# A Summary of Results of the 1997-1998 Kings County Volunteer Water Quality Monitoring Program*

Prepared for

Kings County Water Quality Monitoring Volunteers
and
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## Introduction

In early 1997 the Municipality of Kings County began a volunteer water quality monitoring program at a number of lakes located within the Gaspereau River watershed. This program was initiated in order to validate a lakeshore capacity model developed for this region by Horner Associates Ltd., an Ontario based consulting firm. The model attempts to predict how water quality will be affected by changes in development within the watershed. Three years of data have been collected to date, one year (1993) by Horner Associates Ltd and two years (1997-98) by the volunteer group. This report provides a brief summary of the results.

## Methods

Prior to the beginning of each year of the program volunteers were trained at a workshop held at Acadia University in the procedures for making field observations, recording data and proper collection of water samples. A manual (based on a prototype being developed by the Nova Scotia Department of the Environment) describing in detail the various procedures was also provided to each volunteer. Sampling was carried out at monthly intervals between early May and late October of each year. The water samples collected at each site were delivered on the same day to an individual who had the responsibility of ensuring that samples were collected, packaged properly and sent by bus for analysis at the Environmental Chemistry Laboratory of the Queen Elizabeth II Health Science Centre in Halifax. All of the data collected has been tabulated as an Access database and is presented in Appendix I. In addition to that collected by the volunteers during 1997-98, the database also contains the information collected by Horner and Associates during 1993.

## Results

A total of eleven sites were monitored, but not all were monitored during all years. One of these sites, Hardwood Lake, is located outside of the Gaspereau watershed and serves as a control site. Interpretation of the results is largely restricted to consideration of the levels of total phosphorous, chlorophyll *a* and Secchi Disk depths. These three variables are the ones typically used to evaluate water quality with respect to the influence of development within watersheds. Total phosphorus is the nutrient most commonly associated with *eutrophication*, a term used to describe the conditions associated with excessive algal growth in water bodies. Chlorophyll *a* is a measure of the amount of algae contained in the water and Secchi Disk depth is a measure of the transparency of the water body. The values of each of these parameters commonly associated with varying levels of water quality are presented in Table 1.

Table 1. Water quality criteria.

| Parameter | **GOOD** | **MEDIUM** | **POOR** |
|---|---|---|---|
| Total Phosphorus (mg/l) | < 0.010 | 0.010 - 0.020 | > 0.020 |
| Chlorophyll *a* (μg/l) | < 3.5 | 3.5 - 5.0 | > 5.0 |
| Secchi Depth (meters) | > 5 | 3 - 5 | < 3 |

Bar graphs have been used to summarize the mean value of each of these variables at each site as averages for both 1997 and 1998 (Figure 1a) and averages for each year (Figure 1b). The dashed lines on each graph represent the levels that correspond to good, medium and poor water quality.

In general, total phosphorus levels fall within the lower to mid medium water quality range, the higher values being at Murphy, Gaspereau, Trout River and Little River Lakes. For those lakes having more that one year of data (see Figure 1b) there does not appear to be any consistent trend in total phosphorous levels; Hardwood (the control), George, Black River and Lumsden show increasing phosphorus levels, Loon and Murphy show decreasing levels, and Aylesford shows little change. Hardwood also exhibited an increase but it is not clear how significant this change is. More data is required to determine the significance of these trends. One noteworthy result, however, is the relatively large increase in total phosphorous at Lumsden Pond between 1997 and 1998. This is also true of total nitrogen levels and may indicate that this lake is experiencing nutrient enrichment.

Unlike the total phosphorus levels, the values of chlorophyll *a* fall mostly within the good water quality range. Only Loon Lake and Lumsden Pond are within the medium water quality range. Oddly, despite the high total phosphorus levels at Murphy Lake, chlorophyll *a* levels are among the lowest recorded.

