Appendix A
Hydrologic Modelling Calibration Outputs

APPENDIX A – CALIBRATION OF HYDROLOGIC MODEL

A1. Overview

As noted by Haan et al. (1982) in *Hydrologic Modeling of Small Watersheds,"* There are two calibration criteria: model results should match recorded data, and the estimates of parameter values should be consistent with watershed characteristics". In the case of Mayhew Creek, a large recent rainfall event occurred in September, 2004 and records of both rainfall and streamflow were available. This event was used for calibration of the hydrologic model, HEC-HMS.

A2. Calibration Event

- **Rainfall data**
  - Rainfall data for the storm of Sept 8 - 9, 2004 (in original chart form) for the Trenton Airport climate station 6158875 were obtained from Environment Canada. XCG digitized the charts to produce an hourly rainfall hyetograph (see Figure A.1).

- **Streamflow data**
  - Streamflow data for the period Sept 8 - 12, 2004 for Water Survey of Canada hydrometric station 02HK011 (Mayhew Creek near Trenton) were obtained from the Environment Canada database.

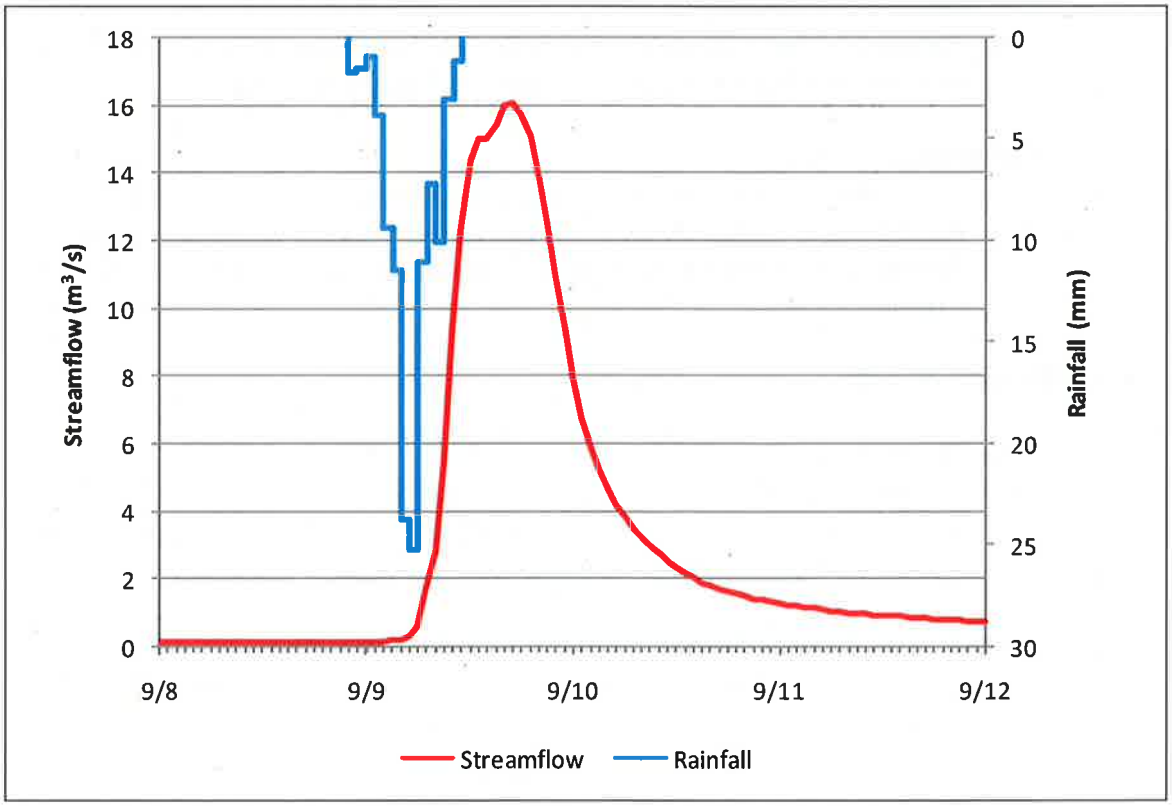


Figure A.1: September 2004 Storm - Streamflow and Rainfall

- **Water level observations**
  - Although no quantitative measurements of water level during the calibration event were available, anecdotal observations were used in the calibration process.

A3. Calibration Methodology

- **Guiding principles**
  - The guiding principle was that the modelled hydrograph at the hydrometric station should closely approximate the observed hydrograph with all parameter values for the dominant physical process and the range expected for the parameters describing that particular process.

- **Basin discretization**
  - The overall drainage basin was discretized in accordance with the principles set out by Watt et al. (1989) in *The Hydrology of Floods in Canada: A Guide to Planning and Design.*

- **Parameter selection**
  - Initial values for all parameters were determined from field measurements, GIS interpretation of LIDAR surveys, and field surveys.

- **Parameters to be calibrated**
  - Parameters that were calibrated included channel lag time, sub basin curve number, sub basin time to peak, and sub basin storage factor.

- **Calibration process**
  - The calibration process involved systematically varying the sub basin parameters to match: a) the observed runoff volume, b) the observed peak discharge, c) the observed time to peak, and d) the observed overall hydrograph shape.

A4. Calibration Results

- **Quantitative assessments**
  - A comparison of modelled and observed runoff volume, peak discharge and time to peak discharge is given in Table A.1. The differences are well within the expected range of uncertainty.

Table A.1: Comparison of Streamflow Characteristics

	Runoff Volume (mm)	Peak Discharge (m^3/s)	Time to Peak from Start of Rainfall (h)
Observed	33.0	16.0	19
Simulated	31.5	16.3	16

- **Qualitative assessment**
  - A comparison of modelled and observed overall hydrograph shape given in Figure A.2 indicates that the model closely replicates the observed flows.

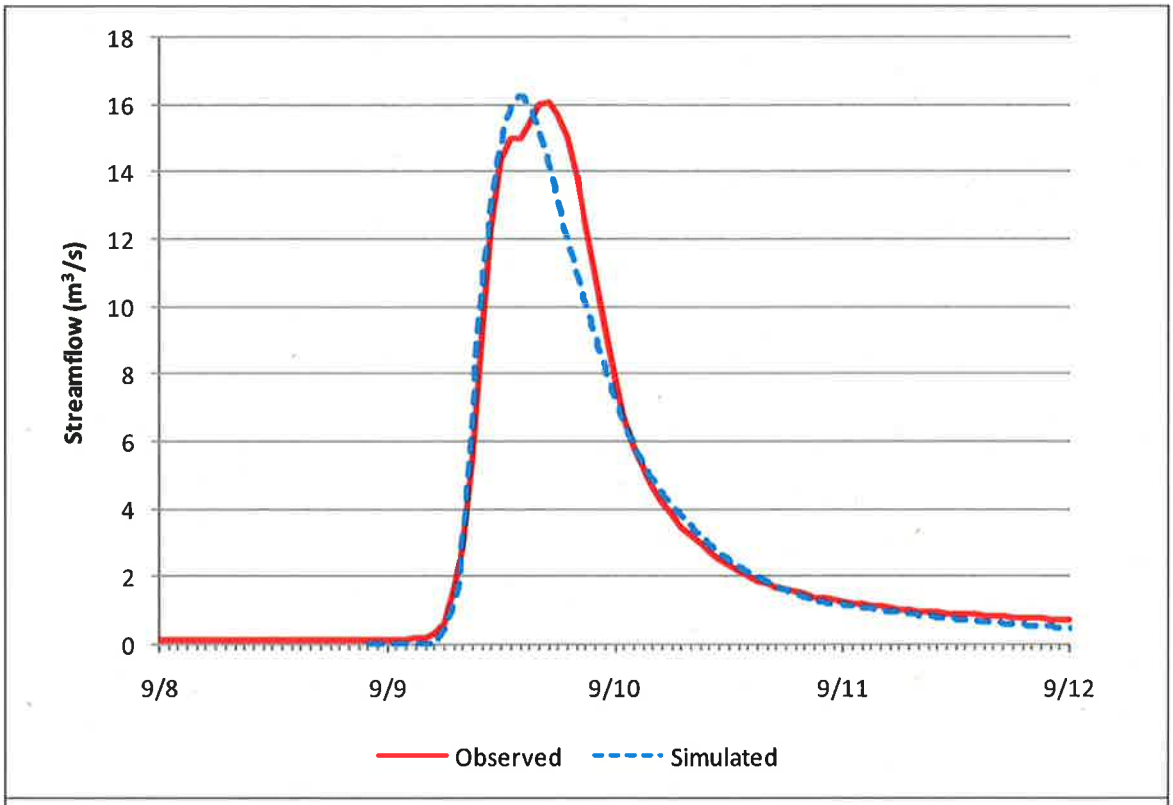


Figure A.2: Comparison of Modelled to Observed Flows for Sept 2004 Event

A5. Assessment of Calibration

- As indicated above, the calibrated model successfully replicates the observed flows. The fact that this has been accomplished a) using a basin discretization that is in accordance with measured topography and dominant physical processes, and b) with parameter values within the expected range, indicates that the calibrated model can be used to simulate streamflow for other large rainfall events up to and including an event of magnitude similar to the calibration event.

