AQUATIC MONITORING PROGRAM
2009 to 2013

Central Lake Ontario Conservation Authority

DURHAM REGION

Central Lake Ontario Conservation

"What we do on the land is mirrored in the water."

AQUATIC MONITORING PROGRAM
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1.0 Introduction

In order to make sound, science-based management decisions about local **watersheds**, the Central Lake Ontario Conservation Authority (CLOCA) conducts long-term watershed health monitoring. This information helps CLOCA understand current conditions, identify ecological trends, provides a strong basis to measure the effectiveness of stewardship activities and also provides guidance in making informed land-use decisions. Typical components of the watershed are monitored: aquatic habitat (e.g. habitat assessments and temperature monitoring); fish and benthic macroinvertebrates (benthos); terrestrial habitat (e.g. riparian and tableland vegetation , wildlife); and, water quality and quantity of both surface water and groundwater. This report focuses on the Aquatic Monitoring Program, specifically Fisheries, Biological Water Quality and Stream Temperature.

To ensure that monitoring is done using standardized protocols, whenever possible, CLOCA participates in national, provincial or municipal networks. Our partners include Environment Canada (EC), Fisheries and Oceans Canada (DFO), Ministry of Environment (MOE), Ministry of Natural Resources (MNR) and other Conservation Authorities.

Located east of Toronto within the Region of Durham (Figure 1), the Authority's jurisdiction encompasses 638 square kilometres and is defined by the area drained by fifteen watersheds (Figure 2). Local municipalities located within the jurisdiction, in whole or in part, include the cities of Oshawa and Pickering, the towns of Ajax and Whitby, the Municipality of Clarington, the townships of Scugog and Uxbridge.

Figure 1. Location of CLOCA jurisdiction (highlighted in green).

A **watershed** is defined as an area drained by a river or creek and its tributaries.

Figure 2. CLOCA jurisdiction.

2.0 Spawning Survey

2.1 Introduction

Spawning surveys are a beneficial component when describing the health of a watershed. A spawning survey involves observing indicators of spawning, in a specific watershed. These indicators include: the presence of adult fish in a likely spawning area (e.g., rainbow trout), the occurrence of active spawning (e.g., fish present on redds) and signs that spawning has taken place (i.e., spawning depressions or **redds)**.

> **redd** - the gravel nest of salmonid fishes.

Sampling methods for capturing fish are sometimes not suitable for obtaining all data needed about a fishery. Many limiting factors may prevent a species of fish from reproducing successfully (producing young). These include poor water quality, migration barriers, temperature, water levels, illegal works etc. Spawning surveys provide useful information for identifying critical spawning habitat. This information is complimentary to standard fish community surveys.

"Not all fish species bury their eggs in substrate: some lay eggs on material, others broadcast their eggs into the water column. Salmonids, both true salmon and trout (*Salmo* and *Oncorhynchus*) as well as char (i.e. brook trout, *Salvelinus fontinalis*) build depressions in the bottom of streams and then lay their eggs into these depressions or redds." (Imhof, 1997).

Spawning locations are not evenly distributed within a watershed. Therefore, collecting information consistently over 3-5 years will identify where important reproduction areas exist and are consistently used by salmonid populations (Imhof, 1997).

Refer to Appendix 1 for monitoring schedule.

2.2 Methodology

2.2.1 Site Selection

Sampling units should be homogeneous to allow consistent monitoring over time. Units should be defined by either human features (e.g., road crossings, barriers) or natural attributes (e.g., changes in stream type, barriers) (Imhof, 1997).

2.2.2 Equipment

Field data sheets along with paper maps should be used to record spawning information. A hand-held Global Positioning System (GPS) unit should be used to record location information in NAD 83 datum (Location Information). A list of needed equipment is below:

- Field data sheets
- Hand-held GPS
- Waders
- Digital camera
- Pencils (2-HB, other types do not scan well)

2.2.3 Survey

As mentioned previously, surveyors are looking for the presence of adults, active spawning and signs that spawning has taken place, so it is recommended that spawning surveys be conducted near the end of the spawning period. Surveys should not continue more than one month after spawning begins because redd scars will begin to fade and identification will become difficult (e.g., due to algae growth) (Imhof, 1997).

