LYNDE CREEK WATERSHED
EXISTING CONDITIONS REPORT
CHAPTER 16 – FISHERIES & AQUATIC HABITAT

June 2008

Central Lake Ontario Conservation

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

The aquatic habitat in a stream and the health of the fishery within it are largely influenced by numerous variables, including many of the topics discussed in other chapters of this report. These include:

- Flow and sediment regimes;
- Water quality and quantity;
- Land use and land cover (including wetlands and riparian habitats);
- Local climate, geography, physiography and surficial geology.

While many of these topics have been discussed previously, each will be discussed briefly within this chapter in relation to the fisheries and aquatic habitat of Lynde Creek starting with a general discussion of each topic and more detailed examination by subwatershed.

'Under section 35 of the Fisheries Act, the Central Lake Ontario Conservation Authority (CLOCA) has a Level 3 agreement with Fisheries and Oceans Canada (DFO) to review proposed Municipal Class Environmental Assessment (EA) projects'

Legislative Requirements
Under section 35 of the Fisheries Act, the Central Lake Ontario Conservation Authority (CLOCA) has a Level 3 agreement with Fisheries and Oceans Canada (DFO) to review development proposals including Municipal Class Environmental Assessment (EA) projects. In this agreement, CLOCA conducts initial reviews on projects to determine if there will be an impact to fish and fish habitat, and if impacts are likely CLOCA will determine how the proponent can mitigate potential impacts. If potential impacts can be mitigated, the Authority will issue a letter of advice (LoA). If impacts to fish and fish habitat cannot be fully mitigated, the Authority works with the proponent and DFO to prepare a fish habitat compensation plan, at which time the project is forwarded to the local DFO office for authorization under the Fisheries Act.

In addition to Fisheries Act requirements, the Authority works to protect hazard lands such as floodways, erodible or unstable soils, and watercourses and wetlands through the Conservation Authorities Act and Ontario Regulation #42/06. This regulation requires a permit from the Conservation Authority prior to various works taking place within a floodplain or regulated area. Further, the Act allows regulations that pertain to the use of water, prohibit or require permission to interfere in any way with the existing channel of a watercourse or wetland, and prohibit or require a permit to undertake development (e.g. construction, structural alterations, grading, filling) in areas where the control of flooding, erosion, dynamic beaches, pollution or the conservation of lands may be affected. This is called "Development, Interference with Wetlands and Alteration to Shorelines and Watercourses Regulation, #42/06".

2.0 STUDY AREA AND SCOPE

'key indicators of aquatic habitat conditions are described including Strahler stream order, stream slope, instream barriers to fish migration and movement riparian vegetation, thermal regimes, land use and land cover'

The Lynde Creek watershed is situated entirely within the Regional Municipality of Durham and covers an area of approximately 130 km^2 (Figure 1). The watershed drains southerly towards Lake Ontario from its headwaters in the Oak Ridges Moraine. The Lynde Creek watershed is divided into 5 subwatersheds being Lynde Main, Heber Down, Kinsale, Ashburn, and Myrtle Station.

This chapter summarizes the current state of the aquatic habitat within Lynde Creek and its fisheries resources at both watershed and subwatershed scale. In addition, relevant historical information regarding fisheries in the Lynde Creek is provided. Key indicators of aquatic habitat conditions are described including Strahler stream order, stream slope, instream barriers to fish migration and movement of sediment and large woody material, riparian vegetation, thermal regimes, land use and land cover. In addition, fish species composition and distribution will be discussed as it relates to these habitat conditions.

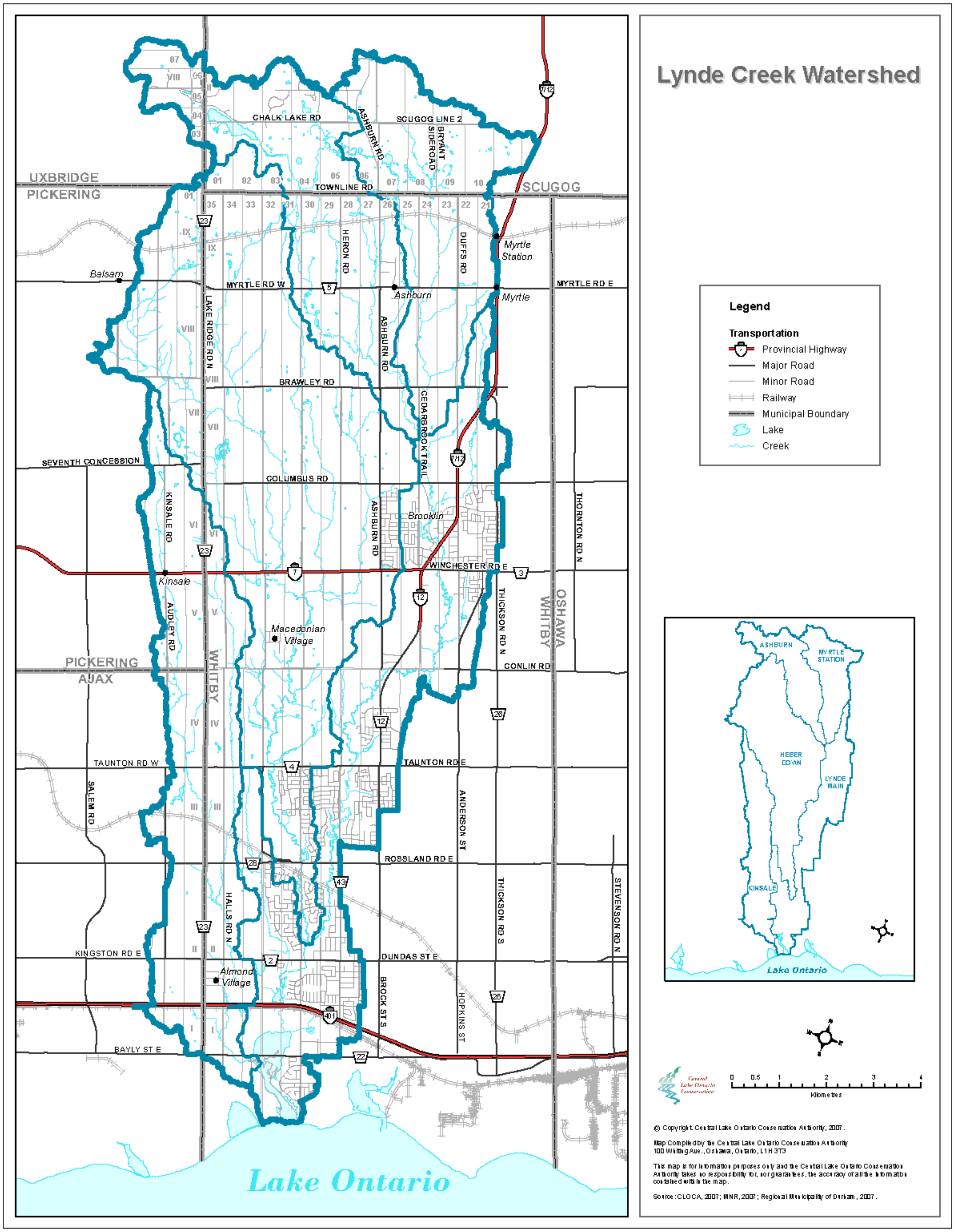


Figure 1: Lynde Creek watershed.

3.0 METHODOLOGY

Habitat characteristics were assessed using the Ontario Stream Assessment Protocol (Stanfield et al., 1998) and from 1:10,000 Ontario Base Map (OBM) data obtained from the Ministry of Natural Resources.

Fish communities were assessed according to fish sampling methods from the Ontario Stream Assessment Protocol (Stanfield et al., 1998). Sample locations were randomly selected at numbers suitable to accurately represent a number of varying instream habitat conditions, physiographic regions within the watershed, and adjacent land use types. The Lynde Creek Marsh represents a different habitat type, and as such was sampled using boat electrofishing as part of the Durham Region Coastal Wetland Monitoring Project.

For greater detail on the methodology used to assess aquatic habitat and fisheries, the reader is referred to the 2006 CLOCA Aquatic Monitoring Report.

While every effort has been made to accurately present the findings reported in this chapter, factors such as significant digits and rounding, and processes such as computer digitizing and data interpretation may influence results. For instance, in data tables no relationship between significant digits and level of accuracy is implied, and as a result values may not always sum to the expected total.

'fish communities were assessed according to fish sampling methods from the Ontario Stream Assessment Protocol (Stanfield et al. 1998)'

CLOCA Electofishing Crew conducting OSAP *© CLOCA*

4.0 FINDINGS

4.1 Lynde Creek Watershed

4.1.1 Aquatic Habitat

4.1.1.1 Strahler Stream Order and Slope

Stream-order is a classification system based on a drainage network and uses the Strahler Method (1964). Based on this method, streams increase in order upon converging with a stream of equal order. For example, a first-order stream (typically headwaters) is a small stream without tributaries. A second-order stream begins at the confluence of two first-order streams and continues until it meets with another second-order stream, forming a third-order stream, and so forth.

Stream-order is directly related to other morphometric and fluvial characteristics and can be useful in describing fish habitat. Based on concepts developed by Strahler (1964), stream-order is directly related to length, width, depth and discharge. As order increases, so too does the size of the stream and the current flowing within. Stream-order is also related to stream slope (or gradient). As stream-order increases, stream slope decreases. Finally, stream-order is related to fish species diversity, where fish diversity increases as a function of stream-order (Mackie, 2001). Stream-orders 1 to 3 can be described as narrow, with an erosional substrate (e.g., rocks, boulders) and an input of leaf-litter. Stream-orders 4 to 6 are wider, characterized by riffle and pool areas, and contain both erosional and depositional (e.g., sand) substrate. Stream-orders greater than 7 are wide, often with turbid water and contain depositional substrates (Mackie 2001).

'first-order streams represent over half (63%) of the total stream length in the Lynde Creek watershed'

The dendritic nature of Lynde Creek gives rise to the majority of stream length as first-order tributaries, which come together to form fewer large-order streams (Figure 2). First-order streams represent over half (63%) of the total stream length in the Lynde Creek watershed (Table 1). The subwatersheds that originate in the upper reaches of the Lynde Creek watershed (Heber Down, Kinsale, Ashburn, and Myrtle Station) have the largest proportion of total stream length as first-order streams. Within the Lynde Creek watershed, 27% of all tributary streams arise from the Oak Ridges Moraine, and 17% arise from the Iroquois Beach, indicating substantial groundwater inputs from both physiographic units (CLOCA, 2006). The numerous streams that originate upon the Oak Ridges Moraine and Lake Iroquois Beach emphasize the importance of these physiographic features as groundwater recharge and discharge areas.

Table 1: Lynde Creek watershed Strahler Stream Order
Total stream length (km) and proportion of the total stream length (in parenthesis) by stream-order of each subwatershed in the Lynde Creek watershed (values calculated from the 2002 CLOCA drainage layer).

Strahler Stream Order					Grand Total
1	2	3	4	5	
204.29	58.67	23.45	33.51	5.45	325.38
(63%)	(18%)	(7%)	(10%)	(2%)	

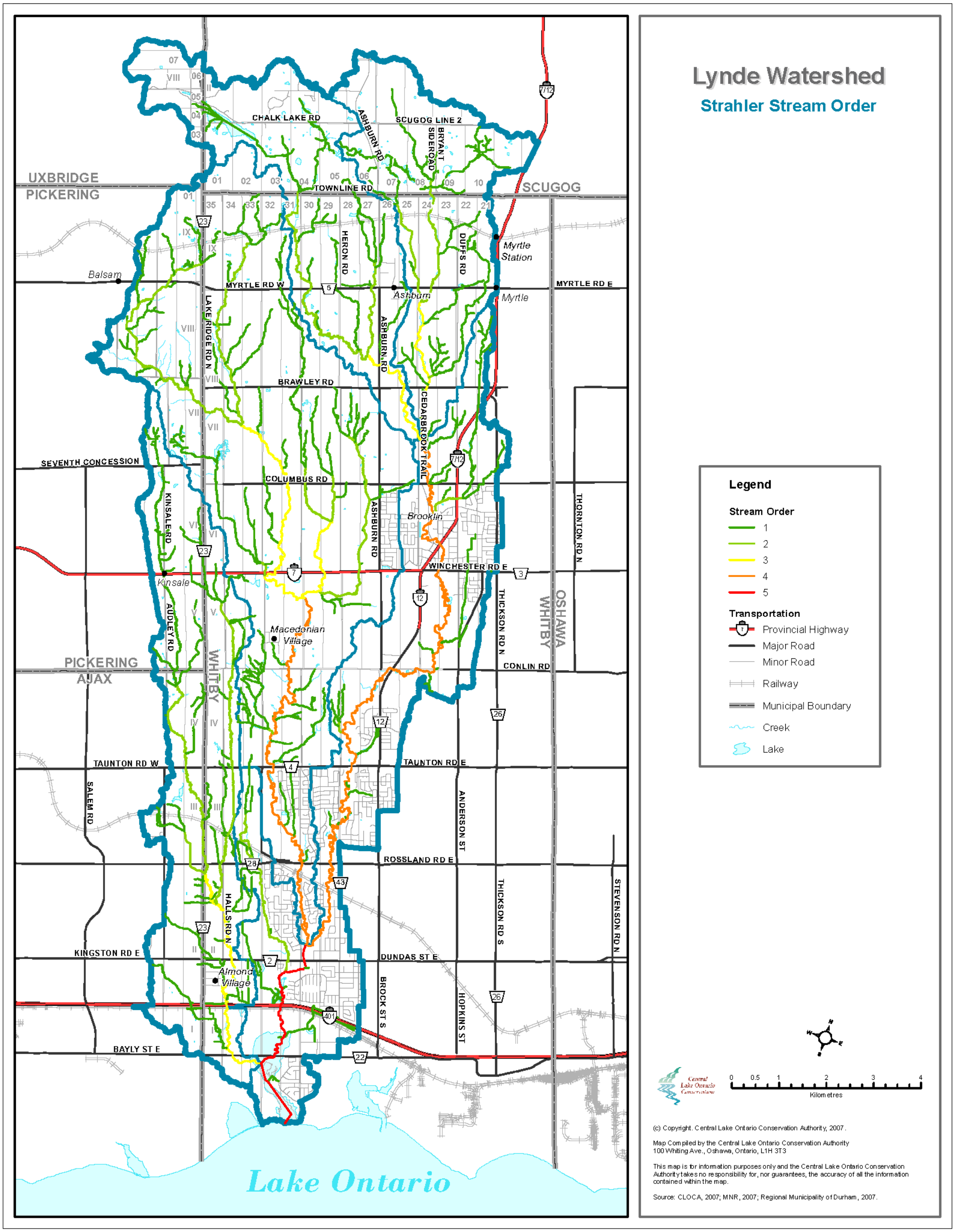


Figure 2: Strahler Stream Order for watercourses in the Lynde Creek watershed.

The slope or gradient of a stream is one of a number of variables used to characterize the type of habitat available to aquatic organisms. Gradient can be used to predict fish habitat structure. The substrate in high gradient streams is typically composed of large materials such as boulders, cobble and gravel, because fast-flowing water tends to wash smaller particles downstream. Silts and sandy materials characterize the substrate of low gradient streams, since water velocity is low enough along the channel bottom water interface to allow fine materials to settle out (Mackie, 2001).

Examination of gradient maps may also reveal areas of potential groundwater discharge. In high gradient areas, where the energy of flowing water has scoured away soil materials, the water may be flowing at the elevation of the water table and leading to the discharge of groundwater. The identification of groundwater seepage areas assists in identifying habitat suitable for the reproduction of salmonids such as brook trout.

Stream-order and slope determine the water velocity of a stream, which dictates the types of habitat and aquatic organisms found within streams. Some fish species are adapted to fast-flowing water, while others are more suited to slower velocities. Understanding stream-order and slope provides insight into fish habitat and communities within the watershed.

The rise of the creek (elevation in m) was divided by the length of the creek (m) to determine slope. Slopes were categorized into four groups: Low Slope (0.0 to 0.3%), Moderate Slope (0.3 to 1.0%), Steep Slope (>1.0 to 5.0%), and Very Steep Slope (>5.0%). A profile of the Lynde Creek watershed from the headwaters on the Oak Ridges Moraine to the outflow into Lake Ontario, including location of physiographic and geographic features can be found in Figure 3.

'the slope or gradient of a stream is one of a number of variables used to characterize the type of habitat available to aquatic organisms'

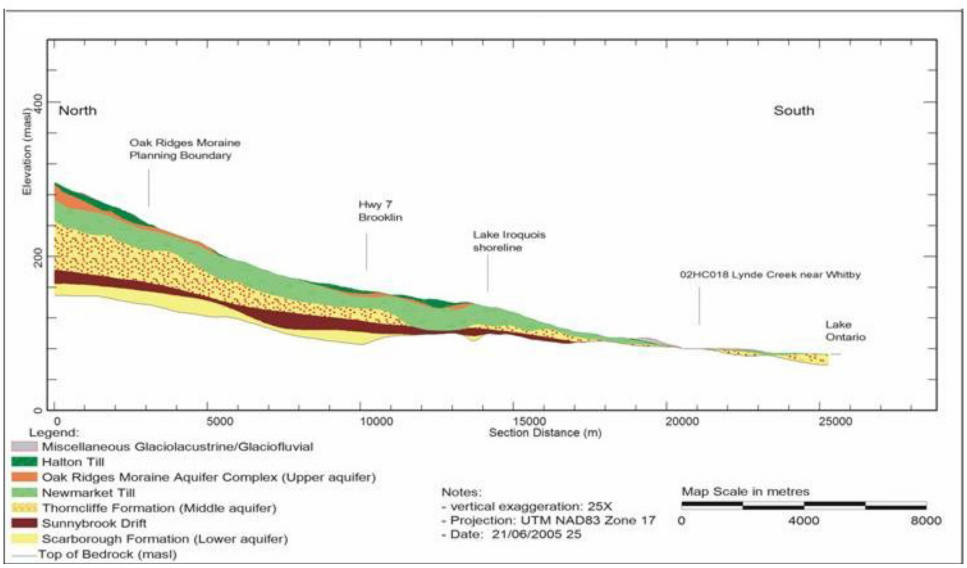


Figure 3: Lynde Creek profile. (Source: Soo Chan et al. 2007).