Appendix B
City of Quinte West Planning Designations Per Official Plan

Mayhew Creek – MDP

Planning Summary – Present and Future Land Use:

Introduction / Context:

Located on the western boundary of the City of Trenton, within the City of Quinte West, the Telephone Road Development Area (TRDA) encompasses a land area of approximately 360 hectares over a linear distance of 3.7 kilometers. The TRDA is located south of the Highway 401 corridor and is centered at the intersection of Telephone Road and Wooler Road in the City's Murray ward. The TRDA is shown on Map 1.

The TRDA was created as a result of the provision of municipal services to the General Mills facility located on the south side of Telephone Road at the western extent of the TRDA.

The effect of the extension of municipal services along Telephone Road, in addition to providing for the expansion of the industrial plant, created the potential for a new urban growth and settlement area for the City, in keeping with provincial Planning mandates.

In order to ensure efficient and orderly development of the new urban growth area, the City of Quinte West initiated a program in 2005 by which the urban growth area would;

i) be removed from the jurisdiction of the City of Quinte West Official Plan, which at this time was primarily a rural area official plan for the City of Quinte West;

ii) be included within the area of jurisdiction of the Trenton Ward Secondary Plan, to be governed by the urban development standards of that plan. In addition specific land use designations and policies were developed for the lands contained within the TRDA.

Official Plan Amendments OPA 12 (City of Quinte West Official Plan) and OPA 79 (Trenton Ward Secondary Plan) were approved by Council in August 2005.

Existing Land Use Pattern and Designations prior to TRDA:

Prior to the OPA's detailed above, and the creation of the TRDA, lands were designated under four separate designations:

a) Agriculture:

Agricultural lands located at the western boundary of the TRDA are primarily occupied by the General Mills and Trenton Cold Storage facilities. Other existing agricultural uses are limited and consist mainly of orchard lands.

b) Rural:

Lands within the previous rural designation cover a variety of land uses including agriculture, and related uses, low density residential, limited commercial and industrial uses, as well as afforested areas and open grasslands.

The predominant form of existing development within the TRDA is that of low density, detached residential dwellings. Limited commercial development is located at the intersection of Wooler and Telephone Roads, with two institutional uses located to the east of Wooler Road.

i) Residential:

There are a total of 459 residential dwellings within the TRDA. 292 of these dwellings are located in the form of strip development along Telephone and Hellyer Roads and Orchard Lane, created through the Consent process prior to Municipal Amalgamation. The balance of the residential dwellings (167units) are located within residential subdivisions, the bulk of which are located north of Telephone Road within the eastern portion of the TRDA. The existing lot fabric is illustrated on attached maps.
Due to the historic use of private water and sanitary services in the area, the majority of residential lots within the TRDA are situated on larger rural type lots, which may in some circumstances provide the potential for additional lot creation through severance, should municipal services be utilized.

ii) Commercial:

Commercial land uses are limited to an existing gas station and convenience store at the intersection of Wooler Road and Telephone Road, and a number of vehicle sales operations on Wooler Road.

c) Special Policy Area 1:

This designation referred to a specific parcel located in Part of Lots 9 and 10, Concession 2, and designated the lands for "Prestige Industrial". These lands have been redesignated through OPA 79 for a mix of industrial, commercial and residential uses. These lands are currently vacant.

d) Aggregate Reserve:

The Aggregate Reserve designation identifies lands with a reasonably high potential of containing commercial quantities of aggregate materials according to the Ministry of Natural Resources. This designation affects a 16 hectare parcel in the south of the TRDA. No extraction licenses have been issued on this property, and the extent of

incompatible land uses within close proximity effectively sterilize future extraction potential.

Land Use Strategy – TRDA (Planning District 12)

The land use strategy for the TRDA as approved under OPA 79, serves to recognize existing and future development within the context of a comprehensive planning strategy of compatible land uses.

The TRDA was placed within a new Planning District 12 that details and addresses the specific designations and requirements for new development located within the TRDA.

As identified on Map 2, Planning District 12 was divided into eight sub-districts as detailed below: (Note: a ninth sub-district I was subsequently included through OPA 21)

To ensure that development within the district is sensitive to the identified environmentally sensitive areas of Planning District 12; primarily the tributaries of Mayhew Creek and Tremur Lake as follows:

(i) The City may require new development and/or re-development to provide environmental studies to identify impacts and offer mitigation measures to protect the environmental features identified on Schedule III A of this Plan. Additional policies contained in Sections 3.B.3.A, 3.B.4, 3B.10.A and 4.0 shall guide development within the Planning District.

(ii) No development shall take place within 30 meters of the top of bank of the tributaries of Mayhew Creek and Tremur Lake as identified.

In areas of the Planning District where municipal services have been installed, any redevelopment and/or alteration of buildings currently on private services that result in an increase in habitable area or sanitary flow rates shall be required to connect into the appropriate sanitary sewer system.

The following land use policies shall apply to each of the sub-districts. Refer to Map 2.

Sub-district A

(i) Sub-district A shall be developed and/or re-developed as the primary industrial area of the District.

(ii) Development and/or re-development of industrial uses shall take place in accordance with Section 3.B.3.A – Industrial Policies – of this Plan.

(iii) Site specific development within the Sub-district shall be preceded by the completion of a storm water management plan in accordance with Section 3.B.14.A of this Plan.

(iv) Sufficient municipal services shall be in place prior to the development and/or re-development of the Sub-district in accordance with Section 3.B.13.A of this Plan.

(v) The City, as part of any development and/or re-development of lands within the Sub-district shall require the entering into of a site plan control agreement pursuant to Section 41 of the Planning Act.

Sub-district B

(i) Sub-district B shall be developed as the secondary industrial area of the District.

(ii) Development and/or re-development of industrial uses shall take place in accordance with Section 3.B.3.A – Industrial Policies – of this Plan.

(iii) Site specific development within the Sub-district shall be preceded by the completion of a storm water management plan in accordance with Section 3.B.14.A of this Plan.

(iv) Sufficient municipal services shall be in place prior to the development and/or re-development of the Sub-district in accordance with Section 3.B.13.A of this Plan.

(v) Notwithstanding subsection (iv) above, municipal sanitary services within Sub-district B shall utilize reduced flow technology, or an equivalent system, that maintains an average daily flow rate of 17,500 liters/hectare/day, or less, allocated to the Sub-district by the City.

The use of reduced flow technology, or equivalent system, shall be subject to the approval of the Ministry of Environment on a site by site basis.

The City, as part of any development and/or re-development of lands within the Sub-district shall require the entering into of a site plan control agreement pursuant to Section 41 of the Planning Act.

Sub-district C

(i) Sub-district C shall be developed for low density residential land uses in accordance with Section 3.B.1.C – Residential First Density Policies – of this Plan and commercial land uses for those lands situated on the north side of the intersection of Telephone Road and Wooler Road to a depth of 92.6 meters and a total area of 0.56 hectares in accordance with Section 3.B.2.G of this Plan.

(ii) The development of the Sub-district shall occur to an overall density of 5 units per net acre.

(iii) Development of properties that exist at the time of the adoption of OPA 79 within

the sub-district shall be serviced by way of a conventional sanitary sewer system. Further subdivision of lots within the sub-district shall be serviced by way of a reduced flow sanitary system.

(iv) The City as part of any severance, subdivision or redevelopment plan shall require the dedication of land adjacent to Tremur Lake to a minimum width of 15 meters to ensure continuous public access strip along the shoreline of Tremur Lake.