Table 1. Salmonid spawning periods for southern Ontario.

brown trout	mid-October to late November[1]
brook trout	late October to mid-December[1]
rainbow trout	mid-April to late June[2]
Chinook salmon	late September to early October[2]

[1] - Imhof, J. Salmonid Spawning Survey - Methodology.
[2] - Scott, W. B., and E. J. Crossman. 1973. Freshwater fishes of Canada. *Fish. Res. Bd. Canada Bull.* 184:184-191

Redds are unique to each salmonid species and therefore it can be difficult to distinguish between species. Also, there are various ways that a false redd can be created by factors such as uprooted vegetation. For more information on redd identification see (Imhof, 1997).

Sampling units should be sampled from start to finish so that temporal comparisons can be made.

Occasionally staff will observe spawning fish while conducting other fieldwork. These observations should be noted and later recorded on an official Spawning Survey field data sheet.

2.2.4 Resources Required

Ideally two people are required to conduct a spawning survey, with one person on each bank of the creek. If this is not practical and only one person conducts the survey it should be recorded on the field data sheet so that the reduced effort can be accounted for.

Due to the short sampling period that spawning surveys can be conducted; the participation of volunteers (e.g., fishing groups, fisherman, students etc.) may be required. This would require some staff time to provide training and organize survey routes.

2.2.5 Data

The MNR watershed map should be referenced for watershed code (Appendix 3)

Each season data will be entered into the Aquatic Database for long-term storage.

As mentioned, it takes several seasons of monitoring to get a complete picture of spawning activities in a watershed. Ideally, sampling units would be surveyed each year to detect change over time. The number of surveys conducted each year will depend on the amount of resources (i.e., surveyors) that are available.

Initially, data will be used mainly for plan review purposes. After data has been collected over a number of seasons it will be useful for other applications such as management planning and watershed reporting.

3.0 Stream Temperature

3.1 Introduction

Temperature is considered a controlling factor with respect to habitat suitability for fish. For species such as brook trout, summer stream temperature is considered the single most important factor influencing distributions (MacCrimmon and Campbell, 1969). CLOCA relies on quality stream temperature data for use in plan review, Watershed Management Plans, Aquatic Resource Management Plans, Fisheries Management Plans, etc.

Refer to Appendix 1 for monitoring schedule.

3.2 Methodology

3.2.1 Site Selection

Locations for temperature loggers will depend on the project or type of monitoring that is needed. Some small watersheds require long-term (indefinite) temperature monitoring (i.e., absence of permanent gauge station) and some watersheds require numerous loggers to compliment other aquatic sampling (i.e., Aquatic Resource Management Plan re-sampling). Stewardship project monitoring locations will be determined on an annual basis.

3.2.2 Equipment

Currently, CLOCA uses HOBO Water Temp Pro temperature loggers (Figure 3).

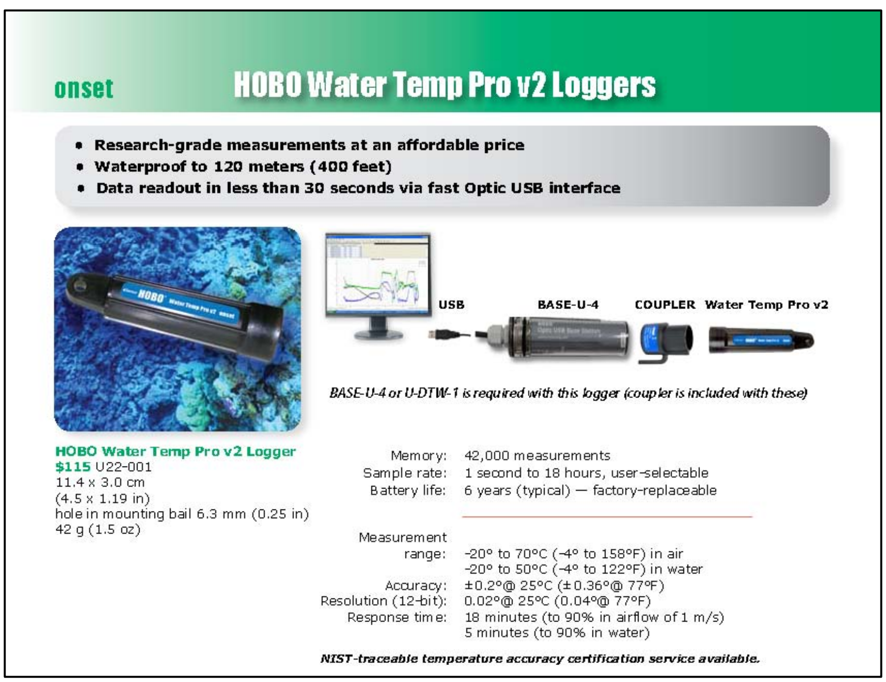

Figure 3. Attributes of water temperature logger model used by CLOCA.

