WATERSHED WATCH

COVERING THE RIDEAU VALLEY WATERSHED

Summary of Results — 2006 – 2008

Each summer since 2001, the Rideau Valley Conservation Authority field technicians have collected water samples from watershed lakes under the **Watershed Watch** program. For the first five years of the program, six to eight lakes were sampled eight times each year. In 2006, the program was modified to allow for annual sampling on 38 lakes (46 sampled waterbodies, after dividing the largest lakes into two or more sampling units). The frequency of sampling was reduced to three times each year per lake to accommodate sampling on more lakes within the watershed.

This report is a summary of the sampling results from 2006 through 2008 — the period for which we have a consistent set of data across all 46 sampled waterbodies. The observed concentrations of total phosphorus (TP), total Kjeldahl nitrogen (TKN), and calcium (Ca) in samples drawn at the deepest points of each sampled waterbody are listed in the accompanying tables. Deep point sample results are most indicative of the "background" concentrations in each waterbody at the time of the sampling.

The primary focus is on tracking the trophic state of the lakes which is done by looking at the quantity (concentration) of nutrients (phosphorus, nitrogen and, too a lesser extent calcium) available to support the growth of algae and aquatic plants.

Total Phosphorus

Taking a closer look at the 391 total phosphorus (TP) data for the past three years, generally, the news is good.

When TP concentrations are routinely greater than 20 micrograms/litre (µg/l) in a lake, profuse plant growth can be expected to occur. As can be seen, relatively few samples had concentrations above 20 µg/l – only nine percent of all the samples collected over the three years.

wide variability over relatively short periods of time, for example:

- Bass Lake: 12 to 67
- Burridge Lake: 9 to 64
- Butterill: 16 to 51
- Fermoy: 29 to 16
- Little Silver: 15 to 70 to 10
- Loon: 13 to 60
- Rainbow: 25 to 14 to 53

All Lakes – TP observations 2006 to 2008

Sample Run		2006	2007	2008
Spring	% samples < 10 ug/l	0	38	22
	% samples > 10, < 20 ug/l	93	60	67
	% samples > 20 ug/l	7	2	11
Mid-summer	% samples < 10 ug/l	5	42	45
	% samples > 10, < 20 ug/l	75	51	53
	% samples > 20 ug/l	20	7	2
Early Fall	% samples < 10 ug/l	7	30	46
	% samples > 10, < 20 ug/l	79	61	49
	% samples > 20 ug/l	14	9	5

Many of the lakes which have had results greater than 20 µg/l also had results less than 10 µg/lat other times. TP concentrations vary from year to year and from season to season through each year. This variability in the observations indicates that there are many factors which influence TP concentration in the lake at a given time.

For example, the data show that TP concentrations were generally higher in 2006 than in 2007 and 2008. This is likely due to temperatures that were higher than in the subsequent two years beginning in mid-March. This continued through the summer and, the resulting evaporation combined with generally lower precipitation beginning in early April, likely resulted in less total discharge through the lake - and therefore greater concentration of nutrients in the lake — over the summer and fall months

No lake had TP concentrations below 10 µg/l on all three sampling dates. There are a few consecutive TP results that would indicate very

With this wide variability, classification of lakes based on averages by year or over the three years does not tell a complete story. And drawing trend lines can be misleading when there is so much time between consecutive observations, and so much range in their values. A “qualitative” scan of the full data set, however, can give an overall impression of the lakes’ status individually and collectively:

- 18 of the lakes (almost half) have tested over 20 µg/lat least once
- 10 tested over 20 µg/l at least twice
- only three tested over 20 µg/l on three or more occasions (Bobs – Mill Bay, Rainbow and Upper Rideau)
- two lakes tested over 20 µg/l in all three sample runs in one season (2006, Bobs – Mill Bay and Upper Rideau)
- in 2007 and 2008 only two lakes tested over 20 µg/ll for two consecutive sample runs (Long Pond, Upper Rideau)

Total Kjeldahl Nitrogen

Total Kjeldahl Nitrogen (TKN) analysis is done as a further indicator of nutrient loading and the possible presence of organic pollution sources. There appears to be a detectable correlation between observed TP concentration and observed TKN concentration on a given sample date at a given site — elevated TP often coincides with elevated TKN. At the same time, it is interesting that a few lakes, such as McLaren and Loon, have consistently high TKN but only slightly elevated TP.

