water to wells and springs.

Average annual flow
The sum of the total amount of water discharged past a certain point on a watercourse on a yearly basis divided by the number of years for which records exist.

Baseflow
The volume of flow in a stream channel that is derived primarily from groundwater discharge.

Benthic invertebrate
Includes all the organisms without a backbone that are found along the bottom of a watercourse.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC)
A federal agency that determines the national status of wild species, subspecies, varieties and nationally significant populations that are considered to be at risk in Canada.

Committee on the Status of Species at Risk in Ontario (COSSARO)
A provincial agency that determines the provincial status of wild species, subspecies, varieties and provincially significant populations that are considered to be at risk in Ontario.

Endangered
A species facing imminent extirpation or extinction.

Estuarine
Relating to the mouth of a river opening into the lake.

Eutrophic
Rich in phosphates, nitrates and other nutrients that promote the growth of algae, which deplete the water of oxygen and cause the extinction of other organisms.

Exotic
A species not historically present in the Etobicoke CreekHumber River Watershed.

Extirpated
A species no longer existing in the wild in Lake Ontario locally, but occurring elsewhere.

Groundwater

Subsurface water occurring below the water table in the saturated zone where all pores are filled with water under hydrostatic pressure.

Habitat Suitability Indices (HSI)

Score between 0 (unsuitable) and 1 (suitable) which is used to determine the suitability of a location for a specific species. It is calculated based upon the habitat requirements of that species.

Headwater

The source or main part of a river or stream.

Hydrologic soil group

The run-off potential of a soil based upon the characteristics of that soil type. 'A' soils have a lower run-off potential than do 'D' soils.

Index of Biotic Integrity (IBI)

A measure of fish community associations that is used to identify the general health of the broader stream ecosystem. It assesses the health of a fish community in terms of species composition, trophic composition and abundance of fish.

Infiltration

The percolation of water from precipitation into soil or rock through pores or fractures and which eventually reaches the ground-water table.

Instream barrier

any human built structure spanning the entire width of a watercourse that blocks upstream movement of fish species. (eg. dam or weir).

Intermittent stream

A stream or stream portion that flows in direct response to precipitation and may be periodically dry.

Introduced

Any species that is not indigenous to the Humber River Watershed. Introductions can be deliberate or accidental, and can include exotic species, naturalized species and native species which are stocked beyond their natural range.

Kettle lake

Enclosed, steep-side crater-like depression filled with water formed by the melt of glacier ice buried under rapidly deposited glacial outwash sediments which collapse to form a kettle hole.

Lacustrine

Of, pertaining to, or inhabiting lakes or other bodies of water.

Native

Any species that was found in the Humber River watershed prior to European settlement.

Naturalized
An introduced species which is now self-sustaining.

Omnivore
An organism that eats both animal and vegetable food.

Periphytic Algae
Species that live attached to substrata within the watercourses.

Permeability
The capacity of a porous medium to transmit a liquid or gas subjected to an energy gradient. Permeability is the result of the species in situ properties of the sediment or rock such as grain size, grain sphericity, roundness and packing, presence or absence of fractures, etc.

Piscivore
Feeding solely or chiefly on fish; fish eating.

Pool
A deep area in a watercourse having slow flowing water and a smooth surface, often found at bends in the river.

Recharge
The downward movement of surface precipitation (ie. rain, snow melt) to the water table and underlying saturated zone. Essentially the process by which surface water becomes groundwater.

Recharge area
The portion of the drainage basin in which the net flow of groundwater is directed downward, away from the water table.

Riffle
Shallow water with rapid current and with surface flow broken by sub-surface substrates.

Riparian vegetation
Streamside vegetation which provides temperature control (shading), habitat diversity, bank stability, food and shelter to aquatic organisms and their habitats.

Riverine
Of, or having to do with a watercourse.

Salmonid
A fish of the salmon or trout family.

Sinuosity
A measure of the degree of meandering or bending of a watercourse. The ratio of channel length to direct down valley distance.

Stream order
A classification system that numbers the tributaries of a river beginning with headwater tributaries and increasing the order number as lower order tributaries join the mainstream. Any single, unbranched tributary is considered a first order stream. Two first order streams join to form a second order stream, two second order streams join to form a third order stream, etc.

Stream slope
The change in gradient of the stream bed between two points, which can be used to infer characteristics of that watercourse.