Loggers are programmed by CLOCA to record water temperature every half-hour and at that frequency they will hold 400+ days worth of data. They should not be set to collect data on the hour, as there have been instances of data corruption when data is recorded exactly at midnight. Loggers should be set to record at one minute after the hour (e.g., use 13:01 rather than 13:00) (Ontario Ministry of Natural Resources, 2005). The battery in each logger will last approx. 5 years but this is dependent on the amount of use.

Installed loggers are secured to an approximately four-foot long section of t-bar using two plastic cables. Plastic cables only connect in one direction and their holding capacity will be compromised if they are reversed. A metal chopsaw (see CLOCA Health and Safety Manual) should be used to cut t-bar to the appropriate length needed. The t-bar is pounded into the creek bottom, with a post pounder or sledge hammer, leaving approximately four to six inches exposed. The attached logger should be placed as close to the creek bottom as possible to prevent it from being exposed to the air during low water conditions. Some thought should be given about the placement of the t-bar in regards to vandalism and theft. If possible, choose an area that is less likely to be found by a passer-by.

Collecting water temperature using portable loggers is divided into three events and this is essential as a quality control check:

1. **Installation** - When the logger is installed data is recorded about the location, logger serial number etc.
2. **Mid-season Status** – Locations that are thought to be vulnerable to out of water condition should be checked multiple times during mid-season when the creek is at base flow. This data is later compared to the temperature data that was collected to ensure that the logger was not out of the water.
3. **Retrieval** - When the logger is removed at the end of the season, data is recorded about the serial number (visible on the side of the logger), date, time, location information etc. This data is then used to cross reference with the data that is down loaded to ensure that no mistakes occurred, e.g. logger intended for Bowmanville Creek was installed in Tooley Creek.

Groundwater temperature is moderated by the sub-surface ground temperature. Depending on the amount of groundwater entering a stream it has the ability to moderate the stream temperature. If enough groundwater enters a stream it will have more of an influence than the air temperature and prevent the stream from freezing. Ideally, loggers should remain in the creek until the air temperature has dropped low enough to freeze sections of the creek. This allows data to be collected about groundwater influence and potential landuse issues such as the draining of swimming pools etc. For example: Site TLBOW03 is located within Long Sault Conservation Area in a section of headwater stream. The minimum temperature for 2005, 2006 and 2007 was approximately 4°C indicating that this coldwater location has a substantial amount of groundwater entering the stream. Also, during the fall swimming pools are drained and prepared for the winter season. This annual event has been known or suspected to increase stream water temperature in some watersheds.

It is expected that each season a few loggers will need to be replaced due to theft or malfunction.

3.2.3 Resources Required

A minimum of one person is required to install, check and retrieve a water temperature logger. All three components would take approximately three hours in total. Downloading and analyzing one logger takes approximately one hour.

3.2.4 Data

It should be noted that the interpretation of stream temperature data can be confusing due to overlapping terminology. Historically in Ontario only two thermal classification categories were used, coldwater and warmwater. In continuing with the fish community-based definition for coldwater stream as to be consistent with past usage and policy within OMNR, the definition of a coldwater stream is *a stream supporting or capable of supporting coldwater fishes* (Bowlby, 2008). Coldwater fishes include but are not limited to salmon and trout. Salmon and trout can be found in both coldwater and coolwater temperature zones and so these zones represent coldwater streams in the traditional sense (Bowlby, 2003).

Classification of stream temperature is divided into three categories: coldwater, coolwater and warmwater (Coker et al., 2001). The thermal classification for each site is determined by analyzing data summarized through the Stream Temperature Analysis Tool and Exchange (STATE), (Jones and Chu, 2007).

