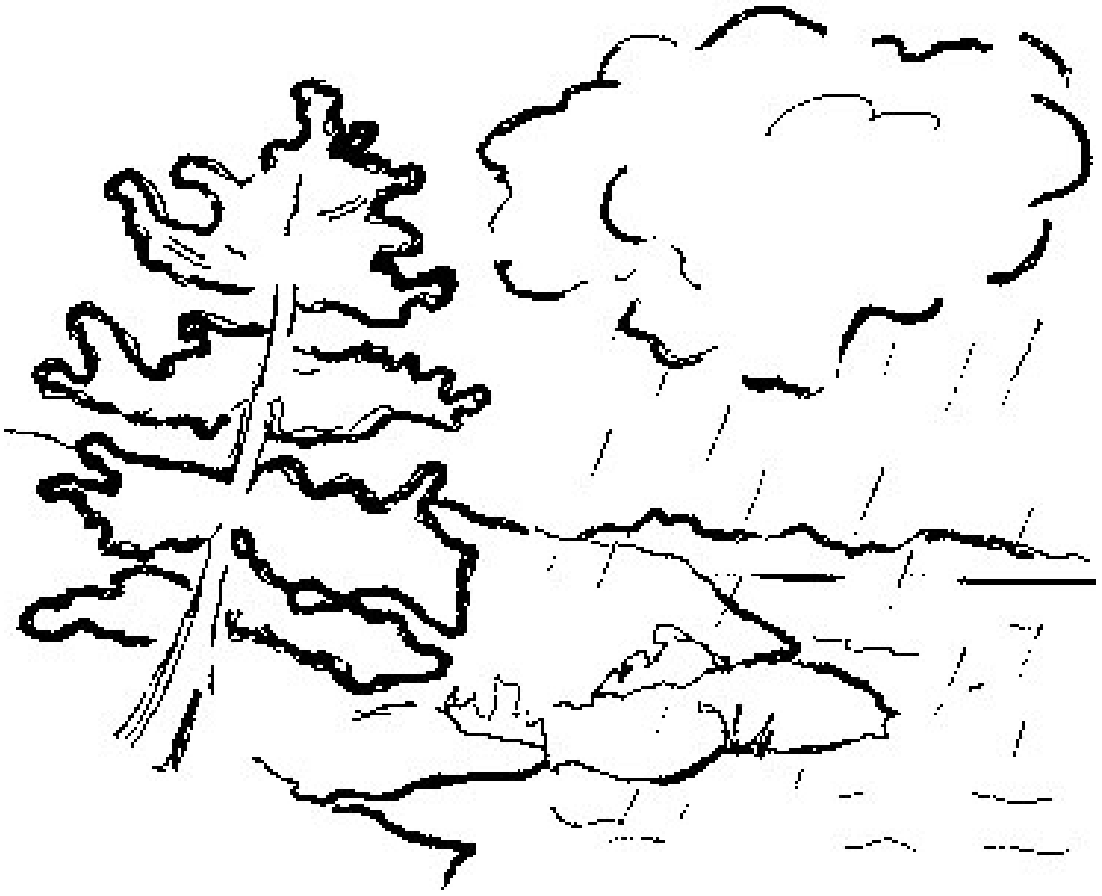
Kawartha Lake Stewards Association

Lake Water Quality 2002 Report

"And Then The Rains Came"



March 2003

KLSA Mission Statement

The Kawartha Lake Stewards Association objects are to carry out a coordinated, consistent, water quality testing program (including bacteria and phosphorus) of lake water on lakes within the Trent Canal System watershed. The Kawartha Lake Stewards Association will ensure water quality test results, prepared by an accredited laboratory with summary analysis, are made available to all interested parties. In future years the Kawartha Lake Stewards Association may expand its water quality program and may concern itself with other related matters.

Jim Keyser, Pat Moffat, Peter Fischer
and Kathleen Mackenzie at executive meeting

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Many thanks to Carol Ingleton and to Alison Rodriguez for the cover graphic and the drawing on page 6, both of which help to convey the title theme of the 2002 report "And Then The Rains Came".

Please Note:
We welcome media coverage of our testing program and our published reports. Whether you are a cottage association representative, member of the media, teacher, student, agency representative or municipal councilor, please feel free to photocopy and distribute parts of this report.

To obtain additional copies of our report or to find out more about KLSA please contact:
Kawartha Lake Stewards Association, 4 Conger St., Peterborough, ON K9H 4Y6
OR any member of the Executive listed in Appendix "A"

Message from the Chair

This is the second annual report concerning the Kawartha Lake Stewards Association's (KLSA) water quality testing program. Our program focuses on bacteria (*E.coli*) and phosphorus in lake water, within the watershed of the Kawartha Lakes section of the Trent-Severn Waterway.

Background

As noted in our first report ("Don't Feed the Geese"-2001), KLSA is a volunteer driven non-profit organization representing local lake associations of property owners in the Kawartha Lakes area. The association was started because there was no co-ordinated lake water testing program being done by government agencies and the testing being done on some lakes by volunteers was inconsistent lake to lake.

"And Then the Rains Came"

We hope you enjoy reading this report, which contains new expanded information on phosphorus and *E.coli*. We have photos, too - thanks to Jeff Chalmers!

Highlights of 2002

Building on the first year's foundation, KLSA had continued success in 2002. Items of note include:

- KLSA volunteers tested 148 sites (compared with 115 sites last year) on thirteen lakes. Appendix "A" lists our executive and other volunteers.
- Two new lakes were added, Scugog and Julian.
- KLSA received the Jerry Strickland Award given by the Federation of Ontario Cottagers' Associations (FOCA). This award is given annually to a FOCA member association that has carried out projects that have significantly benefited the cottage community in the areas of environmental protection, land use, recreational boating or taxation.
- We continued our primary expansion program into Upper Buckhorn, Chemong, and Pigeon lakes with limited success. It is difficult to find new cottage associations on these lakes and we would appreciate any help in this search.
- Our funding activities continued to be successful. About one-half of our funds come from participating associations (including Curve Lake First Nation) and the other half from local municipalities and businesses. We hope our donors find this report interesting and valuable, and we look forward to their continuing support. Appendix B lists our donors and sponsors.
- As indicated in the treasurer's report in Appendix C, we have a small surplus

for report production and next spring's activities. Also note about **85%** of our expenses are for analysis and reporting of *E.coli* by Lakefield Research.

- Last year's report noted that Lakefield College School had very high E.coli levels. They were significantly reduced this year through actions taken by the school to reduce geese populations on their waterfront.
- Unfortunately the Kawartha Fisheries Association (our partner in 2001) decided not to carry out *E.coli* water testing on several lakes including Sturgeon, Cameron, and Balsam. KLSA did attract several ready volunteers on these three lakes but we could not include them in our program for lack of local association and local municipal funding. KLSA will try again this year to gain support from local associations and the City of Kawartha Lakes.
- Two volunteer meetings/training sessions were held this year with excellent presentations by Tom Hutchinson of Trent University, Kevan Light of the Peterborough Water Treatment Plant, and Bev Clark, Co-ordinator of the Lake Partner Program of the Ministry of the Environment.
- A new board of directors was elected for 2002/2003. All members from 2001/2002 were re-elected except Peter Fischer who stepped down due to time conflicts with his business. We welcome Ron Elliot to the board.
- Four executive committee meetings were held this year.
  Roles for members of the committee for 2002/2003 are as follows:
  Jim Keyser - Chair
  Jeff Chalmers - Secretary/Treasurer
  Pat Moffat - Vice-Chair: Fund Raising/Media Relations
  Kathleen Mackenzie - Vice Chair: Water Testing Program
  Mark Potter - Director: Lake Expansion Program
  Ron Elliot - Director: Lake Expansion Program
  Marlene Steele will continue to support the association as recording secretary.

Thank you

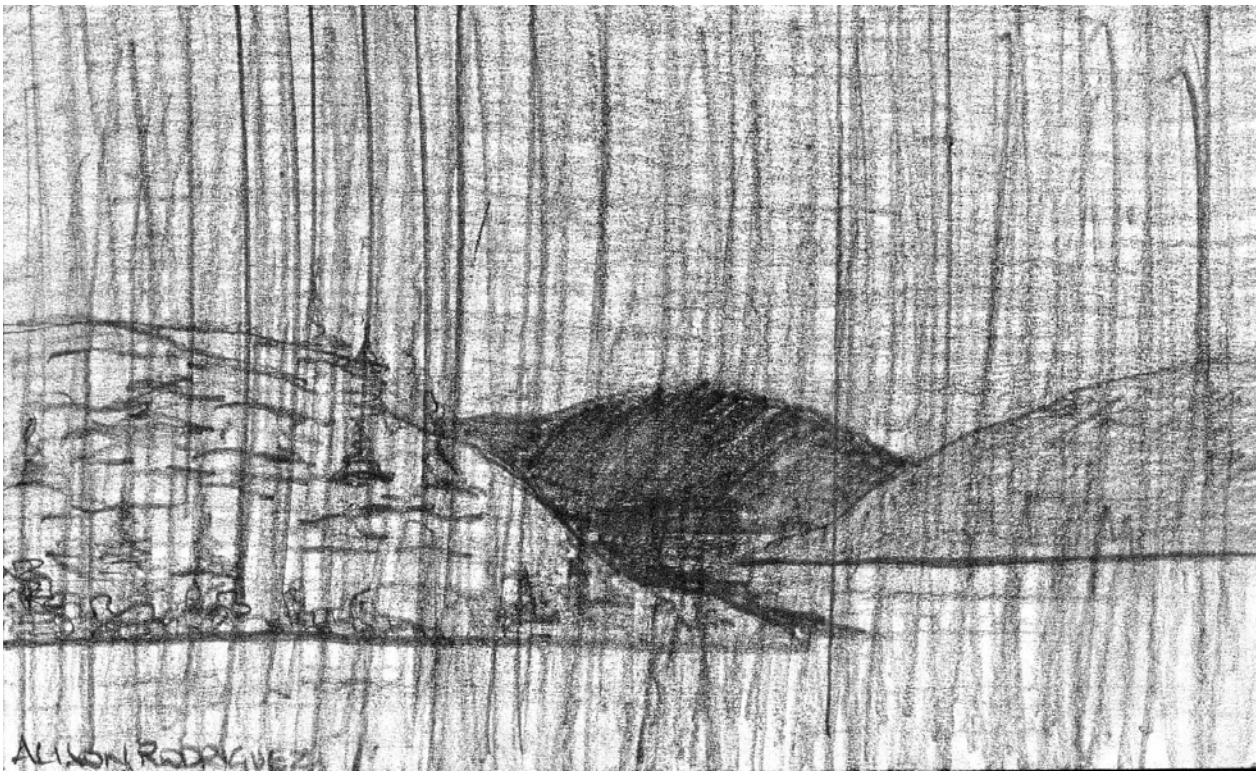
To our volunteers, donors, speakers, Lakefield Research staff and to those such as the staff at the MOE, Peterborough County-City Health Unit, Buckhorn Community Centre, Sir Sandford Fleming College Cartography Department and City of Peterborough Land Information Services Division who helped us in so many ways, I want to extend my sincere thanks. Extra thanks to George Gillespie, of McColl Turner Chartered accountants, for reviewing our financial records and to Tom Cathcart of the Peterborough County-City Health Unit for assisting us during the year and reviewing the bacteria results and draft report. Thanks also to Bev Clark for his

advice during the year, presenting at one of our meetings and reviewing the phosphorus section of this report.

Finally I wish to recognize Kathleen Mackenzie, Pat Moffat, and Jeff Chalmers for their great effort (and success) in organizing, monitoring, funding and reporting on the activities of the KLSA.

To find out more about KLSA, please contact me or any other member of the Board.

Jim Keyser, Chair



Rainy Day in the Kawarthas

KLSA Presented with Jerry Strickland Award

Darrell Selsky, President of FOCA, presents the Jerry Strickland Award to members of KLSA
(l to r) Pat Moffat, Darrell Selsky, Kathleen Mackenzie, Jim Keyser

At FOCA's Annual General Meeting in Toronto on November 2, 2002, KLSA members received a welcome surprise on hearing the announcement that KLSA was one of two associations that had won the Jerry Strickland Award.