(v) Site specific development within the Sub-district with a total lot area greater than 1 hectare shall be preceded by the completion of a storm water management plan in accordance with Section 3.B.14.A of this Plan.

(vi) Development of the Sub-district within 300 meters of the CNR/CPR right-of-way shall take place in accordance with section 3.B.15.A of this Plan.

(vii) Sufficient municipal services shall be in place prior to the development and/or re-development of the Sub-district in accordance with Section 3.B.13.A of this Plan.

Sub-district D

(i) Sub-district D shall be developed for low density residential land uses in accordance with Section 3.B.1.C – Residential First Density Policies – of this Plan and commercial land uses for those lands situated on the north side of the intersection of Telephone Road and Wooler Road to a depth of 123 meters and a total area of 1.53 hectares in accordance with Section 3.B.2.G of this Plan.

(ii) The development of the Sub-district shall occur to an overall density of 5 units per net acre.

(iii) The City as part of any severance, subdivision or redevelopment plan shall require the dedication of land adjacent to Tremur Lake to a minimum width of 30 meters to ensure continuous public access strip along the shoreline of Tremur Lake.

(iv) Development of the Sub-district within 300 meters of the CNR/CPR right-of-way shall take place in accordance with section 3.B.15.A of this Plan.

(v) Site specific development within the Sub-district with a total lot area greater than 1 hectare shall be preceded by the completion of a storm water management plan in accordance with Section 3.B.14.A of this Plan.

(vi) Sufficient municipal services shall be in place prior to the development and/or re-development of the Sub-district in accordance with Section 3.B.13.A of this Plan.

(vii) Notwithstanding subsection (iv) above, municipal sanitary services within Sub-

district D shall utilize reduced flow technology, or an equivalent system, that maintains an average daily flow rate of 225 liters/capita/day, or less, allocated to the Sub-district by the City.

The use of reduced flow technology, or equivalent system, shall be subject to the approval of the Ministry of Environment on a site by site basis.

Sub-district E

(vi) Sub-district E represents the existing privately serviced Barry Heights residential subdivision.

(vii) Development in Sub-district E shall not take place prior to the extension of full municipal services into the area. All development and/or redevelopment within the Sub-district shall take place in accordance with Section 3.B.1.C – Residential First Density Policies – of this Plan.

(viii) The connection of existing residential development to the municipal water and sanitary sewage system is encouraged in accordance with Section 3.B.14.A of this Plan.

(ix) Notwithstanding subsection (iii) above, municipal sanitary services within Sub-district D shall utilize reduced flow technology, or an equivalent system that maintains an average daily flow rate of 225 liters/capita/day, or less.

The use of reduced flow technology, or equivalent system, shall be subject to the approval of the Ministry of Environment on a site by site basis.

Sub-district F

(i) Sub-district F shall be developed for public open space and recreational purposes in accordance with Section 3.B.4.A – Open Space – of this Plan.

Sub-district G

(i) Sub-district G shall be developed for general commercial purposes in accordance with Section 3.B.2.G of this Plan.

(ii) Site specific development within the sub-district shall be preceded by a storm water management plan in accordance with Section 3.B.14.A of this Plan.

(iii) Sufficient municipal services shall be in place prior to the development and/or re-development of the Sub-district in accordance with Section 3.B.13.A of this Plan.

(iv) Notwithstanding subsection (iii) above, municipal sanitary services within Sub-district B shall utilize reduced flow technology, or an equivalent system, that

maintains an average daily flow rate of 14,000 liters/hectare/day, or less, allocated to the Sub-district by the City.

The use of reduced flow technology, or equivalent system, shall be subject to the approval of the Ministry of Environment on a site by site basis."

Sub-district H

(i) Sub-district H shall be developed for general commercial purposes in accordance with Section 3.B.4.G. of this Plan.

(ii) Site specific development within the sub-district shall be preceded by a storm water management plan in accordance with Section 3.B.14.A of this Plan.

(iii) Municipal servicing capacity shall be allocated to the sub-district on an as need basis based on specific development requests within the sub-district.

(iv) Sufficient municipal services shall be in place prior to the development and/or re-development of the Sub-district in accordance with Section 3.B.13.A of this Plan.

(v) Notwithstanding subsection (iii) above, municipal sanitary services within Sub-district B shall utilize reduced flow technology, or an equivalent system, that maintains an average daily flow rate of 14,000 liters/hectares/day, or less, allocated to the Sub-district by the City.

The use of reduced flow technology, or equivalent system, shall be subject to the approval of the Ministry of Environment on a site by site basis.

Sub-District I

i) Sub-district 'I' shall be developed for industrial uses in accordance with Section 3.B.3.A – Industrial Policies; or for general commercial purposes in accordance with Section 3.B.2.G – General Commercial Policies, of this Plan.

ii) Site specific development within the Sub-district shall be preceded by the completion of a storm water management plan in accordance with Section 3.B.14.A of this Plan.

iii) Site specific development within the Sub-district shall be preceded by a flood study to the satisfaction of the Conservation Authority.

iv) Sufficient municipal services shall be in place prior to the development of the Sub-district in accordance with Section 3.B.13.A, of this Plan.

v) Notwithstanding subsection (iv) above, municipal sanitary services within Sub-district 'I' shall utilize reduced flow technology, or an

equivalent system, that maintains an average daily flow rate of 17,500 liters/hectares/day, or less, allocated to the Sub-district by the City. The use of reduced flow technology, or equivalent system, shall be subject to the approval of the Ministry of the Environment on a site by site basis.

vi) The City, as part of any development of lands within the Sub-district shall require the entering into of a site plan control agreement pursuant to Section 41 of the Planning Act.

Additional Residential Land Supply:

The TRDA has sufficient designated lands to accommodate approximately 2,100 new residential units, subject to site specific development constraints.

Specific physical development constraints within the TRDA include the presence of CPR / CNR rail lines and associated rights of way and the Mayhew Creek watershed system, and lands affected by flood plain hazards.

Proposed and Approved Development:

Within the TRDA there currently exists one fully approved and registered Plan of Subdivision and three draft approved Plans of subdivision, as shown on Map 3.

i) Tremur Lake Subdivision (Map item 1) – 30 single detached residential lots. Approved and under construction.

ii) Wild Orchid Subdivision (Map Item 2) – 28 single detached residential lots and 1 commercial lot. Draft approved.