Air temperature data is also useful when analyzing stream water temperature. Air temperature data is collected by EC through Automated Weather Observation Systems at various locations, typically airports. Applicable sites to CLOCA include: Buttonville, Pearson, Peterborough and Toronto Island airports. CLOCA also collects air temperature data through gauge stations located throughout the jurisdiction. Data collected locally is preferable to data collected from a neighboring airport. Additionally, it is known that the air temperature at any given time will differ by a few degrees from the north part of the CLOCA jurisdiction to Lake Ontario.

Although single observation temperature data can be taken with a hand held thermometer "…when resources are available, continuous temperature data collected over a period of weeks or months will invariably provide a more accurate description of the stream's thermal regime." (Stoneman and Jones, 1996).

Fisheries and Oceans Canada (DFO) through Ontario-Great Lakes Area (OGLA) has developed various technical fact sheets including "How to Measure Temperature". When this fact sheet is available it will likely be added to this document.

4.0 Biological Water Quality

4.1 Introduction

CLOCA monitors surface water quality through both chemical and biological sampling. In general, sampling for chemical and physical parameters measures stressors (e.g., environmental contamination), whereas biological sampling measures ecological effects. Biological surveys involve sampling creatures, such as benthic macroinvertebrates ("aquatic bugs"; see photos below) and fish, found living within the aquatic environment. Benthic macroinvertebrates or benthos, make good health indicators of aquatic ecosystems for a number of reasons:

- they generally have limited mobility that makes them vulnerable to many creek stresses that may occur;
- they have short life cycles;
- they are easily collected and identified;
- they are relatively inexpensive to sample;
- and they exist almost everywhere (Ontario Benthos Biomonitoring Network, 2005).

Similar to other biological communities, certain species of invertebrates have specific tolerances to various stresses and are referred to as indicator species. Therefore, the presence or absence of these indicator species can be related to the quality of the water.

Refer to Appendix 1 for monitoring schedule.

4.2 BioMAP

In the past (1996-2004), CLOCA sampled benthos following two separate protocols. The primary protocol for assessing water quality was through BioMAP (Griffiths, 1998), see Table 2 for list of historical BioMAP sampling. The second protocol is part of the OSAP and is a coarse measure of water quality, which uses the Hilsenhoff Index.

4.3 Ontario Benthos Biomonitoring Network (OBBN)

In order to coordinate long-term monitoring efforts CLOCA is a partner in the OBBN coordinated by the Ontario Ministry of Environment and Environment Canada. This provincial network allows practitioners to follow a standardized methodology, share resources and receive technical support.

To test whether an aquatic system has been impaired by human activity, a reference condition approach (RCA) is used to compare benthos at "test sites" (where biological condition is in question) to benthos from multiple, minimally impacted "reference sites" (OBBN, 2005). It is not realistic to expect minimally impacted reference sites to be in pristine condition (i.e., pre-settlement). They should be minimally impacted by human pressures such as: agriculture, development, deforestation, water level regulation etc.

Table 2. List of historical BioMAP sampling from 1997 - 2004.

Watershed	1997		1998		1999		2000		2001	2002	2003	2004
	May	October	May	October	May	October	May	October				
Lynde Creek	4								14		4	3
Pringle Creek	6	2	2	2	2	2					1	1
Corbett Creek											2	
Oshawa Creek	7				17	17					3	3
Montgomery Creek					1	1						
Black Creek	2									4	1	
Harmony Creek										3	1	
Farewell Creek										4	1	
Robinson Creek												1
Tooley Creek	2											1
Darlington Creek												2
Westside Creek												
Bowmanville Creek			11							3	3	3
Soper Creek			7							0	2	3
Bennett Creek												
Totals	21	2	20	2	20	20			14	14	18	17
	148											

It is recommended that 10% of the annual sampling effort should focus on sampling reference sites.

The 2005 sampling season was the first year that CLOCA collected benthos following the OBBN protocol.

4.3.1 Site Selection

Within the watershed that is being sampled, sites should occur generally near previously sampled Aquatic Resource Management Plan sites.