FOCA's formal commendation to KLSA reads:

"The Kawartha Lake Stewards Association... began with cottagers on several lakes on the Trent-Severn Waterway monitoring water quality, each in their own way. When they started sharing experiences, they realized they would have better results if they monitored in a coordinated fashion. Their recruiting drive yielded volunteers on 13 Kawartha Lakes. Because of this wide representation, Kawartha Lake Stewards were able to procure funding from townships and resorts, in addition to funding from the associations themselves… Soon a well-trained and well-informed fleet of 25 volunteers were out on their lakes testing for phosphorus, *E.coli*, and water clarity… In recognition of their efforts to measure water quality on a watershed scale, and in a professional fashion, we would like to present the Jerry Strickland Award to the Kawartha Lake Stewards."

Many thanks, FOCA, for recognizing the efforts of all the volunteers in the Kawartha Lake Stewards Association.

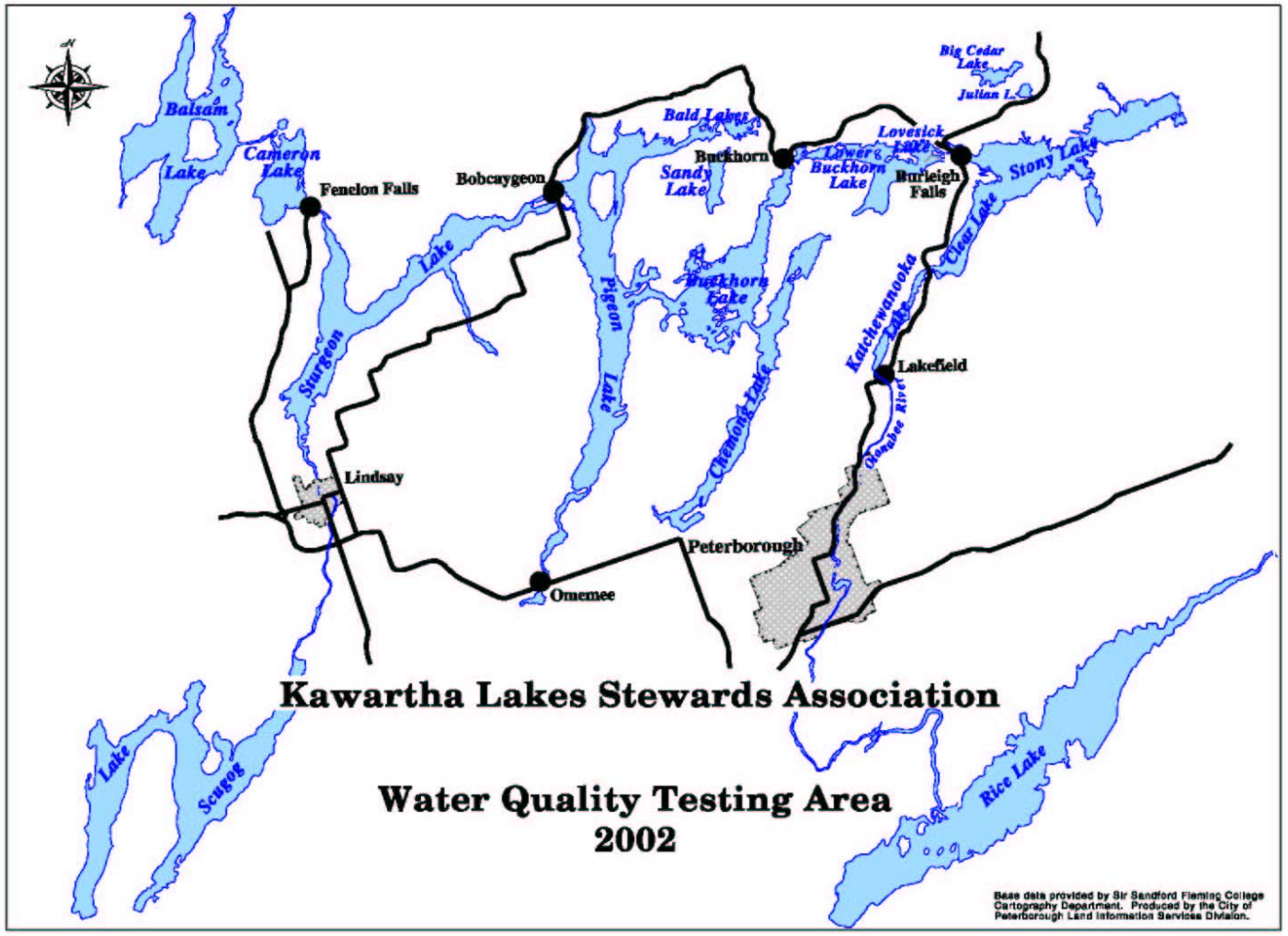
Introduction

The Kawartha Lakes are a connected string of lakes on the boundary between Ontario's northern, Precambrian granite shield and its more southerly limestone formation. The top of the Kawartha watershed is Balsam Lake, with water flowing southeast into Lake Ontario. The Trent-Severn Waterway links these lakes. Originally built to aid the logging industry, the canal is now a busy summer conduit for recreational boaters, fishermen, and campers. It is the largest magnet for tourism in this part of Ontario.

The Kawartha Lakes are ringed with seasonal cottages and, increasingly, year-round homes. For many years, Kawartha area cottagers and residents have been concerned about protecting the water quality in their lakes, as development pressures mount, as increasing numbers of pleasure boats ply the waters, as agricultural operations impinge on shorelines, as waterfowl numbers increase, and as concerns about aging and possibly leaking septic systems increase.

Although KLSA's main activity is volunteer sampling of lake water for phosphorus and *E.coli* bacteria, a very important accompanying activity is the sharing of information and public education. Each year, in the early spring and late fall, KLSA has held two very informative workshops on our testing program and water quality issues in general. Most of our volunteers represent cottagers' and residents' associations in the lower Kawarthas (downstream of Balsam Lake). Each volunteer shares the information learned through KLSA with their local associations, so that many thousands of people become more informed about water quality issues such as how to protect our lakes from excess phosphorus, and where occasional high levels of bacteria in our swimming water might be coming from.

Map of the Kawartha Lakes Testing Area



Summary of Results

2002 was the second year of volunteer surface water testing by the Kawartha Lake Stewards Association (KLSA). As in 2001, overall *E.coli* bacteria levels were low, suggesting that the Kawartha Lakes that we tested can be considered generally safe for swimming. The only exception was Lake Scugog, which had unusually high counts. Phosphorus levels in 2002 were similar to 2001: many of our lakes are in danger of slipping from "good" to "poor" recreational water quality.

Lakes participating in KLSA this year included Big Bald, Buckhorn, Chemong, Clear, Julian, Katchewanooka, Lovesick, Lower Buckhorn, Pigeon, Sandy, Lake Scugog, Stony and Upper Stoney.

Bacteria: Excluding Lake Scugog, out of a total of 748 readings at 141 sites from July 1 to Labour Day, only 14 readings, or 1.9%, were ever above the Ministry of Environment's "safe swimming limit" of 100 *E.coli*/100 ml.* Site 7 on North Pigeon Lake was frequently above this level. It was fortunately not a swimming area, but it was a favourite congregating area for Canada Geese. 95% of all readings were less than 50 *E.coli*/100 ml. There were only two sites that frequently had readings over 20 *E.coli*/100 ml. The first, Site 5 on North Pigeon Lake, a swimming area, was frequently visited by large numbers of Canada Geese. The second, Site 2 on Katchewanooka Lake, had similar readings but the KLSA volunteer could find no probable cause. Many sites showed temporary, one-time "spikes" of over 50 or even 100 *E.coli*/100 ml but then decreased to less than 20 when retested. This situation seems to be normal for the Kawartha Lakes.

Overall bacteria counts were a little higher in 2002 than 2001. This was almost certainly due to the rainier summer. If there was rain 48 hours prior to sampling, counts were higher. High counts were often found at stream inflows after recent rains. As in 2001, sites with high counts were often associated with large numbers of Canada Geese or other waterfowl.

Phosphorus: With one exception, the lakes we tested had average phosphorus levels of 14 to 23 ppb.** Above the level of 20 ppb, unsightly algal overgrowth can occur. If phosphorus levels were to rise in the Kawarthas, there would likely be a noticeable increase in nuisance algal growth. The one lake that had strikingly lower phosphorus levels was Upper Stoney, which is actually not a downstream lake in the Trent-Severn Waterway (TSW) system, but is fed by streams off the granite Canadian Shield, and flows *into* the TSW.

Geology has much to do with phosphorus levels. Phosphorus is low in early spring due to an enormous flushing of the TSW from northern Shield waters. By June, phosphorus levels rise, as this flushing decreases and lakes are increasingly fed by streams from the local limestone-based watershed. Higher mid-summer phosphorus levels reflect this limestone runoff as well as human activities (septic systems, fertilizing, etc.) Spring phosphorus levels were somewhat lower in 2002 than in 2001, probably because of the larger spring flush, while August levels were slightly higher. However, these differences were very small.

* 100 *E.coli*/100 ml = 100 *E.coli* per 100 millilitres of lake water

** ppb = parts per billion (or micrograms per litre)

Bacteria Testing

In 2002, KLSA tested 148 sites on 13 Kawartha Lakes for *E.coli* bacteria. This represents an increase of 33 sites over the 115 sites tested in 2001, the first year of our program. Two additional lakes joined the program in 2002, Julian Lake and Lake Scugog.

Sites were tested six times during the summer, from the July 1st weekend until Labour Day. As in 2001, the goals of this testing were twofold:

- To see how safe the water was for swimming at these sites, and
- To provide baseline data for ongoing monitoring in future years.

Most sites were chosen because it was thought that they would have the highest counts in the lake; that is, they were potential 'hot spots'. Therefore, please realize that the readings shown here do not represent the *average* bacterial levels of our lakes; rather, they would represent some of the *highest* bacterial levels on our lakes. Test sites included:

- Areas of high use (resorts, live-aboard docking areas, etc.)
- Areas of low circulation (quiet, shallow bays)
- Areas near inflows (from culverts, streams, wetlands)
- Areas of concentrated populations of wildlife (near wetlands, areas popular with waterfowl)

Please note: The KLSA did not test drinking water. Only surface waters were tested. All untreated surface waters are considered unsafe for drinking. KLSA results are valid only for the times and locations tested, and are no guarantee that a lake in general will be safe to swim in. This is especially true of Pigeon, Buckhorn, and Chemong, where our volunteers could cover only a small part of the lake.

Why did We Test for *E.coli*?

The main reasons why *E.coli* was the bacteria of choice were:

- Its only source is the fecal material of warm-blooded animals. It is not found, for instance, on rotting vegetation. Presence of E.coli indicates fecal contamination from birds or mammals.
- It is present in fecal material in very high numbers. Healthy humans excrete about 100 million *E.coli* per ¼ teaspoon of fecal matter!

Although most strains of *E.coli* are harmless, some strains cause serious disease, such as in the Walkerton tragedy, or occasionally in ground beef 'scares'. In routine testing, we cannot tell the difference between the harmless and the deadly, so we always treat *E.coli* as if we were dealing with a harmful strain. A high reading of *E.coli*, then, indicates the possibility that many different disease-causing organisms, including disease-causing *E.coli*, may be present in the water.

What We Found

Excluding Lake Scugog (see below), only 14 of the 748 readings (1.9%) were over the Ontario Ministry of the Environment's "safe swimming limit" of 100 *E.coli*/100 ml. (This is somewhat higher than last year's 1.2%.) The "safe swimming limit" is the level at which public beaches are posted. In all but one case, these readings decreased well below the safe swimming limit when retested. Such 'spikes' may have been the result of temporary high runoff, presence of wildlife, or possibly some careless human actions near or in the water (see "Lake-by-Lake Results" section). Fortunately the one site which showed persistent high counts was not a swimming area.

This year, there seemed to be two main causes of high *E.coli* counts:

- Counts were higher 'when the rains came' before the July 22 and July 29 sampling dates. As measured at the north end of Pigeon Lake, 52mm fell in the 48 hours before July 22, and 10mm rain fell in the 48 hours before July 29. No rain fell in the 48 hours previous to the other sampling dates. This runoff effect was not noticeable in 2001, which was an unusually dry summer. Because of the rain, average counts were generally somewhat higher in 2002. This runoff effect is well known; Peterborough public beaches are automatically closed for at least 24 hours after any rainstorm over 25mm. High counts were also measured at Peterborough's public beaches on July 22 and July 29.
- This year, as in 2001, many high counts seemed to correlate with the presence of waterfowl. However, recent research indicates that fecal material from wild Canada Geese may not present as serious a health hazard to humans as some other sources. KLSA will monitor further research on this issue.