Secchi Disk depths fall mostly within the poor water quality range and show little relationship to either total phosphorus or chlorophyll *a* levels. The low Secchi disk readings, however, are probably not indicative of poor water quality, but a result of the presence of naturally colored water due to humic acids which originate from decomposition of conifers and leach into the lakes. The relationship of Secchi Disk depth to chlorophyll *a* levels and variables related to water color is shown in Figure 2. Secchi Disk depth shows a much better relationship to water color than to chlorophyll *a* suggesting that the typical relationship between Secchi Disc depth and water quality may not be appropriate for these lakes.

Figures 3a and 3b are bar graphs of total phosphorous, total nitrogen and the ratio between total nitrogen and total phosphorous. In general, N:P ratios greater than seven indicate that phosphorus, as opposed to nitrogen, is the nutrient limiting algal growth. The N:P ratios are mostly above 15 and clearly indicate that phosphorus is the limiting nutrient in these lakes. This is important to know because the lake capacity model assumes phosphorus to be the limiting nutrient.

Bar graphs of pH, alkalinity and conductivity have also been prepared (Figures 4a and 4b). These variables are all related to each other. pH is a measure of the acidity of the water,

alkalinity is a measure of the ability of the water to buffer or resist changes in pH (i.e., to resist the effects of acid precipitation) and conductivity is a measure of the salt content (hardness) and, in most instances, an approximate measure of the salts that impart alkalinity. The pH of all the lakes is good, ranging between 6 and 7 (generally, pH values below about 5 indicate acidification problems). The levels of alkalinity and conductivity, however, are low indicating that in the near future these lakes may lose their ability to buffer acid precipitation.

Figures 5a and 5b are bar graphs showing the relationship between measured values of total phosphorus and chlorophyll *a* and the values predicted by the lakeshore capacity model. For total phosphorus, the model predictions are good for all lakes except Gaspereau, Trout River and Little River where the values are significantly underestimated. In the case of chlorophyll *a* levels, the model predictions are good only for Hardwood, George, Trout River and Black River Lakes. All other lakes, with the exception of Murphy, are underestimated by the model. Chlorophyll *a* values for Murphy Lake are estimated to be about twice the measured values.

Figure 6 and Appendix II contain graphs that illustrate the seasonal variation in the data. Figure 6 presents the data for all lakes combined and the Figures in Appendix II present the data for each lake. With the exception of total nitrogen levels at Lumsden Pond, there are no obvious consistent seasonal trends. At Lumsden Pond total nitrogen levels exhibit a consistent increase with time.

**Conclusions**

Based on the data, in particular that for chlorophyll *a* levels, collected to date, water quality within the lakes studied generally appears to be good,

The elevated levels of total phosphorus and total nitrogen in 1998 at Lumsden Pond should be noted and further monitored to determine its significance,

Additional data is required to determine whether or not any consistent temporal trends in water quality exist,

There is an obvious need to better define the relationships between water quality and total phosphorus, chlorophyll *a* and Secchi Disk depths for the lakes being monitored.

# Appendix I

Database tabulation of field and laboratory data.

Appendix II

Bar graphs showing seasonal variation in total nitrogen, total phosphorus, chlorophyll *a* and Secchi Disk depths for each lake.

Figure legends.

Figure 1a. Mean values of water quality variables at each lake for 1997-98.

Figure 1b. Mean values of water quality variables at each lake for each year.

Figure 2. Relationship between Secchi Disk depths and variables that influence water transparency.

Figure 3a. Mean values of nitrogen, phosphorus and their ratio at each lake for 1997-98.

Figure 3b. Mean values of nitrogen, phosphorus and their ratio at each lake for each year.

Figure 4a. Mean values of variables related to lake acidification at each lake for 1997-98.

Figure 4b. Mean values of variables related to lake acidification at each lake for each year.

Figure 5a. Comparison of predicted vs. measured levels of water quality parameters at each lake for 1997-98 (predicted levels are indicated by the star-shaped symbol).

Figure 5b. Comparison of predicted vs. measured levels of water quality parameters at each lake for each year (predicted levels are indicated by the star-shaped symbol).

Figure 6. Seasonal variation in water quality parameters for all lakes.