Report on E. Coli Survey of Shoreline Waters and Influent Streams of Tiny Township in the Summer of 2001

To
The Township of Tiny
The Simcoe County District Health Unit
The Ministry of the Environment
Area Beach Associations

By
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BACKGROUND

Early in 2001, the Federation of Tiny Township Shoreline Associations (FoTTSA) decided to focus the spring *Tiny Cottager* on water issues. Among the obvious ones was the quality of swimming water in the Bay.

We knew that some testing had been done at Farlain Lake in the early l990's. We knew that cottagers south of Concession Road l3 W. checked with the Simcoe County District Health Unit each year for results of the Health Unit's testing in their area. We knew that Lafontaine Beach had been posted for a period in August 2000, and that people had concerns about water quality elsewhere.

The *Tiny Cottager* article about the quality of swimming water was written by John Neil, an expert in fresh water and a long-time resident of Thunder Beach. In it he urged that a one-time comprehensive study be conducted of the bacterial quality of recreational water along the shorelines of Tiny Township. He argued that such a study was required to assure Tiny residents of the quality of beach waters and influent streams and to establish a basis from which any future changes could be measured.

With this end in view, many of FoTTSA's member associations were approached to see if there was interest in testing the swimming waters of Tiny Township and whether volunteers could be found to take the necessary samples once a week. The reply was positive. John Neil and Judith Grant (President of FoTTSA) met with the Ministry of the Environment, the Council of Tiny Township, other cottagers' associations, and the Simcoe County District Health Unit in Barrie to discuss how a volunteer program might be put in place.

FoTTSA raised the funds to support the cost of the volunteer program – $6,921. Almost all of this was for E. coli analysis of samples. Contributions came from Tiny Township's shore area associations (including several that are not members of FoTTSA), concerned individuals, a fund-raising campaign and a donation of $l,000 from the T. D. Friends of the Environment Foundation.

The Authors

John Neil, MA, CPH is a biologist. He was employed over a 20 year period with the Ministry of the Environment where he served as Director of the Laboratory and Water Resources Branches. He subsequently was president of a consulting firm conducting studies on environmental and fisheries subjects. He is a life-time summer resident of Thunder Beach.

Judith Grant has a doctorate in English and is the author of several books. She has been a resident of Addison Beach for 50 years and president of The Federation of Tiny Township Shoreline Associations for 2 years.

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INTRODUCTION

The clear clean water of Georgian Bay surrounding the Township of Tiny is the municipality's most precious resource. It attracts cottagers to come and settle in the region and entices inland residents to visit the shoreline.

The quality of recreational water in Tiny Township, however, has received little attention. The Township has no responsibility over the waters of the Bay, the Ministry of the Environment has not been doing in depth studies of local water quality and the Simcoe County District Health Unit's mandate confines its sampling to E. coli surveys of a few public beaches scattered along the Township's 72 kms. of shoreline.

Recreational water quality is a concern of every beach association. Without authoritative information, there is no assurance of the water quality.

It was against this background that the Federation of Tiny Township Shoreline Associations decided to lead a study that would draw volunteer water samplers from their member associations, non member associations and interested individuals. The proposed sampling program was supported and encouraged by the Simcoe County District Health Unit [SCDHU]. It made available its own data collected at public beaches and that collected by Awenda Provincial Park and Marygrove Camp to complete the record of water quality information from around the Township.

The following is the report of the findings of the study and their interpretation by the authors of this report.

PURPOSE OF STUDY

The project was planned

1. to provide a one-time, comprehensive record of recreational water quality for the shoreline waters of Tiny Township and for the permanent influent streams entering the Bay at the shoreline.
2. to bring such information to appropriate authorities so that remedial action could be undertaken if any waters of impaired quality were identified.
3. to develop a commitment on the part of all stakeholders for the need for surveillance over the environmental quality of our waters.

METHODS

The basic plan was to organize a weekly collection of samples from all populated shorelines of Tiny Township. The sample locations and their rough spacing were established in a discussion with Health Unit staff and subsequently detailed on maps (Appendix D). It was agreed that the samples should be collected first thing in the morning on the first day after the nine weekends of the summer, beginning July 3 and ending August 27. The Health Unit increased its sampling of parks and access points from 6 to l0, moved its sampling day from Tuesday to the day after the weekend, and sampled every week rather than biweekly.

The samples were tested for E. coli bacteria numbers. E. coli was selected as tracer, because it is used by the Health Unit in establishing water quality at public beaches. (The Ministry of Health requires a standard for public swimming areas of less than l00 E. coli per l00 ml. water based on the geometric mean of roughly five samples. A geometric mean of a number of samples is used rather than arithmetic averages because it reduces the biasing effect of a single high reading.)