Generally, the lakes tested were well below the Ministry of the Environment's safe swimming limit of 100 *E.coli*/100 ml. However, this limit was set with public beaches in mind. The KLSA believes our lakes should be cleaner than that. Our standards were as follows:

- Sites that were consistently over 50 *E.coli*/100 ml were of serious concern for a swimming area on a lake. Site 7 on north Pigeon Lake consistently had counts greater than 50. Fortunately, it was not a swimming area.
- Sites with a majority of readings (4 or more readings of 6) over 20 *E.coli*/100 ml were investigated, as this was unusual for the Kawartha Lakes. There were 2 such sites, Site 5 on north Pigeon Lake, and Site 2 on Katchewanooka Lake.
- The occasional reading (a 'spike' which decreases on retesting) between 20 and 100 *E.coli*/100 ml was seen at many sites, and was not deemed of concern.

Lake Scugog was an exception. All seven Scugog sites showed high bacteria levels. The Lake Scugog community is extremely active working on several large-scale projects to improve water quality. They are expecting readings to decrease over the next few years with the completion of these projects, which include shoreline naturalization, runoff reduction and waterfowl reduction.

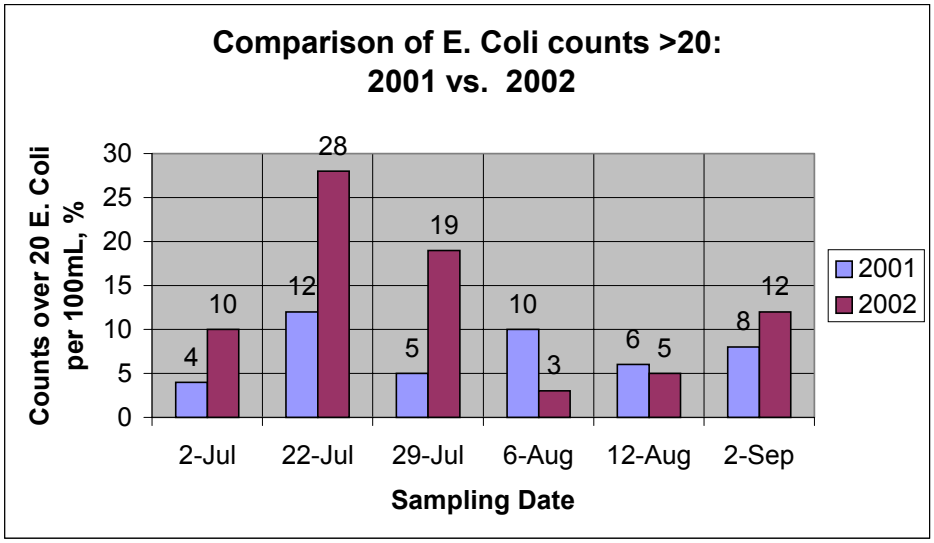
In 2001, high *E.coli* counts were found along the shoreline of Lakefield College School on Katchewanooka Lake. The source seemed to be large numbers of Canada Geese. Summer campers were feeding the geese, and food scraps were left along the shore after waterside picnics. In 2002, Robert Laplante of the school wrote:

> "In order to control the numbers of waterfowl at the lakefront, we restricted food consumption by the summer camp in this area. This seemed to deter the large numbers of birds that normally congregated in this area for feeding. Our testing (in summer of 2002) indicated a consistent low level count, 0 – 4 *E.coli* /100 ml. Testing was done every 2 weeks beginning April 1."

Congratulations, Lakefield College School, on a thorough and successful cleanup job!

Jeff Chalmers demonstrates the bacteria water sampling method.

Comparison of *E.coli* Results: 2001 vs 2002



The incidence of counts greater than 20 was much higher in July 2002 than in July 2001 (see chart above). There were some fairly heavy rains in many areas of the Kawarthas before these testing dates, particularly before the July 22 testing date. When it became dry in August 2002, note that the counts decreased to become similar to 200l. There were no significant rains before any testing dates in 2001. Lake Scugog sites were not included in this data, as they were not the same sites that were tested in 2001. Retest results were also not included.

Who Participated?

Twenty KLSA volunteers from different parts of the following lakes led the water sampling program: Big Bald Lake, Buckhorn Lake, Chemong Lake, Clear Lake, Julian Lake, Katchewanooka Lake, Lovesick Lake, Lower Buckhorn Lake, Pigeon Lake, Sandy Lake, Lake Scugog, Stony Lake, and Upper Stoney Lake. Most volunteers represented local associations of cottagers and residents. Curve Lake First Nations was a KLSA member group.

What We Did

KLSA started the year with an orientation workshop in May to review sampling technique and hand out sampling bottles. KLSA volunteers collected lake water samples on the same weekends, six times throughout the summer season: July 2, July 22, July 29, August 6, August 12, and September 2. Samples were taken to Lakefield Research, usually within a few hours, and tested the same day. Occasionally they were refrigerated overnight before being taken to the lab. Each group tested between 3 and 13 sites, and the same sites were tested on all six dates.

Most of the sites were the same as the 200l sites. It was felt that some sites should remain the same to give long-term baseline data. However, some sites were changed as volunteers became more aware of where potential hot spots could be. New sites were given different new labels.

During the first week of testing, volunteers were notified within three days if a reading was over 20 *E.coli*/100 ml, and were asked to retest. However, on the second week of testing, July 22, after the rains came, there were so many readings over 20 that the level for retesting was raised to 50 *E.coli*/100 ml. and this level was used for the rest of the summer. This decision was made because of funding limitations.

If counts remained high after retesting, or if counts over 50 were found more than once over the summer, our policy was for volunteers to inform adjacent landowners of the results. We wanted to make them aware of the problem for their own swimming safety, and to seek their cooperation in trying to determine where the bacteria were coming from.

Which Animals Were the *E.coli* Coming From?

It would be very valuable to know where the *E.coli* were coming from - humans, livestock, or wildlife. First, identifying the source would help in correcting the problem. Second, it would help us estimate the seriousness of the pollution.

Canada Geese droppings, for instance, pose a relatively low health hazard because they contain fewer human pathogens. (Crawshaw G.J. and L. M. Schwarz. 2002. Common diseases of Canada Geese and their impact on public health. *In* Toronto Zoo. 2002. Urban Canada Goose Management Symposium.) Contamination from septic systems, however, could be much more hazardous.

The science of this sort of identification, called bacteria source tracking or BST, is still in its infancy. New methods such as antibiotic resistance testing or DNA profiling are being developed, but are still expensive and controversial. The *E.coli:f*ecal strep ratio, which differentiates between humans and non-humans, is only considered reliable if :

- it is known how long the bacteria have resided in the water, and
- the counts are very high.

Because of the uncertainty of these tests, KLSA did not attempt to identify the animal source of the *E.coli*.

Mark Potter leads volunteers in a training session at the Buckhorn lock, after the Spring 2002 Workshop.

Lake-by-Lake Results

Please see Appendix "D" for Lake-by-Lake data with commentary.

Generally, readings under 20 *E.coli*/100 ml were considered normal for unpolluted surface water; one would expect a certain number of *E.coli* in a system rich in wildlife. Counts over 20 were retested on the first date (this was the retest level used in 200l). However, on the second date, after the rains came, there were too many sites over 20; volunteers did not have the time and KLSA did not have the funds to carry out all retests for sites over 20. We therefore changed the retest level to 50 *E.coli*/100 ml.

Bacteria tend to 'clump' in surface water. Three samples taken at the same site at the same time (triplicate samples) would be expected to have somewhat different counts of, for example, 3, 10, and 12. Any readings under 20 can be considered to indicate low levels of pollution.

We have made suggestions as to the source of the high counts. We hope this may help other groups decide where to sample on their own lakes, i.e., decide where the 'hot spots' might occur.

Please note: The Ontario standard for drinking water is 0 E.coli/100. The results in Appendix "D" reinforce the fact that untreated surface waters are not safe to drink.

Pat Moffat & Kevan Light respond to questions during the KLSA Spring 2002 Workshop, held at the Buckhorn Community Centre.

Reducing Canada Geese on Your Shoreline

Over the past two years, Canada Geese have been frequently associated with high KLSA *E.coli* counts. Although goose fecal contamination poses a somewhat lower public health hazard than, for example, septic system contamination, some health hazard exists, and droppings are unsightly. Several landowners expressed an interest in learning how to discourage geese from 'dropping in' on their property. In Ontario, perhaps the people most experienced in Canada Goose management are the staff at the Toronto Zoo. Geese have been a problem there for years on shorelines and picnic areas. KLSA was fortunate to be able to tour the Zoo with staff to unearth the secrets of goose management. The Zoo feels they are still experimenting, but here are their suggestions:

- *Reduce areas of short grass*. Geese tend to be on water during the day and in open fields at night. Geese need large areas of short grass because grass is their main food and short grass allows them to see predators coming. You won't find geese in forests or in tall grasses! Golf courses, farm fields, and lawns running down to the shoreline are favourite congregating places for geese.
- *Create an opaque barrier next to the water*. Geese will tend not to leave the water if there is a visible barrier. It doesn't have to be very deep, as long as they can't see past it. Several years ago, grass was cut right to the water's edge at the Toronto Zoo. No more - the Zoo now has native vegetation bordering all its waterways.
- *Use a dog to scare away the geese.* After being chased away by a dog several times, geese won't return.

Phosphorus and Water Clarity Testing

Effects of Excess Phosphorus

High phosphorus levels result in a loss of water *clarity*, in the same way that an untended aquarium becomes green and murky. Phosphorus runs off into lakes from fertilizers, erosion and septic system seepage. The immediate effect is an increase in algal growth, turning the lake murky. Over the years, the algae settle into the sediments. These sediments provide a rich 'soil' for aquatic plant growth and continually 'belch' phosphorus back into the lake. Phosphorus levels and water clarity, then, are used to track lake deterioration.

Measuring Phosphorus

The Ministry of the Environment's Provincial Water Quality Objectives (www.ene.gov.on.ca/envision/gp/#groundwater , Report #3303) state:

- Phosphorus concentrations should not exceed an average of 20 ppb (parts per billion, or micrograms per litre) during the ice-free period. At levels higher than 20 ppb, algal growth accelerates, potentially creating unsightly and often foul-smelling algal 'blooms'.
- Ice-free averages of less than 10 ppb give 'a high level of protection against aesthetic deterioration'.

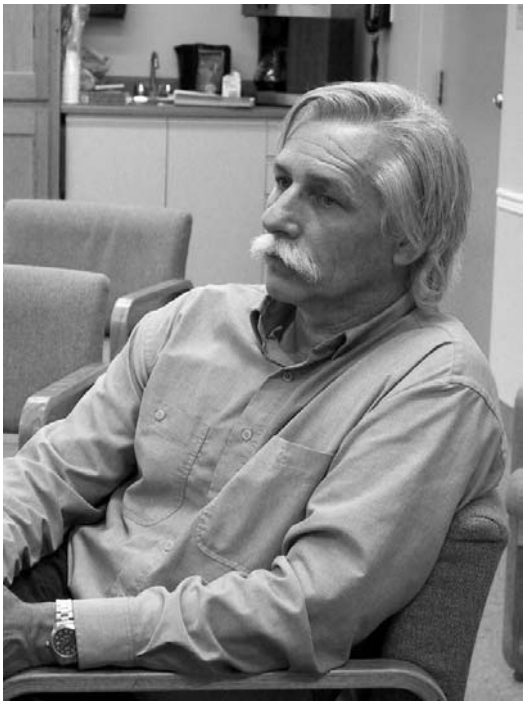
KLSA took water samples for phosphorus analysis at 15 locations, from Pigeon Lake to Lake Katchewanooka. Sampling was taken around the first of each month, from May to October. In contrast to sampling for bacteria, which is done at elbow depth, phosphorus samples are taken from the deepest part of the lakes, with a collection bottle lowered down to the required depth by a heavy object.

New, Improved Lake Partner Program!

