

BLACKSTONE LAKE WATER QUALITY TESTING 2013



**Conducted by Digby and Valerie Sale
BLACKSTONE LAKE COTTAGERS
ASSOCIATION**

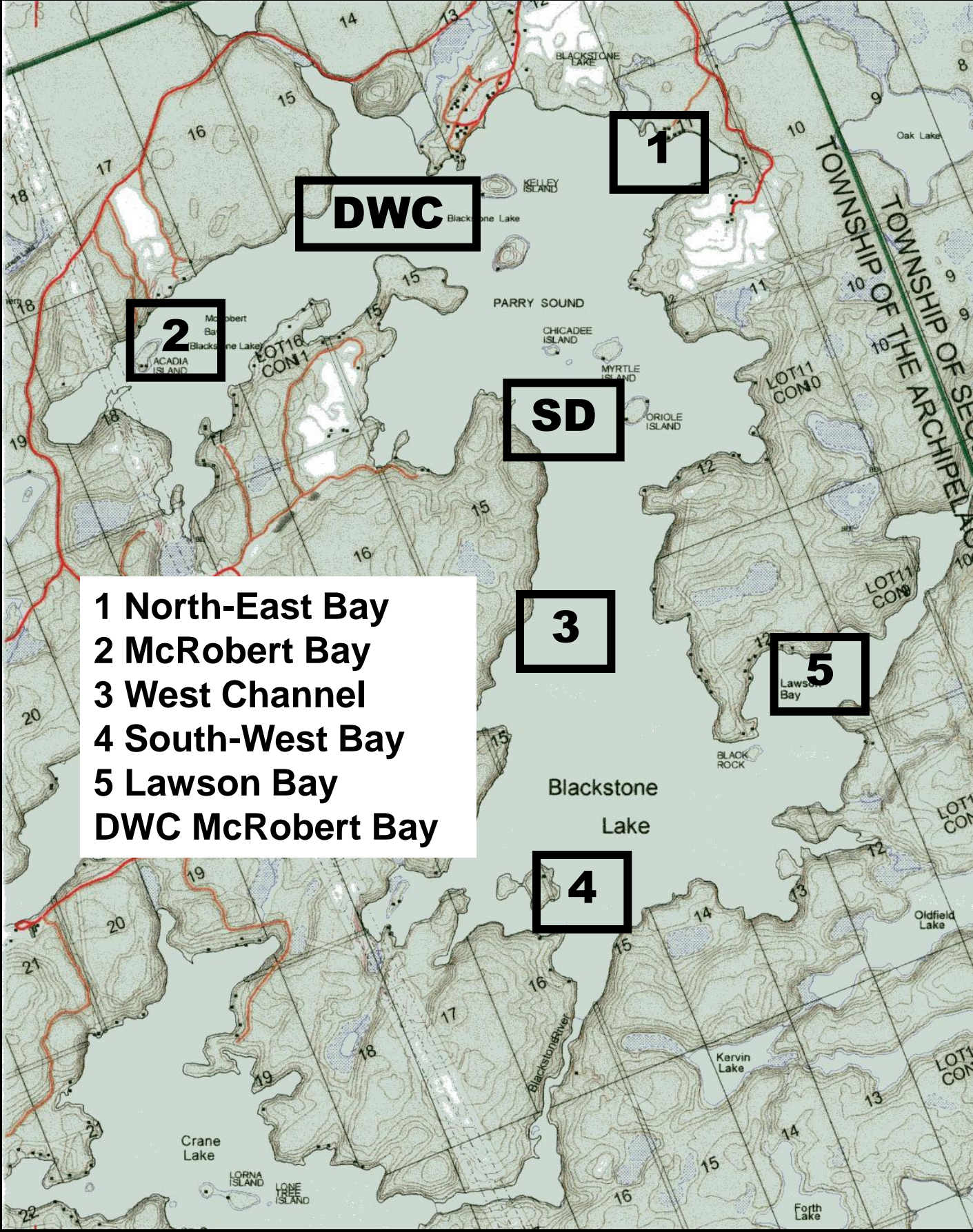
BLACKSTONE LAKE WATER QUALITY TESTING 2013

The Blackstone Lake Cottagers Association conducts three tests of water quality each season: 1) bacterial concentration; 2) water clarity; 3) phosphorus concentration. The bacterial and water clarity tests are sponsored by the Township of the Archipelago. The phosphorus concentration test is sponsored by Ontario's Lake Partner Program. The Lake Partner Program also requests water clarity test results; therefore, the same water clarity results are submitted to both the township and the Lake Partner Program.

Bacterial Concentration. Blackstone Lake was sampled for total coliform (TC) and *E. coli* (EC) at six sites on several dates during the summer season. The six sites are named: 1) North-East Bay ; 2) McRobert Bay ; 3) West Main Channel; 4) South-West Bay); 5) Lawson Bay; 6) Deep Water Control (DWC). DWC is done in deep water in McRobert Bay in line with the outflow from the Blackstone River. The DWC site provides a comparison to sites 1-5, at which samples are taken in shallow water (see below). All sample sites are marked on the map on page 2. The bacterial tests consist of taking water samples in shallow water (50 cm or 1.5 ft). (The exception is site 6, Deep Water Control, in which the sample is taken in deep water.) The sample bottle is lowered to a depth of 22-30 cm (9-15 in.) for sample collection. Once all samples have been collected, sampled water is transferred from the collection bottles onto coliplates and incubated at 35°C (95°F) for 24-26 hours. To test for reproducibility, water from one site is transferred to two coliplates so that duplicate readings can be made. An additional control is provided by transferring distilled water onto one coliplate. After incubation, coliplates are viewed to determine bacterial concentration. The number of "blue" wells (out of a total of 96) in each coliplate indicates TC concentration. The number of blue wells that fluoresce (out of 96) indicates EC concentration. Using a provided table, the number of blue and fluorescent wells is converted to **Most Probable Number (MPN)** of (bacterial) colony-forming units (cfu) per 100 ml sample. An illustration of a coliplate is shown on page 3.

Water Clarity. Water clarity was assessed with Secchi disk readings. These readings were made under controlled conditions (calm water with sunshine at similar time of day) at a designated site (main channel, marked as SD on the map on page 2. On each test date, two measurements were made and averaged. An illustration of a Secchi disk is on page 4

Phosphorus Concentration. Phosphorus concentration is measured once (duplicate samples) early in the season (May) at the SD site (central location of lake). Water samples are sent to Lake Partner Headquarters for analysis.



DWC

1

2

SD

3

5

4

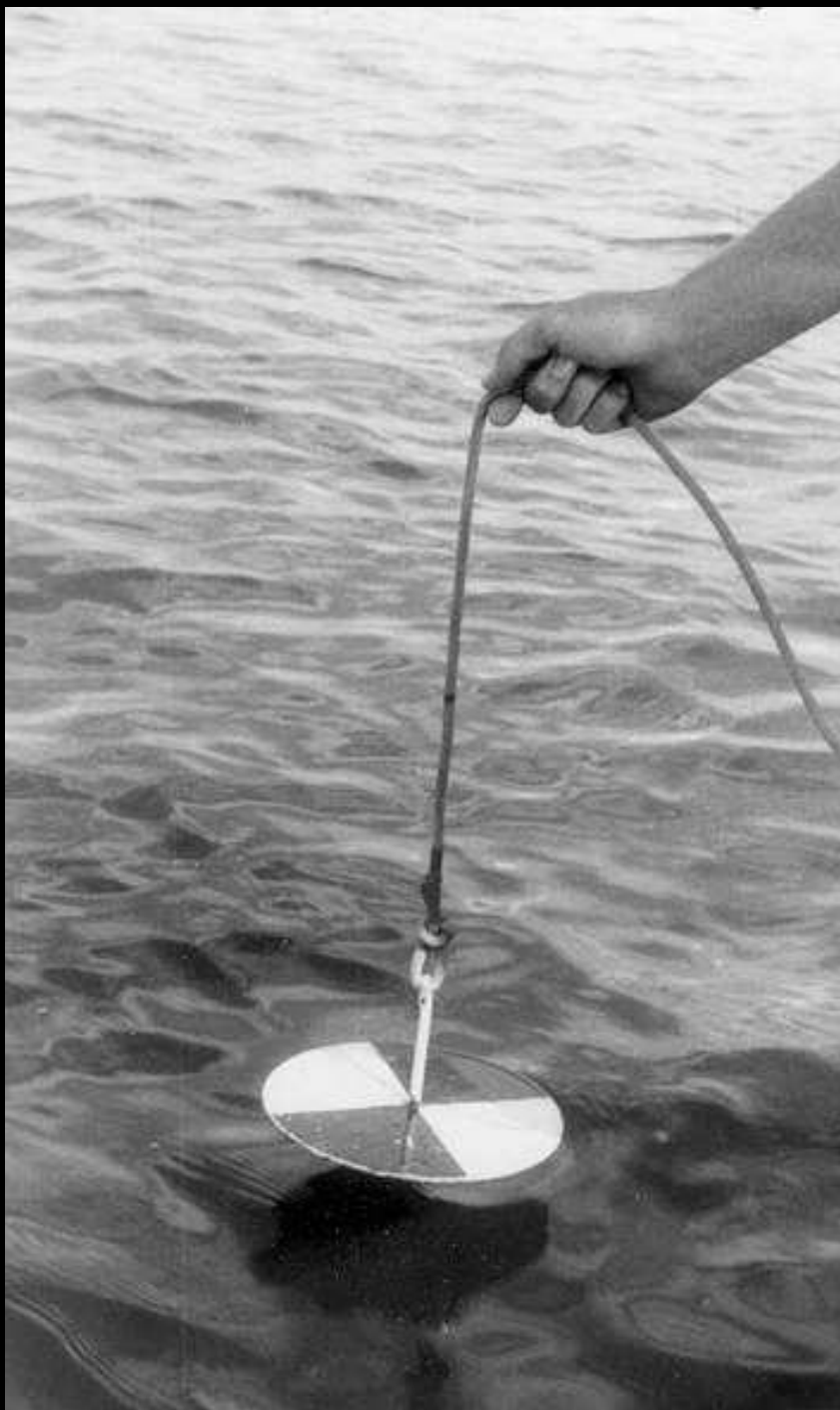
- 1 North-East Bay**
- 2 McRobert Bay**
- 3 West Channel**
- 4 South-West Bay**
- 5 Lawson Bay**
- DWC McRobert Bay**



Water samples poured into 96-well colipates



Samples incubated 24-26 h at 35°C



Secchi disk (SD) about to be lowered into water. SD depth is the greatest depth (measured in metres) at which disk pattern can be visualized

SUMMARY OF RESULTS

Bacterial Concentrations

The **Total Coliform (TC) Concentration** for 2013, averaged across test sites and dates, was **648 ± 955 MPN** (average ± standard deviation). This average exceeded the Township of Archipelago (TOA) objective (100 MPN). In the past, the province had set a regulatory TC guideline of 1000 MPN, above which the water was deemed unsuitable for recreational use. However, TC is no longer used as a regulatory guideline in Provincial Water Quality Objectives, since TC levels have been found to be too variable and are largely considered to be a natural component of ecosystems. Therefore, undue significance should not be placed on TC values that exceed the former provincial guideline. The **E. coli (EC) Concentration** for 2013, averaged across the 5 test sites and 5 test dates, was **2.7 ± 4.6 MPN**. This average met (i.e., was lower than) the Township of Archipelago (TOA) objective (10 MPN). For recreational water use, the Provincial Water Quality regulatory guideline for the upper limit of EC concentration is 100 MPN.