Many of the volunteers came from the beach associations of Tiny Township. A few volunteers presented themselves once it was known that there was to be a water sampling program. In a few instances,

contacts were telephoned and volunteers found. In all, more than 40 samplers participated in the program. Four captains collected the samples from their particular area and transported them to the Health Unit in Midland. The captains also served as backups for the individual samplers.

The training of the volunteers (samplers and captains) took place on the morning of June 23rd at Balm Beach. Eric Watson of the Midland Health Unit gave the instruction, with the assistance of Christina Wieder (the summer student who had done the Health Unit's recreational water sampling in 2000 and was to do it again in 2001). The volunteers were shown how to take samples according to the standard protocol. They were to wade into the water to a depth of a metre to a metre and a half, then to take a sample 15 to 30 cm. below the surface. They were told how to take stream and rivulet samples from flowing water above beach pools, and how to complete the forms. The Federation's recording secretary took notes at the training session and then typed them up. Copies were distributed to the samplers and captains before the first sampling day to ensure that everyone had the instructions clearly in mind. (See Appendix B.)

All volunteers received maps of their sample locations, a plastic-coated reaching pole and an indelible ink marker pen suitable for writing on wet plastic bottles. The Health Unit provided its standard forms, complete with "stick-on" lists on which to record weather and water conditions (Appendix C). The Health Unit also provided all the bottles needed for the summer.

By 10 a.m. on each sampling day the volunteers had collected single samples from approximately 80 swimming locations and from 21 continuously flowing influent streams and rivulets. They placed their samples in refrigerators or coolers until the captain collected them. The chilled samples were then transported by the captains in coolers to the Midland Health Unit for transport to Orillia by the Health Unit, reaching the laboratory between 1:30 and 3 p.m.

The volunteers collected single samples spaced along the shore, whereas the Health Unit took a group of 4, 5 or 6 samples from each park or access point as a basis for calculating a geometric mean in accordance with Health protocol. (It was learned later that Wasaga

Beach Provincial Park follows the method used by the volunteers – individual samples taken at spaced intervals. Wasaga Park does not calculate geometric means.)

The samples collected by the Health Unit, by the staff at Awenda Park and by counsellors at Camp Marygrove were analyzed by the government laboratory in Orillia. As it does not analyze recreational water samples collected by private citizens, those samples had to be analyzed by a private, accredited laboratory. Central Ontario Analytical Laboratory in Orillia was chosen for several reasons. It was in Orillia so that it was possible for the Health Unit to transport the volunteers' samples when it took its own to the government laboratory there. It was the Laboratory used by the Water Department of Tiny Township, and, lastly, it offered an excellent price at $6.50 per sample plus taxes.

The private laboratory reported the results for the volunteer program the day following the sampling. They were sent simultaneously to the Health Unit and to the Federation's President and were posted as public information on the Tiny Cottager website each week. The results of the Health Unit, Awenda Park, and Camp Marygrove were added as they became available. During the summer, the latter were reported as geometric means of the 4, 5, or 6 samples taken at a particular park or access point on a particular sampling day.

At the end of the summer, a geometric mean was calculated for the summer's results at each sampling location. In the case of volunteer locations each geometric mean was based on 9 samples. In the case of the Health Unit, Awenda, and Camp Marygrove, it was based on the geometric means reported each week. All these geomeans were then plotted on a map of Tiny Township and published in *The Tiny Cottager* as a visual representation of the quality of recreational water in Tiny Township. The map is presented here as Figure 1.

Later, as this report was prepared, the individual sample results for areas monitored by the Health Unit, Awenda Park, and Camp Marygrove were added to the master record of results. Appendix A presents a complete record of each individual sample taken in the recreational waters of Tiny Township in the summer of 2001.

(To find the geometric mean of n samples, you multiply them together and take the n'th root of the result. For example, with three samples of 2, 3, and 600, multiplying them together gives 3,600. The third root of 3,600, 15.33, is their geometric mean, because 15.33 x 15.33 x 15.33 gives 3,600. For comparison, the arithmetic mean is the result of adding the three numbers together and dividing by 3. In this case it would be 201.7.)