The Ontario Ministry of the Environment's Lake Partner Program provides sample bottles and mailing containers. Samples are tested for phosphorus at an MOE laboratory at no cost to cottagers other than volunteer time. Ontario cottagers are fortunate to have this excellent program, and this past summer it became even better! In 2002, water samples were sent to a different laboratory, the Ontario Ministry of the Environment's research laboratory in Dorset, Ontario. This laboratory is the best in Ontario for testing surface water samples for phosphorus.

Because the Lake Partner Program is now using a different laboratory, our phosphorus measurements are almost ten times more precise than they were before 2002! As of 2002, a measurement of 6.0 ppb means that the measurement has a 95% probability of being between 5.4 and 6.6 ppb. This greater precision means that we will be able to detect much smaller changes in phosphorus levels month-to-month and year-to-year.

Bev Clark, Coordinator of the Lake Partner Program, Ontario Ministry of the Environment, discusses the 2002 program at the KLSA Fall 2002 Workshop in Buckhorn.



Comparison of Phosphorus Results: 2001 vs 2002

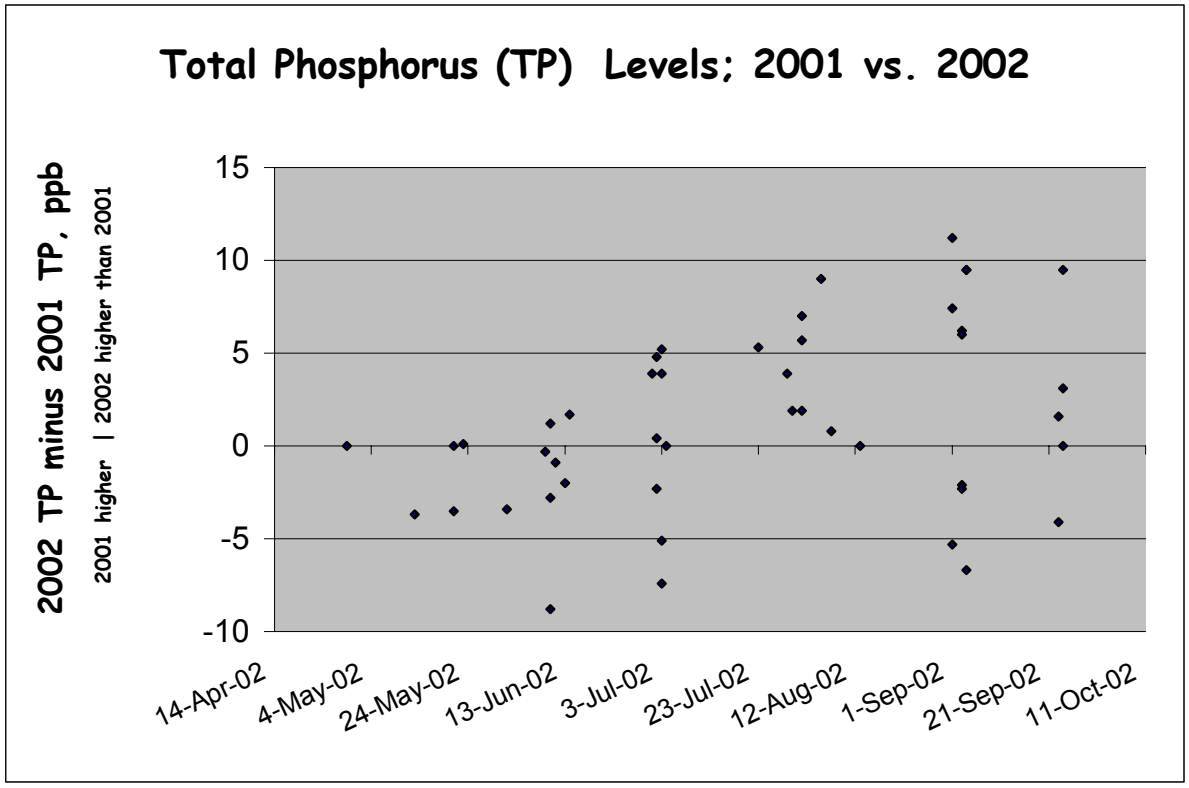
June-to-September Average Phosphorus* Levels in 2001 and 2002

Lake	Location	2001 TP, ppb	2002 TP, ppb
Big Bald	Centre	13.5	15.7
Clear	Centre	12	14.6
Katchewanooka	SE Douglas Is.	15	18.4
Lovesick	80 ft. hole	19.5	21.1
Lower Buckhorn	Heron Is.	19.5	17.6
Pigeon	N End Back Channel	14.5	16.2
Stony	N Mouse Is.	16	14.6
Upper Buckhorn	Buckhorn Narrows	19	23.2
Upper Buckhorn	Centre	16	16.9
Upper Stoney	Centre	8.8	9
Average		15.4	16.7

*Four-month averages were used here because KLSA was missing several May and October readings. However, these would be very close to whole-season averages, as spring levels are lower and October levels are higher than average.

Keeping in mind that a seasonal-average phosphorus level of 20 ppb indicates potential for algal blooms, it appears that many of our lakes are approaching the 'danger zone' of algae overgrowth (see Appendix "E" for complete set of data). If phosphorus levels were to rise, there would likely be an increased incidence of nuisance algal growth.

The chart above indicates that 2002 phosphorus readings were slightly higher than in 2001. However, because of the low precision of the 2001 readings, this difference cannot be considered significant. Using our data, we must conclude that we cannot see a significant difference between seasonal average 2001 and 2002 phosphorus levels.

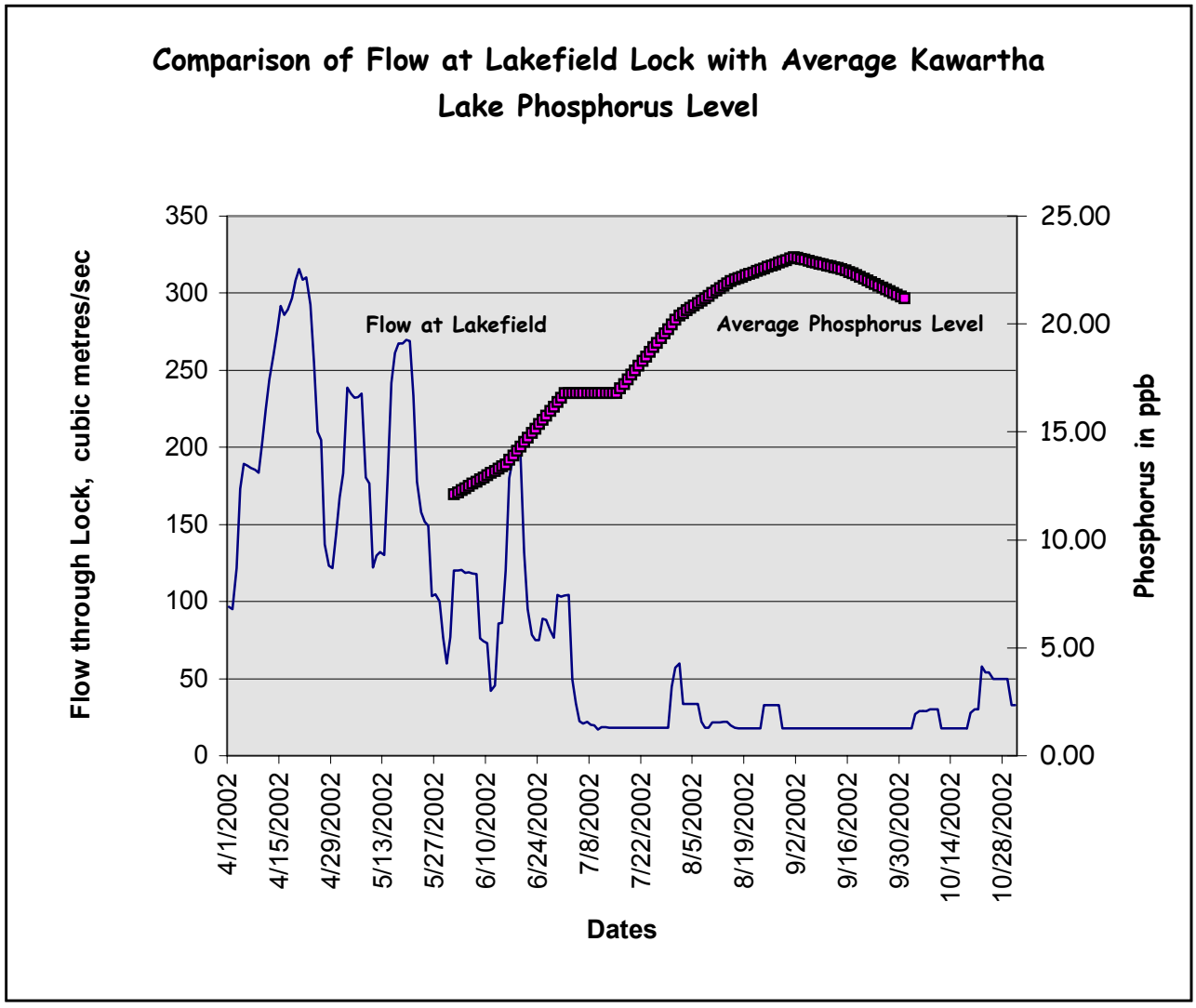


The graph above compares phosphorus levels for 2001 and 2002. If phosphorus was lower in 2002, the point on the graph was negative (blow the '0' line). If phosphorus was higher in 2002, the point was positive. The graph indicates that:

- In 2002, the lakes started out (in May and early June) with somewhat lower levels of phosphorus, about 2 to 3 ppb *lower* than 2001. Possibly this was because of the large flow through the locks in May and June, when there were some unusually heavy rains. In early August, 2002 phosphorus levels were 3 to 4 ppb *higher* than 2001 in all lakes. There was no obvious reason for this.
- At any other times, lakes could be up to 10 ppb higher or lower than in 2001. One lake's 2002 readings might be higher in July and lower in September; the next lake might show the reverse. There was no discernible pattern of higher or lower phosphorus levels.

The variation between the two years emphasized the need for long term data sets. It will take a few years, it seems, to be able to distinguish between 'real' changes and natural fluctuations.

What Drives the Seasonal Phosphorus Cycle on Our Lakes?



As seen on the above graph, which is an approximated average of the graphs of 10 lakes, a Kawartha lake starts out in the spring with a relatively low phosphorus level of about 12 ppb. This rises steadily until it reaches the mid-twenties in August. It then decreases somewhat to about 20 ppb in October.

The KLSA was fortunate to have Mr. Bev Clark, Coordinator of the Lake Partner Program and longtime lake research scientist, speak at our September meeting. He addressed the question, "What determines phosphorus levels in a Kawartha lake?"

The main determinant of phosphorus levels in any lake is the chemistry of the surrounding rocks and soil. If rocks and soil are rich in phosphorus, the lakes close by will be high in phosphorus. Most of the Kawartha Lakes are situated on the border between phosphorus-rich limestone to the south (think maple forests and farmland) and phosphorus-poor Canadian Shield granite to the north (think pine forests and rock).

In May, there is an enormous amount of snowmelt water, which 'flushes' the Trent-Severn Waterway. This water comes from as far north as Algonquin Park, down the Gull River into Balsam Lake, and down through the system. Since this spring flushing water is mainly from Canadian Shield country, it is low in phosphorus, generally about 8 ppb throughout the ice-out season. This results in low phosphorus levels in May. In June, the volume of flushing water from the north decreases. Runoff becomes more local - from fertilized farm fields and waterside lawns, golf courses, from septic systems and erosion, from the limestone to the south of us, and even from the lake sediments themselves. Phosphorus levels climb.

We all want to keep our lakes healthy. To do so, we need take our concerns beyond our own shorelines. We need to know conditions upstream. For example, in the l960's, many of the Kawartha lakes were quite green due to heavy algal growth. Boat wakes looked like pea soup. The solution to this high-phosphorus problem was to install a phosphorus removal treatment step at the Lindsay sewage treatment plant. There was significant clearing noticed even as far downstream as Lake Katchewanooka.

To keep our lakes healthy, we need planning at the watershed level as well as at the local level. The KLSA's data can be one tool to accomplish this.

A Mystery Lake in the Midst of Us!