The results for 2013 continue a pattern of high (relative to TOA objective of 100 MPN) TC and low EC values relative to Township and Provincial objectives. At present there is no explanation for the high TC values; however, as noted above, TC is no longer used as a regulatory guideline in Provincial Water Quality Objectives, since TC levels have been found to be too variable and are largely considered to be a natural component of ecosystems.

Note: For water consumption, the provincial guidelines for TC and EC are ≤ 5 MPN and 0 MPN, respectively.

Excerpts from Township's Review of Bacterial Data

It is important to recognize that water quality does change for a number of reasons both within the season and between seasons. When looking at the data it is important to think about all the different things that might cause variations in your water quality data, both natural and human-caused, and be careful not to rush to any one conclusion. When looking at the data for an area and/or comparing areas, you should keep in mind a number of factors:

SUMMARY OF RESULTS

1) Differences in the watershed where a lake is located will cause natural variations to occur between lakes. 2) Seasonal differences in water temperature, rainfall, average temperatures etc. will all result in seasonal variations in data. 3) bacterial populations can be highly variable. *E.Coli* are much more specific to fecal sources from warm-blooded animals and as such are used as an indicator of human influences to water. But, not only humans can introduce *E.Coli* to water. So, we must carefully consider long term averages and the location of water samples (i.e. sampling near wetlands may result in increased *E.Coli* counts simply because of the higher likelihood of animal life). 4) Bacterial populations can also quickly change in numbers over a very short period of time (days). It is often difficult to determine the source of bacteria, hence our primary concern is with areas that demonstrate ongoing high levels of *E.Coli* which may imply a constant source. 5) The bacterial objectives of 100TC and 10EC for recreational waters in the Township of The Archipelago have proven to be quite useful and accurate for many (but not all) areas of the Township given long term averages. However, some natural variation away from these areas may be due to the characteristics of the areas and not necessarily a result of a pollution source. Areas that exhibit high TC and a concurrent high EC should be examined more carefully for the potential of a human-caused introduction of bacteria if the results continue on an ongoing basis.

Summary Township's Comments about Blackstone Lake

Blackstone Lake continues to have quite elevated TC levels. The variation throughout the year remains quite high (i.e. standard deviation of 1152 for an average of 702 at Station 1). Much of the really high TC level seems to stem from one sample time in July and it would be interesting to see how closely that corresponds with a strong rain event or not. Regardless, the high variability suggests that this is not a constant challenge. Encouragingly, EC levels continue to be quite low and under the long term standards for the Township. There are times when TC can be elevated for the lake (see previous results for Crane Lake); however, because EC levels remain low results here indicate that water is still safe and good for recreational use.

SUMMARY OF RESULTS

Water Clarity (Secchi Disk Depth)

The 2013 season average for Secchi disk (SD) depth was **4.8 ± 0.7 m**. There is no Township Objective or provincial guideline for Secchi disk depth. Greater disk depths indicate greater water clarity. Greater water clarity is associated with lower algae concentration, which in turn is associated with a lower phosphorus concentration. Blackstone's SD depths indicate excellent water clarity and thus a relatively low phosphorus concentration (which was confirmed with direct phosphorus measurements, see below).

Phosphorus Concentration

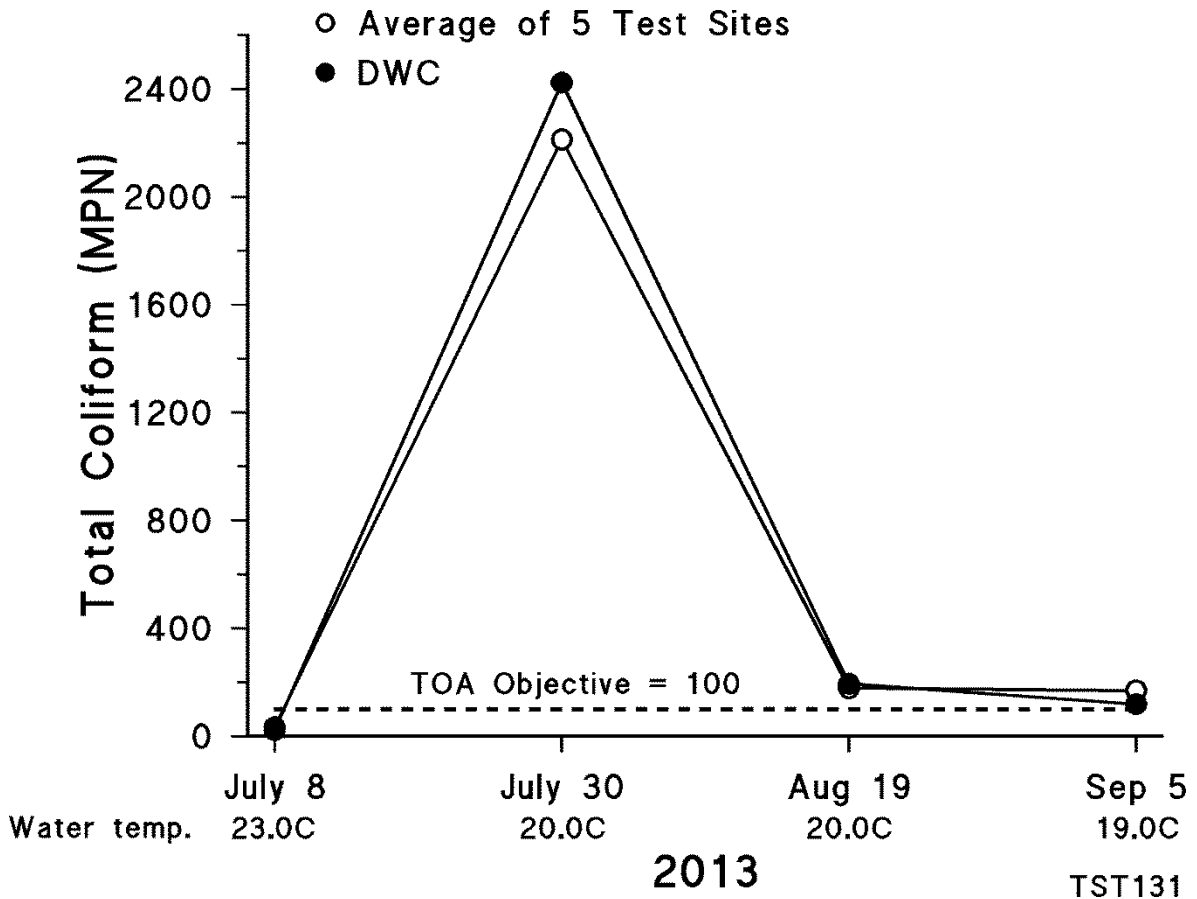
Blackstone Lake's phosphorus concentration for 2013 was **6.6 µg/L**. Lakes are classified as *Oligotrophic* (<10 µg/L), *Mesotrophic* (10-20 µg/L) and *Eutrophic* (>20 µg/L). Based on phosphorus concentration recorded over a period of years, Blackstone Lake would be classified as Oligotrophic. Oligotrophic lakes, because of their low phosphorus concentration, do not support dense aquatic vegetation and are much less susceptible to algae growth and algae blooms.

Note: detailed results are given in the following pages.

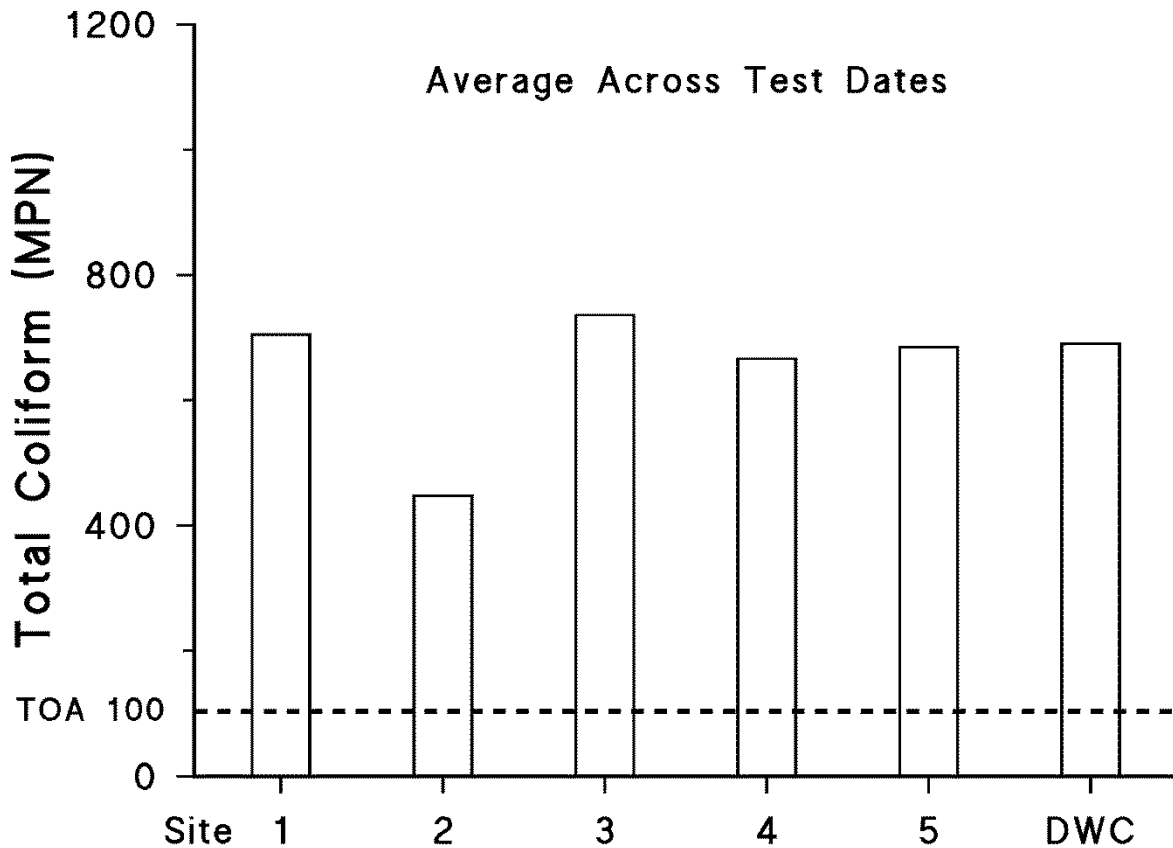
RESULTS

Bacterial Concentration

The **Total Coliform Concentration (TC)** for 2013, averaged across test sites, is shown for the sample dates indicated in the figure below. Also shown are the values for the *Deep Water Control Site (DWC)* on the indicated dates. TC values exceeded the Township of Archipelago (TOA) objective (100 MPN) on all but one test date. The DWC values met the objective on two test dates. In the past, the province had set a regulatory TC guideline of 1000 MPN, above which the water was deemed unsuitable for recreational use. However, TC is no longer used as a regulatory guideline in Provincial Water Quality Objectives, since TC levels have been found to be too variable and are largely considered to be a natural component of ecosystems. Therefore, undue significance should not be placed on TC values that exceed the former provincial guideline.