Subwatershed
A subunit of a watershed, often defined as the drainage area of a tributary of a watercourse.

Surficial geology
Overburden soils deposited by the most recent glaciation.

Suspended solid
Solids that either float on the surface of, or are in suspension in, water, water or other liquids, and which are largely removable by laboratory filtering.

Threatened
A species likely to become endangered if limiting factors are not reversed.

Tributary
A contributing stream or river; one that runs into another or into a lake.

Vulnerable
A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.

Watershed
The land area drained by a river or stream and its tributaries.

Wetland
Areas that are seasonally or permanently covered by shallow water, as well as lands where the water table is close to or at the surface. The four types of wetlands are bogs, fens, marshes and swamps.

APPENDICES

Appendix I: Flow data from gauging stations on streams in the Toronto and surrounding area. Data was obtained from Cummings Cockburn Ltd. (1989) and Environment Canada (1990).

RIVER	LOCATION	GAUGING STATION NUMBER	DRAINAGE AREA (KM^2)	MEAN 7-DAY BASEFLOW ($M^3/S/KM^2$)	AVERAGE ANNUAL MEAN DAILY FLOW ($M^3/S/KM^2$)	RATIO OF MEAN BASEFLOW TO AVERAGE ANNUAL FLOW (%)
Credit River	near Cataract	02HB001	205	0.619	1.78	34.78
Credit River	at Erindale	02HB002	795	2.135	7.99	26.72
Don River (west)	at York Mills	02HC005	88.1	0.156	0.808	19.31
Don River (east)	at Don Mills	02HC029	130	0.423	1.5	28.20
Duffins Creek	at Pickering	02HC006	249	0.723	2.82	25.64
Duffins Creek (east)	above Pickering	02HC019	93.5	0.459	1.24	37.02
Duffins Creek (west)	at Green River	02HC026	98.1	0.251	1.07	23.46
Etobicoke Creek	at Brampton	02HC017	63.2	0.046	0.592	7.77
Highland Creek	near West Hill	02HC013	88.1	0.235	1.04	22.6
Mimico Creek	at Islington	02HC033	70.6	0.113	0.792	14.27
Rouge River	near Markham	02HC022	186	0.16	1.5	10.67
Rouge River (Little)	near Locust Hill	02HC028	77.7	0.087	0.813	10.70
Shelter Valley Brook	near Grafton	02HD010	64.8	0.306	0.825	37.09
Wilmot Creek	near Newcastle	02HD009	82.6	0.344	0.953	36.10

Appendix II: Barrier Mitigation Projects in the Humber River Watershed.

Old Mill Dam Notching, Toronto

Raymore Park Denil Fishway, Toronto

Doctors McLean Park Rocky Ramp, Woodbridge

Board of Trade Denil Fishway, Woodbridge

McFall Dam Notching and Rocky Ramp, Bolton

Palgrave Step-Pool Fishway, Palgrave

Appendix III: Water Quality Data Compiled from the Upper Main Humber Subwatershed (Albion Hills Monitoring Station) from 1999 to 2002.

Station #: H 83018 (data collected from May 17, 1999 to January 23, 2002)							
	#Obs	**Min**	**Max**	**Mean**	**Median**	**PWQO or other guideline**	**% Meet Objective**
Dissolved Oxygen (mg/L)	25	7.2	16	11.3	11.8	6	100%
Phosphorus (mg/L)	27	0.01	0.39	0.04	0.03	0.03	52%
Suspended Sediment (mg/L)	26	1	110	11	5.9	25	92%
						80	96%
Chloride (mg/L)	26	6	296	52	42	250	96%
						500	100%
E. Coli (counts/100 mL)	19	5	230	56[1]	10	100	69%
Unionized Ammonia (mg/L)	20	0	0.064	0	0	0.02	95%
Nitrate (mg/L)	23	0.01	1	0.48	0.5	0.3	25%
Water Temp. (^oC)	22	-0.2	24.2	10.2	8	21[2]	77%

Obs. = observations.

[1] - Geometric mean = 21 counts/100 mL

[2] - Approximate upper threshold for coldwater fisheries.

Water Quality Data Compiled from the East Humber Subwatershed (Rutherford Road Monitoring Station) from 1999 to 2002.