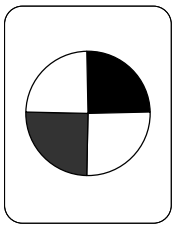
In both 2001 and 2002, it was apparent that one of the lakes tested was very different from the rest. Its phosphorus levels started at the same levels as the other lakes, but hardly increased over the summer. Its seasonal average phosphorus level in 2001 was 8.8; in 2002 it was 8.6! Some sort of low-phosphorus weirdo!

This was Upper Stoney Lake. Why would it have such a low phosphorus level?

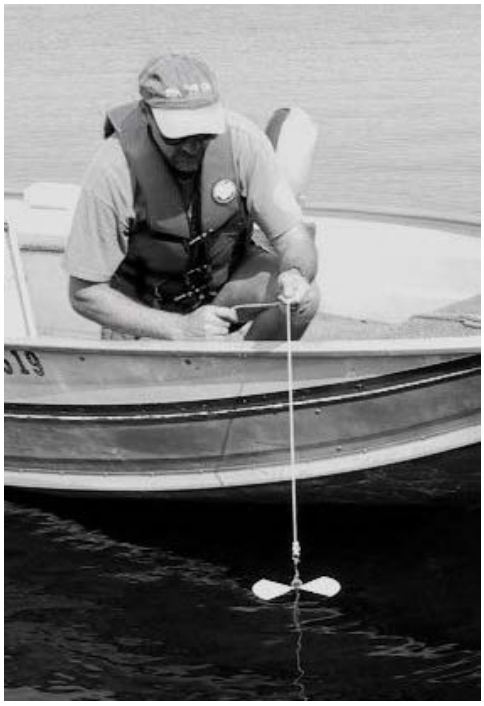
- Situated at the east end of Stony Lake, the Upper Stoney Lake basin actually flows INTO the Trent-Severn. Runoff into Upper Stoney is from the north, which is forested and relatively undeveloped, with little limestone. The south shore of Upper Stoney borders limestone country, but runoff tends to move south out of, not into, the lake.
- Upper Stoney is a deep lake in parts, up to 33 m (110 feet), so there is more water to dilute the phosphorus.

Measuring Water Clarity (Secchi Disk Depth)

Secchi disk depth is a measure of lake water clarity. A Secchi disk is a circle the size of a paint can lid. It looks like a pie cut in quarters with alternating black and white sections. The disk is lowered until it disappears from sight. This is called the Secchi disk depth. A clear lake will have a larger Secchi disk depth than a murky lake.

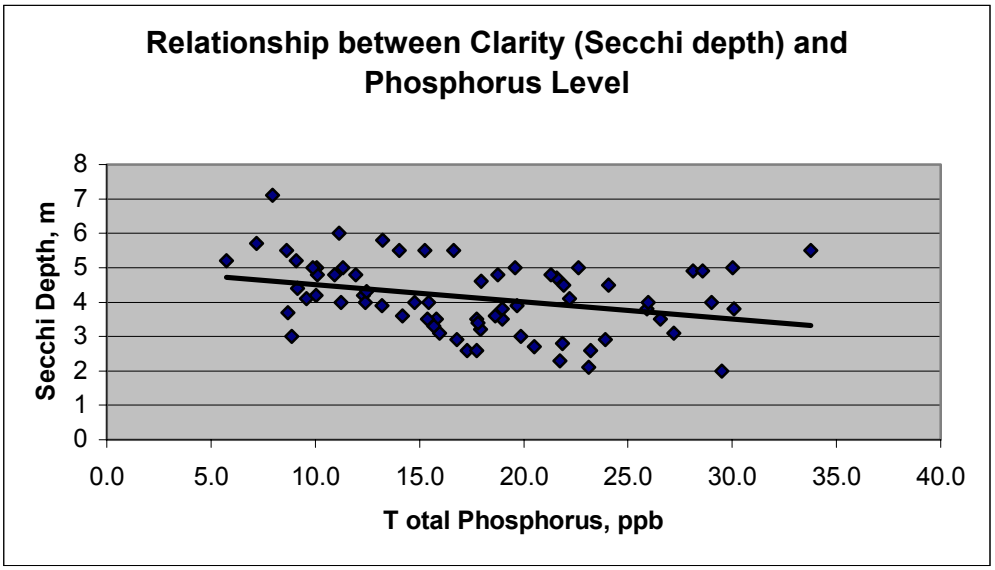


KLSA volunteers took Secchi disk readings at the same time as phosphorus, and Secchi readings were submitted to the Lake Partner Program. See Appendix "E" for a complete set of data.



Jeff Chalmers demonstrates how water clarity tests are taken using the Secchi disk.

Comparison of Phosphorus Level and Clarity



In the graph above, individual data points represent a phosphorus and a Secchi reading taken together at one site. For example, the point furthest to the left represents a Secchi reading of 5.2 m and a phosphorus reading of 5.7 ppb. As one would expect, clarity decreased with rising phosphorus levels. However, it didn't decrease as much as we thought it would. Also, we had expected to see a much closer correlation between phosphorus and Secchi depth measurements; we had not expected so much scatter in the graph.

This phosphorus/clarity relationship needs more investigation. Should we be looking at each location or each lake separately, perhaps? Has the relationship changed since zebra mussels invaded the Kawarthas? How close is this correlation in other lakes in Ontario? More data and more careful analysis should help answer these questions in the future.

Looking Ahead

Watersheds are complicated, living ecosystems. Our Kawartha Lakes are affected by a myriad of factors. Each year, it seems, volunteers participating in the KLSA learn about another aspect of the system, another piece of the watershed puzzle.

Last year, in 2001, we were surprised to find that high bacterial counts seemed to be correlated with the presence of large groups of waterfowl. In 2002, we saw that correlation once again, but we also learned of recent research that indicates that fecal contamination from waterfowl presents a much lower health hazard than contamination from human sewage. In 2002, we also observed that rainstorms – and there were several heavy ones in July! - appeared to raise *E.coli* levels as well.

In 2002, we learned that flows through the Trent-Severn Waterway seemed to have a significant effect on phosphorus levels. We discovered that the high flows of spring were reflected in low phosphorus levels. In the mid-summer our water contained much higher levels of phosphorus, probably reflecting runoff from the more local watershed, which is dominated by limestone. It would be very interesting to know how much of the higher phosphorus levels in mid-summer came from the limestone beds themselves, and how much were due to increased human activity in the area at the height of the tourism and cottaging season. Answering this question would require expert consultants to work on a Kawartha phosphorus study.

But in general, if we want to answer the questions "What determines my lake's water quality?" and "How can we help improve our water quality?" we need to think beyond our own lakes. To borrow a well-known dictum, "Act locally, think watershed-ly." Water moves swiftly through the interconnected lakes of the Trent-Severn Waterway, and one lake's water soon becomes the next lake's water. Somewhere between the Gull River just north of Balsam Lake, the height of our watershed, and Pigeon Lake, not even very far downstream, phosphorus levels double, rising from 8 ppb to 16 ppb. Why does this happen? Can we do anything about it? Is it just going to get worse or might it get better? Is it inevitable that the Kawartha Lakes will become clogged with algae and water weeds every summer?

Aside from hiring expert consultants (which KLSA's budget cannot afford, unless financial contributions rise considerably), one way to work towards answers to these and other questions is to continue gathering information, to continue fitting in more pieces of the puzzle using our mounting data. The KLSA welcomes more volunteers! --

especially in the larger lakes such as Pigeon, Buckhorn, and Chemong. If you are interested in visiting several locations on your lake several times during the season to collect water samples for *E.coli* and phosphorus analysis, and participating in informative KLSA workshops, please contact the KLSA using the contacts listed in Appendix A at the end of this report. For phosphorus only, you can also contact the Ontario Lake Partner Program directly at 1-800-470-8322 or at lakepartner@ene.gov.on.ca.

Jeff Chalmers takes Secchi depth measurement

Appendix A: KLSA Executive and Other Volunteers

Jim Keyser, Chair Lower Buckhorn Lake Owners' Ass'n	(416) 694-4141, (705) 654-3839 email: jjameskeyser@aol.com
Pat Moffat, Vice-Chair Lovesick Lake Cottagers' Ass'n	(416) 260-5858, (705) 654-4012 email: patmoffat@yahoo.com
Kathleen Mackenzie, Vice-Chair Ass'n of Stony Lake Cottagers	(416) 283-7659, (705) 654-3051 email: k_mackenzie@sympatico.ca
Jeff Chalmers, Sec/Treas. Birchcliff Prop. Owners' Ass'n (Clear Lake)	(705) 743-8671, (705) 652-8992 email: hchalmers@cogeco.ca
Mark Potter, Director Newcomb Dr. Cottagers' Ass'n (Lwr Buckhorn)	(416) 232-4007, (705) 654-4340 email: potter4@sympatico.ca
Ron Elliott, Director North Pigeon Lake Ratepayers' Ass'n	(705) 731-0759

Big Bald Lake: Big Bald Lake Ass'n - Richard Dean, Susan Iles

Buckhorn Lake: Buckhorn Sands Property Owners' Ass'n - Mary and Mike Belas
Sandbirch Estates - Keith Clark
North Shore - Jim Peart

Chemong Lake: Curve Lake First Nation - Joe Taylor

Clear Lake: Birchcliff Cottagers' Ass'n - Jeff Chalmers
West Side - Jim Gillespie
Kawartha Park Cottagers' Association - Judith Platt

Julian Lake: George Loyst

Katchewanooka Lake: Peter Fischer

Lovesick Lake: Lovesick Lake Cottagers' Association - Pat Moffat,
Marlene Steele, Ron and Katie Brown, Ann Ambler and Jim Braund

Lower Buckhorn Lake: Newcomb Lane Cottagers' Association - Jeff Lang,
Mike Piekny, Mark and Diane Potter
Deer Bay Reach Property Owners' Association - Wayne Stovell
Hill Estates - Joyce and Linda Tunks, Frank and Shirley Corkery
Lower Buckhorn - Fred Turk, Cindy Boyle and Jim Chapman

Pigeon Lake: Sugar Bush Tall Cedars - James Cole, Sharon Matthews
Concession 17 Cottagers' Association - Gary Adams,
Sheila Gordon-Dillane
North Pigeon Lake Ratepayers' Association - Ron and Gail Elliott
Gamiing - Mieke Schipper

Sandy Lake: Harvey Lakeland - Doug Russell

Lake Scugog: Scugog Lake Stewards - Barbara Karthein, Deborah Tiffin

Stony Lake: Association of Stony Lake Cottagers - Ralph Reed, Bob Woosnam

Upper Stoney Lake: Upper Stoney Lake Association - Karl and Kathy Macarthur

Listed are our primary volunteers; many others helped on many occasions. KLSA would like to thank all the 2002 volunteers for their time and effort.