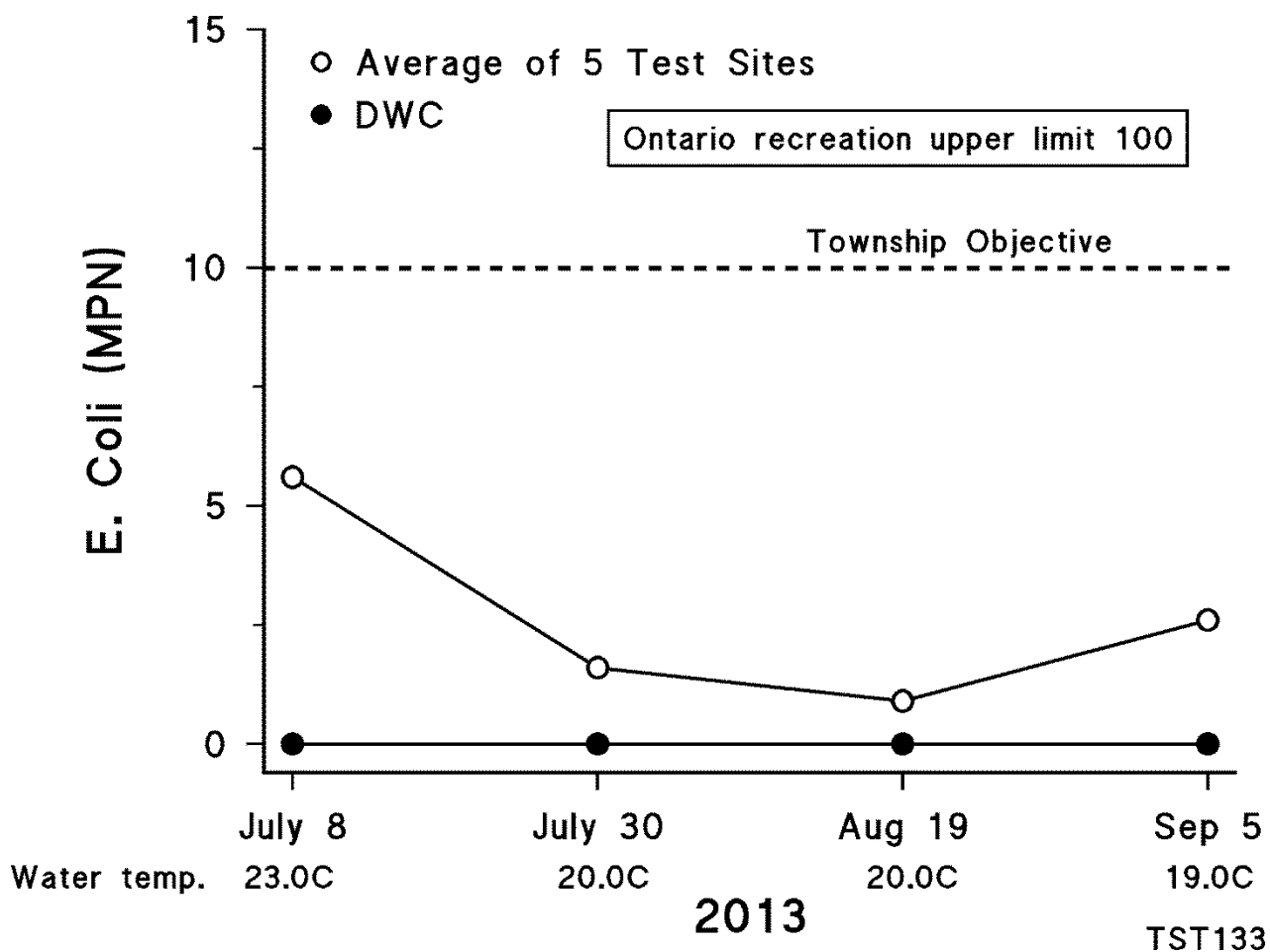
The **Total Coliform Concentration (TC)** for 2013 for the test sites, averaged across test dates, is shown in the figure below. Also shown is the value for the *Deep Water Control Site (DWC)*, averaged across test dates. TC values exceeded the Township of Archipelago (TOA) objective (100 MPN) at all sites. In the past, the province had set a regulatory TC guideline of 1000 MPN, above which the water was deemed unsuitable for recreational use. However, TC is no longer used as a regulatory guideline in Provincial Water Quality Objectives, since TC levels have been found to be too variable and are largely considered to be a natural component of ecosystems. Therefore, undue significance should not be placed on TC values that exceed the former provincial guideline.



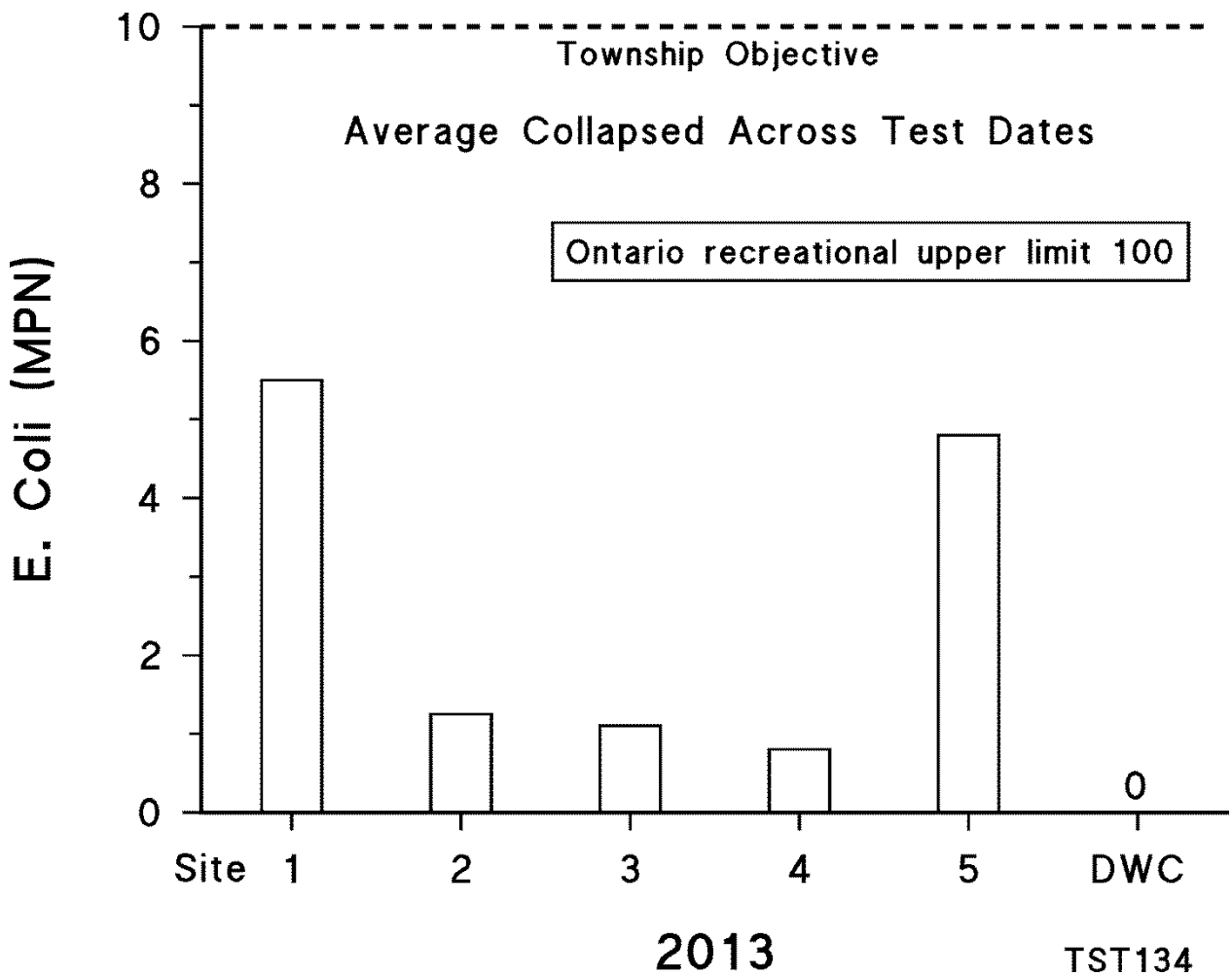
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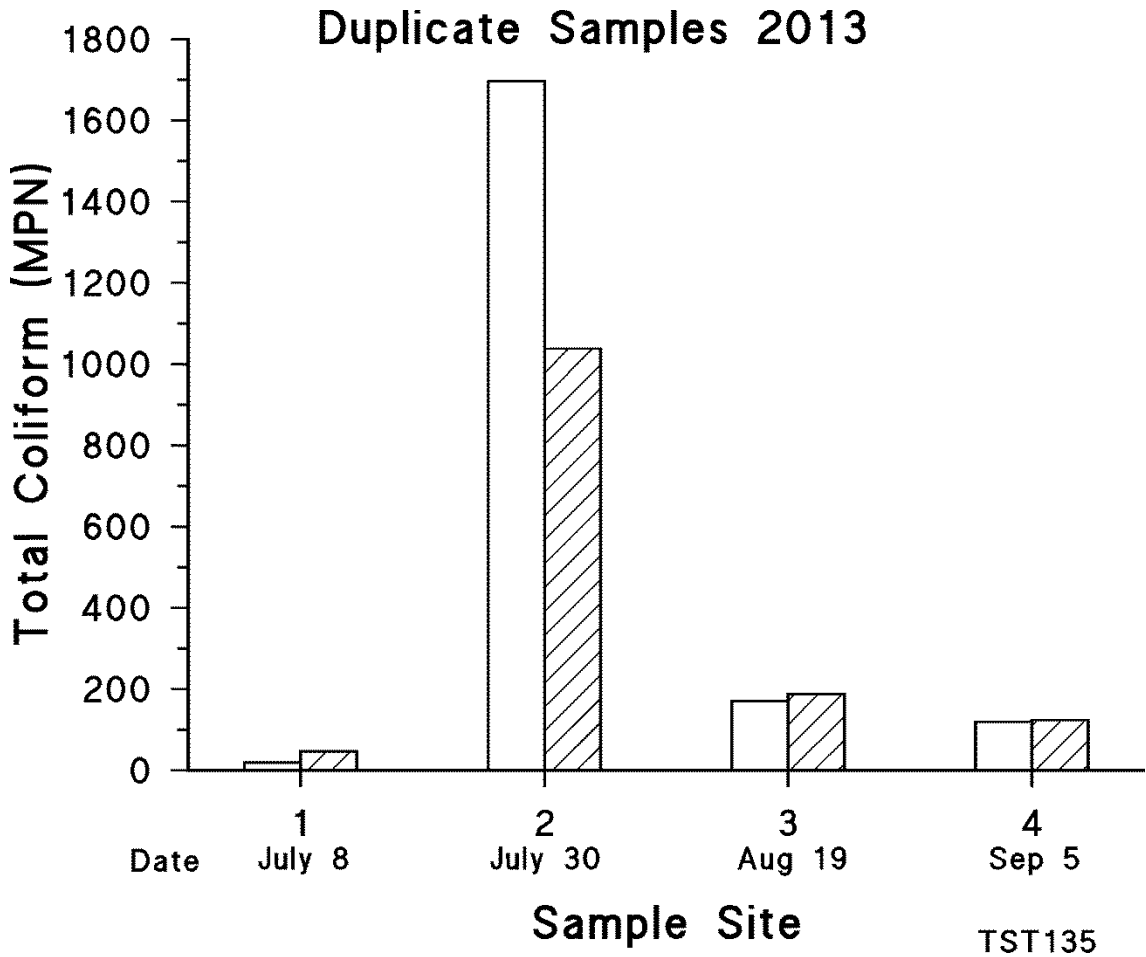
The **E. Coli Concentration (EC)** for 2013, averaged across test sites, is shown for the sample dates indicated in the figure below. Also shown are the values for the *Deep Water Control Site (DWC)* on the indicated dates. EC average values were lower than the Township of Archipelago (TOA) objective (10 MPN) on all test dates. The same was true for the DWC site. The province has set a regulatory EC guideline of 100 MPN, above which the water is deemed unsuitable for recreational use. Blackstone's values are well below this limit.