Based on this qualitative look at the data for the past three years, there are some lakes that appear to have more erratic nutrient concentrations on a persistent basis and could be considered to be closer to the eutrophic category than others:

- Bass Lake
- Bobs - Mill Bay
- Butterill Lake
- Little Crosby Lake
- Little Silver Lake
- Loon Lake
- McLaren Lake
- Rainbow Lake
- Upper Rideau Lake

These water bodies are not concentrated within any single branch of the lakes and stream network within the Rideau System above Kilmarnock. However, it is worth noting that three of these lakes are within the watersheds of two of the lakes that are classified as cold water habitat for salmonid (lake trout) fish species:

- Butterill Lake > Upper Rideau Lake > Big Rideau Lake
- Loon Lake > Big Rideau Lake

Results from water clarity measurements and dissolved oxygen / temperature profiles corroborate the nutrient monitoring results. The depth at which a Secchi disk can no longer be seen is an indication of how much suspended material there is in a lake. Visibility of less than two metres is considered to be an indication of poor water quality. A measurement of two metres was taken in Beveridges Bay of Lower Rideau Lake in 2007 but the average for all the lakes is about 4.9 metres which, as with the TP concentrations, is indicative of mesotrophic or middle-aged waterbodies.

Other Water Quality Indicators

Dissolved oxygen / temperature profiles have been done routinely at the deep points of the lakes each summer and have typically indicated that the lakes are generally affected by moderate growth of algae and plants that sink to the bottom as they die off. All of the lakes experience anoxic conditions (no oxygen) to some extent in the lower part of the water column (hypolimnion) where oxygen is depleted by respiration and by the decay process and cannot be replaced until the lake cools in the fall. The reduction of oxygen in the deeper parts combined with warming of the upper waters causes the useable water for fish to decline through the summer. This is a particular problem for lakes that have lake trout populations that need cold water and lots of oxygen — Crow, Eagle, Green Bay of Bobs Lake and Big Rideau. Eagle Lake appears to be the "worst" case of the cold water lakes with minimum habitable conditions occurring in each of the last three years.

In keeping with the other parameters, samples for **Esherichia Coli** (*E.Coli*) have been sporadically above the Provincial Water Quality Objectives (PWQO), but not significantly or persistently so. This sampling, done at shoreline locations around the lakes, is intended to detect sources of bacterial and toxic pollution. The PWQO for *E.Coli* is 100 counts per 100 millitres of sample for swimming. In the three years of the Watershed Watch Program being summarized here, 16 of 1,040 samples had counts above the PWQO. None persisted through subsequent sampling. Two high *E.Coli* results in July and August of 2004 were recorded on Black Lake. It was attributed to cattle access to the lake. A fence was installed and no further exceedances have occurred. Exceedances in other lakes could not be related to particular sources.

The last parameter to be discussed here is **calcium**. It is not directly a cause of or product of eutrophication but is relevant to the health of lakes in two ways. Present research indicates that zebra mussels need 20 µg/L of calcium for their lifecycle. Half of the Rideau watershed lakes have calcium concentrations above 20 µg/L. Zebra mussels have been detected in 19 of the 38 lakes over the several years of monitoring. In 2008, 29 of the lakes were sampled and mussels were found in eight, all with calcium concentrations above 20 µg/L. Continued effort is necessary to ensure that invasive mussels do not have the opportunity to spread to any other lakes.

Measuring calcium concentrations may also be useful in the context of understanding the impacts of climate change. Researchers have suggested that, with the decline in acid rain, there has been a corresponding decline in calcium concentrations due to reduced chemical reaction between rainwater and carbonaceous soils and rock. Like the zebra mussel, many creatures need calcium to form their shells and skeletal structures. Unlike the zebra mussel, such minute animals as Daphnia are important elements of lake food chains and declines in their populations can be expected to have repercussions throughout the food web. The period of record for calcium concentration observations is too short to detect any trends yet.

If close attention is paid to land use and land management practices — not only around the nine apparently more susceptible lakes mentioned above but also to all of the lakes of the Rideau Valley and in their watersheds, nutrient loads from human activities can be controlled and reduced so as to avoid accelerating the eutrophication process. There is a lot of good information on best management available in many places. RVCA intends, by publishing these data on an annual basis, to provide the information that landowners, non-governmental organizations and government bodies need in order to evaluate the progress they are making to achieve healthy lake environments on a sustained basis.