Station #: H 83020 (data collected from May 17, 1999 to January 23, 2002)							
	#Obs	**Min**	**Max**	**Mean**	**Median**	**PWQO or other guideline**	**% Meet Objective**
Dissolved Oxygen (mg/L)	24	7	16.8	12	11.7	6	100%
Phosphorus (mg/L)	26	0	0.52	0.06	0.02	0.03	65%
Suspended Sediment (mg/L)	25	3	115	24.6	11	25	72%
						80	92%
Chloride (mg/L)	25	6	141	51	45	250	100%
						500	100%
E. Coli (counts/100 mL)	21	5	3000	257[1]	20	100	76%
Unionized Ammonia (mg/L)	24	0	0.03	0	0	0.02	96%
Nitrate (mg/L)	23	0.01	1.4	0.43	0.33	0.3	44%
Water Temp. (^{o}C)	21	-0.3	27.4	9.6	7.4	21[2]	86%

Obs. = observations.

[1] - *Geometric mean = 31 counts/100 mL*

[2] - *Approximate upper threshold for cold water fisheries.*

Water Quality Data Compiled from the East Humber Subwatershed (Pine Grove Monitoring Station) from 1999 to 2000.

Station #: H 83004 (data collected from May 17,1999 to December 20, 2000)							
	# Obs	**Min**	**Max**	**Mean**	**Median**	**PWQO or other guideline**	**% Meet Objective**
Dissolved Oxygen (mg/L)	25	7.1	17	12.1	12	6	100%
Phosphorus (mg/L)	27	0	0.62	0.06	0.02	0.03	67%
Suspended Sediment (mg/L)	26	1	115	16.9	6	25	85%
						80	92%
Chloride (mg/L)	26	13	294	100	83	250	96%
						500	100%
E. Coli (counts/100 mL)	20	5	880	136[1]	85	100	60%
Unionized Ammonia (mg/L)	26	0	0.09	0.01	0.001	0.02	88%
Nitrate (mg/L)	24	0	2.27	0.42	0.21	0.3	62%
Water Temp. (°C)	22	-0.3	25.7	11	8.8	21[2]	77%

Obs. = observations.
[1] - Geometric mean = 48 counts/100 mL
[2] - Approximate upper threshold for coldwater fisheries.

Water Quality Data Compiled from the West Humber Subwatershed (Claireville Monitoring Station) from 1996 to 2000.

Station #: HRW 15.5 (data collected from May 27, 1996 to December 20, 2000)[1]							
	# Obs	**Min**	**Max**	**Mean**	**Median**	**PWQO or other guideline**	**% Meet Objective**
Dissolved Oxygen (mg/L)	25	6.9	21.5	11.5	10.9	6	100%
Phosphorus (mg/L)	17	0.01	0.75	0.1	0.04	0.03	30%
Suspended Sediment (mg/L)	17	5	170	23.2	13	25	88%
						80	94%
Chloride (mg/L)	17	19	654	220	162	250	65%
						500	88%
E. Coli (counts/100 mL)	18	5	1900	266[2]	5	100	61%
Unionized Ammonia (mg/L)	11	0	0.064	0.016	0.004	0.02	72%
Nitrate (mg/L)	15	0	3.3	0.67	0.3	0.3	53%
Water Temp. (°C)	21	-0.4	25.7	16.9	19.1	21[3]	62%

Obs. = observations.

[1] - May 17, 1999 to Dec. 20, 2000 for Phosphorus, Suspended Sediment, Chloride, Unionized Ammonia, and Nitrate; prior to May 17, 1999, samples were not collected during the cold season (Dec - Apr.)

[2] - Geometric mean = 47 counts/100 mL

[3] - Approximate upper threshold for cold water fisheries.

Water Quality Data Compiled from the Black Creek Subwatershed (Pioneer Village Monitoring Station) from 1996 to 1998.

Station #: HB 16.5 (data collected from May 27, 1996 to October 6, 1998)[1]							
	# Obs	**Min**	**Max**	**Mean**	**Median**	**PWQO or other guideline**	**% Meet Objective**
Dissolved Oxygen (mg/L)	11	3.1	10.7	7	7	6	91%
E. Coli (counts/100 mL)	11	130	3900	1140	500	100	0%
Water Temp.(°C)	11	11.6	22.4	17.1	17.8	21[2]	91%

Obs. = observations.