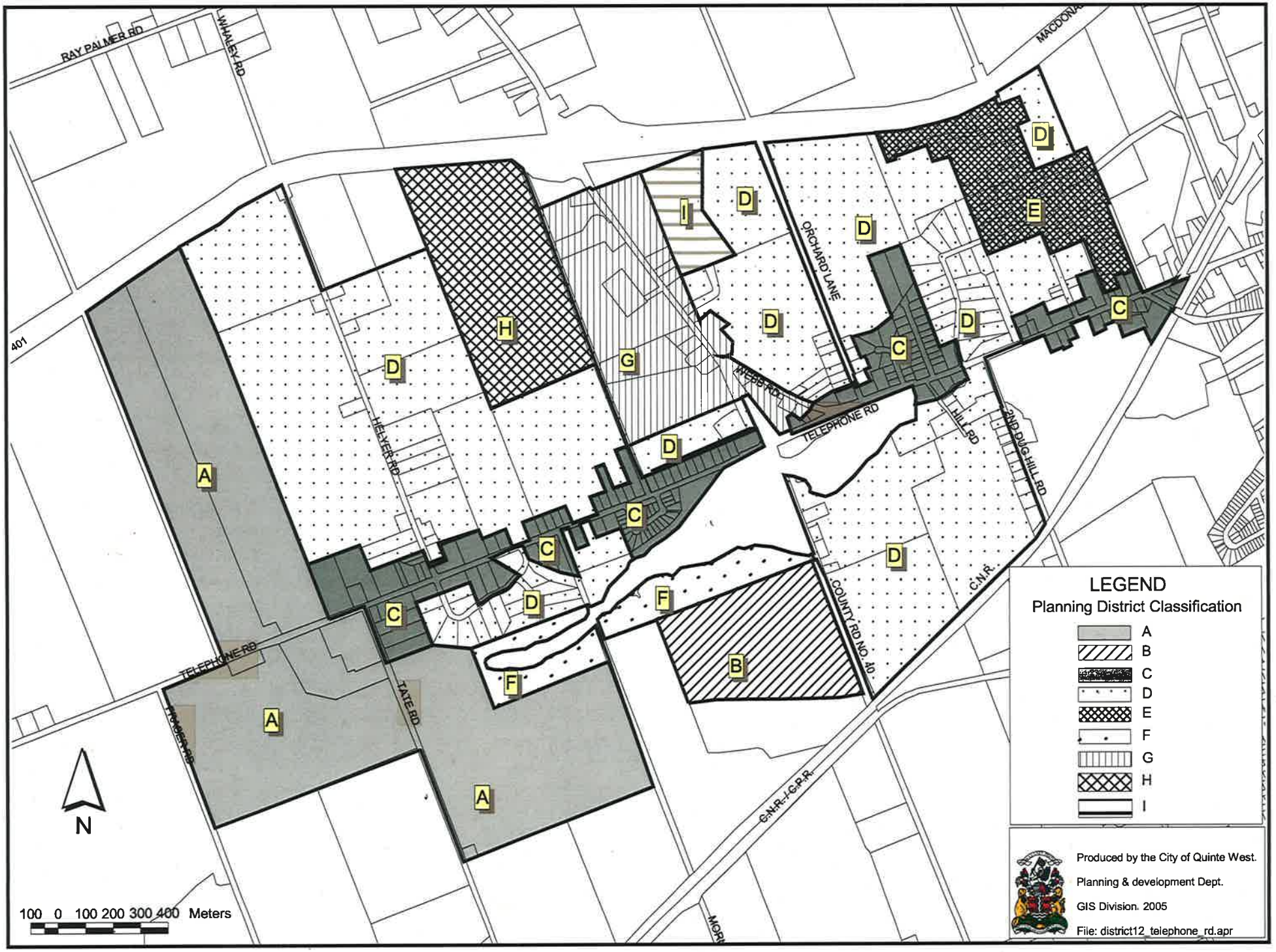
iii) Orchard Lane Plan of Subdivision (Map Item 3) – 188 single detached residential lots. Draft approved.

iv) Elks Lodge Plan of Subdivision (Map item 4) – 6 single detached residential lots. Draft approved.

Initiated primarily by the submission of the Orchard Lane draft plan application, and the redesignation of lands on the western side of Orchard Lane (OPA 21) for residential use; the City has undertaken a consultant study for lands located to

the north-east of the intersection of Wooler Road and Telephone Road (see Map 4).

This study will investigate the existing vehicular access capacity within this portion of the TRDA and review future opportunities and options for road access to service these designated lands. In addition the study will prepare initial servicing options and design for these lands. This study was initiated in February 2008 and is expected to be concluded by May 2008. City Planning staff will ensure that this study and its findings will co-ordinate with the Mayhew creek Watershed – MDP study.


RAY PALMER RD
WHALEY RD
401
HELYER RD
MEBB RD
ORCHARD LANE
TELEPHONE RD
HILL RD
2ND DIVG HILL RD
TATE RD
FRASER RD
COUNTY RD NO. 40
C.N.R.
C.N.R./C.P.R.
N
100 0 100 200 300 400 Meters
LEGEND
Planning District Classification
A
B
C
D
E
F
G
H
I
Produced by the City of Quinte West.
Planning & development Dept.
GIS Division. 2005
File: district12_telephone_rd.apr

Appendix C
Ecological Field Monitoring Notes and Reports

List of Documents:

- **Fish Sampling Results**
- **Water Temperature Data**
- **Water Quality – PWQMN Station Interpretation**
- **Benthic Field sheets (digital copy only)**
- **Baseflow Field sheets (digital copy only)**

Fish Sampling Results - Mayhew Creek

Station Id	MC-01	MC-02	MC-03	MC-04	MC-05	MC-06	MC-07	MC-08	MC-09	MC-10	MC-11	MC-12	Mayhew Creek		
E-fishing Time (seconds)	730	0 - no water	1113	1047	361	656	344	563	697	346	0 - no water	657	6514		
CPUE (fish/minute)	17	0	5	7	5	2	2	2	5	6	0	7	6.36		
CPUE (fish/hr.)	1045	0	314	440	299	137	115	147	284	375	0	405	381		
Species Caught	Number caught	Number caught	Number caught	Number caught	Number caught	Number caught	Number caught	Number caught	Number caught	Number caught	Number caught	Number caught	Number caught	CPUE (fish/hour)	CPUE (fish/sec)
banded killifish									1				1	0.55	0.0002
blacknose dace	1				4	1	1	2	2				11	6.1	0.0017
blacknose shiner			3	1									4	2.2	0.0006
bluntnose minnow			20	19	9		4						52	29	0.0080
brook stickleback			28	9	1	2	5	11		2			58	32	0.0089
brook trout	2		6	1	4	1							14	7.7	0.0021
brown trout					2								2	1.1	0.0003
central mudminnow				2			1	2	1				6	3.3	0.0009
chinook salmon	1												1	0.6	0.0002
common shiner	11			2					1				14	7.7	0.0021
creek chub	20		5	35	8	11		7		2		15	103	57	0.0158
cutlip minnow	16												16	8.8	0.0025
emerald shiner												5	5	2.8	0.0008
fallfish	3												3	1.7	0.0005
fathead minnow			2	34									36	20	0.0055
finescale dace			5	9									14	7.7	0.0021
horneyhead chub	3												3	1.7	0.0005
logperch	5												5	2.8	0.0008
longnose dace	142												142	78	0.0218
northern redbelly dace					2	3							5	2.8	0.0008
pearl dace			9	13									22	12	0.0034
pumpkinseed												10	10	5.5	0.0015
rainbow trout	2												2	1.1	0.0003
rock bass	1												1	0.55	0.0002
sand shiner	1												1	0.55	0.0002
american brook lamprey						7							7	3.9	0.0011
large-mouth bass												3	3	1.7	0.0005
small-mouth bass									3				3	1.7	0.0005
white sucker			19	1				1	43	32		35	131	72	0.0201
yellow perch	3			2					4			6	15	8.3	0.0023
salmonid (juvenile)	1		3										4	2.2	0.0006
cyprinid sp. (juvenile)			89	66				67	62			54	338	**187**	0.0519
Total number of species	14	0	9	12	7	6	4	5	7	3	0	6	**30**		
Total number of fish	**212**	**0**	**97**	**128**	**30**	**25**	**11**	**23**	**55**	**36**	**0**	**74**	**690**		

Mayhew Creek - Water Temperature Summary

	MAC04	MAC08	MAC09	MAC10	MAC12
Median	22.5	19.5	25.5	16.5	18.5
Min Temp	21.5	19.0	24.5	15.0	17.5
Max Temp	25.0	23.0	28.0	18.5	20.0
Average	23.0	20.2	25.9	16.2	18.8