4.1.1.2 Instream Barriers

Instream barriers may be any type of water control structure, culvert, or weir that obstructs or limits fish movement, particularly from accessing upstream habitat, or causing fish to congregate at the base of the barrier for prolonged time periods. Not only do instream barriers have direct effects on fish, they also affect water quality and habitat conditions within the stream. Impoundment of water behind a physical structure causes the sediment to settle out from the stream water, leading to silt build-up in the pond and sediment depravation downstream. Sediment depravation downstream of the barrier causes an increased rate of stream bank erosion as the sediment-reduced water flowing past the barrier has more energy and scours the stream banks more quickly. This also leads to increased erosion of sediments in depositional areas of the lower stream reaches. Sediment accumulation in a pond requires periodic dredging, or sediment will be flushed into downstream creek sections. Flushing silt downstream can smother fish spawning beds and habitat.

In some cases within the watersheds, instream barriers act to separate upstream fish communities from down-stream fish communities. The isolation of upstream fish populations may be either beneficial or detrimental. Brook trout, for example, were distributed throughout this watershed historically, but currently live in headwater areas where suitable conditions still exist and are often separated by instream barriers from competing populations of brown and rainbow trout. However, the isolation of brook trout populations can cause a genetic bottle-neck effect, resulting in population declines. If an obstruction has been in place for a significant length of time, such that the fish communities above and below the structure have become isolated from one another, the best management option may be to protect the isolated populations upstream by maintaining the obstruction. However, it is unclear as to which factor is more limiting to the success of upstream fish species, interspecific competition from other fish species, or the genetic effects of long-term isolation.

'the isolation of upstream fish populations may be either beneficial or detrimental'

Instream barriers within the Lynde Creek watershed were assessed based on the obstruction of fish movement of migratory species. Currently, there are 8 known instream barriers within the Lynde Creek watershed (Figure 4). In addition, there are a number of potential instream barriers which require further investigation. These barriers have been identified as question marks in Figure 4. Note that the weir located at Devil's Den Pond (Heber Down subwatershed) has recently been modified to allow for fish passage.

Coronation Street Culvert © CLOCA

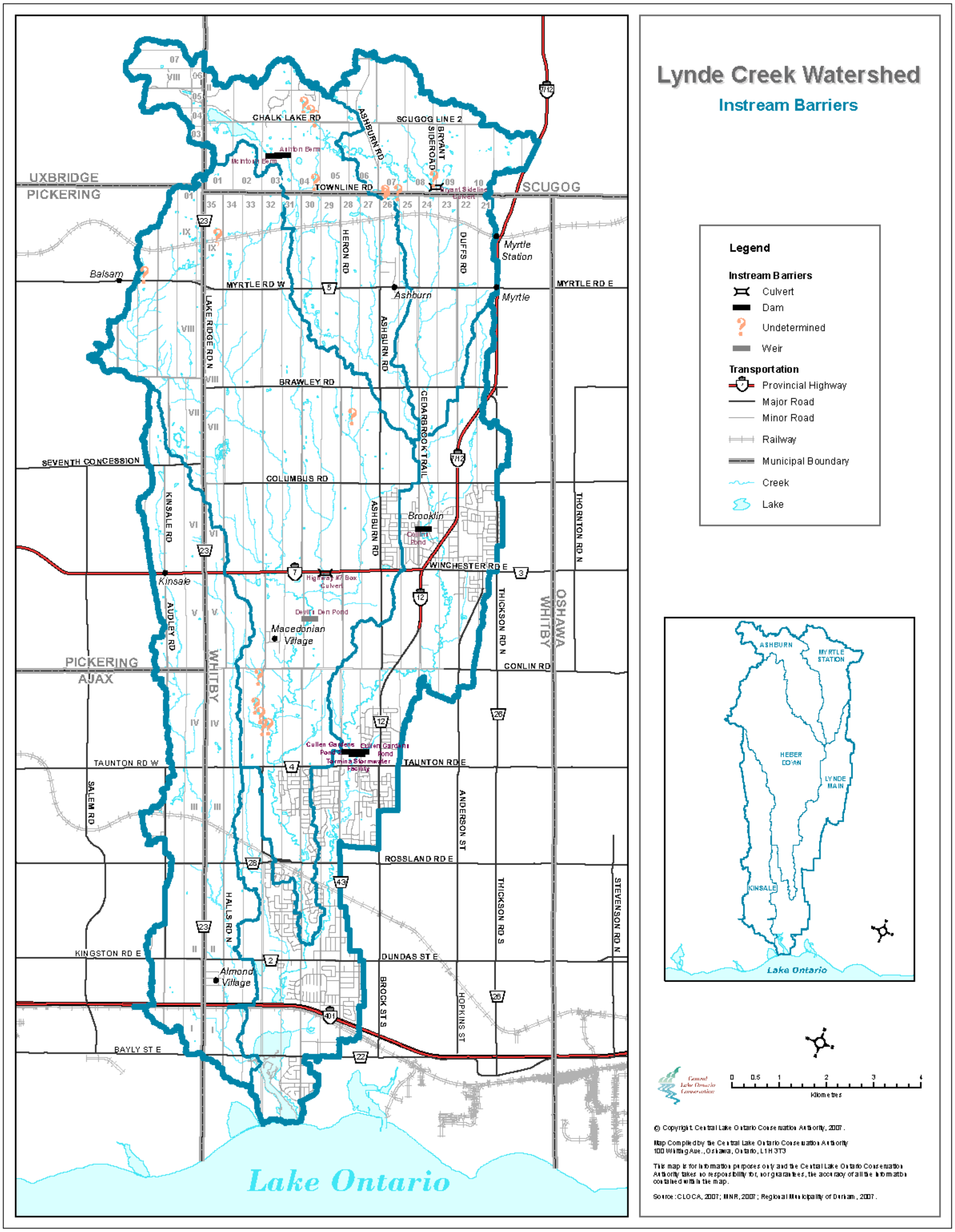


Figure 4: Location of known instream barriers to fish migration, and transport of sediment and large woody material in the Lynde Creek watershed.

4.1.1.3 Riparian Vegetation

Riparian vegetation plays an important role in water quality and aquatic life. A buffer strip of riparian vegetation helps filter land-flowing water before it enters the stream, provides shade to help moderate stream temperature, provides allochthanous nutrient input (e.g. external nutrients like dead leaves or other terrestrial debris), and helps to maintain the stability of the stream bank (Mackie, 2001). While all streams benefit from riparian cover, lower order streams (see highlighted columns in Table 2) in particular benefit greatly from riparian cover and the positive effects are apparent in higher order areas downstream.

Environment Canada guidelines (EC, 2004) indicate that 75% of stream length should have 30m riparian vegetation buffers on each side of the stream. Riparian vegetation cover in the Lynde Creek watershed falls short of the Environment Canada guidelines (EC, 2004), as only 34% of the entire stream length has 30m riparian buffers (Table 2).

By stream-order, the proportion of riparian cover is greatest along third (72%) and fourth-order (57%) streams, and worst along first (25%), fifth (30%) and second-order (41%) streams. Riparian cover is especially important for low-order streams, which are more affected by environmental change than large-order streams (EC 2004); however, only 32% of the total stream length of first to third-order streams has adequate riparian buffers. While it is difficult to make watershed-wide predictions of stream and fishery quality based on the absence of riparian vegetation, it is known that riparian cover benefits aquatic life and the low proportion of riparian cover in the Lynde Creek watershed may be correlated with poor stream and fishery health in some areas of the watershed.

"a buffer strip of riparian vegetation helps filter land-flowing water before it enters the stream, provides shade to help moderate stream temperature, provides allochthanous nutrient input, and helps to maintain the stability of the stream bank (Mackie, 2001)"

Table 2: Status of riparian vegetation in the Lynde Creek watershed.
Total stream length with 30m riparian cover (km) and percent of total stream length with cover (in parenthesis) by stream-order. Highlighted columns represent lower order streams which benefit greatly from riparian cover and may be given priority when determining areas for restoration.

Strahler Stream Order					**Grand Total**
1	2	3	4	5	
50.12	24.20	16.81	19.17	1.63	111.93
(25%)	(41%)	(72%)	(57%)	(30%)	(34%)


Lynde Main Subwatershed © CLOCA

4.1.1.4 Stream Health

Landscape Influences

Natural land cover and various land uses have direct and indirect effects on the physical, chemical, and biological characteristics of streams (Figure 5). The use of models to quantify the impacts of land use on aquatic ecosystems has become a powerful tool and is well represented in scientific literature (Kilgour and Stanfield, 2006; Stanfield and Kilgour, 2006; Stanfield et al., 2006; Arnold and Gibbons, 1996). To quantify the relationship between land use disturbance and aquatic ecosystem health in southern Ontario streams, Stanfield and Kilgour (2006) developed a locally derived model called the Land Disturbance Index (LDI) which incorporates fish, benthic invertebrates, instream habitat and landscape data from sites across the north shore of Lake Ontario, including CLOCA watersheds. The LDI model predicts a threshold response for fish communities in response to increased land disturbance such that salmonids are present in streams with low amounts of impervious cover and an absence from those with high amounts of impervious cover (Stanfield and Kilgour 2006). The high to moderately disturbed areas are manifested through below average water quality and high stream temperatures.

Temperature is a limiting factor for the survival and productivity of fish and other aquatic organisms. All fish species have specific temperature requirements, and these requirements can change throughout their various life-stages. Some fish species are considered cold/cool-water fishes because their productivity is optimized in cooler water temperatures; whereas, species which are considered warm-water fishes have optimal productivity in warm temperatures. Cold-water contains more dissolved oxygen than warm-water, and can support fishes that are sensitive to dissolved oxygen levels, such as trout and salmon. Warm-water fishes are able to tolerate lower oxygen levels.

'temperature is a limiting factor for the survival and productivity of fish and other aquatic organisms'

Temperature data provide an understanding of fish communities and habitat use, and can be used to predict the productive capacity of a particular habitat or stream reach. Stream temperature can be affected by a number of factors such as riparian vegetation cover, groundwater input, stormwater input, and climate change. By comparing historical and recent trends in stream temperature, degradation in thermal stability can be identified and management recommendations can be focused on the protection or rehabilitation of particular stream temperatures. The reader is referred to Chapter 10 – Water Temperature for additional detail regarding stream thermal classifications within the watershed.

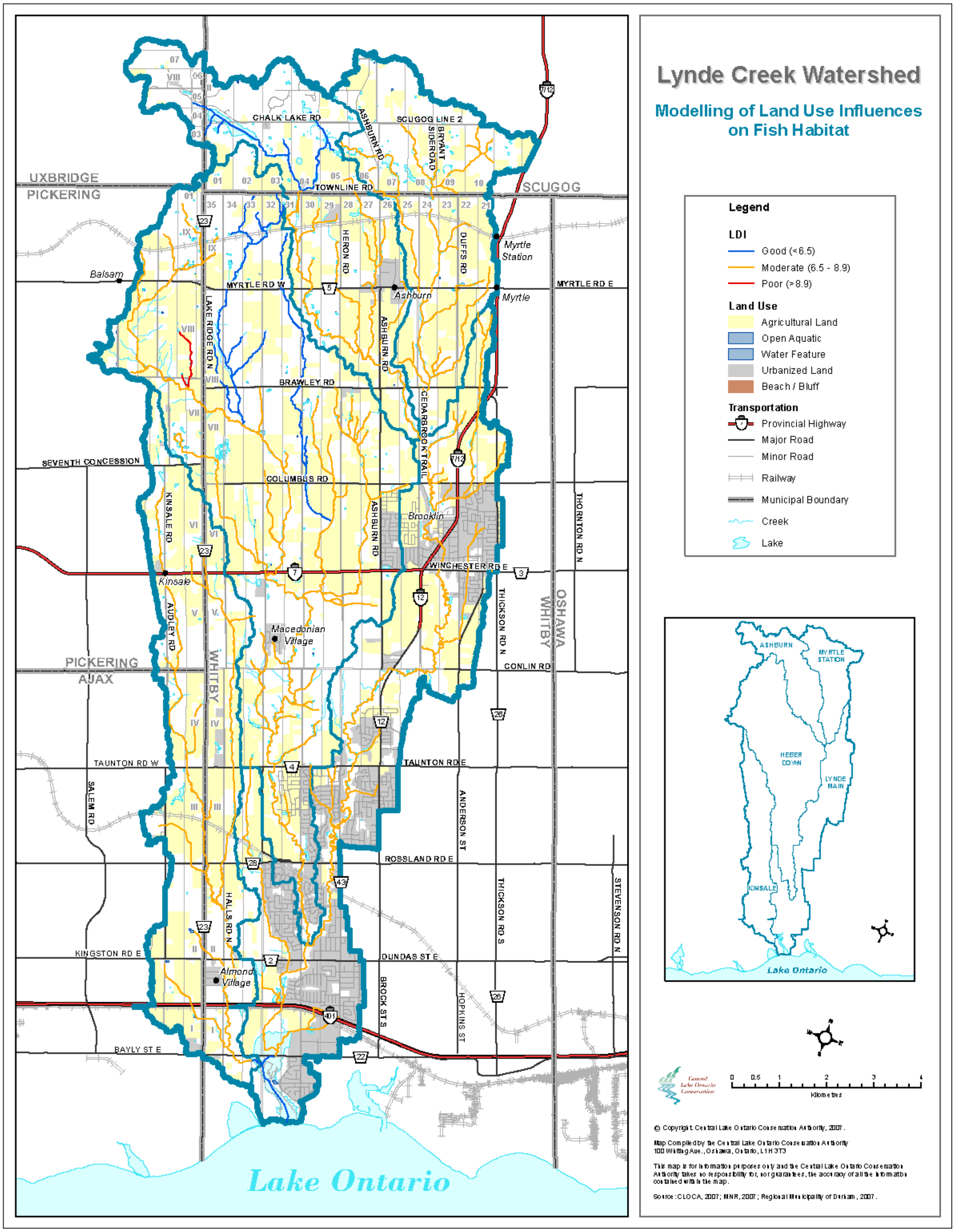


Figure 5: Land Disturbance Index (LDI) for the Lynde Creek watershed.

4.1.2 Fisheries

The following section provides a brief summary of the fish community within Lynde Creek. Additional information including fish species and family abundance can be found in the Central Lake Ontario Fisheries Management Plan (CLOCA/MNR, 2007) and the Lynde Creek Aquatic Resource Management Plan (CLOCA, 2006).

Fish sampling was conducted using back-pack electrofishing at 55 sites in 2001 (Figure 6). Currently, there are approximately 37 fish species, representing 12 families, known to occur within the Lynde Creek watershed including those found only within the Lynde Creek Marsh (Table 3). While this only represents 51% of the 73 species known to inhabit CLOCA's jurisdiction and Lake Ontario, there may be other species using the creek that have not been identified due to the timing of sampling and biases associated with the sampling gear. Many of the fishes distributed within the CLOCA's jurisdiction and Lake Ontario will use either stream, marsh or lake habitats; however, some species are particular to Lake Ontario or are present in the stream during part of the year but difficult to detect due to the timing of aquatic monitoring. These include: American eel, burbot, lake trout, splake, lake herring, rainbow smelt, white bass, and white perch. Historically, anadromous fishes of Lake Ontario, such as Chinook, coho and Atlantic salmon, migrated upstream into Lynde Creek in order to spawn. In recent years, however, only two salmonids have been observed, brook trout and rainbow trout.

'redside dace is a species which is of special concern federally, and is designated as threatened provincially'

Historically, there were approximately 41 fish species, representing 12 families, known to occur within the Lynde Creek watershed. Of these species, Atlantic salmon, coho salmon, Chinook salmon, brown trout, slimy sculpin, white bass, central mudminnow and Iowa darter were reported historically, but were not captured during 2001 sampling events, or 2002-2006 marsh sampling. These species may be present within the watershed, but at population sizes too low to have been detected from sampling methods employed (single-pass electrofishing), or number of sites sampled throughout the watershed. Alternatively, it is possible that the distributions of some of these species have changed in recent years, and they are no longer found within the Lynde Creek watershed. For example, Atlantic salmon are extirpated from Lake Ontario and hence have been absent from Lynde Creek since the late 1800s. Recent restoration efforts are underway to reintroduce Atlantic salmon into Lake Ontario through stocking and habitat rehabilitation, however, no reintroduction efforts are scheduled for this watershed and as a result they will likely remain absent from Lynde Creek in the foreseeable future.

Of the species found within the Lynde Creek watershed, redside dace is a species which is of special concern federally, and is designated as threatened provincially. The distribution of redside dace is limited to only a few watersheds in southern Ontario (Andersen 2002). This species is particularly sensitive to habitat changes, specifically turbidity and water temperature. As a result of increased land development within the Greater Toronto Area (GTA), the availability of suitable habitat for redside dace has declined significantly (Holm and Crossman, 1986; RSD Recovery Team, 2005). This trend of habitat loss has also been observed in the Lynde Creek watershed (CLOCA, 2006), as has a decline in species occurrence (Andersen, 2002).