[1] - Samples were not collected during the cold season (Dec - Apr.)

[2] - Approximate upper threshold for coldwater fisheries.

Water Quality Data Compiled from the Lower Main Humber Subwatershed (Steeles Avenue Monitoring Station) from 1996 to 1998.

Station #: H 14.3 (data collected from May 17, 1996 to October 6, 1998)[1]							
	# Obs	**Min**	**Max**	**Mean**	**Median**	**PWQO or other guideline**	**% Meet Objective**
Dissolved Oxygen (mg/L)	10	8.1	13	9.8	9.2	6	100%
E. Coli (counts/100 mL)	9	5	600	261	270	100	22%
Water Temp. (°C)	10	10.8	24.1	18	18.4	21[2]	90%

Obs. = observations.

[1] - Samples were not collected during the cold season (Dec - Apr.)

[2] - Approximate upper threshold for coldwater fisheries.

Water Quality Data compiled from Lower Humber Subwatershed (Black Creek Monitoring Station) from 1996 to 2000.

Station #: HB 83012 (data collected from May 27, 1996 to December 20, 2000)[1]							
	# Obs	**Min**	**Max**	**Mean**	**Median**	**PWQO or other guideline**	**% Meet Objective**
Dissolved Oxygen (mg/L)	34	7.6	17.1	12.2	12.4	6	100%
Phosphorus (mg/L)	27	0.01	0.85	0.08	0.04	0.03	44%
Suspended Sediment (mg/L)	26	2	49	11.2	6	25	88%
						80	100%
Chloride (mg/L)	26	37	2110	495	310	250	35%
						500	73%
E. Coli (counts/100 mL)	25	5	19000	2305[2]	500	100	32%
Unionized Ammonia (mg/L)	20	0	0.03	0.01	0	0.02	90%
Nitrate (mg/L)	24	0.06	2.8	1.21	1.35	0.3	17%
Water Temp. (°C)	32	-0.5	28.9	14.7	16.7	21[3]	72%

Obs. = observations.

[1] - Samples were analyzed for phosphorus, suspended sediment, chloride, unionized ammonia, and nitrate from May 17, 1999 to Dec. 20, 2000 only; prior to May 17, 1999, samples were not collected during the cold season (Dec - Apr.)

[2] - Geometric mean = 307 counts/100 mL

[3] - Approximate upper threshold for coldwater fisheries

Water Quality Data Compiled from the Lower Main Humber Subwatershed (Scarlett Road Monitoring Station) from 1996 to 1998.

Station #: H 5.0 (data collected from May 17, 1996 to October 6, 1998)[1]							
	# Obs	**Min**	**Max**	**Mean**	**Median**	**PWQO or other guideline**	**% Meet Objective**
Dissolved Oxygen (mg/L)	10	9.2	12.9	10.1	9.8	6	100%
E. Coli (counts/100 mL)	10	5	1700	463	245	100	20%
Water Temp. (^oC)	10	15.3	25.4	20.4	20.8	21[2]	50%

Obs. = observations.

[1] *- Samples were not collected during the cold season (Dec - Apr.)*

[2] *- Approximate upper threshold for coldwater fisheries.*

Water Quality Data Compiled from the Lower Main Humber Subwatershed (Old Mill Monitoring Station) from 1996 to 2000.

Station #: H 83019 (data collected from May 27, 1996 to December 20, 2000)[1]							
	# Obs	**Min**	**Max**	**Mean**	**Median**	**PWQO or other guideline**	**% Meet Objective**
Dissolved Oxygen (mg/L)	34	5.5	17.1	11.9	11.2	6	94%
Phosphorus (mg/L)	26	0.01	0.52	0.07	0.03	0.03	36%
Suspended Sediment (mg/L)	25	2	124	17.7	5	25	84%
						80	92%
Chloride (mg/L)	25	18	853	226	147	250	80%
						500	88%
E. Coli (counts/100 mL)	26	9	11000	9091[2]	560	100	8%
Unionized Ammonia (mg/L)	25	0	0.11	0.01	0	0.02	96%
Nitrate (mg/L)	23	0.01	2	0.76	0.59	0.3	39%
Water Temp. (°C)	31	0	25.3	14.2	17.3	21[3]	74%

Obs. = observations.

