Sandy Lake
Water Quality Report

Prepared for:

The Sandy Lake Cottage Owner's Association

Prepared by:

Cassie McLean
Water Quality Management Section
Manitoba Conservation and Water Stewardship
Winnipeg, Manitoba

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Water Quality Investigations and Routine Monitoring:

This report provides an overview of the Sandy Lake volunteer water quality monitoring program during the open water season of 2014, and compares these results to historic water quality on Sandy Lake to determine change in water quality through time. There are three water quality monitoring stations located across Sandy Lake; the southeast end, south narrows and northeast end. Monthly samples were collected from July 2, 2014 to September 2, 2014. Water quality samples were analyzed for general chemistry and nutrients.

Total Phosphorus

As part of the Lake Winnipeg Action Plan, Manitoba is implementing several strategies to better manage plant nutrients. Part of this Action Plan includes the development of more appropriate site-specific or regional-specific water quality objectives or guidelines for nutrients. In the meantime, the narrative guidelines will be retained for nutrients such as nitrogen and phosphorus until more site specific objectives are developed. It is generally recognized, however, that narrative guidelines for phosphorus likely do not apply to many waterways in the Canadian prairie region since other factors such as turbidity, stream velocity, nitrogen, and other conditions most often limit algal growth. As well, relatively high levels of phosphorus in excess of the narrative guidelines may arise naturally from the rich prairie soils. It should be noted that most streams and rivers in southern Manitoba exceed this guideline, in some cases due to the natural soil characteristics in the watershed and/ or due to inputs from human activities and land-use practices.

The Manitoba Water Quality objective for total phosphorus in lakes is 0.025 mg/L (Water Science and Management Branch, 2011). Historically, total phosphorus concentrations in Sandy Lake were typically above the 0.025 mg/L objective for lakes, however, a few samples were below the objective (Figure 1). Conversely in 2014, total phosphorus concentrations in Sandy Lake showed a steady increase in which concentrations nearly doubled from July 2nd to September 2nd. In 2014, all total phosphorus samples were well above the water quality objective for lakes of 0.025 mg/L (Figure 2). This indicates the lake has become more eutrophic or nutrient rich, since the 1980's, which is common in waterways across Manitoba. However, the steady increase in phosphorus concentration over the summer of 2014 indicates a significant phosphorus source to the lake, either through external nutrient loading to the watershed surrounding the lake, or internal nutrient loading from re-suspension of phosphorus in the lake sediment. Therefore, future management decisions should focus on reducing nutrient loading to Sandy Lake in order to reduce the frequency and severity of algal blooms on the lake.

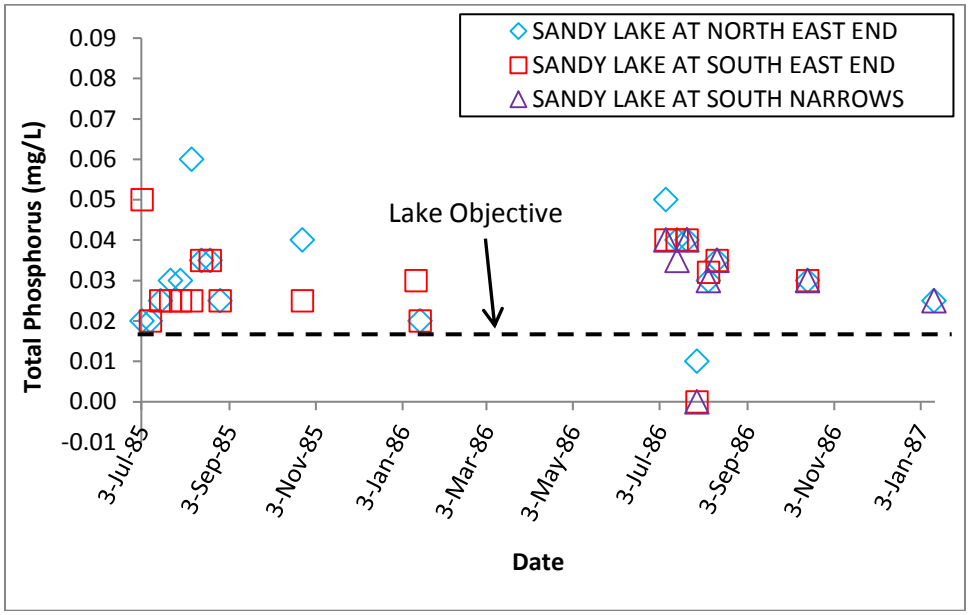

Figure 1: Total phosphorus (mg/L) concentrations for Sandy Lake from July 3, 1985 to January 12, 1987.