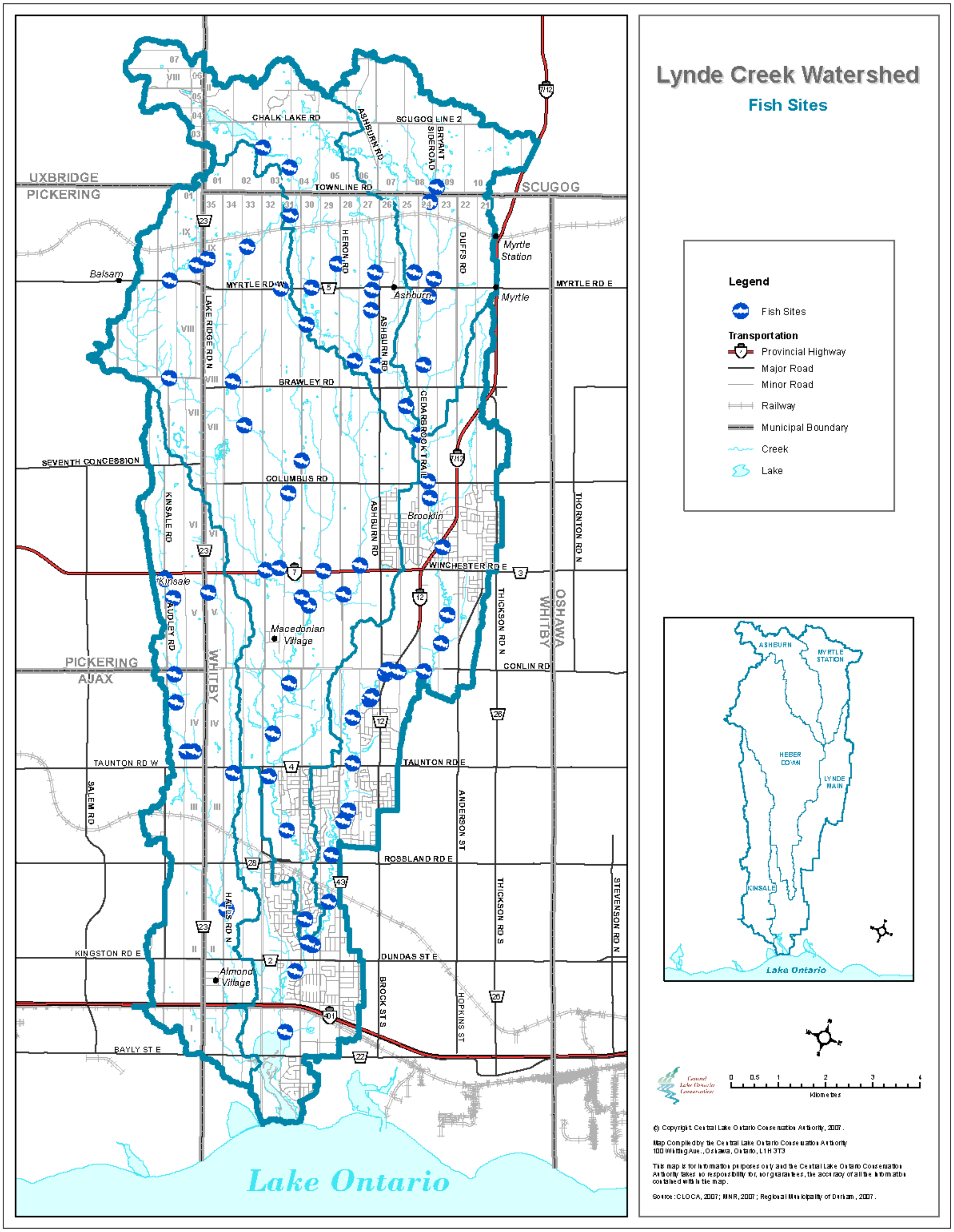


Figure 6: Location of fish sampling sites from the 2001 aquatic monitoring program.

Table 3: Known fish species within the Lynde Creek watershed, 2001 (including Lynde Creek Marsh, 2002-2006*). Data from Mandrak and Crossman 1992 and CLOCA fisheries records.

Family	Common Name	Scientific Name	Thermal Class	COSEWIC Status	COSSARO Status
Amiidae	bowfin*	Amia calva	Warm	NAR	NAR
Catostomidae	white sucker	Catostomus commersonii	Cool	NAR	NAR
Centrarchidae	rock bass	Ambloplites rupestris	Cool	NAR	NAR
	pumpkinseed	Lepomis gibbosus	Warm	NAR	NAR
	smallmouth bass	Micropterus dolomieu	Cool	NAR	NAR
	largemouth bass*	Micropterus salmoides	Warm	NAR	NAR
	black crappie*	Pomoxis nigromaculatus	Cool	NAR	NAR
Clupeidae	alewife*	Alosa pseudoharengus	Cold	NAR	NAR
	gizzard shad*	Dorosoma cepedianum	Cool	NAR	NAR
Cottidae	mottled sculpin	Cottus bairdii	Cold	NAR	NAR
Cyprinidae	emerald shiner*	Notropis atherinoides	Cool	NAR	NAR
	spottail shiner*	Notropis hudsonius	Cool	NAR	NAR
	redside dace	Clinostomus elongates	Cool	SC	THR
	spotfin shiner	Cyprinella spiloptera	Warm	NAR	NAR
	common carp+*	Cyprinus carpio	Warm	NAR	NAR
	common shiner	Luxilus cornutus	Cool	NAR	NAR
	golden shiner*	Notemigonus crysoleucas	Cool	NAR	NAR
	blacknose shiner	Notropis heterolepis	Cool	NAR	NAR
	rosyface shiner	Notropis rubellus	Warm	NAR	NAR
	sand shiner	Notropis stramineus	Warm	NAR	NAR
	northern redbelly dace	Phoxinus eos	Cool/Warm	NAR	NAR
	bluntnose minnow	Pimephales notatus	Warm	NAR	NAR
	fathead minnow	Pimephales promelas	Warm	NAR	NAR
	longnose dace	Rhinichthys cataractae	Cool	NAR	NAR
	creek chub	Semotilus atromaculatus	Cool	NAR	NAR
Esocidae	northern pike*	Esox lucius	Cool	NAR	NAR
Gasterosteidae	brook stickleback	Culaea inconstans	Cool	NAR	NAR
Ictaluridae	brown bullhead	Ameiurus nebulosus	Warm	NAR	NAR
	stonecat	Noturus flavus	Warm	Group 2	NAR
Percidae	yellow perch	Perca flavescens	Cool	NAR	NAR
	walleye*	Sander vitreus	Cool	NAR	NAR
	rainbow darter	Etheostoma caeruleum	Cool	NAR	NAR
	logperch	Percina caprodes	Cool/Warm	NAR	NAR
	johnny darter	Etheostoma nigrum	Cool	NAR	NAR
Petromyzontidae	American brook lamprey	Lampetra appendix	Cold	Group 3	NAR
Salmonidae	rainbow trout+	Oncorhynchus mykiss	Cold	NAR	NAR
	brook trout	Salvelinus fontinalis	Cold	NAR	NAR

+ Introduced species (Mandrak and Crossman 1992; Atlantic salmon were once native but have subsequently been re-introduced).
THR = Threatened; SC = Special Concern; NAR = Not at Risk; Group 2 = Potentially at risk, mid-priority candidate for further assessment; Group 3 = Potentially at risk, low-priority candidate for further assessment.
COSEWIC and COSSARO status as of April 2006 and October 2006 respectively

While not considered at risk, as of October 2006 there were two species that reside in this watershed that are considered potentially at risk by COSEWIC and require further review. American brook lamprey has been federally designated as potentially at risk and is a low priority candidate for further assessment (Group 3). Similarly, stonecat has been federally designated as potentially at risk and is a mid-priority candidate for further assessment (Group 2).

4.2 Subwatershed Findings

4.2.1 Lynde Main Subwatershed

4.2.1.1 Aquatic Habitat

Strahler Stream Order

The Lynde Main subwatershed is a high-order stream system (Table 4 and Figure 7). High-order streams are less susceptible to environmental change than subwatersheds with larger proportions of low-order streams (EC, 2004). In the Lynde Main subwatershed, the majority of permanently flowing reaches are comprised of fourth and fifth-order streams (40%). While 50% of all watercourses are first order streams, many of these are ephemeral or intermittent tributaries. As a result, it is predicted that the Lynde Main subwatershed will have the greatest fish species diversity, while the remaining subwatersheds will have less diversity.

Table 4: Lynde Main subwatershed Strahler Stream Order.
Total stream length (km) and proportion of the total stream length (in parenthesis) by stream-order of the subwatershed (values calculated from the 2002 CLOCA drainage layer).

Strahler Stream Order					Grand Total
1	2	3	4	5	
33.31	5.79	0.37	21.29	5.45	66.21
(50%)	(9%)	(1%)	(32%)	(8%)	

'the Lynde Main subwatershed is a high-order stream system'

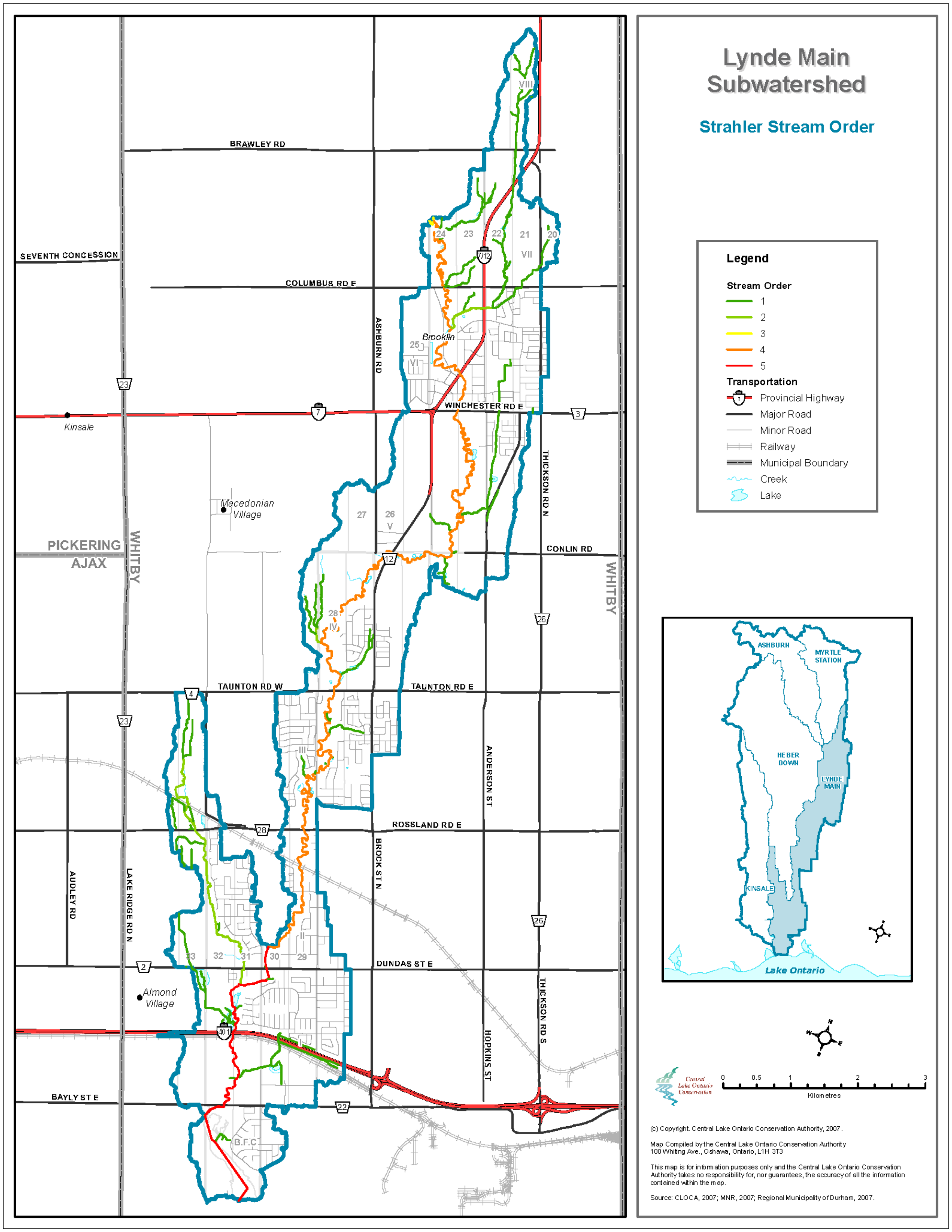


Figure 7: Strahler Stream Order for watercourses in the Lynde Main subwatershed.

Instream Barriers

Instream barriers within the Lynde Main subwatershed were assessed based on the obstruction of fish movement of migratory species. There are 3 known potential instream barriers within the Lynde Main subwatershed (Figure 8). These barriers are summarized in Table 5 and a description of each is provided.

Table 5: Known instream barriers in the Lynde Main subwatershed.
Fish passage indicates whether fish can move through the barrier to access upstream habitats (Salmonids indicates that only jumping species of salmon and trout can pass over the barrier).

Obstruction	Type	Year Built	Status	Fish Passage
Cullen Gardens Pond	Dam	1860's	Active	Salmonids*
Cullen Gardens Pond 2	Dam	Unknown	Active	Not Passable
Collins Pond	Dam	1859	Active	Salmonids*

* Dam is only in operation during summer months to allow for seasonal migration of salmonids.

<u>Cullen Gardens Dam</u>

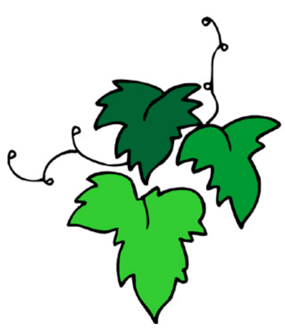
The Cullen Gardens dam was originally built in the late 1860's to retain water to drive grist mill machinery. The area at the time was known as Bagotville and the mill itself was known as the Patly Mills. The Town of Whitby recently purchased these lands from the owners who operated Cullen Gardens and Miniature Village. The staff of Cullen Gardens indicated that the dam is opened during the spring and fall to accommodate anadromous fish. With all stop-logs in place, the pond is 1.5m higher than the creek elevation.

'there are 3 known instream barriers within the Lynde Main subwatershed.

Little is known about the second Cullen Gardens pond. The dam is considered impassable to fish, however, further investigations into the origins of the dam, dimensions and materials of this structure are needed.

<u>Collins Dam</u>

The Collins dam was originally built by J. B. Bickel in 1859 to retain water to drive grist mill machinery. The dam is currently owned by the Collins family, and the recreational pond above is jointly owned by the Collins and Vessey families. The Vessey family has indicated that the dam is opened in the spring of the year to accommodate rainbow trout spawning runs and drawn down in the winter to relieve siltation problems and create ice skating conditions. With all stop logs in place the dam is 1.5m higher than the creek elevation. The dam also incorporates a 1.5m long concrete apron.



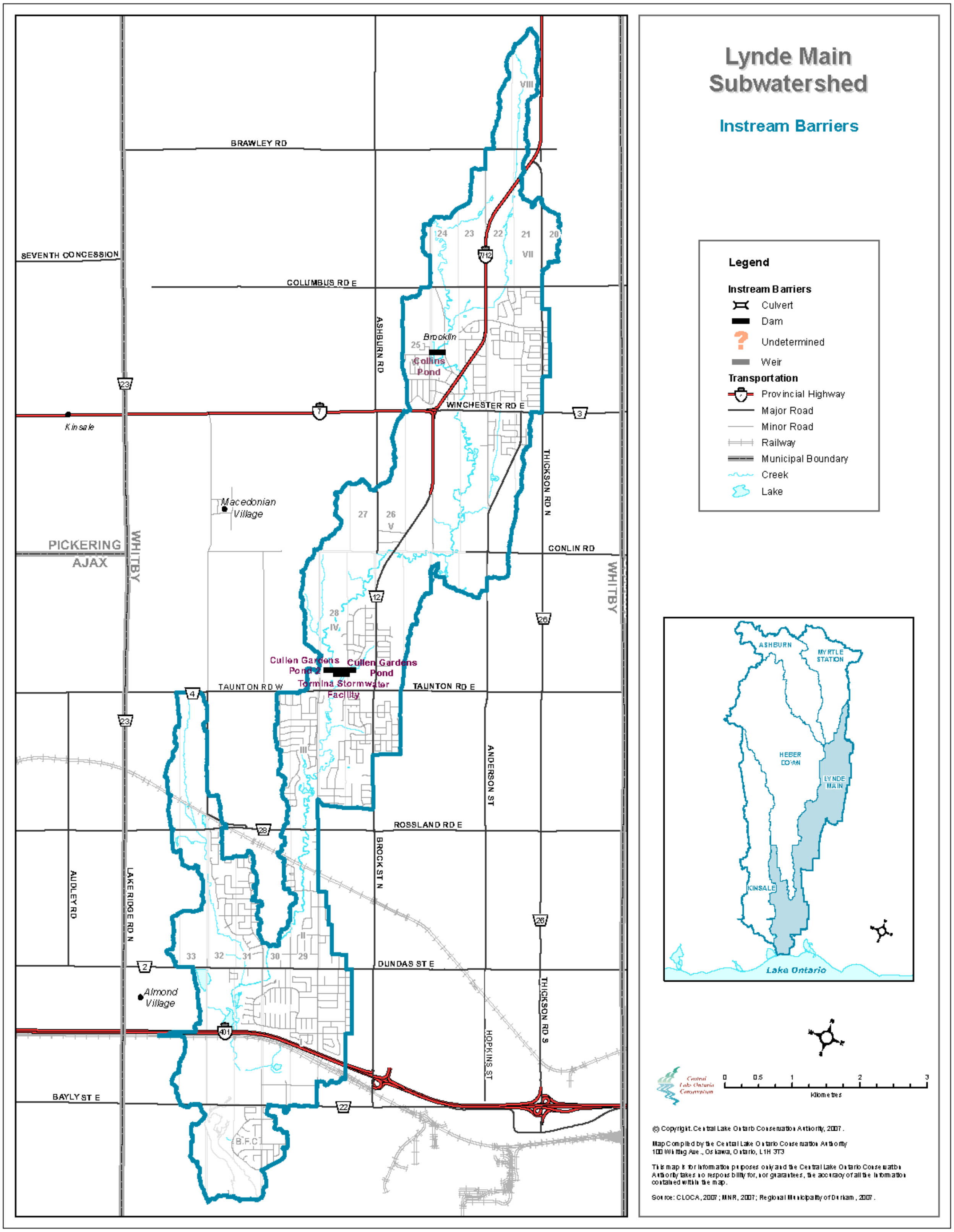


Figure 8: Location of known instream barriers to fish migration, and transport of sediment and large woody material in the Lynde Main subwatershed.

Riparian Vegetation

Riparian vegetation cover in the Lynde Main subwatershed falls short of the EC guidelines (EC, 2004) at only 34% (Table 6). By stream-order, the proportion of riparian cover is greatest along second (50%) and fourth-order (59%) streams, and lowest along first (17%), third (39%) and fifth-order (30%) streams. Riparian cover is especially important for low-order streams, which are more affected by environmental change than large-order streams (EC 2004); however, only 34% of the total stream length has adequate riparian buffers.

'Environment Canada guidelines (EC, 2004) indicate that 75% of stream length should have 30m riparian vegetation buffers on each side of the stream'

Table 6: Status of riparian vegetation in the Lynde Main subwatershed.
Total stream length with 30m riparian cover (km) and percent of total stream length with cover (in parenthesis) by stream-order. Highlighted columns represent lower order streams which benefit greatly from riparian cover and may be given priority when determining areas for restoration.

Strahler Stream Order					**Grand Total**
1	2	3	4	5	
5.68	2.89	0.14	12.48	1.63	22.82
(17%)	(50%)	(39%)	(59%)	(30%)	(34%)

Landscape Influences

Land disturbance in the Lynde Main subwatershed is categorized as moderately disturbed in the majority of reaches (Figure 9). The Lynde Main subwatershed is dominated by urban and agricultural land uses (43% and 32% respectively), although it has one of the greatest percentages of total riparian cover within the watershed (34%). This subwatershed receives water from five other subwatersheds before passing through Lynde Creek Marsh into Lake Ontario. The LDI scores are moderate throughout the Lynde Main subwatershed. This is likely the result of the cumulative effects of urban and agricultural land uses that dominate the landscape both within this watershed and those upstream which drain into it.