[1] - Samples were analyzed May 17, 1999 to Dec. 20, 2000 for Phosphorus, Suspended Sediment, Chloride, Unionized Ammonia, and Nitrate; prior to May 17, 1999, samples were not collected during the cold season (Dec - Apr.)

[2] - Geometric mean = 982 counts/100 mL

[3] - Approximate upper threshold for cold water fisheries.

Appendix IV: Scientific Names for Fish Species of the Humber River Watershed.

FAMILY	COMMON NAME	SCIENTIFIC NAME
PETROMYZONTIDAE - Lamprey family	American brook lamprey	*Lethenteron appendix*
	northern brook lamprey	*Ichthyonyzon fossor*
	sea lamprey	*Petromyzon marinus*
LEPISOSTEIDAE - Gar family	longnose gar	*Lepisosteus osseus*
AMIDAE - Bowfin family	bowfin	*Amia calva*
CLUPEIDAE - Herring family	alewife	*Alosa pseudoharengus*
	gizzard shad	*Dorosoma cepedianum*
SALMONINAE - Salmon and trout subfamily	Chinook salmon	*Oncorhynchus tshawytscha*
	rainbow trout	*Oncorhynchus mykiss*
	Atlantic salmon	*Salmo salar*
	brown trout	*Salmo trutta*
	brook trout	*Salvelinus fontinalis*
OSMERIDAE - Smelt family	rainbow smelt	*Osmerus mordax*
ESOCIDAE - Pike family	northern pike	*Esox lucius*
	muskellunge	*Esox masquinongy*
UMBRIDAE - Mudminnow family	central mudminnow	*Umbra limi*
CATOSTOMIDAE - Sucker family	white sucker	*Catostomus commersoni*
	northern hog sucker	*Hypentelium nigricans*
CYPRINIDAE - Minnow family	goldfish	*Carassius auratus*
	northern redbelly dace	*Phoxinus eos*
	finescale dace	*Phoxinus neogaeus*
	redside dace	*Clinostomus elongatus*
	carp	*Cyprinus carpio*
	brassy minnow	*Hybognathus hankinsoni*
	silvery minnow	*Hybognathus regius*
	hornyhead chub	*Nocomis biguttatus*
	river chub	*Nocomis micropogon*
	golden shiner	*Notemigonus crysoleucas*
	emerald shiner	*Notropis atherinoides*
	common shiner	*Luxilus cornutus*
	blackchin shiner	*Notropis heterodon*
	blacknose shiner	*Notropis heterolepis*
	spottail shiner	*Notropis hudsonius*
	rosyface shiner	*Notropis rubellus*
	spotfin shiner	*Cyprinella spiloptera*
	sand shiner	*Notropis stramineus*
	mimic shiner	*Notropis volucellus*
	bluntnose minnow	*Pimephales notatus*
	fathead minnow	*Pimephales promelas*
	blacknose dace	*Rhinichthys atratulus*
	longnose dace	*Rhinichthys cataractae*
	creek chub	*Semotilus atromaculatus*
	fallfish	*Semotilus corporalis*
	pearl dace	*Margariseus margarita*
	stoneroller	*Campostoma anomalum*

FAMILY	COMMON NAME	SCIENTIFIC NAME
ICTALURIDAE - Catfish family	yellow bullhead	*Ameiurus natalis*
	brown bullhead	*Ameiurus nebulosus*
	channel catfish	*Ictalurus punctatus*
	stonecat	*Noturus flavus*
ANGUILLIDAE - Freshwater Eel family	American eel	*Anguilla rostrata*
CYPRINODONTIDAE - Killifish family	banded killifish	*Fundulus diaphanus*
CASTEROSTEIDAE - Stickleback family	brook stickleback	*Culaea inconstans*
	threespine stickleback	*Gasterosteus aculeatus*
PERCOPSIDAE - Trout-perch family	trout-perch	*Percopsis omiscomaycus*
PERCICHTHYIDAE - Temperate Bass family	white perch	*Morone americana*
	white bass	*Morone chrysops*
CENTRARCHIDAE - Sunfish family	rock bass	*Ambloplites rupestris*
	green sunfish	*Lepomis cyanellus*
	pumpkinseed	*Lepomis gibbosus*
	bluegill	*Lepomis macrochirus*
	smallmouth bass	*Micropterus dolomieu*
	largemouth bass	*Micropterus salmoides*
	black crappie	*Pomoxis nigromaculatus*
PERCIDAE - Perch family	yellow perch	*Perca flavescens*
	walleye (yellow pickerel)	*Sander vitreus*
	rainbow darter	*Etheostoma caeruleum*
	Iowa darter	*Etheostoma exile*
	fantail darter	*Etheostoma flabellare*
	johnny darter	*Etheostoma nigrum*
	logperch	*Percina caprodes*
	blackside darter	*Percina maculata*
	river darter	*Percina shumardi*
	tessellated darter	*Etheostoma olmstedi*
SCIAENIDAE - Drum family	freshwater drum	*Aplodinotus grunniens*
COTTIDAE - Sculpin family	mottled sculpin	*Cottus bairdi*
GOBIIDAE – Goby Family	round goby	*Neogobius melanostomus*