Some of the Volunteers attending the September Workshop

Appendix B: Donors and Sponsors of the KLSA

The Township of Galway, Cavendish and Harvey
The Township of Douro-Dummer
The Township of Smith, Ennismore and Lakefield
The City of Peterborough
The Trent Severn Waterway
Mattamy Homes, Big Island, Pigeon Lake
Buckhorn Tourist Association
Ardagh Cottage Resort, Lovesick Lake
Marrick's Landing, Lovesick Lake
Forest Hill Lodge, Lovesick Lake
Swish Maintenance, Peterborough
Lake Edge Cottages, B & B, Katchewanooka Lake
Carol McCanse, Katchewanooka Lake
Julian Lake Cottagers' Association, Julian Lake
North Pigeon Lake Ratepayers' Association
Big Bald Lake Cottagers' Association
Harvey-Lakeland Cottagers' Association, Buckhorn Lake
Sandbirch Estates Association, Buckhorn Lake
Lower Buckhorn Lake Owners' Association
Lovesick Lake Cottagers' Association, Lovesick Lake
Upper Stoney Lake Cottagers' Association, Upper Stoney Lake
Association of Stony Lake Cottagers, Stony Lake
Birchcliff Property Owners' Association of Douro-Dummer, Clear Lake
Kawartha Park Cottagers' Association, Clear Lake

Appendix C: Financial Report

Revenue & Expenses

For the period Nov. 28, 2001 to Dec. 31, 2002

Balance Forward November 28, 2001		**$3,223.22**
Revenue		
Kawartha Park Cottagers Assoc. (2001)	165.00	
Carol McCanse (Katchewanooka)	50.00	
Trent Severn Waterway (balance of 2001 commitment)	500.00	
Buckhorn Tourist Association	200.00	
Galway-Cavendish-Harvey Township Council	1,000.00	
Mattamy Homes, Big Island, Pigeon Lake	1,500.00	
Smith-Ennismore-Lakefield Township Council	500.00	
GIC Investment interest (Feb. 14/02)	5.80	
Sand Birch Estates Assoc.	200.00	
Upper Stoney Lake Cottagers Assoc.	500.00	
Swish Maintenance	250.00	
Lower Buckhorn Cottagers Assoc.	400.00	
Harvey-Lakeland Cottage Assoc.	200.00	
Big Bald Lake Cottagers Assoc.	240.00	
Marrick's Landing (Lovesick Lake)	50.00	
Lovesick Lake Cottagers Assoc.	625.00	
City of Peterborough	1,250.00	
Julian Lake Cottagers Assoc.	150.00	
Association of Stony Lake Cottagers	500.00	
Birchcliff Property Owners Assoc. of Douro-Dummer	500.00	
Katch Fund (Lake Edge Cottages, Katchewanooka)	200.00	
Forest Hill Lodge (Lovesick Lake)	50.00	
Ardagh Cottage Resort (Lovesick Lake)	50.00	
Sand Birch Estates Assoc.	100.00	
Douro-Dummer Township Council	750.00	
Assoc. of Stony Lake Cottagers (Private Testing)	126.00	
GIC Investment interest (Sept 23/02)	34.19	
North Pigeon Lake Ratepayers Assoc.	300.00	
Kawartha Park Cottagers Assoc. (2002)	196.00	
Total	10,591.99	**$10,591.99**

Expenses

Bank Fee Nov. 27/01 - Dec. 31/02	51.33	
OD Interest Nov 19/01 (posted after 2001 reporting)	0.39	
Cheque printing fees	94.32	
Fleming College report printing	594.00	
LMS Prolink Ltd. Insurance	788.40	
Jeff Chalmers, office supplies & postage	275.43	
Buckhorn Community Centre May/02 Donation	30.00	
Pat Moffat, supplies, copying, phone	56.65	
Lakefield Research #C38487	913.78	
Lakefield Research #C38488	389.48	
FOCA Membership	133.75	
Lakefield Research #C39103	1,123.50	
Lakefield Research #C39104	831.39	
Lakefield Research #C39137	277.13	
Lakefield Research #C39186	763.98	
Lakefield Research #C39187	471.87	
Lakefield Research #C39293	1,116.01	
Buckhorn Community Centre Sept/02 Donation	30.00	
Lakefield Research #C40042	868.84	
Total	8,810.25	$8,810.25

Net Balance **$5,004.96**

Receivables

	0.00
Total	0.00

A. Jeffrey Chalmers, Secretary/Treasurer

Financial Statements of

KAWARTHA LAKES STEWARDS ASSOCIATION

December 31, 2002

Note To The Financial Statements
December 31, 2002

COMPARATIVE FIGURES

The 2001 comparative figures were reported in the 2001 financial statements of the Association as at and for the period ended November 30, 2001. The transactions occurring in December 2001 were for bank charges of $9 and, therefore, were considered not significant and included as a part of the fiscal 2002 year.

McCOLL TURNER

McCOLL TURNER

McColl Turner LLP
Chartered Accountants
362 Queen St., Peterborough, ON
K9H 3J6

Telephone 705 743 5020
Facsimile 705 743 5081
Email info@mccollturner.com
Website www.mccollturner.com

REVIEW ENGAGEMENT REPORT

To Mr. Jeff Chalmers, Secretary-Treasurer

KAWARTHA LAKES STEWARDS ASSOCIATION

We have reviewed the balance sheet of Kawartha Lakes Stewards Association as at December 31, 2002 and the statement of revenue and expenditure for the year then ended. Our review was made in accordance with Canadian generally accepted standards for review engagements and accordingly consisted primarily of enquiry, analytical procedures and discussion related to information supplied to us by the Association.

A review does not constitute an audit and consequently we do not express an audit opinion on these financial statements.

Based on our review, nothing has come to our attention that causes us to believe that these financial statements are not, in all material respects, in accordance with Canadian generally accepted accounting principles.

McColl Turner LLP

Peterborough, Ontario
March 21, 2003

KAWARTHA LAKES STEWARDS ASSOCIATION

Balance Sheet - December 30, 2002

(unaudited)

	2002	2001 (note)
ASSETS		
Current Assets		
Cash and Guaranteed Investment Certificate	$ 5,005	3,223
Amounts receivable	-	500
	5,005	3,723
LIABILITIES		
Current Liabilities		
Accounts payable and accrued liabilities	$ 150	$ 150
FUND EQUITY	4,855	3,573
	$ 5,005	$ 3,723

Statement of Revenue and Expenditure

Year ended December 31, 2002

(unaudited)

	2002	2001 (note)
REVENUE		
Trent Severn Waterway grant	$ -	$ 2,500
Municipal grants	3,500	2,450
Associations	4,076	
Private contributions	2,476	5,073
Pledge receivable	-	500
Interest	40	46
	10,092	10,569
EXPENDITURE		
Water testing fees	6,756	5647
Annual report costs	869	-
Telephone, copies and other administrative costs	211	382
Registration fees, insurance and membership fee	922	796
Accounts payable	-	150
Bank charges	52	21
	8,810	6,996
EXCESS OF REVENUE OVER EXPENDITURE FOR THE PERIOD	$ 1,282	$ 3,573
FUND EQUITY - BEGINNING OF PERIOD	3,573	-
FUND EQUITY - END OF PERIOD	$ 4,855	$ 3,573

McCOLL TURNER

Appendix D: Lake-by-Lake *E.coli* Results

Big Bald Lake

2002 *E.coli* Lake Water Testing *E.coli* Count, *E.coli*/100 ml Test Date							
Site No.	02-Jul-02	08-Jul-02 Retest	22-Jul-02	29-Jul-02 No tests done	06-Aug-02	12-Aug-02	02-Sept-02 No tests done
1	25	-	14	-	2	<2	-
2	4	-	2	-	0	<2	-
4	2	-	20	-	1	<2	-
6	**64**	2	4	-	**224**	20	-
		2	<2		**170**	10	
		8	10		13	**30**	
		90	10		1	6	
		6	**162**		**76**	10	
						2	
7	4	-	2	-	1	<2	-

The frequent high counts at Site 6 may have been caused by its proximity to a wetland. Relatively numerous wildlife and low circulation in wetlands can result in somewhat high counts in drainage waters from wetlands.

Please Note: a "-" indicates no data available for that date.

Buckhorn Lake: Buckhorn Sands

2002 *E.coli* Lake Water Testing *E.coli* Count, *E.coli*/100 ml Test Date						
Site No.	02-Jul-02	21-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	02-Sep-02
A	2	2	4	2	<2	2
B	10	10	6	2	<2	4
C	1	<2	0	2	<2	<2
D	0	10	6	10	<2	6

Counts were uniformly low. The volunteer stated that there was almost no rain locally.

Buckhorn Lake: Sandbirch Estates

2002 *E.coli* Lake Water Testing *E.coli* count, *E.coli*/100 ml Test Date						
Site No.	08-Jul-02	22-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	06-Sep-02
A	<2	20	22	10	2	<2
B	<2	10	84	2	4	<2
C	<2	2	60	2	<2	4

Sites B and C, which both showed a 'spike' on July 29, are popular congregating areas for Canada geese. There were often twelve to fifteen geese in the water in these shallow areas. Site C had a beach where geese liked to spend time when people were not there. The geese have been seen at these two sites on several dates in 2001 and 2002, and only on this date were readings high. There was no visible source of inflow into either of these sites.

Buckhorn Lake: North Shore

2002 *E.coli* Lake Water Testing *E.coli* count, *E.coli*/100 ml Test Date						
Site No.	08-Jul-02	22-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	06-Sept-02 No tests done
1	12	10	2	10	2	-
2	14	4	6	2	<2	-
3	4	8	1	2	10	-
4	11	30	7	**60**	**116**	-
					100	
					86	
5	10	-	**60**	4	4	-
				2		
				2		
6	10	10	**90**	**46**	4	-
				128	4	
				24	<2	
7	14	4	20	2	<2	-
8	14	10	0	10	**570**	-

Site 4 was a resort with a number of boat slips. Testing was done near the boats; next year testing should be done at the nearby swimming area as well. Site 6, which was elevated on July 29 and August 6, is an area of high use, both swimming and boating. The highest counts were found during the weekends when the lake was most heavily used. Site 8 was a shoal, which was a favorite gathering place for a large and varied population of waterfowl. On the first four dates, when counts were low, testing was upwind from the shoal. However, on August 12, the wind came from the opposite direction, and so testing was downwind from the shoal. The volunteer noticed a strong smell coming from the shoal, so it is likely that the high counts are a result of bird droppings.

Chemong Lake

2002 *E.coli* Lake Water Testing *E.coli* count = *E.coli*/100 ml Test Dates						
Site No.	02-Jul-02	22-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	02-Sept-02 No tests done
1	4	10	8	12	40	-
2	8	24	**340**	26	10	-
				14		
				14		
3	3	<2	10	6	2	-
4	16	30	23	4	16	-
5	2	2	9	<2	2	-

The counts in Chemong Lake were perhaps slightly higher than some of the 'cleanest' lakes, but this is to be expected as Chemong is quite shallow and does not have as high a flushing rate as most of the Trent lakes. The high count at Site 2 on Jul. 29 may have been due to an unusual number of large live-aboard boats in the bay when sampling was done.

Chemong Lake: Curve Lake First Nation

2002 *E.coli* Lake Water Testing *E.coli* count, *E.coli*/100 ml Test Date						
Site No.	02-Jul-02	22-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	02-Sept-02 No tests done
1	8	**84**	18	2	6	-
2	0	10	2	0	4	-
3	0	2	8	0	<2	-
4	8	26	<2	2	6	-
5	4	20	**80**	2	2	-
				1		
				1		
6	2	22	10	1	<2	-
7	4	10	14	0	8	-
8	2	**50**	**50**	5	10	-

As in many other lakes, the water near the Curve Lake peninsula showed somewhat elevated counts "when the rains came" on July 22 and 29.

Clear Lake: Birchcliff Property Owners of Douro-Dummer

2002 *E.coli* Lake Water Testing *E.coli* count, *E.coli*/100 ml Test Date							
Site No.	02-Jul-02	08-Jul-02 Retest	22-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	02-Sep-02
1	2	-	<2	<2	<2	0	2
2	6	-	<2	<2	<2	0	<2
3	6	-	4	14	<2	0	4
4	10	-	**90**	30	10	10	8
				52	10		
				24	6		
5	8	-	<2	8	14	2	14
6	2	-	36	10	16	2	12
7	**72**	2	2	<2	<2	<2	<2
		4					
		10					
		<2					
		<2					
8	2	-	**2**	30	<2	16	44

Although generally counts were very low, Site 4 showed elevated counts for 2 weeks. There were no high readings in this location in 2001. The property owner reported that area geese were frequently on their shore and there was "evidence of geese" on the lawn. The golden retriever visiting for the rest of the summer seems to have solved the problem. Another possible source was an adjacent wetland. Site 7 was a 'spike' on July 2. The resident in the bay reported bird activity just before the sample date.

Clear Lake: Kawartha Park Cottagers' Ass'n

2002 *E.coli* Lake Water Testing *E.coli* count, *E.coli*/100 ml Test Date						
Site No.	02-Jul-02	22-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	06-Sep-02
A	0	<2	<2	<2	<2	<2
B	0	<2	<2	<2	<2	<2
C	0	<2	<2	<2	<2	<2
D	6	4	<2	<2	<2	<2

Counts here were consistently very low, despite one of the sites receiving high volumes of drainage water from a stream.

Clear Lake: West Shore

2002 *E.coli* Lake Water Testing *E.coli* count, *E.coli*/100 ml Test Date						
Site No.	02-Jul-02	22-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	02-Sep-02
1	14	4	**96**	<2	16	4
				10		
				<2		
2	0	6	<2	16	<2	<2
3	16	**50**	10	2	<2	<2
			14			
			14			

Site 1 had both a marina and a culvert nearby, either of which may have the source of July 29's high count. This is also a fairly confined area, with low circulation.
The elevated reading at Site 3/July 22 was probably due to the heavy rains in the previous 48 hours. Site 3 was at the mouth of a stream, which had a heavy flow at the time.