'the LDI scores are moderate throughout the Lynde Main subwatershed'

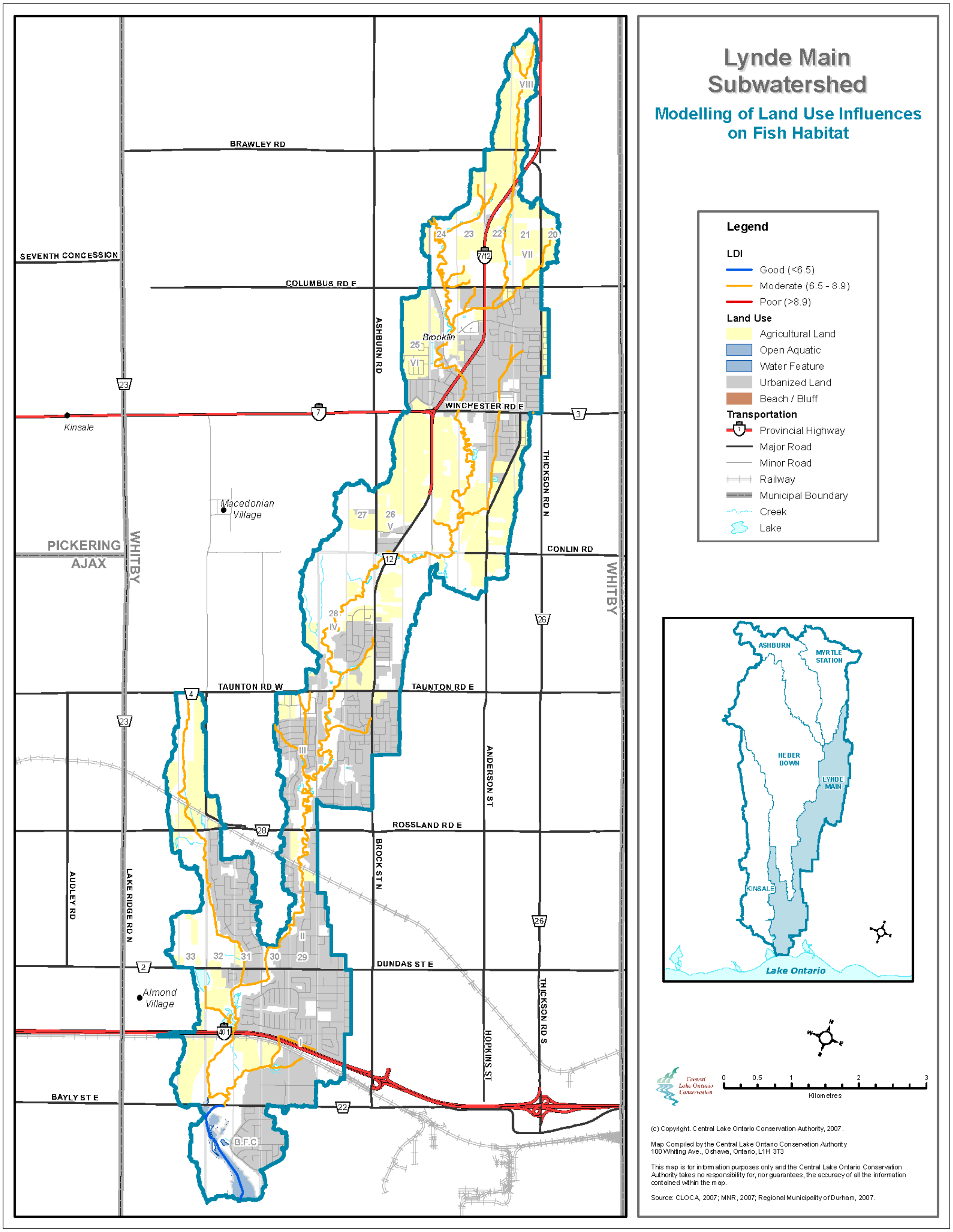


Figure 9: Land Disturbance Index (LDI) for Lynde Main subwatershed.

4.2.1.2 Fisheries

Since Lynde Creek meets Lake Ontario as a fifth-order stream and coastal marsh, it is possible to find many lake-dwelling species within this branch. The Lynde Main subwatershed supports a diverse fish community of 24 species from 9 families (CLOCA 2006, CLOCA/MNR, 2007). Figure 10 depicts the fish sampling sites as part of the 2001 aquatic monitoring program within the subwatershed. Fish species caught in this subwatershed are representative of cool and cold-water fish, typical of trout streams (sucker, sculpin, dace and trout; Moyle and Cech 2000), and warm-water fish. Many of the warm-water fish such as sunfish, bass, minnows, and suckers are likely present year-round, while cold/cool-water fish such as salmon and trout use this branch as a migration route to upstream spawning grounds, or as rearing habitat for their young. Redside dace are also found within this subwatershed. Smallmouth bass and logperch were caught in the Lynde Main. Logperch were not found in any other Lynde Creek subwatershed.

4.2.1.3 Lynde Creek Marsh

The Lynde Creek Marsh is an important transition area between the Lacustrine habitat of Lake Ontario and the riverine habitat of Lynde Creek. As part of the Durham Region Coastal Wetland Monitoring Project, the fish community in the Lynde Creek Marsh has been monitored annually since 2002. Fish species found within the marsh include alewife, gizzard shad, northern pike, white sucker, common carp, golden shiner, emerald shiner, spottail shiner, bluntnose minnow, fathead minnow, brown bullhead, pumpkinseed, smallmouth bass, black crappie and yellow perch. In addition to these species, anadromous species from Lake Ontario like salmon and trout species likely utilize this marsh for staging and migration in the spring and fall months.

'the Lynde Main subwatershed supports a diverse fish community of 24 species from 9 families'

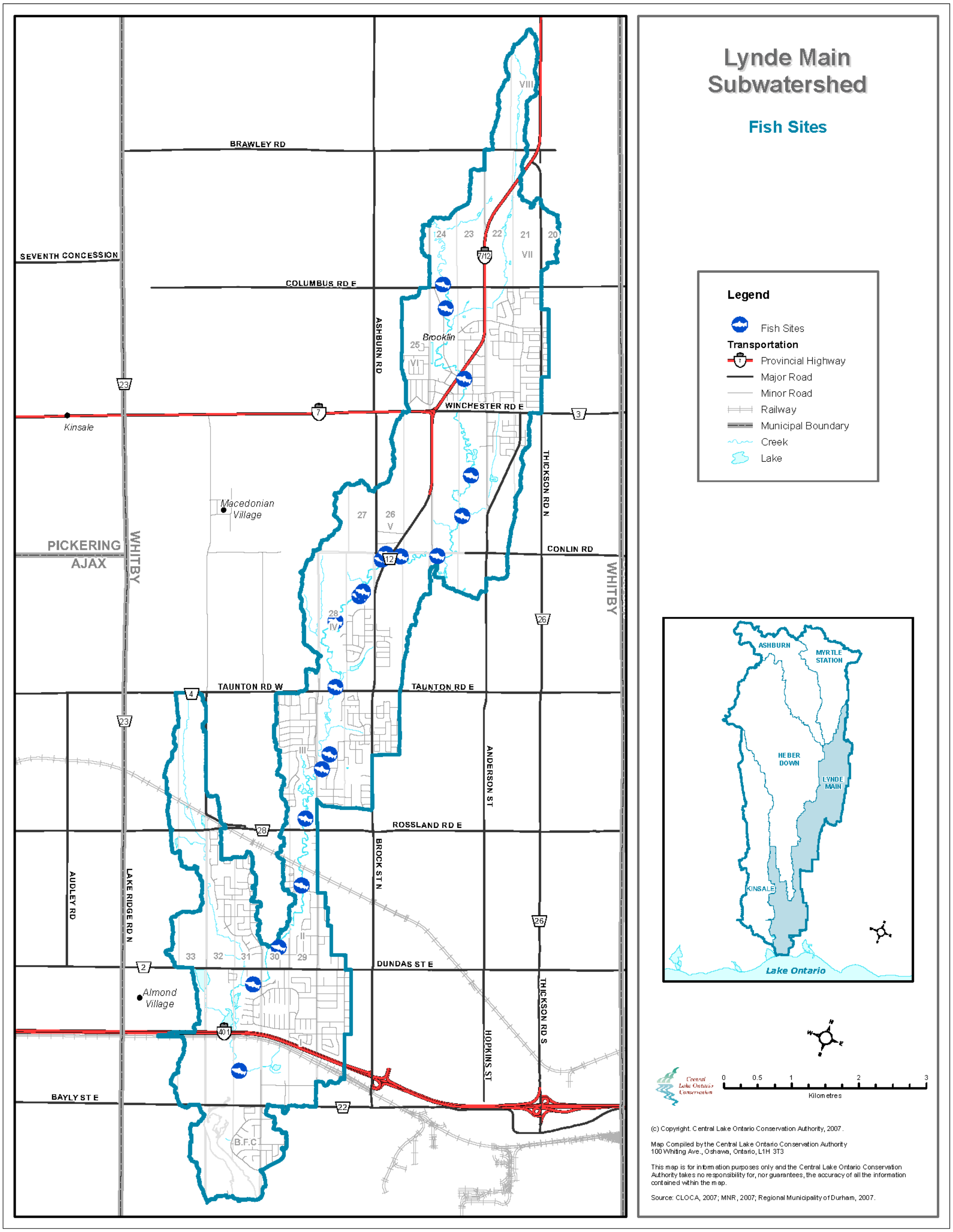


Figure 10: Location of fish sampling sites from the 2001 aquatic monitoring program in the Lynde Main subwatershed.

4.2.2 Heber Down Subwatershed

4.2.2.1 Aquatic Habitat

Strahler Stream Order

The Heber Down subwatershed is a low-order stream system (Table 7 and Figure 11). Lower order streams (1 to 3) are more susceptible to habitat degradation from environmental impacts. Much of the Heber Down subwatershed is comprised of first to third-order streams (89%) with the remaining being fourth-order (11%).

Table 7: Heber Down subwatershed Strahler Stream Order.
Total stream length (km) and proportion of the total stream length (in parenthesis) by stream-order of the subwatershed (values calculated from the 2002 CLOCA drainage layer).

Strahler Stream Order					Grand Total
1	2	3	4	5	
70.77	21.62	9.03	12.22	0.00	113.65
(62%)	(19%)	(8%)	(11%)	(0%)	

'much of the Heber Down subwatershed is comprised of first to third-order streams (89%)'

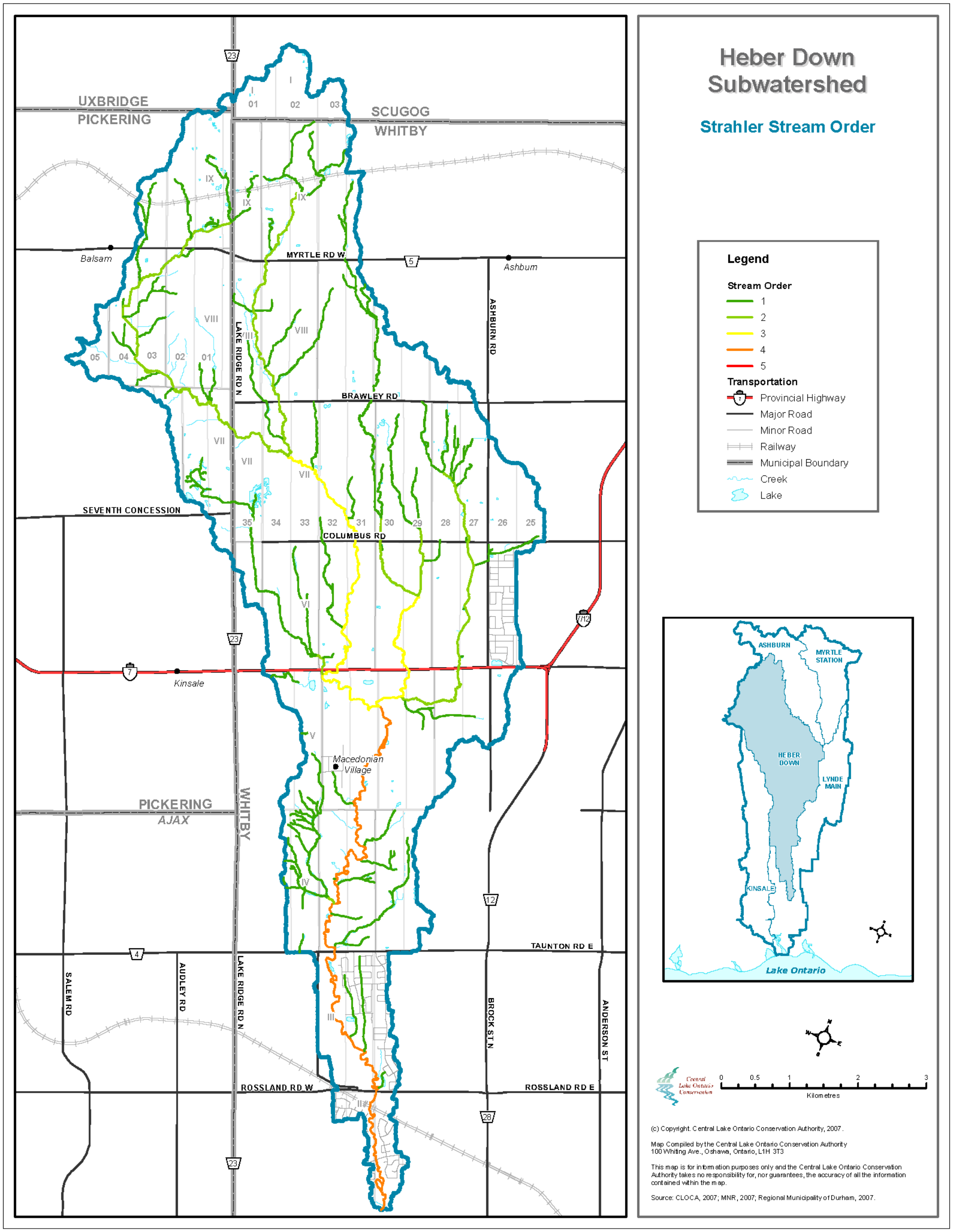


Figure 11: Strahler Stream Order for watercourses in the Heber Down subwatershed.

Instream Barriers

Instream barriers within the Heber Down subwatershed were assessed based on the obstruction of fish movement of migratory species. There are 10 known potential instream barriers within the Heber Down subwatershed (Figure 12), at least one of which is impassable to all fishes (Highway #7 box culvert). While this barrier restricts access of migratory salmonids to spawning habitat upstream, it is possible that it provides refuge for redside dace. Only 2 instream barriers have been inventoried. These barriers are summarized in Table 8 and a description of each is provided.

Table 8: Known instream barriers in the Heber Down subwatershed.
Fish passage indicates whether fish can move through the barrier to access upstream habitats (Salmonids indicates that only jumping species of salmon and trout can pass over the barrier).

Obstruction	Type	Year Built	Status	Fish Passage
Devil's Den Pond	Weir	1950's	Active	Passable
Highway #7 Box Culvert	Culvert	Unknown	Active	Not Passable

Devil's Den Pond

The Devil's Den weir was built by CLOCA in 1980 to create a partial creek diversion to the Devil's Den pond; a popular recreation feature within Heber Down Conservation Area. The weir was two-tiered and was constructed of steel gabion basket filled with rip-rap. In periods of low flow this structure was a barrier to fish movement. The gabion baskets were removed by CLOCA in September of 2005 and a more natural bioengineered step pool structure was created to divert water to the pond while allowing for fish passage.

'there are 10 known potential instream barriers within the Heber Down subwatershed'

Highway 7 Culvert

The Highway 7 culvert appears to have been modified several times since the initial installation to accommodate road widening. The culvert is a two metre concrete box including a ramp angle of 45° which precludes passage by fish. Removal or redesign of this culvert would facilitate fish passage, but the presence of redside dace upstream from the structure should be considered before remediation works take place. The culvert currently restricts access to approximately 9.5km of creek.

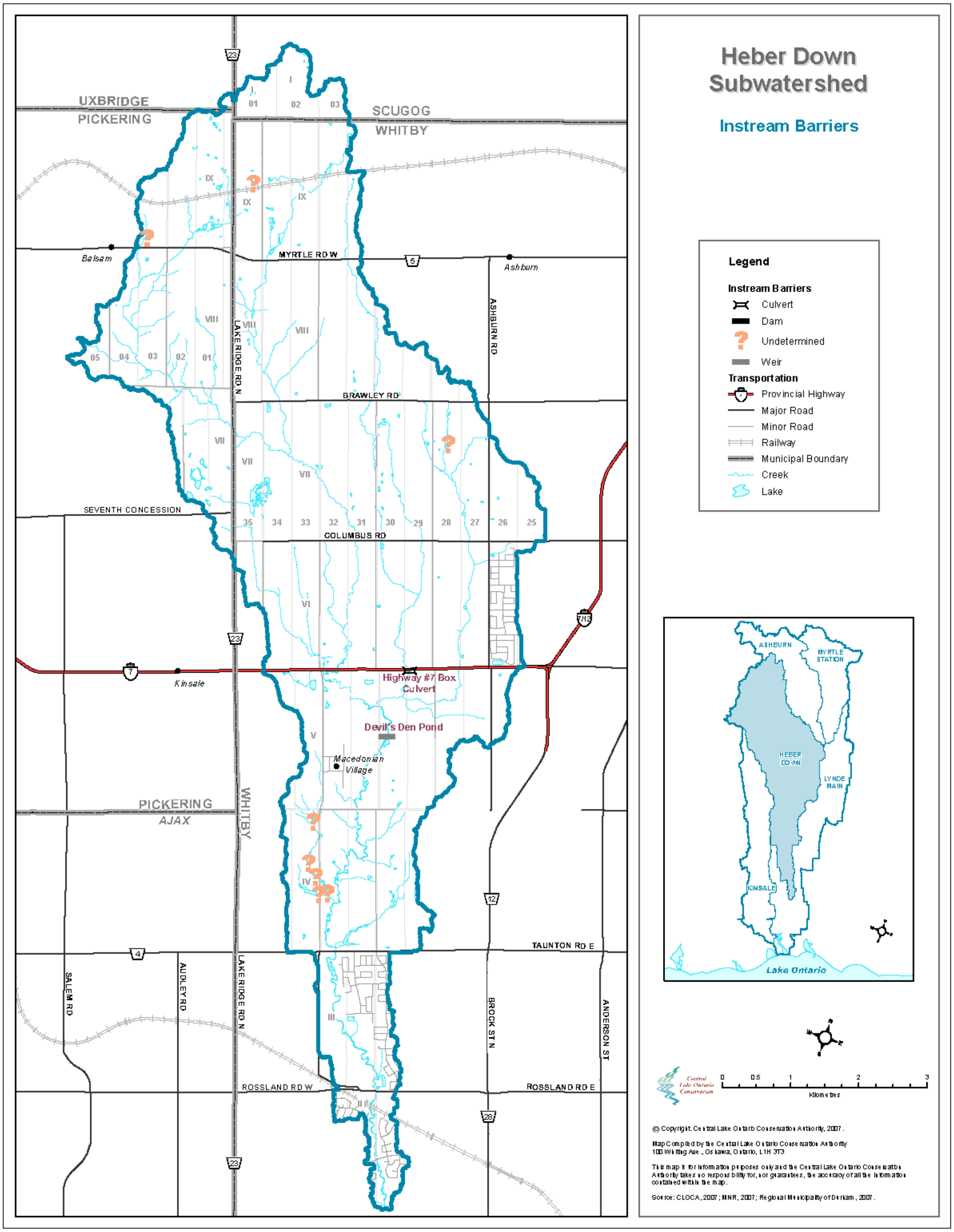


Figure 12: Location of known instream barriers to fish migration, and transport of sediment and large woody material in the Heber Down subwatershed.