Appendix V: The Distribution of Fish Species and 2001 Sampling Stations in the Humber River Watershed.

SPECIES	UPPER MAIN HUMBER RIVER SUBWATERSHED	EAST HUMBER RIVER SUBWATERSHED	WEST HUMBER RIVER SUBWATERSHED	BLACK CREEK SUBWATERSHED	LOWER MAIN HUMBER SUBWATERSHED
LAMPREY FAMILY					
American brook lamprey	HU002WM, HU012WM, HU027WM, HU028WM, HU035WM, OSPGO1, OSPG04, OSPG07	HU021WM, HU023WM, HU024WM, OSPC01, OSPC02			
SALMON FAMILY					
Rainbow trout	HU012WM, HU027WM	HU001WM, HU022WM, OSPC02			HU010WM
Brown trout	HU026WM, HU027WM, HU028WM, HU029WM, HU030WM, HU033WM, HU034WM, HU036WM, OSPG01, OSPG04, OSPG05, OSPG06, OSPG07, OSPG08	HU001WM, HU020WM, OSPCO2			
Brook trout	HU027WM, HU030WM, HU031WM, HU032WM, HU034WM, HU035WM, HU037WM, HU038WM, OSBC01, OSPGO1, OSPG08	OSPC01, OSPC02			
SUCKER FAMILY					
White sucker	HU002WM, HU011WM, HU019WM, HU026WM - HU029WM, HU031WM - HU037WM, OSPG02 - OSPG08	HU001WM, HU021WM - HU025WM, OSPCO1, OSPC02	HU013WM - HU017WM		HU007WM, HU009WM, HU010WM, lakefront
Northern hog sucker	HU002WM, HU026WM, HU028WM, HU033WM, HU036WM, HU038WM	HU022WM	HU013WM, HU017WM	HU006WM	HU010WM

SPECIES	UPPER MAIN HUMBER RIVER SUBWATERSHED	EAST HUMBER RIVER SUBWATERSHED	WEST HUMBER RIVER SUBWATERSHED	BLACK CREEK SUBWATERSHED	LOWER MAIN HUMBER SUBWATERSHED
MINNOW FAMILY					
Redside dace	HU011WM	HU0O1WM, HU021WM, HU023WM	HU015WM		
Common carp		Eaton Hall			HU007WM, lakefront
Brassy minnow	HU027WM, HU031WM, HU032WM, OSPG03, OSPG05				
River chub	HU002WM, HU012WM	HU001WM, HU022WM			HU003WM, HU007WM, HU010WM
Golden shiner	HU002WM, HU011WM, HU019WM, HU029WM, HU031WM, HU033WM,	HU021WM, HU022WM, HU023WM, HU024WM, Eaton Hall	HU013WM, HU015WM, HU016WM		HU003WM, HU007WM, HU009WM, HU010WM
Emerald shiner		HU021WM			
Common shiner	HU002WM, HU011WM, HU031WM, OSPG02, OSPG03, OSPG04, OSPG05, Eginton Flats	HU001WM, HU020WM, HU021WM, HU022WM, HU024WM, OSPC02	HU014WM, HU015WM,		HU003WM, HU007WM, HU008WM, HU009WM, lakefront
Rosyface shiner	HU002WM				
Spotfin shiner					HU003WM
Spottail shiner	HU019WM, HU033WM	HU022WM, HU023WM	HU013WM - HU015WM		Lakefront
Bluntnose minnow	OSBC01, OSPG03	HU023WM, HU025WM	HU013WM - HU015WM, HU017WM		HU003WM, HU009WM, lakefront