FINDINGS

The samplers were very dependable. As a result there is a full set of data from which to interpret water quality. Samples were collected at precisely defined locations each week, in a manner approved by the Health Unit, cooled, and conveyed to the testing laboratories by early afternoon. The conditions under which the samples were taken were noted: time of day, rainfall, wind direction, sunlight, bather density, waterfowl affecting sampling site, wave action, water clarity, and algae. (Most of the conditions concern matters observed as the samples were taken. However, some rainfall observations are dependent on the location of the sampler during the weekend before the sampling day. The volunteers all lived at the beach they were sampling so they knew local rain conditions; the Health Unit's sampler, who took samples at 10 different beaches spotted along the length of Tiny's 72 kms. of shore, lived at Sand Castle Beach just south of the 18th Concession Road W., so she knew about rainfall conditions there, but not necessarily those elsewhere.) In general, it should be noted that the summer of 2001 was very dry in Tiny Township.

This report does not make use of any of the detailed "conditions" data, as that requires the skills of a professional water quality researcher and is beyond the scope of this report. This report also makes no attempt to emulate the SCDHU's method of grouping samples taken on a particular day at a particular stretch of beach as the basis of a geometric mean calculation. This could certainly be done in some areas where volunteer sample locations were clustered fairly tightly. But too many were too widely spaced. There is also no use made in this report of sample information from streams that dried up, or of

extra samples taken at some streams to ascertain whether the E. coli numbers were elevated before the stream water reached the shore. This information is included in Appendix A, but not explored.

What follows is based on individual sample results rather than geometric means. It is a broad brush analysis indicating the quality of water surrounding the Township based on E. coli numbers, and suggesting where additional study is required.

Table I presents the number of sampling locations and the total number of samples collected in support of this study.

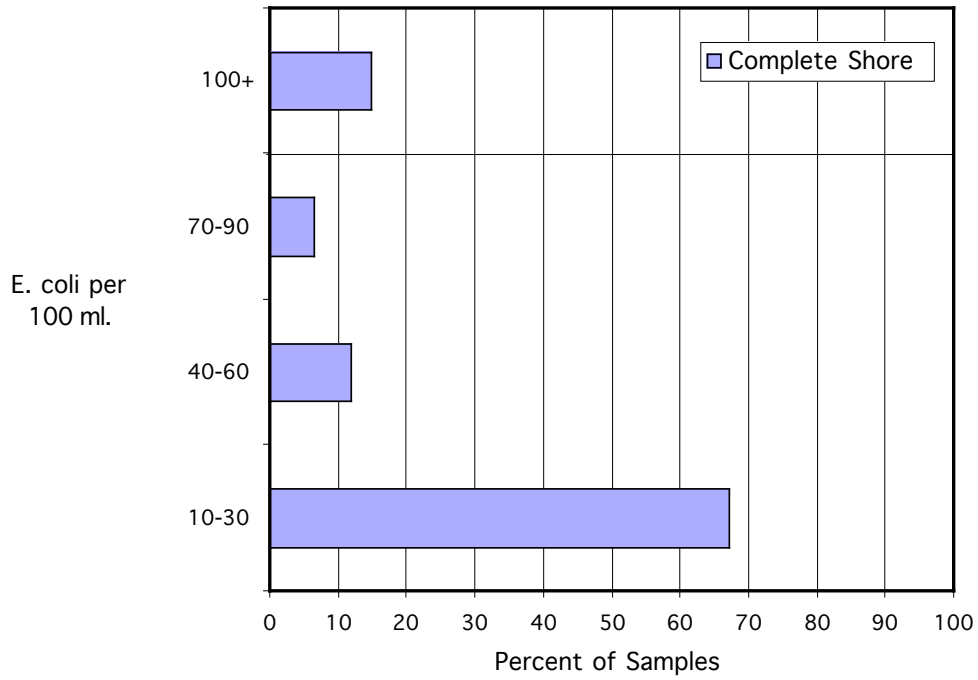
Table I Sampling Program

AGENCY	LOCATIONS	NUMBER OF SAMPLES
Volunteer	101	949
Health Unit	51	456
Awenda Park	20	160
Marygrove Camp	5	30
	177	1595

Shoreline Sample Findings

Chart 1 presents an overview of the distribution of E. coli numbers for the 1361 shoreline samples taken through the summer.