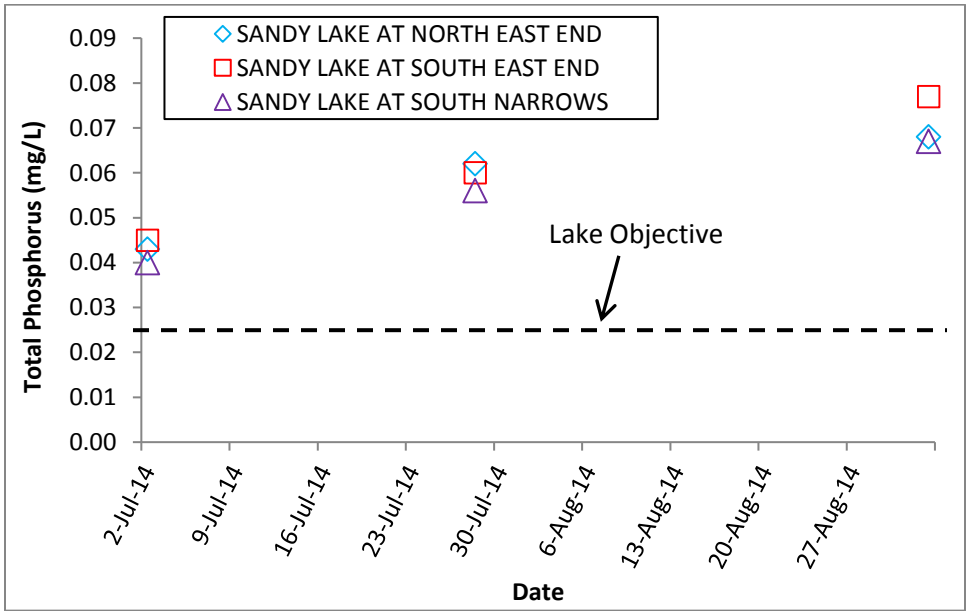

Figure 2: Total phosphorus (mg/L) concentrations for Sandy Lake from July 2, 2014 to September 2, 2014.

Total Nitrogen

The narrative objective for total nitrogen states nitrogen should be limited to the extent necessary to prevent nuisance growth and reproduction of aquatic rooted, attached and floating plants, fungi, or bacteria, or to otherwise render the water unsuitable for other beneficial uses (Water

Science and Management Branch, 2011). Nitrogen and phosphorus are two essential nutrients which stimulate algal growth in Lake Winnipeg and its watershed. Currently there is no guideline for total nitrogen for the protection of aquatic life in Manitoba. However, other jurisdictions have adopted a chronic total nitrogen guideline of 1.0 mg/L (Alberta Environment 1999). Total nitrogen concentrations in Sandy Lake are all well above the chronic guideline of 1.0 mg/L. However, since the 1980's total nitrogen concentrations have remained relatively constant around 2.0 mg/L (Figures 3 and 4). In 2014 there was a small increase in total nitrogen concentrations over the summer, therefore, management decisions should strive to reduce nutrient loading to Sandy Lake and the surrounding watershed.

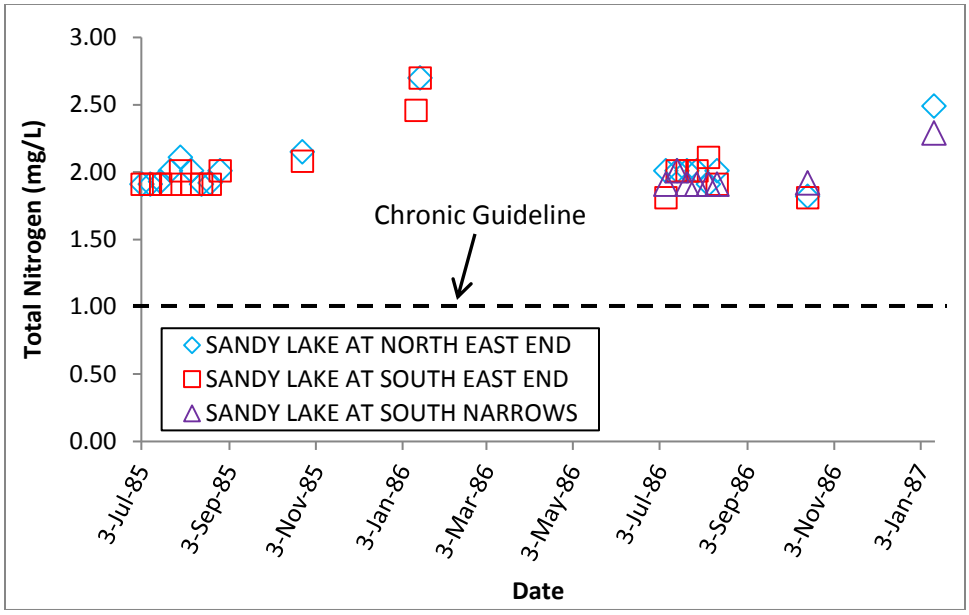

Figure 3: Total nitrogen (mg/L) concentrations for Sandy Lake from July 3, 1985 to January 12, 1987.

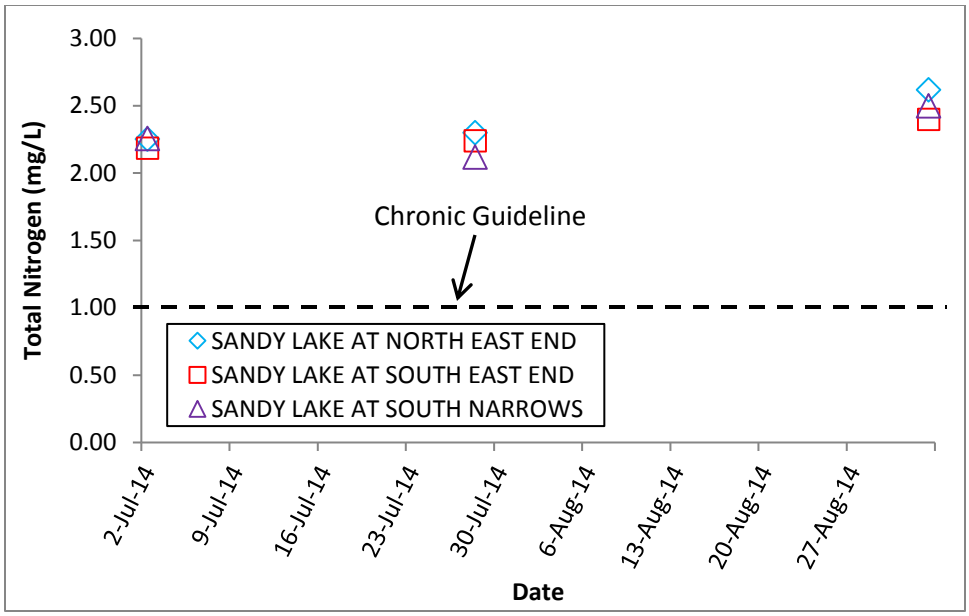

Figure 4: Total nitrogen (mg/L) concentrations for Sandy Lake from July 2, 2014 to September 2, 2014.