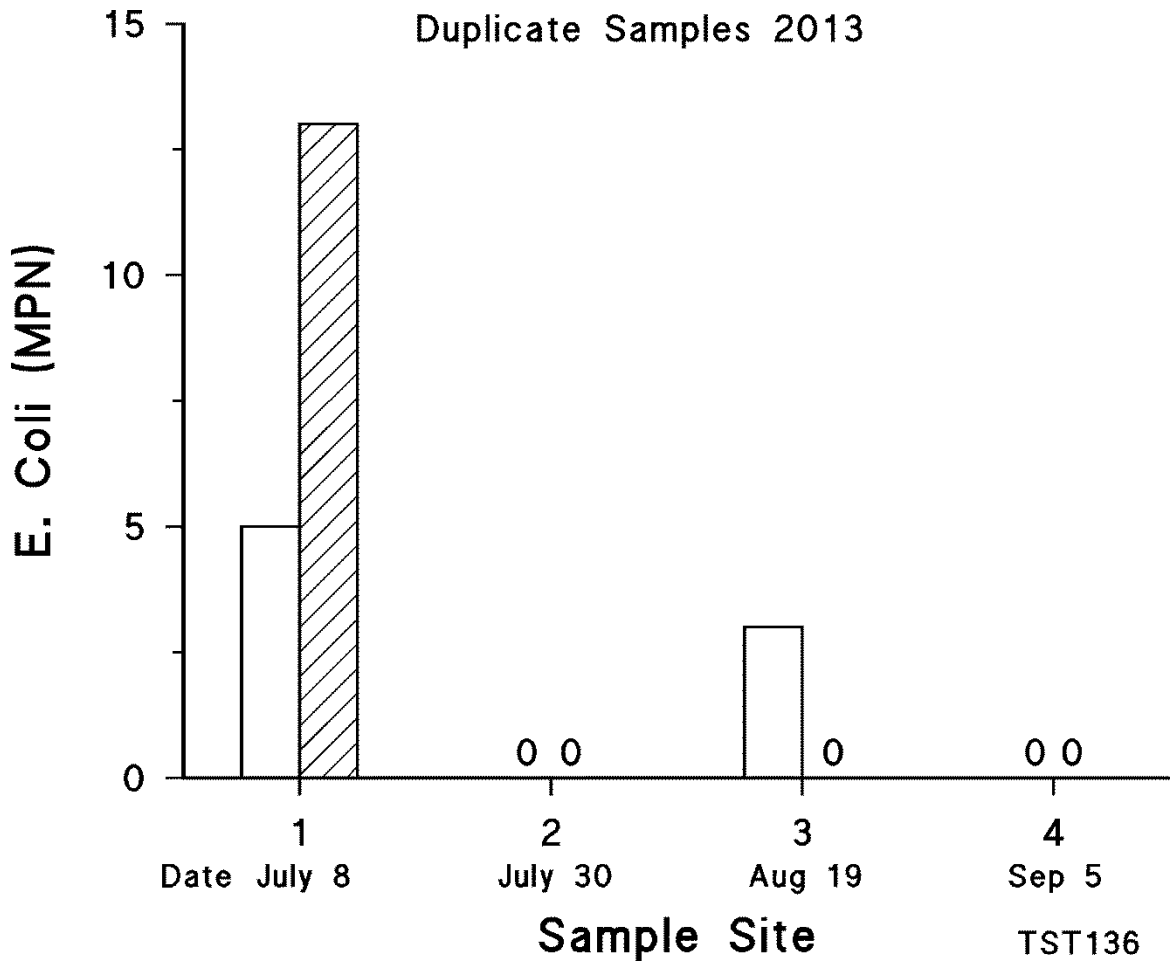
The **E. coli Concentration (EC)** for 2013 for the test sites, averaged across test dates, is shown in the figure below. Also shown is the value for the *Deep Water Control Site (DWC)*, averaged across test dates. EC values were lower than Township of Archipelago (TOA) objective (10 MPN) at all sites. The province has set a regulatory EC guideline of 100 MPN, above which the water is deemed unsuitable for recreational use. Blackstone's values are below this limit.



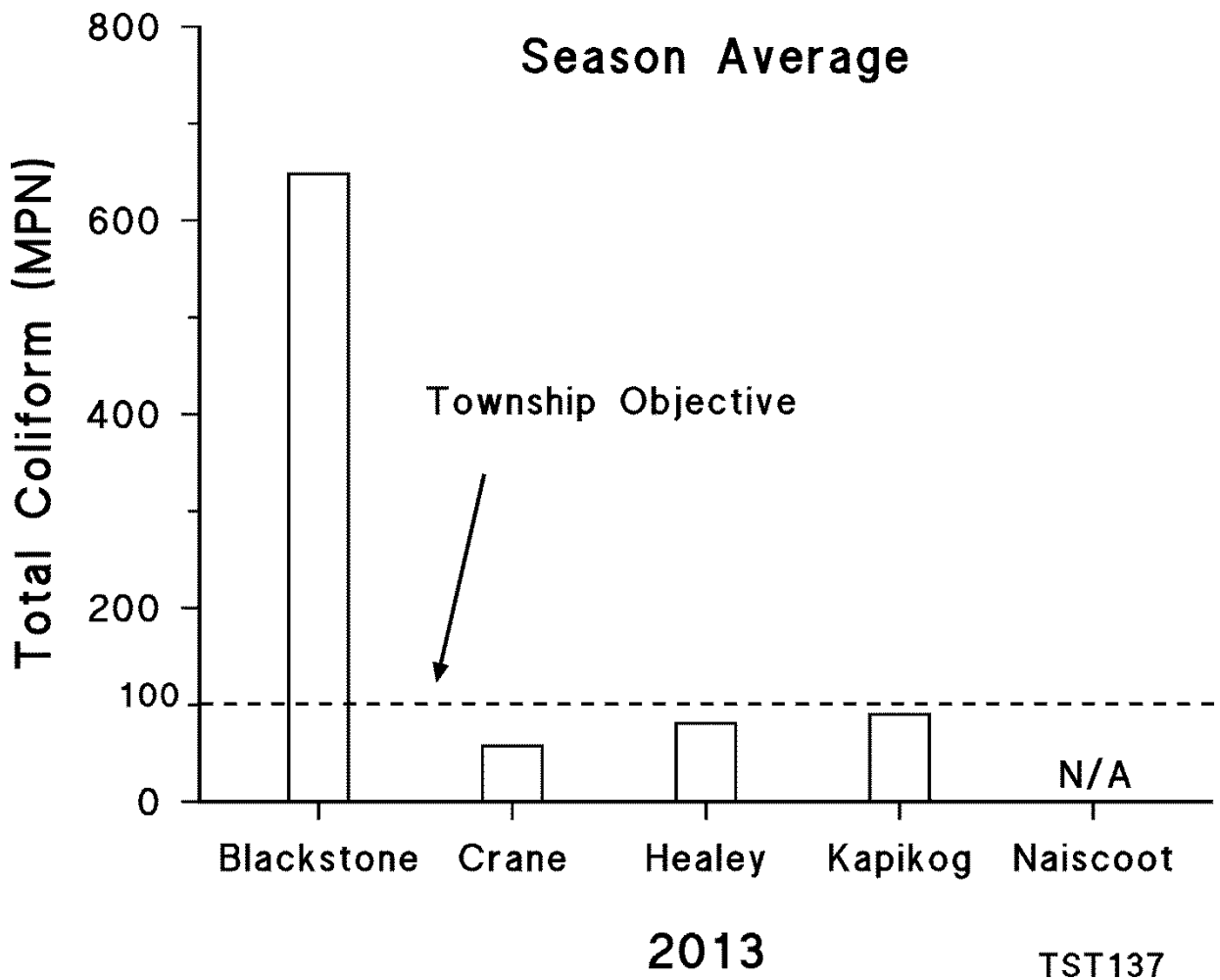
Reproducibility of bacterial concentration measurements. On each indicated test date, a water sample from one test site was transferred to two coliplates (duplicate samples) to monitor the reproducibility of the measurements. The figure below shows that the reproducibility for the **Total Coliform (TC)** measurement was good.



