

Appendix ‘C-1’ – Surface Water and Groundwater Quality Evaluation Methods

Surface Water Quality Evaluation and Scoring

The surface water quality assessment was carried out on a watershed basis. The watersheds in the Cataraqui Source Protection Area (CSPA) are shown on **Map 2-2**. The following watershed breakdown was used for this assessment (from east to west):

- Buells and Butler’s Creeks
- St. Lawrence River
- Lyn and Jones Creek
- Gananoque River
- Cataraqui River
- Frontenac Islands
- Amherst Island
- Little Cataraqui Creek
- Collins Creek
- Millhaven Creek
- Bay of Quinte.

Grades were assigned to each watershed based on the score for the 75th percentile concentration for total phosphorous and chloride at the Provincial Water Quality Monitoring Network (PWQMN) stations, Cataraqui Region Conservation Authority data on Hilsenhoff Order level biotic index for benthic macroinvertebrates, and the trophic status from the Lake Partner Program (MOE).

The data range used was 2004 to 2008 for all datasets (five years) and the components of the surface water assessment were weighted as follows:

- PWQMN (chloride and total phosphorus) (37.5 per cent)
- benthic macroinvertebrates (Hilsenhoff Biotic Index) (25 per cent)
- Lake Partner Program (Canadian Water Quality Guideline trophic status based on total phosphorus) (37.5 per cent).

The weighting of benthic macroinvertebrate data was lower relative to the other two data sources as a reflection that this data set may be affected by factors other than water quality and that a more refined measure of biotic integrity (family level index) was not available.

Further detail on how each data set was incorporated into this assessment is provided below.

Benthic Invertebrates

The Hilsenhoff Biotic Index (HBI) based on order-level data for subwatersheds was scored based on the table below. The average values per subwatershed were used, as a modification of the methods recommended by Conservation Ontario for the preparation of watershed report cards across Ontario.

Provincial Water Quality Monitoring Network

All PWQMN stations within the watersheds were used in this analysis. Five-year, 75th percentile data for chloride and total phosphorus concentrations were used. Total phosphorus was evaluated according to the methods for the production of Watershed Report Cards across Ontario, whereas the evaluation for chloride was based on the natural background concentrations and concentrations of chloride that may cause impacts on aquatic life, based on the information presented in Priority Substances List Assessment Report: Road Salt (Environment Canada and Health Canada, 2001).

Benthic Invertebrates		Provincial Water Quality Monitoring Network			
HBI (Order)		Chloride		Phosphorus (mg/l)	
Score	75 th Percentile	Score	75 th Percentile (mg/l)	Score	75 th Percentile (mg/l)
5	<5.00	5	0-35	5	<0.03
4	5.01-5.75	4	36-70	4	0.03-0.10
3	5.76-6.50	3	71-140	3	0.11-0.17
2	6.51-7.25	2	141-210	2	0.18-0.24
1	>7.25	1	>210	1	>0.24

Lake Partner Program

The source for this data is the Ontario Lake Partner Program, download from the Provincial database (data available for the Cataraqui and Gananoque subwatersheds only). The inclusion of this data set allowed for the consideration of lake country, for which no PWQMN data exist. The data range considered was 2004 to 2008.

The Canadian Water Quality Guideline classifications for trophic status were used to score the each of the lakes and the score per subwatershed was assigned based on the average of all single lake median trophic statuses. The classification “ultra-oligotrophic” (0 - <4 micrograms per litre) was excluded from the scoring based on local conditions.

Lake Partner Program		
Score	Classification	75 th Percentile (µg/l)
5	Oligotrophic	4 to <10
4	Mesotrophic	10 to <20
3	Meso-eutrophic	20 to <35
2	Eutrophic	35 to <100
1	Hyper-eutrophic	≥100

Surface Water Quality: Overall Grades

The overall grade for each watershed was assigned according to the average score of the evaluated components, described above. The breakdown of the grades assigned to a given score is given in the table below (numbers have been rounded).

Grade	Average Score of Components	Grade	Average Score of Components
A	4.7 – 5.0	C	2.7 – 3.0
A -	4.3 – 4.7	C -	2.3 – 2.7
B +	4.0 – 4.3	D +	2.0 – 2.3
B	3.7 – 4.0	D	1.5 – 2.0
B -	3.3 – 3.7	D -	1.0 – 1.5
C +	3.0 – 3.3	F	0 – 1.0

Groundwater Quality Evaluation and Scoring

Groundwater quality was evaluated, using the main bedrock units as units of analysis. The main bedrock units in the Cataraqui Source Protection Area are: Precambrian, Verulam, Bobcaygeon, Gull River, March, Nepean/Potsdam, and Oxford.

Recent, high quality groundwater data are sparse and several data sources were used to represent as much of the Cataraqui Source Protection Area as possible. Data sources for the groundwater quality evaluation were:

- Provincial Groundwater Monitoring Network (PGMN) (2003-2004, 2006-2009)
- Western Cataraqui Groundwater Study (Trow, 2007) with data from 2001
- United Counties Leeds and Grenville Groundwater Management Study (Dillon, 2001) with data spanning 1969-2001.

Grades were assigned based on average score for the 75th percentile concentration for nitrate + nitrite (50 per cent), chloride (25 per cent) and sodium (25 per cent), weighted as referenced in brackets. Sources of sodium and chloride are often similar and are therefore given a combined weighting equal to that of nitrate+nitrite. Where all three datasets were present for the area (within one bedrock unit), PGMN data was given a 50 per cent weight, Trow 25 per cent, and Dillon 25 per cent, but the datasets are not consistent across the Cataraqui area.

The scores for the three water quality parameters evaluated in the groundwater quality assessment were determined follows:

**Cataraqui Source Protection Area
Assessment Report – Appendix ‘C-1’
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Nitrite+Nitrate		Chloride		Sodium	
Score	75 th Percentile (mg/l)	Score	75 th Percentile (mg/l)	Score	75 th Percentile (mg/l)
5	<3.0	5	0-50	5	0-10
4	3.1-7.0	4	51-100	4	11-20
3	7.1-10.0	3	101-150	3	21-110
2	10.1-20.0	2	151-200	2	111-199
1	>20.0	1	>200	1	>199

The nitrate+nitrite and chloride criteria were already developed for use in the Cataraqui Region Conservation Authority Watershed Report Card (CRCA, 2009).

The sodium criteria were developed for this assessment report exercise. The rationale for the ranges associated with each grade is explained below.

- a score of five was given for areas with half the concentration related to the Health Objective listed on the Ontario Drinking Water Standard for people with sodium restrictive diets
- a score of four was given for areas where sodium concentration was in the upper range, including the limit, for the above noted objective.
- a score of one was given for areas where sodium exceeded the Ontario Drinking Water Standard Aesthetic Objective
- The remaining scores are simply a division of the remaining values between scores of four and one.

Groundwater Quality: Overall Grades

The overall grade for each bedrock subunit was assigned according to the average score of the evaluated components, described above. The breakdown of the grades assigned to a given score is given in the table below (numbers have been rounded).

Grade	Average Score of Components	Grade	Average Score of Components
A	4.7 – 5.0	C	2.7 – 3.0
A -	4.3 – 4.7	C -	2.3 – 2.7
B +	4.0 – 4.3	D +	2.0 – 2.3
B	3.7 – 4.0	D	1.5 – 2.0
B -	3.3 – 3.7	D -	1.0 – 1.5
C +	3.0 – 3.3	F	0 – 1.0