Chlorophyll-*a*

Chlorophyll-*a* is a pigment found within all green plants, including algae. It is crucial for plant growth because it absorbs light, thereby providing energy for photosynthesis. In the case of algae, chlorophyll-*a* comprises a large portion of the algal cell mass. Therefore, the amount of chlorophyll-*a* in a water sample is a good indicator of the amount of algae present in the water. There is no maximum acceptable guideline established for chlorophyll-*a* concentration in water. However, elevated chlorophyll-*a* concentrations may be indicative of other problems such as elevated nitrogen and phosphorus concentrations. Also, elevated concentrations of chlorophyll-*a* in drinking water sources often occur concurrently with poor tastes, displeasing odours and colouration, and clogged filtration systems. Decomposition of large algal blooms may deplete the oxygen supply in water, leading to anaerobic conditions. Chlorophyll-*a* concentration can be used to determine trophic status of a lake, or the total weight of living biomass in a waterbody based on chlorophyll-*a* concentration, phosphorus and nitrogen. In 2014, the chlorophyll-*a* concentration in Sandy Lake significantly increased from July 2nd to September 2nd. This increase in chlorophyll-*a* concentration shifted the trophic status of the lake from mesotrophic to hypereutrophic, indicating significant algal production in mid to late summer (Figure 5). This increase in chlorophyll-*a* concentration was correlated to the same increase in oxygen biochemical demand (Figure 6), suggesting a significant amount of oxygen was being consumed in the water column from mid to late summer, which was likely caused by the senescence of algal biomass. Unfortunately no comparable historic data were available for chlorophyll-*a* and oxygen biochemical demand.

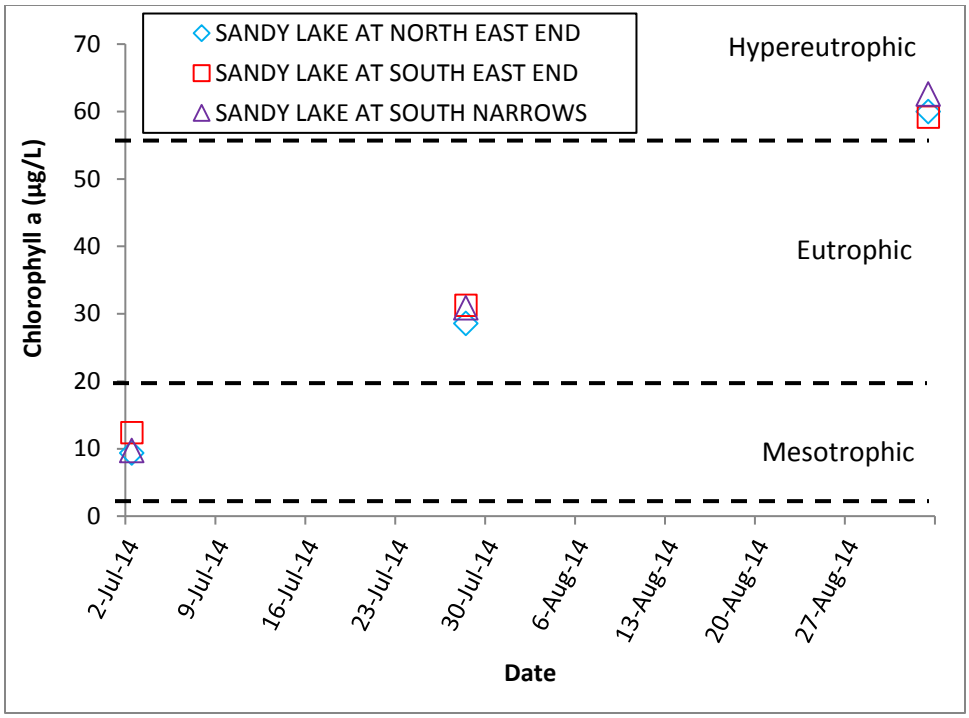

Figure 5: Chlorophyll-*a* (µg/L) concentrations for Sandy Lake from July 2, 2014 to September 2, 2014.

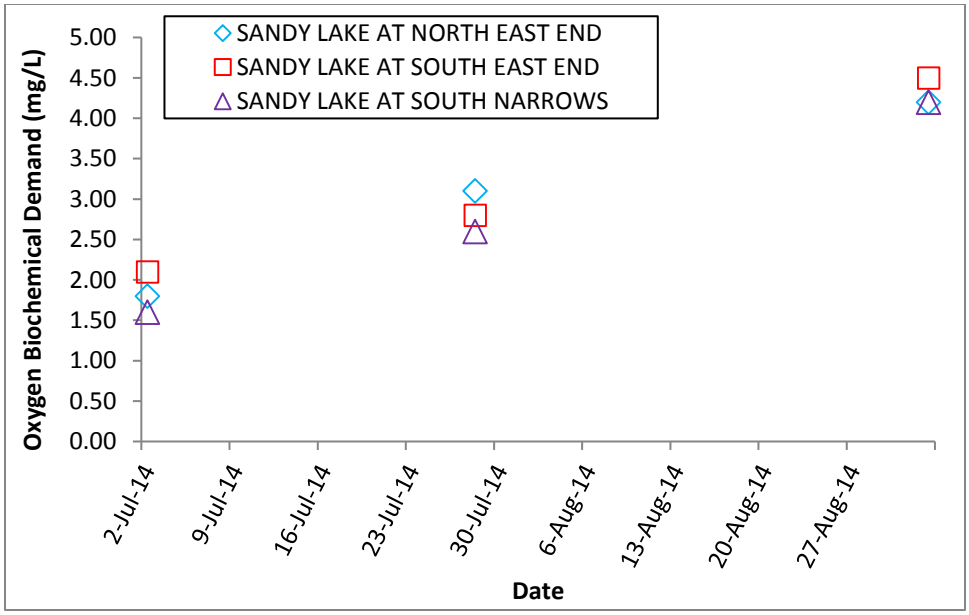

Figure 6: Oxygen biochemical demand (mg/L) concentrations for Sandy Lake from July 2, 2014 to September 2, 2014.