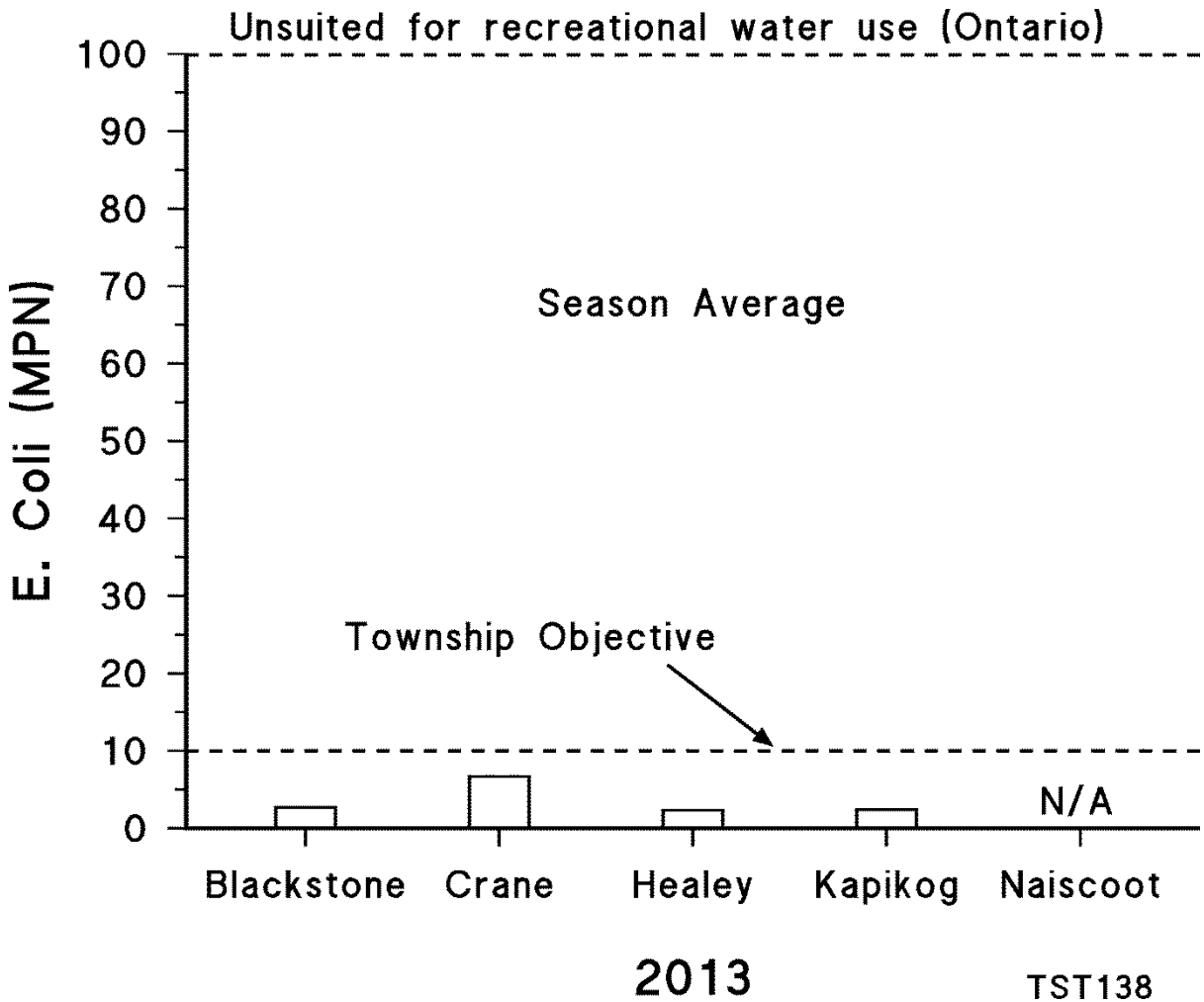
Reproducibility of bacterial concentration measurements. On each indicated test date, a water sample from one test site was transferred to two coliplates (duplicate samples) to monitor the reproducibility of the measurements. The figure below shows that the reproducibility for the **E. coli (EC)** measurement was good. “0” means that no EC were detected.



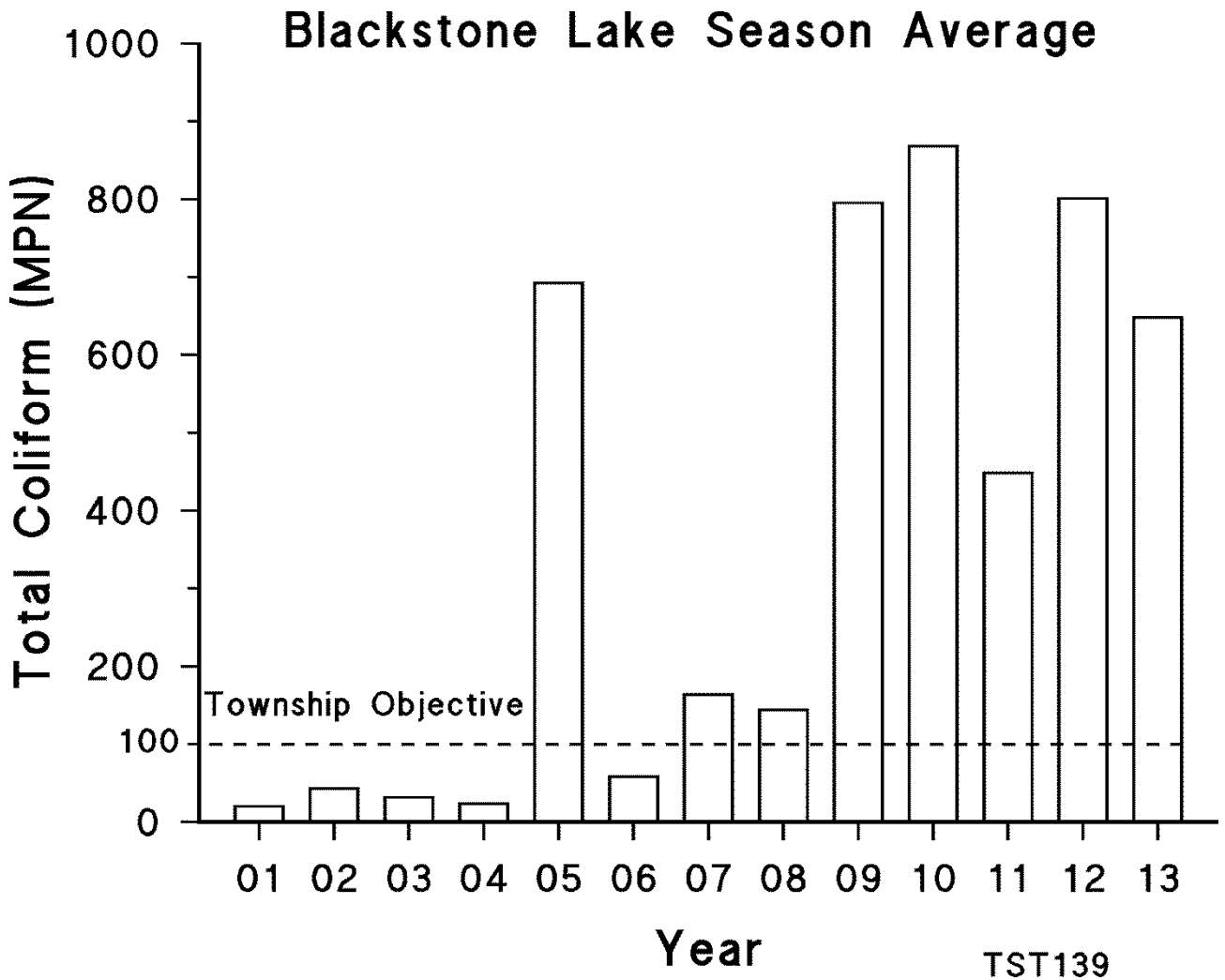
Blackstone's Total Coliform (TC) Concentration compared to some other lakes in the township. For all lakes, season averages are based on measurements collapsed across all test dates and sites. The seasonal average for Blackstone and Healey lakes exceeded the Township objective (100 MPN).



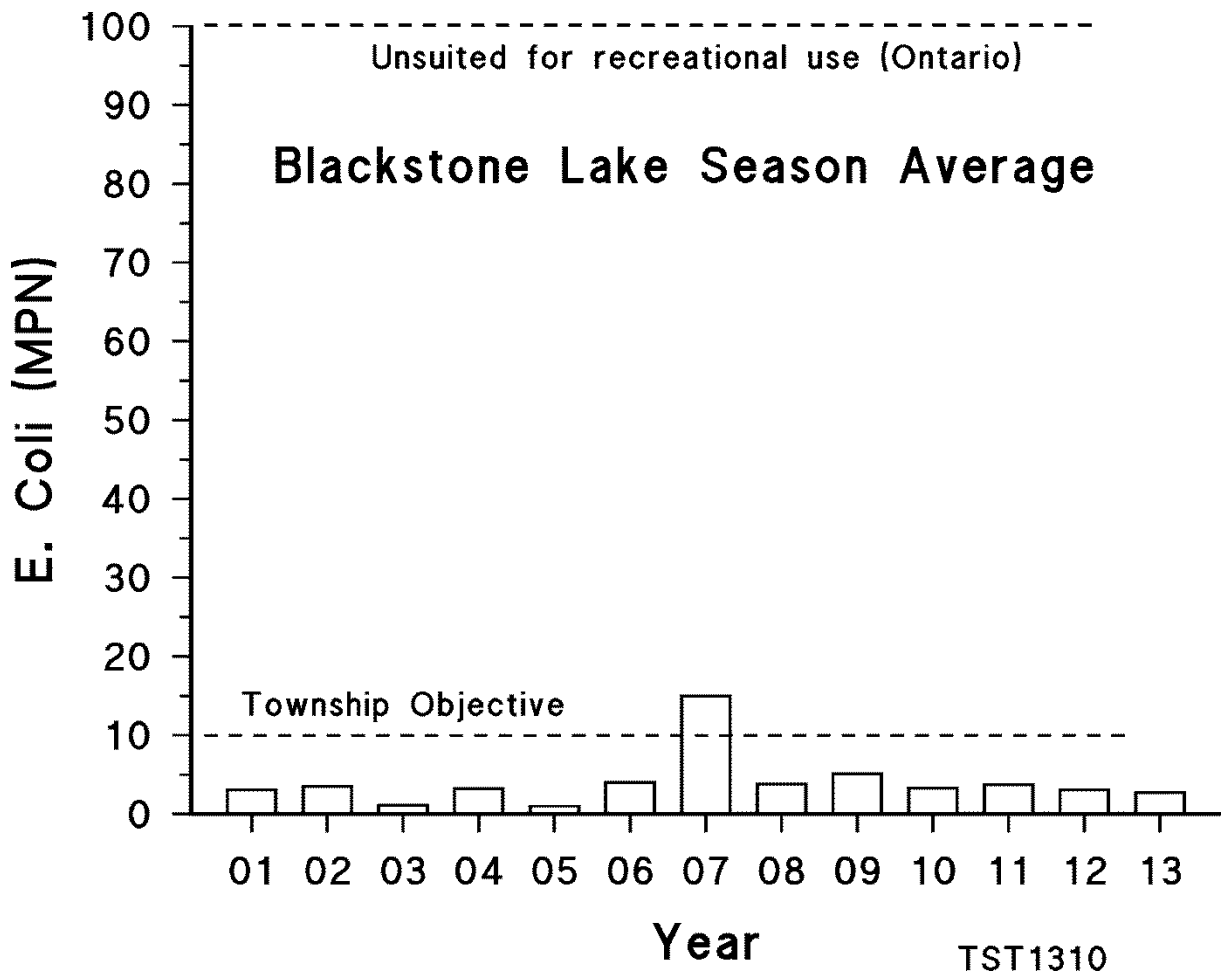
Blackstone's E. coli (EC) Concentration compared to some other lakes in the township. For all lakes, season averages are based on measurements collapsed across all test dates and sites. All lake averages except Crane lake met (i.e., were below) the Township Objective (10 MPN).



Blackstone Lake's Total Coliform (TC) season average from 2001 to 2013. Season averages are calculated from data collapsed across test sites and dates. In recent years the season average has exceeded the Township Objective (100 MPN).