Julian Lake

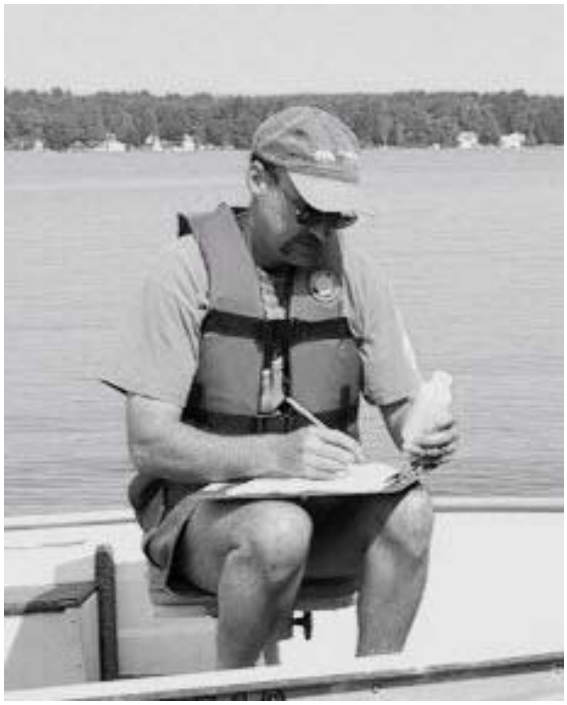
2002 *E.coli* Lake Water Testing *E.coli* count, *E.coli*/100 ml Test Date						
Site No.	02-Jul-02	22-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	02-Sep-02
A	2	16	4	2	<2	<2
B	2	12	<2	10	<2	2
C	0	8	<2	<2	<2	<2

This is a small landlocked, spring fed lake which is not on the Trent-Severn Waterway. Canada Geese are not seen on this lake. It is moderately developed with private cottages. Counts were consistently low, with a slight rise on July 22, probably reflecting recent rainfall.

Katchewanooka Lake

2002 *E.coli* Lake Water Testing *E.coli* count, *E.coli*/100 ml Test Date								
Site No.	02-Jul-02	08-Jul-02 Retest	15-Jul-02 Retest	22-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	04-Sep-02
1	14	-	-	**50**	<2	4	6	51
					8			
					2			
2	**50**	12	8	30	22	10	10	38
		18	8					
		74	12					
3	18	-	-	26	180	10	<2	19
4	18	-	-	30	8	<2	<2	31
5	14	-	-	<2	40	12	<2	5
6	1	-	-	<2	<2	16	4	5

Site 2/July 2 may have shown an elevated count due to a number of dead fish nearby.
Site 1/July 22 was a shallow back bay with very little circulation, so may have been affected by the heavy rains.
At Site 3/July 29, there was a flock of Canada Geese, a group of Mallard ducks and a Great Blue Heron when the water was sampled.



Jeff Chalmers records *E.coli* sample information

Lovesick Lake

2002 *E.coli* Lake Water Testing *E.coli* count, *E.coli*/100 ml Test Date							
Site No.	02-Jul-02	08-Jul-02 Retest	22-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	02-Sep-02
1	2	-	0	<2	<2	8	2
2	0	-	34	4	<2	<2	0
3	4	-	14	2	<2	2	0
4	2	-	28	10	<2	2	0
5	2	-	6	2	<2	<2	1
6	0	-	6	<2	<2	<2	0
7	0	-	6	2	<2	<2	1
8	2	-	10	<2	<2	6	0
9	4	-	152	30	2	10	5
				10			
				20			
10	84	12	16	10	<2	20	1
		10					
		20					
		<2					
11	1	-	14	20	<2	4	1
12	6	-	<2	<2	<2	<2	0
13	14	-	16	2	2	2	3

There were only two high bacteria readings, 84 and 152, at two different resorts and on two different weekends in July. The first site settled back down to 20 or below a few days later, and the second site to 30. There were discussions with resort owners about the heavy rains, water flowing into a beach area, and visiting geese, but no clear cause was found for either high *E.coli* level. Overall, at most sites around the lake, *E.coli* readings were consistently low.

Lower Buckhorn Lake

2002 *E.coli* Lake Water Testing *E.coli* count, *E.coli*/100 ml Test Date						
Site No.	02-Jul-02	22-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	02-Sep-02
1	11	24	30	6	<2	<2
2	3	8	36	10	<2	2
3	24	**170**	10	10	14	32
4	38	**92**	**62**	4	10	8
				40	16	
				30		
				10		
5	2	2	34	<2	4	<2
6	1	36	6	2	<2	<2
7	0	2	2	4	4	<2
8	20	28	2	<2	4	<2
9	33	40	10	10	4	<2
10	0	48	4	2	<2	<2

The rise in counts on July 22, the rainiest date, were obviously higher on this lake. Both site 3 and site 4 were at the inflows of rivers which drain a large area of wetland. Upstream from site 4 was tested in 2001, and the somewhat elevated counts continued upstream from the area of cottages. It would seem that upstream wildlife may be the cause of these elevated counts.

Pigeon Lake: Concession 17 Cottagers' Ass'n

2002 *E.coli* Lake Water Testing *E.coli* count, *E.coli*/100 ml Test Date							
Site No.	02-Jul-02	July 8, 2002 Retest	22-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	02-Sep-02
1	0	-	<2	2	<2	<2	<2
2	0	-	2	6	<2	<2	<2
3	0	-	<2	2	10	<2	<2
4	42	<2	2	<2	<2	<2	<2
		<2					
		<2					
		<2					
		<2					
5	0	-	<2	<2	<2	<2	0

Only one reading, Site 4/July 2, was somewhat elevated. There was some heavy rain before this date. Site 4 is adjacent to a swampy area, which probably feeds some water into the area, especially after a rain. There didn't seem to be a bird problem in that area, but there was a well-used, higher-elevation pasture (cows, horses, llamas, etc.) just across the road from the swampy area and a few hundred meters from the lake.

Pigeon Lake: Gamiing

2002 *E.coli* Lake Water Testing *E.coli* count, *E.coli*/100 ml Test Date							
Site	02-Jul-02	12-Jul-02 Retest	22-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	02-Sep-02
West	2	-	6	<2	6	2	18
East	10	-	**60**	28	10	**15000**	20
				42			
				36			
South	**38**	**80**	**80**	**60**	4	6	4
		40	**40**	30	8		
		50	10	**46**	2		
			20				

The very high reading on Aug. 12 at Site 'East' was reason for alarm. Although the counts decreased on retesting, every effort needs to be made, in such cases, to find the source of the bacteria. On Aug. 12, there were about 15 children swimming at this location (none were noticed on the other testing dates) and there are several live-aboard boats parked nearby.
Site 'South' was at the south end of Pigeon Lake, and therefore downstream from a densely populated shoreline. It would be interesting to test along this shore to localize the source of these elevated counts.

Pigeon Lake: North Pigeon Lake Ratepayers' Ass'n

2002 *E.coli* Lake Water Testing *E.coli* count, *E.coli*/100 ml Test Date								
Site No.	02-Jul-02	July 8, 2002 Retest	July 15, 2002 Retest	22-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	06-Sep-02
1	2	-	-	**130**	<2	<2	-	6
					10			
2	2	-	-	12	10	10	0	28
3	2	-	-	<2	10	20	<2	2
4	4	-	-	**90**	30	8	2	16
					40			
5	**60**	**164**	12	8	24	34	40	10
		68	20					
			16					
			6					
6	6	-	-	**220**	12	20	**80**	24
					20			
					8			
7	**54**	34	-	**220**	**280**	**52**	**410**	**48**
		52			**242**			
		50			**210**			
8	2	-	-	<2	40	<2	2	0
9	12	-	-	44	14	10	10	2
10	8	-	-	<2	<2	4	-	<2

Site 5 and 6 were swimming areas. Rafts and other floating objects attracted large populations of geese, as did the grassy area near the shore. The geese are less of a problem in August, as the geese chicks learn to fly at the end of July. The owner of Site 6 was aware of the problem, and wanted to know how to discourage the geese from visiting.
Site 7 had a dock section running parallel to the shore, which was a favourite place for Canada geese to congregate. This was not a swimming area, but the owners are aware that the area had high counts.

Pigeon Lake: Sugar Bush/Tall Cedars

2002 *E.coli* Lake Water Testing *E.coli* count, *E.coli*/100 ml Test Date						
Site No.	02-Jul-02	22-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	06-Sep-02
A	0	<2	<2	<2	<2	<2
B	0	<2	<2	<2	<2	<2
C	0	<2	<2	<2	<2	<2
D	0	10	<2	6	<2	50

Counts were very low. The somewhat elevated count at Site D on Sep. 6 was possibly due to a congregation of several houseboats in this rather deep bay. Live-aboard boats were not present on any other sampling day.

Sandy Lake: Harvey Lakeland

2002 *E.coli* Lake Water Testing *E.coli* count, *E.coli*/100 ml Test Date						
Site No.	02-Jul-02	22-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	02-Sep-02
1	0	28	20	30	12	4
2	0	10	2	<2	4	400
3	2	<2	<2	<2	<2	2
4	0	10	2	<2	<2	<2
5	2	2	4	4	<2	<2
6	0	<2	<2	<2	<2	4

Counts were generally very low. However, Site 1 had somewhat elevated counts, probably because it was right beside a raft which was covered in bird feces; this caused the water to be somewhat murky. The very high reading at Site 2 on Sept. 2 was also probably due to bird droppings. On this date, the sampler tested further into the bay than on the other 5 dates, right beside a shoal, which was a congregating center for waterfowl.

Kevan Light, Assistant Superintendent at the Peterborough Utilities Water Treatment Plant, gave a presentation, at the KLSA May 2002 workshop, on the river water sampling, testing and processing methods used at the plant.

Scugog Lake

2002 *E.coli* Lake Water Testing *E.coli* count, *E.coli*/100 ml Test Date						
Site No.	08-Jul-02	22-Jul-02	29-Jul-02 No Tests	06-Aug-02	12-Aug-02	06-Sep-02
A	1,220	14,000	-	400	54	80
B	60	540	-	4,600	62	22
C	-	990	-	100	18	900
D	240	248	-	40	400	42
E	180	12	-	690	6	14
F	80	16	-	320	20	60
G	6	210	-	10	26	30

Deborah Tiffen and Barbara Karthein of the Scugog Lake Stewards write: "Lake Scugog has tested well over the years in most areas. This year, it was decided that all areas tested within the KLS program should be maximum problem areas to prompt solutions, many of which are Canada goose related. One test, showing a morbidly high count of 14,000 *E.coli*/100 ml., was taken after a major rain at the lake outlet of an open storm water culvert, which drains a large commercial/ residential section of Port Perry.

Compounding the drainage problem was a huge Canada goose population. When the small shoreline access area was fenced to prevent geese, the next test in similar conditions, dropped to 800 *E.coli*/100 ml., which is still high. However, next year the Scugog Shores Millennium Project will be improving water quality at this storm drain by diverting water through a constructed wetland and naturalized area. Depending on testing, after completion, additional work may be required elsewhere.

New shoreline buffer zones planned for Parks, driven by other high readings, should reduce the significant goose problem further on our municipal waterfront next year. Further testing is planned for major storm sewer outlets around the Lake. Many positive efforts are taking place by a wide variety of environmental bodies, all with the strong support of Municipal Council. We look forward to positive change as the result of our research."

Stony Lake: Ass'n of Stony Lake Cottagers

2002 *E.coli* Lake Water Testing
E.coli count, *E.coli*/100 ml
Test Date

Site No.	02-Jul-02	22-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	02-Sep-02
A	1	<2	2	<2	10	10
E	2	2	2	<2	10	2
F	3	2	<2	<2	<2	<2
G	3	10	2	2	<2	<2
H	9	2	4	-	-	-
I	10	20	10	4	<2	<2
J	19	10	**70**	20	10	22
				10	10	
				50	18	
K	11	28	10	10	2	4
L	10	<2	4	<2	10	2
N	0	**250**	10	<2	0	<2
			30	2		
			12	6		
P	27	6	<2	<2	<2	2

Site N was near a stream inflow. On July 22, the inflow was many times the normal, and so were the *E.coli* counts.
Site J, which had somewhat elevated counts, is a shallow area of high use and fairly low circulation.