Concentrations of Total Phosphorus

Concentrations of TP (micrograms/litre) cold water fish habitat

LAKE	2006			2007			2008			average
Adam	18	28	22	14	14	11	15	14	14	17
Bass	15	16	15	10	10	13	20	12	67	20
Big Rideau	10	14	13	8	7	9	8	7	9	9
Black	13	16	17	12	9	12	9	12	9	12
Bobs Buck Bay	18	17	17	8	10	9	12	10	8	12
Bobs Central Narrows	13	13	19	10	8	8	11	7	8	11
Bobs E. Basin, Long Bay	14	11	14	12	9	6	10	8		10
Bobs Green Bay	12	9	12	7	7	9	7		7	9
Bobs Mill Bay	54	21	30	16	14	14	12	10		21
Bobs Mud Bay	13	15	18	14	9	9	9	9	15	12
Bobs Norris Bay	16	16	14	14	10	7	10	5		12
Bobs West Basin	12	12	16	9	9	7	11	8	9	10
Burridge	18	16	11	9	9	64	6	5	6	16
Butterill		39	17	10	11	16	51	13	9	21
Carnahan	18	17	15	17		20	13	9	15	16
Christie	13	15	14	10	8	11	8	13	9	11
Crosby	13	14	13	18	12	10	12	12	13	13
Crow	12	11	13	7	10	25	11	8	6	11
Davern	12	16	8	12	8	7	11	5	7	10
Eagle	12	13	10	8	5	8	15	6		10
Elbow		16	17	14	14	11	11	11	16	14
Farren	12	9	11	9	9	19	7	13	8	11
Fermoy	20	29	16				11		10	17
Green	13	17	10	7	6	6	5	5	7	8
Hoggs Bay, Big Rideau		16	15	11	11	10	16	16	16	14
Leggatt	12			8	19	10	13	11	6	11
Little Crosby	16	16	45	18	21		14		12	20
Little Silver	15	70	10	29	14	15	17	8	13	21
Long (west)	16	23	14	10	17	11	13	9	10	14
Long east	14	21	18	9	8	15	24	8	8	14
Long Pond	14	18	13	12	9	29	26	15	9	16
Loon		14	11	11	11	12	13	60	12	18
Lower Rideau	13	15	13	14	11	13	11		10	12
McLaren	20	19	18	12	13	14	22	16		17
O'Brien	13	10	9	9	5	8	11	9	7	9
Otter	11	12	14	8	5	12	6	9	8	9
Otty	16	18	16	8	10	15	7	11	13	13
Pike	14	15	9	12	9	11	12	10	10	11
Rainbow	21	25	15	17	14	16	25	14	53	22
Rock	12	11	11	8	7	11	5	9	11	9
Round	12	11	12	9		9	10	9	7	10
Spectacle	19	16		13	13	14	14	12	12	14
Tommy	19	16	14	16	11	11	15	11	8	13
Upper Rideau	26	27	25	13	22	24	14	19	20	21
Westport Sand	18		22	14	27	17	12	11	13	17
Wolfe	16	13	27	9	11	15	10	11	10	13
average	16	18	16	12	11	14	13	11	13	14
# samples	42	44	44	45	43	44	46	42	41	391
# exceedances (>20)	3	9	6	1	3	4	5	1	2	34
% exceedances	7%	20%	14%	2%	7%	9%	11%	2%	5%	9%

Concentrations of Total Kjeldahl Nitrogen

Concentrations of TKN (micrograms/litre) cold water fish habitat

LAKE	2006			2007			2008			average
Adam	400	1520	420	410	490	420	420	430	450	551
Bass	410	420	370	410	430	470	400	430	1150	499
Big Rideau	310	360	310	310	310	325	337	320	365	327
Black	430	430	410	410	370	390	410	420	380	406
Bobs Buck Bay	440	450	420	340	410	400	360	370	450	404
Bobs Central Narrows	420	390	360	360	400	380	370	330	350	373
Bobs E. Basin, Long Bay	445	360	360	350	340	390	365	305		364
Bobs Green Bay	290	330	310	260	360	340	310		330	316
Bobs Mill Bay	880	530	650	440	430	500	400	320		519
Bobs Mud Bay	400	390	410	390	330	370	370	340	410	379
Bobs Norris Bay	460	390	330	420	370	370	410	270		378
Bobs West Basin	330	390	380	380	420	428	360	350	330	374
Burridge	420	410	370	340	370	580	430	360	440	413
Butterill		610	460	410	500	510	760	450	390	511
Carnahan	470	490	480	520		550	380	440	500	479
Christie	370	340	300	310	330	450	400	340	380	358
Crosby	380	430	410	420	410	370	460	450	420	417
Crow	290	310	360	270	320	460	260	270	270	312
Davern	400	480	410	430	390	380	340	350	430	401
Eagle	310	330	340	350	330	330	330		310	329
Elbow	410		510	420	450	480	460	400	440	446
Farren	320	380	410	340	380	350	330	380	340	359
Fermoy	390	580	460					330	530	458
Green	310	430	340	280	290	320	290	280	340	320
Hoggs Bay, Big Rideau		430	490	420	430	370	440	430	600	451
Leggatt	400			290	410	330	330	360	340	351
Little Crosby	400	460	560		400	410	430		430	441
Little Silver	405	450	320	415	335	405	410	280	425	383
Long (west)	450	470	410	480	440	400	320	360	370	411
Long east	360	460	470	400	400	400	450	310	360	401
Long Pond	450	490	410	410	460	510	490	420	400	449
Loon		510	530	560	460	630	510	1160	540	613
Lower Rideau	345	380	390	400	425	490	510	390	380	412
McLaren	560	640	600	440	540	700	550	590		578
O'Brien	410	500	440	400	410	410	430	410	390	422
Otter	400	405	395	345	410	415	410	415		399
Otty	410	530	400	350	430	490	380	410	400	422
Pike	300	420	390	390	380	460	390	330	410	386
Rainbow	480	570	460	480	460	570	590	500	830	549
Rock	410	400	450	370	360	370	340	360	380	382
Round	350	370	490	370		360	320	320	360	368
Spectacle	440		390	490	430	430	400	420	420	428
Tommy	480	420	430	430	440	450	400	400	420	430
Upper Rideau	425	460	430	400	425	475	410	515	400	438
Westport Sand	480		430	400	400	410	410	360	440	416
Wolfe	365	385	400	365	345	505	365	305	385	380
average	409	464	419	390	400	435	405	395	431	417
# samples	43	42	45	44	43	45	45	43	41	391
# exceedances (>500)	2	8	5	2	1	8	5	3	5	39
% exceedances	5%	19%	11%	5%	2%	18%	11%	7%	12%	10%