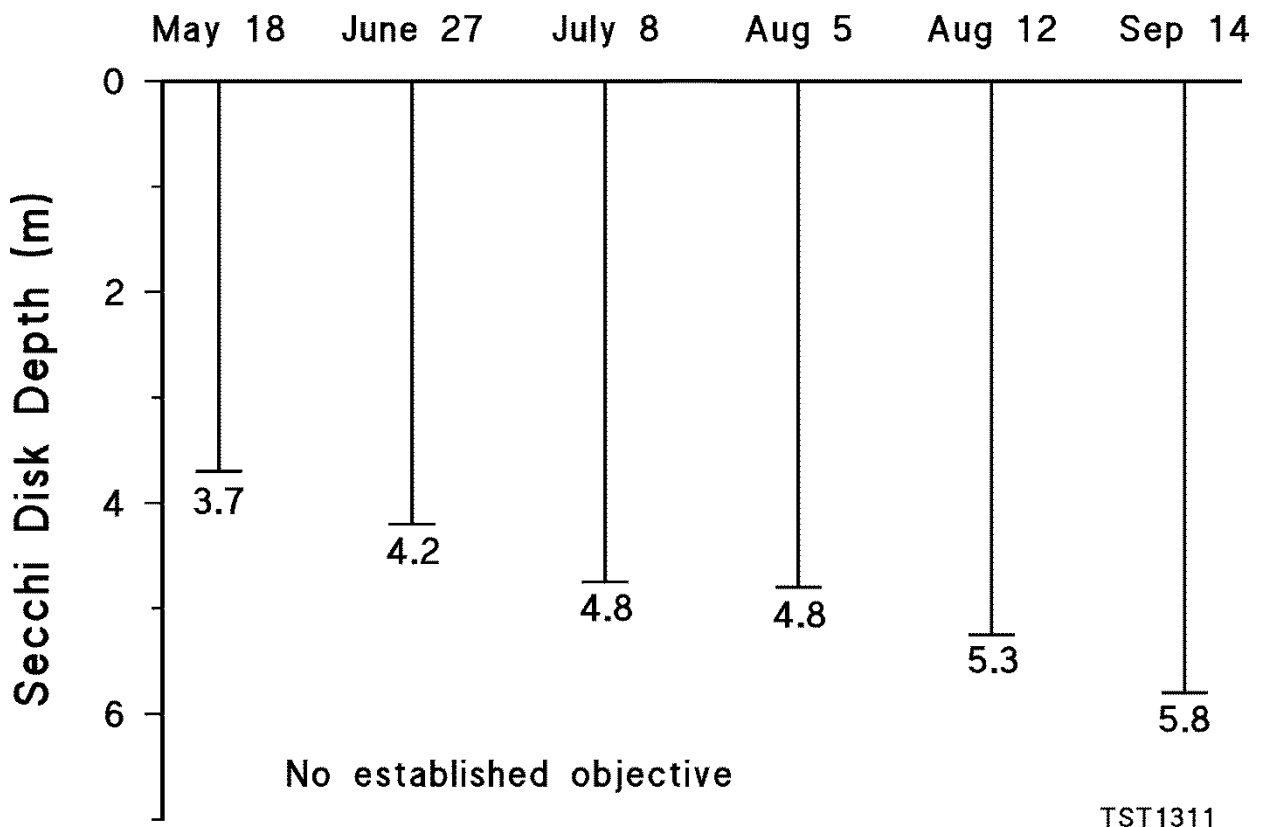
Blackstone Lake's E. Coli (EC) concentration, shown as season averages from 2001 to 2013. Season averages are calculated from data collapsed across test sites and dates. In all but one year (2007) the season average met (i.e., was at or below) the Township Objective (10 MPN or less).



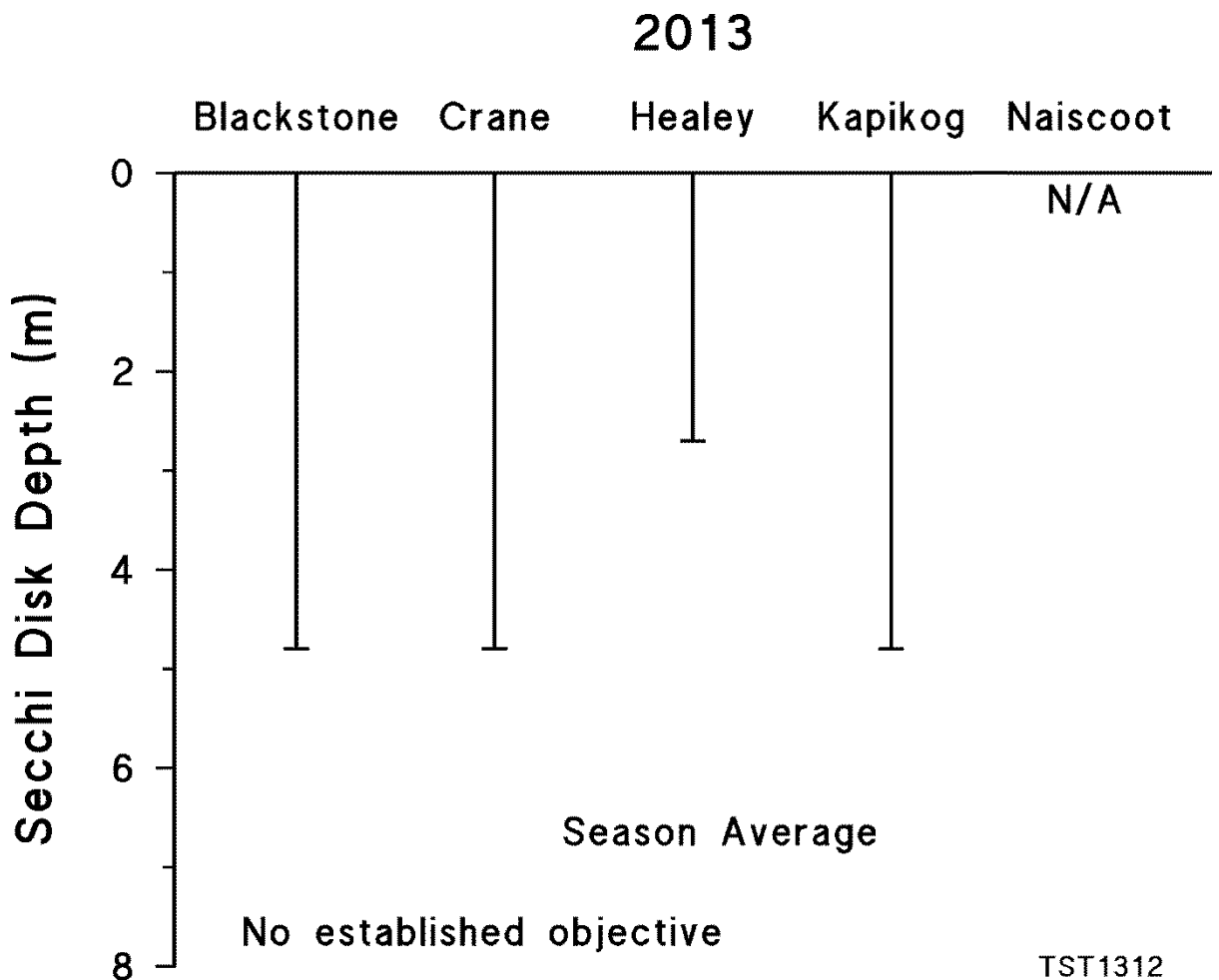
Water Clarity (Secchi Disk Depth)

The figure below shows the Secchi disk readings on the test dates indicated. There is no Township Objective or provincial guideline for Secchi disk depth. Greater disk depths indicate greater water clarity. Greater water clarity is associated with lower algae concentration, which in turn is associated with a lower phosphorus concentration. Blackstone's disk depths indicate very good water clarity and thus a relatively low phosphorus concentration. Note the increasing disk depth over the season. This pattern occurs most years.