Chart I – E. Coli Distribution
Complete Shore

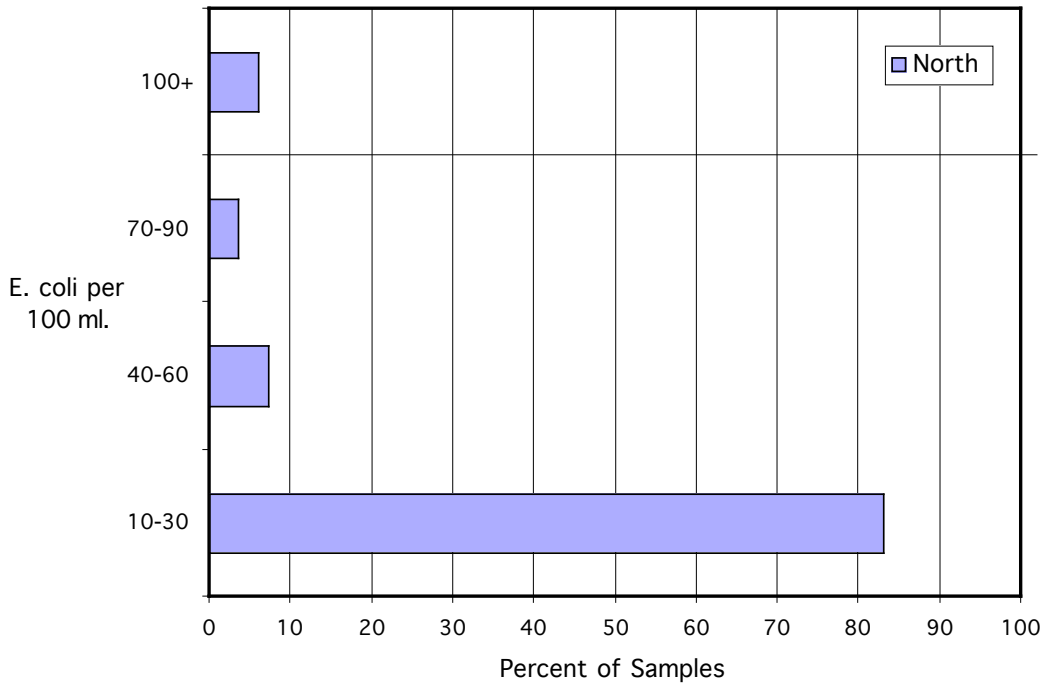


Here it is evident that Tiny Township's Recreational Swimming water is generally good. Of the 1361 samples, 912 had readings of 10-30 E. coli (67%); 161 samples had readings of 40-60 (12%); and 87 samples had readings of 70-90 (6%). In other words, 1160 samples (85%) had less than 100 E. coli per 100 ml.

However, the geographical distribution of low and high E. coli levels is quite different in different parts of the shoreline of Tiny Township. (See Figure 2.)

Chart II presents the distribution of sample results in the north end (Concession Road 17 W., around the north end of the peninsula, south along the eastern shore, and in Farlain Lake).

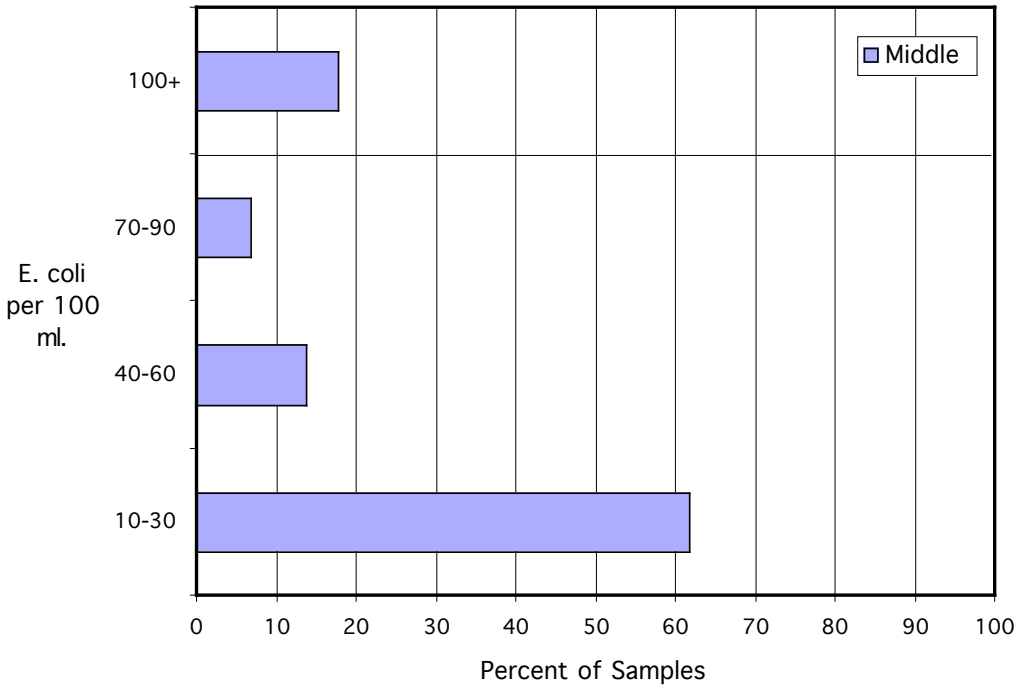
Chart II – E. Coli Distribution – North End