Escherichia coli

Escherichia coli (E. coli) is one type of fecal coliform, which is a bacteria commonly found all warm-blooded animals including humans, livestock, wildlife, and birds. *E. coli* itself does not

generally cause illness, but when present in large numbers the risk of becoming ill from other organisms is elevated. The most common illnesses contracted by bathers are infections of the eyes, ears, nose, and throat as well as stomach upsets. Typical symptoms include mild fever, vomiting, diarrhea and stomach cramps. Extensive studies were undertaken by Manitoba Water Stewardship in 2003 to determine the source of occasionally high *E. coli* counts and the mechanism of transfer to Lake Winnipeg beaches. Studies have shown large numbers of *E. coli* present in the wet sand of beaches. During periods of high winds, when water levels are rising in the south basin, these bacteria can be washed out of the sand and into the swimming area of the lake. Research shows less than 10% of *E. coli* found at Lake Winnipeg beaches is from human sources, with the remaining percentage from birds and animals.

Figure 7 illustrates the annual mean *E. coli* densities from the main beach of Sandy Lake. Typically, *E. coli* densities were below both the irrigation objective of 1000 CFU/ 100 mL, and the recreation objective of 200 CFU/ 100 mL (Water Science and Management Branch, 2011). This was with the exception of one occasion in August 2001 which exceeded the irrigation objective, and July 2000 which exceeded the recreation objective.

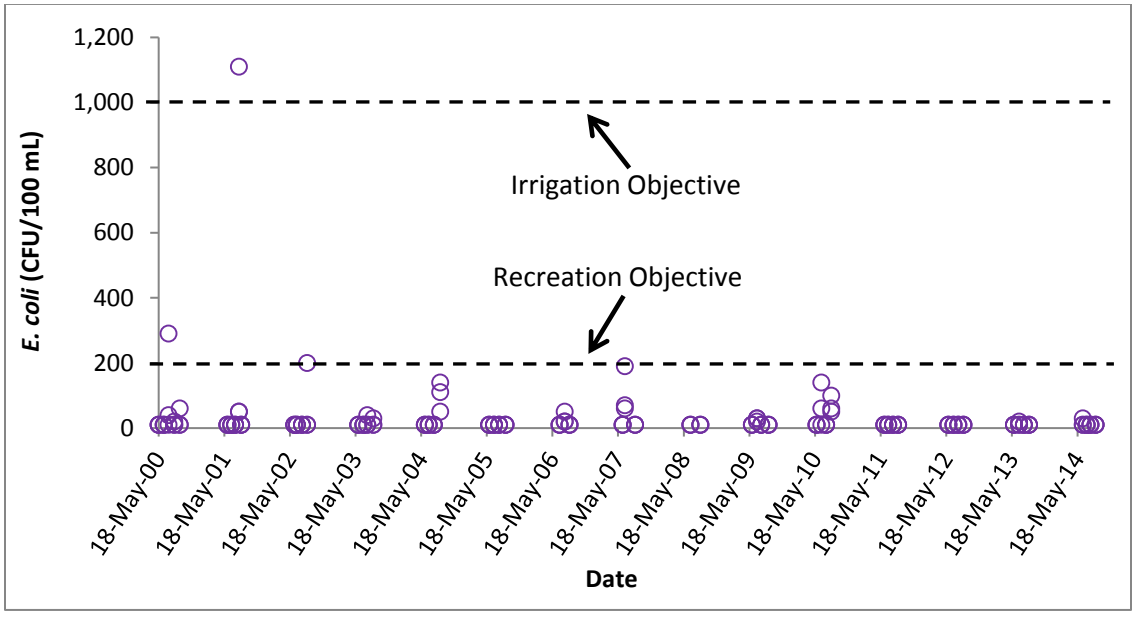

Figure 7: Annual mean *E. coli* densities (CFU/ 100 mL) from the main beach of Sandy Lake between 2000 and 2014.

pH

Water pH is a measure of the concentration of hydrogen ions (H^+) in the water. The concentration of H^+ in water determines the water's acidity. The pH is measured on a negative logarithm scale from 0 to 14. Therefore, the lower the pH value for a water sample, the higher the concentration of H^+ and the more acidic the water. A pH value of 7.0 units is neutral, while those above 7 are

basic (*i.e.,* alkaline). Knowledge of pH is important as it influences the concentration of a number of trace metals and the productivity of aquatic organisms. As well, chlorination of water for disinfecting purposes is less successful if pH is above 8.5. The pH can vary throughout the year, and guidelines and objectives are shown as ranges. Maintenance of pH within the guideline and objective ranges should be an important goal for all surface water supplies. The Manitoba Water Quality Standards, Objectives, and Guidelines for aquatic life are between the pH range of 6.5 and 9.0 (Water Science and Management Branch, 2011). The pH levels in Sandy Lake have remained relatively constant from the 1980's to present, and although they have a tendency to be on the alkaline side, all samples historic and present day are within the acceptable range for the maintenance of healthy aquatic life (Figures 8 and 9).