Riparian Vegetation

Riparian vegetation cover in the Heber Down subwatershed falls short of the EC guidelines (EC, 2004) at only 34% (Table 9). By stream-order, the proportion of riparian cover is greatest along third (73%) and fourth-order (57%) streams, and lowest along first (25%) and second-order (36%) streams.

'Environment Canada guidelines (EC, 2004) indicate that 75% of stream length should have 30m riparian vegetation buffers on each side of the stream'

Table 9: Status of riparian vegetation in the Heber Down subwatershed.
Total stream length with 30m riparian cover (km) and percent of total stream length with cover (in parenthesis) by stream-order. Highlighted columns represent lower order streams which benefit greatly from riparian cover and may be given priority when determining areas for restoration.

Strahler Stream Order					**Grand Total**
1	2	3	4	5	
17.72	7.76	6.63	6.70	0.00	38.81
(25%)	(36%)	(73%)	(55%)	(0%)	(34%)

Landscape Influences

This subwatershed is dominated by agricultural and urban land uses (52% and 17% respectively) (Figure 13), but has one of the greatest percentages of total riparian cover within the watershed (34%). The LDI scores range from poor in a section of the west branch north of Concession 8, to moderate in reaches largely south of Winchester Road, to good in the middle branches that pass through the Heber Down Conservation Area. Reaches with poor to moderate LDI ratings are likely influenced by the cumulative effects of urban and agricultural land uses which dominate the landscape. Similarly, it is not coincidence that the reaches with good LDI ratings are surrounded by forest, thicket and have higher than average riparian cover.

'LDI scores range from poor in a section of the west branch north of Concession 8, to moderate in reaches largely south of Winchester Road, to good in the middle branches that pass through the Heber Down Conservation Area'

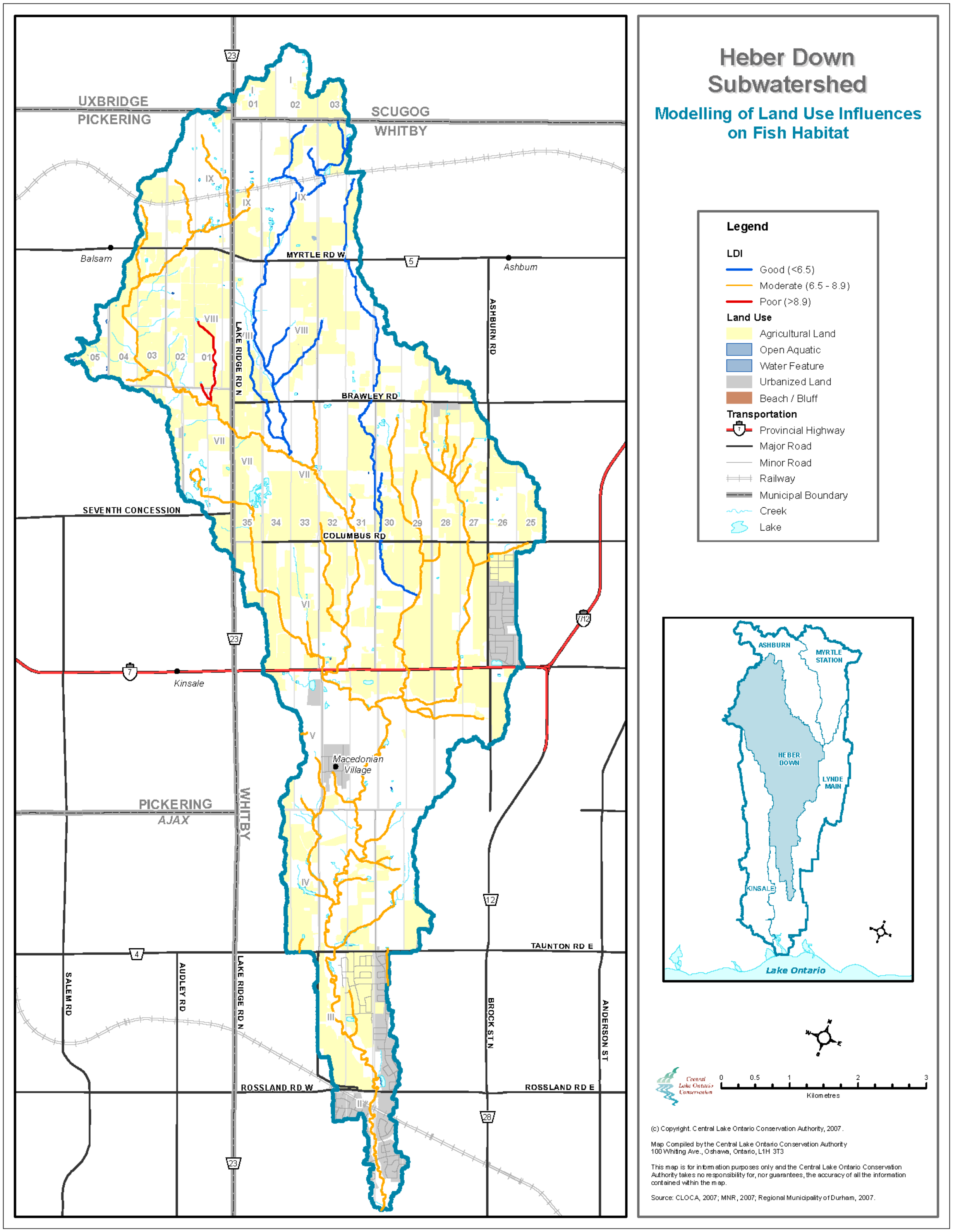


Figure 13: Land Disturbance Index (LDI) for the Heber Down subwatershed.

4.2.2.2 Fisheries

The Heber Down subwatershed of Lynde Creek supports a diverse fish community of 22 species from 9 families (CLOCA, 2006; CLOCA/MNR, 2007). Figure 14 depicts the fish sampling sites as part of the 2001 aquatic monitoring program within the subwatershed. Fish species caught in Heber Down are representative of cool and cold-water fish typical of trout streams (sucker, sculpin, dace and trout; Moyle and Cech, 2000) in addition to warm-water fish. Redside dace, a species of concern federally and a provincially threatened species are found within this subwatershed. Redside dace is very sensitive to habitat changes, in particular changes to water temperature and turbidity. It has been found that in the Greater Toronto Area, the availability of suitable habitat has declined significantly as a result of increased land development (Holm and Crossman, 1986; RSD Recovery Team, 2005).

Given its close proximity to Lake Ontario, it is possible to find lake-dwelling species such as smallmouth bass within this branch. Warm-water fish such as minnows, and suckers are likely present year-round, while cold/cool-water fish such as salmon and trout use this branch for spawning and as rearing habitat for their young. The presence of Young of Year (YOY) trout indicates that this area is important spawning and rearing habitat.

'Heber Down subwatershed of Lynde Creek supports a diverse fish community of 22 species from 9 families'

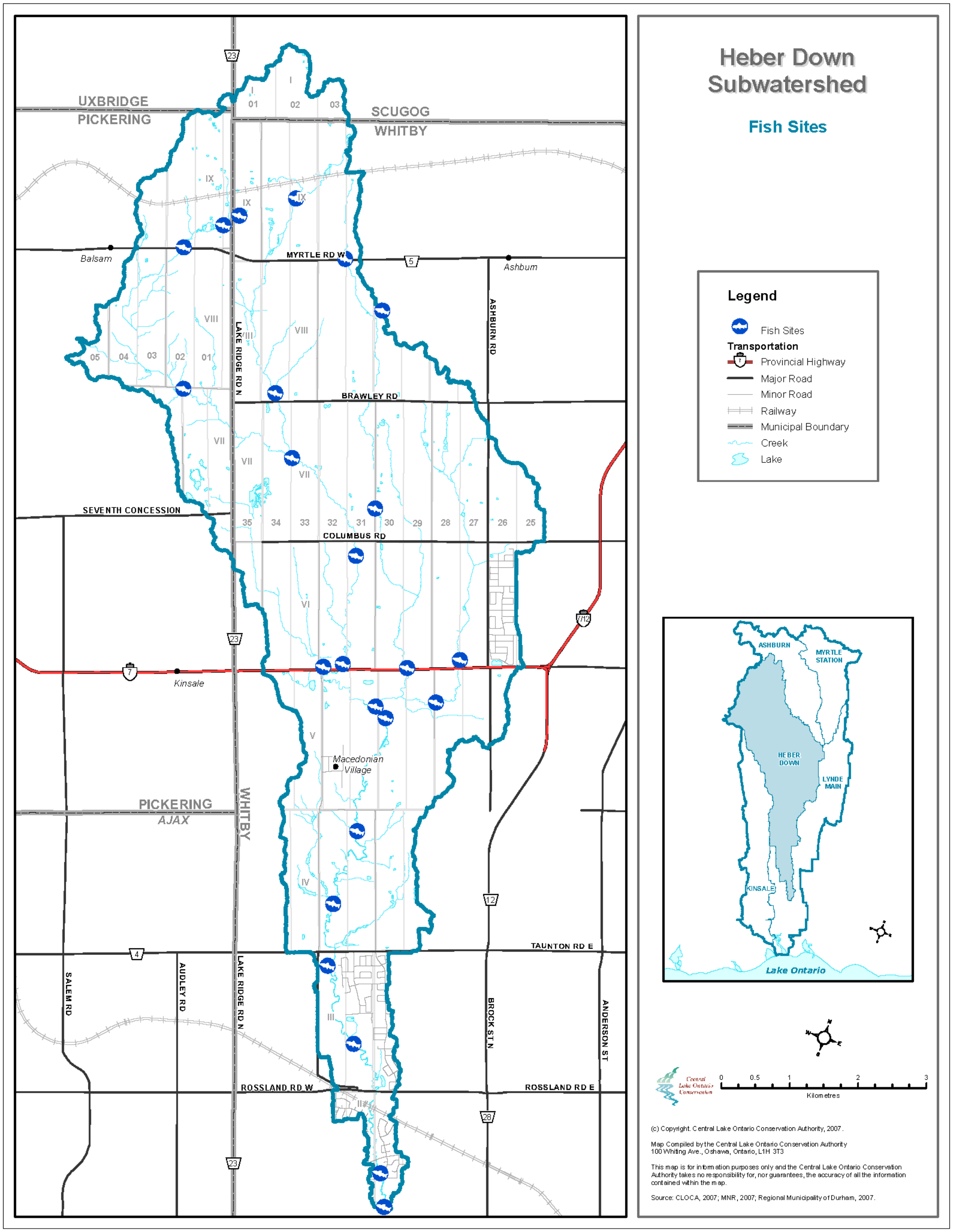


Figure 14: Location of fish sampling sites from the 2001 aquatic monitoring program in the Heber Down subwatershed.

4.2.3 Kinsale Subwatershed

4.2.3.1 Aquatic Habitat

Strahler Stream Order

The Kinsale subwatershed is a low-order stream system (Table 10 and Figure 15). Lower order streams (1 to 3) are more susceptible to habitat degradation from environmental impacts and may be more susceptible to environmental change (EC, 2004). The entire Kinsale subwatershed is comprised of first to third-order streams (100%).

Table 10: Kinsale subwatershed Strahler Stream Order.
Total stream length (km) and proportion of the total stream length (in parenthesis) by stream-order of the subwatershed (values calculated from the 2002 CLOCA drainage layer).

Strahler Stream Order					**Grand Total**
1	2	3	4	5	
45.52	15.89	7.50	0.00	0.00	68.91
(66%)	(23%)	(11%)	(0%)	(0%)	

'the Kinsale subwatershed is a low-order stream system'

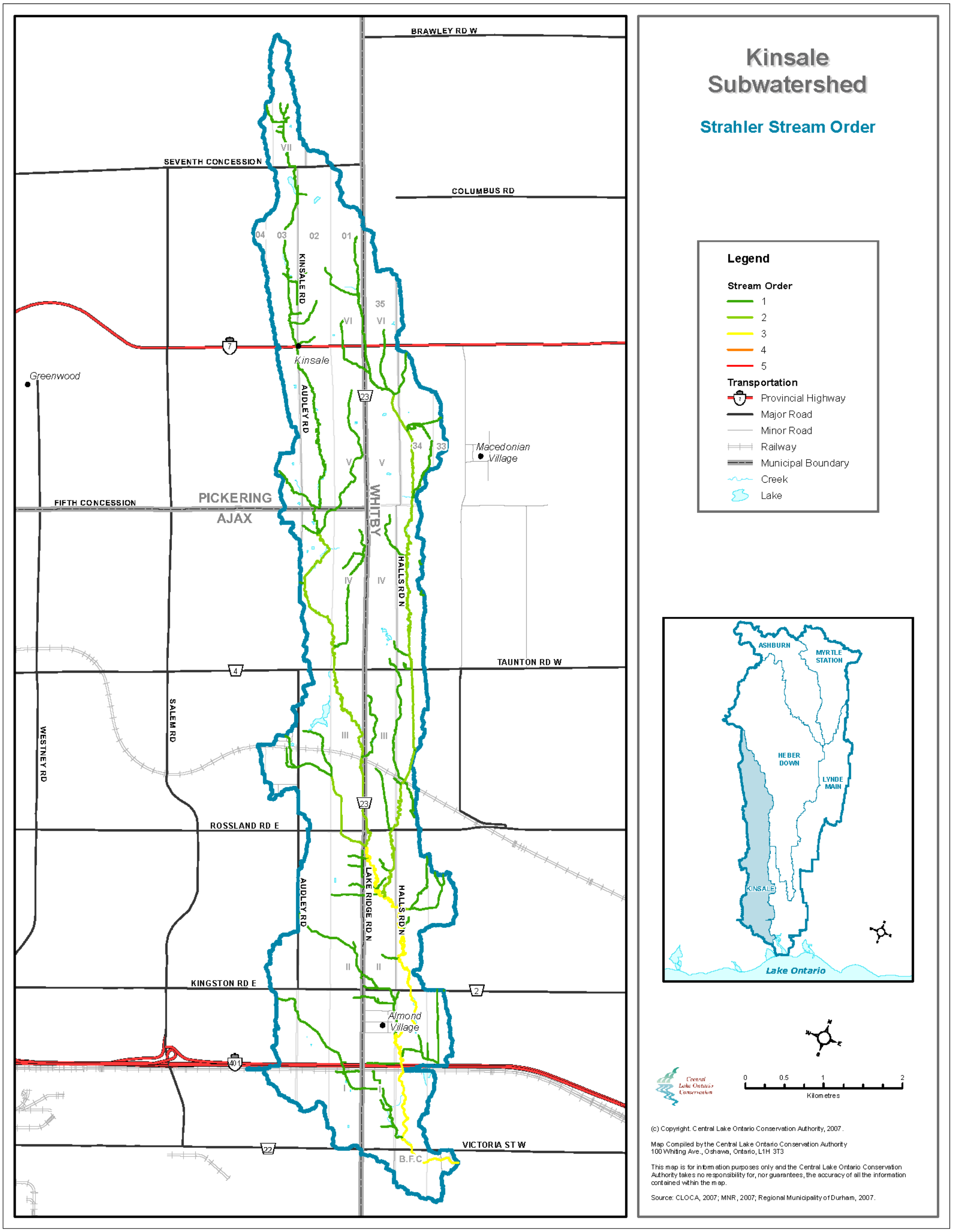


Figure 15: Strahler Stream Order for watercourses in the Kinsale subwatershed.

Instream Barriers

Instream barriers within the Kinsale subwatershed were assessed based on the obstruction of fish movement of migratory species. Currently, there are no known instream barriers within the subwatershed.

Riparian Vegetation

Riparian vegetation cover in the Kinsale subwatershed falls short of the EC guidelines (EC, 2004) as only 38% of the entire stream length has 30m riparian buffers (Table 11).

By stream-order, the proportion of riparian cover is greatest along third (60%) and second-order (45%) streams, and lower along first-order (32%) streams. Riparian cover is especially important for low-order streams; however, only 38% of the total stream length of first to third-order streams has adequate riparian buffers.

'Environment Canada guidelines (EC, 2004) indicate that 75% of stream length should have 30m riparian vegetation buffers on each side of the stream'

Table 11: Status of riparian vegetation in the Kinsale subwatershed.
Total stream length with 30m riparian cover (km) and percent of total stream length with cover (in parenthesis) by stream-order. Highlighted columns represent lower order streams which benefit greatly from riparian cover and may be given priority when determining areas for restoration.

Strahler Stream Order					**Grand Total**
1	2	3	4	5	
14.36	7.18	4.51	0.00	0.00	26.04
(32%)	(45%)	(60%)	(0%)	(0%)	(38%)

Landscape Influences

The entire subwatershed has 38% riparian cover (the highest proportion of any Lynde Creek subwatershed), first-order streams have only 32%. The dominant land use/land cover types within the subwatershed are agriculture (66%), urban development (15%), and forest (13%). All watercourses within the Kinsale subwatershed have moderate LDI ratings (Figure 16). The surrounding urbanization, intensive agriculture and insufficient riparian cover are likely contributing factors to the poor water quality found within this subwatershed. Furthermore, with the dominance of agricultural land and very little natural land cover within this subwatershed, it may be necessary to have greater than 75% of the stream length with riparian cover, and/or greater than 30m wide buffers (EC 2004).