Here 468 of a total of 563 samples had E. coli readings in the 10-30 range – or 83%. A total of 529 samples (94%) had readings of less than 100. This is very good. Only 34 samples had readings of 100 or more. Most of these were scattered: 18 sampling locations had one, four other locations had two each. Only two locations had four samples that registered 100 E. coli/100 ml. or more.

The picture is much more mixed from Concession 17 W. south to Concession 6 W., as can be seen in Chart III.

Chart III – E. Coli Distribution
Concession Road 6 W. to Concession Road 17 W.



In this section of the western shore, the share of samples in the 10-30 range was 21.5% less than in the north of Tiny Township. Here, out of a total of 619 samples, 382 (61.5%) fell into the 10-30 range. Where in the north end only 7% of samples had readings of 40-60, here twice as many – 13.5% (85 samples) -- had this slightly elevated count. Where in the north end, 4% of samples had readings of 60-90, here 7% (42 samples) fell into this range. Here 110 samples (18%) had counts of 100 E. coli or more/100 ml.

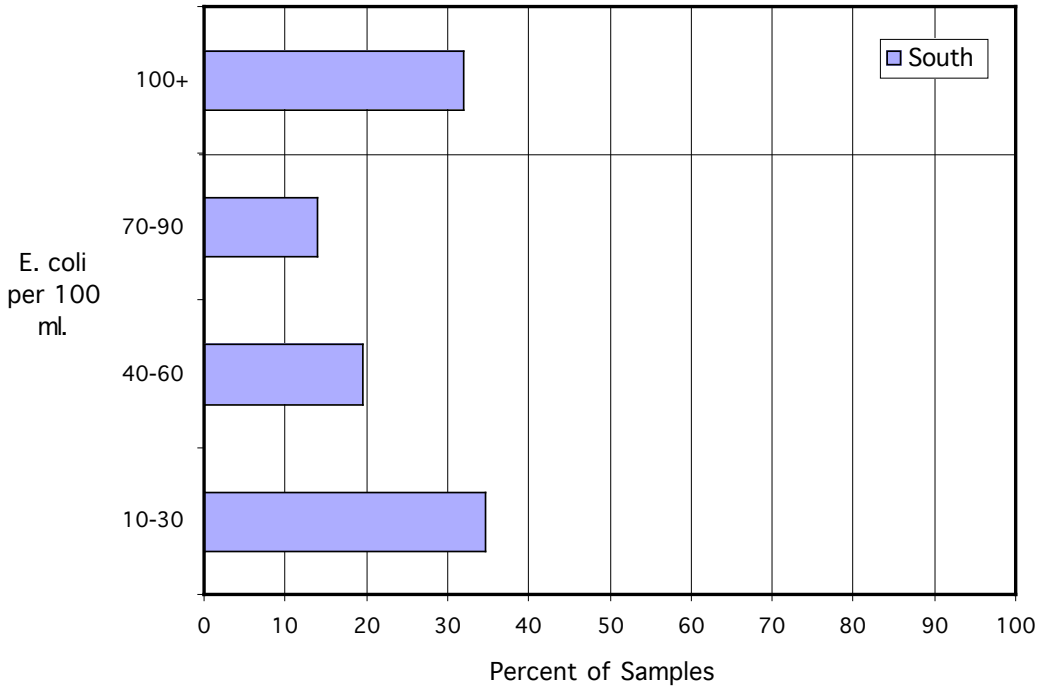
Of the 69 sampling locations in this area, 16 had no readings of 100 or more and 23 had just one sample in the course of the summer with a reading of 100 or more. But 12 stations had two readings of 100 or above, 12 more had three such readings, three stations had four, and three stations had five readings of 100 or above.

Two beaches along this shoreline, Cove Beach and Lafontaine Beach in the vicinity of Concession Road 16 W., had swimming advisories posted

because geometric mean counts of over l00 were found by the Health Unit for all the samples taken at each beach on consecutive days.

South of the 6th Concession Road W., the results were considerably worse than in the middle section of the western shore or in the north end, as can be seen in Chart IV.

Chart IV – E. Coli Distribution
Town Line to Concession Road 6 W.