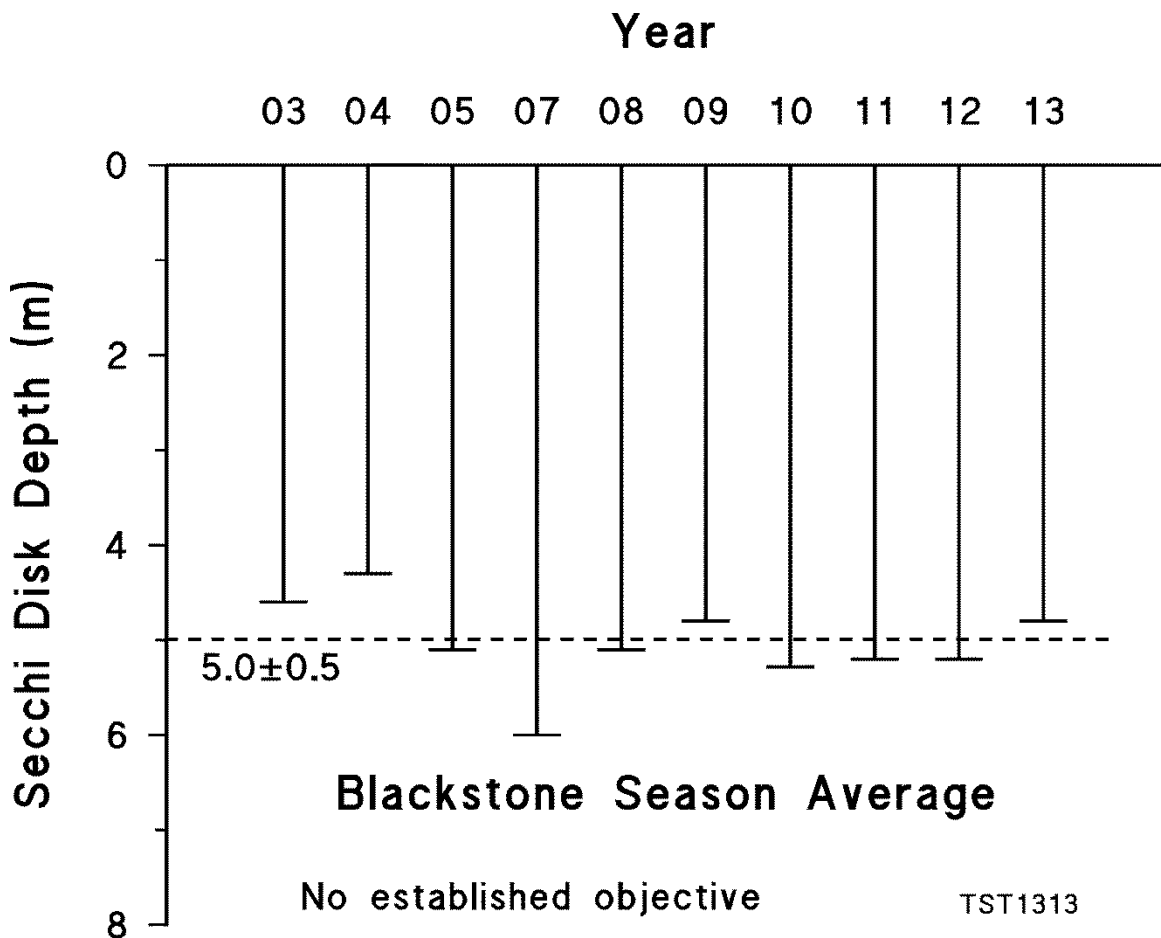
2013



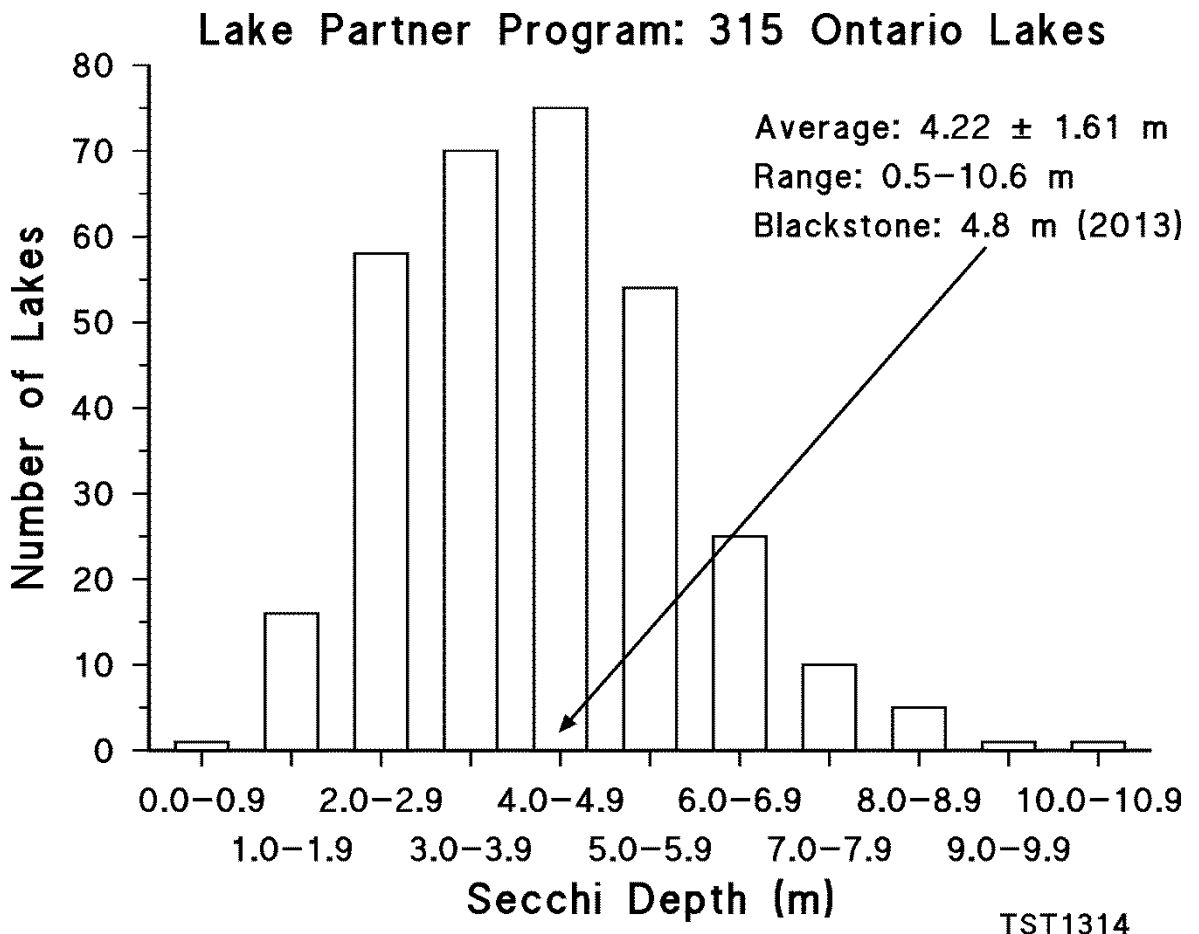
Blackstone's Secchi Disk Depth compared to some other lakes in the township. Disk depths are shown as season averages. There is no Township Objective or provincial guideline for Secchi disk depth. Greater disk depths indicate greater water clarity. Greater water clarity is associated with lower algae concentration, which in turn is associated with a lower phosphorus concentration. Blackstone's disk depths indicate very good water clarity and thus a relatively low phosphorus concentration.



Blackstone's Secchi Disk Depth readings from 2003 to 2013. Disk depths are shown as season averages. The average over this period is 5.0 m. There is no Township Objective or provincial guideline for Secchi disk depth. Greater disk depths indicate greater water clarity. Greater water clarity is associated with lower algae concentration, which in turn is associated with a lower phosphorus concentration. Blackstone's disk depths indicate very good water clarity and thus a relatively low phosphorus concentration.

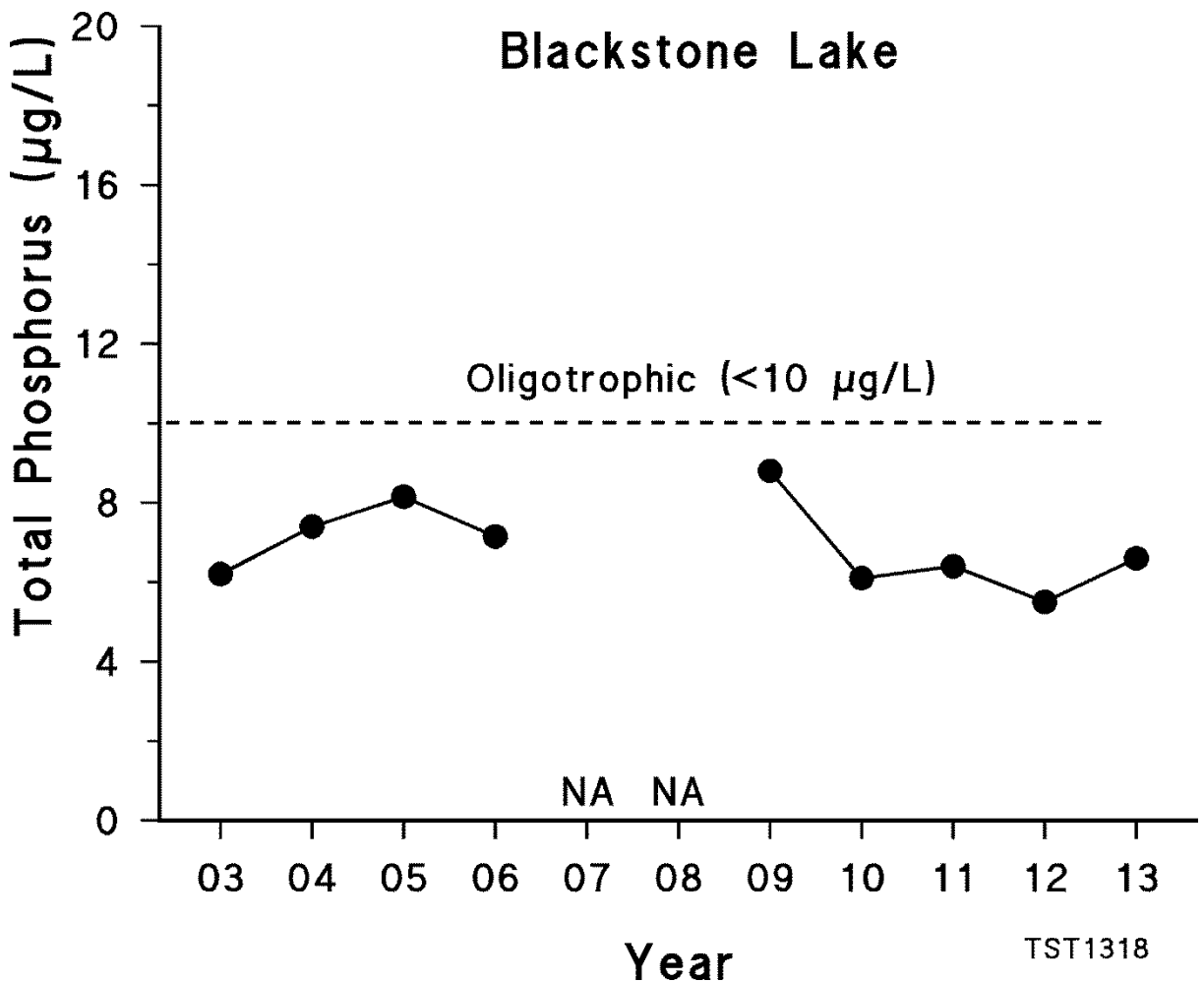


Blackstone's 2013 Secchi Disk Depth compared to the distribution of readings made in 315 Ontario Lakes. Blackstone's season average (4.8 m) was greater than the average depth (4.22 m) for 315 lakes. There is no provincial guideline for Secchi disk depth. Greater disk depths indicate greater water clarity. Greater water clarity is associated with lower algae concentration, which in turn is associated with a lower phosphorus concentration. Blackstone's disk depths indicate very good water clarity and thus a relatively low phosphorus concentration.