'all watercourses within the Kinsale subwatershed have moderate LDI ratings'

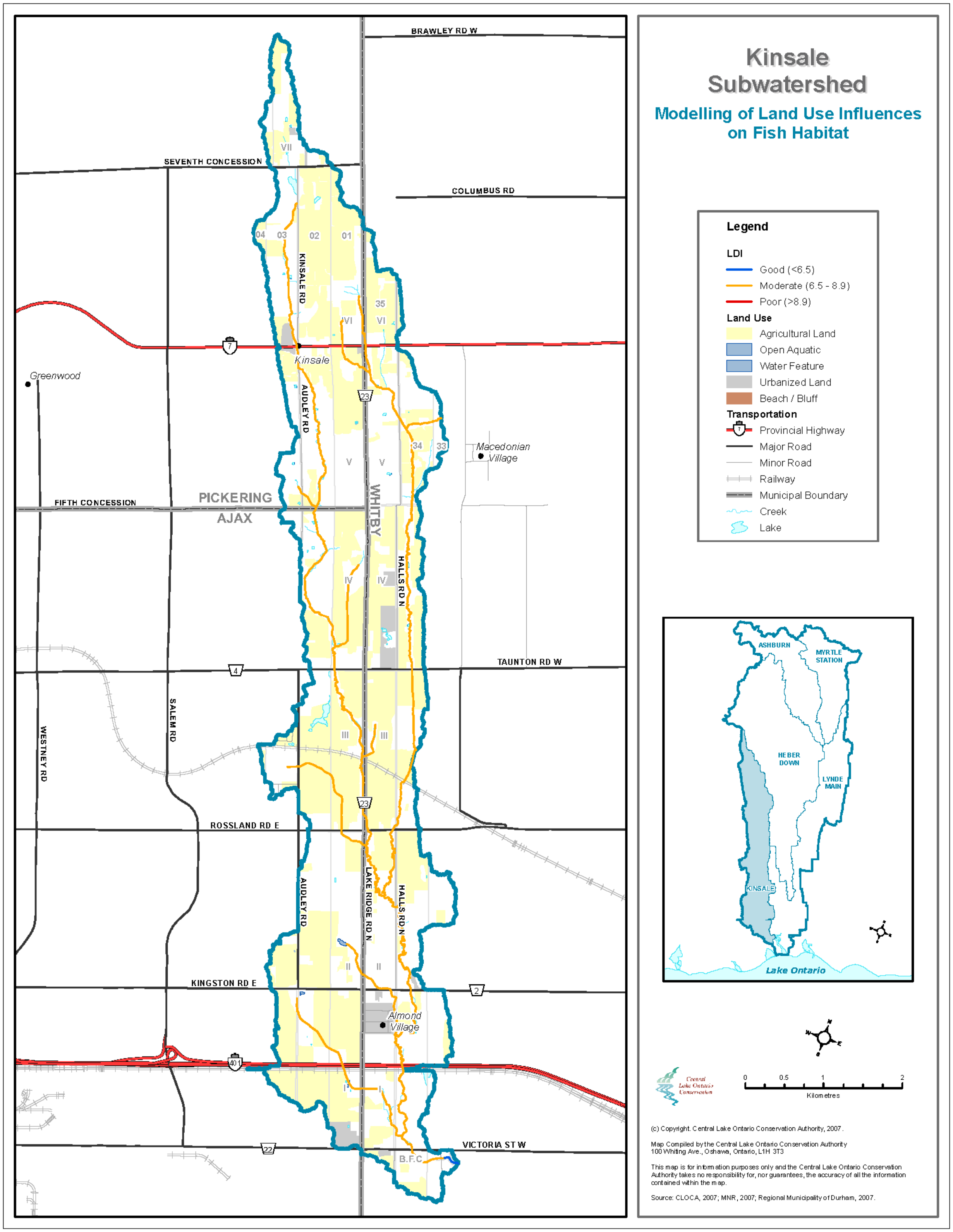


Figure 16: Land Disturbance Index (LDI) for Kinsale subwatershed.

4.2.3.2 Fisheries

Figure 17 depicts the fish sampling sites as part of the 2001 aquatic monitoring program within the subwatershed. The Kinsale subwatershed supports a fish community of 8 species from 4 families, which are representative of both cold/cool and warm-water fish (CLOCA, 2006; CLOCA/MNR, 2007). The moderate fish species diversity in the Kinsale subwatershed is typical of most low order stream systems. Unlike other first and second-order streams within Lynde Creek, trout species are lacking from this subwatershed. The absence of salmonids within the Kinsale subwatershed may be due to a number of factors linked to habitat degradation, including insufficient water quantity. Residents of this subwatershed have reported historical presence of salmonids, possibly brook trout.

'the absence of salmonids within the Kinsale subwatershed may be due to a number of factors linked to habitat degradation, including insufficient water quantity'

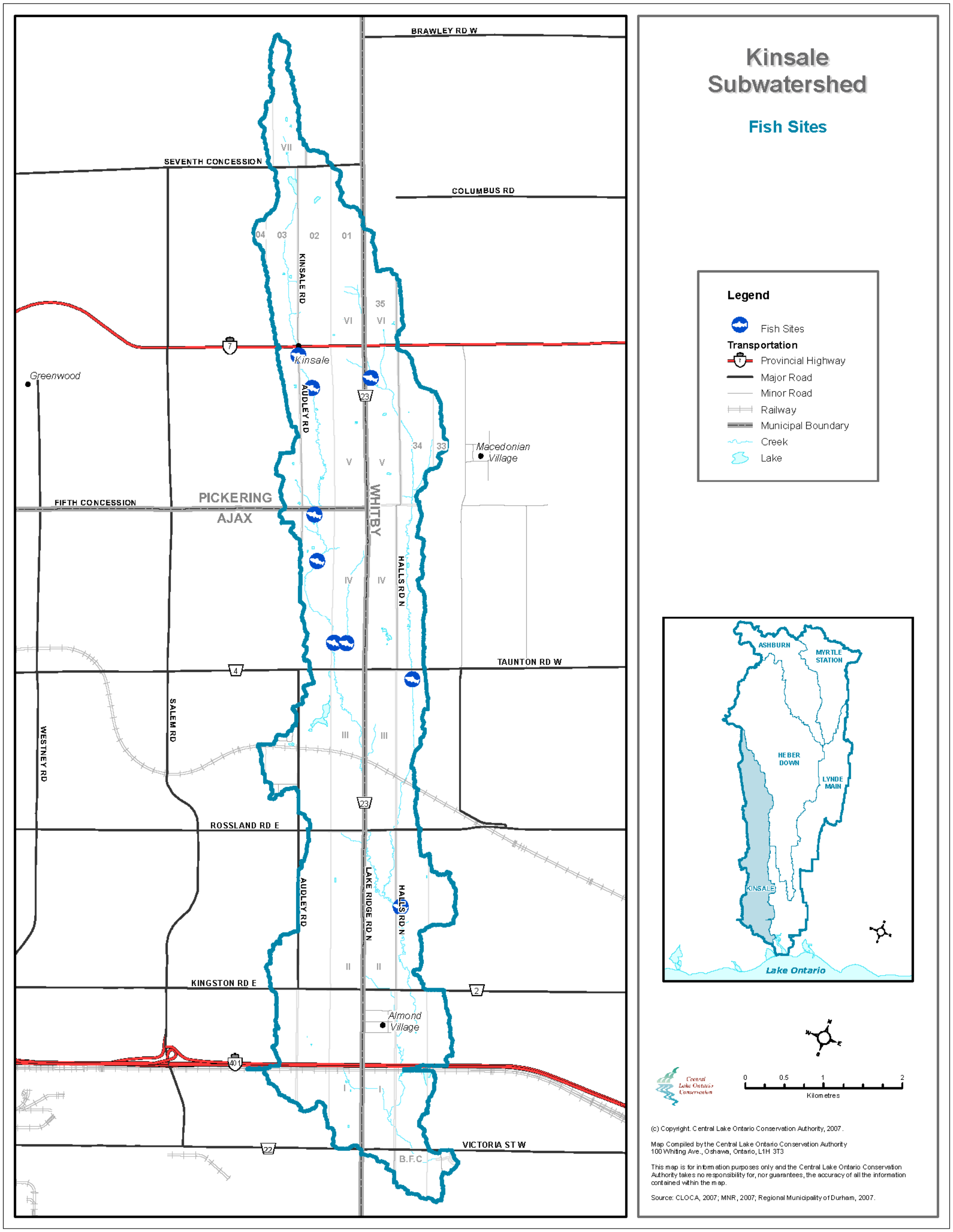


Figure 17: Location of fish sampling sites from the 2001 aquatic monitoring program in the Kinsale subwatershed.

4.2.4 Ashburn Subwatershed

4.2.4.1 Aquatic Habitat

Strahler Stream Order

The Ashburn subwatershed is a low-order stream system (Table 12 and Figure 18). Lower order streams (1 to 3) are more susceptible to habitat degradation from environmental impacts; therefore, subwatersheds that have a large proportion of low-order streams may be more susceptible to environmental change (EC, 2004). The entire Ashburn subwatershed is comprised of first to third-order streams (100%).

Table 12: Ashburn subwatershed Strahler Stream Order.
Total stream length (km) and proportion of the total stream length (in parenthesis) by stream-order of the subwatershed (values calculated from the 2002 CLOCA drainage layer).

Strahler Stream Order					**Grand Total**
1	2	3	4	5	
25.27	9.76	3.18	0.00	0.00	38.21
(66%)	(26%)	(8%)	(0%)	(0%)	

'the Ashburn subwatershed is a low-order stream system'

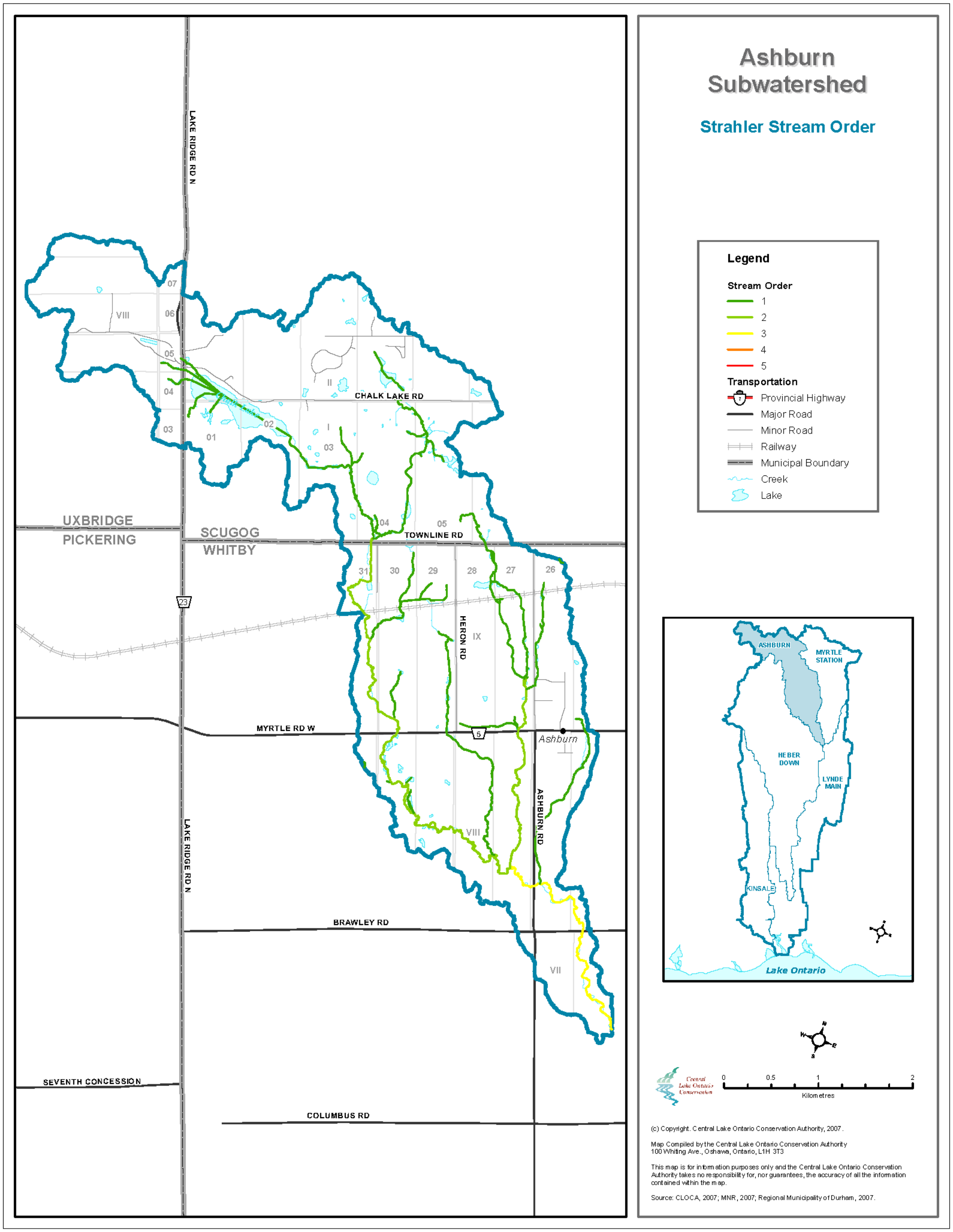


Figure 18: Strahler Stream Order for watercourses in the Ashburn subwatershed.

Instream Barriers

Instream barriers within the Ashburn subwatershed were assessed based on the obstruction of fish movement of migratory species. There are six potential barriers within the subwatershed (Figure 19). Currently, there are 2 known instream barriers within the subwatershed that were inventoried. These barriers are summarized in Table 13 and a description of each is provided. Though not inventoried, various details regarding the Muirhead Berm are known and as such, this berm is noted in Table 13 and a brief description is also provided.

Table 13: Known instream barriers in the Ashburn Subwatershed.
Fish passage indicates whether fish can move through the barrier to access upstream habitats (Salmonids indicates that only jumping species of salmon and trout can pass over the barrier).

Obstruction	Type	Year Built	Status	Fish Passage
Ashton Berm	Dam	1920's	Active	Not Passable
McIntosh Berm	Dam	1900's	Active	Not Passable
Muirhead Berm	Unknown	Unknown	Active	Undetermined

Ashton Berm

The Ashton berm was originally built in the 1920's to create a pond for irrigation and livestock watering. The pond is located approximately 400m upstream from the McIntosh Berm and 750m downstream from Chalk Lake. As a result, the pond shares many of the same species as the lake including largemouth bass (see Section 4.2.4.2). The pond is regulated by a top draw outlet structure that is approximately 1.5m higher than the creek.

'there are six potential barriers within the subwatershed'

McIntosh Berm

The McIntosh berm was originally built in the early 1900's to create a pond for irrigation and livestock watering. The pond incorporated a top-draw outlet structure within the berm which is approximately 2m above creek elevation. The McIntosh berm restricts access to approximately 800m of creek.

Muirhead Berm

The Muirhead berm is approximately 5m higher than the creek elevation and was built to create a pond for recreational purposes in the 1970's. The Muirhead family has indicated that the bottom-draw pond has been stocked with rainbow trout, but the success of the stocking in unknown. This berm currently restricts access to approximately 1.5 km of creek.

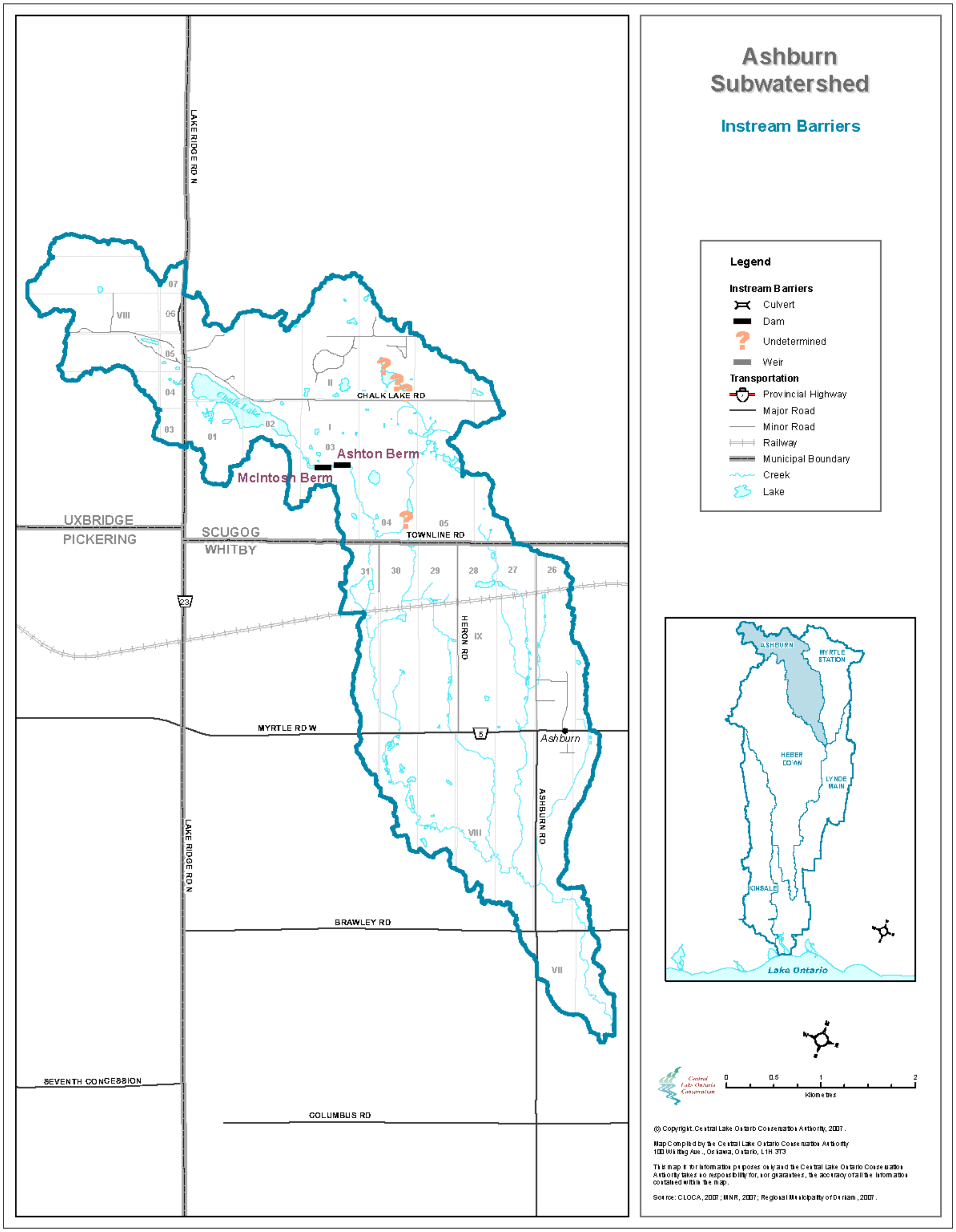


Figure 19: Location of known instream barriers to fish migration, and transport of sediment and large woody material in the Ashburn subwatershed.