4.3.2 Methodology

Benthos may be collected at various times of the year but samples must be compared to others collected from a similar sampling window. Both the number of animals collected and the types of stressors vary depending on the season. Generally the most popular time to sample benthos is in May. During this time animals are large making them easier to identify and also spring data is abundant (OBBN, 2005).

More details about sampling methodology are available through documentation provided by the province (OBBN, 2005).

4.3.3 Resources Required

A minimum of two people is required to conduct an OBBN site. A site generally takes two hours to complete in the field not including benthos identification. Benthos identification is completed in the office and generally takes one day to complete.

Entering site information into the OBBN database takes approximately one hour.

4.3.4 Data

Once the benthos for a particular sample have been identified to the minimum coarse-level, the results along with site information (e.g., location, water temp) can be entered into the online database. Once an appropriate reference site(s) has been determined a statistical test determines whether the test site falls within the normal range of the reference site(s).

Future versions of the database will allow direct comparisons of various protocols (e.g., BioMAP) to data collected under the OBBN protocol.

More details about data analysis are available through (OBBN, 2005).

4.40 Freshwater Mussels

4.4.1 Introduction

Freshwater mussels are part of the Phylum Mollusca (molluscs), which also includes snails, slugs, clams, scallops, oysters, squids and octopuses. In Ontario all of the mussels are part of the Family Unionidae. Of the 55 species that occur in Canada, Ontario has 41, 28 of which are showing signs of decline. In North America 21 species are already extinct (Metcalfe-Smith and MacKenzie and Carmichael and McGoldrick, 2005).

Freshwater mussels have been identified in the CLOCA jurisdiction through the Aquatic Monitoring Program in the past but they have not been specifically targeted.

4.4.2 Site Selection

Non-wadable sections of streams generally the transition zone between marsh habitat and wadable sections of streams is where sampling will be focused. Sampling units will be the same as those defined for spawning surveys (see Spawning Survey, Site Selection).

Refer to Appendix 1 for monitoring schedule.

4.4.3 Methodology

Many methods are used to sample mussels and include: visual searches, tactile searches, sediment collection and sieving, or special methods such as brail bars, dredges, or muskrat middens (Strayer and Smith, 2003).

Mussels are preyed upon by various animals such as River Otters, Mink, Raccoons, Muskrats, birds and fish. Many of these predators especially Muskrats, leave piles of mussel shells called “middens” along the shore and around structures such as tree roots and bridge abutments. During periods of low water, shorelines can be walked to determine if mussels are present in the area (Metcalfe-Smith and MacKenzie and Carmichael and McGoldrick, 2005).

Mussel Collecting and the Law: Freshwater mussels are considered to be fishes (shellfishes) and are protected under the Ontario Fishery Regulations made under the federal *Fisheries Act*. These regulations prohibit the collection of live mussels of any species in Ontario without a permit from the MNR. It is an offence to undertake any activity that affects an aquatic species listed as Extirpated, Endangered or Threatened under SARA, without a permit from DFO. In the case of freshwater mussels, collecting and processing even the shells of one of these species requires a permit (Metcalfe-Smith and MacKenzie and Carmichael and McGoldrick, 2005).

4.4.4 Resources Required

An efficient way of surveying the shoreline of streams is similar to conducting a spawning survey in that two people are needed, one on each bank. Usually, a couple of sampling units can be surveyed in a day.

4.4.5 Data

Mussel shells collected will be identified to species level and recorded on the field data sheet. Some shells of each species identified from each sampling unit will be kept as voucher specimens. Field data sheet information will be entered into the Aquatic Information Database.

5.0 Fisheries

5.1 Introduction

Fish are one of our most valued natural resources from ecological, economic, social and cultural perspectives. Healthy fish and environments result from protecting and/or restoring aquatic ecosystems (Draft Terms of Reference, 2005). In order to help determine aquatic ecosystem health and monitor it over time CLOCA conducts fisheries assessments in various watersheds each season. Ongoing annual aquatic monitoring is recommended in the Central Lake Ontario Fisheries Management Plan (CLOFMP; CLOCA/MNR 2007). Information collected during these programs supports the goals and objectives of the CLOFMP and allows for an adaptive management approach.