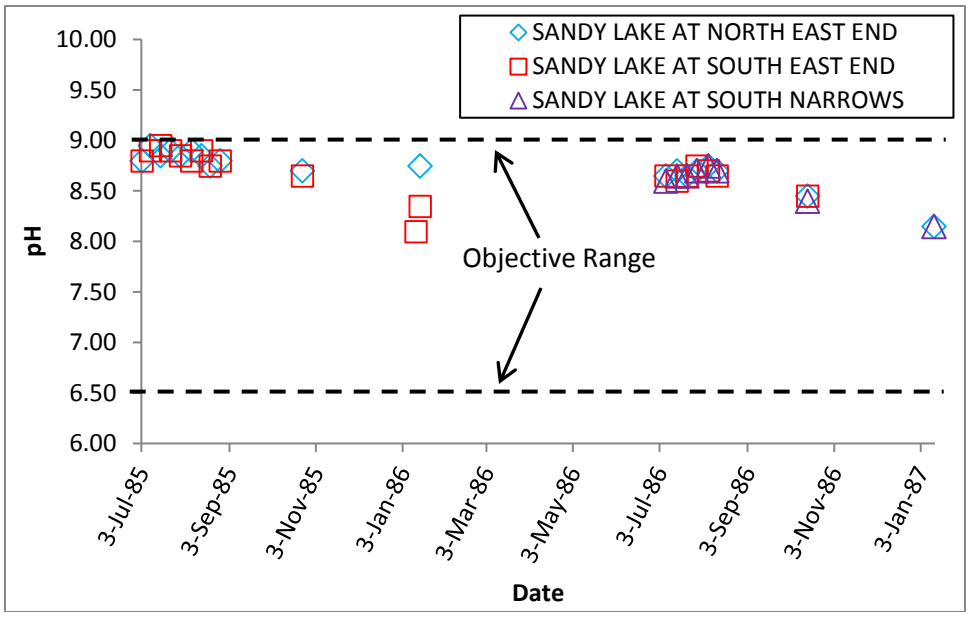

Figure 8: pH levels for Sandy Lake from July 3, 1985 to January 12, 1987.

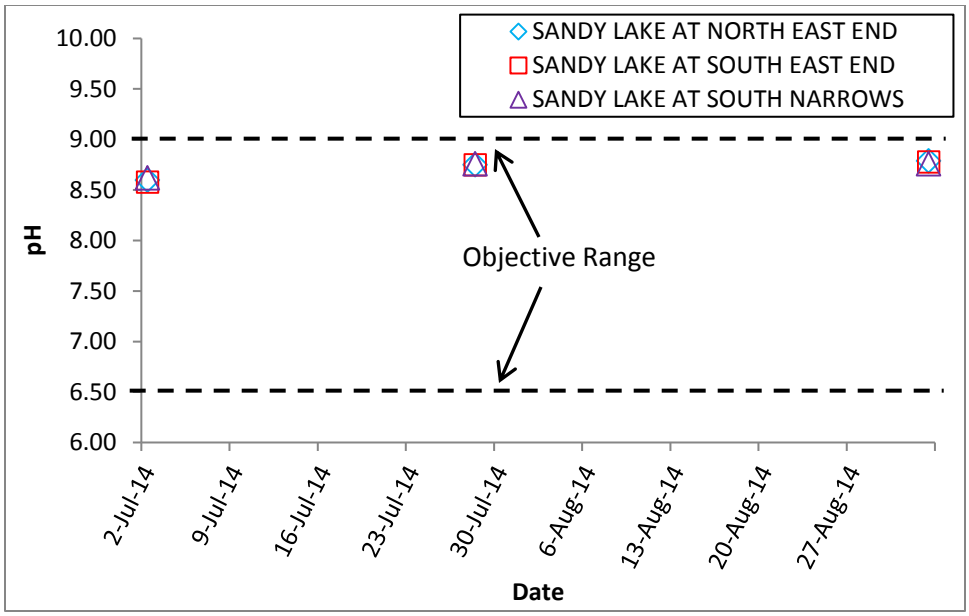

Figure 9: pH levels for Sandy Lake from July 2, 2014 to September 2, 2014.

Total Suspended Solids

Total suspended solids are the non-filterable residue in a water sample. As the name implies, it refers to suspended rather than dissolved particles, and includes clay, silt, large inorganic and organic molecules, and even small aquatic plants and animals. Land run-off and algal blooms are major contributors to the level of total suspended solids in surface waters. High levels of total suspended solids in a water body result in a lower degree of light penetration. This may be advantageous in that it leads to a decline in algae and weed growth. However, it can lead to problems with water intake filters, decrease the success of chlorination, and reduce suitability for desirable aquatic organisms. There are no guidelines for total suspended solids surface water supplies and objectives for protection of aquatic life vary based upon ambient background conditions. Total suspended solid concentration in Sandy Lake has remained relatively constant from the 1980's to present (Figures 10 and 11). This was with the exception of 2014 in which a three-fold increase in total suspended solids was observed from July to September. This may be partially explained by the elevated chlorophyll-*a* concentrations during this time. As well, summer recreation may impact total suspended solid concentrations due to an increase in boat traffic.