Here, in the southernmost part of the western shore of Tiny Township, only 35% of samples were in the 10-30 range (62 out of 179). The percentage of samples in the 40-60 and 70-90 ranges were likewise larger. And 57 samples (32%) had readings of 100 or more, many of them substantially more. Of these 57, 24 had readings that were higher than 300, and 10 of these were >600 E. coli/100 ml.

In this part of the shore, NONE of the 20 stations was free of samples that tested at 100 E. coli or more. Two had just one sample

at 100 or above. Nine stations had two samples at 100 and above. Three stations had three; four had four; one had five; and one had seven.

Three stations had readings substantially higher than the others. Tamarack Trail (V-WB2) had 7 readings that were over 100, many of them substantially over. Siesta Drive (V-WB1) had 4 readings that were over 100, and Laurel Avenue (V-EB1) had 5 readings out of the summer's nine samples that were over 100. These three stations are widely separated. They are all at public access points. A factor they share is proximity to Spratt Point.

Stream Sample Findings

From the beginning the intention was to ascertain the quality of water in streams flowing over the beaches into the Bay. These waters frequently form ponds on the beach and children are attracted to the shallow water. Likewise they are considered vulnerable to pollution as they frequently flow through high density shoreline development. As no other agency samples these waters routinely, it was decided to include weekly sample collections by volunteers from 23 streams. In this report, only the 21 which maintained a permanent flow throughout the summer are considered.

Most of the 21 streams have a spring source flowing from the base of the bluff that surrounds the shoreline of the Township. They arise within a kilometer or two of the shore and have relatively small flow. An important exception is the stream that enters the Bay south of Concession Road 13 W.: it rises near the border of Awenda Park and flows for approximately 13 km. through forested and agricultural lands before passing through shoreline development and into the Bay. It has a significant flow and creates a major pond at the shoreline.

As may be expected, results from stream samples were generally higher than those from the bay and lake. The 10-30 E. coli range preponderated in lake and bay samples, but in streams the dominant range was >600 (35% of all samples, or 63 out of a total of 179).

Several streams stood out as having very low counts — the one that exits through the Deanlea Beach Culvert (V-DBD), the stream at Pennorth (V-PS), and the stream that flows down the ditch on the 14th Concession Road W. (V-ABD), for example. The numbers recorded for many other streams were highly variable. Seven streams are a matter of concern as they had six or seven of the nine results in excess of 600 E. coli/l00ml of sample.

Table V Results for Problem Streams

STREAM	LOW	HIGH	SAMPLES >600
Woodland Beach (V-WBS2)	30	1600	6/9
Woodland Beach (V-WBS1)	70	1250	7/9
N. of Conc. 6 (V-WBGS)	140	1640	7/9
Balm Beach (V-BS1)	430	1150	6/9
Cawaja Beach (V-CBS2)	400	>600	6/9
S. of 13th Con. (V-NBstream)	360	1850	6/9
Thunder Beach (V-TBS2)	130	5600	7/9

The laboratory analyzing the volunteer samples reported results between l0 and 600. When the number of E. coli exceeded 600, the result was given as >600. If an accurate count is wanted, then dilution and a second analyses is required. When some of the streams produced several results greater than 600, some dilutions were requested, so that some results during August reflect actual counts. (The decision to ask for dilutions was taken at a meeting with the SCDHU.) As only a few samples of the streams reporting high numbers were analyzed for actual counts, the reported geometric means in Appendix A are lower than their true values.

DISCUSSION

Historical Information

The records of previous sampling data were made available to this study by the SCDHU. Information on many of the sites sampled this year by the Health Unit goes back to the l980's. The results are variable from year to year, but in general are similar to this year's. At one location, Balm Beach, a significant improvement is noted between the late 80's and early 90's and the past several years. Records were also available for a few streams sampled in the late 80's and early 90's (Thunder Beach, the one south of the 13th Concession Road W., Balm Beach, Ossossane). As in our study, the Thunder Beach creek showed the highest level of indicator organisms.

A search was also made of records of beach sampling for Wasaga Beach. Allenwood Beach abuts the southern boundary of Tiny Township and a review of results for their closest sampling point indicates that for 30 samples over the past three years, only four have been above l00 and 23 have been 20 or less. This would suggest that any high readings up the shore were not due to water transport from the south. It is of interest, given our results at the 20 sampling locations from the Town line north to Concession Road 6 W., that at Wasaga in the summer of 2001, the first 10 sampling points immediately south of Tiny, reported only seven out of a total of 90 (8%) that tested at 100 E. coli or more.