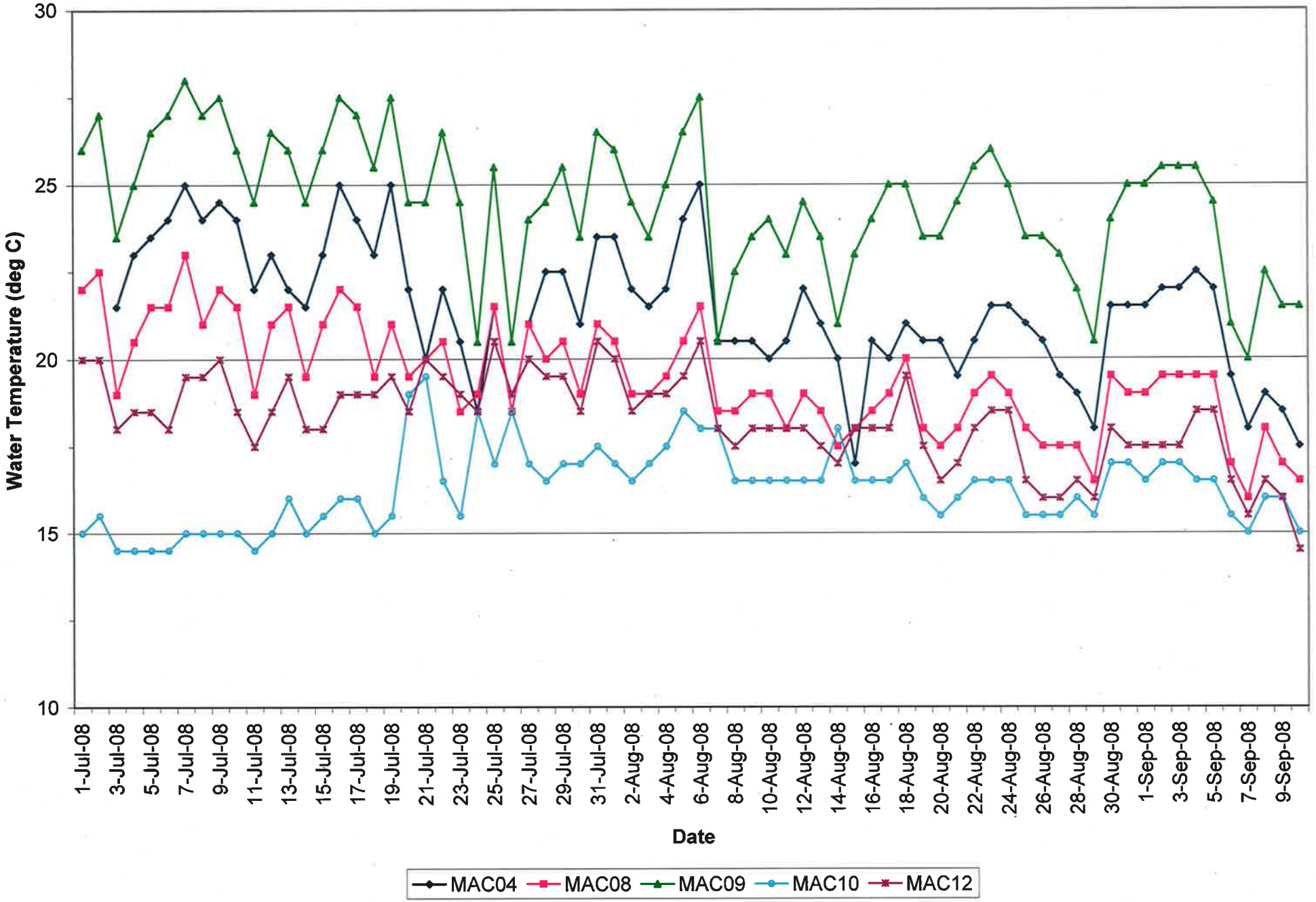
Cold-water	< 19°C
Cool-water	19°C - 25°C
Warm-water	> 25°C

Mayhew Creek
Temperatures at 4:15 pm

	MAC04	MAC08	MAC09	MAC10	MAC12
01/07/2008	22	22	26	15	20
02/07/2008		22.5	27	15.5	20
03/07/2008	21.5	19	23.5	14.5	18
04/07/2008	23	20.5	25	14.5	18.5
05/07/2008	23.5	21.5	26.5	14.5	18.5
06/07/2008	24	21.5	27	14.5	18
07/07/2008	25	23	28	15	19.5
08/07/2008	24	21	27	15	19.5
09/07/2008	24.5	22	27.5	15	20
10/07/2008	24	21.5	26	15	18.5
11/07/2008	22	19	24.5	14.5	17.5
12/07/2008	23	21	26.5	15	18.5
13/07/2008	22	21.5	26	16	19.5
14/07/2008	21.5	19.5	24.5	15	18
15/07/2008	23	21	26	15.5	18
16/07/2008	25	22	27.5	16	19
17/07/2008	24	21.5	27	16	19
18/07/2008	23	19.5	25.5	15	19
19/07/2008	25	21	27.5	15.5	19.5
20/07/2008	22	19.5	24.5	19	18.5
21/07/2008	20	20	24.5	19.5	20
22/07/2008	22	20.5	26.5	16.5	19.5
23/07/2008	20.5	18.5	24.5	15.5	19
24/07/2008	18.5	19	20.5	18.5	18.5
25/07/2008	21.5	21.5	25.5	17	20.5
26/07/2008	18.5	18.5	20.5	18.5	19
27/07/2008	21	21	24	17	20
28/07/2008	22.5	20	24.5	16.5	19.5
29/07/2008	22.5	20.5	25.5	17	19.5
30/07/2008	21	19	23.5	17	18.5
31/07/2008	23.5	21	26.5	17.5	20.5
01/08/2008	23.5	20.5	26	17	20
02/08/2008	22	19	24.5	16.5	18.5

03/08/2008	21.5	19	23.5	17	19
04/08/2008	22	19.5	25	17.5	19
05/08/2008	24	20.5	26.5	18.5	19.5
06/08/2008	25	21.5	27.5	18	20.5
07/08/2008	20.5	18.5	20.5	18	18
08/08/2008	20.5	18.5	22.5	16.5	17.5
09/08/2008	20.5	19	23.5	16.5	18
10/08/2008	20	19	24	16.5	18
11/08/2008	20.5	18	23	16.5	18
12/08/2008	22	19	24.5	16.5	18
13/08/2008	21	18.5	23.5	16.5	17.5
14/08/2008	20	17.5	21	18	17
15/08/2008	17	18	23	16.5	18
16/08/2008	20.5	18.5	24	16.5	18
	MAC04	**MAC08**	**MAC09**	**MAC10**	**MAC12**
17/08/2008	20	19	25	16.5	18
18/08/2008	21	20	25	17	19.5
19/08/2008	20.5	18	23.5	16	17.5
20/08/2008	20.5	17.5	23.5	15.5	16.5
21/08/2008	19.5	18	24.5	16	17
22/08/2008	20.5	19	25.5	16.5	18
23/08/2008	21.5	19.5	26	16.5	18.5
24/08/2008	21.5	19	25	16.5	18.5
25/08/2008	21	18	23.5	15.5	16.5
26/08/2008	20.5	17.5	23.5	15.5	16
27/08/2008	19.5	17.5	23	15.5	16
28/08/2008	19	17.5	22	16	16.5
29/08/2008	18	16.5	20.5	15.5	16
30/08/2008	21.5	19.5	24	17	18
31/08/2008	21.5	19	25	17	17.5
01/09/2008	21.5	19	25	16.5	17.5
02/09/2008	22	19.5	25.5	17	17.5
03/09/2008	22	19.5	25.5	17	17.5
04/09/2008	22.5	19.5	25.5	16.5	18.5
05/09/2008	22	19.5	24.5	16.5	18.5
06/09/2008	19.5	17	21	15.5	16.5
07/09/2008	18	16	20	15	15.5
08/09/2008	19	18	22.5	16	16.5
09/09/2008	18.5	17	21.5	16	16
10/09/2008	17.5	16.5	21.5	15	14.5

Mayhew Creek
Water Temperature @ 4:15pm



Surface Water Quality –
Part of Appendix C for the April, 2009 Mayhew Creek Master Drainage Plan

Two surface water monitoring stations in Mayhew Ck have been sampled since 2002 as part of the Provincial Water Quality Monitoring Network (PWQMN) for the purpose of monitoring ambient (background) conditions. The Fraser Rd (Easting – 288194, Northing – 4885893) monitoring station is located in Mayhew Creek off of Telephone Road, west of Trenton. The Front St (Easting – 292368, Northing – 4887353) monitoring station is downstream near the mouth of where Mayhew Creek meets the Trent River in Trenton. They have been sampled for a set of water quality parameters that include basic chemistry, metals and nutrients, four to six times per year during the ice-free season.

The data analysis involved comparing the results of the water quality parameters to the Provincial Water Quality Objectives (PWQO) or if no objective was available then it was compared to the Ontario Drinking Water Quality Standards (ODWS). The primary purpose of the PWQOs' is to protect aquatic life and recreational water uses while the ODWSs' are used in the protection of public health through the provision of a safe drinking water. Parameters that have a PWQO are either toxic at high concentrations to those aquatic animals, e.g. fish and invertebrates that live in the water column and sediment or are bioaccumulative and can cause food-web effects when fish, wildlife, birds, and people consume contaminated organisms.

The two PWQMN stations had concentrations of aluminum, cadmium, cobalt, lead, pH, total phosphorous that were greater than the PWQOs from 2002 to 2008. They also had concentrations of hardness and manganese greater than the ODWSs. Fraser Rd, the upstream station, also had concentrations of iron and turbidity that were greater than the PWQO, but they did not exceed the objectives at the Front St station, downstream. Parameters that were greater than the PWQO at the Front St station but were not at the Fraser Rd station upstream were total kjeldahl nitrogen (TKN) and zinc.