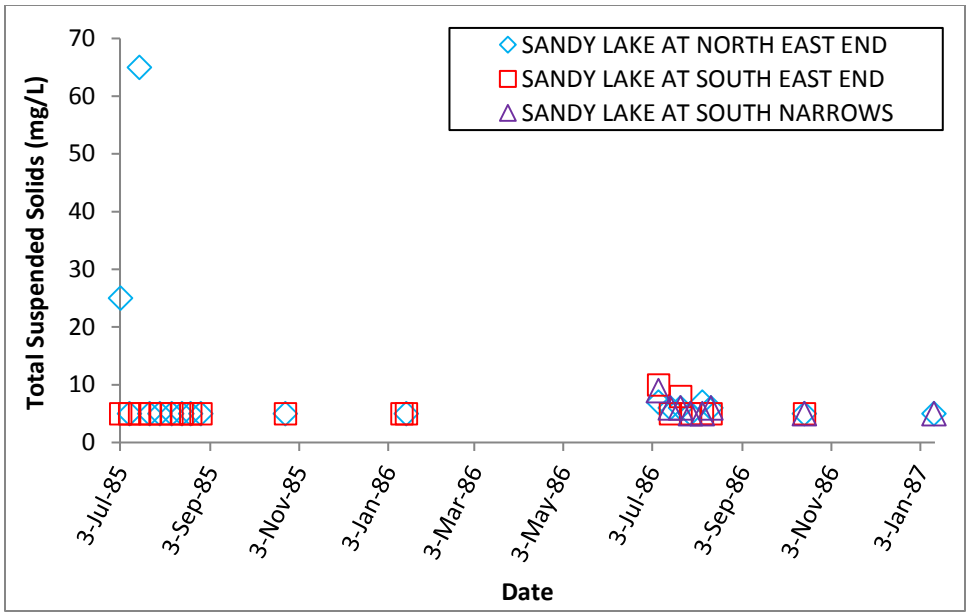

Figure 10: Total suspended solids (mg/L) concentrations for Sandy Lake from July 3, 1985 to January 12, 1987.

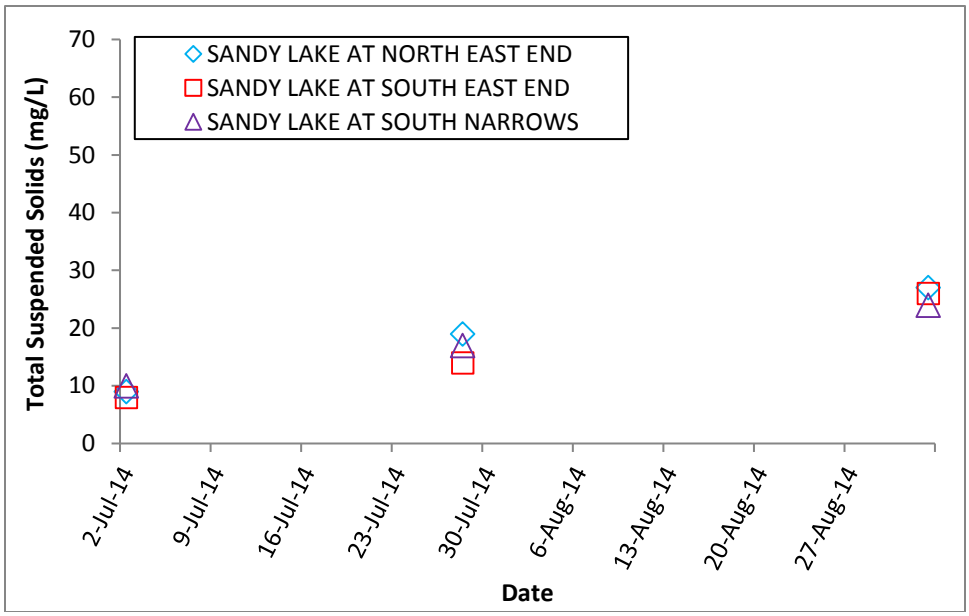

Figure 11: Total suspended solids (mg/L) concentrations for Sandy Lake from July 2, 2014 to September 2, 2014.

Discussion

Nutrient enrichment or eutrophication is one of the most important water quality issues in Manitoba. Excessive levels of phosphorus and nitrogen fuel the production of algae and aquatic plants. Extensive algal blooms can cause changes to aquatic life habitat, reduce essential levels of oxygen, clog fisher's commercial nets, interfere with drinking water treatment facilities, and

cause taste and odour problems in drinking water. In addition, some forms of blue-green algae can produce highly potent toxins.

Studies have shown that since the early 1970s, phosphorus loading has increased by about 10% to Lake Winnipeg and nitrogen loading has increased by about 13%. A similar phenomenon has also occurred in many other Manitoba streams, rivers, and lakes.

Manitobans, including those in the Sandy Lake watershed, contribute about 47% of the phosphorus and 44% of the nitrogen to Lake Winnipeg (Bourne *et al.* 2002, updated in 2006). About 15% of the phosphorus and 6% of the nitrogen entering Lake Winnipeg is contributed by agricultural activities within Manitoba. In contrast, about 9% of the phosphorus and 6% of the nitrogen entering Lake Winnipeg from Manitoba is contributed by wastewater treatment facilities such as lagoons and sewage treatments plants.

As part of Lake Winnipeg Action Plan, the Province of Manitoba is committed to reducing nutrient loading to Lake Winnipeg to those levels that existed prior to the 1970s. The Lake Winnipeg Action Plan recognizes that nutrients are contributed by most activities occurring within the drainage basin and that reductions will need to occur across all sectors. Reductions in nutrient loads across the Lake Winnipeg watershed will benefit not only Lake Winnipeg but also improve water quality in the many rivers and streams that are part of the watershed. The Lake Winnipeg Stewardship Board's 2006 report "Reducing Nutrient Loading to Lake Winnipeg and its watershed: Our Collective Responsibility and Commitment to Action" (LWSB 2006) provides 135 recommendations on actions needed to reduce nutrient loading to the Lake Winnipeg watershed. However, reducing nutrients loading to the Lake Winnipeg watershed is a challenge that will require the participation and co-operation of all levels of government and all watershed residents. Ensuring good water quality in the Sandy Lake watershed and downstream is a collective responsibility among all living in the watershed.