Historically, watersheds within the Central Lake Ontario Conservation Authority supported healthy cold-water fish communities and a strong brook trout and Atlantic salmon fishery. With increasing urbanization and changing land-use patterns, many of the cold water streams have become cool or warm-water systems. The Atlantic salmon fishery has since collapsed and has been supplemented by stocking of Pacific salmon and trout species. The distribution of brook trout in many areas has been reduced to the undeveloped headwater reaches where natural cover is still present (CLOCA/MNR 2007).

Generally, CLOCA conducts fisheries sampling in streams using a common sampling method called **electrofishing.** On occasion, when electrofishing is not a suitable technique, other sampling methods, such as seine nets, fyke nets and minnow traps, are utilized.

Electrofishing is a sampling method that temporarily immobilizes fish in water using electricity. Once immobilized, they can be captured with nets and fisheries staff can collect biological information (e.g., length, weight) before releasing them.

Refer to Appendix 1 for monitoring schedule.

5.2 Stream Sampling

Backpack electrofishing (Figure 4) is the most common method used to sample fish in wadable streams. For the most part, sampling by CLOCA is conducted according to the Ontario Stream Assessment Protocol (OSAP) published by the Ministry of Natural Resources (Stanfield, 2005).

Not exact model used by CLOCA

Figure 4. Example of a backpack electrofisher.

5.2.1 Site Selection

A selection of previously sampled Aquatic Resource Management Plan fisheries sites (OSAP) will be re-sampled each season. Additional supplemental sites will be surveyed as needed.

5.2.2 Methodology

The majority of the CLOCA jurisdiction is privately owned and therefore before actual sampling occurs, property permission must be obtained. This is best accomplished by using current air photos and GIS products such as parcel fabric. Parcel fabric is a digital layer used in GIS that contains property information such as property boundaries. It can be overlaid onto digital air photos to allow the user to quickly become familiar with the area of interest. In the past this technology wasn't available and gaining property permission took a considerable amount of time and resources.

Next the site must be delineated and marked well in advance of sampling. This allows the surveyor to confirm that the area of interest will be suitable and that a new location is not required. Site length must be determined by measuring within the creek to allow consistent delineation between sites.

More details about sampling methodology are available through (OSAP, 2005).

5.2.3 Resources Required

A minimum of three people is required to conduct a backpack electrofishing survey. A survey generally takes one day to complete.

Identification using a microscope and data entry takes 3.5 hours per site.

5.2.4 Data

Data is entered into the CLOCA database.

5.3 Marsh Sampling

For the most part, marsh sampling is conducted according to the Durham Region Coastal Wetland Monitoring Program (Environment Canada, 2003), although other techniques have been used in the past. Boat electrofishing (see picture on front cover) is a common method used to sample marshes, lakes and non-wadable streams.

5.3.1 Site Selection

Details about site selection are available through (Environment Canada, 2003).

5.3.2 Methodology

Details about methodology are available through (Environment Canada, 2003).

5.3.3 Resources Required

A minimum of 5 people is required to conduct a boat electrofishing survey consistent with DRCWMP methodology. A survey generally takes one day to complete. More details about methodology are available through (Environment Canada, 2003).

Identification using a microscope and data entry takes 3.5 hours per site.

5.3.4 Data

Data is entered into one central database used for all partners participating in the project and the results are reported through EC reports. More details about data are available through (Environment Canada, 2003).

6.0 Equipment

6.1 Introduction

Technology plays a vital role in the collection of quality data for various CLOCA projects. The quality of the data produced from the equipment is dependent on a knowledgeable operator. Along with personnel communication about how to operate a piece of equipment, the owner's manual should be reviewed for technical details that may have been omitted.

Scientific equipment (e.g., thermometers) often have a certificate of calibration, which states the accuracy of the product and how it was determined by the manufacturer (e.g., "This Instrument was calibrated using Instruments Traceable to National Institute of Standards and Technology.", Control Company). When possible the serial number of the equipment that is being used to collect data should be recorded on the field data sheet. This becomes critically important if data collected is used for legal purposes and needs to be qualified (e.g., OMB proceeding).

6.2 Location Information

The following information was taken from the Natural Heritage Information Centre Website (http://nhic.mnr.gov.on.ca/MNR/nhic/species/species_report_guide.cfm).