The Severn Sound Remedial Action Plan (Mayrand et al 200l) published the results of their six index swimming beaches along the urban shores of Midland Bay and Waubaushene. In 2000 a total of 71 sample sets collected between June l9 and August 28 resulted in only six exceeding l00 E. coli/100 ml and the geometric means for 4 of the 6 stations were below 20 for the whole summer. Results from urban areas like these might be expected to be high; yet they are better than those in some areas of the Tiny shoreline.

Studies by Other Associations & Municipalities

Severn Sound Remedial Action Plan: Studies of water quality and coliform numbers have been conducted over a number of years from representative locations in the Severn Sound Area including Penetang and Midland Bays. Data from these studies is available from published reports.

Georgian Bay Association: The GBA has undertaken a broad program which includes both biological and water chemistry studies. Included in it is E. coli testing (Schiefer 2000). Their study area extends from Honey Harbour to the North Channel. E. coli evaluations are reported for areas likely to be more polluted than the waters of Tiny Township -- enclosed bays with high density cottage development, marinas and mixed use waters and boat mooring bays. None of their results (all individual samples rather than geometric means of a number of samples) exceed l00 E. coli/l00 ml. They have proposed a "Suggested Recreational Water Use Objective for Eastern Georgian Bay" of 20 E. coli/l00 ml. The municipality provides financial support which is used in part to employ a part-time biologist and facilitator. These professionals assist with the planning and reporting of work done by their volunteers.

Muskoka Lakes Association: The Muskoka Lakes Association has employed a consultant (Gartner Lee Ltd.) to guide its water quality investigations. The focus of recent work has been to measure differences in near shore and off shore water quality using a number of parameters including E. coli numbers. Sampling is done by the association's marine patrol. An annual budget of $20-30,000 has been proposed for these studies.

Kawartha Lakes: A broad water quality study (chemical and microbiological) is also under way in the Kawartha Lakes. This is being conducted by volunteer samplers with municipal financial support.

Jurisdictional Responsibility

Federal: Water quality research and international water quality agreements are administered through the Federal Government.

Provincial: Responsibility for pollution control is vested in the Province. In the Great Lakes, the Ministry of the Environment Water Monitoring Division conducts studies of near shore water quality. Their Great Lakes program relating to Georgian Bay consists of six index stations which are monitored for a broad number of biological, chemical, and bacteriological paramaters at six year intervals. The closest index station to Tiny Township is off Collingwood. Where local problems occur, investigation and enforcement would be the responsibility of the district office. (The one for Tiny Township is located in Barrie.)

County: The Simcoe County District Health Unit (under the direction of the Medical Officer of Health) is responsible for public health in Simcoe County. To ensure public beaches are safe for swimming, it has monitored the bacterial quality of a number of beaches for many years. Where waters exceed the provincial standard by having a geometric mean of 100 E. coli/100 ml in two consecutive samplings, a swimming advisory is posted until acceptable water quality has returned. The Health Unit does not sample shoreline waters other than public beaches. It does not undertake stream sampling or follow-up studies to determine sources of contamination, nor does it undertake corrective action or enforcement.

Municipal: The Township has no mandated responsibility for the Bay waters surrounding the municipality. It has, however, recently become responsible for septic tank inspections and is preparing to embark on a review of all septic tank installations of residential properties.

It was in the absence of any jurisdictional agency undertaking a detailed study of the bacterial quality of the Bay waters and of streams in the shore area that residents came together to plan and execute this detailed study of the bacterial water quality of some l00 locations over the 72 km of the Bay and Farlain Lake shores.

Related Scientific Studies

A number of important scientific reports looked at where coliforms in beach areas originate, their decay rates in the environment, and their relationship to sediments. Others examined swimming related illnesses, birds as contributors of fecal organisms and the impact of storms on water quality. All of these studies have some relevance to the circumstances in Tiny Township.

Seyfried et al (l997) studied factors affecting coliform concentrations in water and sediments at l0 locations on the Eastern shore of Georgian Bay. A relationship was demonstrated between concentrations in water and in sediment, wave action and organic carbon. A second study (Seyfried l995) determined that fecal coliform levels were approximately l0 times higher in sediments than in corresponding surface water samples. A related paper (Seyfried l985) reported on a health survey of people using beaches and found morbidity rates of 69.6 per l000 swimmers and 29.5 per l000 for non swimmers. Respiratory, gastro-intestinal, eye, ear and allergic symptoms occurred in that order. In another paper she reported on a microbiological study (Seyfried l998) to differentiate coliforms produced by dog, man, horse, Canada goose and domestic geese. While successful to a degree, she indicated in a subsequent personal discussion there is no practical means available at present to determine the origin of fecal contaminants.