Riparian Vegetation

Riparian vegetation cover in the Ashburn subwatershed falls short of the EC guidelines (EC, 2004) as only 29% of the entire stream length has 30m riparian buffers (Table 14).

By stream-order, the proportion of riparian cover is greatest along third (72%), and lower along first (22%), and third-order (32%) streams. Riparian cover is especially important for low-order streams, which are more affected by environmental change than large-order streams (EC, 2004); however, only 29% of the total stream length of first to third-order streams has adequate riparian buffers.

'Environment Canada guidelines (EC, 2004) indicate that 75% of stream length should have 30m riparian vegetation buffers on each side of the stream'

Table 14: Status of riparian vegetation in the Ashburn subwatershed.
Total stream length with 30m riparian cover (km) and percent of total stream length with cover (in parenthesis) by stream-order. Highlighted columns represent lower order streams which benefit greatly from riparian cover and may be given priority when determining areas for restoration.

Strahler Stream Order					**Grand Total**
1	2	3	4	5	
5.52	3.11	2.30	0.00	0.00	10.93
(22%)	(32%)	(72%)	(0%)	(0%)	(29%)

Landscape Influences

The subwatershed only has 29% riparian cover, with the first-order streams having only 22% cover. The subwatershed is dominated by agricultural land uses (42%) with a relatively large proportion of forest cover (29%); which comes close to meeting the Environment Canada recommendation of 30% as a minimum (EC, 2004).

Land Disturbance Index values in the Ashburn subwatershed (Figure 20) range from good (<6.5) in the northernmost reaches to moderate (6.5-8.9) in the lower reaches. Factors contributing to the above average ratings in the northernmost reaches likely include higher than average forest cover (the highest proportion of all subwatersheds) and moderate wetland cover (8.2%) and moderate proportion of urbanized land (16.4%) and possibly differing geology.

'Land Disturbance Index values in the Ashburn subwatershed range from good (<6.5) in the northernmost reaches to moderate (6.5-8.9) in the lower reaches'


Land Use in the Ashburn Subwatershed ***© CLOCA***

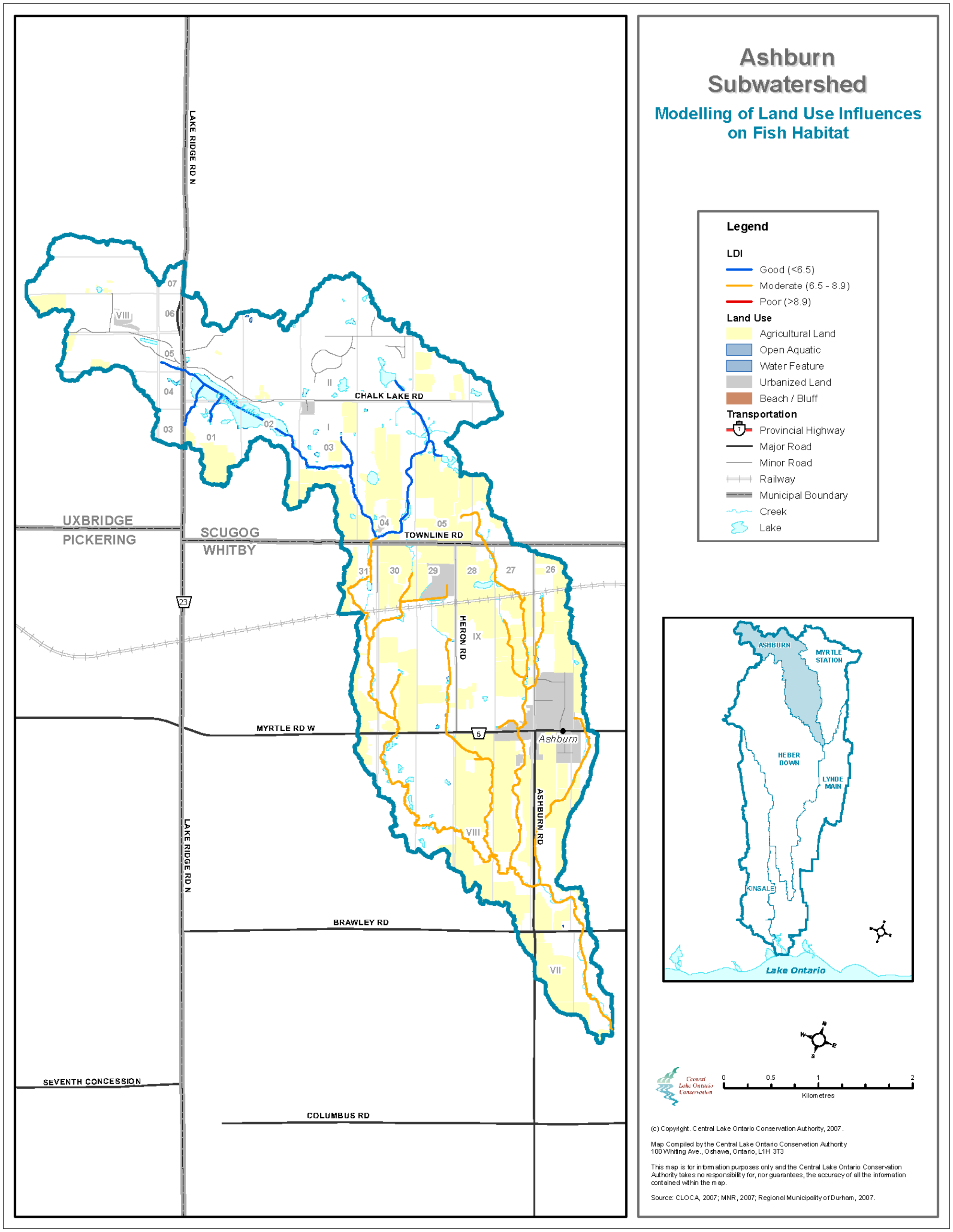


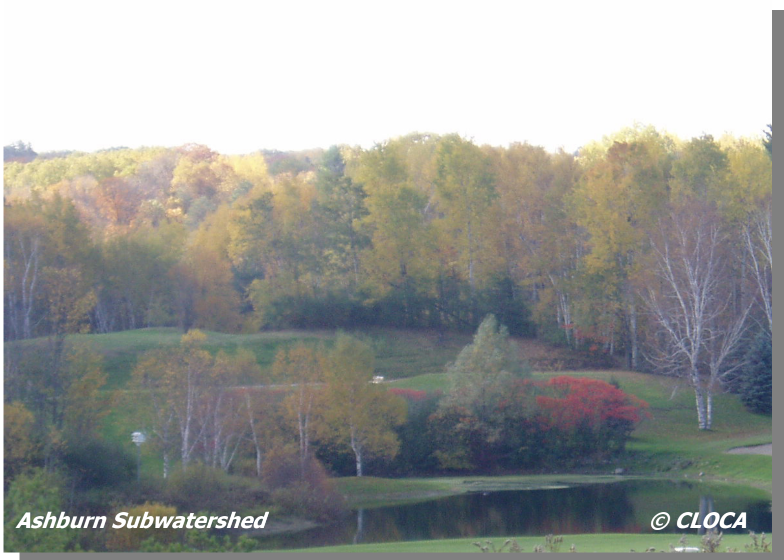
Figure 20: Land Disturbance Index (LDI) for the Ashburn subwatershed.

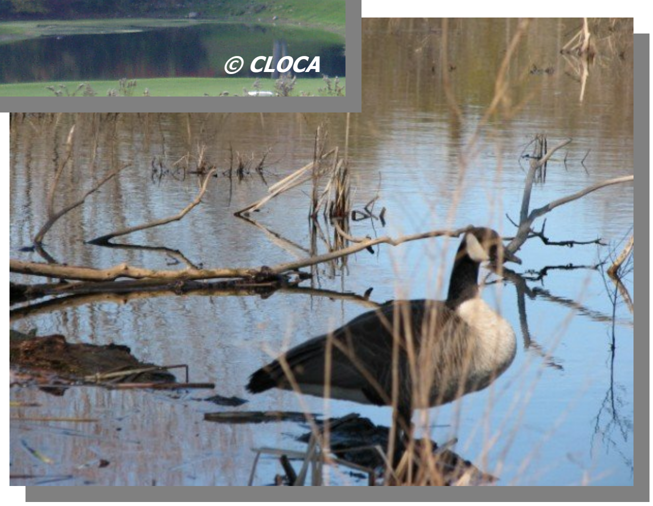
4.2.4.2 Fisheries

Figure 21 depicts the fish sampling sites as part of the 2001 aquatic monitoring program within the subwatershed. The Ashburn subwatershed has a diverse fish community of 13 species, representing 7 families (CLOCA, 2006; CLOCA/MNR, 2007). Fish species caught in the creek are representative of a low stream-order system and is typical of trout streams with primarily cold/cool-water fish (trout, stickleback, white sucker and sculpin) with the presence of warm-water species (fathead and bluntnose minnows and pumpkinseed). Redside dace, a species of concern federally and a provincially threatened species are also found within the Ashburn subwatershed. Redside dace is very sensitive to habitat changes, in particular changes to water temperature and turbidity. It has been found that in the Greater Toronto Area, the availability of suitable habitat has declined significantly as a result of increased land development (Holm and Crossman, 1986; RSD Recovery Team, 2005).

Chalk Lake is found within the headwaters of this subwatershed. Historical information for this kettle lake shows that rainbow trout, white sucker, creek chub, northern redbelly dace, bluntnose minnow, fathead minnow, pumpkinseed, Iowa darter and brook stickleback were once present (ODERM, 1964). While many of these species are likely still present, more recent sampling and anecdotal information suggests that largemouth bass and northern pike may also be present and trout are likely scarce (CLOCA, 2006).

'historical information for this kettle lake shows that rainbow trout, white sucker, creek chub, northern redbelly dace, bluntnose minnow, fathead minnow, pumpkinseed, Iowa darter and brook stickleback were once present (ODERM 1964)'





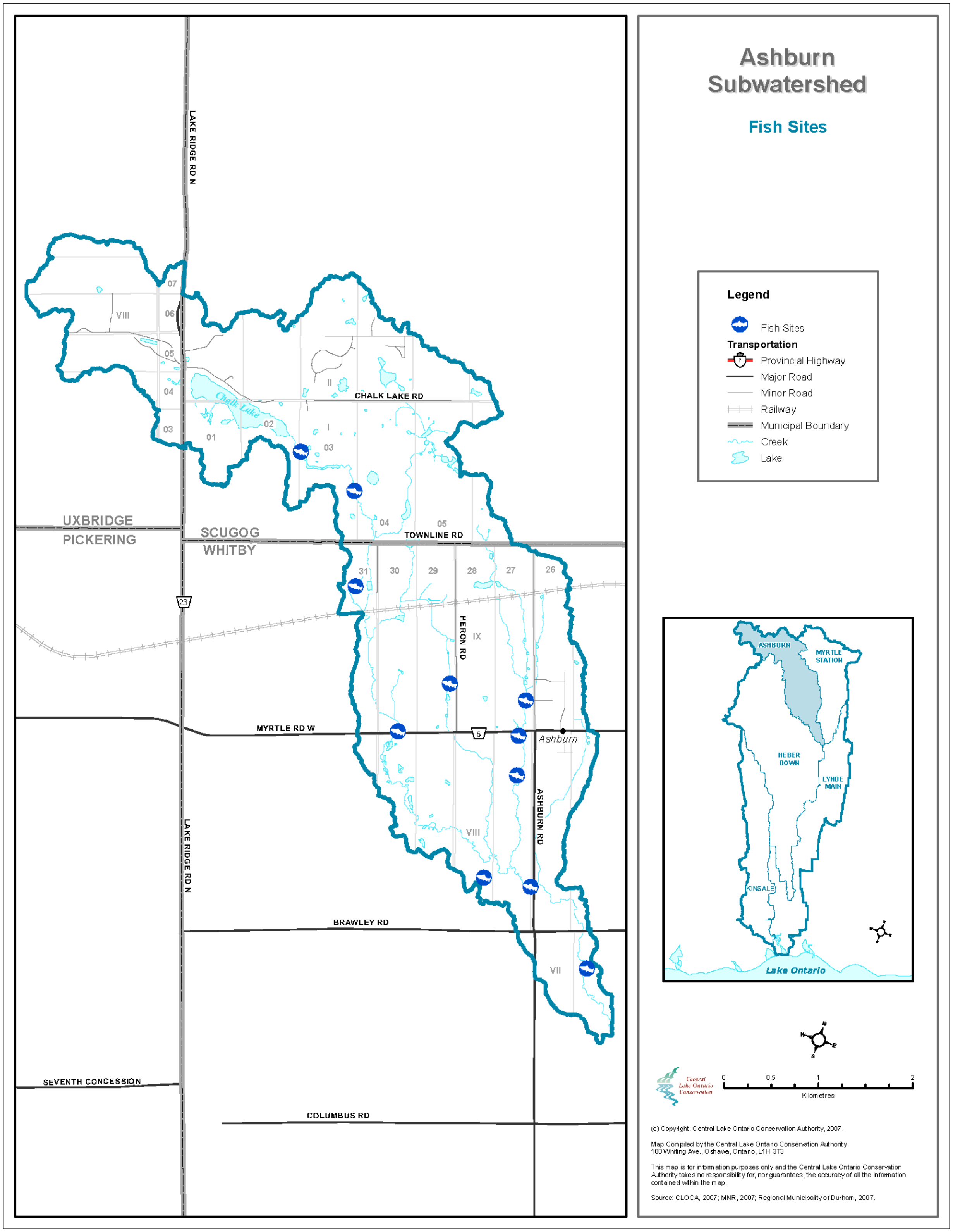


Figure 21: Location of fish sampling sites from the 2001 aquatic monitoring program in the Ashburn subwatershed.

4.2.5 Myrtle Station Subwatershed

4.2.5.1 Aquatic Habitat

Strahler Stream Order

The Myrtle Station subwatershed is a low-order stream system (Table 15 and Figure 22). Lower order streams (1 to 3) are more susceptible to habitat degradation from environmental impacts; therefore, subwatersheds that have a large proportion of low-order streams may be more susceptible to environmental change (EC, 2004). The entire subwatershed is comprised of first to third-order streams (100%).

Table 15: Myrtle Station subwatershed Strahler Stream Order.
Total stream length (km) and proportion of the total stream length (in parenthesis) by stream-order of the subwatershed (values calculated from the 2002 CLOCA drainage layer).

Strahler Stream Order					Grand Total
1	2	3	4	5	
29.42	5.61	3.38	0.00	0.00	38.41
(77%)	(15%)	(9%)	(0%)	(0%)	

'the Myrtle Station subwatershed is a low-order stream system'

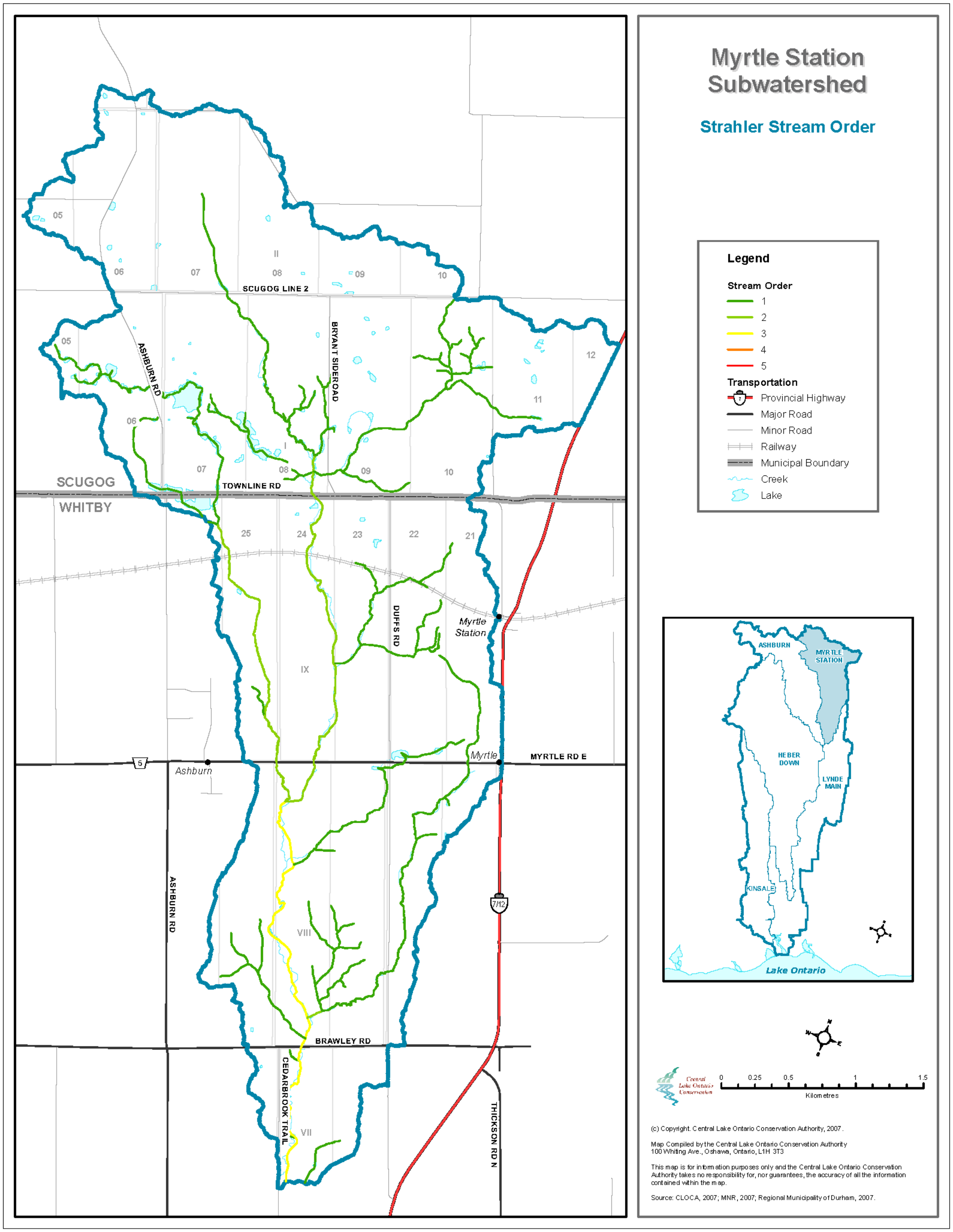


Figure 22: Strahler Stream Order for watercourses in the Myrtle Station subwatershed.