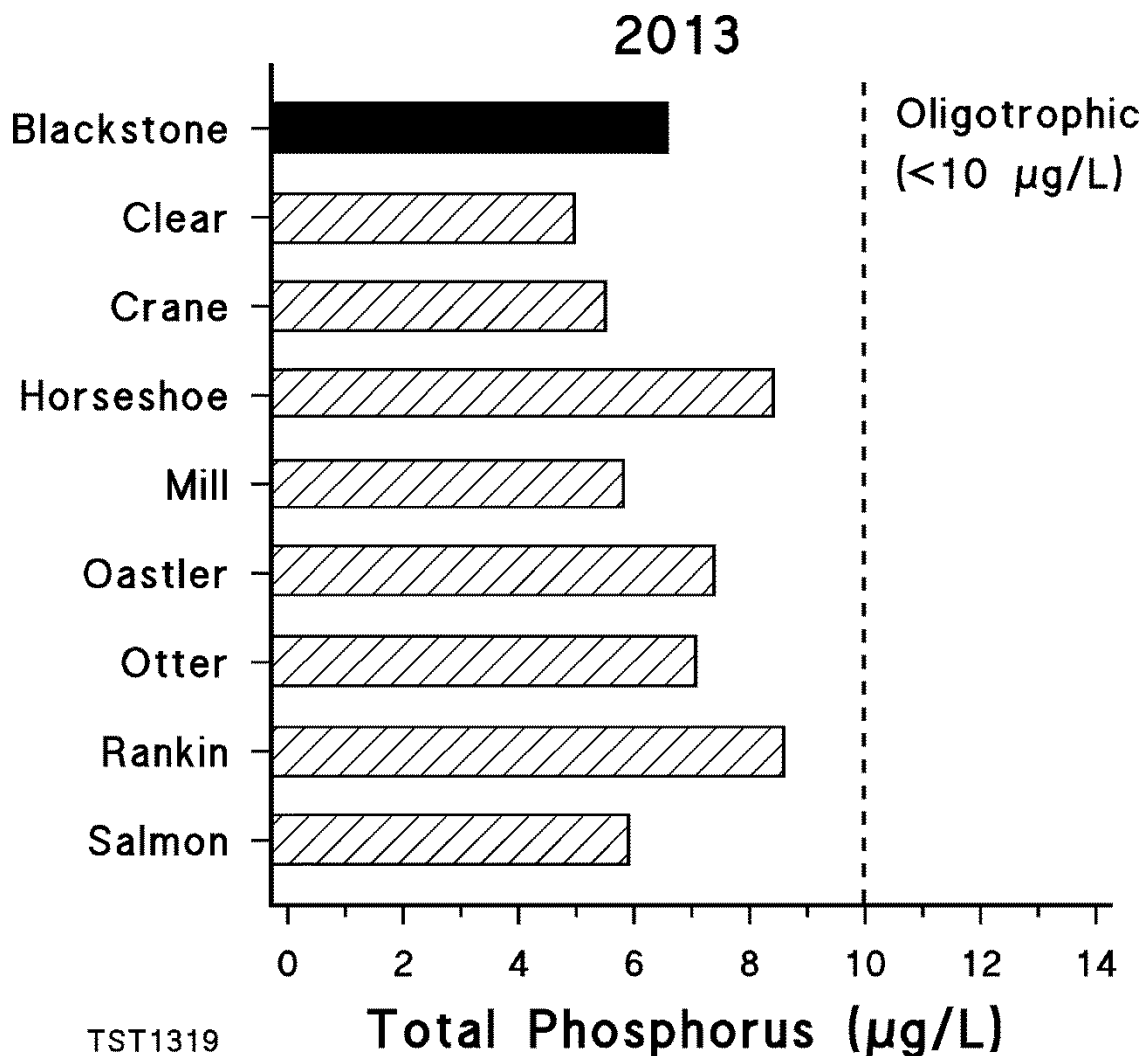


Phosphorus Concentration

The figure below shows Blackstone Lake's phosphorus concentration from 2002 to 2013. For 2013, Blackstone Lake's phosphorus concentration was 6.6 $\mu\text{g/L}$. Since 2003, all phosphorus concentrations have been below 10 $\mu\text{g/L}$. Lakes are classified as *Oligotrophic* (<10 $\mu\text{g/L}$), *Mesotrophic* (10-20 $\mu\text{g/L}$) and *Eutrophic* (>20 $\mu\text{g/L}$). Based on phosphorus concentration recorded over a period of years, Blackstone Lake would be classified as Oligotrophic. Oligotrophic lakes, because of their low phosphorus concentration, do not support dense aquatic vegetation and are much less susceptible to algae growth and algae blooms.

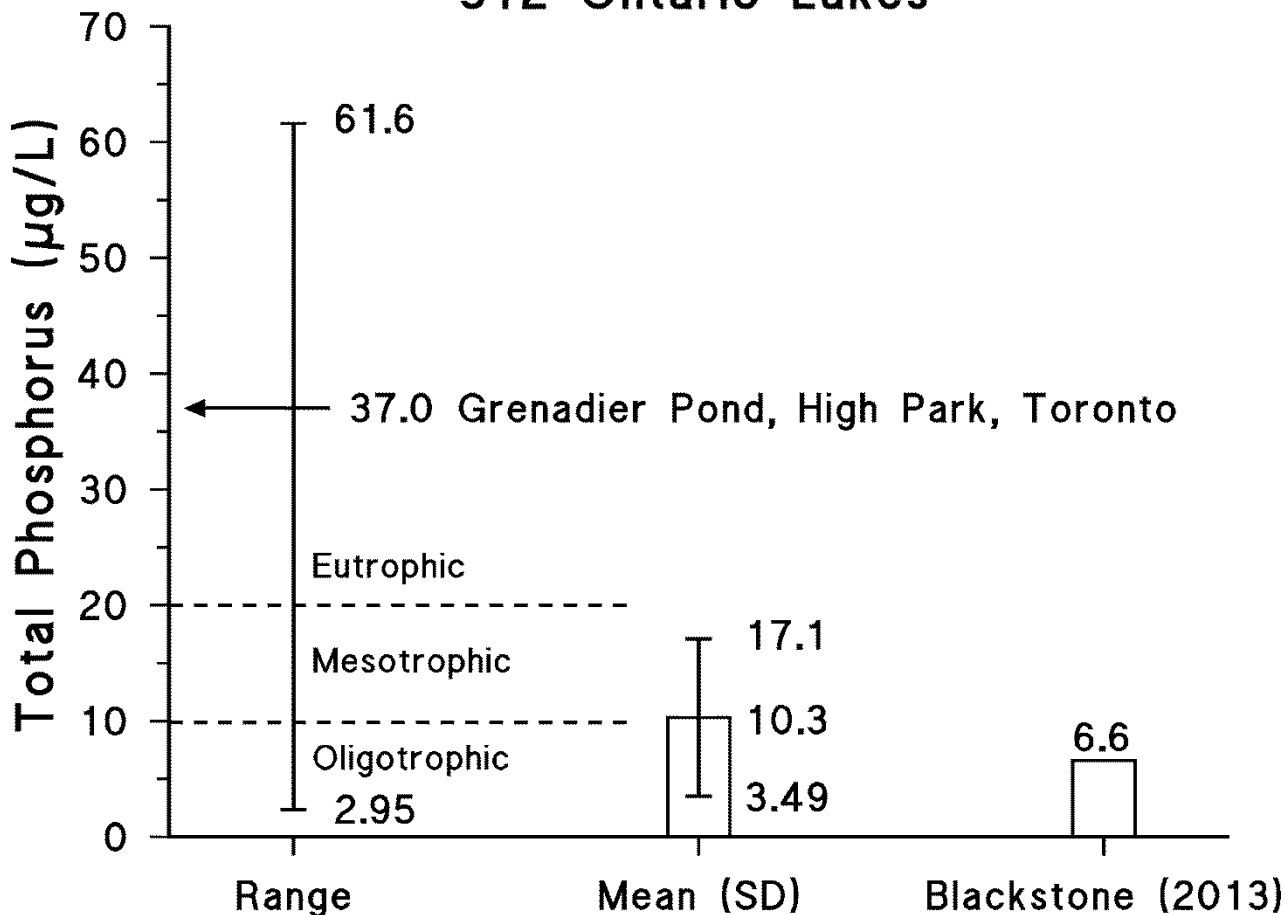


This figure compares Blackstone Lake's 2013 phosphorus concentration with some other lakes in the region. For each lake values are from 2013. All of these lakes would be classified as Oligotrophic (<10 µg/L). Oligotrophic lakes, because of their low phosphorus concentration, do not support dense aquatic vegetation and are much less susceptible to algae growth and algae blooms.

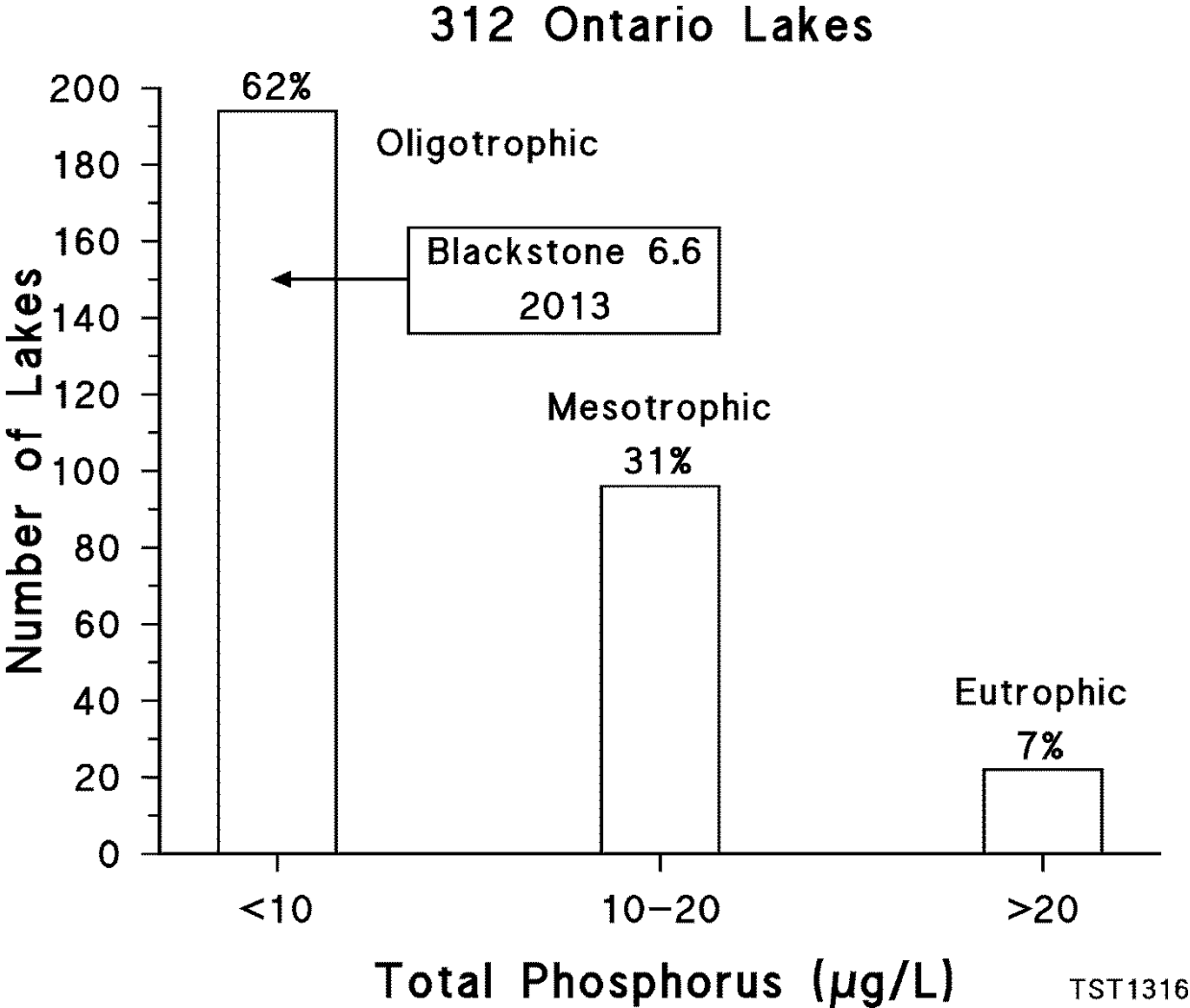


This figure puts Blackstone Lake's phosphorus concentration into a larger perspective. In 312 Ontario lakes, phosphorus concentration ranged from ~3 to 60 µg/L. Grenadier Pond is an example of a Eutrophic body of water. The average (mean) concentration across all 312 lakes was 10.3 µg/L. The standard deviation (SD) indicated that about 70% of the lakes had concentrations between 3.5 and 17.1 µg/L. Lakes are classified as *Oligotrophic* (<10 µg/L), *Mesotrophic* (10-20 µg/L) and *Eutrophic* (>20 µg/L). Thus, the average phosphorus concentration of 10.3 µg/L is just above the Oligotrophic limit (<10 µg/L). Blackstone Lake's value for 2013 (6.6 µg/L) and in previous years puts it in the Oligotrophic group. Oligotrophic lakes, because of their low phosphorus concentration, do not support dense aquatic vegetation and are much less susceptible to algae growth and algae blooms.

312 Ontario Lakes



This figure puts Blackstone Lake's phosphorus concentration into a larger perspective in a different way. The majority (62%) of tested lakes were classified as Oligotrophic (<10 µg/L). Blackstone Lake's phosphorus concentration in 2013 (6.6 µg/L) and in previous years puts Blackstone in the majority Oligotrophic group.



This figure shows the distribution of phosphorus concentration in 194 Ontario lakes classified as Oligotrophic (<10 µg/L). Blackstone Lake's phosphorus concentration for 2013 (6.6 µg/L) falls approximately in the middle of the distribution.