The parameters mentioned above can come from naturally occurring sources. Generally, low concentrations of aluminum, hardness, total phosphorus, cobalt are said to come from weathering igneous and various other types of rock. Cadmium, lead, manganese, and zinc at low concentrations could be attributed by ore minerals in the local geology. Nutrients such as total phosphorous and TKN at low concentrations can also come from decaying plant matter, such as wetlands. According to the Water Quality Sourcebook: A guide to water quality parameters a 1979 publication by Environment Canada the concentrations of cobalt and total phosphorous at both monitoring stations and iron at Fraser Rd and TKN at Front St exceeded the natural ranges observed in Canada (McNeely et al 1979).

In most cases, but not all the concentrations of the parameters were higher at the Front St monitoring station compared to Fraser Rd located upstream in Mayhew Ck. A good indicator of soil erosion that may contain concentrations of phosphorus, trace metals, pesticides and other contaminants (including bacteria) is particulate residue (Figure 1). In Mayhew Ck results range from 1.1 to 22.5 mg/L at Front St and1.5 to 15.7 mg/L at Fraser St monitoring station. The median (50th percentile) particulate reside at the downstream station at Front St (4.3 mg/L) was higher than at Fraser Rd (3.65 mg/L) from 2002 to 2008. A very similar measure to particulate residue is turbidity, however not identical and had shown a different pattern in results where the median and maximum concentration of turbidity at the downstream station, Front St, was lower than at Fraser Rd.

As mentioned earlier, total phosphorous, TKN, cobalt and iron concentrations at these two Mayhew Ck monitoring stations were considered being in the higher range for

Canadian natural waters as well as exceeding a water quality objective. Total phosphorous is an indicator of fertilizer runoff, industrial effluents, sewage with human excrement or detergents. Total Phosphorous results at Front St (downstream station) ranging from 0.015 to 0.406 mg/L was higher than at Fraser Rd ranging from 0.015 to 0.08 mg/L between 2002 and 2008 (Figure 2). According to the Conservation Ontario Watershed Report Card pilot study data analysis protocol based on a 5 year pooling, the 75th percentile for both Front St (0.1 mg/L) and Fraser Rd (0.03 mg/L) had a grade of B from 2004 to 2008. TKN is a measure of ammonia and organic nitrogen which is important to assessing the available nitrogen for biological activities in aquatic environments. Organic nitrogen may be attributed from septic system or sewage effluent contamination. TKN concentrations at Front St ranging from 0.34 to 1.48 mg/L was higher than at Fraser Rd that ranged from 0.29 to 0.95 mg/L (Figure 3). Besides the natural sources of igneous rock, cobalt at higher concentrations can be an indicator of municipal and industrial effluent or of long range transport from the combustion of oil and coal released into the atmosphere and deposited. Front St, downstream in Mayhew Ck had a higher median (0.374 µg/L) and maximum (1.86 µg/L) cobalt concentrations than Fraser Rd (median = 0.287 µg/L, maximum = 1.35 µg/L) located farther upstream. Iron in water like other parameters has natural sources, but at higher concentrations it can be an indicator of contamination from industrial wastes, the burning of coke or coal, acid mining processing, and corrosion of iron and steel. Iron concentrations at Fraser Rd had results greater than the PWQO of 300 µg/L and the concentrations normally found in aerated waters in Canada (<500 µg/L). Fraser Rd, upstream had a median of 162 µg/L and a maximum of 620 µg/L while Front St did not have concentrations at this level (median = 145 µg/L, maximum = 273 µg/L) (Figure 4).

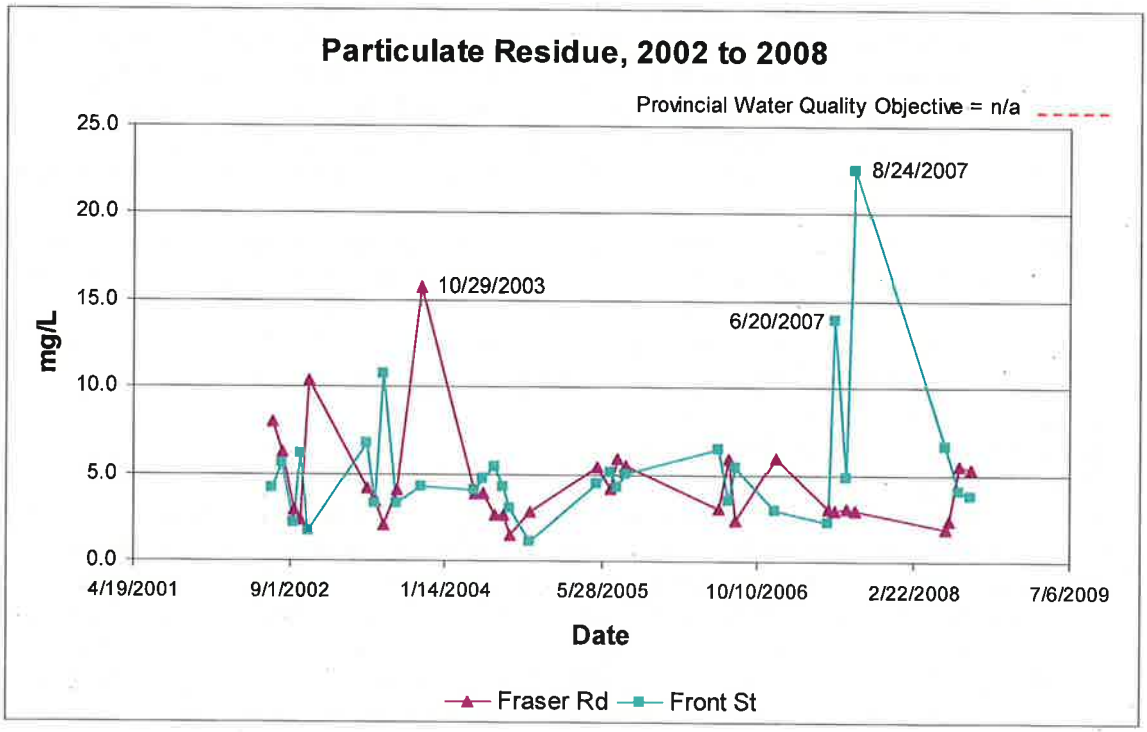


Figure 1: Particulate residue concentrations from Front St and Fraser Rd PWQMN stations in Mayhew Creek, 2002 to 2008.

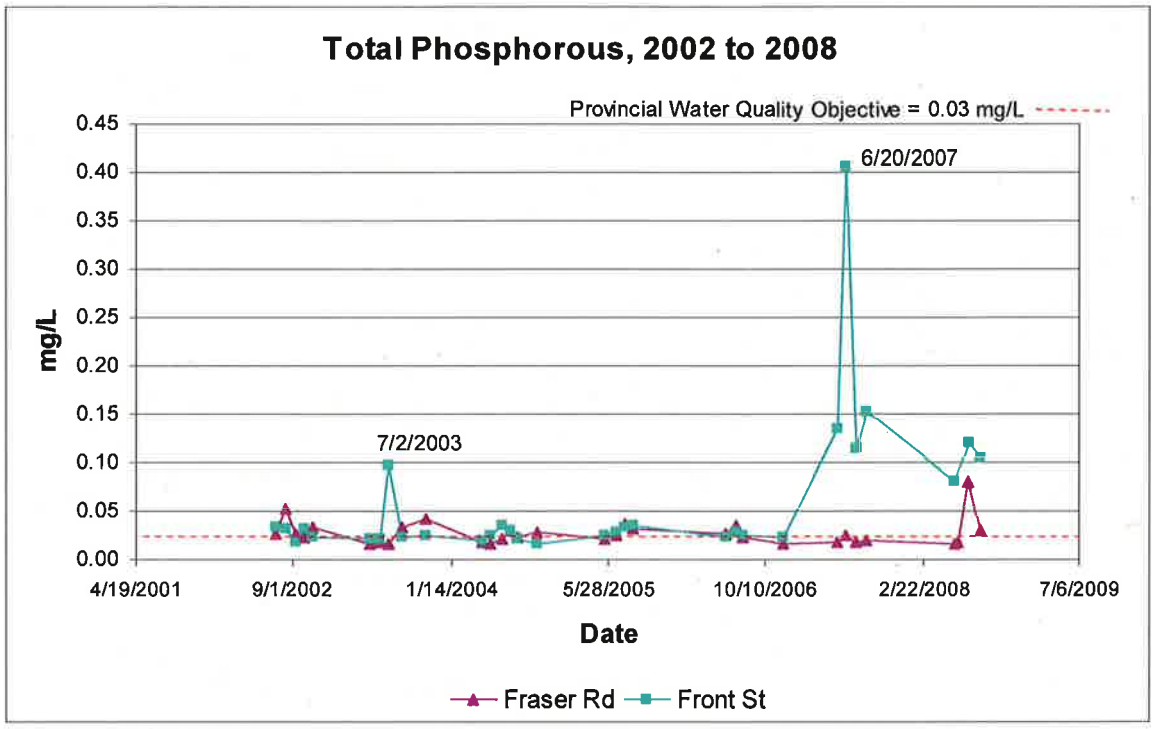


Figure 2: Total Phosphorous concentrations from Front St and Fraser Rd PWQMN stations in Mayhew Creek, 2002 to 2008.