UTM Coordinates: UTM stands for Universal Transverse Mercator. It is a numerical value that represents the precise location of a site using a type of grid system. A UTM consists of three sets of numbers. A two-digit "Zone", a six-digit "Easting", and a seven-digit "Northing". Together, these three numbers refer to a precise location. An example of a full UTM would be 17 693455 5071456.

There are several ways to generate an UTM. Hand-held GPS (Global Positioning System) units are the easiest and most accurate way to generate a coordinate (either a UTM or Latitude and Longitude) for a location, provided you are physically at that location with your GPS unit. These units are relatively inexpensive, small in size and easy to carry around in the field, and are available at most outdoors and camping stores. They will display geographic coordinates in UTM, Latitude and Longitude, or both.

A UTM grid reference can also be generated from an NTS (National Topographic System) mapsheet. This method can be used regardless of whether or not you are physically at the site. Such mapsheets are available at camping and outdoors stores, as well as map stores. NTS maps are available at two scales, 1:50,000 and 1:250,000. A scale of 1:50,000 is the most useful for fieldwork. More information on where to buy these maps can be found at: **http://maps.nrcan.gc.ca/cmo/dealers.html**. Instructions on generating a UTM from an NTS mapsheet can be found at: **http://maps.nrcan.gc.ca/maps101/grid_ref.html** and can also be found on the right margin of the mapsheet.

Datum: When reporting a location using a UTM, there are two grid systems that are used in Canada - NAD27 (North American Datum 1927) and NAD83 (North American Datum 1983). The datum used on an NTS mapsheet is indicated somewhere on the bottom of the map. In addition, when using a hand-held GPS unit, you can program your unit to display the coordinates in either NAD27 or NAD83. It is important to indicate the "datum" with any UTM because, in Ontario, they differ by approximately 200 metres in the Northing (and a little in the Easting). Naturally, NAD83 is the more up-to-date system and is preferred, but as long as the datum system used is provided with the coordinates, a conversion can be made.

UTM Source: The UTM Source field allows you to report what method you used to generate a UTM (or any other coordinates - e.g. Latitude, Longitude). The following codes are used:

GPS - generated using a hand-held GPS unit
NTS - read from a National Topographic System map sheet
OBM - read from an Ontario Base Map sheet
Other - derived in some other fashion (e.g. Latitude and Longitude derived from a gazetteer or atlas)

7.0 References

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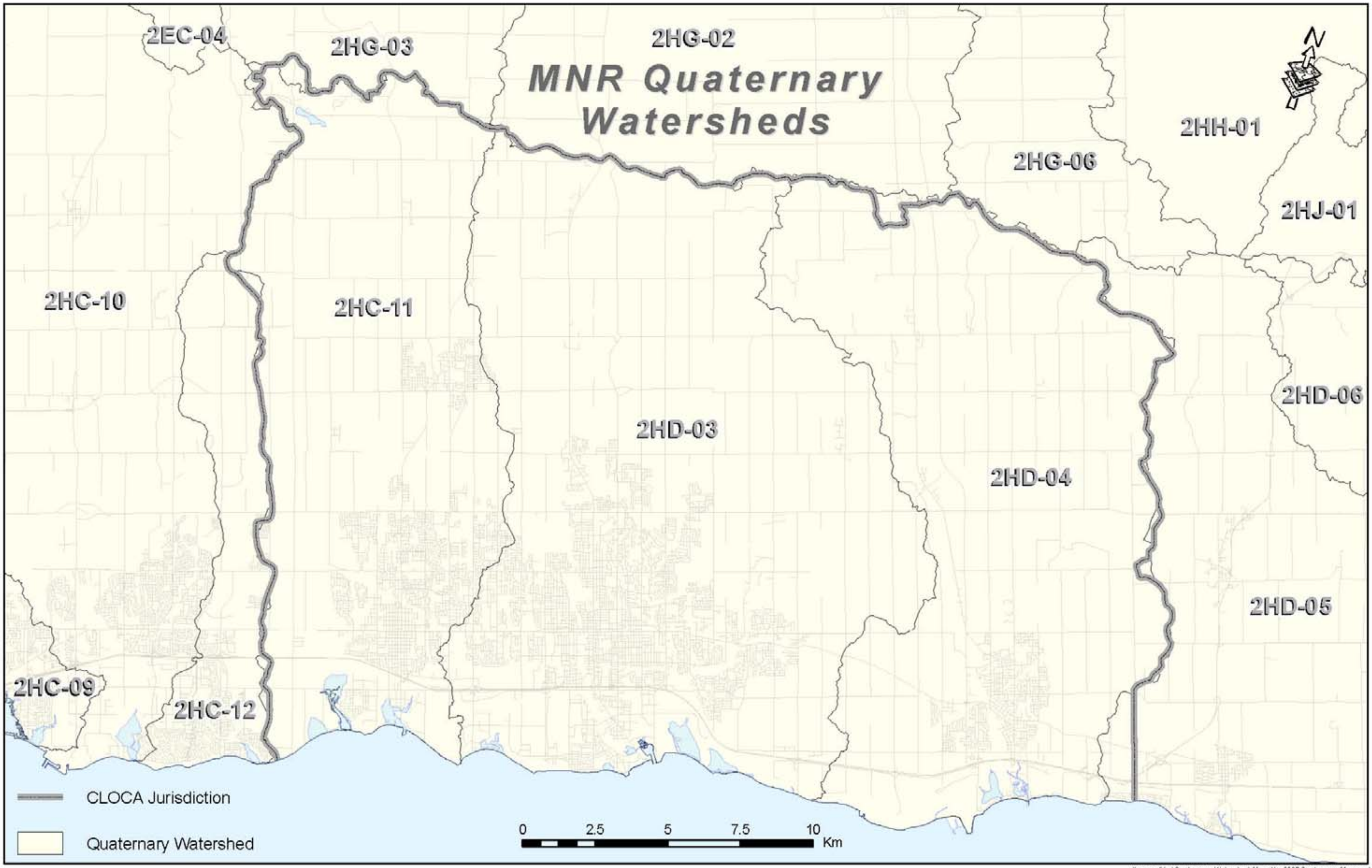
Appendix 1: Aquatic Monitoring Program Monthly Schedule