Mattson, Li & Sherman (2000) conducted a study of the effects of water flow from a storm drain into the shoreline waters at Pete Peterson Park in Midland. They demonstrated a direct relationship between a rain event which carried E. coli levels of >600 to the adjacent beach within three hours. After 24 hours, levels had returned to their usual level at the beach area. In a personal discussion with Sherman on the possible contribution of geese and gulls to E. coli levels, he indicated that in their studies of Little Lake Park in Midland where excessively high concentrations of these birds occur, they have not been able to attribute more than 70% of fecal contamination to bird populations. Over the past l0 years, only seven of 80 sample sets from Little Lake have exceeded l00 E. coli/ml.

Probably the most important studies relative to sources of coliform contaminants for an open shoreline similar to that of Tiny Township were done by Palmateer et al. (1993). In one study they marked E. coli and followed their progress through a drainage ditch to the Ausable

river and out onto the open beach at Grand Bend. Within 24 hours, marked E. coli had reached the beach. Their studies showed that the bacteria may be free floating and decay quickly (hours) or they may be sorbed (stuck) to fine clay or organic particles and have a longevity of up to 85 days. Several factors affect the outcome. Variable stream flows may move more or less particle attached bacteria to outflows. Waves may suspend coliforms from their attachment. Ultra violet rays of sunlight kill coliforms quickly. Sediment protects the bacteria from light and organic carbon extends their longevity.

CONCLUSIONS

The Tiny Township study has provided a clear record of water quality along the shoreline of the municipality for the summer of 2001. While the water quality is generally good, there is evidence of depreciation at several specific locations along the western shore. To identify the sources of contamination and bring about corrective action, a careful study is required to determine where and how E. coli enter the beaches. When the problem is understood, appropriate action can be taken.

The clear, clean waters of the Bay are highly valued by the residents of Tiny Township. Any environmental depreciation needs to be dealt with promptly. The Township has adopted a forward looking Official Plan dealing with its land resources. Unfortunately, shoreline water quality, because it does not fall within the municipality's jurisdiction, has been neglected. In the absence of any other official agency taking responsibility, we urge the Township to provide the leadership which will ensure that the recreational waters of Tiny are returned to and maintained at the highest quality.

RECOMMENDATIONS

In consideration of the findings of this report, it is recommended that:

1. the general E. coli levels found in the shoreline waters at the northern end of Tiny Township be recognized as a goal for all waters in the Township that are used for recreational purposes.

2. the Township of Tiny commission a study into the sources of contamination along the western shore from the town line to Concession Road 17 W., with special reference to the two areas where water quality is seriously impaired, and that remedial action be taken as required.

3. the Township of Tiny commission studies of the seven problem streams, and that remedial action be taken as required.

4. the Township direct its consultant (C. C. Tatham and Associates) to give priority for inspections of septic tank systems to those areas of shoreline exhibiting questionable water quality and also to installations adjacent to those streams identified as having high E. coli counts.

5. the SCDHU be requested to provide appropriate wording for signs for posting at beach outflows of streams exhibiting high E. coli counts.

6. the Health Unit continue its usual monitoring of parks and public access points in Tiny Township and that it also monitor Tamarack Trail, Siesta Drive, Laurel Avenue and Cove Beach.

7. individual beach associations be encouraged to monitor the quality of the water fronting their shoreline until such time as some public agency agrees to monitor recreational water along the full length of Tiny's shore.

8. the Health Unit create an information sheet for inclusion with the next tax bill about recreational water issues and especially the dangers of some stream outflows.

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ACKNOWLEDGEMENTS

We are indebted to the Simcoe County Health Unit, and in particular to Eric Watson of the Midland Office and Ted Devine of the Barrie Office, for their support in planning the study, coordinating their sampling program to match the volunteer dates and locations, delivering samples from Midland to the Orillia laboratories, for doing geometric mean calculations for this report, and making their historical data available.

The assistance given by Dr. Patricia L. Seyfried in several conversations, by Dr. Karl Schiefer in a long discussion, by Keith Sherman in several discussions was invaluable in sharpening our thinking about the results in Tiny. Pat Moffat, coordinator of the Kawartha Lakes volunteer sampling program also provided valuable insights.

Mark Shoreman, the Park Superintendent at Wasaga Beach Provincial Park, kindly made the Park's data available and discussed its findings.