Upper Stoney Lake: Upper Stoney Lake Cottagers' Ass'n

2002 *E.coli* Lake Water Testing
E.coli count, *E.coli*/100 ml
Test Date

Site No.	02-Jul-02	22-Jul-02	29-Jul-02	06-Aug-02	12-Aug-02	02-Sep-02	11-Sep-02 Retest
6	2	24	18	4	2	<2	-
20	6	16	18	4	6	2	-
21	0	6	2	2	<2	**124**	6
52	28	12	10	14	10	10	-
56	1	10	<2	<2	<2	6	-
62	2	4	<2	6	2	2	-
63A	2	20	10	<2	<2	<2	-
65	4	12	6	6	2	<2	-
70	1	<2	2	<2	<2	2	-
78A	0	30	10	<2	<2	4	-
85	3	<2	2	<2	<2	<2	-
99	0	4	10	<2	<2	2	-

Counts were generally low, with a slight elevation seen on July 22 after the rain. The high count at Site 21 on Sep. 2 seems to have been short-lived. Site 21 is in an area of high use, but there was no obvious cause of the high count.

Appendix E: 2002 Phosphorus and Secchi Data

Following is the complete record of phosphorus and Secchi disk measurements taken in 2002. Look up your lake and ask:

- How close is our lake to the 20 ppb seasonal average limit?
- How well do our Secchi readings and phosphorus readings correlate?
- How do your lake's phosphorus levels change throughout the season?

2002 Phosphorus and Secchi Data

					Phosphorus Readings			
Lake	Site	Volunteer	Site Description	Date	Sample 1 (ug/L)	Sample 2 (ug/L)	Means (ug/L)	Secchi (m)
Stony	2	Woosnam, Bob	Lake center-Mouse Island	12-May-02	10.5	8.7	9.6	4.1
				2-Jun-02	9.7	10.4	10.0	4.2
				29-Jun-02	13.3	13.2	13.2	3.9
				5-Aug-02	15.4	15.4	15.4	4
				26-Aug-02	20.7	18.7	19.7	3.9
				6-Oct-02	21.2	22.0	21.6	4.7
Pigeon	4	Cole, James	N end, Back channel	7-Jul-02	15.3	15.2	15.3	5.5
				31-Jul-02	18.8	16.7	17.7	3.5
				5-Aug-02	21.5	10.1	15.8	3.5
				6-Sep-02	25.9	26.0	25.9	3.8
				8-Oct-02	28.1	N/A	28.1	4.9
Pigeon	12	Elliott, Ron & Gail	North end	26-May-02	8.5	7.4	8.0	7.1
				6-Jun-02	8.4	9.8	9.1	5.2
				6-Jul-02	12.5	11.4	11.9	4.8
				5-Aug-02	14.6	16.2	15.4	3.5
				5-Sep-02	17.6	18.2	17.9	3.2
Big Bald	1	Dean, Richard	Mid-lake	6-Jun-02	8.8	8.5	8.6	5.5
				1-Jul-02	11.9	12.8	12.3	4.2
				6-Aug-02	16.0	16.0	16.0	3.1
				2-Sep-02	10.7	11.2	10.9	4.8
Clear	2	Chalmers, Jeff	Main Basin, lake centre	2-Jun-02	8.9	9.4	9.2	4.4
				1-Jul-02	13.7	11.1	12.4	4
				8-Aug-02	14.4	15.1	14.8	4
				2-Sep-02	18.1	26.3	22.2	4.1
				15-Sep-02	26.5	27.9	27.2	3.1
				6-Oct-02	28.5	28.7	28.6	4.9
Lower Buckhorn	1	Potter, Mark	Heron Island	20-May-02	15.1	9.9	12.5	4.3
				8-Jun-02	11.2	11.3	11.2	4
				1-Jul-02	20.4	19.3	19.9	3
				7-Aug-02	21.8	21.9	21.9	2.8
				1-Sep-02	17.4	17.2	17.3	2.6
				6-Oct-02	19.3	18.6	19.0	3.5

2002 Phosphorus and Secchi Data

					Phosphorus Readings			
Lake	Site	Volunteer	Site Description	Date	Sample 1 (ug/L)	Sample 2 (ug/L)	Means (ug/L)	Secchi in m
Lower Buckhorn	**4**	MacLeod, Don	Deer Bay Reach W-Nr Buoy, Main Lake	20-May-02	12.2	10.4	11.3	5
				15-Jun-02	19.0	16.9	18.0	4.6
				17-Jul-02	18.9	19.0	19.0	3.8
				17-Aug-02	29.7	30.5	30.1	3.8
				17-Sep-02	18.8	18.5	18.6	3.6
Lower Buckhorn	**5**	Turk, Fred	Off Mileage Is. Trent Canal Channel	6-Jun-02	15.8	15.6	15.7	3.3
				29-Jun-02	22.7	21.1	21.9	4.5
				20-Jul-02	26.9	21.2	24.1	4.5
				10-Aug-02	26.6	31.5	29.0	4
				29-Aug-02	25.6	27.5	26.5	3.5
Lower Buckhorn	**6**	Potter, Mark	Deer Bay-centre	20-May-02	9.2	8.2	8.7	3.7
				8-Jun-02	14.0	14.3	14.2	3.6
				2-Jul-02	17.4	16.2	16.8	2.9
				7-Aug-02	20.0	21.1	20.5	2.7
				1-Sep-02	23.9	22.5	23.2	2.6
				6-Oct-02	17.3	18.3	17.8	3.4
Katchewanooka	**1**	Fischer, Peter	SE Douglas Island	21-May-02	10.7	11.6	11.1	6
				29-Jun-02	14.8	22.7	18.8	4.8
				5-Aug-02	22.3	20.3	21.3	4.8
				2-Sep-02	22.5	22.8	22.6	5
Lovesick	**1**	Moffat, Pat	80' hole at N. end, deepest part	20-May-02	10.2	10.0	10.1	4.8
				13-Jun-02	13.8	14.3	14.0	5.5
				2-Jul-02	16.7	16.6	16.6	5.5
				5-Aug-02	32.0	28.0	30.0	5
				1-Sep-02	20.6	31.4	26.0	4
				20-Oct-02	13.1	26.0	19.6	5
Upper Buckhorn	**1**	Belas, Mary	N end- Buckhorn Narrows, red buoy C310	21-May-02	8.9	8.9	8.9	3
				2-Jun-02	14.1	21.4	17.7	2.6
				2-Jul-02	25.5	22.3	23.9	2.9
				6-Aug-02	20.8	22.7	21.7	2.3
				3-Sep-02	30.4	28.6	29.5	2
				1-Oct-02	22.7	23.5	23.1	2.1
Upper Stoney	**1**	MacArthur, Karl	Quarry Bay	7-Jun-02	6.8	7.5	7.2	5.7
				1-Jul-02	9.7	16.8	13.2	5.8
				5-Aug-02	9.9	N/A	9.9	5
				1-Sep-02	5.7	5.8	5.7	5.2

Appendix F: Rainfall in the Kawarthas

Rainfall (mm) at Three Locations in the Kawarthas, Summer 2002

Oliver Centre (North Pigeon Lake), Trent University (North Peterborough, Peterborough Airport (South Peterborough)

Water Testing Dates are shaded and BOLD

June							July							August							September						
	Oliver	Trent University				Ptbo.		Oliver	Trent University				Ptbo.		Oliver	Trent University				Ptbo.		Oliver	Trent University				Ptbo.
Date	Centre	9am	5pm	Total	T	En. Can.	Date	Centre	9am	5pm	Total	T	En. Can.	Date	Centre	9am	5pm	Total	T	En. Can.	Date	Centre	9am	5pm	Total	T	En. Can.
1	0.20			0.00		1.60	1	0.00			0.00		0.00	1	0.30			0.00		0.20	1	0.00			0.00		0.00
2	0.00	1.60		1.60		0.00	2	0.00			0.00		0.00	2	19.60	10.80		10.80	*	0.00	**2**	**0.00**			**0.00**		**0.00**
3	0.00			0.00		0.00	3	0.00			0.00		0.00	3	0.00			0.00		0.00	3	0.10			0.00		0.00
4	0.30			0.00		0.80	4	0.00			0.00		0.00	4	0.10			0.00		0.00	4	0.00			0.00		0.00
5	0.00	0.40		0.40		1.20	5	0.00			0.00		0.00	5	0.10			0.00		0.00	5	0.00			0.00		0.00
6	0.00			0.00		0.00	**6**	**0.00**			**0.00**		**0.00**	**6**	**0.00**			**0.00**		**0.00**	6	0.00			0.00		0.00
7	0.10			0.00		0.00	7	0.00			0.00		0.00	7	0.00			0.00		0.00	7	0.00			0.00		0.00
8	0.00			0.00		0.00	8	0.20			0.00		0.00	8	0.00			0.00		0.00	8	0.00			0.00		0.00
9	1.00	T		T		0.60	9	1.10		3.20	3.20		6.20	9	0.00			0.00		0.00	9	0.00			0.00		0.00
10	0.00			0.00		0.00	10	0.00			0.00		0.00	10	0.00			0.00		0.00	10	5.30		1.00	1.00		4.80
11	24.50			0.00		50.50	11	0.00			0.00		0.00	11	0.00			0.00		0.00	11	0.00	8.60		8.60		0.00
12	0.30	68.40		68.40		22.90	12	0.00			0.00		0.00	**12**	**0.00**			**0.00**		**0.00**	12	0.00			0.00		0.00
13	0.00			0.00		0.00	13	0.00			0.00		0.00	13	0.40			0.00		T	13	0.00			0.00		0.00
14	2.40		3.80	3.80		6.00	14	0.00			0.00		0.00	14	1.10		0.20	0.20		3.40	14	18.80			0.00		11.20
15	21.70	1.00	0.80	1.80		1.00	15	0.10			0.00		0.00	15	0.00	3.40		3.40		0.40	15	1.70	9.00	0.20	9.20		5.40
16	19.40	4.20	4.40	8.60		11.40	16	0.00			0.00		0.00	16	12.60		10.40	10.40	*	4.20	16	0.00			0.00		0.00
17	1.30	T		T		0.20	17	0.00			0.00		0.00	17	0.00			0.00		0.00	17	0.00			0.00		0.00
18	0.00			0.00		0.00	18	0.00			0.00		T	18	0.00			0.00		0.00	18	0.10			0.00		0.00
19	0.00			0.00		0.00	19	0.00			0.00		0.00	19	4.40		1.80	1.80		3.20	19	0.00			0.00		0.00
20	0.00			0.00		0.00	20	0.00			0.00		0.00	20	0.10	0.60		0.60		0.00	20	0.00			0.00		0.60
21	0.00			0.00		2.00	21	0.00			0.00		5.20	21	0.10			0.00		0.00	21	0.40	0.60		0.60		0.20
22	0.00			0.00		T	**22**	**52.60**	**22.60**	**9.80**	**32.40**	*	**58.20**	22	12.30		20.40	20.40	*	20.00	22	3.10			0.00		0.80
23	6.00			0.00		0.00	23	7.50	3.00		3.00		1.60	23	0.20	T		T		0.40	23	0.00	1.60		1.60		0.00
24	0.30	0.80		0.80		0.20	24	0.00			0.00		0.00	24	0.00			0.00		0.00	24	0.10			0.00		0.00
25	0.00			0.00		0.00	25	0.00			0.00		0.00	25	0.00			0.00		0.00	25	0.10			0.00		0.00
26	20.50	11.20	T	11.20	*	20.00	26	30.10	0.20	5.20	5.40		9.40	26	0.00			0.00		0.00	26	0.00			0.00		0.00
27	5.40	10.00	17.40	27.40	*	10.20	27	0.10	0.20		0.20		0.20	27	0.00			0.00		0.00	27	9.50		21.80	21.80		36.00
28	0.00			0.00		0.00	28	7.00		12.40	12.40	*	4.80	28	0.00			0.00		0.00	28	0.10	0.60		0.60		0.00
29	0.00			0.00		0.00	**29**	**3.20**			**0.00**		**4.60**	29	0.00			0.00		0.00	29	0.00			0.00		T
30	0.00			0.00		0.00	30	0.00	3.60		3.60		0.00	30	0.00			0.00		0.00	30	8.50		5.60	5.60		1.40
							31	0.00			0.00		0.00	31	0.00			0.00		0.00							

* Means Thunderstorm T Means Trace of rain <0.2 mm

Notes

Notes