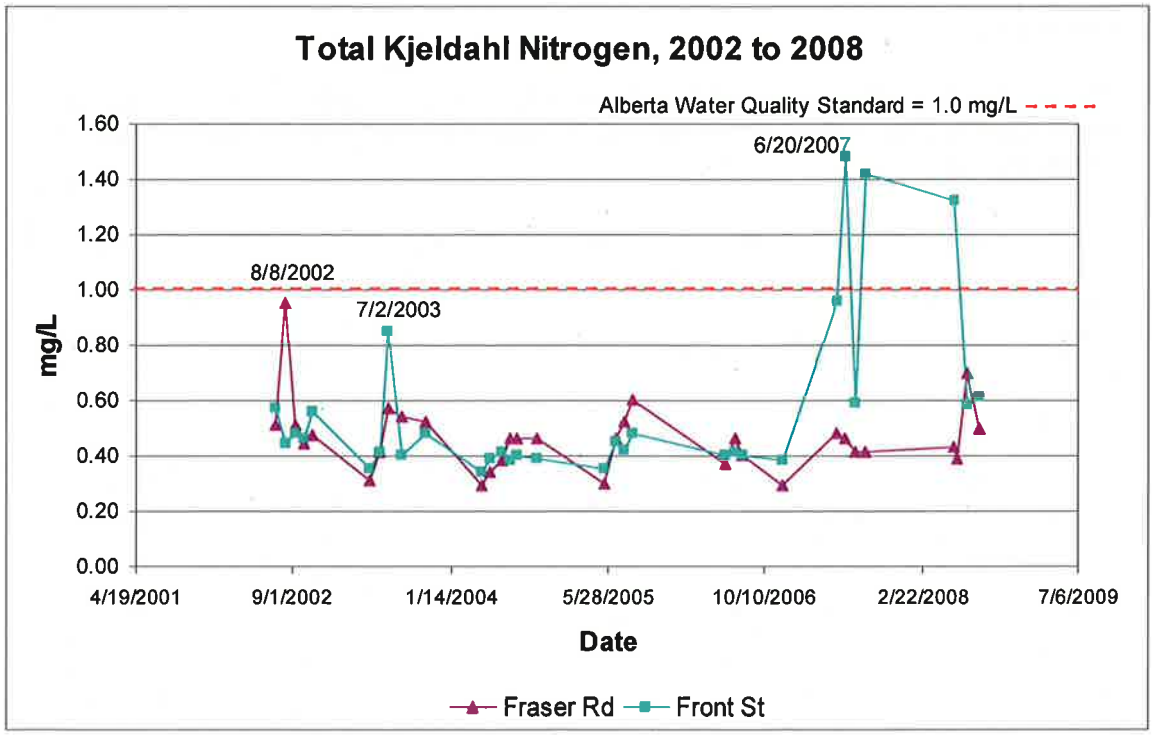


Figure 3: Total Kjeldahl Nitrogen (TKN) concentrations from Front St and Fraser Rd PWQMN stations in Mayhew Creek, 2002 to 2008.

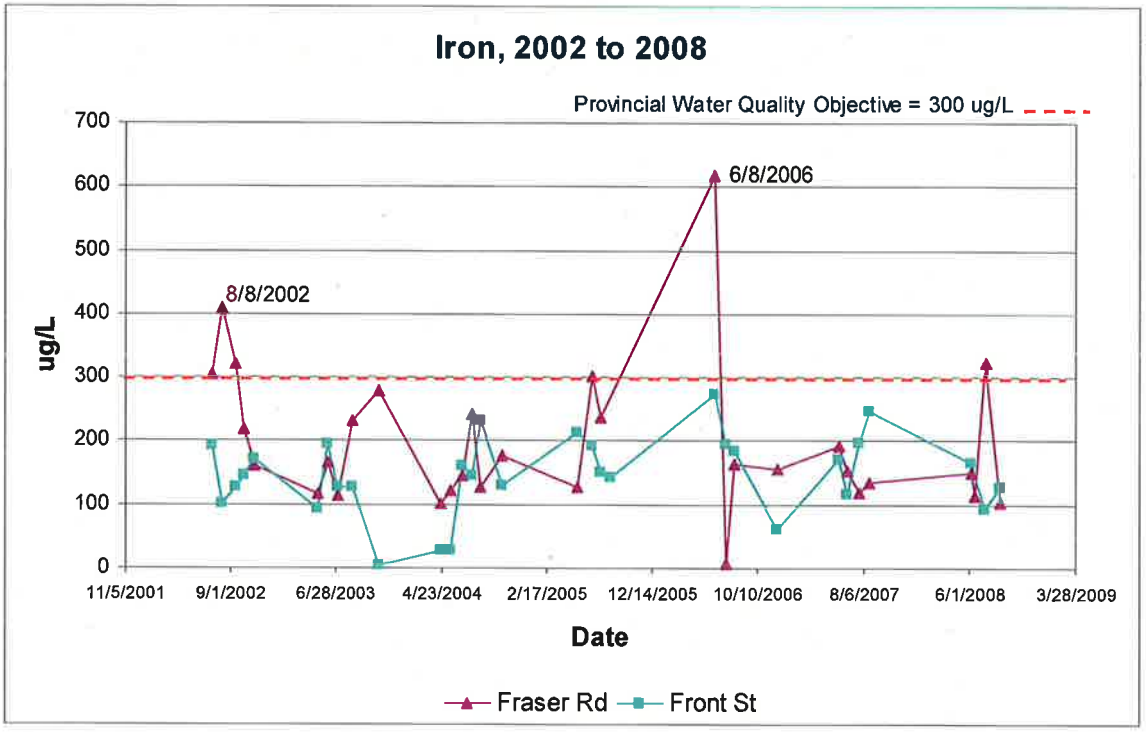


Figure 4: Iron concentrations from Front St and Fraser Rd PWQMN stations in Mayhew Creek, 2002 to 2008.

References

McNeely, R.N., V.P. Neimanis, and L. Dwyer. 1979. Water Quality Sourcebook: A guide to Water Quality Parameters. Environment Canada. Ottawa, Ontario. ISBN: 0-662-10520-6. Pp. 89

Mayhew Creek Surface Water Quality

Basic Statistics for the Mayhew Creek PWQMN station at Fraser Rd, west end of Trenton, ON from 2002 to 2008.