Concentrations of Calcium

Concentrations of Ca (milligrams/litre)					2008
LAKE	2006	2007	2008	average	ZM results
Adam	27.0	30.0	33.0	30	ZM
Bass	24.0	29.0	27.7	27	NM '08
Big Rideau	27.5		26.7	27	ZM
Black	23.0	22.0	22.3	22	MND
Bobs Buck Bay	13.3	15.3	14.7	14	NM '08
Bobs Central Narrows	16.9	17.3	16.3	17	NM '08
Bobs E. Basin, Long Bay	14.9	17.7	17.1	17	MND
Bobs Green Bay	24.0	27.0	23.4	25	NM '08
Bobs Mill Bay	16.9	16.7	17.5	17	NM '08
Bobs Mud Bay	17.7	19.4	17.9	18	NM '08
Bobs Norris Bay	16.9	18.0	18.4	18	MND
Bobs West Basin	14.2	16.3	15.2	15	NM '08
Burridge	33.0	34.0	32.3	33	ZM
Butterill	40.0	39.0	33.8	38	NM '08
Carnahan	14.7		14.2	14	MND
Christie	19.2	19.4	18.3	19	NM '08
Crosby	15.4	15.7	14.7	15	MND
Crow	17.3	17.3	17.5	17	NM '08
Davern	34.0	35.0	34.3	34	NM '08
Eagle	14.0	15.1	14.5	15	MND
Elbow		7.1	7.2	7	MND
Farren	28.0	30.0	28.7	29	MND
Fermoy	21.0		29.6	25	MND
Green	4.3	4.4	3.9	4	MND
Hoggs Bay, Big Rideau	25.0		22.7	24	ZM
Leggatt		9.0	9.1	9	NM '08
Little Crosby	14.8	16.0	14.9	15	NM '08
Little Silver	17.2	17.9	16.9	17	MND
Long (west)	16.3	12.0	14.1	14	MND
Long (east)	23.0	24.0	24.0	24	MND
Long Pond	27.5	28.0	27.7	28	MND
Loon			40.7	41	MND
Lower Rideau	24.5	26.5	25.5	26	ZM
McLaren	33.0	29.0	30.5	31	NM '08
O'Brien	22.5	22.5	22.0	22	MND
Otter	31.0	32.5	32.2	32	ZM
Otty	28.0	27.0	28.0	28	NM '08
Pike		19.1	18.0	19	MND
Rainbow	18.2	18.9	19.1	19	MND
Rock	5.5	5.8	5.2	5	MND
Round	27.0		23.0	25	NM '08
Spectacle	12.4	16.1	10.9	13	MND
Tommy	17.2	31.0	15.9	21	MND
Upper Rideau	23.0	26.5	24.3	25	ZM
Westport Sand		29.0	26.3	28	ZM
Wolfe	27.5	28.0	27.5	28	NM '08

# samples	173
# exceedances (>20)	87
% exceedances	50%

zebra mussels detected	ZM
monitored - not detected	MND
not monitored in 2008	NM '08
ZM previously detected	

Big Rideau Lake, photo: Simon Lunn

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