Instream Barriers

Instream barriers within the Myrtle Station subwatershed were assessed based on the obstruction of fish movement of migratory species. There are 5 potential barriers within the subwatershed (Figure 23). There is 1 instream barrier within the subwatershed that has been inventoried which is summarized in Table 16 and a description is provided.

While there are 5 potential instream barriers in the Myrtle Station subwatershed, for the most part, their status with respect to the passage of fish is unknown. The Bryant Sideline culvert in the mid-reaches of the subwatershed is considered a barrier to fish species. Further investigation into the passability of the other potential barriers is necessary in order to draw any conclusions on the distribution of salmonids in relation to barriers to migration.

Table 16: Known instream barriers in the Myrtle Station subwatershed.
Fish passage indicates whether fish can move through the barrier to access upstream habitats (Salmonids indicates that only jumping species of salmon and trout can pass over the barrier).

Obstruction	Type	Year Built	Status	Fish Passage
Bryant Sideline Culvert	Culvert	Unknown	Active	Not Passable

<u>Bryant Sideline Culvert</u>

The Bryant Sideline culvert is a corrugated steel culvert with concrete sections added. All sections are in ill repair and have separated from one another. The upstream corrugated steel section has failed and has slumped into the creek and the most downstream concrete section has been undermined and does not carry flow throughout most of the year. This culvert currently restricts access to approximately 2km of creek.

'while there are 5 potential instream barriers in the Myrtle Station subwatershed, for the most part, their status with respect to the passage of fish is unknown'

Section of Bryant Sideline Culvert © CLOCA

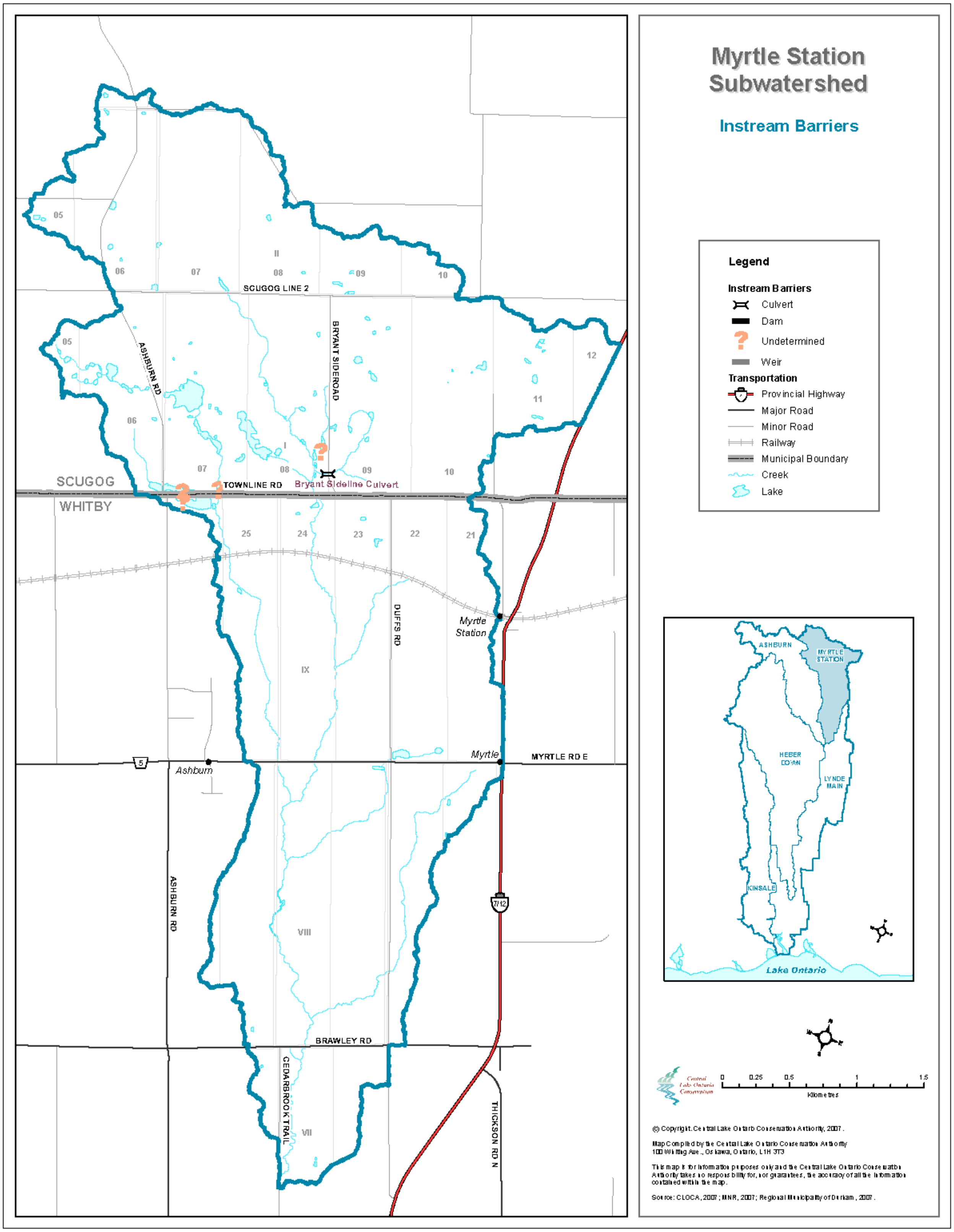


Figure 23: Location of known instream barriers to fish migration, and transport of sediment and large woody material in the Myrtle Station subwatershed.

Riparian Vegetation

Riparian vegetation cover in the Myrtle station subwatershed falls short of the EC guidelines (EC, 2004) as only 35% of the entire stream length has 30m riparian buffers (Table 17).

By stream-order, the proportion of riparian cover is greatest along third (96%) and second-order (58%) streams, and lowest along first (23%). Riparian cover is especially important for low-order streams, which are more affected by environmental change than large-order streams (EC 2004); however, only 35% of the total stream length of first to third-order streams has adequate riparian buffers.

'Environment Canada guidelines (EC, 2004) indicate that 75% of stream length should have 30m riparian vegetation buffers on each side of the stream'

Table 17: Status of riparian vegetation in the Myrtle Station subwatershed.
Total stream length with 30m riparian cover (km) and percent of total stream length with cover (in parenthesis) by stream-order. Highlighted columns represent lower order streams which benefit greatly from riparian cover and may be given priority when determining areas for restoration.

Strahler Stream Order					Grand Total
1	2	3	4	5	
6.85	3.26	3.23	0.00	0.00	13.33
(23%)	(58%)	(96%)	(0%)	(0%)	(35%)

Landscape Influences

The entire subwatershed has 35% riparian cover (the second highest proportion of any Lynde Creek subwatershed); while first-order streams have only 23% cover. The dominant land use/land cover types within the subwatershed are agriculture (59%), forest (17%) and urban development (9%). All watercourses within the Myrtle Station subwatershed have moderate LDI values (Figure 24). Factors contributing to the moderate ratings are likely insufficient riparian cover, presence of instream barriers and dominance of agricultural and urban land uses.

'all watercourses within the Myrtle Station subwatershed have moderate LDI values'

Various Land Uses in the Lynde Creek Watershed

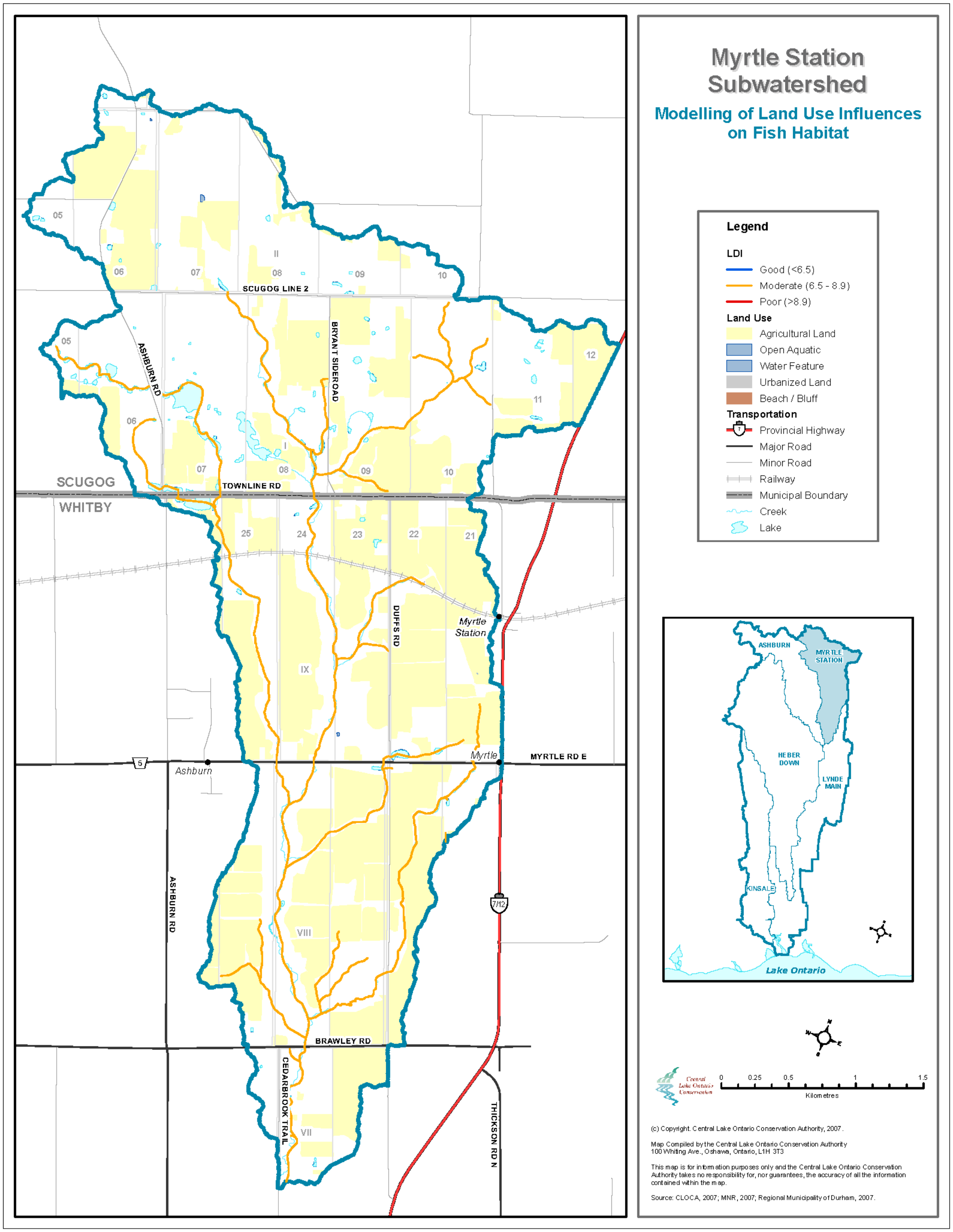


Figure 24: Land Disturbance Index (LDI) for Myrtle Station subwatershed.

4.2.5.2 Fisheries

Figure 25 depicts the fish sampling sites as part of the 2001 aquatic monitoring program within the subwatershed. The Myrtle Station subwatershed has a very diverse cold/cool-water fish community of 14 species from 8 families (CLOCA, 2006; CLOCA/MNR, 2007). Fish species caught in the creek are representative of cool and cold-water fish typical of low stream-order trout streams (sucker, sculpin, dace and trout; Moyle and Cech, 2000) in addition to warm-water fish. Redside dace, a species of concern federally and a provincially threatened species are found in this subwatershed. Redside dace is very sensitive to habitat changes, in particular changes to water temperature and turbidity. It has been found that in the Greater Toronto Area, the availability of suitable habitat has declined significantly as a result of increased land development (Holm and Crossman, 1986; RSD Recovery Team, 2005).

'the Myrtle Station subwatershed has a very diverse cold/cool-water fish community of 14 species from 8 families'

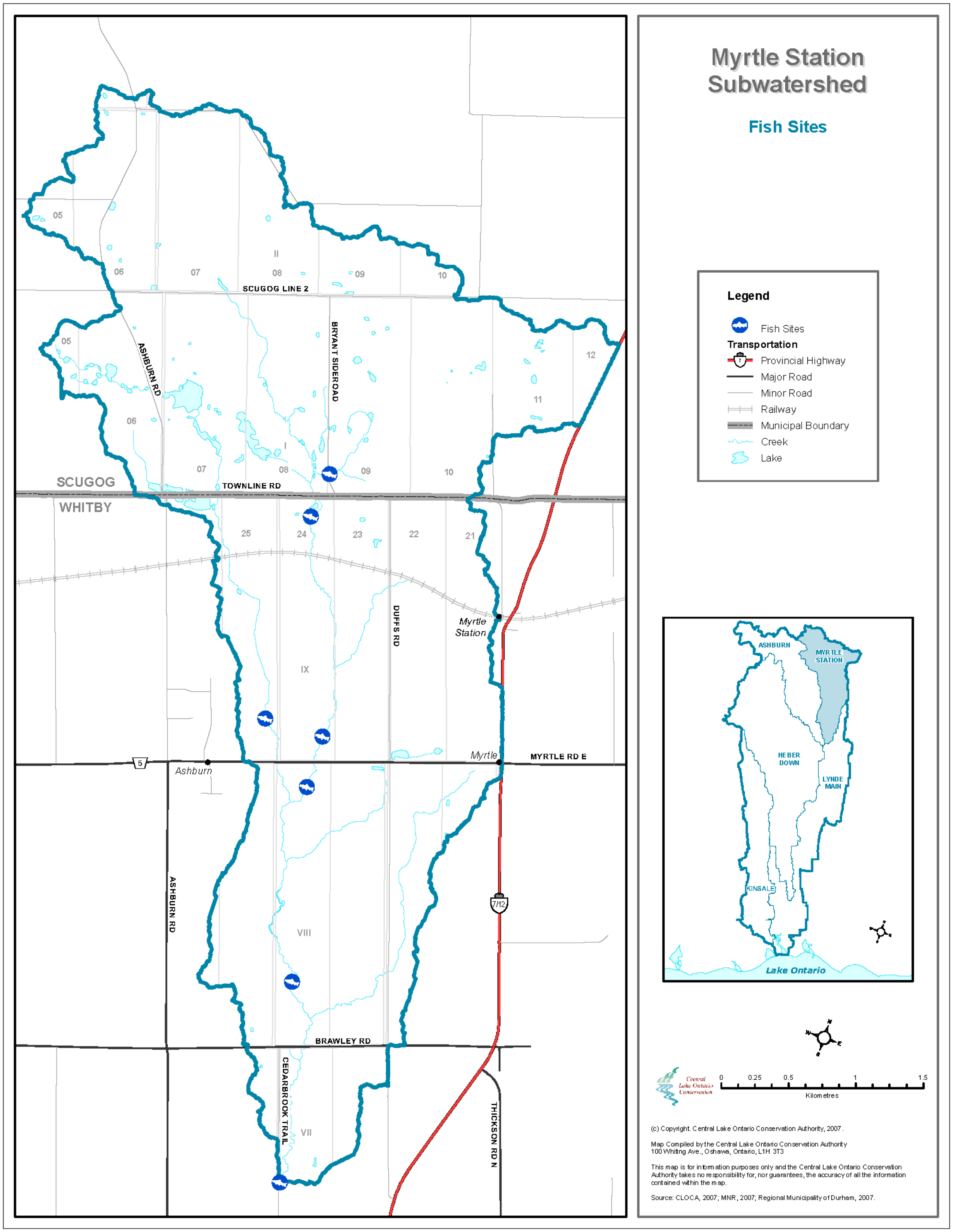


Figure 25: Location of fish sampling sites from the 2001 aquatic monitoring program in the Myrtle Station subwatershed.

5.0 CONCLUSIONS

The fisheries and aquatic habitat of Lynde Creek and its tributaries face many environmental stressors including impacts from alternative land uses (e.g. urbanization and intensive agriculture). This is manifested through water quality degradation, increased stream temperatures and ultimately impacts to aquatic life. While the watershed has its challenges, it still supports healthy fisheries including brook trout and rainbow trout populations, and the provincially and federally designated species at risk, redside dace.

6.0 REFERENCES

'fisheries and aquatic habitat of Lynde Creek and its tributaries face many environmental stressors'

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7.0 GLOSSARY ADDITIONS

Anadromous

Refers to an organism that lives in the sea as an adult and returns to fresh water to spawn in the spring. May also refer to organisms that live in lakes and returns to creeks/tributaries to spawn.

BioMAP

A measure of environmental stress (biological water quality) using tolerance values developed for Southern Ontario

Biomass
The total weight of organisms per unit area at any given moment in time.

Extirpated
Any indigenous species no longer existing in the wild in a particular location but existing elsewhere.

Fish
Section 2 of the Federal Fisheries Act defines fish to include "parts of fish, shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, and the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals".

Fish Habitat
Section 34(1) of the Federal Fisheries Act defines fish habitat as "spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly to carry out their life processes".

Hilsenhoff Biotic Index (HBI)
A qualitative measure of water quality using tolerance values to weigh abundance in an estimate of organic pollution

Invasive species
Alien species (species that have been moved from an area to which they were native to areas where they did not naturally live and evolve, either intentionally or unintentionally) whose introduction and spread threatens the environment and the economy.

Riparian
Terrestrial areas bordering aquatic zones showing an influence of water that is not normally found in adjacent uplands.

Species at Risk (SAR)
Species that are at risk of extinction, extirpation or endangerment globally or within a jurisdiction or region.

Threatened
Any species that is likely to become an endangered species within the foreseeable fixture throughout all or a significant portion of its range.