Watershed	Monitoring Year
Bowmanville/Soper Creek	2006
Oshawa Creek	2007
Black/Harmony/Farewell Creek	2008
Lynde Creek	2009
Small Watersheds	2010
Bowmanville/Soper Creek	2011
Oshawa Creek	2012
Black/Harmony/Farewell Creek	2013

Appendix 2: Aquatic Monitoring Program Yearly Schedule



Appendix 3: MNR Quaternary Watersheds

Appendix 4: EC - Air Temperature Collected Through AWOS

1.2.8 TEMPERATURE (http://text.msc.ec.gc.ca/msb/manuals/awos/chap1_e.html#128_e)

1.2.8.1 Temperature Sensor:

TYPE...Yellow Springs International Model 44212 thermistor housed in a Stevenson Screen.
PERIPHERAL INTERFACE...TC (See 1.2.1).
PI ALGORITHM VERSION...Version 1.0

Appendix
EC - Air Temperature Collected Through AWOS

1.2.8.2 Sensor Functional Description

The sensor is put into an electrical circuit as a resistor, the resistance of which changes as the temperature changes.

1.2.8.3 Accuracy

± 0.3°C.

1.2.8.4 Output

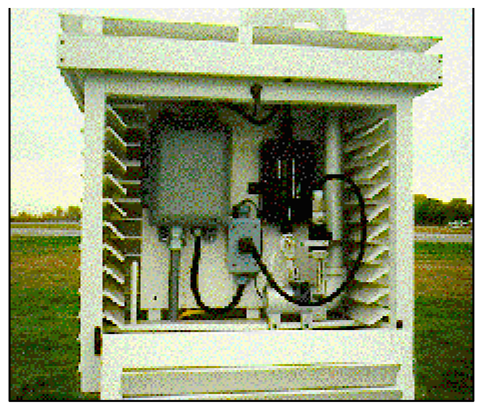


Figure 1-8 Stevenson Screen with Temperature/Dew Point

A temperature in degrees and tenths Celsius is output from the PI once every minute, and the latest one is used for the reports.
NOTE: Hourly maxima and minima are reported in the free format of the AWOS output. Measurement of this parameter does not differ from manned observations.

1.2.8.5 Special Criteria

Nil

1.2.8.6 Known Limitations of the AWOS Temperature Sensor

The sensor is generally reliable.