Water Quality Management Zones

In June 2005 *The Water Protection Act* received royal ascension. This Act is intended to enable regulations to be developed for strengthening adherence to water quality standards, for protecting water, aquatic ecosystems or drinking water sources, and to provide a framework for integrated watershed management planning. The first regulation under *The Water Protection Act* — the *Nutrient Management Regulation (see:* www.gov.mb.ca/waterstewardship/wqmz/index.html) — defines five Water Quality Management Zones for Nutrients to protect water from excess nutrients that may arise from the over-application of fertilizer, manure, and municipal waste

sludge on land beyond the amounts reasonably required for crops and other plants during the growing season.

As of January 1, 2009, substances containing nitrogen or phosphorus cannot be applied to areas within the Nutrient Buffer Zone or land within Nutrient Management Zone N4 (Canada Land Inventory Soil Capability Classification for Agriculture Class 6 and 7, and unimproved organic soils). The width of the Nutrient Buffer Zone varies depending upon the nature of the body of water and is generally consistent with those contained in the Livestock Manure and Mortalities Management Regulation (42/98).

The *Nutrient Management Regulation* (MR 62/2008) prohibits the construction, modification, or expansion of manure storage facilities, confined livestock areas, sewage treatment facilities, and wastewater lagoons on land in the Nutrient Management Zone N4 or land in the Nutrient Buffer Zone. Further, the construction, installation, or replacement of an on-site wastewater management system (other than a composting toilet system or holding tank) within Nutrient Management Zone N4 or land in the Nutrient Buffer Zone is prohibited (Part 4: Section 14(1):f).

It is recommended that measures are taken to prevent the watering of livestock in any watercourses to prevent bank erosion, siltation, and to protect water quality by preventing nutrients from entering surface water.

No development should occur within the 99 foot Crown Reserve from the edge of any surface water within the rural municipalities. Permanent vegetation should be encouraged on lands within the 99 foot crown reserve to prevent erosion, siltation, and reduce the amount of nutrients entering surface water.

The Nutrient Management Regulation under *The Water Protection Act*, prohibits the application of a fertilizer containing more than 1% phosphorus by weight, expressed as P_2O_5, to turf within Nutrient Management Zone N5 (built-up area such as towns, subdivisions, cottage developments, etc.) except during the year in which the turf is first established and the following year. In residential and commercial applications, a phosphorus containing fertilizer may be used if soil test phosphorus (using the Olsen-P test method) is less than 18 ppm.

The Nutrient Management Regulation (MR 62/2008) under *The Water Protection Act*, requires Nutrient Buffer Zones (set-back distances from the water's edge) be applied to all rivers, streams, creeks, wetlands, ditches, and groundwater features located across Manitoba including within urban and rural residential areas and within agricultural regions (Table A1 in Appendix 1).

Drainage

Although it is recognized that drainage in Manitoba is necessary to support sustainable agriculture, it is also recognized that drainage works can impact water quality and fish habitat. Types of drainage include the placement of new culverts or larger culverts to move more water, the construction of a new drainage channels to drain low lying areas, the draining of potholes or sloughs to increase land availability for cultivation and the installation of tile drainage. Artificial drainage can sometimes result in increased nutrient (nitrogen and phosphorus), sediment and pesticide load to receiving drains, creeks and rivers. All types of drainage should be constructed so that there is no net increase in nutrients (nitrogen and phosphorus) to waterways. To ensure that drainage maintenance, construction, and re-construction occurs in an environmentally friendly manner, the following best available technologies, and best management practices aimed at reducing impacts to water quality and fish habitat are recommended.

The following recommendations are being made to all drainage works proposals during the approval process under *The Water Rights Act*:

- There must be no net increase in nutrients (nitrogen and phosphorus) to waterways as a result of drainage activities. Placement of culverts, artificial drainage and construction and operation of tile drains can sometimes result in increased nutrient (nitrogen and phosphorus), sediment and pesticide loads to receiving drains, creeks and rivers.
- Synthetic fertilizer, animal manure, and municipal wastewater sludge must not be applied within drains.

Culverts

- Removal of vegetation and soil should be kept to a minimum during the construction and the placement of culverts.
- Erosion control methodologies should be used on both sides of culverts according to the Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat.
- A strip of vegetation 1 to 3 metres wide should be maintained along drainage channels as a buffer. This will reduce erosion of channels and aid in nutrient removal.
- The proponent should revegetate exposed areas along drainage channels.

Surface Drainage

- Surface drainage should be constructed as shallow depressions and removal of vegetation and soil should be minimized during construction.

- Based on Canada Land Inventory Soil Capability Classification for Agriculture (1965), Class 6 and 7 soils should not be drained.
- There should be no net loss of semi-permanent or permanent sloughs, wetlands, potholes or other similar bodies of water in the sub-watershed within which drainage is occurring.
- Erosion control methodologies outlined in Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat should be used where the surface drain intersects with another water body.
- A strip of vegetation 1 to 3 metres wide should be maintained along surface drainage channels as buffers. These will reduce erosion of channels and aid in nutrient removal.
- The proponent should revegetate exposed areas along banks of surface drainage channels.

Manitoba Conservation and Water Stewardship is working towards the development of an environmentally friendly drainage manual that will provide additional guidance regarding best management practices for drainage in Manitoba.

Conclusions and Recommendations:

- Both the historic and 2014 total phosphorus concentrations in Sandy Lake were well above the Manitoba objective for lakes of 0.025 mg/L. Since the 1980's total phosphorus concentration has increased in Sandy Lake. In 2014 there was a steady increase in total phosphorus concentration over the summer. This indicates nutrient loading is occurring; either externally from the surrounding watershed, or internally from re-suspension of phosphorus in the lake sediment. Therefore, future management decisions should focus on reducing nutrient loading to Sandy Lake and the surrounding watershed, in order to reduce the frequency and severity of algal blooms on the lake.
- Both the historic and 2014 total nitrogen concentrations in Sandy Lake were all well above the chronic guideline of 1.0 mg/L. However, since the 1980's total nitrogen concentrations have remained relatively constant. In 2014 there was a small increase in total nitrogen concentration over the summer. However, future management decisions should still focus on reducing nutrient loading to Sandy Lake and the surrounding watershed.
- Unfortunately no comparable historic chlorophyll-*a* data were available for the three 2014 sample locations, however, there was a significant increase in chlorophyll-*a* concentration over the summer of 2014. The increase in chlorophyll-*a* concentration was correlated to an increase in oxygen biochemical demand. This suggests there was significant algal

production which consumed oxygen from the water column as the algae senesced. Since algal production relies on an adequate supply of nutrients, future management decisions should focus on reducing nutrient loading to Sandy Lake and the surrounding watershed.