Parameter	Unit	# of Samples	min	max	mean	median	# of Exceedences	% of Exceedences	PWQO §	ODWS ϕ
ALKALINITY, TOTAL	mg/L	32	152	228	181.7	179	0	0		30 - 500
ALUMINIUM, UNFILTERED TOTAL	ug/L	31	-2.87	142	23.2	13.5	2	6	75	
BARIUM, UNFILTERED TOTAL	ug/L	31	25.1	59.9	45.7	46.6	0	0		1000
BERYLIUM,UNFILTERED TOTAL	ug/L	31	-0.036	0.022	0.002	0.00976	0	0	1100	
BOD, 5 DAY, TOTAL DEMAND	mg/L	11	0.7	3.3	1.5	1.5		0		
CALCIUM, UNFILTERED TOTAL	mg/L	32	52	146	115	113.3		0		
CADMIUM, UNFILTERED TOTAL	ug/L	31	-0.884	1.34	0.226	0.151	9	29	0.5	5
CHLORIDE, UNFIL.REAC	mg/L	32	28.9	53.9	43.1	42.65	0	0		250
CONDUCTIVITY, 25C	uS/cm	32	402	576	477	470		0		
COBALT, UNFILTERED TOTAL	ug/L	31	-1.76	1.35	0.162	0.287	2	6	0.9	
CHROMIUM, UNFILTERED TOTAL	ug/L	31	-1.9	1.07	0.093	0.0689	0	0	8.9	50
COPPER, UNFILTERED TOTAL	ug/L	31	-0.741	1.41	0.382	0.419	0	0	5	1000
IRON, UNFILTERED TOTAL	ug/L	31	6.64	620	199	162	6	19	300	300
STREAM CONDITION		18	0.8	0.8	0.8	0.8		0		
HARDNESS, TOTAL	mg/L	32	145	230	184	179.5	32	100		100
POTASSIUM,UNFILTERED TOTAL	mg/L	24	0.82	1.77	1.23	1.195		0		
MAGNESIUM,UNFILTERED TOTAL	mg/L	32	11.42871	19.14	15.2	15.345		0		
MANGANESE,UNFILTERED TOTAL	ug/L	31	-0.00317	236	57.2	47.5	30	97		0.05
MOLYBDENUM,UNFILTERED TOTAL	ug/L	31	-2.56	1.01	-0.279	-0.25	0	0	40	
SODIUM, UNFILTERED TOTAL	mg/L	24	20.9	33.6	27.2	27.25	24	100		20
NICKEL, UNFILTERED TOTAL	ug/L	31	-1.82	1.42	0.104	0.167	0	0	25	
AMMONIUM, TOTAL UNFIL.REAC	mg/L	32	0.002	0.266	0.042	0.0305		0		
NITRITE, UNFILTERED REACTIVE	mg/L	32	0.001	0.072	0.010	0.005	0	0		1
NITRATES TOTAL, UNFIL.REAC	mg/L	32	0.005	0.467	0.096	0.035	0	0		10
NITROGEN,TOT,KJELDAHL/UNF.REA	mg/L	32	0.29	0.95	0.463	0.46	0	0	1.0 (Alberta WQO)	

Parameter	Unit	# of Samples	min	max	mean	median	# of Exceedences	% of Exceedences	PWQO §	ODWS ϕ
LEAD, UNFILTERED TOTAL	ug/L	31	-21.1	12.4	-0.252	0.719	2	6	5	10 at pt of consumption
PH (-LOG H+ CONCN)		32	8.13	8.62	8.357	8.375	2	6	6.5 - 8.5	6.5 - 8.5
PHOSPHATE,FILTERED REACTIVE	mg/L	32	0.0005	0.0078	0.002	0.00075		0		
PHOSPHORUS,UNFILTERED TOTAL	mg/L	32	0.015	0.08	0.026	0.024	8	25	0.03	
RESIDUE,PARTICULATE	mg/L	32	1.5	15.7	4.5	3.65		0		
STRONTIUM, UNFILTERED TOTAL	ug/L	31	135	184	162	166		0		
TITANIUM, UNFILTERED TOTAL	ug/L	31	-0.511	6.12	0.530	0.275		0		
TURBIDITY	FTU	23	1.14	12.3	3.049	2.6	1	4		5
VANADIUM, UNFILTERED TOTAL	ug/L	31	-0.903	2.26	0.448	0.491	0	0	6	
ZINC, UNFILTERED TOTAL	ug/L	31	-1.08	4.47	1.01	0.71	0	0	20	5000

§ Provincial Water Quality Objective 1999
ϕ Ontario Drinking Water Quality Standard 2006

Basic Statistics for the Mayhew Creek PWQMN station at Front St, Trenton, ON from 2002 to 2008.

Parameter	Unit	# of Samples	min	max	mean	median	# of Exceedences	% of Exceedences	PWQO §	ODWS ϕ
ALKALINITY, TOTAL	mg/L	31	102	330	202.3	198	0	0		30 - 500
ALUMINIUM, UNFILTERED TOTAL	ug/L	31	-3.48	89	26.7	22.5	1	3	75	
BARIUM, UNFILTERED TOTAL	ug/L	31	28.1	83.5	51.3	48.0	0	0		1000
BERYLIUM,UNFILTERED TOTAL	ug/L	31	-0.0461	0.025	0.001	0.007	0	0	1100	
BOD, 5 DAY, TOTAL DEMAND	mg/L	11	0.5	1.8	0.982	0.9		0		
CALCIUM, UNFILTERED TOTAL	mg/L	31	75	211	132	125.1		0		
CADMIUM, UNFILTERED TOTAL	ug/L	31	-0.434	3.69	0.375	0.101	10	32	0.5	5
CHLORIDE, UNFIL.REAC	mg/L	31	42.4	170	68.6	49.6	0	0		250
CONDUCTIVITY, 25C	uS/cm	31	251	1080	593	538		0		
COBALT, UNFILTERED TOTAL	ug/L	31	-0.705	1.86	0.278	0.374	2	6	0.9	
CHROMIUM, UNFILTERED TOTAL	ug/L	31	-2.72	0.95	0.104	0.240	0	0	8.9	50

Parameter	Unit	# of Samples	min	max	mean	median	# of Exceedences	% of Exceedences	PWQO §	ODWS ϕ
COPPER, UNFILTERED TOTAL	ug/L	31	-0.126	3.17	0.784	0.590	0	0	5	1000
IRON, UNFILTERED TOTAL	ug/L	31	5.47	273	147	145	0	0	300	300
STREAM CONDITION		19	0.8	0.8	0.8	0.8		0		
HARDNESS, TOTAL	mg/L	31	136	308	209	209	31	100		100
POTASSIUM,UNFILTERED TOTAL	mg/L	24	0.87	2.3	1.45	1.33		0		
MAGNESIUM,UNFILTERED TOTAL	mg/L	31	13.43	22.6	17.9	17.7		0		
MANGANESE,UNFILTERED TOTAL	ug/L	31	0.062	121	38.0	38.1	31	100		0.05
MOLYBDENUM,UNFILTERED TOTAL	ug/L	31	-1.97	2.1	-0.105	-0.014	0	0	40	
SODIUM, UNFILTERED TOTAL	mg/L	24	25.9	41.3	29.8	28.5	24	100		20
NICKEL, UNFILTERED TOTAL	ug/L	31	-0.737	4.16	0.762	0.469	0	0	25	
AMMONIUM, TOTAL UNFIL.REAC	mg/L	31	0.002	0.62	0.056	0.022		0		
NITRITE, UNFILTERED REACTIVE	mg/L	31	0.002	0.08	0.017	0.011	0	0		1
NITRATES TOTAL, UNFIL.REAC	mg/L	31	0.028	2.41	0.444	0.188	0	0		10
NITROGEN,TOT,KJELDAHL/UNF.REA	mg/L	31	0.34	1.48	0.566	0.44	3	10	1.0 (Alberta WQO)	
LEAD, UNFILTERED TOTAL	ug/L	31	-11.1	5.41	-1.799	-1.11	1	3	5	10 at pt of consumption
PH (-LOG H+ CONCN)		31	8.09	8.53	8.304	8.3	1	3	6.5 - 8.5	6.5 - 8.5
PHOSPHATE,FILTERED REACTIVE	mg/L	31	0.0005	0.117	0.020	0.0036		0		
PHOSPHORUS,UNFILTERED TOTAL	mg/L	31	0.015	0.406	0.058	0.027	14	45	0.03	
RESIDUE,PARTICULATE	mg/L	31	1.1	22.5	5.4	4.3		0		
STRONTIUM, UNFILTERED TOTAL	ug/L	31	123	287	188	175		0		
TITANIUM, UNFILTERED TOTAL	ug/L	31	-0.846	2.9	0.365	0.245		0		
TURBIDITY	FTU	23	1.25	3.1	2.255	2.37	0	0		5
VANADIUM, UNFILTERED TOTAL	ug/L	31	-0.851	1.94	0.543	0.51	0	0	6	
ZINC, UNFILTERED TOTAL	ug/L	31	-0.978	29.8	3.08	0.94	1	3	20	5000

§ Provincial Water Quality Objective 1999

ϕ Ontario Drinking Water Quality Standard 2006