SPECIES	UPPER MAIN HUMBER RIVER SUBWATERSHED	EAST HUMBER RIVER SUBWATERSHED	WEST HUMBER RIVER SUBWATERSHED	BLACK CREEK SUBWATERSHED	LOWER MAIN HUMBER SUBWATERSHED
Fathead minnow	HU019WM, HU027WM, OSPG08	HU021WM, HU025WM	HU013WM, HU017WM		
Blacknose dace	HU002WM, HU011WM, HU019WM, HU027WM-HU038WM, OSBC01, OSPG01 - OSPG08	HU001WM, HU021WM - HU025WM, OSPC01, OSPC02	HU014WM - HU017WM		HU003WM, HU004WM, HU009WM, HU010WM
Longnose dace	HU002WM, HU011WM, HU012WM, HU026WM	HU022WM - HU024WM, OSPC02			HU003WM, HU007WM - HU010WM
Hornyhead chub	HU002WM				
Creek chub	HU002WM, HU011WM, HU019WM, HU026WM, HU028WM - HU038WM, OSPG01 - OSPG08	HU001WM, HU021WM - HU-25WM, OSPC01, OSPC02	HU013WM - HU017WM		HU003WM, HU004WM, HU007WM - HU009WM
Northern redbelly dace	HU027WM, HU031WM, HU032WM, OSPG01, OSPG03, OSPG04				
Central stoneroller	HU011WM				HU003WM, HU007WM, HU009WM
CATFISH FAMILY					
Brown bullhead			HU014WM		HU003WM, lakefront
Stonecat	HU002WM				HU003WM
STICKLEBACK FAMILY					
Brook stickleback	HU011WM, HU032WM, OSPG01		HU017WM		

SPECIES	UPPER MAIN HUMBER RIVER SUBWATERSHED	EAST HUMBER RIVER SUBWATERSHED	WEST HUMBER RIVER SUBWATERSHED	BLACK CREEK SUBWATERSHED	LOWER MAIN HUMBER SUBWATERSHED
SUNFISH FAMILY					
Rock bass	HU002WM, HU033WM, OSPG02-OSPG05	HU022WM	HU013WM, HU01 4WM		
Pumpkinseed	HU011WM,, HU12WM, HU019WM, HU027WM	HU021WM, HU025WM, OSPC02, Eaton Hall			Lakefront
Black crappie		Eaton Hall			
Bluegill		Eaton Hall			
Largemouth bass	HU019wm, HU037WM	Eaton Hall	HU013WM, HU014WM		Lalefront
PERCH FAMILY					
Rainbow darter	HU002WM, HU012WM, HU026WM, HU036WM	HU001WM, HU021WM - HU024WM, OSPC02	HU013WM - HU016WM		HU003WM, HU007WM, HU009WM, HU010WM
Iowa darter		Eaton Hall			
Fantail darter	HU002WM, HU011WM, HU012WM, HU026WM, HU029WM, HU033WM, OSPG02 - OSPG05	HU022WM, HU023WM, OSPC02	HU013WM - HU015WM		HU003WM, HU007WM, HU009WM, HU010WM
Johnny darter	HU011WM, HU012WM, HU019WM, HU026WM, HU029WM, HU031WM, HU033WM, HU036WM, OSPG01-OSPG08	HU001WM, HU021WM - HU025WM, OSPC02	HU013WM - HU015WM, HU017WM		HU003WM, HU009WM
Blackside darter	HU019WM				
Yellow perch	HU019WM	Eaton Hall			

SPECIES	UPPER MAIN HUMBER RIVER SUBWATERSHED	EAST HUMBER RIVER SUBWATERSHED	WEST HUMBER RIVER SUBWATERSHED	BLACK CREEK SUBWATERSHED	LOWER MAIN HUMBER SUBWATERSHED
SCULPIN FAMILY					
Mottled sculpin	HU026WM-HU028WM, HU034WM, HU036WM - HU038WM, OSPG02-OSPG08	HU001WM, HU020WM, HU021WM, HU024WM, OSPC01,OSPC02			
GOBY FAMILY					
Round Goby					HU003WM