- Historic total suspended solid concentrations in Sandy Lake remained relatively constant. However, in 2014 a three-fold increase in total suspended solids was observed from July to September. This may be partially explained by the elevated chlorophyll-*a* concentrations during this time. As well, summer recreation may impact total suspended solid concentrations due to an increase in boat traffic. Therefore, future management decisions should focus on reducing surface runoff and erosion.
- Although *E. coli* densities were typically below both the irrigation and recreation objective, there were a number of samples which were near the recreation objective, indicating periodic sources of *E. coli* entering the beach area. Therefore, future management decisions should ensure cattle are excluded from having direct access to Sandy Lake and surrounding water bodies. This will continue to minimize bacterial contamination and nutrient loading to surface waters.

- Reducing nutrient loading to Sandy Lake will ultimately help maintain a healthy lake environment and decrease the risk of degrading water quality. The Province and others are taking action to reduce nutrient loading to lakes and rivers in order to reduce the intensity, frequency and duration of algal blooms and to improve the overall health of our waterways. Some of these initiatives are detailed in the Province's "Tomorrow Now – Manitoba's Green Plan": http://gov.mb.ca/conservation/tomorrownowgreenplan/pdf/tomorrowNowBook.pdf.
- Also every citizen living in the watershed can play a role in improving water quality. Information on how you can help protect water quality is available at the following websites:

- Lake Friendly Initiative:

  Lake Friendly (http://www.lakefriendly.ca/) document “Do What Matters” http://www.lakefriendly.ca/pdf/Lake_Friendly_Practices_and_Actions.pdf. See section on “at school”.

- Lake Winnipeg Stewardship Board’s recommendations to the Province of Manitoba on how to reduce nutrient loading to the Lake Winnipeg watershed:

  http://www.gov.mb.ca/waterstewardship/water_quality/lake_winnipeg/lwsb2007-12_final_rpt.pdf

- What You Can Do:

  http://www.gov.mb.ca/waterstewardship/water_quality/lake_winnipeg/your_role.html

- Many steps can be taken to protect the Sandy Lake watershed and its downstream environment. These include:
  - Maintain a natural, riparian buffer along waterways. Natural vegetation slows erosion and helps reduce the amount of nitrogen and phosphorus entering lakes, rivers and streams.
  - Where feasible, “naturalize” drainage systems to reduce streambed and stream bank erosion, and allowing opportunities for nutrients to be assimilated and settled out of the stream.
  - Value and maintain wetlands. Similar to riparian buffers along waterways, wetlands slow erosion and help reduce nutrient inputs to lakes, rivers, and streams. Wetlands also provide flood protection by trapping and slowly releasing excess water while providing valuable habitat for animals and plants.
  - Reduce or eliminate the use of phosphorus-based fertilizers on lawns, gardens, and at the cottage.
  - Choose low phosphorus or phosphorus-free cleaning products.
  - Prevent soil from eroding off urban and rural properties and reaching storm drains or municipal ditches.
  - Ensure that septic systems are operating properly and are serviced on a regular basis. It’s important that septic systems are pumped out regularly and that disposal fields are checked on a regular basis to ensure that they are not leaking or showing signs of saturation.
  - Evaluate options for potential reduction of nutrients from municipal wastewater treatment systems. Consider options such as effluent irrigation, trickle discharge, constructed wetland treatment, or chemical treatment to reduce nutrient load to the watershed.

- Review the recommendations in the Lake Winnipeg Stewardship Board 2006 report “Reducing Nutrient Loading to Lake Winnipeg and its Watershed: Our Collective Responsibility and Commitment to Action” with the intent of implementing those that are relevant to the Sandy Lake watershed.

Contact Information

For more information, please contact:

Water Quality Management Section
Manitoba Conservation and Water Stewardship
Suite 160, 123 Main St
Winnipeg, Manitoba R3C 1A5
Phone: 204-945-0002
Fax: 204-948-2357

And visit the Department’s web site: http://www.gov.mb.ca/conservation/index.html

References:

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Appendix 1:
Table A1: The Nutrient Buffer Zone widths as outlined in the Nutrient Management Regulation (MR 62/2008) under *The Water Protection Act*.

Water Body	A [1]	B [1]
○ a lake or reservoir designated as vulnerable	30 m	35 m
○ a lake or reservoir (not including a constructed stormwater retention pond) not designated as vulnerable ○ a river, creek or stream designated as vulnerable	15 m	20 m
○ a river, creek or stream not designated as vulnerable ○ an order 3, 4, 5, or 6 drain or higher ○ a major wetland, bog, swamp or marsh ○ a constructed stormwater retention pond	3 m	8 m

([1]) Use column A if the applicable area is covered in permanent vegetation. Otherwise, use column B.

A healthy riparian zone is critical to river ecosystem health providing shade, organic inputs, filtering of nutrients and habitat creation (falling trees). Preserving space along rivers gives the river freedom to naturally meander across the landscape and buffers the community from flooding impacts. Reference to the Nutrient Buffer Zone and its significance can be coupled with **Section 3.1.8 – Environmental Policies** which identifies the goals of enhancing surface water and riverbank stability, and the importance of respecting setbacks.